METROPOLITAN POLICE

Request an intellectual property (IP) licence

Date: **19 March 2025**
Time: **09:36**
This form has been sent to the Metropolitan Police via the Single Online Home reporting service.

MIP-165-25-0100-000

Your details

Your details

Title
Mr

First name
tshingombe

Surname
tshitadi

Company name
engineering

Email address
tshingombefiston@gmail.com

Phone number
0725298946

Your request

Your request

Select the option that most applies to you
Request an intellectual property (IP) licence to use a trademark belonging to the Met or Mayor's Office for Policing and Crime (MOPAC) for any purpose

Details of your enquiry
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Request an intellectual property (IP) licence
Request an intellectual property (IP) licence
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To understand how your data is collected and handled read our privacy notice.
Review
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Your details
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Ms
First name
tshingombe
Surname
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Company name
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Email address
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0725298946
Your request
Select the option that most applies to you
Request an intellectual property (IP) licence to use a trademark belonging to the Met or Mayor's Office for Policing and Crime (MOPAC) for any purpose
Details of your enquiry
tshingombe tshitadi Prospect ID : 04032024205966073800f0884bebd2415f9d5d6b20c80a2237 Postdoctoral in 0 First Name : tshingombe Last Name : tshitadi Email : tshingombefiston@gmail.com Alternative Email : Address 1 : Address 2 : City : Johannesburg State : Country : South Africa Home Phone : Work Phone : Cell Phone : 0725298946 Fax :
Age : 42 Gender : Website Address : Language : English Internal Comments : The AIU AI Program Generator creates custom program courses based on your desired work field and educational background. This intelligent tool tailors a curriculum to align with industry demands and your academic strengths, ensuring efficient learning and maximizing your
potential for career success. The program generator offers a preview of potential courses at AIU, each with several lessons. Once enrolled, students can customize courses during Phase 2 by collaborating with their tutor and advisor. This ensures a personalized educational experience tailored to their unique needs and goals at http://aiu.edu. Course Name
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Studies in Autonomous Vehicles and Drones for Electric Vehicle Engineering This course provides an in-depth exploration of th .... 02/06/2025 Specialist Engineering in Infrastructure and Contractors: Electrochemical Engineering This Master's degree course offers in-depth knowle .... 02/06/2025 Energy Storage and Battery Technology This course
explores advanced concepts in energy s .... 02/06/2025 Advanced Robotic Process Automation in Electrical Engineering This course aims to equip students with advanced k .... 02/06/2025 Master's in Artificial General Intelligence and Social Sciences This course aims to explore the intersection of Ar .... 01/28/2025 Online Retail and E-commerce in the
Renewable Energy Sector This course explores the intersection of online re .... 01/28/2025 Publishing and Natural Resources Management This Masters-level course is designed to explore t .... 01/28/2025 Masters in Supply Chain Management and Traceability This course is designed for students pursuing a Ma .... 01/28/2025 Social Media Marketing for
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master's level course is designed to bridge t .... 01/28/2025 Doctorate in Specialist Engineering Infrastructure and Contractors: Electrical Engineering This advanced course is designed for students purs .... 11/22/2024 1. Users Table: - user_id : 04032024205966073800f0884bebd2415f9d5d6b20c80a2237 - username:tshingombe - email:tshitadi -
password: kananga5 - address 2. Products Table: - product_id : 04032024205966073800f0884bebd2415f9d5d6b20c80a2237 - name: engineering - description: circulum assessment - price: 1000$ - category_id:45677 3. Categories Table: - category_id : 04032024205966073800f0884bebd2415f9d5d6b20c80a2237 - name 4. Orders Table: - order_id :
04032024205966073800f0884bebd2415f9d5d6b20c80a2237 - user_id :9879 - order_date:25/02/2025 - total_amount 5. Order_Items Table: - order_item_id : 04032024205966073800f0884bebd2415f9d5d6b20c80a2237 - order_id : 123456 - product_id:tshi - quantity:100 - item_price :10000$
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providing electrical services to property owners in the City of Johannesburg that are not serviced by Eskom. To determine if you are a City Power customer you can check your existing City of Johannesburg invoice and see if you are being billed for electricity. If you don't have an invoice or if you don't have a service connection you can check the township
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notification Messaging 25 25 new notifications Notifications application can also be found with the downloadable documents on the below table. On Sat, Nov 30, 2024 at 5:11 PM tshingombe fiston wrote: https://www.sars.gov.za/businesses-and-employers/trusts/registering-as-a-trust/register-a-trust-supporting-documents/ 4 Attachments
• Scanned by Gmail tshingombe fiston On Sat, Nov 30, 2024 at 5:38 PM tshingombe fiston wrote: City Power is responsible for providing electrical services to property ow Nov 30, 2024, 5:42 PM tshingombe fiston On Sat, Nov 30, 2024 at 5:38 PM tshingombe fiston wrote: City Power is responsible for providing electrical services to property ow Dec 1,
2024, 12:17 PM postmaster@sap.onmicrosoft.com Delivery has failed to these recipients or groups: SARS Human Capital and Development (System@successfactors.com) The recipient's mailbox is full and can't acce Dec 1, 2024, 12:19 PM tshingombe fiston Turn on more accessible mode Skip Ribbon Commands Skip to main content Webmail Contact
Us Sign Out - HomeCurrently selected - Our Company - Company Information Dec 1, 2024, 12:52 PM Mail Delivery Subsystem Message blocked Your message to sarb-graduaterecruit@resbank.co.za has been blocked. See technical details below for more information. LEARN MORE This link will Dec 1, 2024, 12:53 PM Mail Delivery Subsystem Message
blocked Your message to admni@resbank.co.za has been blocked. See technical details below for more information. LEARN MORE This link will take you to a Dec 1, 2024, 12:53 PM Mail Delivery Subsystem Address not found Your message wasn't delivered to customerservice@eskom.co.za because the address couldn't be found, or is unable to receive
mail. LEARN MORE T Dec 1, 2024, 12:53 PM Mail Delivery Subsystem Address not found Your message wasn't delivered to GITServiceDesk@eskom.co.za because the address couldn't be found, or is unable to receive mail. LEARN MORE Th Dec 1, 2024, 12:53 PM postmaster@dmre.gov.za Your message to examweb@dmr.gov.za couldn't be
delivered. The group examweb only accepts messages from people in its organization or on its allowed senders list Dec 1, 2024, 12:53 PM postmaster@sap.onmicrosoft.com Diagnostic information for administrators: Generating server: AS8PR02MB8519.eurprd02.prod.outlook.com System@successfactors.com Remote server returned '554 5.2. Dec 1,
2024, 12:55 PM tshingombe fiston Dec 1, 2024, 12:55 PM electricity consumption.[30] tshingombe fiston Sat, Nov 30, 2024, 5:38 PM to regionArevenue, regionBrevenue, tenderadvicecentre, estimations, wmcqueries, Mediadesk, SARS, me City Power is responsible for providing electrical services to property owners in the City of Johannesburg that are
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View ad library Feed post number 1 City Power JohannesburgCity Power Johannesburg 1,034 followers1,034 followers 2w • 2 weeks ago City Power's Green Energy Future: Solar Microgrids Empower Communities hashtag#CityPowerServices hashtag#CityPowerEnergyPlan City Power's Green Energy Future: Solar Microgrids Empower Communities City
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Capital and Development (System@successfactors.com) The recipient's mailbox is full and can't acce Dec 1, 2024, 12:19 PM tshingombe fiston Turn on more accessible mode Skip Ribbon Commands Skip to main content Webmail Contact Us Sign Out - HomeCurrently selected - Our Company - Company Information Dec 1, 2024, 12:52 PM Mail Delivery
Subsystem Message blocked Your message to sarb-graduaterecruit@resbank.co.za has been blocked. See technical details below for more information. LEARN MORE This link will Dec 1, 2024, 12:53 PM Mail Delivery Subsystem Message blocked Your message to admni@resbank.co.za has been blocked. See technical details below for more
information. LEARN MORE This link will take you to a Dec 1, 2024, 12:53 PM Mail Delivery Subsystem Address not found Your message wasn't delivered to customerservice@eskom.co.za because the address couldn't be found, or is unable to receive mail. LEARN MORE T Dec 1, 2024, 12:53 PM Mail Delivery Subsystem Address not found Your
message wasn't delivered to GITServiceDesk@eskom.co.za because the address couldn't be found, or is unable to receive mail. LEARN MORE Th Dec 1, 2024, 12:53 PM postmaster@dmre.gov.za Your message to examweb@dmr.gov.za couldn't be delivered. The group examweb only accepts messages from people in its organization or on its allowed
senders list Dec 1, 2024, 12:53 PM postmaster@sap.onmicrosoft.com Diagnostic information for administrators: Generating server: AS8PR02MB8519.eurprd02.prod.outlook.com System@successfactors.com Remote server returned '554 5.2. Dec 1, 2024, 12:55 PM tshingombe fiston Dec 1, 2024, 12:55 PM to SARS, regionArevenue,

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Out Top Link Bar oOur Company oAbout Electricity oWhat we're doing oIDM oCustomer Care oCareers oTenders My Applications My Applications Position Created Engineering Prof Civil Auxiliary Plant (Generation) Lethabo Power Station 2024/04/24 12:59 PM Engineers in Training X09_ Electrical HC x2_ C and I x3_Mechanical or Chemical
x3_Industrial Engineering x1 (Gx Kusile Powe 2024/05/19 09:36 AM Senior-Clerk-General-Administration-(Dx)-CPM-Aliwal-North 2024/05/19 09:38 AM Engineer Prof Engineering (NP)Distribution Bloemfontein 2024/05/19 09:38 AM Middle Manager Nuclear Safety and Assurance (ISED) X1 (Generation) Koeberg NPS 2024/05/19 09:39 AM Senior Advisor
Education and Training (ETD) x1 (Engineering and Maintenance) Peaking 2024/05/29 02:40 PM Technical Official PPM Mechanical X2 (Distribution) EAL Midrand 2024/09/01 01:27 PM 1 Learning-Programme-Engineer-in-Training-x-2,-Generation,-Megawatt-Park 2024/09/01 01:29 PM Learning Programme Engineer in Trainng x17 GX Matla Power Station
2024/09/01 01:29 PM Manager Site Outage Execution, Generation, Tutuka Power Station 2024/09/01 01:30 PM Re Advert Snr Technologist Electrical Engineering Substation x2 (National Transmission Company South Africa) MWP Sunninghill 2024/09/01 01:31 PM Re Advert Snr Technologist Electrical Engineering Substation x2 (National Transmission
Company South Africa) MWP Sunninghill 2024/09/01 01:31 PM Senior Technician Chemistry x2 (Technical Support and Oils Micro) (Generation) Koeberg NPS 2024/09/01 01:32 PM Officer Safety Health Environment X1 Generation Medupi Power Station 2024/09/01 01:33 PM Learning Programme Outages x1 - Graduate in Training , Generation,
Megawatt Park and Witbank 2024/09/01 01:34 PM Learning Programme - Graduate in Training-Quantity Surveyor, Generation, Megawatt Park 2024/09/01 01:35 PM Senior Advisor Supplier Development, Localisation and Industrialisation x2, Generation, Megawatt Park and Tutuka Power Stat 2024/09/01 01:35 PM Graduate-in-Training (Finance)
2024/09/01 01:37 PM Re Advert Snr Draughtsperson Draughting Electrical Substation Engineering x3 NTCSA MWP 2024/09/01 01:38 PM Technician-in-Training x2 (1xC+I and 1+Mech) 2024/09/01 01:39 PM Snr. Supervisor Tech Instrument x 2 (Generation) Tutuka Power Station 2024/09/01 01:39 PM Engineer-in-Training-Control and Instrumentation
AND-Auxiliary and Ancillary-(Peaking Durbanville)-X2 2024/09/01 01:40 PM Re Advert Senior Technician Configuration X1 (Generation) Medupi Power Station 2024/09/01 01:42 PM Engineer Prof Eng Quality of Supply (National Transmission Company South Africa) Newscastle 2024/09/01 01:43 PM Learning Programme - Graduate in Training x1,
Generation, Megawatt Park 2024/09/01 01:44 PM Learning-Programme -Graduate-in-Training-x3,-Generation,-1Megawatt-Park 2024/09/01 01:45 PM Learning Programme-Graduate in Training x 3, Generation, Megawatt Park 2024/09/01 01:46 PM Learning Programme-Graduate in Training x 2, Generation, Megawatt Park 2024/09/01 01:47 PM Senior
Supervisor Technical Projects (National Transmission Company South Africa)Northwest and Limpopo 2024/09/01 01:49 PM Snr-Advisor-Applications-Support-(Group-IT-DIVISION)-Megawatt-Park 2024/09/01 01:50 PM 1 - 30 Follows us on oOur Company Company Information Leadership Investors Sustainable Development CSI Media
Room PAIA Eskom Heritage Photo Gallery Video Clips oAbout Electricity Electricity Tips Electricity Technologies Eskom Power Series Renewable Energy Facts & Figures Visitor Centers MODIS Fire Alerts oWhat we're doing Electricity Generation New Build Transmission Development Plan Ancillary Services GCCA Report
Supply Status Info Site For IPPs School Of Welding Eskom initiatives oIDM Integrated Demand Management Energy Advice Eskom Solar Water Heating Programme Measurement Verification oCustomer Care CS Online Tarrifs And Charges MYPD3 Customer Service Information Subscribe CS Mobile Customer Feedback
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LEARN MORE This link will Dec 1, 2024, 12:55 PM Mail Delivery Subsystem Message blocked Your message to admni@resbank.co.za has been blocked. See technical details below for more information. LEARN MORE This link will take you to a Dec 1, 2024, 12:55 PM Mail Delivery Subsystem Address not found Your message wasn't delivered to
customerservice@eskom.co.za because the address couldn't be found, or is unable to receive mail. LEARN MORE T Dec 1, 2024, 12:55 PM Mail Delivery Subsystem Address not found Your message wasn't delivered to GITServiceDesk@eskom.co.za because the address couldn't be found, or is unable to receive mail. LEARN MORE Th Dec 1, 2024,
12:55 PM postmaster@sap.onmicrosoft.com Diagnostic information for administrators: Generating server: AS1PR02MB7918.eurprd02.prod.outlook.com System@successfactors.com Remote server returned '554 5.2. Dec 1, 2024, 12:56 PM postmaster@dmre.gov.za Your message to examweb@dmr.gov.za couldn't be delivered. The group examweb only
accepts messages from people in its organization or on its allowed senders list Dec 1, 2024, 12:56 PM RegionB Revenue Dec 2, 2024, 10:26 AM to SARS, RegionA, RegionB, Estimations, WMCQUERIES, Media, me On Sat, Nov 30, 2024 at 5:38 PM tshingombe fiston wrote: City Power is responsible for providing electrical services to property owners in
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ads by City Power Johannesburg. View ad library Feed post number 1 City Power JohannesburgCity Power Johannesburg 1,034 followers1,034 followers 2w • 2 weeks ago City Power's Green Energy Future: Solar Microgrids Empower Communities hashtag#CityPowerServices hashtag#CityPowerEnergyPlan City Power's Green Energy Future: Solar
Microgrids Empower Communities City Power Johannesburg By Kgagodi MadibaCity Power is taking significant strides to reduce greenhouse gas emissions and bring sustainable energy solutions to Johannesburg co Home My Network Jobs 1 1 new message notification Messaging 25 25 new notifications Notifications
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automatically archived by Mimecast Ltd, an innovator in Software as a Service (SaaS) for business. Providing a safer and more useful place for your human generated data. Specializing in; Security, archiving and compliance. To find out more Click Here. tshingombe fiston On Mon, 02 Dec 2024, 10:26 RegionB Revenue, wrote: On Sat, Nov 30, 2024 at 5:38
PM tshingombe fiston Feb 2, 2025, 2:29 PM tshingombe fiston Feb 3, 2025, 11:36 AM to regionArevenue, wmcqueries, Mediadesk, estimations, tenderadvicecentre, RegionB 6 Attachments • Scanned by Gmail RegionB Revenue Dear valued customer, Please provide us with your municipal account number and describe the nature of your query in detail.
Accept cookies Reject cookies Customise cookies
Close
Review
Your details
Your request
Back
Your details ChangeYour details
Your request ChangeYour request
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
1 of 39 3/11/2025, 1:20 PM
Thank you for utilizing the regional Feb 5, 2025, 12:50 PM tshingombe fiston Thanks - municipality city Johannesburg - CDs R169241870 -; Feb 5, 2025, 1:19 PM RegionB Revenue Dear valued customer, Kindly provide a transfer letter The Region B Customer Service Team On Mon, Dec 2, 2024 at 10:26 AM RegionB Revenue SIL, the voltage drops from sending end and the line consumes VARs. For load < SIL, the voltage increases from the sending end, and the line generates VARs. Short line The short line approximation is normally used for lines shorter than 80 km (50 mi). There, only a series impedance Z is considered, while C and
G are ignored. The final result is that A = D = 1 per unit, B = Z Ohms, and C = 0. The associated transition matrix for this approximation is therefore: Medium line The medium line approximation is used for lines running between 80 and 250 km (50 and 155 mi). The series impedance and the shunt (current leak) conductance are considered, placing half of
the shunt conductance at each end of the line. This circuit is often referred to as a nominal π (pi) circuit because of the shape (π) that is taken on when leak conductance is placed on both sides of the circuit diagram. The analysis of the medium line produces: Counterintuitive behaviors of medium-length transmission lines: voltage rise at no load or small
current (Ferranti effect) receiving-end current can exceed sending-end current Long line The long line model is used when a higher degree of accuracy is needed or when the line under consideration is more than 250 km (160 mi) long. Series resistance and shunt conductance are considered to be distributed parameters, such that each differential length
of the line has a corresponding differential series impedance and shunt admittance. The following result can be applied at any point along the transmission line, where is the propagation constant. To find the voltage and current at the end of the long line, should be replaced with (the line length) in all parameters of the transmission matrix. This model applies
the Telegrapher's equations. High-voltage direct current Main article: High-voltage direct current High-voltage direct current (HVDC) is used to transmit large amounts of power over long distances or for interconnections between asynchronous grids. When electrical energy is transmitted over very long distances, the power lost in AC transmission becomes
appreciable and it is less expensive to use direct current instead. For a long transmission line, these lower losses (and reduced construction cost of a DC line) can offset the cost of the required converter stations at each end. HVDC is used for long submarine cables where AC cannot be used because of cable capacitance.[31] In these cases special highvoltage cables are used. Submarine HVDC systems are often used to interconnect the electricity grids of islands, for example, between Great Britain and continental Europe, between Great Britain and Ireland, between Tasmania and the Australian mainland, between the North and South Islands of New Zealand, between New Jersey and New York City,
and between New Jersey and Long Island. Submarine connections up to 600 kilometres (370 mi) in length have been deployed.[32] HVDC links can be used to control grid problems. The power transmitted by an AC line increases as the phase angle between source end voltage and destination ends increases, but too large a phase angle allows the
systems at either end to fall out of step. Since the power flow in a DC link is controlled independently of the phases of the AC networks that it connects, this phase angle limit does not exist, and a DC link is always able to transfer its full rated power. A DC link therefore stabilizes the AC grid at either end, since power flow and phase angle can then be
controlled independently. As an example, to adjust the flow of AC power on a hypothetical line between Seattle and Boston would require adjustment of the relative phase of the two regional electrical grids. This is an everyday occurrence in AC systems, but one that can become disrupted when AC system components fail and place unexpected loads on
the grid. With an HVDC line instead, such an interconnection would: Convert AC in Seattle into HVDC; Use HVDC for the 3,000 miles (4,800 km) of cross-country transmission; and Convert the HVDC to locally synchronized AC in Boston, (and possibly in other cooperating cities along the transmission route). Such a system could be less prone to
failure if parts of it were suddenly shut down. One example of a long DC transmission line is the Pacific DC Intertie located in the Western United States. Capacity This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (November 2022) (Learn
how and when to remove this message) The amount of power that can be sent over a transmission line varies with the length of the line. The heating of short line conductors due to line losses sets a thermal limit. If too much current is drawn, conductors may sag too close to the ground, or conductors and equipment may overheat. For intermediate-length
lines on the order of 100 kilometres (62 miles), the limit is set by the voltage drop in the line. For longer AC lines, system stability becomes the limiting factor. Approximately, the power flowing over an AC line is proportional to the cosine of the phase angle of the voltage and current at the ends. This angle varies depending on system loading. It is
undesirable for the angle to approach 90 degrees, as the power flowing decreases while resistive losses remain. The product of line length and maximum load is approximately proportional to the square of the system voltage. Series capacitors or phase-shifting transformers are used on long lines to improve stability. HVDC lines are restricted only by
thermal and voltage drop limits, since the phase angle is not material. Understanding the temperature distribution along the cable route became possible with the introduction of distributed temperature sensing (DTS) systems that measure temperatures all along the cable. Without them maximum current was typically set as a compromise between
understanding of operation conditions and risk minimization. This monitoring solution uses passive optical fibers as temperature sensors, either inside a high-voltage cable or externally mounted on the cable insulation. For overhead cables the fiber is integrated into the core of a phase wire. The integrated Dynamic Cable Rating (DCR)Real Time Thermal
Rating (RTTR) solution makes it possible to run the network to its maximum. It allows the operator to predict the behavior of the transmission system to reflect major changes to its initial operating conditions. Reconductoring Some utilities have embraced reconductoring to handle the increase in electricity production. Reconductoring is the replacement-inplace of existing transmission lines with higher-capacity lines. Adding transmission lines is difficult due to cost, permit intervals, and local opposition. Reconductoring has the potential to double the amount of electricity that can travel across a transmission line.[33] A 2024 report found the United States behind countries like Belgium and the Netherlands in
adoption of this technique to accommodate electrification and renewable energy. [34] In April 2022, the Biden Administration streamlined environmental reviews for such projects, and in May 2022 announced competitive grants for them funded by the 2021 Bipartisan Infrastructure Law and 2022 Inflation Reduction Act.[35] The rate of transmission
expansion needs to double to support ongoing electrification and reach emission reduction targets. As of 2022, more than 10,000 power plant and energy storage projects were awaiting permission to connect to the US grid — 95% were zero-carbon resources. New power lines can take 10 years to plan, permit, and build.[33] Traditional power lines use a
steel core surrounded by aluminum strands (Aluminium-conductor steel-reinforced cable). Replacing the steel with a lighter, stronger composite material such as carbon fiber (ACCC conductor) allows lines to operate at higher temperatures, with less sag, and doubled transmission capacity. Lowering line sag at high temperatures can prevent wildfires from
starting when power lines touch dry vegetation.[34] Although advanced lines can cost 2-4x more than steel, total reconductoring costs are less than half of a new line, given savings in time, land acquisition, permitting, and construction.[33] A reconductoring project in southeastern Texas upgraded 240 miles of transmission lines at a cost of $900,000 per
mile, versus a 3,600-mile greenfield project that averaged $1.9 million per mile.[33] Control This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (November 2022) (Learn how and when to remove this message) To ensure safe and predictable
operation, system components are controlled with generators, switches, circuit breakers and loads. The voltage, power, frequency, load factor, and reliability capabilities of the transmission system are designed to provide cost effective performance. Load balancing The transmission system provides for base load and peak load capability, with margins for
safety and fault tolerance. Peak load times vary by region largely due to the industry mix. In hot and cold climates home air conditioning and heating loads affect the overall load. They are typically highest in the late afternoon in the hottest part of the year and in mid-mornings and mid-evenings in the coldest part of the year. Power requirements vary by
season and time of day. Distribution system designs always take the base load and the peak load into consideration. The transmission system usually does not have a large buffering capability to match loads with generation. Thus generation has to be kept matched to the load, to prevent overloading generation equipment. Multiple sources and loads can
be connected to the transmission system and they must be controlled to provide orderly transfer of power. In centralized power generation, only local control of generation is necessary. This involves synchronization of the generation units. In distributed power generation the generators are geographically distributed and the process to bring them online and
offline must be carefully controlled. The load control signals can either be sent on separate lines or on the power lines themselves. Voltage and frequency can be used as signaling mechanisms to balance the loads. In voltage signaling, voltage is varied to increase generation. The power added by any system increases as the line voltage decreases. This
arrangement is stable in principle. Voltage-based regulation is complex to use in mesh networks, since the individual components and setpoints would need to be reconfigured every time a new generator is added to the mesh. In frequency signaling, the generating units match the frequency of the power transmission system. In droop speed control, if the
frequency decreases, the power is increased. (The drop in line frequency is an indication that the increased load is causing the generators to slow down.) Wind turbines, vehicle-to-grid, virtual power plants, and other locally distributed storage and generation systems can interact with the grid to improve system operation. Internationally[where?], a slow
move from a centralized to decentralized power systems have taken place. The main draw of locally distributed generation systems is that they reduce transmission losses by leading to consumption of electricity closer to where it was produced.[36] Failure protection Under excess load conditions, the system can be designed to fail incrementally rather than
all at once. Brownouts occur when power supplied drops below the demand. Blackouts occur when the grid fails completely. Rolling blackouts (also called load shedding) are intentionally engineered electrical power outages, used to distribute insufficient power to various loads in turn. Communications This section does not cite any sources. Please help
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3 of 39 3/11/2025, 1:20 PM
improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (November 2022) (Learn how and when to remove this message) Grid operators require reliable communications to manage the grid and associated generation and distribution facilities. Fault-sensing protective relays at each end of the line
must communicate to monitor the flow of power so that faulted conductors or equipment can be quickly de-energized and the balance of the system restored. Protection of the transmission line from short circuits and other faults is usually so critical that common carrier telecommunications are insufficiently reliable, while in some remote areas no common
carrier is available. Communication systems associated with a transmission project may use: Microwaves Power-line communication Optical fibers Rarely, and for short distances, pilot-wires are strung along the transmission line path. Leased circuits from common carriers are not preferred since availability is not under control of the operator.
Transmission lines can be used to carry data: this is called power-line carrier, or power-line communication (PLC). PLC signals can be easily received with a radio in the long wave range. High-voltage pylons carrying additional optical fibre cable in Kenya Optical fibers can be included in the stranded conductors of a transmission line, in the overhead shield
wires. These cables are known as optical ground wire (OPGW). Sometimes a standalone cable is used, all-dielectric self-supporting (ADSS) cable, attached to the transmission line cross arms. Some jurisdictions, such as Minnesota, prohibit energy transmission companies from selling surplus communication bandwidth or acting as a telecommunications
common carrier. Where the regulatory structure permits, the utility can sell capacity in extra dark fibers to a common carrier. Market structure Main article: Electricity market Electricity transmission is generally considered to be a natural monopoly, but one that is not inherently linked to generation.[37][38][39] Many countries regulate transmission separately
from generation. Spain was the first country to establish a regional transmission organization. In that country, transmission operations and electricity markets are separate. The transmission system operator is Red Eléctrica de España (REE) and the wholesale electricity market operator is Operador del Mercado Ibérico de Energía – Polo Español, S.A.
(OMEL) OMEL Holding | Omel Holding. Spain's transmission system is interconnected with those of France, Portugal, and Morocco. The establishment of RTOs in the United States was spurred by the FERC's Order 888, Promoting Wholesale Competition Through Open Access Non-discriminatory Transmission Services by Public Utilities; Recovery of
Stranded Costs by Public Utilities and Transmitting Utilities, issued in 1996.[40] In the United States and parts of Canada, electric transmission companies operate independently of generation companies, but in the Southern United States vertical integration is intact. In regions of separation, transmission owners and generation owners continue to interact
with each other as market participants with voting rights within their RTO. RTOs in the United States are regulated by the Federal Energy Regulatory Commission. Merchant transmission projects in the United States include the Cross Sound Cable from Shoreham, New York to New Haven, Connecticut, Neptune RTS Transmission Line from Sayreville, New
Jersey, to New Bridge, New York, and Path 15 in California. Additional projects are in development or have been proposed throughout the United States, including the Lake Erie Connector, an underwater transmission line proposed by ITC Holdings Corp., connecting Ontario to load serving entities in the PJM Interconnection region.[41] Australia has one
unregulated or market interconnector – Basslink – between Tasmania and Victoria. Two DC links originally implemented as market interconnectors, Directlink and Murraylink, were converted to regulated interconnectors.[42] A major barrier to wider adoption of merchant transmission is the difficulty in identifying who benefits from the facility so that the
beneficiaries pay the toll. Also, it is difficult for a merchant transmission line to compete when the alternative transmission lines are subsidized by utilities with a monopolized and regulated rate base.[43] In the United States, the FERC's Order 1000, issued in 2010, attempted to reduce barriers to third party investment and creation of merchant transmission
lines where a public policy need is found.[44] Transmission costs The cost of high voltage transmission is comparatively low, compared to all other costs constituting consumer electricity bills. In the UK, transmission costs are about 0.2 p per kWh compared to a delivered domestic price of around 10 p per kWh.[45] The level of capital expenditure in the
electric power T&D equipment market was estimated to be $128.9 bn in 2011.[46] Health concerns Main article: Electromagnetic radiation and health Mainstream scientific evidence suggests that low-power, low-frequency, electromagnetic radiation associated with household currents and high transmission power lines does not constitute a short- or longterm health hazard. Some studies failed to find any link between living near power lines and developing any sickness or diseases, such as cancer. A 1997 study reported no increased risk of cancer or illness from living near a transmission line.[47] Other studies, however, reported statistical correlations between various diseases and living or working near
power lines. No adverse health effects have been substantiated for people not living close to power lines.[48] The New York State Public Service Commission conducted a study[49] to evaluate potential health effects of electric fields. The study measured the electric field strength at the edge of an existing right-of-way on a 765 kV transmission line. The field
strength was 1.6 kV/m, and became the interim maximum strength standard for new transmission lines in New York State. The opinion also limited the voltage of new transmission lines built in New York to 345 kV. On September 11, 1990, after a similar study of magnetic field strengths, the NYSPSC issued their Interim Policy Statement on Magnetic Fields.
This policy established a magnetic field standard of 200 mG at the edge of the right-of-way using the winter-normal conductor rating. As a comparison with everyday items, a hair dryer or electric blanket produces a 100 mG – 500 mG magnetic field.[50][51] Applications for a new transmission line typically include an analysis of electric and magnetic field
levels at the edge of rights-of-way. Public utility commissions typically do not comment on health impacts. Biological effects have been established for acute high level exposure to magnetic fields above 100 μT (1 G) (1,000 mG). In a residential setting, one study reported "limited evidence of carcinogenicity in humans and less than sufficient evidence for
carcinogenicity in experimental animals", in particular, childhood leukemia, associated with average exposure to residential power-frequency magnetic field above 0.3 μT (3 mG) to 0.4 μT (4 mG). These levels exceed average residential power-frequency magnetic fields in homes, which are about 0.07 μT (0.7 mG) in Europe and 0.11 μT (1.1 mG) in North
America.[52][53] The Earth's natural geomagnetic field strength varies over the surface of the planet between 0.035 mT and 0.07 mT (35 μT – 70 μT or 350 mG – 700 mG) while the international standard for continuous exposure is set at 40 mT (400,000 mG or 400 G) for the general public.[52] Tree growth regulators and herbicides may be used in
transmission line right of ways,[54] which may have health effects. Specialized transmission Grids for railways Main article: Traction power network In some countries where electric locomotives or electric multiple units run on low frequency AC power, separate single phase traction power networks are operated by the railways. Prime examples are countries

such as Austria, Germany and Switzerland that utilize AC technology based on 16 2/3 Hz. Norway and Sweden also use this frequency but use conversion from the 50 Hz public supply; Sweden has a 16 2/3 Hz traction grid but only for part of the system. Superconducting cables High-temperature superconductors (HTS) promise to revolutionize power
distribution by providing lossless transmission. The development of superconductors with transition temperatures higher than the boiling point of liquid nitrogen has made the concept of superconducting power lines commercially feasible, at least for high-load applications.[55] It has been estimated that waste would be halved using this method, since the
necessary refrigeration equipment would consume about half the power saved by the elimination of resistive losses. Companies such as Consolidated Edison and American Superconductor began commercial production of such systems in 2007.[56] Superconducting cables are particularly suited to high load density areas such as the business district of
large cities, where purchase of an easement for cables is costly.[57] HTS transmission lines[58] Location Length (km) Voltage (kV) Capacity (GW) Date Carrollton, Georgia 2000 Albany, New York[59] 0.35 34.5 0.048 2006 Holbrook, Long Island[60] 0.6 138 0.574 2008 Tres Amigas 5 Proposed 2013 Manhattan: Project Hydra Proposed 2014 Essex,
Germany[61][62] 1 10 0.04 2014 Single-wire earth return Main article: Single-wire earth return This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (November 2022) (Learn how and when to remove this message) Single-wire earth return
(SWER) or single-wire ground return is a single-wire transmission line for supplying single-phase electrical power to remote areas at low cost. It is principally used for rural electrification, but also finds use for larger isolated loads such as water pumps. Single-wire earth return is also used for HVDC over submarine power cables. Wireless power transmission
Main article: Wireless power transfer This section does not cite any sources. Please help improve this section by adding citations to reliable sources. Unsourced material may be challenged and removed. (November 2022) (Learn how and when to remove this message) Both Nikola Tesla and Hidetsugu Yagi attempted to devise systems for large scale
wireless power transmission in the late 1800s and early 1900s, without commercial success. In November 2009, LaserMotive won the NASA 2009 Power Beaming Challenge by powering a cable climber 1 km vertically using a ground-based laser transmitter. The system produced up to 1 kW of power at the receiver end. In August 2010, NASA contracted
with private companies to pursue the design of laser power beaming systems to power low earth orbit satellites and to launch rockets using laser power beams. Wireless power transmission has been studied for transmission of power from solar power satellites to the earth. A high power array of microwave or laser transmitters would beam power to a
rectenna. Major engineering and economic challenges face any solar power satellite project. Security The examples and perspective in this article may not represent a worldwide view of the subject. You may improve this article, discuss the issue on the talk page, or create a new article, as appropriate. (March 2013) (Learn how and when to remove this
message) The federal government of the United States stated that the American power grid was susceptible to cyber-warfare.[63][64] The United States Department of Homeland Security works with industry to identify vulnerabilities and to help industry enhance the security of control system networks.[65] In June 2019, Russia conceded that it was
"possible" its electrical grid is under cyber-attack by the United States.[66] The New York Times reported that American hackers from the United States Cyber Command planted malware potentially capable of disrupting the Russian electrical grid.[67] Records Highest capacity system: 12 GW Zhundong–Wannan (准东-皖南)±1100 kV HVDC.[68][69]
Highest transmission voltage (AC): oplanned: 1.20 MV (Ultra-High Voltage) on Wardha-Aurangabad line (India), planned to initially operate at 400 kV.[70] oworldwide: 1.15 MV (Ultra-High Voltage) on Ekibastuz-Kokshetau line (Kazakhstan) Largest double-circuit transmission, Kita-Iwaki Powerline (Japan). Highest towers: Yangtze River Crossing
(China) (height: 345 m or 1,132 ft) Longest power line: Inga-Shaba (Democratic Republic of Congo) (length: 1,700 kilometres or 1,056 miles) Longest span of power line: 5,376 m (17,638 ft) at Ameralik Span (Greenland, Denmark) Longest submarine cables: oNorth Sea Link, (Norway/United Kingdom) – (length of submarine cable: 720 kilometres or
447 miles) oNorNed, North Sea (Norway/Netherlands) – (length of submarine cable: 580 kilometres or 360 miles) oBasslink, Bass Strait, (Australia) – (length of submarine cable: 290 kilometres or 180 miles, total length: 370.1 kilometres or 230 miles) oBaltic Cable, Baltic Sea (Germany/Sweden) – (length of submarine cable: 238 kilometres or 148 miles,
HVDC length: 250 kilometres or 155 miles, total length: 262 kilometres or 163 miles) Longest underground cables: oMurraylink, Riverland/Sunraysia (Australia) – (length of underground cable: 170 kilometres or 106 miles) See also Energy portal Dynamic demand (electric power) Demand response List of energy storage power plants Traction
power network Backfeeding Conductor marking lights Double-circuit transmission line Electromagnetic Transients Program (EMTP) Flexible AC transmission system (FACTS) Geomagnetically induced current, (GIC) Graphene-clad wire Grid-tied electrical system List of high-voltage underground and submarine cables Load profile National Grid (disambiguation) Power-line communications (PLC) Power system simulation Radio frequency power transmission Wheeling (electric power transmission) References encyclopedia An electrical grid may have many types of generators and loads; generators must be controlled to maintain stable operation of the system. In an electric
power system, automatic generation control (AGC) is a system for adjusting the power output of multiple generators at different power plants, in response to changes in the load. Since a power grid requires that generation and load closely balance moment by moment, frequent adjustments to the output of generators are necessary. The balance can be
judged by measuring the system frequency; if it is increasing, more power is being generated than used, which causes all the machines in the system to accelerate. If the system frequency is decreasing, more load is on the system than the instantaneous generation can provide, which causes all generators to slow down. History Before the use of automatic
generation control, one generating unit in a system would be designated as the regulating unit and would be manually adjusted to control the balance between generation and load to maintain system frequency at the desired value. The remaining units would be controlled with speed droop to share the load in proportion to their ratings. With automatic
systems, many units in a system can participate in regulation, reducing wear on a single unit's controls and improving overall system efficiency, stability, and economy. Where the grid has tie interconnections to adjacent control areas, automatic generation control helps maintain the power interchanges over the tie lines at the scheduled levels. With
computer-based control systems and multiple inputs, an automatic generation control system can take into account such matters as the most economical units to adjust, the coordination of thermal, hydroelectric, and other generation types, and even constraints related to the stability of the system and capacity of interconnections to other power grids.[1]
Types Turbine-governor control Turbine generators in a power system have stored kinetic energy due to their large rotating masses. All the kinetic energy stored in a power system in such rotating masses is a part of the grid inertia. When system load increases, grid inertia is initially used to supply the load. This, however, leads to a decrease in the stored
kinetic energy of the turbine generators. Since the mechanical power of these turbines correlates with the delivered electrical power, the turbine generators have a decrease in angular velocity, which is directly proportional to a decrease in frequency in synchronous generators. Steady state frequency-power relation for a turbine governor The purpose of the
turbine-governor control (TGC) is to maintain the desired system frequency by adjusting the mechanical power output of the turbine.[2] These controllers have become automated and at steady state, the frequency-power relation for turbine-governor control is, where, is the change in turbine mechanical power output is the change in a reference power
setting is the regulation constant which quantifies the sensitivity of the generator to a change in frequency is the change in frequency. For steam turbines, steam turbine governing adjusts the mechanical output of the turbine by increasing or decreasing the amount of steam entering the turbine via a throttle valve. Load-frequency control Load-frequency
control (LFC) is employed to allow an area to first meet its own load demands, then to assist in returning the steady-state frequency of the system, Δf, to zero.[3] Load-frequency control operates with a response time of a few seconds to keep system frequency stable. Economic dispatch The goal of economic dispatch is to minimize total operating costs in
an area by determining how the real power output of each generating unit will meet a given load.[4] Generating units have different costs to produce a unit of electrical energy, and incur different costs for the losses in transmitting energy to the load. An economic dispatch algorithm will run every few minutes to select the combination of generating unit power
setpoints that minimizes overall cost, subject to the constraints of transmission limitation or security of the system against failures.[5] Further constraints may be imposed by the water supply of hydroelectric generation, or by the availability of sun and wind power. "Grid storage" redirects here. For data storage with grid computing, see Grid-oriented storage.
Energy from fossil or nuclear power plants and renewable sources is stored for use by customers. Diagram showing flow of energy between energy storage facilities and power grids, as a function of time over a 24 hour period Grid energy storage, also known as large-scale energy storage, are technologies connected to the electrical power grid that store
energy for later use. These systems help balance supply and demand by storing excess electricity from variable renewables such as solar and inflexible sources like nuclear power, releasing it when needed. They further provide essential grid services, such as helping to restart the grid after a power outage. As of 2023, the largest form of grid storage is
pumped-storage hydroelectricity, with utility-scale batteries and behind-the-meter batteries coming second and third.[1] Lithium-ion batteries are highly suited for shorter duration storage up to 8 hours. Flow batteries and compressed air energy storage may provide storage for medium duration. Two forms of storage are suited for long-duration storage:
green hydrogen, produced via electrolysis and thermal energy storage.[2] Energy storage is one option to making grids more flexible. An other solution is the use of more dispatchable power plants that can change their output rapidly, for instance peaking power plants to fill in supply gaps. Demand response can shift load to other times and interconnections
between regions can balance out fluctuations in renewables production.[3] The price of storage technologies typically goes down with experience. For instance, lithium-ion batteries have been getting some 20% cheaper for each doubling of worldwide capacity.[4] Systems with under 40% variable renewables need only short-term storage. At 80%, mediumduration storage becomes essential and beyond 90%, long-duration storage does too. The economics of long-duration storage is challenging, and alternative flexibility options like demand response may be more economic. Roles in the power grid Any electrical power grid must match electricity
production to consumption, both of which vary significantly
over time. Energy derived from solar and wind sources varies with the weather on time scales ranging from less than a second to weeks or longer. Nuclear power is less flexible than fossil fuels, meaning it cannot easily match the variations in demand. Thus, low-carbon electricity without storage presents special challenges to electric utilities.[5] Electricity
storage is one of the three key ways to replace flexibility from fossil fuels in the grid. Other options are demand-side response, in which consumers change when they use electricity or how much they use. For instance, households may have cheaper night tariffs to encourage them to use electricity at night. Industry and commercial consumers can also
change their demand to meet supply. Improved network interconnection smooths the variations of renewables production and demand. When there is little wind in one location, another might have a surplus of production. Expansion of transmission lines usually takes a long time.[6] Potential roles of energy storage in the grid[7][8] Consumption Network
Generation Short-term flexibility Increased use rooftop solar, cost reductions from time-based rates Congestion relief Renewables integration (smoothing, arbitrage) Essential grid services Backup power during outages Frequency regulation Black start System reliability and planning Creation of mini-grids Savings in transmission and distribution network
Meeting peak demand Energy storage has a large set of roles in the electricity grid and can therefore provide many different services. For instance, it can arbitrage by keeping it until the electricity price rises, it can help make the grid more stable, and help reduce investment into transmission infrastructure.[9] The type of service provided by storage
depends on who manages the technology, whether the technology is based alongside generation of electricity, within the network, or at the side of consumption.[8] Providing short-term flexibility is a key role for energy storage. On the generation side, it can help with the integration of variable renewable energy, storing it when there is an oversupply of wind
and solar and electricity prices are low. More generally, it can exploit the changes in prices of electricity over time in the wholesale market, charging when electricity is cheap and selling when it is expensive. It can further help with grid congestion (where there is insufficient capacity on transmission lines). Consumers can use storage to use more of their selfproduced electricity (for instance from rooftop solar power).[8][7] Storage can also be used to provide essential grid services. On the generation side, storage can smooth out the variations in production, for instance for solar and wind. It can assist in a black start after a power outage. On the network side, these include frequency regulation (continuously)
and frequency response (after unexpected changes in supply or demand). On the consumption side, storage can help to improve the quality of the delivered electricity in less stable grids.[8][10] Investment in storage may make some investments in the transmission and distribution network unnecessary, or may allow them to be scaled down. Additionally,
storage can ensure there is sufficient capacity to meet peak demand within the electricity grid. Finally, in off-grid home systems or mini-grids, electricity storage can help provide energy access in areas that were previously not connected to the electricity grid.[8] Forms Energy from sunlight or other renewable energy is converted to potential energy for
storage in devices such as electric batteries. The stored potential energy is later converted to electricity that is added to the power grid, even when the original energy source is not available. In daytime, different renewable sources provide different amounts of power to the grid. At night, energy is provided by batteries that were charged during the day when
renewable energy exceeded customer demand. Electricity can be stored directly for a short time in capacitors, somewhat longer electrochemically in batteries, and much longer chemically (e.g. hydrogen), mechanically (e.g. pumped hydropower) or as heat.[11] The first pumped hydroelectricity was constructed at the end of the 19th century around the Alps
in Italy, Austria, and Switzerland. The technique rapidly expanded during the 1960s to 1980s nuclear boom, due to nuclear power's inability to quickly adapt to changes in electricity demand. In the 21st century, interest in storage surged due to the rise of sustainable energy sources, which are often weather-dependent.[12] Commercial batteries have been
available for over a century,[13] their widespread use in the power grid is more recent, with only 1 GW available in 2013.[14] Batteries Main article: Battery energy storage system A 900 watt direct current light plant using 16 separate lead acid battery cells (32 volts) from 1917.[15] Lithium-ion batteries Lithium-ion batteries are the most commonly used
batteries for grid applications, as of 2024, following the application of batteries in electric vehicles (EVs). In comparison with EVs, grid batteries require less energy density, meaning that more emphasis can be put on costs, the ability to charge and discharge often and lifespan. This has led to a shift towards lithium iron phosphate batteries (LFP batteries),
which are cheaper and last longer than traditional lithium-ion batteries.[16] Costs of batteries are declining rapidly; from 2010 to 2023 costs fell by 90%.[17] As of 2024, utility-scale systems account for two thirds of added capacity, and home applications (behind-the-meter) for one third.[18] Lithium-ion batteries are highly suited to short-duration storage
(50%), the temperature ratio between the two must reach a factor of 5.[61] Thermal energy storage is also used in combination with concentrated solar power (CSP). In CSP, solar energy is first converted into heat, and then either directly converted into electricity or first stored. The energy is released when there is little or no sunshine.[62] This means that
CSP can be used as a dispatchable (flexible) form of generation. The energy in a CSP system can for instance be stored in molten salts or in a solid medium such as sand.[63] Finally, heating and cooling systems in buildings can be controlled to store thermal energy in either the building's mass or dedicated thermal storage tanks. This thermal storage can
provide load-shifting or even more complex ancillary services by increasing power consumption (charging the storage) during off-peak times and lowering power consumption (discharging the storage) during higher-priced peak times.[64] Economics Costs Experience curve of lithium-ion batteries: the price of batteries dropped by 97% in three decades.[65]
[66] The levelized cost of storing electricity (LCOS) is a measure of the lifetime costs of storing electricity per MWh of electricity discharged. It includes investment costs, but also operational costs and charging costs.[67] It depends highly on storage type and purpose; as subsecond-scale frequency regulation, minute/hour-scale peaker plants, or day/weekscale season storage.[68][69][70] For power applications (for instance around ancillary services or black starts), a similar metric is the annuitized capacity cost (ACC), which measures the lifetime costs per kW. ACC is lowest when there are few cycles (<300) and when the discharge is less than one hour. This is because the technology is reimbursed only
when it provides spare capacity, not when it is discharged.[71] The cost of storage is coming down following technology-dependent experience curves, the price drop for each doubling in cumulative capacity (or experience). Lithium-ion battery prices fast: the price utitilities pay for them falls 19% with each doubling of capacity. Hydrogen production via
electrolysis has a similar learning rate, but it is much more uncertain. Vanadium-flow batteries typically get 14% cheaper for each doubling of capacity. Pumped hydropower has not seen prices fall much with increased experience.[4] Market and system value There are four categories of services which provide economic value for storage: those related to
power quality (such as frequency regulation), reliability (ensuring peak demand can be met), better use of assets in the system (e.g. avoiding transmission investments) and arbitrage (exploiting price differences over time). Before 2020, most value for storage was in providing power quality services. Arbitrage is the service with the largest economic potential
for storage applications.[72] Storage requirements based on the share of variable renewable energy (VRE). For energy storage, this is the energy stored at a given time, not the total over the year[73] VRE share Power (% of peak demand) Energy storage (% of annual demand) 50% Less than 20% 0.02% 80% 20–50% 0.03–0.1% 90% 25–75% 0.05–0.2%
In systems with under 40% of variable renewables, only short-term storage (of less than 4 hours) is needed for integration. When the share of variable renewables climbs to 80%, medium-duration storage (between 4 and 16 hours, for instance compressed air) is needed. Above 90%, large-scale long-duration storage is required.[74] The economics of longduration storage is challenging even then, as the costs are high. Alternative flexibility options, such as demand response, network expansions or flexible generation (geothermal or fossil gas with carbon capture and storage) may be lower-cost.[75] Like with renewables, storage will "cannibalise" its own income, but even more strongly. That is, with more
storage on the market, there is less of an opportunity to do arbitrage or deliver other services to the grid.[76] How markets are designed impacts revenue potential too. The income from arbitrage is quite variable between years, whereas markets that have capacity payments likely show less volatility.[77] Electricity storage is not 100% efficient, so more
electricity needs to be bought than can be sold. This implies that if there is only a small variation in price, it may not be economical to charge and discharge. For instance, if the storage application is 75% efficient, the price at which the electricity is sold needs to be at least 1.33 higher than the price for which it was bought.[78] Typically, electricity prices vary
most between day and night, which means that storage up to 8 hours has relatively high potential for profit. Article Talk Read Edit View history Tools Appearance Text Small Standard Large Width Standard Wide Color (beta) Automatic Light Dark From Wikipedia, the free encyclopedia Diagram comparing
losses from conventional generation vs. cogeneration Part of a series on Sustainable energy Energy conservation Renewable energy Sustainable transport Category Renewable energy portal v t e Cogeneration or combined heat and power (CHP) is the use of a heat engine[1] or power station to generate electricity and useful heat at the same
time. Cogeneration is a more efficient use of fuel or heat, because otherwise-wasted heat from electricity generation is put to some productive use. Combined heat and power (CHP) plants recover otherwise wasted thermal energy for heating. This is also called combined heat and power district heating. Small CHP plants are an example of decentralized
energy.[2] By-product heat at moderate temperatures (100–180 °C (212–356 °F) can also be used in absorption refrigerators for cooling. The supply of high-temperature heat first drives a gas or steam turbine-powered generator. The resulting low-temperature waste heat is then used for water or space heating. At smaller scales (typically below 1 MW), a
gas engine or diesel engine may be used. Cogeneration is also common with geothermal power plants as they often produce relatively low grade heat. Binary cycles may be necessary to reach acceptable thermal efficiency for electricity generation at all. Cogeneration is less commonly employed in nuclear power plants as NIMBY and safety considerations
have often kept them further from population centers than comparable chemical power plants and district heating is less efficient in lower population density areas due to transmission losses. Cogeneration was practiced in some of the earliest installations of electrical generation. Before central stations distributed power, industries generating their own
power used exhaust steam for process heating. Large office and apartment buildings, hotels, and stores commonly generated their own power and used waste steam for building heat. Due to the high cost of early purchased power, these CHP operations continued for many years after utility electricity became available.[3] Overview Måsnedö CHP power
station in Denmark. This station burns straw as fuel. The adjacent greenhouses are heated by district heating from the plant. Many process industries, such as chemical plants, oil refineries and pulp and paper mills, require large amounts of process heat for such operations as chemical reactors, distillation columns, steam driers and other uses. This heat,
which is usually used in the form of steam, can be generated at the typically low pressures used in heating, or can be generated at much higher pressure and passed through a turbine first to generate electricity. In the turbine the steam pressure and temperature is lowered as the internal energy of the steam is converted to work. The lower-pressure steam
leaving the turbine can then be used for process heat. Steam turbines at thermal power stations are normally designed to be fed high-pressure steam, which exits the turbine at a condenser operating a few degrees above ambient temperature and at a few millimeters of mercury absolute pressure. (This is called a condensing turbine.) For all practical
purposes this steam has negligible useful energy before it is condensed. Steam turbines for cogeneration are designed for extraction of some steam at lower pressures after it has passed through a number of turbine stages, with the un-extracted steam going on through the turbine to a condenser. In this case, the extracted steam causes a mechanical
power loss in the downstream stages of the turbine. Or they are designed, with or without extraction, for final exhaust at back pressure (non-condensing).[4][5] The extracted or exhaust steam is used for process heating. Steam at ordinary process heating conditions still has a considerable amount of enthalpy that could be used for power generation, so
cogeneration has an opportunity cost. A typical power generation turbine in a paper mill may have extraction pressures of 160 and 60 psi (1.10 and 0.41 MPa). A typical back pressure may be 60 psi (0.41 MPa). In practice these pressures are custom designed for each facility. Conversely, simply generating process steam for industrial purposes instead of
high enough pressure to generate power at the top end also has an opportunity cost (See: Steam supply and exhaust conditions). The capital and operating cost of high-pressure boilers, turbines, and generators is substantial. This equipment is normally operated continuously, which usually limits self-generated power to large-scale operations. A
cogeneration plant in Metz, France. The 45 MW boiler uses waste wood biomass as an energy source, providing electricity and heat for 30,000 dwellings. A combined cycle (in which several thermodynamic cycles produce electricity), may also be used to extract heat using a heating system as condenser of the power plant's bottoming cycle. For example,
the RU-25 MHD generator in Moscow heated a boiler for a conventional steam powerplant, whose condensate was then used for space heat. A more modern system might use a gas turbine powered by natural gas, whose exhaust powers a steam plant, whose condensate provides heat. Cogeneration plants based on a combined cycle power unit can have
thermal efficiencies above 80%. The viability of CHP (sometimes termed utilisation factor), especially in smaller CHP installations, depends on a good baseload of operation, both in terms of an on-site (or near site) electrical demand and heat demand. In practice, an exact match between the heat and electricity needs rarely exists. A CHP plant can either
meet the need for heat (heat driven operation) or be run as a power plant with some use of its waste heat, the latter being less advantageous in terms of its utilisation factor and thus its overall efficiency. The viability can be greatly increased where opportunities for trigeneration exist. In such cases, the heat from the CHP plant is also used as a primary
energy source to deliver cooling by means of an absorption chiller. CHP is most efficient when heat can be used on-site or very close to it. Overall efficiency is reduced when the heat must be transported over longer distances. This requires heavily insulated pipes, which are expensive and inefficient; whereas electricity can be transmitted along a
comparatively simple wire, and over much longer distances for the same energy loss. A car engine becomes a CHP plant in winter when the reject heat is useful for warming the interior of the vehicle. The example illustrates the point that deployment of CHP depends on heat uses in the vicinity of the heat engine. Thermally enhanced oil recovery (TEOR)
plants often produce a substantial amount of excess electricity. After generating electricity, these plants pump leftover steam into heavy oil wells so that the oil will flow more easily, increasing production. Cogeneration plants are commonly found in district heating systems of cities, central heating systems of larger buildings (e.g. hospitals, hotels, prisons)
and are commonly used in the industry in thermal production processes for process water, cooling, steam production or CO2 fertilization. Rostock Power Station, a bituminous coal-fired combined heat and power plant in Germany Trigeneration or combined cooling, heat and power (CCHP) refers to the simultaneous generation of electricity and useful
heating and cooling from the combustion of a fuel or a solar heat collector. The terms cogeneration and trigeneration can also be applied to the power systems simultaneously generating electricity, heat, and industrial chemicals (e.g., syngas). Trigeneration differs from cogeneration in that the waste heat is used for both heating and cooling, typically in an
absorption refrigerator. Combined cooling, heat, and power systems can attain higher overall efficiencies than cogeneration or traditional power plants. In the United States, the application of trigeneration in buildings is called building cooling, heating, and power. Heating and cooling output may operate concurrently or alternately depending on need and
system construction. Types of plants Hanasaari Power Plant, a coal-fired cogeneration power plant in Helsinki, Finland Topping cycle plants primarily produce electricity from a steam turbine. Partly expanded steam is then condensed in a heating condensor at a temperature level that is suitable e.g. district heating or water desalination. Bottoming cycle
plants produce high temperature heat for industrial processes, then a waste heat recovery boiler feeds an electrical plant. Bottoming cycle plants are only used in industrial processes that require very high temperatures such as furnaces for glass and metal manufacturing, so they are less common. Large cogeneration systems provide heating water and
power for an industrial site or an entire town. Common CHP plant types are: Gas turbine CHP plants using the waste heat in the flue gas of gas turbines. The fuel used is typically natural gas. Gas engine CHP plants use a reciprocating gas engine, which is generally more competitive than a gas turbine up to about 5 MW. The gaseous fuel used is
normally natural gas. These plants are generally manufactured as fully packaged units that can be installed within a plantroom or external plant compound with simple connections to the site's gas supply, electrical distribution network and heating systems. Typical outputs and efficiencies see [6] Typical large example see [7] Biofuel engine CHP plants use
an adapted reciprocating gas engine or diesel engine, depending upon which biofuel is being used, and are otherwise very similar in design to a Gas engine CHP plant. The advantage of using a biofuel is one of reduced fossil fuel consumption and thus reduced carbon emissions. These plants are generally manufactured as fully packaged units that can be

installed within a plantroom or external plant compound with simple connections to the site's electrical distribution and heating systems. Another variant is the wood gasifier CHP plant whereby a wood pellet or wood chip biofuel is gasified in a zero oxygen high temperature environment; the resulting gas is then used to power the gas engine. Combined
cycle power plants adapted for CHP Molten-carbonate fuel cells and solid oxide fuel cells have a hot exhaust, very suitable for heating. Steam turbine CHP plants that use the heating system as the steam condenser for the steam turbine Nuclear power plants, similar to other steam turbine power plants, can be fitted with extractions in the turbines to
bleed partially expanded steam to a heating system. With a heating system temperature of 95 °C it is possible to extract about 10 MW heat for every MW electricity lost. With a temperature of 130 °C the gain is slightly smaller, about 7 MW for every MWe lost.[8] A review of cogeneration options is in [9] Czech research team proposed a "Teplator" system
where heat from spent fuel rods is recovered for the purpose of residential heating.[10] Smaller cogeneration units may use a reciprocating engine or Stirling engine. The heat is removed from the exhaust and radiator. The systems are popular in small sizes because small gas and diesel engines are less expensive than small gas- or oil-fired steam-electric
plants. Some cogeneration plants are fired by biomass,[11] or industrial and municipal solid waste (see incineration). Some CHP plants use waste gas as the fuel for electricity and heat generation. Waste gases can be gas from animal waste, landfill gas, gas from coal mines, sewage gas, and combustible industrial waste gas.[12] Some cogeneration plants
combine gas and solar photovoltaic generation to further improve technical and environmental performance.[13] Such hybrid systems can be scaled down to the building level[14] and even individual homes.[15] MicroCHP Micro combined heat and power or "Micro cogeneration" is a so-called distributed energy resource (DER). The installation is usually less
than 5 kWe in a house or small business. Instead of burning fuel to merely heat space or water, some of the energy is converted to electricity in addition to heat. This electricity can be used within the home or business or, if permitted by the grid management, sold back into the electric power grid. Delta-ee consultants stated in 2013 that with 64% of global
sales the fuel cell micro-combined heat and power passed the conventional systems in sales in 2012.[16] 20,000 units were sold in Japan in 2012 overall within the Ene Farm project. With a Lifetime of around 60,000 hours. For PEM fuel cell units, which shut down at night, this equates to an estimated lifetime of between ten and fifteen years.[17] For a
price of $22,600 before installation.[18] For 2013 a state subsidy for 50,000 units is in place.[17] MicroCHP installations use five different technologies: microturbines, internal combustion engines, stirling engines, closed-cycle steam engines, and fuel cells. One author indicated in 2008 that MicroCHP based on Stirling engines is the most cost-effective of
the so-called microgeneration technologies in abating carbon emissions.[19] A 2013 UK report from Ecuity Consulting stated that MCHP is the most cost-effective method of using gas to generate energy at the domestic level.[20][21] However, advances in reciprocation engine technology are adding efficiency to CHP plants, particularly in the biogas field.
[22] As both MiniCHP and CHP have been shown to reduce emissions [23] they could play a large role in the field of CO2 reduction from buildings, where more than 14% of emissions can be saved using CHP in buildings.[24] The University of Cambridge reported a cost-effective steam engine MicroCHP prototype in 2017 which has the potential to be
commercially competitive in the following decades.[25] Quite recently, in some private homes, fuel cell micro-CHP plants can now be found, which can operate on hydrogen, or other fuels as natural gas or LPG.[26][27] When running on natural gas, it relies on steam reforming of natural gas to convert the natural gas to hydrogen prior to use in the fuel cell.
This hence still emits CO2 (see reaction) but (temporarily) running on this can be a good solution until the point where the hydrogen is starting to be distributed through the (natural gas) piping system. Another MicroCHP example is a natural gas or propane fueled Electricity Producing Condensing Furnace. It combines the fuel saving technique of
cogeneration meaning producing electric power and useful heat from a single source of combustion. The condensing furnace is a forced-air gas system with a secondary heat exchanger that allows heat to be extracted from combustion products down to the ambient temperature along with recovering heat from the water vapor. The chimney is replaced by a
water drain and vent to the side of the building. Trigeneration Trigeneration cycle A plant producing electricity, heat and cold is called a trigeneration[28] or polygeneration plant. Cogeneration systems linked to absorption chillers or adsorption chillers use waste heat for refrigeration.[29] Combined heat and power district heating See also: District heating In
the United States, Consolidated Edison distributes 66 billion kilograms of 350 °F (177 °C) steam each year through its seven cogeneration plants to 100,000 buildings in Manhattan—the biggest steam district in the United States. The peak delivery is 10 million pounds per hour (or approximately 2.5 GW).[30][31] Industrial CHP Cogeneration is still common
in pulp and paper mills, refineries and chemical plants. In this "industrial cogeneration/CHP", the heat is typically recovered at higher temperatures (above 100 °C) and used for process steam or drying duties. This is more valuable and flexible than low-grade waste heat, but there is a slight loss of power generation. The increased focus on sustainability has
made industrial CHP more attractive, as it substantially reduces carbon footprint compared to generating steam or burning fuel on-site and importing electric power from the grid. Smaller industrial co-generation units have an output capacity of 5–25 MW and represent a viable off-grid option for a variety of remote applications to reduce carbon emissions.
[32] Utility pressures versus self generated industrial Industrial cogeneration plants normally operate at much lower boiler pressures than utilities. Among the reasons are: 1.Cogeneration plants face possible contamination of returned condensate. Because boiler feed water from cogeneration plants has much lower return rates than 100% condensing power
plants, industries usually have to treat proportionately more boiler make up water. Boiler feed water must be completely oxygen free and de-mineralized, and the higher the pressure the more critical the level of purity of the feed water.[5] 2.Utilities are typically larger scale power than industry, which helps offset the higher capital costs of high pressure.
3.Utilities are less likely to have sharp load swings than industrial operations, which deal with shutting down or starting up units that may represent a significant percent of either steam or power demand. Heat recovery steam generators A heat recovery steam generator (HRSG) is a steam boiler that uses hot exhaust gases from the gas turbines or
reciprocating engines in a CHP plant to heat up water and generate steam. The steam, in turn, drives a steam turbine or is used in industrial processes that require heat. HRSGs used in the CHP industry are distinguished from conventional steam generators by the following main features: The HRSG is designed based upon the specific features of the
gas turbine or reciprocating engine that it will be coupled to. Since the exhaust gas temperature is relatively low, heat transmission is accomplished mainly through convection. The exhaust gas velocity is limited by the need to keep head losses down. Thus, the transmission coefficient is low, which calls for a large heating surface area. Since the
temperature difference between the hot gases and the fluid to be heated (steam or water) is low, and with the heat transmission coefficient being low as well, the evaporator and economizer are designed with plate fin heat exchangers. Cogeneration using biomass Biomass refers to any plant or animal matter in which it is possible to be reused as a source
of heat or electricity, such as sugarcane, vegetable oils, wood, organic waste and residues from the food or agricultural industries. Brazil is now considered a world reference in terms of energy generation from biomass.[33] A growing sector in the use of biomass for power generation is the sugar and alcohol sector, which mainly uses sugarcane bagasse as
fuel for thermal and electric power generation.[34] Power cogeneration in the sugar and alcohol sector In the sugarcane industry, cogeneration is fueled by the bagasse residue of sugar refining, which is burned to produce steam. Some steam can be sent through a turbine that turns a generator, producing electric power.[35] Energy cogeneration in
sugarcane industries located in Brazil is a practice that has been growing in last years. With the adoption of energy cogeneration in the sugar and alcohol sector, the sugarcane industries are able to supply the electric energy demand needed to operate, and generate a surplus that can be commercialized.[36][37] Advantages of the cogeneration using
sugarcane bagasse In comparison with the electric power generation by means of fossil fuel-based thermoelectric plants, such as natural gas, the energy generation using sugarcane bagasse has environmental advantages due to the reduction of CO2 emissions.[38] In addition to the environmental advantages, cogeneration using sugarcane bagasse
presents advantages in terms of efficiency comparing to thermoelectric generation, through the final destination of the energy produced. While in thermoelectric generation, part of the heat produced is lost, in cogeneration this heat has the possibility of being used in the production processes, increasing the overall efficiency of the process.[38]
Disadvantages of the cogeneration using sugarcane bagasse In sugarcane cultivation, is usually used potassium source's containing high concentration of chlorine, such as potassium chloride (KCl). Considering that KCl is applied in huge quantities, sugarcane ends up absorbing high concentrations of chlorine.[39] Due to this absorption, when the
sugarcane bagasse is burned in the power cogeneration, dioxins [39] and methyl chloride [40] ends up being emitted. In the case of dioxins, these substances are considered very toxic and cancerous.[41][42][43] In the case of methyl chloride, when this substance is emitted and reaches the stratosphere, it ends up being very harmful for the ozone layer,
since chlorine when combined with the ozone molecule generates a catalytic reaction leading to the breakdown of ozone links.[40] After each reaction, chlorine starts a destructive cycle with another ozone molecule. In this way, a single chlorine atom can destroy thousands of ozone molecules. As these molecules are being broken, they are unable to
absorb the ultraviolet rays. As a result, the UV radiation is more intense on Earth and there is a worsening of global warming.[40] Comparison with a heat pump A heat pump may be compared with a CHP unit as follows. If, to supply thermal energy, the exhaust steam from the turbo-generator must be taken at a higher temperature than the system would
produce most electricity at, the lost electrical generation is as if a heat pump were used to provide the same heat by taking electrical power from the generator running at lower output temperature and higher efficiency.[44] Typically for every unit of electrical power lost, then about 6 units of heat are made available at about 90 °C (194 °F). Thus CHP has an
effective Coefficient of Performance (COP) compared to a heat pump of 6.[45] However, for a remotely operated heat pump, losses in the electrical distribution network would need to be considered, of the order of 6%. Because the losses are proportional to the square of the current, during peak periods losses are much higher than this and it is likely that
widespread (i.e. citywide application of heat pumps) would cause overloading of the distribution and transmission grids unless they were substantially reinforced. It is also possible to run a heat driven operation combined with a heat pump, where the excess electricity (as heat demand is the defining factor on se[clarification needed]) is used to drive a heat
pump. As heat demand increases, more electricity is generated to drive the heat pump, with the waste heat also heating the heating fluid. As the efficiency of heat pumps depends on the difference between hot end and cold end temperature (efficiency rises as the difference decreases) it may be worthwhile to combine even relatively low grade waste heat
otherwise unsuitable for home heating with heat pumps. For example, a large enough reservoir of cooling water at 15 °C (59 °F) can significantly improve efficiency of heat pumps drawing from such a reservoir compared to air source heat pumps drawing from cold air during a −20 °C (−4 °F) night. In the summer when there's both demand for air
conditioning and warm water, the same water may even serve as both a "dump" for the waste heat rejected by a/c units and as a "source" for heat pumps providing warm water. Those considerations are behind what is sometimes called "cold district heating" using a "heat" source whose temperature is well below those usually employed in district heating.
[46] Distributed generation Most industrial countries generate the majority of their electrical power needs in large centralized facilities with capacity for large electrical power output. These plants benefit from economy of scale, but may need to transmit electricity across long distances causing transmission losses. Cogeneration or trigeneration production is
subject to limitations in the local demand and thus may sometimes need to reduce (e.g., heat or cooling production to match the demand). An example of cogeneration with trigeneration applications in a major city is the New York City steam system. Thermal efficiency Every heat engine is subject to the theoretical efficiency limits of the Carnot cycle or
subset Rankine cycle in the case of steam turbine power plants or Brayton cycle in gas turbine with steam turbine plants. Most of the efficiency loss with steam power generation is associated with the latent heat of vaporization of steam that is not recovered when a turbine exhausts its low temperature and pressure steam to a condenser. (Typical steam to
condenser would be at a few millimeters absolute pressure and on the order of 5 °C (41 °F) hotter than the cooling water temperature, depending on the condenser capacity.) In cogeneration this steam exits the turbine at a higher temperature where it may be used for process heat, building heat or cooling with an absorption chiller. The majority of this heat
is from the latent heat of vaporization when the steam condenses. Thermal efficiency in a cogeneration system is defined as: Where: = Thermal efficiency = Total work output by all systems = Total heat input into the system Heat output may also be used for cooling (for example, in summer), thanks to an absorption chiller. If cooling is achieved in the
same time, thermal efficiency in a trigeneration system is defined as: Where: = Thermal efficiency = Total work output by all systems = Total heat input into the system Typical cogeneration models have losses as in any system. The energy distribution below is represented as a percent of total input energy:[47] Electricity = 45% Heat + Cooling =
40% Heat losses = 13% Electrical line losses = 2% Conventional central coal- or nuclear-powered power stations convert about 33–45% of their input heat to electricity.[48][5] Brayton cycle power plants operate at up to 60% efficiency. In the case of conventional power plants, approximately 10-15% of this heat is lost up the stack of the boiler. Most of
the remaining heat emerges from the turbines as low-grade waste heat with no significant local uses, so it is usually rejected to the environment, typically to cooling water passing through a condenser.[5] Because turbine exhaust is normally just above ambient temperature, some potential power generation is sacrificed in rejecting higher-temperature steam
from the turbine for cogeneration purposes.[49] For cogeneration to be practical power generation and end use of heat must be in relatively close proximity (Training Transcript 4. To change the date range, click on the filter in the top left corner We appreciate your input and look forward to fulfilling your future learning needs. If you have any questions or concerns, please contact us at
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papers and more to take your data center into the future. Success story Building data centers to exceed big expectations } Success story Building data centers to exceed big expectations Data center Visualize our solutions in our 3D environment } Data center Visualize our solutions in our 3D environment An explosion 4x hotter than the sun The mere
drop of a tool or accidental contact with electrical systems can set off an arc flash and instantly generate an energy explosion releasing temperatures in excess of 36,000°F. That's four times hotter than the sun. Why arc flashes occur An arc flash is the explosive energy released when an electrical fault, for instance a short circuit, causes an arc. The
danger's associated with an arc flash event include heat, flying debris, sound, UV radiation and more. 2 3 5 7 6 4 1 Power intensive environments are especially vulnerable In heavy power, continuous operation industries, arc flash poses a very real threat. Environments operating with 125 kVA or larger transformers call for special safety measures.
Protecting personnel and equipment is everyone's responsibility. 8 Employees require education Electrical workers must be trained and should understand the risks of arc flash safety. This includes reading and understanding arc flash labels and wearing the proper personal protective equipment (PPE) to perform energized work. Codes and standards are
always changing and it is imperative that your organization be in compliance. Arc flash labels provide advance warning Arc flash labels indicate two key pieces of information: The expected incident energy (measured in calories per cm2)—at a working distance of 18 inches or 24 inches—which drives the proper PPE required for protection. And the distance
a worker without PPE must work to avoid a non-curable burn (typically measured in feet). Avoiding electrical disasters Time and distance are the most controllable variables reducing the risk of arc flash issues. Reducing the time that an event persists by tripping a breaker or blowing a fuse significantly reduces the arc flash incident energy. Increasing
distance to the arc flash by remote operation, or with closed doors or protective barriers, protects workers in case an event occurs. Better equipment can help Installing the right equipment can help mitigate arc flash hazards. Specially designed low voltage motor control centers (MCCs) and switchgear can reduce the probability of electrical shock and arc
flash energy during maintenance. As powerful as an 8-stick dynamite blast A 10,000A arc on a 480-volt circuit can have the explosive force of eight (8) sticks of dynamite. Another example of the energy in an arc flash: copper expands at 67,000 times its volume during an arc flash event—a small, pea-sized piece of copper would

expand to fill the volume of
a railroad car| 9 10 Good safety optimizes operational efficiency A sound safety policy incorporating arc flash safety solutions will protect your people and equipment, minimizing risk and increasing uptime. Human error is often to blame The most common cause of electrical accidents is human error. And the majority of those mistakes occur during routine
maintenance of power system equipment or troubleshooting controls. Follow the Charge » to consider when designing your data center 10 THINGS ABOUT ARC FLASH SAFETYEach year, Eaton is performing discharge tests for over 300 000 batteries in Finland, where the EMEA UPS factory is located, to guarantee the safety and the functionality of the
complete battery system. Eaton has a performing battery approval process, that leads to utilizing only the premium batteries on the market. In addition, regular audits are performed in all the facilities of the approved battery suppliers of Eaton Battery replacement service Batteries are the core element of any critical power protection system, hence they are
assuring the backup time delivery. Most frequent cause of unplanned outages is premature end of life of few battery blocks. Handling batteries without proper training can lead to disastrous results of full UPS system investment 30-80% + - Continous quality monitoring Eaton is utilizing millions of batteries per year for UPS applications globally. Battery
quality indeed plays the most critical role in battery selection criteria. >300 000 BATTERIES>1 000 000 Batteries utilized globally TESTED FOR EATON 3PH UPS IN EMEA PER YEAR As identical as possible battery performance between each battery blocks in the same string is crucial for the battery lifetime and battery string performance. In the graphs
there are real test results from the same discharge test for 20 blocks of lower quality and 20 blocks of high quality batteries. With lower quality batteries there is much higher dispersion in the graphs than with high quality batteries. Eaton EMEA 3ph UPS service Good quality battery example Low quality battery example End of discharge Time Voltage Time
Voltage End of discharge Changes to the products, to the information contained in this document, and to prices are reserved; so are errors and omissions. Only order confirmations and technical documentation by Eaton is binding. Photos and pictures also do not warrant a specific layout or functionality. Their use in whatever form is subject to prior approval
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Switzerland Eaton.com © 2022 Eaton All Rights Reserved Publication No. SA161013EN June 2022Eaton is a registered trademark. All other trademarks are property of their respective owners. Safety ensured With over 50 years of experience in qualifying batteries for UPS applications, Eaton is replacing more than 200 000 blocks every year in EMEA.
Eaton field service engineers and authorized partners are trained to perform the battery replacement according to the required safety procedures. In addition, Eaton's trained personnel is able to set and operate UPS and battery according to the site specific requirements, like environmental temperature and humidity, and Eaton UPS features like ABM, ESS
and VMMS. This is crucial for safety and optimal UPS system performance. As an active steward of the environment, Eaton guarantees an efficient disposal of the end-of-life batteries. To benefit from battery replacement and other features, Eaton offers Service Level Agreements for maintaining the condition of your UPS to ensure its continuous
performance while allowing you to accurately plan your budget. For more information about UPS services please visit https://www.eaton.com/gb/en-gb/services.html >200 000 BLOCKS REPLACED PER YEAR Years of expertise with UPS batteries 50+ >4000 A can be delivered from a battery cabinet ABM A correct set-up of the charging method promotes
battery life Relevance A-Z Z-A Filters News and insights (3) Product (26) Resources (289) Multi-mode (6) Online (7) 13-19 kVA (2) 161-400 kVA (4) 20-40 kVA (5) 401-1200 kVA (3) 41-80 kVA (4) Data centre (6) Marine (2) Network closet (1) Server room (2) End of row (3) Facility level (3) Horizontal (2) Mounted with
UPS (1) Tower (7) Basic (2) Configurable (1) Managed (1) Metered input (1) Switched (1) Single phase (2) Three phase (7) Articles (1) Brochures (48) Catalogues (33) Infographics and listicles (2) Presentations (1) Application notes (2) Certification reports (18) Drawings (45) Product notifications (1) Installation instructions (25) Eaton 93PM G2 UPS https://www.eaton.com/za/en-gb/catalog/backup-power-ups-surge-it-power-distribution/eaton-93pm-generation-2-ups.html Models Resources Power Xpert 9395P UPS https://www.eaton.com/za/en-gb/catalog/backup-power-ups-surge-it-power-distribution/power-xpert-9395P.html Models Resources Eaton 93PM UPS
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https://www.eaton.com/content/dam/eaton/products/backup-power-ups-surge-it-power-distribution/backup-power-ups/eaton-93pr/india/eaton-93pr-25-200kw-ups-technical-specification.pdf /content/dam/eaton/products/backup-power-ups-surge-it-power-distribution/crouse-hinds/catalog-pages/crouse-hinds-mtl-rack-pro-catalog-page.pdf Crouse-Hinds series
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Configure. Review. Complete. Order. Plan your
service according to your maintenance needs and budget Basic: professional routine maintenance for your UPS Standard (+): essential services to minimize failure rate and its impact ("+" supported by Cyber Secured Monitoring) Advanced (+): your choice to optimize maintenance investment ("+" supported by Cyber Secured Monitoring) Premium:
integral solution to maximize your power security supported by Cyber Secured Monitoring Choose what should be included in your contract: Emergency response (8/5 or 24/7) Yes No Travel and labour costs Yes No All spare parts expenses Yes No Cyber Secured Monitoring - including 24/7 monitoring, remote diagnostic, periodical health reports Yes No
UPS type * kVA * UPS Serial no. Flexible energy systems will power the future The transition to a more sustainable, low-carbon future is accelerating. This energy transition is driven by the progressive replacement of carbon-based fuels with renewables, clean air regulation and the direct and indirect electrification of more applications. Today, energy flows
through the grid in more directions and through more devices than ever before, and although that decentralisation creates more complexities and challenges, it also creates new potential. Everything as a Grid is our approach to reinventing the way power is distributed, stored and consumed. Our Everything as a Grid approach is shaping a future where
homeowners and businesses can reduce the cost and environmental impact of energy. Flexible, intelligent power creates new opportunities for everyone. Energy transition: Everything as a Grid Our Everything as a Grid approach reinvents how power is distributed, stored and consumed worldwide. Because the world's energy needs are shifting, but what
matters isn't. Eaton.com/EnergyTransition Watch the full story The transition to renewable power Global renewable adoption is on the rise; electricity demand is expected to reach 38,700 terawatt-hours by 2050 – with renewables providing 50% of that energy.1 The highly distributed nature of renewable energy is upending the traditional power delivery
model. Electricity no longer flows in one direction from the utility that generates it to those who consume it. The new energy ecosystem comprises an intricate network of "prosumers" – consumers and businesses who produce their own energy locally, use what's needed and in many cases, are looking to export excess power back to the grid. Furthermore,
the electrification of transport, building systems and industrial processes will drive considerable increases in demand for electrical power over the coming decades. Data centers, offices, factories and similar sites can participate in the transition via battery and thermal energy storage systems and grid-interactive uninterruptible power systems. This will give
rise to vast bi-directional electricity flows requiring a network with the flexibility to cope with higher volatility and demand. 57 % Increase in global electricity demand by 2050 13X Growth in energy storage installed base by 2030 4X Growth of electricity required for data and computing by 2030 Planning for the shift to more electrical power The electrification
of more areas of the economy, including transport, building systems and industry will drive a substantial increase in power demand by 2050. It is technically feasible to meet this extra demand with electricity generated from low or zero carbon sources. However, this will require concerted government support through policy and regulation as well as research
and development to reduce the cost of new green energy sources like clean hydrogen. Decarbonisation: cleaner power Businesses and consumers are participating in cleaner power initiatives. Active corporate sourcing of renewable electricity reached 465 terawatt-hours (TWh), with production for self-consumption reaching 165TWh.2 On the consumer
side, electric vehicle (EV) charging technology prices continue to fall, while charging point accessibility continues to rise. By facilitating the trading of self-generated clean electricity to reduce energy costs, we're enabling energy users, both consumers and businesses, to participate in demand response programmes where the utility can turn demand and/or
on-site generation up or down in response to signals for real-time grid balancing needs. Democratisation: less reliance on the grid More homes, businesses and communities are becoming self-sufficient power producers that rely less on the utility grid. They generate, store and consume their own energy via renewable solar arrays, wind turbines, microgrids
and battery storage. And they create a bi-directional flow that is changing the way power is managed and reducing the impact of sudden outages caused by rolling blackouts, cyberattacks and extreme weather events. These prosumers may also sell excess energy back to the grid and take advantage of demand response programmes to help reduce utility
bills. Digitalisation: connectivity behind powerful decisions Digital innovation can be used to make smarter business or personal energy management decisions. It's the transformation of the data from appliances, equipment or processes into actionable insights that help consumers and businesses drive new efficiencies, maximise uptime and manage their
energy footprint. Through technologies that support bi-directional power generation, storage and energy management, we're playing a critical role in helping meet demand growth and balance grid volatility. We are reimagining and rebuilding the electrical power value chain. Need help with the shift to more electrical power? Contact us Embracing the new
power paradigm Homes, offices, stadiums, factories and data centres can now generate and store more of their own power to optimise energy costs, lower their carbon footprint and in some cases, reduce reliance on the grid. This is Everything as a Grid. Traditional electrical power infrastructures must be upgraded, with software and services optimising
every process, to realise new energy benefits. We enable a systems approach to infrastructure integration and the technologies that help transform power generation and distribution for homes, buildings and utilities. Buildings as a grid Unlock the energy transition for your building See how the energy transition can help you seize the opportunity to improve
the performance and expand functional use of your building infrastructure. Eaton introduces its Buildings as a Grid approach to energy transition Eaton introduces its Buildings as a Grid approach to help customers accelerate decarbonization, boost resilience, reduce energy costs and create new revenue streams. Responding to the high demand for low
carbon Renewable and battery market shares continue to rise and play a larger role in the global power supply, even in the wake of the COVID-19 pandemic. The steady increase of competitiveness in renewables, along with their modularity, rapid scalability and job creation potential, make them highly attractive as countries and communities evaluate
economic stimulus options.3 The challenge lies in balancing variable renewable power and storage options against the always-there, always-on power that users demand. By helping utilities, building managers and homeowners adopt renewable power and storage strategies, we're helping to make clean energy available when and where it's needed.
Energy storage Capture renewable energy whenever it's available and use it on demand. You'll see immediate gains in reliability, realise greater independence from the utility grid and avoid dips in grid power supply due to brownouts, cyberattacks and weather-related events. This transformational technology revolutionises power for all, with energy storage
available for the home, commercial and industrial buildings and even large-scale implementations for utilities. EnergyAware UPS Our EnergyAware technology helps applications like data centres to support energy providers by balancing sustainable power generation and consumption. The technology optimises power usage during peak demand hours and
helps facilities earn additional revenues from currently deployed assets while maintaining complete control of deployed uninterruptible power systems and batteries. Electric vehicles Changing energy demands will affect infrastructure investments – and understanding that impact will be critical in enabling a resilient systems approach that seamlessly and
flexibly integrates different assets and EV infrastructure. Power systems, EV manufacturers and charging infrastructure providers can then drive a deeper understanding of energy usage to maximise energy efficiency and lower operational costs to consumers. Microgrids Built to help isolate power from the main grid, microgrids balance multiple sources of
on-site generation and demand to make energy available when it is needed. Grid modernisation Discover how utilities can adopt grid modernisation technologies to build resilient, efficient and secure power networks. Find out more about Eaton's global sustainability commitments, including carbon neutrality by 2030 Find out more Adapting to fast-changing
regulations Regulators are starting to make important changes to incentivise services like demand response to reduce costs, encourage and integrate the uptake of clean energy and increase customer participation. However, we have far to go if we are to replicate best practices and further encourage innovation. This includes financial mechanisms that

reward utilities and distribution companies for contracting with distributed energy providers in place of capital investments – a departure from traditional regulation in which the addition of new capital assets is the main source of profit. Through market data analysis and expert insights, we help companies and countries prepare for and embrace the regulatory
changes needed to assure a reliable power mix. Ensuring cybersecurity throughout the transition Only 48% of utility executives feel they are prepared to handle the challenges of a cyberattack interruption.4 As utilities address the challenges of improving power reliability and efficiency, they must also contend with the near-constant barrage of security
threats. We proactively address cyber threats via a system-wide defensive approach and an unwavering focus on the dangers malware, spyware and ransomware present across the globe. Our team members meet and exceed competencies recognised by international standards organisations like UL, IEC, ISA and others through rigorous, in-depth
technical training programmes. Our "secure-by-design" philosophy, processes and secure development lifecycle are integrated into product development and guide our labs, procurement and design teams as the foundation of innovation. And our understanding of and influence in changing global standards help guide safer, more efficient energy
infrastructures. Powering the energy transition The technologies that convert wind and sunlight to renewable energy have matured, allowing for more flexible power possibilities. The growth of renewables, localised electricity production and bi-directional energy helps more homes, businesses and communities produce their own clean, dependable energy
for less reliance on the utility grid. Count on Eaton for the technologies and digital intelligence needed for you to join this energy transition. Through our Everything as a Grid approach, infrastructures can be re-vamped to manage and optimise renewable integration, so you can realise more efficient, sustainable power that costs less. MTL4500/MTL5500
range Analogue Input Modules with passive input for 4-wire separately powered transmitters MTL4541A, MTL4541AS, MTL5541A, MTL5541AS, MTL4544A, MTL4544AS, MTL5544A, MTL5544AS April 2024 SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 Safety manual MTL intrinsic safety solutions FUNCTIONAL SAFETY MANAGEMENT These
products are for use as elements within a Safety System conforming to the requirements of IEC 61508:2010 and enable a Safety Integrity Level of up to SIL 2 to be achieved for the instrument loop in a simplex architecture. Eaton Electric Ltd, Luton is a certified Functional Safety Management company meeting the requirements of IEC61508:2010 Part 1,
Clause 6. * * Subject to special conditions for detection of out-of-range signal currents. Refer to content of this manual for details. SIL IEC 61508:2010 2 2SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 This manual supports the application of the products in functional-safety related loops. It must be used in conjunction with other supporting
documents to achieve correct installation, commissioning and operation. Specifically, the data sheet, instruction manual and applicable certificates for the particular product should be consulted, all of which are available on the MTL web site. In the interest of further technical developments, Eaton reserve the right to make design changes. Contents 1
Introduction 3 1.1 Application and function 3 1.2 Variant description 3 1.3 Product build revisions covered by this manual 4 2 System configuration 5 2.1 Associated system components 6 3 Selection of product and implications 6 4 Assessment of functional safety 6 4.1 Hardware Safety Integrity 6 4.2 Systematic Safety Integrity 7 4.3 SIL Capability 7 4.4
Example of use in a safety function 7 4.5 EMC 8 4.6 Environmental 8 5 Installation 8 6 Maintenance 9 7 Appendices 9 7.1 Appendix A: Summary of applicable standards 9 7.2 Appendix B: Proof Test Procedure, MTLx541A/AS, MTLx544A/AS Modules 10 - 12 Analogue Input Modules with passive input for 4-wire transmitters Hardware Fault Tolerance (HFT)
† Module type 0, 1 MTL4541A, MTL4541AS, MTL5541A, MTL5541AS, MTL4544A, MTL4544AS, MTL5544A, MTL5544AS † These modules have an inherent fault tolerance of 0. SIL IEC 61508:2010 2 3SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 1 INTRODUCTION 1.1 Application and function The Analogue Input module types MTLx541A/
MTLx541AS (single channel) and MTLx544A/MTLx544AS (dual channel) are intrinsic safety isolators that interface with process measurement transmitters located in a hazardous area of a process plant. They are also designed and assessed according to IEC 61508 for use in safety instrumented systems up to SIL 2. The MTLx541A provides an input for a
separately-powered 4/20mA transmitter located in a hazardous area, and repeats the transmitter current into a load in the safe area. The MTLx544A supports two identical channels for use with two separate transmitters. The MTLx541AS and MTLx544AS versions act as a current sink for the safe area connection rather than driving the current into the load.
All the modules allow bi–directional transmission of HART communication signals superimposed on the 4/20mA loop current, so that the transmitter can be interrogated either from the operator station or by a hand- held communicator (HHC). There are no configuration switches or operator controls to be set on the modules. These modules are members of
the MTL4500 and MTL5500 range of products. 1.2 Variant Description Functionally the MTL4500 and MTL5500 range of modules are the same but differ in the following way: - the MTL4500 modules are designed for backplane mounted applications - the MTL5500 modules are designed for DIN-rail mounting. In both models the hazardous area field-wiring
connections (terminals 1,2, and optionally 4,5) are made through the removable blue connectors, but the safe area and power connections for the MTL454xA/MTL454xAS modules are made through the connector on the base, while the MTL554xA/MTL554xAS modules use the removable grey connectors on the top and side of the module. Note that the
safe-area connection terminal numbers differ between the backplane and the DIN-rail mounting models. The analogue input models covered by this manual are: Module type Number of channels Safe area connection MTL4541A and 5541A 1 Current source MTL4541AS and 5541AS 1 Current sink MTL4544A and 5544A 2 Current source MTL4544AS and
5544AS 2 Current sink Note: To avoid repetition, further use of MTLx54xA and MTLx54xAS in this document can be understood to include both DIN-rail and backplane models. Individual model numbers will be used only where there is a need to distinguish between them. All the module types described in this manual have the same connectivity for the field
signals, supporting 4-wire process transmitters or currents sourced in the hazardous area. The connection of the repeated current signals into the input measurement channels for the safety logic system follows the arrangement shown in the following diagram. When the input channels of the Safety Instrumented System (SIS) are providing power for the
loop, the 'S' variants of the isolator modules are used to 'sink' the measuring current. In the other cases the isolator modules 'source' the measuring current that flows into a load resistor inside the input card of the Safety Instrumented System. 4SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 2+ 1- Pwr 0V 24V Safety Instrumented System (SIS) Logic
Solver with 'Passive' input MTLx541A/ MTLx544A (Safe area current source) B A 2+ 1- Pwr 0V 24V Safety Instrumented System (SIS) Logic Solver with 2-wire input A B Current limiter Output terminal MTL4541A, MTL4541AS MTL5541A, MTL5541AS A 8 11 B 9 12 4-wire Transmitter or current source Pwr Field wiring MTLx541AS/MTLx544AS (Safe area
current sink) Figure 1.1 – Input and output connections 1.3 Product build revisions covered by this manual The information provided in this manual is valid for the product build revisions listed in the following table: Model Type Product build revision covered by this manual MTL4541A Up to and including 08 MTL4541AS Up to and including 08 MTL5541A Up
to and including 08 MTL5541AS Up to and including 08 MTL4544A Up to and including 08 MTL4544AS Up to and including 08 MTL5544A Up to and including 08 MTL5544AS Up to and including 08 The product build revision is identified by the field 'CC' in the module Product Identification Number that appears at the bottom left-hand corner of the side
label: The CC field immediately precedes the 7-digit Serial Number field, DDDDDDD. Example: 5SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 2 System configuration An MTLx54x module may be used in single-channel (1oo1) safety functions up to SIL 2. The worked example in this manual is for a SIL 2 application. The figure below shows the
system configuration and specifies detailed interfaces to the safety-related and non safety-related system components. It does not aim to show all details of the internal module structure, but is intended to support understanding for the application. Figure 2 – System Configuration The MTLx54xA/MTLx54xAS modules are designed to receive an active
4-20mA signal from separately powered process transmitters in the hazardous area and to repeat the current flowing in the field loop to the safe-area load. The shaded area indicates the safety-related system connection, while the power supply con- nections are not safety-related. The term 'Logic Solver' has been used to denote the safety system
performing the monitoring function of the process loop variable. Note: When using the MTLx544A/MTLx544AS dual-channel modules, it is not appropriate for both channels to be used in the same loop, or the same safety function, as this creates concerns regarding common-cause failures. Consideration must also be given to the effect of common-cause
failures when both loops of a dual- channel module are used for different safety functions. Hazardous area Safe area Logic Solver (Safety related) Logic Solver (Safety related) Power supply (Not safety related) MTL5544A/MTL5544AS (2-channel version) shown. MTL5541A/MTL5541AS (single-channel version) omits Ch 2. 20 - 35V dc 6SM4541A/AS,
5541A/AS, 4544A/AS, 5544A/AS rev 2 2.1 Associated System Components There are many parallels between the loop components that must be assessed for intrinsic safety as well as functional safety. In both situations the contribution of each part is considered in relation to the whole. The MTLx54xA/MTLx54xAS modules are components in the signal
path between safety-related process trans- mitters and safety-related control systems. The transmitter or other field device must be suitable for the process and have been assessed and independently verified for use in functional safety applications. The field instrument and Analogue input card of the Logic Solver shall have a normal operating range of
4-20mA but be capable of working over an extended range of 3 to 22mA for under- and over-range. The Logic Solver shall have the ability to detect and annunciate input currents higher than the threshold of 21mA and lower than the threshold of 3.6mA to determine out-of-range conditions. Note that the transmission of HART data is not considered as part
of the safety function and is excluded from this analysis. However, for HART data communication to take place, the input impedance of the receiving equip- ment must be at least 240R. 3 Selection of product and implications The safe area output signal from the MTLx541A/AS and MTLx544A/AS modules is within the operating range of 4-20mA under
normal conditions. If the field wiring to the transmitter or connection between the isolator and logic solver is open-circuit then the loop current will fall to less than 3.6mA and close to zero. If the field wiring connection between the transmitter and isolator is short-circuited, the loop current will also fall to below 3.6mA. For module types MTLx541A and
MTLx544A that source the 4-20mA signal in the safe area circuit, then the current seen by the logic solver will fall to less than 3.6mA and close to zero if the connection between the isolator and logic solver is shorted. For module types MTLx541AS and MTLx544AS that sink the 4-20mA signal in the safe area circuit, then the current seen by the logic solver
will rise to a value greater than 21mA if the connection between the isolator and logic solver is shorted. In both cases, the fault condition must be detected by the logic solver in Functional Safety applications. This should also include the detection of power supply failures which cause the output of the isolator to fall to zero mA. 4 Assessment of Functional
Safety 4.1 Hardware Safety Integrity The hardware assessment shows that MTLx541A/MTLx541AS and MTLx544A/MTLx544AS modules: • have a hardware fault tolerance (HFT) of 0 • are classified as Type A devices ("non-complex" component with well-defined failure modes) • have no internal diagnostic elements The failure rates of these modules at an
ambient temperature of 45°C are as follows: Failure mode Failure rate (FIT)* MTL4541A MTL5541A MTL4541AS MTL5541AS MTL4544A MTL5544A MTL4544AS MTL5544AS Output current >21mA (upscale) 3 3 3 14 Output current 2% in error 42 42 49 49 Output current correct within ±2% 73 73 80 81 *(FITs means failures per 109 hours or failures per
thousand million hours) • Reliability data for this analysis is taken from IEC TR 62380:2004 Reliability Data Handbook. • Failure mode distributions are taken principally from IEC 62061:2005 Safety of Machinery. • Stated failure rates for dual-channel modules apply to a single channel. It is assumed that the module is powered from a nominal 24V dc supply
and operating at a maximum ambient temperature of 45°C. 7SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 4.2 Systematic Safety Integrity The MTLx54x modules have a systematic safety integrity measure of SC 2. This has been established using compliance Route 1S, as described in IEC 61508-2: 2010, section 7.4.2.2 c. 4.3 SIL Capability
Considering both the hardware safety integrity and the systematic capability, this allows the modules to be used in safety functions up to SIL 2 in a simplex architecture (HFT=0), provided SFF ≥60% is the case for the application. The hardware safety integrity assessment has been conducted according to compliance Route 1H, as described in IEC
61508-2:2010, section 7.4.4. (See example below). Note: • Independent of hardware architecture and systematic capability considerations, the hardware probability of failure for the entire safety function needs to be calculated for the application to ensure the required PFH (for a high or continuous demand safety function) or PFDAVG (for a low demand
safety function) for the SIL is met. 4.4 Example of use in a safety function In this example, the application context is assumed to be: • the safety function is to repeat current within ±2% • the logic solver will diagnose currents above 21mA and below 3.6mA as faults and take appropriate action The failure modes shown above can then be defined as: Failure
mode Category Output current >21mA (upscale) Dangerous detected, dd Output current 2% in error Dangerous undetected, du Output current correct within ±2% No effect, ne* The failure rates of the MTL4541A and MTL5541A for these categories are then (FITs): Model sd su dd du ne* MTL4541A or MTL5541A 0 0 227 42 73 In this example, the safe
failure fraction (SFF) is 84.4%. * ne is not used in the calculation of SFF. Defining the "output current correct within ±2%" failure mode as ne represents a conservative approach to the calculation of SFF. Interpreting this failure mode as su (safe, undetected) may also be considered and yields an SFF value of 87.7%. Accordingly, the SFF of all module types
described in this manual, when used in the same application, are as follows: Model sd su dd du ne SFF MTL4541A, MTL5541A, MTL4541AS, MTL5541AS 0 0 227 42 73 84.4% MTL4544A, MTL5544A 0 0 267 49 80 84.5% MTL5544AS, MTL5544AS 0 0 267 49 81 84.5% 8SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 4.5 EMC The MTL4500 and
MTL5500 modules are designed for operation in normal industrial electromagnetic environ- ment but, to support good practice, modules should be mounted without being subjected to undue conducted or radiated interference, see Appendix A for applicable standards and levels. 4.6 Environmental The MTL4500 and MTL5500 modules operate over the
temperature range from -20°C to +60°C, and at up to 95% non-condensing relative humidity. The modules are intended to be mounted in a normal industrial environment without excessive vibration, as specified for the MTL4500 & MTL5500 product ranges. See Appendix A for applicable standards and levels. Continued reliable operation will be assured if
the exposure to temperature and vibration are within the values given in the specification. 5 Installation There are two particular aspects of safety that must be considered when installing the MTL4500 or MTL5500 modules and these are: • Functional safety • Intrinsic safety Reference must be made to the relevant sections within the instruction manual for
MTL4500 range (INM4500) or MTL5500 range (INM5500) which contain basic guides for the installation of the interface equipment to meet the requirements of intrinsic safety. In many countries there are specific codes of practice, together with industry guidelines, which must also be adhered to. Provided that these installation requirements are followed
then there are no additional factors to meet the needs of applying the products for functional safety use. To guard against the effects of dust and water the modules should be mounted in an enclosure providing at least IP54 protection degree, or the location of mounting should provide equivalent protection such as inside an equipment cabinet. In
applications using MTL4500 range, where the environment has a high humidity, the mounting backplanes should be specified to include conformal coating. 9SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 6 Maintenance To follow the guidelines pertaining to operation and maintenance of intrinsically safe equipment in a hazardous area, yearly
periodic audits of the installation are required by the various codes of practice. In addition, proof- testing of the loop operation to conform with functional safety requirements should be carried out at the intervals determined by safety case assessment. Proof testing must be carried out according to the application requirements, but it is recommended that this
be carried out at least once every three years. Refer to Appendix B for the proof testing procedure of the MTLx541A/AS and MTLx544A/AS modules. Note that there may also be specific requirements laid down in the E/E/PE operational maintenance procedure for the complete installation. If an MTLx541A/AS and MTLx544A/AS module is found to be faulty
during commissioning or during the normal lifetime of the product, then such failures should be reported to the local MTL office. When appropriate, a Cus- tomer Incident Report (CIR) will be notified by Eaton to enable the return of the unit to the factory for analysis. If the unit is within the warranty period then a replacement unit will be sent. Consideration
should be given to the service lifetime for a device of this type, which is in the region of ten years. Operating an MTLx541A/AS and MTLx544A/AS module for longer than this period could invalidate the functional safety analysis, meaning that the overall safety function no longer meets its target SIL. If high failure rates of the MTL modules are detected,
indicating that they have entered the 'end of life phase' of their service life, then they should be replaced promptly. 7 Appendices 7.1 Appendix A: Summary of applicable standards This annex lists all standards referred to in the previous sections of this document: IEC 61508:2010 Functional safety of
electrical/electronic/programmable electronic safetyrelated systems. Parts 1 and 2 as relevant EN 61131-2:2003 Programmable controllers – Part 2: Equipment requirement and tests (EMC requirements) EN 61326-1:2013 Electrical equipment for measurement, control and laboratory use – EMC requirements. (Criterion A) IEC 61326-3-1:2017 Electrical equipment for measurement, control and laboratory
use – EMC requirements – Part 3-1: Immunity requirements for equipment performing or intended to perform safety related functions (functional safety) – General industrial applications. (Criterion FS) NE21:2007 Electromagnetic Compatibility of Industrial Process and Laboratory Control Equipment. (Criterion A) Lloyds Register Type Approval System:
2015, Test Specification Number 1. Specifically vibration: 1.0mm displacement @ 5 to 13.2Hz and EN 60068-2-27 Environmental testing. Test Ea and guidance. Shock. (Criterion FS) 10SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 7.2 Appendix B: Proof Test Procedure, MTLx541A/AS, MTLx544A/AS Modules Confirmation, through testing, that a
safety function will operate as designed, is a necessary periodic activity to ensure that the probability of failure upon demand (PFDavg) is maintained. In some applications, the user may prefer to conduct a proof test on the overall safety instrumented function without dismantling or disconnecting the individual instrumentation components, in order to avoid
disturbing the integrity of the installation. However, where it is deemed desirable to perform proof testing on the MTL modules individually, the following procedure may be used. Proof tests of the other components of the loop must then be conducted in accordance with their manufacturers' instructions, to maintain the integrity of the overall safety function.
Alternative proof tests may be devised and applied, provided they give a similar level of test coverage that is appropriate to the safety function. The tests described here - see Figure 7.1 - compare the output current of the MTL isolator with the input current (A1) over the required range of operation, and measure the "error current" i.e. the difference between
the two - as indicated on A2. The tests should be employed per channel, as appropriate. Figure 7.1 - Basic test arrangement Ammeter A2 must be capable of measuring currents of either polarity. If it is not an auto-ranging instrument, set it to a high range before switch on, and then adjust sensitivity to obtain the required reading. Proof Test Procedure Test
sequence: 1. System - Normal operation test 2. Input /Output characteristic functional safety test 3. System - Normal operation test Modules types MTL4541A, MTL4544A, MTL5541A, MTL5544A Modules types MTL4541AS, MTL4544AS, MTL5541AS, MTL5544AS 11SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 1 System - Normal
operation test Make sure that the module to be tested is operating normally in the target system, without errors and in an energised mode. If the module is in a faulty or de-energised loop, restore normal fault-free and energised operation before testing. 2 Input/Output characteristic functional safety test Observe normal anti-static precautions when handling
equipment during device testing. Remove the unit from the target system and connect it as shown in Figure 7.2. This figure shows the arrangement for the MTLx541A/ AS single-channel modules; for equivalent connections for the MTLx544A/AS dual-channel modules, refer to the relevant product data sheets. Note that it is acceptable to leave the unit in
the target system but only after ensuring that the all the hazardous area input and safe area output terminals have been disconnected from the system and are available for test. Alternatively, for the backplane-mounted MTL4500 range modules, a separate backplane can be used to provide access to the power and output connections. Note that the
combination of the 24V power supply and variable resistor RV1 in the hazardous area connection can be provided by a suitable industrial current simulator, which is likely to be more readily available. Also, the 250R resistor does not need to be a precision type; any value in the range 200-300R is acceptable would suffice, such as a standard value of 240R.
Where a second power supply is introduced for testing the MTLx541AS or MTLx544AS module variants, note that both power supplies must be floating and not share a common 0V connection. During testing, a 24V nominal system power supply in the range 20.0 to 35.0V should be connected between terminals 13 and 14 (+ve to terminal 14). Figure 7.2 -
Connections for testing the MTL5541A/AS and MTL4541A/AS modules 1 2 3 4 5 6 Ch1 i/p Ch2 i/p Ch2 o/p Ch1 o/p MTL5541A 13(–) 14(+) 7 8 9 10 11 12 V VS Power supply + MTL5501-SR 13(-) 14(+) V S +– +– +– + – +– V + Ch1 i/p Ch2 i/p Insert 250R and 24V supply for MTLx54xS modules, otherwise use direct link to o/p(+) 14 13 12 11 1 0 9 8 7
MTL4541A 1 2 3 4 5 6 Ch1 i/p Ch2 i/p Ch2 o/p Ch1 o/p + – + – + – + – A 1 A1 250RRV 1 + 250R 24V dc 24V dc – – + – + – A1 A 1 250RRV 1 + 250R 24V dc 24V dc – – 12SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 Channel 1 Channel 2 Measurements Make the following measurements. It is recommended to record the results in a table
such as that shown on the next page. 1. Adjust resistor RV1 to vary the loop current (measured by Ammeter A1) through the range 4 to 20mA. (Tests 1 - 5 in table) 2. The measured current imbalance (measured by Ammeter A2) over this range should not exceed ±50µA. 3. Adjust RV1 to vary the current (A1) to 3.5mA and then 21.5mA (tests 6 & 7 in
table). 4. The measured current imbalance (A2) at these currents should not exceed ±200µA. 5. Record the supply voltage Vs. If appropriate, repeat these measurements for Channel 2. 3 System - Normal operation test Disconnect the test setup from the unit and reconnect the original system configuration. Make sure that the tested unit operates normally
in the target system, as before, without errors and in energised mode. Date: _____/_____/_____ Supply voltage Vs: _____V dc Module type: _____ Serial No: _____ Test # Description Actual Target 1 Current imbalance (A2) at loop current (A1) = 4mA <±50µA 2 Current imbalance (A2) at
loop current (A1) = 8mA <±50µA 3 Current imbalance (A2) at loop current (A1) = 12mA <±50µA 4 Current imbalance (A2) at loop current (A1) = 16mA <±50µA 5 Current imbalance (A2) at loop current (A1) = 20mA <±50µA 6 Current imbalance (A2) at loop current (A1) = 3.5mA <±200µA 7 Current imbalance (A2) at loop current (A1) = 21.5mA <±200µA
Test Step# Description Actual Target 1 Current imbalance (A2) at loop current (A1) = 4mA <±50µA 2 Current imbalance (A2) at loop current (A1) = 8mA <±50µA 3 Current imbalance (A2) at loop current (A1) = 12mA <±50µA 4 Current imbalance (A2) at loop current (A1) = 16mA <±50µA 5 Current imbalance (A2) at loop current (A1) = 20mA <±50µA 6
Current imbalance (A2) at loop current (A1) = 3.5mA 21mA (upscale) Dangerous detected, dd Output
current 2% in error Dangerous undetected, du Output current correct within ±2% No effect, ne* The failure rates of the MTL4541A and MTL5541A for these categories are then (FITs): Model sd su dd du ne* MTL4541A or MTL5541A 0 0 227 42 73 In this example, the safe failure fraction (SFF) is 84.4%. * ne is not used in the calculation of SFF. Defining the
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sd su dd du ne SFF MTL4541A, MTL5541A, MTL4541AS, MTL5541AS 0 0 227 42 73 84.4% MTL4544A, MTL5544A 0 0 267 49 80 84.5% MTL5544AS, MTL5544AS 0 0 267 49 81 84.5% 8SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 4.5 EMC The MTL4500 and MTL5500 modules are designed for operation in normal industrial electromagnetic
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guides for the installation of the interface equipment to meet the requirements of intrinsic safety. In many countries there are specific codes of practice, together with industry guidelines, which must also be adhered to. Provided that these installation requirements are followed then there are no additional factors to meet the needs of applying the products for
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backplanes should be specified to include conformal coating. 9SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 6 Maintenance To follow the guidelines pertaining to operation and maintenance of intrinsically safe equipment in a hazardous area, yearly periodic audits of the installation are required by the various codes of practice. In addition, prooftesting of the loop operation to conform with functional safety requirements should be carried out at the intervals determined by safety case assessment. Proof testing must be carried out according to the application requirements, but it is recommended that this be carried out at least once every three years. Refer to Appendix B for the proof testing
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should be reported to the local MTL office. When appropriate, a Cus- tomer Incident Report (CIR) will be notified by Eaton to enable the return of the unit to the factory for analysis. If the unit is within the warranty period then a replacement unit will be sent. Consideration should be given to the service lifetime for a device of this type, which is in the region of
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Programmable controllers – Part 2:
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on the MTL modules individually, the following procedure may be used. Proof tests of the other components of the loop must then be conducted in accordance with their manufacturers' instructions, to maintain the integrity of the overall safety function. Alternative proof tests may be devised and applied, provided they give a similar level of test coverage that
is appropriate to the safety function. The tests described here - see Figure 7.1 - compare the output current of the MTL isolator with the input current (A1) over the required range of operation, and measure the "error current" i.e. the difference between the two - as indicated on A2. The tests should be employed per channel, as appropriate. Figure 7.1 - Basic
test arrangement Ammeter A2 must be capable of measuring currents of either polarity. If it is not an auto-ranging instrument, set it to a high range before switch on, and then adjust sensitivity to obtain the required reading. Proof Test Procedure Test sequence: 1. System - Normal operation test 2. Input /Output characteristic functional safety test 3. System
- Normal operation test Modules types MTL4541A, MTL4544A, MTL5541A, MTL5544A Modules types MTL4541AS, MTL4544AS, MTL5541AS, MTL5544AS 11SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 1 System - Normal operation test Make sure that the module to be tested is operating normally in the target system, without errors and in an energised mode. If the module is in a faulty or de-energised loop, restore normal fault-free and energised operation before testing. 2 Input/Output characteristic functional safety test Observe normal anti-static precautions when handling equipment during device testing. Remove the unit from the target system and connect it as shown in
Figure 7.2. This figure shows the arrangement for the MTLx541A/ AS single-channel modules; for equivalent connections for the MTLx544A/AS dual-channel modules, refer to the relevant product data sheets. Note that it is acceptable to leave the unit in the target system but only after ensuring that the all the hazardous area input and safe area output
terminals have been disconnected from the system and are available for test. Alternatively, for the backplane-mounted MTL4500 range modules, a separate backplane can be used to provide access to the power and output connections. Note that the combination of the 24V power supply and variable resistor RV1 in the hazardous area connection can be
provided by a suitable industrial current simulator, which is likely to be more readily available. Also, the 250R resistor does not need to be a precision type; any value in the range 200-300R is acceptable would suffice, such as a standard value of 240R. Where a second power supply is introduced for testing the MTLx541AS or MTLx544AS module variants,
note that both power supplies must be floating and not share a common 0V connection. During testing, a 24V nominal system power supply in the range 20.0 to 35.0V should be connected between terminals 13 and 14 (+ve to terminal 14). Figure 7.2 - Connections for testing the MTL5541A/AS and MTL4541A/AS modules 1 2 3 4 5 6 Ch1 i/p Ch2 i/p Ch2 o/
p Ch1 o/p MTL5541A 13(–) 14(+) 7 8 9 10 11 12 V VS Power supply + MTL5501-SR 13(-) 14(+) V S +– +– +– +– +– +– V + Ch1 i/p Ch2 i/p Insert 250R and 24V supply for MTLx54xS modules, otherwise use direct link to o/p(+) 14 13 12 11 1 0 9 8 7 MTL4541A 1 2 3 4 5 6 Ch1 i/p Ch2 i/p Ch2 o/p Ch1 o/p + – + – + – + – + – A 1 A1 250RRV 1 + 250R 24V
dc 24V dc – – + – + – A1 A 1 250RRV 1 + 250R 24V dc 24V dc – – 12SM4541A/AS, 5541A/AS, 4544A/AS, 5544A/AS rev 2 Channel 1 Channel 2 Measurements Make the following measurements. It is recommended to record the results in a table such as that shown on the next page. 1. Adjust resistor RV1 to vary the loop current (measured by Ammeter
A1) through the range 4 to 20mA. (Tests 1 - 5 in table) 2. The measured current imbalance (measured by Ammeter A2) over this range should not exceed ±50µA. 3. Adjust RV1 to vary the current (A1) to 3.5mA and then 21.5mA (tests 6 & 7 in table). 4. The measured current imbalance (A2) at these currents should not exceed ±200µA. 5. Record the supply
voltage Vs. If appropriate, repeat these measurements for Channel 2. 3 System - Normal operation test Disconnect the test setup from the unit and reconnect the original system configuration. Make sure that the tested unit operates normally in the target system, as before, without errors and in energised mode. Date: _____/_____/_____ Supply
voltage Vs: _____V dc Module type: _____ Serial No: _____ Test # Description Actual Target 1 Current imbalance (A2) at loop current (A1) = 4mA <±50µA 2 Current imbalance (A2) at loop current (A1) = 8mA <±50µA 3 Current imbalance (A2) at loop current (A1) = 12mA <±50µA 4 Current
imbalance (A2) at loop current (A1) = 16mA <±50µA 5 Current imbalance (A2) at loop current (A1) = 20mA <±50µA 6 Current imbalance (A2) at loop current (A1) = 3.5mA <±200µA 7 Current imbalance (A2) at loop current (A1) = 21.5mA <±200µA Test Step# Description Actual Target 1 Current imbalance (A2) at loop current (A1) = 4mA <±50µA 2
Current imbalance (A2) at loop current (A1) = 8mA <±50µA 3 Current imbalance (A2) at loop current (A1) = 12mA <±50µA 4 Current imbalance (A2) at loop current (A1) = 16mA <±50µA 5 Current imbalance (A2) at loop current (A1) = 20mA <±50µA 6 Current imbalance (A2) at loop current (A1) = 3.5mA 0: all speed related parameters (P-01, P-02, P-20…P-23) are set and displayed in
rpm. Fur- thermore the slip compensation is activated, which ensures, that the motor speed is kept constant even with changing loads. In case the value of P-10 corresponds to a synchronous speed (e.g. 3000 rpm for a 2 pole motor at 50 Hz), the speed is set and displayed in rpm, but the slip compensation is not activated. With slip compensation Without
slip compensation The slip is the difference between a synchronous speed because of a rotating field and the actual speed of the motor. The name plate in the example on page 5 shows a rated speed of 1410 rpm. It is a 4 pole motor with a synchronous speed of 1500 rpm. Between no load and rated load there is a slip of 90 rpm. Running the motor with a
Variable Speed Starter, one wants to prevent the speed vari- ance by compensating the slip. With slip compensation: at load increase j voltage and frequency are increased accordingly k. The speed n1 remains constant. At load decrease voltage and frequency are reduced. Without slip compensation: with load j the speed drops from n1 to n2 k, when
unloading the speed increases again. PNU Parameter Name Range Default 217.0 P-10 Motor Nom Speed 0 / 200 … 18000 rpm 0 rpm 2017-11-09 AP040017EN DE1 Motor Data – Motor Protection – V/f Curves – Slip Compensation Page 8 Motor protection The Variable Speed Starters of the series DE1 own an internal motor protection function, which
trips the drive after a certain time in case of overload. The display shows the fault message "I.t-trP". The overload is related to the rated current of the motor, set with P-08. In case the output current of the device exceeds the value set with P-08 „Motor Nom Current", this status is displayed on the keypad. 7-Segment LED display: dots a…f are flashing
OLED display: text „O-L" is displayed It has to be considered that, similar to a thermal overload relay, the current is used to estimate the temperature inside the motor. This kind of "indirect temperature measurement" is sufficient in many cases, but doesn't reflect the real temperature conditions inside the motor. In case of Variable speed it has to be taken
into account, that the cooling of the motor is done by an impeller, which is mount- ed on the motor's shaft. Therefore the cooling is reduced at lower speeds. Experience shows that this is not critical between approx. 40 % and 100 % speed, but below 40 % it can lead to problems, if the application requires full torque also in this range (= full amount of
losses). In pump and fan applica- tions where the torque is square with the speed, this effect is uncritical. In case of steady operation with nearly rated load below 40 % rated speed it is recommended to use motors with temperature sensors (thermistors or thermo contacts), which provide information about the real motor temperature. Thermistors as well as
temperature contacts can be directly connected to DE1 devices. Example thermistor Example temperature contact Parameter P-15 has to be set in a way, that the function „External Fault" (EXTFLT) is assigned to ter- minal 3 (DI3). During proper operation, a High-Signal is applied to terminal 3. In case of fault the temperature contact must open respectively
the resistance of the thermistor has to increase. DE1 trips at a resistance of > 3.6 kΩ, Reset can be performed at values 100 % of the current set in P-08 for a certain time. · Check if the value of P-08 is equal to the motor rated current · Check motor connection (star / delta) · Flashing dots on the display indicate an operation with overload (> P- 08).
Increase ramp time or decrease load in this case. · Check the load mechanically to ensure it is free and no jams, blockages or other mechanical faults exist. „Fault Code" 5 x flash 2 s OFF O-t Heatsink overtemperature. The drive is too hot. · Check the ambient temperature around the drive is within the speci- fied range (maximum 50 °C / 60 °C, partly with
derating) · Ensure sufficient cooling air is free to circulate around the drive (dis- tance to other devices above and below the variable speed starter). · Improve cooling of the control cabinet, when necessary. · The cooling slots may not be closed e.g. by pollution or by devices which are mounted too close „Fault Code" 6 x flash 2 s OFF Internal fault in power
section " Please refer to your next Eaton sales office. „Fault Code" 7 x flash 2 s OFF SC-trp Loss of the serial communication · Check, if the connection to drives and other devices in the network is correct · Each participant in the network must have its own unique address. Two devices with the same address are not allowed. „Fault Code" 8 x flash 2 s OFF
P-dEf Default parameters have been loaded „Fault Code" 9 x flash 2 s OFF Distorsion of the d.c. voltage „Fault Code" 10 x flash 2 s OFF 4-20 F Analog input current out of range · Check settings of P-16 for AI1 · In case of 4-20mA: Check reference signal on wire break 2017-11-13 AP040029EN DE1 Starting, Stopping and Operation Page 19 Message
Possible causes and remedy „Fault Code" 11 x flash 2 s OFF U-t Undertemperature. This message is displayed, when the ambient temperature is below – 10 °C. To start the drive, the temperature must be above this value. „Fault Code" 12 x flash 2 s OFF Th-flt Thermistor on the heatsink is faulty. Please refer to your next Eaton sales of- fice. „Fault Code"
13 x flash 2 s OFF dAtA-F Fault in the internal memory. Parameters are not saved and default settings are reloaded. Try to save the (again modified) parameters again. If the message still appears: Please refer to your next Eaton sales office. 2017-11-13 AP040029EN DE1 Starting, Stopping and Operation Page 20 5 Stopping There are multiple
possibilities to stop a variable speed drive: Possible with DE1? Accessories required Switch off, drive coasts to standstill YES None Ramp down to standstill YES None Ramp down to standstill with overvoltage control YES None Dynamic braking with brake resistor No - DC braking YES None Feedback energy to the mains NO - Mechanical brake (Variant
DE11 only) YES None. Control with DE11 5.1 Ramping down or coasting? Parameter P-05 „Stop Mode" determines, if the motor coasts or if it ramps down when the enable signal (FWD, REV, STOP) is removed. 5.1.1 Stop Mode (P-05) Coast to stop (P-05 = 0): When the enable signal is removed, the output of the inverter is disabled and the motor coasts
to stop. Ramp to stop (P-05 = 1): When the enable signal is removed, the motor ramps to standstill with the ramp set with P-04. ATTENTION: In a drive system the energy always flows from the subsystem with the higher frequency to the one with lower frequency. If the output frequency of the variable speed starter is reduced too fast (deceleration ramp too
short) and the motor still turns at a higher speed than the one corre- sponding to the output frequency of the inverter because of its inertia, the motor becomes a genera- tor and feeds back energy into the d.c. link. This leads to an increase of the d.c. link voltage and pos- sibly to a trip with the message O.Volt (Overvoltage). To prevent this, variable speed
starters have the function "Overvoltage control", which is enabled by default. More details see chapter 4.2.1. PNU Parameter Name Range Default 620.1 P-05 Stop Mode 0: coast to stop 1: ramp to stop 0 2017-11-13 AP040029EN DE1 Starting, Stopping and Operation Page 21 5.2 DC braking to standstill A DC current is injected into the motor, which
generates a braking torque. The rotating energy of the machine is converted into heat, dissipated by the motor. This means that a DC braking must not be performed quite often, not to overload the motor. A DC braking cannot be used for a speed reduction e.g. from 1000 rpm to 800 rpm, but to a braking to standstill only. The DC braking is also used to stop
rotating motors (e.g. fans, which turn because of the chimney effect inside a wind tunnel) before they start. This is to prevent overcurrent trips. See chapter 3.3 "Starting a rotating motor". 5.2.1 DCBrake (P-25), t-DCBrake@Stop (P-26), DCBrake Voltage (P-27), f- DCBrake@Stop (P-28) Parameter P-25 „DCBrake" determines, in which situations a DC
braking is performed. In case a DC braking is required at stop, P-25 has to be set to 1 or 3. The behavior at removal of the signals FWD / REV / START depends on the stop mode (P-05). P-05 = 0 (coast to stop): The DC braking starts, once the signal FWD / REV / START is removed. P-05 = 1 (ramp to stop) At removal of FWD / REV / START the motor
decelerates with the ramp set with "t-dec" (P-04). Once the frequency set with "f-DCBrake@Stop" (P-28) is reached, the DC braking starts. The strength and the duration depend on the settings of P-26 "t-DCBrake@Stop" and P-27 "DCBrake Voltage" (in percent of the motor rated voltage P-07). With P-25 = 3 it has to be noted, that the brak- ing time before
a start is the same as after a stop. During a DC braking the LED „Fault code" on the front of the variable speed starter lights yellow. 2017-11-13 AP040029EN DE1 Starting, Stopping and Operation Page 22 PNU Parameter Name Range Default 2221.0 P-25 DCBrake 0: OFF 1: ON at Stop 2: ON before Start 3: ON before Start and at Stop 0 2222.1 P-26 tDCBrake@Stop 0.0…10 s 0.0 s 2220.0 P-27 DCBrake Voltage 0.0…100 % 0.0 % 2223.0 P-28 f-DCBrake@Stop 0 … P-01 (f-max) 0.0 Hz 2017-11-13 AP040029EN DE1 Starting, Stopping and Operation Page 23 5.3 Control of a mechanical brake HINT: The information is exclusively valid for the variant DE11! When a mechanical brake is used it should be
activated at a certain speed. The relay contact be- tween the terminals 13 and 14 have the possibility to generate a speed dependent signal. The threshold is adjustable. It can be configured, if the relay contact closes above or below the threshold. Die Funktion des Ausgangs ist entsprechend zu konfigurieren. Kind of signal Terminals Function Threshold
Normally open contact 13 / 14 P-51 „RO1 Function" P-52 „RO1 Upper Limit" 5.3.1 RO1 Funktion (P-51), RO1 obere Grenze (P-52) PNU Parameter Name Wertebereich Werk 451.0 P-51 RO1 Function 0: Drive running 1: Drive healthy 2: Motor at target speed 3: Drive tripped 4: Speed > RO1 Upper Limit (P-19) 5: Motor current > RO1 Upper Limit (P-19) 6:
Speed 0 the setting is done in rpm instead of Hz. · The value, which can be set with
P-01 „f-max", is limited to five times „Motor Nom Frequen- cy" (P-09) with a maximum of 300 Hz. 1.3 Behavior during change over between reference sources During a change over between two reference sources, e.g. from an analog signal to a fixed frequency, the new reference is approached with the actual ramp. The ramp times are determined by "tacc" (P- 03) for acceleration and "t-dec" (P-04) for deceleration. 2017-11-10 AP040042EN DE1 Set Point Setting Page 7 1.4 Skip frequencies to avoid resonances In some applications an operation of the motor in a certain frequency band leads to mechanical res- onances, which can end up in a destruction of machine parts. The devices of the series
PowerXLTM DE1… have the possibility to skip this frequency band for steady operation to avoid this effect. Fading out frequencies is possible with all kind of reference sig- nals, not depending on where they come from, e.g. analog input, fixed frequency, digital reference … , whatever is selected. The band width is determined by P-42 "f-SkipBand1", while
the center point is defined by P-43 "f-Skip1". The diagram on the left hand side shows the behavior. Setting P-26 to zero, deactivates the function. REF = Reference Example: A motor runs up to 50 Hz. In the range between 15 Hz and 25 Hz mechanical resonances can occur. Therefore the motor may not run inside this range steadily. Band width: P-42 = 25
Hz – 15 Hz = 10 Hz Center point: P-43 = 15 Hz + 25 Hz 2 = 20 Hz How it works: The reference is below the disabled range. " Drive runs with the set frequency. " Increase of refer- ence into the disabled range " Motor accelerates and remains at the lower limit (in this example: 15 Hz). " Increase of reference above the disabled range " Motor accelerates with
the ramp, set with P-03 "t-acc" to the new speed. " Motor operates above the disabled range according to the refer- ence. " Reduction of reference into the disabled area " Motor decelerates and remains at the up- per limit (in this example: 25 Hz). " Reduction of reference below the disabled area " Motor decel- erates with the ramp, set with P-04 "t-dec" to
the new speed. PNU Parameter Name Range Default 22.0 P-42 f-SkipBand1 0…P-01 0 Hz1) 21.0 P-43 f-Skip1 0…P-01 0Hz1) 1) The default setting of P-10 "Motor Nom Speed" = 0. In this case the values for P-42 and P-43 are given in Hz. When P-10 is different from „0", P-42 and P-43 have to be set in min-1. 2017-11-10 AP040042EN DE1 Set Point
Setting Page 8 2 Analog reference Variable speed starters of the series DE1 have one analog input: · Analog input AI1 terminal 4 The configuration of the inputs and outputs is described inside the Application Note „I/O Configura- tion" (AP040036EN). Beside the setting of the signal format (voltage or current), a scaling factor can be used to adopt the speed
to the input signal. 2.1 Selecting the sense of rotation The analog value at terminal 4 determines the amount of speed. The control commands FWD and REV select clockwise or counter clockwise sense of rotation. If a change of sense is required, the actual command (e.g. FWD) has to be removed first, before applying the other one (e.g. REV). Applying
FWD and REV simultaneously leads to a coasting of the motor. 2.2 Format of the analog value The speed reference signal can be a voltage signal as well as a current one. It is invertible with Pa- rameter P-18 in a way that a minimum signal leads to the maximum speed and vice versa. Format P-18 counter clockwise rotation clockwise rotation f-min f-max
f-min f-max 0 … 10 V (U 0-10) 0 0 V • REV 10 V • REV 0 V • FWD 10 V • FWD 1 10 V • REV 0 V • REV 10 V • FWD 0 V • FWD 0 … 20 mA (A 0-20) 0 0 mA • REV 20 mA • REV 0 mA • FWD 20 mA • FWD 1 20 mA • REV 0 mA • REV 20 mA • FWD 0 mA • FWD 4 … 20 mA (t 4-20) 0 4 mA • REV 20 mA • REV 4 mA • FWD 20 mA • FWD 1 20 mA +
REV 4 mA • REV 20 mA • FWD 4 mA • FWD 4 … 20 mA (r 4-20) 0 4 mA • REV 20 mA • REV 4 mA • FWD 20 mA • FWD 1 20 mA • REV 4 mA • REV 20 mA • FWD 4 mA • FWD Note: In case a terminal configuration without the commands FWD and REV is selected with P-15, the sense of rotation is set with the commands START and DIR. -
Clockwise rotation " START · Counter clockwise rotation " START + DIR 2017-11-10 AP040042EN DE1 Set Point Setting Page 9 3 Fixed frequencies Fixed frequencies are references, which are set once, e.g. during commissioning and which can be selected by a digital command when required. The devices of the series DE1 have up to 4 fixed frequencies f-Fix1 … f-Fix4, which can be selected independently. 3.1 Setting the frequency value The setting of the fixed frequencies is done with P-20 up to P-23. Each value can be between zero and the maximum frequency „f-max" (P-01). It has to be noted, that the minimum frequency "f-min" (P-02) will not be undercut, even when the fixed frequency is
set to a lower value than P-02. Example: P-02 (f-min) = 10 Hz P-20 (f-Fix1) = 5 Hz When f-Fix1 is selected, the drive runs with 10 Hz! PNU Parameter Name Range Default 5.1 P-20 f-Fix1 0 … f-max (P-01) 20.0 Hz 5.2 P-21 f-Fix2 0 … f-max (P-01) 30.0 Hz 5.3 P-22 f-Fix3 0 … f-max (P-01) 40.0 Hz 5.4 P-23 f-Fix4 0 … f-max (P-01) 50.0 Hz 3.2 Selecting the
sense of rotation When using a fixed frequency the sense of rotation is determined by the commands FWD (clockwise) and REV (counter clockwise) respectively DIR. 3.3 Selecting the fixed frequency The fixed frequencies can be activated via commands at the control terminals or via a field bus. The selection is binary coded " for 4 fixed frequencies 2 Bits
(FF20 and FF21) are required. The predefined terminal configurations selected with P-15 enable access to the fixed frequencies. 3.3.1 Selection with predefined terminal configurations (P-15) 2017-11-10 AP040042EN DE1 Set Point Setting Page 10 Inside the Application Note „I/O Configuration" (AP040036EN) the configuration of the control ter- minals is
described. The following commands are important for the selection of fixed frequencies: Abbreviation Function FF1 Selection between the analog speed reference at analog input AI1 (ter- minal 6) and the fixed frequency 1 (f-Fix1), set with P-20. Low = analog reference, High = f-Fix1. FF20 / FF21 Selection of the digital frequencies f-Fix1 … f-Fix4 with
digital commands FF20 FF21 f-Fix1 (P-20) L L f-Fix2 (P-21) H L f-Fix3 (P-22) L H f-Fix4 (P-23) H H 3.3.2 Use of fixed frequencies in device functions In certain situations, fixed frequencies are selected by a device function. Please take care, that there is no collision because of user specific settings. Fixed frequency Function f-Fix1 When P-16 = 4 (analog
inputs with a signal 4 … 20 mA) the drive ramps to f-Fix1, in case of wire break in the reference circuit. 2017-11-10 AP040042EN DE1 Set Point Setting Page 11 4 Digital reference The speed reference of the variable speed starters DE1 can also be given via digital commands. The command UP (faster) increases the content of the reference counter, while
DOWN (slower) reduces it. The use of a digital reference has the advantage, that the reference can be set from different loca- tions by paralleling push buttons, which is required in cases of large machines. The setting occurs between the minimum speed / frequency (f-min, P-02) and the maximum fre- quency / speed (f-max, P-01) with the actual ramp.
The setting can be done with the keypad as well as via terminals. Example: · When an enabled drive gets the "UP" command, the motor accelerates according to the ac- tual ramp according to "t-acc" (P-03) · When the „UP" command is removed, the speed remains constant. Applying "UP" again leads to a further acceleration. The maximum frequency /
speed is defined with "f-max" (P- 01). · Consequently, applying „DOWN" leads to a speed reduction. · When starting, the drive ramps to the speed determined by P-24 without an "UP" command. 2017-11-10 AP040042EN DE1 Set Point Setting Page 12 4.1 Configuration 4.1.1 Terminals / Keypad With the settings P-15 = 4, 5 or 6 UP and DOWN commands
via terminals are possible. In case a key- pad DEX-KEY-LED is used, the reference value can be modified by using the arrow keys in addition. With P-12 = 1 or 2 the variable speed starter can be started and stopped with the keys on the key- pad. The behavior depends on the setting of P-24 "Digital Reference Reset Mode" (see 4.1.2) 4.1.2 Reference at
start and at changeover between speed sources When starting a drive with a digital reference and when changing over from another speed source, e.g. a fixed frequency, to a digital reference the reference value to be ramped to is determined by the setting of P-24 "Digital Reference Reset Mode": · P-24 = 0 or 2 o Minimum speed o Example 1: Behavior at
start § Drive runs with digital reference " switch OFF " restart " drive ramps to the minimum speed, set with P-02 „f-min". 2017-11-10 AP040042EN DE1 Set Point Setting Page 13 o Example 2: Behavior at changeover between speed sources § Drive runs with digital reference " Changeover to another speed source by applying a signal to the terminal " drive
ramps to the speed required by the other speed source " Select "Digital reference" by removing the signal from the terminal " drive remains at the speed of the other speed source. The speed can now be changed with the keys on the keypad or with the signals UP and DOWN at the control terminals. · P-24 = 1 or 3 o Start with the latest speed before
switching OFF or changing over to another speed source, set with the keypad or with the commands UP and DOWN at the terminals. This also applies to cases where another speed source was active at the time of switching OFF, but which is not selected at restart. o Example 1: The digital reference was set with the keypad to 1000 rpm. The speed source
was changed from "Digital reference" to „Fixed Frequency 1" by means of a command at the control terminals. The drive is switched OFF when "Fixed Frequen- cy1" is active. § Select „Digital reference" at the terminals " drive ramps to the 1000 rpm set with the keypad § „Fixed Frequency 1" was selected at the terminal when restarting " Drive ramps to
Fixed Frequency 1 § Changeover to "Digital reference" with the signal at the terminals " drive ramps to 1000 rpm o Example 2: Switching OFF when the drive runs with another speed source than the digital reference § Selection of the other speed source is still active at restart " drive ramps to the speed of the other speed source. § Selection of the other
speed source is not active at restart " drive ramps to the latest digital reference. P-24 „Digital Reference Reset Mode" also determines, how the drive can be started when P-12 = 1 or 2: · P-24 = 0…1 o Starting of the drive by pushing the green START button on the keypad. § To start, an additional signal at the terminals is necessary (START / FWD / REV) ·
P-24 = 2…3 o The start of the drive is carried out via the terminals (see also 4.1.1). A start with the button on the keypad is not possible. o Note: With P-12 = 2 it is still possible to reverse the drive by pushing the green but- ton on the keypad. 2017-11-10 AP040042EN DE1 Set Point Setting Page 14 PNU Parameter Name Range Default 620.3 P-24 Digital
Reference Reset Mode 0 / 1: START via keypad 0: Minimum speed (P-02) 1: Previous speed from Keypad / terminals (UP/DOWN) 2 / 3: START via terminals 2: Minimum speed (P-02) 3: Previous speed from Keypad / terminals (UP/DOWN) 1 4.2 Bedienung 4.2.1 Starting / Stopping Drives, which operate with a digital reference, can be started via terminals
as well as via keypad. The possibilities depend on the setting of the parameters P-12 "Local ProcessData Source", P-15 "DI Con- fig Select" and P-24 "Digital Reference Reset Mode". Note: It can also be selected, that a signal from the terminal as well as one from the keypad must be ap- plied to start the drive. In this case the signal at the terminal must be
present before the button on the keypad is pushed. P-12 P-24 P-15 Starting via terminal only Starting via keypad only Starting via terminal AND keypad P-12 = 0 P-24 = 0…3 P-15 = 4 / 5 / 6 YES NO NO P-12 = 1 / 2 P-24 = 0 / 1 P-15 = 0 … 9 NO NO YES P-24 = 2 / 3 P-15 = 0 … 9 YES* NO NO *In this case the keypad cannot be used to start the drive, but
with P1-12 = 2 the green button can still be used to reverse it (see 4.2.3) 4.2.2 Increase / reduce speed When using a digital reference the speed is changed via the commands UP and DOWN. For the dura- tion of the commands the speed is increased respectively reduced. The commands are given via the keypad or via terminals. The behavior of the drive
is depending on keypad or terminal adjustment. While a command via ter- minals modifies the speed with the actual ramp directly, an adjustment with the keypad has a slope and works more smoothly. This results in a delay of about 1.5 s for every actuation. With the setting of P-12 = 1 or 2 a speed adjustment via keypad is always possible, an adjustment
via terminals only with the settings P-12 = 1 or 2 AND P-15 = 4 / 5 / 6. 2017-11-10 AP040042EN DE1 Set Point Setting Page 15 Note: · Simultaneous use of UP and DOWN (both via terminals or both via keypad) reduces the speed. · The terminal command dominates the one from the keypad. This also means: DOWN via keypad and UP via terminal " the
speed increases. · A speed adjustment via keypad is also possible in cases where starting and stopping via key- pad is disabled. 4.2.3 Change sense of rotation The sense of rotation at start with a digital reference is basically determined by the terminal com- mands. With P12 = 2 one has the possibility to reverse the motor by pressing the green Start
button on the keypad. Behavior at start: see column "Sense of rotation at START" in the table below. P-12 P-24 P-15 Sense of rotation via terminal Sense of rotation via keypad Sense of rotation at START P-12 = 0 P-24 = 0 … 3 P-15 = 4 / 5 NO NO No change of sense of rotation possible P-15 = 6 YES Sense of rotation as selected via terminals P-12 = 1
P-24 = 0 … 3 P-15 = 3 / 4 / 5 / 7 NO NO No change of sense of rotation possible P-15 = 8 / 9 YES (DIR) Sense of rotation as selected via terminals P-24 = 2 / 3 P-15 = 0 / 1 / 2 / 6 YES (FWD / REV) P-12 = 2 P-24 = 0 … 3 P-15 = 3 / 4 / 5 / 7 NO YES (INV) Sense of rotation as selected via termi- nals, taking into ac- count a possible in- version at the time of
stopping the drive (Start button on the keypad). P-15 = 8 / 9 YES (DIR) P-24 = 2 / 3 P-15 = 0 / 1 / 2 / 6 YES (FWD / REV) Note: · P-15 = 0 / 1 / 2 / 6: o Applying the FWD and REV commands simultaneously leads to a coasting of the motor o In applications with reversion, the Stop Mode should be set in a way, that the ramp is active (P1-5 = 1). If this is not
the case a changeover between the com- mands FWD and REV is detected as stop command and the drive behaves ac- cording the setting with P-05. After this, it restarts into the opposite direction. Starting a motor, which is still turning can lead to an overcurrent trip. · P-12 = 2 o A possible inversion with the Start button on the keypad is stored at stop.

The drive restarts with the same sense of rotation he had before stopping. Please note, that in this case the sense of rotation at restart cannot be clearly defined by the terminal commands.. www.eaton.eu Application Note 11/2017 AP040036EN PowerXL™ DE1 Variable Speed Starter I/O Configuration Level 2 1 – Fundamental – No previous experience
necessary 2 – Basic – Basic knowledge recommended 3 – Advanced – Reasonable knowledge required 4 – Expert – Good experience recommended 2017-11-13 AP040036EN DE1 I/O Configuration Page 2 Contents 1 General 5 2
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Follow the engineering instructions (AWA/IL) for the device concerned. • Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system. • Before installation and before touching the device ensure that you are free of electrostatic charge. • The functional earth (FE, PES) must be connected to the
protective earth (PE) or the potential equalization. The system installer is responsible for implementing this connection. • Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automatic control functions. • Suitable safety hardware and software measures should be implemented for the I/O
interface so that an open circuit on the signal side does not result in undefined states. • Deviations of the mains voltage from the rated value must not exceed the tolerance limits give n in the specification, otherwise this may cause malfunction and/or dangerous operation. • Emergency stop devices complying with IEC/EN 60204-1 must be effective in all
operating modes. Unlatch- ing of the emergency-stop devices must not cause a restart. • Devices that are designed for mounting in housings or control cabinets must only be oper ated and c on- trolled after they have been properly installed and with the housing closed. • Wherever faults may cause injury or material damage, external measures must be
implemented to ensure a safe operating state in the event of a fault or malfunction (e.g. by means of separate limit switches, me - chanical interlocks etc.). • Variable speed starters may have hot surfaces during and immediately after operation. • Removal of the required covers, improper installation or incorrect operation of motor or var iable spe ed starter
may destroy the device and may lead to serious injury or damage. • The applicable national safety regulations and accident prevention recommendations must be applied to all work carried on live variable speed starters. • The electrical installation must be carried out in accordance with the relevant electrical regulations (e . g. with regard to cable cross
sections, fuses, PE). • Transport, installation, commissioning and maintenance work must be carried out only by qualified per - sonnel (IEC 60364, HD 384 and national occupational safety regulations). • Installations containing variable speed starters must be provided with additional monitoring and protective devices in accordance with the applicable safety
regulations. Modifications to the variable speed star te rs using the operating software are permitted. • All covers and doors must be kept closed during operation. • To reduce the hazards for people or equipment, the user must include in the machine design me asure s that restrict the consequences of a malfunction or failure of the variable speed starter
(incre ased motor speed or sudden standstill of motor). These measures include: • Other independent devices for monitoring safety related variables (speed, travel, e nd positions etc.). • Electrical or non-electrical system-wide measures (electrical or mechanical interlocks). • Never touch live parts or cable connections of the variable speed starter after it has
been disc on- nected from the power supply. Due to the charge in the capacitors, these parts may still be alive after disconnection. Consider appropriate warning signs. 2017-11-13 AP040036EN DE1 I/O Configuration Page 4 Disclaimer The information, recommendations, descriptions, and safety notations in this document are based on Eaton's experience
and judgment and may not cover all contingencies. If further information is required, an Eaton sales office should be consulted. Sale of the product shown in this literature is subject to the terms and conditions outlined in the applicable Terms and Conditions for Sale of Eaton or other contractual agreement between Eaton and the pur- chaser. THERE ARE
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indirect, incidental, or consequential damage or loss whatsoev- er, including but not limited to damage or loss of use of equipment, plant or power sy stem, cost of capital, loss of power, additional expenses in the use of existing power facilities, or claims against the purchaser or user by its customers resulting from the use of the infor- mation,
recommendations, and descriptions contained herein. The information contained in this manual is subject to change without notice. 2017-11-13 AP040036EN DE1 I/O Configuration Page 5 1 General The variable speed starters of the series PowerXLTM DE1 are configured for many applications by default. In addition there is the possibility to adopt the
devices to the application. Not only internal variables like ramp times or speed are changed, but also different functions can be assigned to the terminals. This possibility is universal inside the DE1 series and does not depend on the power rating. This Application Note describes • the existing input and output terminals • the technical data • the assignment of
functions to terminals • the configuration of the I/Os Wiring diagram of a variable speed starter DE1 with default settings 2017-11-13 AP040036EN DE1 I/O Configuration Page 6 2 Hardware All signals at the input terminal have the same signal common (0 V). Terminal 4 can be used as digital input as well as analog input. The respective function depends
on the configuration (see chapter 3ff). 2.1 Designation of the control terminals and technical data Designation Function Default 0 V Signal common for all inputs (terminals. 1 … 4) - + 10 V Control voltage and reference voltage 20 mA max. Signal common: 0 V - 1 (DI1) Digital input 1 HIGH: 9 … 30 V 10 V: 1,15 mA / 24 V: 3 mA FWD 2 (DI2) Digital input 2
HIGH: 9 … 30 V 10 V: 1,15 mA / 24 V: 3 mA REV 3 (DI3) Digital input 3 HIGH: 9 … 30 V 10 V: 0,12 mA / 24 V: 0,3 mA FF1 4 (AI1 / DI4) Analog input 1 or digital input 4 analog: 0 … 10 V; 0,12 mA 0/4 … 20 mA, RB = 500 Ω digital: HIGH: 9 … 30 V 10 V: 0,12 mA / 24 V: 0,3 mA REF (analog, 0 … 10 V) 13 Relay RO1 (NO) 250 V, 6 A AC / 30 V, 5 A DC RUN,
device enabled14 2.2 Wiring examples The control terminals of the devices DE1 are fixed. On the variant DE11, the terminal block for the control signals is pluggable. To apply control signals to the terminals, the internal 10 V as well as ex- ternal voltages, e.g. 24 V from a PLC, can be used. 2.2.1 Example 1: Application motor starter 2017-11-13
AP040036EN DE1 I/O Configuration Page 7 2.2.2 Example 2: Application with variable speed 2.2.3 Example 3: Control voltage from an external voltage source 2017-11-13 AP040036EN DE1 I/O Configuration Page 8 2.2.4 Example 4: external reference value 2.2.5 Example 5: control by a PLC 2017-11-13 AP040036EN DE1 I/O Configuration Page 9 2.3
Relay output Depending on the kind of load, we recommend the use of protection circuitry for the relay outputs. 2017-11-13 AP040036EN DE1 I/O Configuration Page 10 3 Configuration The table gives an overview, how to determine the function of the single I/Os. Designation Selection / setting of Function Format (signal range) Scaling (Gain) Inversion
Hysteresis Offset 0 V fixed - - - - - +10 V fixed - - - - - 1 (DI1) P-12 / P-15 - - - - - 2 (DI2) - - - - - 3 (DI3) - - P-19 - - 4 (AI1 / DI4) P-16 P-17 P-18 - P-44 DE1: 13 fixed - - - - - DE1: 14 - DE11: 13 P-51 - - - P-52 / P-53 / P-54 - DE11: 14 3.1 Inputs The function of the inputs can be configured in different ways: • using the default settings. • configuration with the
configuration module DXE-EXT-SET. The numbers at the selector switch correspond to the settings of P-15 in terminal mode (P-12 = 0) • via the optional keypad DX-KEY-LED • via the parameter software DrivesConnect The available terminal combinations depend on the selection of the “Local ProcessData Source” (P- 12). Default: P-15 = 0, P-12 = 0.
3.1.1 Terminal configuration PNU Parameter Name Range Default 423.0 P-15 DI Config Select 0 … 9 0 2017-11-13 AP040036EN DE1 I/O Configuration Page 11 2017-11-13 AP040036EN DE1 I/O Configuration Page 12 2017-11-13 AP040036EN DE1 I/O Configuration Page 13 2017-11-13 AP040036EN DE1 I/O Configuration Page 14 For the terminal
functions the following abbreviations are used: Abbreviation Function DIR Used for the selection of the sense of rotation in connection with the START command. Low = cw (FWD) High = ccw (REV) ATTENTION: in case of a wire break the drive reverses in case REV is selected! Alternative: use configuration with FWD/REV. DOWN “Reduce speed”
command, when a digital reference is selected. Used in combination with the command UP. In case UP and DOWN are ap- plied simultaneously. The motor reduces its speed for the duration of the simultaneous signals with the deceleration ramp set with “t-dec” (P-04). ENA Enable variable frequency drive. To start the drive an additional start signal
(START, FWD, REV) is necessary. When removing ENA, the mo- tor coasts to stop. ENAINV In case ENAINV is used instead of ENA, the sense of rotation is invert- ed, compared to the one determined by a keypad or a fieldbus. Example: ENA + FWD = FWD, ENAINV + FWD = REV ENAREF Enable signal for the speed reference. This signal is necessary
to oper- ate the variable speed starter in addition to START respectively FWD/REV. At disconnection of ENAREF the variable speed starter ramps to stand still, but the variable speed starter will not be disa- bled. EXTFLT External fault. Enables the inclusion of an external signal into the fault messages of the variable speed starter. P-19 = 0: During
operation a High signal must be applied to the termi- nal. A Low signal leads to a trip with the message “E-trip”. P-19 = 1: During operation a Low signal must be applied to the termi- nal. A High signal leads to a trip with the message “E-trip”. FF1 Selection between the analog speed reference at analog input AI1 (terminal 4) and the fixed frequency 1 (fRequest an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
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Fix1), set with P-20. Low = analog reference, High = f-Fix1 FF20 / FF21 Selection of the fixed frequency with digital commands. The fixed frequencies f-Fix1 … f-Fix4 are defined with P-20 … P-23. FF20 FF21 f-Fix1 (P-20) L L f-Fix2 (P-21) H L f-Fix3 (P-22) L H f-Fix4 (P-23) H H FWD START with a clockwise rotating field (FWD = Forward). When applying a
High signal to the respective terminal, the motor accelerates with the predefined ramp. Removing the signal leads to a stop. The stop behavior depends on the setting of P-05 “Stop Mode”. At standstill the variable speed starter is disabled. In applications with two direc- tions, counter clockwise rotation is selected with REV. FWD and REV are logically
connected (XOR). Applying both signals at the same time leads to a trip of the variable speed starter. 2017-11-13 AP040036EN DE1 I/O Configuration Page 15 Abbreviation Function REF Analog input AI1 (terminal 4) is used as speed reference input. P-16: Format (voltage input / current input …) P-17: Scaling P-18: Inversion REV START with a counter
clockwise rotating field (REV = Reverse). When applying a High signal to the respective terminal, the motor acceler- ates with the predefined ramp. Removing the signal leads to a stop. The stop behavior depends on the setting of P-05 “Stop Mode”. At standstill the variable speed starter is disabled. In applications with two directions, clockwise rotation is
selected with FWD. FWD and REV are logically connected (XOR). Applying both signals at the same time leads to a trip of the variable speed starter. START Starts and stops the motor. When applying a High signal to the re- spective terminal, the motor accelerates with the predefined ramp. Removing the signal leads to a stop. The stop behavior depends
on the setting of P-05 “Stop Mode”. At standstill the variable speed start- er is disabled. In applications with two directions, the sense of rota- tion is selected with DIR or INV.In applications with Smartwire DT this signal is necessary in addition to the start command coming via bus. UP “Increase speed” command, when a digital reference is selected. Used in
combination with the command DOWN. In case UP and DOWN are applied simultaneously. The motor reduces its speed for the duration of the simultaneous signals with the deceleration ramp set with “t- dec” (P-04). 3.1.2 Displaying input signals The status of the inputs can be displayed by selecting the respective parameters. PNU Parameter Name
Range Default 560.0 P00-01 Analog input1 0.0 … 100 % input signal - 550.0 … 550.3 P00-04 DI1 Status 0 / 1 - The value, displayed with P00-01, takes also a potential scaling factor (P-17) into account. Example: P00-01 = Signal at AI1 [%] · P-17 The display on the keypad can be used to see the status of the digital inputs DI1 … DI4. It starts with DI1 on
the left hand side of the display. 0 = Low signal, 1 = High signal at the respective input termi- nal. Voltages between 9 and 30 V are identified as High signal. If an input is configured as analog input, its status is displayed in P00-04 with 0 with voltage levels up to 9 V, above this with 1. 2017-11-13 AP040036EN DE1 I/O Configuration Page 16 3.1.3
Configuration of digital input DI3 Digital input 3 (Terminal 3) can be used to include an external signal into the fault messages. Parame- ter P-19 (DI3 Logic) determines, if a HIGH or a LOW signal is necessary at terminal 3 to indicate a proper status. PNU Parameter Name Range Default 650.2 P-19 DI3 Logic 0 " HIGH = OK, LOW = fault 1 " LOW = OK,
HIGH = fault 0 DI3 can be configured in a way, that a thermistor can be used to protect the connected motor. In this case P-19 must be set to 0. Parameter P-15 has to be set in a way, that the function „External Fault“ (EXTFLT) is assigned to terminal 3 (DI3). During proper opera- tion, a High-Signal is applied to terminal 3. In case of fault the tem- perature
contact must open respectively the resistance of the ther- mistor has to increase. DE1 trips at a resistance of > 3.6 kΩ, Reset can be performed at values “RO1 Upper Limit” , output will be logic 0 if value “RO1 Upper Limit” , output will be logic 1 if value RO1 Upper Limit (P-52) 5: Motor current > RO1 Upper Limit (P-52) 6: Speed RO1 Upper Limit (P-52) 6: Speed < RO1 Upper Limit (P-52) 7: Motor current < RO1 Upper Limit (P-52) 8: DE1 not enabled 9: Speed not at speed reference
value 0 452.0 P-52 RO1 Upper Limit 0.0 … 200.0 % 100.0 % 454.0 P-53 RO1 Hysteresis 0.0 … 100.0 % 0.0 % 457.0 P-54 RO1 Switch-On Delay 0.0 … 250.0 s 0.0 s Application Note 07/2022 AP040184EN PowerXL DG1 – Firmware Update Level 3 1 – Fundamental – No previous experience necessary 2 – Basic – Basic knowledge recommended 3 –
Advanced – Reasonable knowledge required 4 – Expert – Good experience recommended 2 Application Note Firmware Update DG1 07/2022 AP040184EN Eaton.com All proprietary names and product designations are brand names or trademarks registered to the relevant title holders. Services For service and support, please contact your local sales
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Application Note Firmware Update DG1 07/2022 AP040184EN Eaton.com 3 DANGER! DANGEROUS ELECTRICAL VOLTAGE! • Disconnect the power supply of the device. • Ensure that devices cannot be accidentally restarted. • Verify isolation from the supply. • Ground and short-circuit. • Cover or enclose any adjacent live components. • Follow the
engineering instructions (AWA/IL) for the device concerned. • Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system. • Before installation and before touching the device ensure that you are free of electrostatic charge. • The functional earth (FE, PES) must be connected to the protective
earth (PE) or the potential equalization. The system installer is responsible for implementing this connection. • Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automatic control functions. • Suitable safety hardware and software measures should be implemented for the I/O interface so
that an open circuit on the signal side does not result in undefined states. • Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specification, otherwise this may cause malfunction and/or dangerous operation. • Emergency stop devices complying with IEC/EN 60204-1 must be effective in all operating
modes. Unlatching of the emergency-stop devices must not cause a restart. • Devices that are designed for mounting in housings or control cabinets must only be operated and controlled after they have been properly installed and with the housing closed. • Wherever faults may cause injury or material damage, external measures must be implemented to
ensure a safe operating state in the event of a fault or malfunction (e.g. by means of separate limit switches, mechanical interlocks etc.). • The used device may have hot surfaces during and immediately after operation. • Removal of the required covers, improper installation or incorrect operation of motor or device may destroy the device and may lead to
serious injury or damage. • The applicable national safety regulations and accident prevention recommendations must be applied to all work carried on live device. • The electrical installation must be carried out in accordance with the relevant electrical regulations (e. g. with regard to cable cross sections, fuses, PE). • Transport, installation, commissioning
and maintenance work must be carried out only by qualified personnel (IEC 60364, HD 384 and national occupational safety regulations). • Installations containing device must be provided with additional monitoring and protective devices in accordance with the applicable safety regulations. Modifications to the device using the operating software are
permitted. • All covers and doors must be kept closed during operation. • To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or failure of the device (increased motor speed or sudden standstill of motor). These measures include: – Other independent devices
for monitoring safety related variables (speed, travel, end positions etc.). – Electrical or non-electrical system-wide measures (electrical or mechanical interlocks). – Never touch live parts or cable connections of the device after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be alive after
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..... 6 Firmware Upgrade..... 7 Resetting to default settings ..... 11 Firmware Upgrade for optional cards
..... 12 6 Application Note Firmware Update DG1 07/2022 AP040184EN Eaton.com General The device software of the DG1 can be updated to a newer version or downgraded to an old one. Both is done via the so-called firmware update tool. Connecting the Drive to a PC 1. Remove the front cover. 2.
Connect the programming cable to terminals 25 and 26. Abbildung 1: Connecting the programming cable Apply main voltage Start the drive by applying the main voltage. Depending on frame size: 230V AC à single phase: L1(L)/L3(N) 400V AC à three phase: L1/L2/L3 Application Note Firmware Update DG1 07/2022 AP040184EN Eaton.com 7 Firmware
Upgrade 1. First download the desired firmware package from the Eaton website and unzip the file. Abbildung 2: Firmware package 2. Open the Firmware Upgrade Tool. Abbildung 3: Firmware Upgrade Tool 3. Select the previously downloaded firmware package from your directory by clicking "Browse". Abbildung 4: Power Xpert InControl Software 4.
Select the file “DG1_C0033“. Abbildung 5: DG1_C0033 5. Check the cable connection and the COM port in the Windows Device Manager. 8 Application Note Firmware Update DG1 07/2022 AP040184EN Eaton.com Abbildung 6: Device Manager 6. Enter "1" for "Slave Address" and select the COM port. Abbildung 7: Settings 7. Establish the connection via
"Connect". Abbildung 8: Establish connection 8. After the firmware has been detected, a dialog for confirming the firmware package is displayed. The tool automatically sets check marks once the version differences have been detected. Abbildung 9: Update process 9. Choose „Block 0“ for german and „Block 1“ for english. Application Note Firmware
Update DG1 07/2022 AP040184EN Eaton.com 9 Abbildung 10: Update process 10. Confirm the selection with „Program“. Abbildung 11: Confirming 11. Verify that the update has been completed correctly. ("Programming Success - Verification OK"). If "Verification OK" appears, select "Disconnect". If "Failed" appears, repeat the update process or contact
After Sales Service. 10 Application Note Firmware Update DG1 07/2022 AP040184EN Eaton.com Abbildung 12: Update completed Application Note Firmware Update DG1 07/2022 AP040184EN Eaton.com 11 Resetting to default settings Reset all parameter to the factory settings by proceeding as follows: Parameters à Basic Settings à System à
Parameter Sets (P21.1.3) Then select “Reload defaults“. Abbildung 13: Parameter reset Now the firmware update is completed. You can disconnect the programming cable, remove the power connector and reattach the front cover. 12 Application Note Firmware Update DG1 07/2022 AP040184EN Eaton.com Firmware Upgrade for optional cards 1.
Connect the optional module to one of the expansion slots. Abbildung 14: Installating expansions 2. Follow the steps 2.1 to 4.8. 3. Confirm the selection with „Program“. Abbildung 15: Confirming the selection 4. Check the update version of the board. If "Code is same" appears, no update needs to be performed here. Application Note Firmware Update DG1
07/2022 AP040184EN Eaton.com 13 Abbildung 16: Check the version 5. Click „Disconnect“ to disconnect the communication again. If the drive now remains in "Loader Mode", a connection should be established again via "Connect" and then disconnected again via "Disconnect". If the drive is still in "Booth Loader Mode" and the "Startup Wizard" does not
appear, please contact After Sales Service. Eaton Industries GmbH Hein-Moeller-Str. 7- 11 D-53115 Bonn © 2020 Eaton Corporation . Alle Rechte vorbehalten 07/2022 AP040184EN Eaton is dedicated to ensuring that reliable, efficient and safe power supply is available when it is needed most. With vast of energy management across different industries,
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Reasonable knowledge required 4 – Expert – Good experience recommended 2017-04-25 AP040168EN DG1 Load balancing in multi motor applications Page 2 Contents 1 General ..... 5 2 Load balancing via slip
..... 6 3 Load balancing via drooping..... 7 3.1 Application example ..... 8 4 Adjustable load balancing via torque control
..... 9 2017-04-25 AP040168EN DG1 Load balancing in multi motor applications Page 3 Danger! - Dangerous electrical voltage! · Disconnect the power supply of the device. · Ensure that devices cannot be accidentally restarted. · Verify isolation from the supply. · Cover or enclose any adjacent live
components. · Follow the engineering instructions (AWA/IL) for the device concerned. · Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system. · Before installation and before touching the device ensure that you are free of electrostatic charge. · The functional earth (FE, PES) must be
connected to the protective earth (PE) or the potential equalization. The system installer is responsible for implementing this connection. · Connecting cables and signal lines should be installed so that inductive or capacitive interference does not impair the automatic control functions. · Suitable safety hardware and software measures should be
implemented for the I/O interface so that an open circuit on the signal side does not result in undefined states. · Deviations of the mains voltage from the rated value must not exceed the tolerance limits given in the specification, otherwise this may cause malfunction and/or dangerous operation. · Emergency stop devices complying with IEC/EN 60204-1
must be effective in all operating modes. Unlatch- ing of the emergency-stop devices must not cause a restart. · Devices that are designed for mounting in housings or control cabinets must only be operated and con- trolled after they have been properly installed and with the housing closed. · Wherever faults may cause injury or material damage, external
measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (e.g. by means of separate limit switches, me- chanical interlocks etc.). · Frequency inverters may have hot surfaces during and immediately after operation. · Removal of the required covers, improper installation or incorrect operation of motor or
frequency invert- er may destroy the device and may lead to serious injury or damage. · The applicable national safety regulations and accident prevention recommendations must be applied to all work carried on live frequency inverters. · The electrical installation must be carried out in accordance with the relevant electrical regulations (e. g. with regard to
cable cross sections, fuses, PE). · Transport, installation, commissioning and maintenance work must be carried out only by qualified per- sonnel (IEC 60364, HD 384 and national occupational safety regulations). · Installations containing frequency inverters must be provided with additional monitoring and protective devices in accordance with the
applicable safety regulations. Modifications to the frequency inverters us- ing the operating software are permitted. · All covers and doors must be kept closed during operation. To reduce the hazards for people or equipment, the user must include in the machine design measures that restrict the consequences of a malfunction or

failure of the frequency
inverter (increased motor speed or sud- den standstill of motor). These measures include: – Other independent devices for monitoring safety related variables (speed, travel, end positions etc.). – Electrical or non-electrical system-wide measures (electrical or mechanical interlocks). – Never touch live parts or cable connections of the frequency inverter
after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be alive after disconnection. Consider appropriate warning signs. 2017-04-25 AP040168EN DG1 Load balancing in multi motor applications Page 4 Disclaimer The information, recommendations, descriptions, and safety notations in this
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the use of the information, recommendations, and descriptions contained herein. The information contained in this manual is subject to change without notice. 2017-04-25 AP040168EN DG1 Load balancing in multi motor applications Page 5 1 General In cases, in which multiple motors are fixed permanently our coupled via friction, an equal load shar- ing
between the motors is required. Already small differences in the mechanical structure of the drives inside the system or manufacturing tolerances can lead to an unbalanced load sharing. Beside an oversizing other measures exist to balance the load to ensure a reliable operation of the applica- tion and to prevent overload situations for single motors. Like
in many other cases, multiple solutions exist, differing in complexity and costs. There is a funda- mental interest to choose the variant with the best value for money. In the end the application de- termines, which kind of solution can be chosen. This application note describes three of the possible solutions in connection with variable frequency drives and
provides an indication of the right solu- tion. The following chapters describe, how the different solutions work. The table below gives an overview about the substantial features and differences. Control via slip Droop function Torque control Control mode Speed control Speed control 1 motor with speed control, the other ones with torque control Number of
variable frequency drives 1 variable frequency drive per motor; con- necting multiple mo- tors in parallel to the output of one device is possible. 1 variable frequency drive per motor 1 variable frequency drive per motor Load balancing via Slip Load dependent corrective value Torque control Accuracy of balancing + ++ +++ Motors (power, manufacturer)
Equal motors necessary Different motors possible Different motors possible Mechanical coupling between the motors Preferably coupled via friction; fixed mechan- ical coupling possible in some applications. Preferably coupled via friction; fixed mechan- ical coupling possible in some applications. Fixed coupling and coupling via friction possible. In case of
coupling via friction a speed limitation is recommended. 2017-04-25 AP040168EN DG1 Load balancing in multi motor applications Page 6 2 Load balancing via slip The speed of a three phase induction motor depends on the load. When it is supplied with the voltage and frequency ac- cording to its name plate, an unloaded motor turns with near- ly
synchronous speed, while the speed at rated load corre- sponds to the rated speed. In case of a 50 Hz mains supply and a four pole motor this means, that the unloaded motor turns with approximately 1500 rpm and at rated load e.g. with 1470 rpm. The difference between synchronous speed and the speed of the motor axis is called slip. In the example
on the left the motor is loaded with torque M1 and it turns with the speed n1. The load is increased up to M2 j ¨ The speed drops down to n2 k. This behavior is utilized in a slip dependent load balancing. This simplest kind of “automatic” load sharing presumes, that the mechanics as well as the motors of all parts of the system are identical. In theory all
motors have to carry the same load per definition, but tolerances, temperature dependen- cy and small mechanical differences let the loads drift apart, even when the motors were equally loaded at the point of start. But how does load balancing work? The motor with the highest load drops in speed and in this case the other one(s) have to carry more load
than before. The load is now more or less balanced. There is no possibility for load adjustment and the sharing is defined by the system. Therefore it makes sense to add some margin when calculating the motor powers. The variable frequency drive DG1 has to work in the motor control mode “Freq Control” (P8.1 = 0). In case each motor has its own
variable frequency drive, they must have identical parameter settings. Parameter Name Range Default P8.1 Motor Control Mode Freq Control (0) Speed Control (1) Open Loop Speed Control (5) Open Loop Torque Control (6) Freq Control (0) It is also possible to connect multiple motors in parallel to one variable frequency drive. It has to be noted, that
each motor must have its own motor protection, because the total current is “known” by the variable frequency drive, but not how it is shared between the single motors. 2017-04-25 AP040168EN DG1 Load balancing in multi motor applications Page 7 3 Load balancing via drooping In case speed controlled drive systems are mechanically connected
through form fit or friction, the fastest drive takes the load and pulls the other ones, which are less, or in extreme cases, not loaded. To counteract this effect, the speed reference will be corrected, depending on the load. At load in- crease, the droop function reduces the resulting speed reference (set reference – speed reduction), the motor falls back a little
bit in its speed and the other motors inside the system take more load automatically. Application experience shows, that it is of advantage in many cases to have one motor inside the system, where the droop function is disabled (P8.13 “Load Drooping” = 0.00 %), while it is enabled (P8.13 “Load Drooping” different from 0.0 %) for all other motors inside the
system. The set value of P8.13 is the percentage of speed by which the speed drops in case the motor is loaded with rated torque. With reduced load, the speed reduction will be reduced accordingly. In exceptional cases it can also be advantageous to enable the droop function for all motors. The variable frequency drive DG1 has to work in the motor
control mode “Open Loop Speed Control” (P8.1 = 5) to achieve the best result. Parameter Name Range Default P8.1 Motor Control Mode Freq Control (0) Speed Control (1) Open Loop Speed Control (5) Open Loop Torque Control (6) Freq Control (0) P8.13 Load Drooping 0.00 % … 100.00 % 0.00 % 2017-04-25 AP040168EN DG1 Load balancing in multi
motor applications Page 8 3.1 Application example Material is transported through the machine by means of two conveyor belts. Each belt is driven by its own motor. Because of the contact pressure, the two belts are connected mechanically. In case one of the two mo- tors tries to run a little bit faster than the other one, it leads to an unequal load sharing.
Without an enabled droop function, motor 1 takes 80 % of its rated load, motor 2 85 %. Because of the higher load, motor 2 becomes warmer than motor 1, possibly one can also see the difference in speed on the material which is transported between the belts. Now the droop function will be enabled with P8.13. The system will change to equal load
sharing iteratively. Values at the beginning (we are looking to the system at an output frequency of 40 Hz, P1.9 = 50 Hz, P8.13 = 10.00 %): Resulting speed of motor 1: 40 Hz – ((10 % · 50 Hz) · 80 %) = 36 Hz Resulting speed of motor 2: 40 Hz – ((10 % · 50 Hz) · 85 %) = 35,75 Hz Motor 2 now runs slower than motor 1 " The load of motor 1 increases "
Therefore the load of motor 2 is reduced ..... . This is a repetitive process until an equal sharing of the load is achieved. Remaining differences in load can be adjusted with 8.13. 2017-04-25 AP040168EN DG1 Load balancing in multi motor applications Page 9 4 Adjustable load balancing via torque control Inside this system, one motor is speed controlled
and the other one(s) torque controlled. The speed controlled motor determines the speed of the system, while the torque is the control variable for the other motors. Here it is possible to use motors of different ratings and it is also possible to set indi- vidual shares of the load. A torque control is much more complex than the principles described in chapters 2
and 3. On the other hand you have much more possibilities to adopt the control to the application, which results in a higher accuracy. Nevertheless the other principles are useful in simple applications because of their simplicity and value for money. Torque control is extensively described inside the application Note „AP040167EN Torque Control“. Please
refer to this document. One important aspect must be mentioned here: A torque controlled motor always tries to bring the required torque (or tension in case of linear movements) to the load. When this is not possible, the torque is used for acceleration to the maximum possible speed. This is not critical as long as the mo- tors are connected together
mechanically, e.g. when all pinions work on the same geared ring. In cases where the speeds of the motors involved are not synchronized mechanically and a slip in speed is possible, it is strongly recommended to limit the speed of the torque controlled motor. The neces- sary aspects and settings are comprehensively described in the application note
AP040167EN men- tioned above. www.eaton.eu Application Note 01/2018 AP040177EN DE PowerXL™ DG1 Variable Frequency Drives Motor data and V/f curves Level 2 1 – Fundamental – No previous experience necessary 2 – Basic – Basic knowledge recommended 3 – Advanced – Reasonable knowledge required 4 – Expert – Good experience
recommended 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 2 Contents 1 General ..... 5 2 Motor data ..... 5 2.1 Motor Nom Current ..... 6 2.2 Motor Nom Speed ..... 6 2.3 Motor PF ..... 6 2.4 Motor Nom Voltage ..... 6 2.5 Motor Nom Frequency ..... 7 2.6 Motor Identification ..... 7 3 Motor Control Mode ..... 9 3.1 Frequency Control (V/f) ..... 9 3.2 Speed Control ..... 9 3.3 Open Loop Speed Control ..... 10 4 V/f curve ..... 11 4.1 Optimizing the V/f curve at Frequency Control and Speed Control ..... 12 4.1.1 Improving the torque behavior ..... 13 4.1.2 Increasing energy efficiency ..... 15 4.2 87 Hz curve ..... 15 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 3 Danger! - Dangerous electrical voltage! · Disconnect the power supply of the device. · Ensure
that devices cannot be accidentally restarted. · Verify isolation from the supply. · Cover or enclose any adjacent live components. · Follow the engineering instructions (AWA/IL) for the device concerned. · Only suitably qualified personnel in accordance with EN 50110-1/-2 (VDE 0105 Part 100) may work on this device/system. · Before installation and before
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installed and with the housing closed. · Wherever faults may cause injury or material damage, external measures must be implemented to ensure a safe operating state in the event of a fault or malfunction (e.g. by means of separate limit switches, me- chanical interlocks etc.). · Frequency inverters may have hot surfaces during and immediately after
operation. · Removal of the required covers, improper installation or incorrect operation of motor or frequency invert- er may destroy the device and may lead to serious injury or damage. · The applicable national safety regulations and accident prevention recommendations must be applied to all work carried on live frequency inverters. · The electrical
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machine design measures that restrict the consequences of a malfunction or failure of the frequency inverter (increased motor speed or sud- den standstill of motor). These measures include: – Other independent devices for monitoring safety related variables (speed, travel, end positions etc.). – Electrical or non-electrical system-wide measures (electrical
or mechanical interlocks). – Never touch live parts or cable connections of the frequency inverter after it has been disconnected from the power supply. Due to the charge in the capacitors, these parts may still be alive after disconnection. Consider appropriate warning signs. 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 4 Disclaimer The
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are variable frequency drives for the supply of three phase in- duction motors. By default they are configured, that motors of the respective power class can be supplied without changing the settings. Many standard cases can be covered. There are some applications, which require an adaptation by changing parameters. In this Applica- tion Note the
following aspects are covered: · Selection of the motor control mode · Adaptation to the connected motor · Slip compensation · Setting the V/f curve 2 Motor data Condition for a proper operation is the right connection (star / delta) of the motor to the output ter- minals of the device. The rated voltage of the motor windings is decisive. Device Output Voltage
Motor Connection DG1-32… 3 x 230 V 230 / 400 V Delta DG1-34… 3 x 400 V 230 / 400 V 400 / 660 V Star Delta DG1-34… 3 x 400 V 230 / 400 V Delta Special case: 87 Hz-curve (see section 4.2) An adaptation to the connected motor can be done with the following parameters: · P1.6 Motor Nom Speed · P1.7 Motor PF · P1.8 Motor Nom Voltage · P1.9
Motor Nom Frequency The respective values can be taken from the name plate of the motor or from the data sheet of the motor manufacturer. They are used for the setting of the motor protection and define the V/f curve. 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 6 2.1 Motor Nom Current Parameter P1.5 „Motor Nom Current“ is set to
the rated current Ie of the variable frequency drive by default. At the same time it is the set value for the thermal protection of the motor. In case the mo- tor has a nominal current different to the one of the VFD, P1.5 must be set accordingly to ensure motor protection. It must be pointed out, that this current value is set, which is assigned to the type of
connection of the motor. In the example above it is 3,2 A at 230 V (Delta) respectively 1,9 A at 400 V (Star). Parameter Name Range Default P1.5 Motor Nom Current 0,1 · Ie … 2 · Ie Ie Ie = Rated current of the variable frequency drive All measures to protect the connected motor are described in the Application Note AP040176EN “Starting, stopping and
operation”. 2.2 Motor Nom Speed The setting of P1.6 „Motor Nom Speed“ is necessary for three reasons: · to display the right speed value in all modes of operation · for calculation of the slip compensation in operation mode “Speed Control” (P8.1 = 1) · for calculations inside the motor model when operating in vector mode (P8.1 = 5 „Open Loop Speed
Control“ Please use the name plate value for setting P1.6. Parameter Name Range Default P1.6 Motor Nom Speed 300 … 20000 rpm 1750 rpm 2.3 Motor PF In vector mode (P8.1 = 5 „Open Loop Speed Control“) the power factor (cos ϕ), which is specified on the motor’s name plate, must be set. Parameter Name Range Default P1.7 Motor PF 0.3 … 1
0.85 2.4 Motor Nom Voltage Motor rated voltage (name plate) taking the connection (star / delta) into account. In exceptional cases, a different setting of P1-07 is necessary. See section 4.2 “87 Hz curve” Parameter Name Range Default P1.8 Motor Nom Voltage 180 … 690 V Ue Ue = Rated voltage of the variable frequency drive, e.g. 230 V or 400 V
depending on the device type 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 7 2.5 Motor Nom Frequency Rated frequency of the motor. By default this parameter is set to the mains frequency (50 Hz in Eu- rope, 60 Hz in USA) and doesn't need to be changed in the majority of cases. In case, motors with rated frequencies different from the
mains frequency (e.g. 200 Hz for fast rotat- ing motors) or if the 87 Hz curve is used (see section 4.2), P1.9 has to be set accordingly. When changing the value of P1.9 the setting of P8.5 “Field Weakening Point” is set to the same value. If the application requires different values for P1.9 and P8.5, Motor Nom Frequency must be set first, before adopting the
value for the field weakening point Parameter Name Range Default P1.9 Motor Nom Frequency 0.00 … 400.00 Hz 50 Hz 2.6 Motor Identification The motor identification MUST be performed in vector mode (P8.1 = 5 or 6) to gain the required pa- rameter values for an optimal performance of the motor. ATTENTION: The motor data (e.g. the resistance)
change with the temperature. Therefore the motor identification run shall be performed with a warm motor. The kind of motor identification run is determined by the setting of P8.14 „Identification“. The fol- lowing motor data are identified: · Motor Stator Resistance R1 (P8.50) · Motor Rotor Resistance R2 (P8.51) · Motor Leak Inductance X1 (P8.52) · Motor
Mutual Inductance Xh (P8.53) · Motor Excitation Current (P8.54) P8.14 = 0: No Action No identification of the motor data will be performed. This is the setting during normal operation of the drive. P8.14 = 1: Identification Only Stator Resistor During the identification run only the stator resistance is identified. The other values remain un- changed. P8.14 = 2:
Identification with Run The values for the parameters P8.50 ip to P8.54 are identified. The measurement is done with a run- ning motor. The motor must be unloaded (load decoupled, no gearbox …). P8.14 = 3: Identification No Run The values for the parameters P8.50 ip to P8.54 are identified. During the measurement the motor is standing still.
2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 8 How to perform a motor identification run: · Before starting a motor identification run, the motor data (parameters P1.5 up to P1.9) must be set. · Select the motor control mode P8.1 = “3: Open Loop Speed Control”. · Select in P8.14 „Identification“, which kind of identification shall be
performed (P8.14 = 1…3). · Remove any connection between the drive and a PC during identification run. · Apply START command · The identification of the motor data takes place automatically and is active for about 30 s re- spectively until the START signal will be removed. · On the keypad „Motor Identification“ is shown. · The motor data are identified
and assigned to the respective parameters. · In case an identification is not possible, the fault message “Motor ID Fault” (#57) is displayed. One reason could be that the rated power of the connected motor deviates too much from the one of the variable frequency drive. Alternatively the motor data can be set manually on the basis of technical information
supplied by the motor manufacturer. · After a motor identification run, the START signal must be reapplied to start the motor. The motor doesn't start automatically, even when the START signal is still applied to the respec- tive terminal. · Parameter P8.14 “Identification” is reset to “0: No action” automatically as soon as the iden- tification run is finished.
Parameter Name Range Default P8.14 Identification 0: No Action 1: Identification Only Stator Resistor 2: Identification with Run 3: Identification No Run 0: No Action P8.50 Stator Resistor 0.001 … 65535 W 0.033 W P8.51 Rotor Resistor 0.001 … 65535 W 0.034 W P8.52 Leak Inductance 0.01 … 655.35 mH 0.12 mH P8.53 Mutual Inductance 0.1 … 6553.5
mH 3.4 mH P8.54 Excitation Current 0.1 … 7.4 A 0.1 A 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 9 3 Motor Control Mode Parameter P8.1 „Motor Control Mode“ determines the way, how the motor is controlled (e.g. fre- quency or vector control). The information given inside the Application Note refer to the settings P8.1 = 0, 1 or 5. By
default the variable frequency drive is configured for Frequency Control (P8.1 = 0), which is mainly used in simple applications. With speed control (P8.1 = 1 or 5) an improved speed accuracy and a better torque performance can be achieved. In this case the motor data must be set and with Open Loop Speed Control (P8.1 = 5) a motor identification run
(P8.14, see section 2.6) is necessary. Parameter Name Range Default P8.1 Motor Control Mode 0: Frequency Control 1: Speed Control 5: Open Loop Speed Control 6: Open Loop Torque Control 0 3.1 Frequency Control (V/f) P8.1 = 0 The output frequency of the variable frequency drive is proportional to the reference, which is for example applied to an
analog input. The ratio between the output voltage and the frequency is kept constant. This leads to a speed change when the load is changing, like with a single speed motor connected DOL to the mains. This control mode is preferred, when multiple motors are connected in parallel at the output of one single variable frequency drive respectively in simple
applications, where no special requirements concerning speed accuracy at variable load exist. 3.2 Speed Control P8.1 = 1 In principle the Speed Control works like the Frequency Control described in section 3.1. At Speed Control the slip compensation is activated in addition, which takes care, that the motor speed is kept approximately constant even in
case of load changes. In this motor control mode the motor data must be set (P1.5 up to P1.9) The slip is the difference between a synchronous speed because of a rotating field and the actual speed of the motor. The name plate in section 2 shows a rated speed of 1410 rpm. It is a 4 pole mo- tor with a synchronous speed of 1500 rpm. Between no load
and rated load there is a slip of 90 rpm. Running the motor with a variable frequency drive, one wants to prevent the speed variance by compensating the slip. 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 10 with slip compensation without slip compensation With slip compensation: at load increase j voltage and frequency are increased
accordingly k. The speed n1 remains constant. At load decrease voltage and frequency are reduced. Without slip compensation: with load j the speed drops from n1 to n2 k, when unloading the speed increases again. 3.3 Open Loop Speed Control P8.1 = 5 Open loop means, that a feedback of the motor speed to the variable frequency drive, e.g. by using
an encoder, is not required. The speed information used in the control algorithm is the result of a calculation by the motor model. To ensure an optimal performance, the motor data (parameters P1.5 up to P1.9) must be set and a motor identification run must be performed (see section 2.6). Speed accuracy and torque performance are improved compared
to the motor control mode “Speed Con- trol” described in section 3.2. Note: When multiple motors are connected in parallel to one single variable frequency drive, this motor control mode may not be used! 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 11 4 V/f curve The V/f curve determines the magnetization of the motor and therefore
the torque behavior signifi- cantly. In addition the energy efficiency of the complete system can be impacted. As described in section 3, multiple motor control modes exist. Common to all of them is, that the field weakening point (FWP) and the maximum frequency must be defined. In case of open loop speed control (P8.1 = 5), the variable frequency drive
calculates the necessary settings on the basis of this information and the determined motor data. In case of frequency control (P8.1 = 0) or speed control with slip compensation (P8.1 = 1) it is possible to modify the V/f curve to improve the torque behavior (see section 4.1). · P1.2 „Max Frequency“ maximum frequency for the application. This frequency
may be above the „Motor Nom Fre- quency“ (P1.9). · P8.5 „Field Weakening Point“ This parameter defines the frequency, at which the maximum output voltage, defined with P8.6, is reached. · P8.6 „Voltage at FWP“ Maximum voltage of the variable frequency drive in percent of the Motor Nom Voltage (P1.8). This voltage is reached at the field weakening
point (FWP) defined with P8.5. Note: At a change of parameter P1.9 „Motor Nom Frequency“ P8.5 is automatically set to the same frequency value. In applications, where the frequency at FWP is different to the Motor Nom Fre- quency, P1.9 must be set first, before setting P8.5. The same is true for the voltage. Here P1.8 “Mo- tor Nom Voltage“ must be set
before P8.6 “Voltage at FWP”. Parameter Name Range Default P1.2 Max Frequency P1.1 … 400 Hz 50.0 Hz P8.5 Field Weakening Point 8.0 Hz … P1.2 P1.9 P8.6 Voltage at FWP 10 … 200 % – P1.8 P1.8 2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 12 4.1 Optimizing the V/f curve at Frequency Control and Speed Control The V/f curve
shown in section 4 is idealized (P8.4 = 0 “Linear”) and sufficient for many applications. There are two cases, where the shape of the V/f curve should be adopted: · where a higher starting torque is required, respectively where the motor has to run at lower speed stationary · in pump and fan applications, where the motor losses shall be reduced by field
weakening under part load conditions. The different shapes of the V/f curve can be selected with P8.4 “V/Hz Ratio”. · P8.4 = 0 „Linear“ Voltage and frequency change linearly from zero up to the field weakening point (FWP) · P8.4 = 1 „Squared“ Voltage and frequency change squared from zero up to the field weakening point (FWP). See also section 4.1.2. ·
P8.4 = 2 „Programmable“ The shape of the curve can be configured, see also section 4.1.1 · P8.4 = 3 „Linear + Flux Optimization“ The shape of the V/f curve is adopted to the load conditions automatically, see also section 4.1.2. Parameter Name Range Default P8.4 V/Hz Ratio 0: Linear 1: Squared 2: Programmable 3: Linear + Flux Optimization 0: Linear
2018-01-15 AP040177EN DG1 Motor data and V/f curves Page 13 4.1.1 Improving the torque behavior When operating with lower speeds, the voltage drop inside the motor becomes particularly noticea- ble, which leads to a reduced speed, unbalanced run and in extreme cases to a standstill of the motor with current flow at the same time. This effect can
be reduced by increasing the output voltage in the lower speed range. P8.3 “V/Hz Optimization” determines, in which way this will be achieved: · P8.3 = 1 „Enabled“ The voltage is increased automatically. The value depends on the motor rating and the values are based on experience. Setting: o Set motor data in parameter group 1

side Blue: hazardousarea side 12mm trim length with ferrule see table below INM 5500 Rev 186 3 2 2 3 Finishing Wire up individual isolators in accordance with wiring schedules. Daisy-chain power supply connections between individual power plugs or use the power bus (see section 4.1). Segregate hazardous- and safe-area wiring into separate trunking or looms wherever
possible to avoid errors and maintain a tidy installation. Use an MTL5599 dummy isolator to provide termination and earthing for unused cores from the hazardous area. 4 ACCESSORIES 4 1 MTL5500 power bus - Installation and use 4 1 1 MTL5500 range power bus A power bus kit enables power supply terminals (13 and 14) of up to 32 installed
MTL5500 range of units to be linked to a standard 24V power supply. The bus consists of a chain of power plugs and different lengths are available to suit various numbers of modules as follows. Number of modules Kit ID code (contains grey power plugs for 24V dc supply) 1 to 8 PB-8T 9 to 16 PB-16T 17 to 24 PB-24T 25 to 32 PB-32T Table 4 1: Power
bus kit options 4 1 2 Installation 1. Check to make sure the bus length is correct for the number of modules involved. 2. If the number of modules is less than the maximum number the chain will support, cut off the surplus power plugs at the tail end of the chain - leaving sufficient cable to attach further power plugs if it becomes necessary later. 3. Insert
power plugs into the power terminals on the safe- area side of each module in sequence. 4. Connect the power supply source to the tail end of the chain (using the insulation displacement connectors [Scotchloks] provided if required). Notes: 1. To avoid excessive voltage drop or over-current, DO NOT connect power buses in . 2. Surplus sections can be
used (and, if required) connected together provided the cut ends are safely terminated and/or connected together. Use single ferrules with a crimp tool or insulation displacement connectors (Scotchloks). Suitable ferrules and connectors are provided with the kits. Figure 4 1: Power bus wiring, joining and terminating – + Optional insulation displacement
connectors x2 INM 5500 Rev 187 4 2 MPA5500 AC power adaptor When only one or two MTL5500 modules are required for a particular application, it may be desirable to power the units from the AC mains supply directly, rather than use a separate DC supply unit. The MPA5500 is an adaptor that plugs into the DC power socket on the side edge of an
MTL5500 module and clips securely onto the module housing. Its 25V DC power output is sufficient to supply a single module and can be connected to any normal ac power source. Figure 4 2: MPA5500 AC power adaptor To fit the adaptor, locate the tongue of the adaptor into the top slot on the side of the MTL5500 module and press the adaptor until it fits
closely to the body of the module, as shown. Use double-insulated AC power cable with conductor parameters of 0.2–1.5mm2, or 0.25– 1.5mm2 if using ferrules. Strip the outer insulation by no more than 30mm, then strip the inner conductors by 8mm. Insert the cables appropriately in the cage-clamp connectors marked 'L' and 'N'. The incoming AC power
must have some form of power disconnection device, such as a switch or circuit breaker; a coupler that can be disconnected without the use of a tool; or a separable plug, without a locking device, to mate with an adjacent socket outlet. In addition, some form of cable anchorage must be used to relieve the cable conductors from strain, including twisting,
where they connect to the adaptor, and which will also protect the insulation of the cable from abrasion. WARNING This adaptor is not suitable for use with MTL5000 range of modules. Direction of removal of MPA5500 Area required for removal of MPA5500 11 20 15.8 118.8 133 AC inputs Top of DIN rail INM 5500 Rev 188 4 3 Earth rail and tagging
accessories This section explains how to specify and assemble earth rail and tagging strip accessories for the MTL5500 range. The accessories consist of mounting brackets, earth rails, tagging strips and associated parts. They provide facilities for earthing, terminating cable screens and tagging (identifying) the positions of individual units. 4 3 1 Parts list
IMB57 Insulating mounting block (Figures 4 3, 4 4 & 4 5) One required at each end of a tagging strip/earth rail. Suitable for low-profile (7.5mm) and high- profile (15mm) symmetrical DIN rail. ERB57S Earth-rail bracket, straight (figure 4 3, 4 4 & 4 9) Nickel-plated bus bar; supplied with two push fasteners, one earth-rail clamp (14mm, 35mm2) and one earth
cable clamp (10mm, 16mm2). Note: ERB57S is the preferred choice of earth-rail bracket. It is usually fitted in the upper slot on insulating mounting block IMB57. Where the earth rail is required to be positioned at a lower height and to allow access to the IMB57 mounting screws, the straight earth-rail bracket ERB57S can be inserted in the lower slot, but
only after insulating mounting blocks IMB57 are clamped to the DIN rail. This may not be possible if, for example, trunking is fitted. In this case, fit offset earth-rail bracket ERB570 (see figure 4.4 & 4.10) in the upper slot: the mounting blocks can then be fitted in a restricted space with this bracket already fitted. ERB570 Earth-rail bracket, offset (figure 4 9)
Nickel-plated bus bar; supplied with two push fasteners, one earth-rail clamp (14mm, 35mm2) and one earth cable clamp (10mm, 16mm2). ERL7 Earth rail, 1m length (figure 4 9) Nickel-plated bus bar; may be cut to length. TAG57 Tagging strip, 1m length (figure 4 3, 4 4 & 4 6) Cut to size. Supplied with tagging strip label. TGL57 Tagging strip labels, set of
10 x 0 5m (figure 4 3 & 4 4) Spares replacement, for use with TAG57 tagging strip. MS010 DIN rail module spacer, 10mm, pack of 5 (figure 4 7) Grey spacer; Used to provide 10mm air-circulation space between modules, if necessary. ETM7 Earth terminal, bag of 50 (figure 4 8) For terminating cable screens and 0V returns on the ERL7 earth rail. For
cables ≥ 4mm2. TH5000 Tag holder Spares replacement. Connectors (Figure 4 5) Spares replacement: HAZ1-3, HAZ4-6, HAZ-CJC, PWR5000, SAF7-9, SAF10-12 (SAF1-3 and SAF4-6 grey connectors, also available for use in safe-area applications). 4 3 2 Assembly 4 3 2 1 Fitting earth rails a) In upper position Before fitting insulating mounting blocks
IMB57, check that the swing nuts in the base of each unit are turned back into the moulding. Locate the mounting blocks on the DIN rail in the chosen position and tighten the screws (see figure 4.10). Check that the swing nuts rotate correctly to locate underneath the flanges of the DIN rail. INM 5500 Rev 189 TGL57 TAG57 ERB57 ERB570 ETM7 Snap
off extension when using IMB57 as central support 10mm Earth clamp ERB57S in upper position ERB57S in lower position IMB57 Push fastener 14mm Earth-rail clamp ERL7 THR2 IMB57 ERL7 HAZ1-3 HAZ4-6 TH5000 TAG57 TGL57 SAF7-9 SAF10-12 ERB57S ETM7 PWR5000 Figure 4 3: Assembly drawing showing part numbers Figure 4 4: Mounting
details Figure 4 5: IMB57 Insulating mounting block Figure 4 6: TAG57 Tagging strip, 1m length Figure 4 7: MS010 DIN rail module spacers Figure 4 8: ETM7 Earth terminals Figure 4 9: Earth rails and clamps INM 5500 Rev 1810 Figure 4 10: Fitting IMB57 Slide a straight earth-rail bracket ERB57S into the upper slot in each mounting block.
Push two plastic push fasteners into each bracket to locate the brackets in the mounting blocks. Cut earth rail ERL7 to the length needed. Slide the required number of ETM7 earth terminals (5mm or 7mm wide) onto the rail. Clamp each end of the earth rail to earth-rail brackets ERB57S using the terminal clamps (14mm, 35mm2) supplied. Fit an earth
clamp (10mm, 16mm2) to the free end of each earth-rail bracket. Note: For lengths of earth-rail greater than 500mm, provide additional support by installing a third IMB57 mounting block and earth-rail bracket, mid-way between the end mounting blocks. Snap out the perforated extension between the lugs on this mounting block if a continuous tagging strip
is to be fitted (see figure 4.6). b) In lower position, where at least 150mm clearance exists on one side, measured from the edge of the mounting block. As for a), but slide earth-rail brackets ERB57S into the lower slots in each mounting block. c) In lower position, where there is insufficient clearance to fit earth-rail brackets ERB57S. As for a), but slide offset
earth-rail brackets ERB57O into the upper slot in each mounting block before assembling the mounting blocks to the DIN rail. ERB57S brackets cannot be used because they obscure the fixing screws on the mounting blocks. 4 3 2 2 Fitting tagging strips Assemble mounting blocks IMB57 to the DIN rail as above. Cut TAG57 tagging strip and label to the
length needed, and insert label so that the appropriate side is visible. Clip the strip onto the lugs on the mounting blocks. Hinge up the strip to provide access to the tops of the isolators. Note: If necessary, provide additional support for long lengths of tagging strip by installing an extra IMB57 mounting block mid-way between the end mounting blocks. Snap
out the perforated extension between the lugs on this mounting block. 4 3 3 Completed assemblies Figure 4.11 illustrates a complete assembly of MTL5500 isolators using the accessories mentioned above. The broken-line boxes either side of the assembly represent cable trunking, and the accompanying dimensions represent the recommended minimum
spacing between the trunking and the module assemblies. INM 5500 Rev 1811 Colour Module no Function Yellow MTL5501-SR Digital Inputs White MTL551x Red MTL552x Digital Outputs Blue MTL5531/33 Vibration Purple MTL5532 Pulse Blue MTL5541x MTL5544x Analogue Inputs Green MTL5546x MTL5549x Analogue Outputs Blue MTL556x Fire &
Smoke Orange MTL557x MTL558x Temperature inputs Grey MTL5599 Dummy isolator Table 4 2: MTL5500 front label colour coding Figure 4 11: MTL5500 complete assembly INM 5500 Rev 1812 5 DX ENCLOSURES Enclosures are usually selected on the basis of the number of units they will accommodate and Table 5.1 shows the capacity of each of
the enclosures. Figure 5.2 shows each type of enclosure containing MTL5500 modules. Table 5 1: DX range of enclosures - module capacities Enclosure Number of MTL5500 isolators 16mm mounting pitch DX070 4 (2*) DX170 10 (8*) (DX430) 26 (24*) no longer available * Use these figures when two IMB57 mounting brackets for tagging/earth-rail
accessories are included. Note: The user should be aware that some workshop preparation may be required for the cable gland plates before the enclosure is ready for on-site installation. 5 1 Environmental conditions Environmental conditions that should be taken into account when installing DX enclosures include:- See section Maximum ambient
temperature limits 5.1.1 Storage temperatures 5.1.2 Humidity 5.1.3 Corrosion resistance 5.1.4 Flammability 5.1.5 Impact resistance 5.1.6 Chemical resistance 5.1.7 5 1 1 Maximum outside enclosure temperature limits Figure 5 1: Graph depicting outside enclosure temperature limits for DX enclosures used with MTL5500 isolators The maximum outside
enclosure temperature depends upon the total power dissipated by the installed modules which, in turn, depends upon their number and type. It can also be influenced by the Authority whose standards may need to be applied to the system, e.g. Baseefa, Factory Mutual Research Corporation, Canadian Standards Association. Figure 5.1 shows, in
graphical form, the maximum outside enclosure temperatures (TMO) for given levels of power dissipation. The graph was derived from the following equation and should be used to calculate accurately the suitability of any particular mix of modules. TMO = 60°C - ∂T where ∂T = k1 x P P = total power (watts) dissipated by modules in an enclosure k1 = is a
dissipation constant for a given enclosure and module . Select the relevant value from Table 5.2. (60°C is the temperature inside the enclosure) 60 40 20 10 30 50 0 10 20 30 40 Power dissipation (watts) Max. outside enclosure temperature (°C) Enclosures DX070 DX170 DX430 INM 5500 Rev 1813 Figure 5 3: Optimum orientation for wall mounted
enclosure DX070 DX170 MTL5500 4.03 1.88 Table 5 2: Dissipation constant k1 for enclosures (°C/watt) Orientation of the enclosures is also important - the optimum position being on a vertical surface with the internal DIN-rail horizontal as shown in Figure 5.3. Any other position can reduce the maximum allowable ambient temperature by up to 5°C.
Examples Tables 5.3 and 5.4 list likely combinations of MTL5500 modules in the three enclosure types and indicate the acceptable maximum permitted outside enclosure temperature for these based on the graph in Figure 5.1. See the specifications included in the datasheets for the power dissipation figures of individual MTL5500 modules. Table 5 3:
Typical mix of MTL5500 modules Enclosure Modules installed Power dissipation of modules in watts (P) Maximum outside enclosure temp (TMO)°C DX070 2 x MTL5511 + 2 x MTL5544 (2 x 0.72) + (2 x 1.4) = 4.24 42.9 DX170 5 x MTL5511 + 5 x MTL5544 (5 x 0.72) + (5 x 1.4) = 10.6 40.1 Table 5 4: Power versus maximum outside enclosure temperature
Enclosure Number of installed modules k °C/watt Power dissipation of modules in watts (P) Maximum outside enclosure temp (TMO) °C DX070 4 4.03 4.0 43.9 4 4.03 6.0 35.8 DX170 10 1.88 10.0 41.2 10 1.88 15.0 31.8 5 1 2 Storage temperatures Storage temperatures are safe within the range -40°C to +80°C. 5 1 3 Humidity limits Safe humidity limits are
within the range 5 to 95% RH. 5 1 4 Extended ambient temperature modules Modules with the -T suffix are rated for use in an ambient temperature up to 65°C if suitably certified. INM 5500 Rev 1814 Figure 5 2: DX range of enclosures 150 DX070 130 113.5 153.5 70 180 163.5 203.5 Ø 5.2 184 147 (inside) Top of DIN rail 270 8080 540 430 520 576 249
305 Ø 7.2 DX430 184 147 (inside) Top of DIN rail 170 249 305 102 102 360 339 395 270 Ø 7.2 DX170 131 (inside) n b DX430 no longer available INM 5500 Rev 1815 5 1 5 Corrosion resistance The effect of corrosion on DX enclosures is negligible. 5 1 6 Flammability rating The flammable properties of the materials used in the construction of the
enclosures are well understood by manufacturers and ratings have been established to a number of standards. One of the better known standards is the Underwriter's Laboratory standard UL 94 and the ratings for the enclosure materials are given as: Materials UL94 rating Polycarbonate (all lids) V2/V0 Polycarbonate with glass reinforcement (DX070
base) V1/V0 Polyester with glass reinforcement (DX170 & DX430 bases) V0 Items made from similar materials are well established as suitable for use in process I/O marshalling areas. 5 1 7 Impact resistance The enclosure designs have been tested to an impact resistance of greater than 2 Joules which exceeds the BS EN 61010-1 requirements of 0.5
Joules. 5 1 8 Chemical resistance The overall chemical resistance of the enclosures is limited by the resistance of the transparent polycarbonate lid. The glass-reinforced polycarbonate/polyester (GRP) bases have a higher resistance than plain polycarbonate. Table 5.5 lists qualitative evaluations of resistance to a variety of chemical agents. Table 5 5:
Qualitative evaluations of resistance to various chemical agents Chemical agents Qualitative evaluation of resistance Salt water; neutral salts; acids (low concentrations); hydraulic oil Excellent Alcohols Very good Acids (high concentrations); alkalis (low concentrations); petrol; cooling fluids Good Alkalis (high concentrations); solvents. Poor 5 2 Mounting 5
2 1 General These instructions are concerned solely with mounting the DX enclosures. Instructions for wiring and testing individual modules within the enclosures are provided in Section 6. Sufficient space is provided within the enclosures to accommodate tagging and earth-rail accessories but this is at the expense of a reduction in the number of modules
that can be fitted. 5 2 2 Location and orientation 5 2 2 1 Location The DX enclosures are intended for safe (non-hazardous) area use. The enclosures are rated NEMA 4X; consequently, in N. America or Canada, assuming the modules have the required approvals, they can be used in Class 1, Division 2 (gases) location, but check with local requirements
and ensure all cable entries also conform. In this case, an additional warning label will be required on or near the enclosure warning that the MTL5500 interfaces must not be removed unless the area is known to be non-hazardous. The enclosures are NOT suitable for Class II or III, Division 2 hazardous locations. INM 5500 Rev 1816 5 2 2 2 Orientation As
noted earlier (see section 5.1.1), for optimum temperature performance the enclosures should be mounted on a vertical surface with the internal DIN rail horizontal. 5 2 3 Mounting details See Figure 5.2 for the dimensions and mounting hole distances, etc., of the three DX enclosures. The recommended method of mounting-described here-uses the four
wall-mounting lugs supplied with each enclosure. An alternative method of mounting is by direct attachment to the mounting surface through the corner holes. Note: When the wall-mounting lugs are used to attach the enclosures, the overall depth of the enclosure is increased by an additional 3.3 mm (DX070) or 7 mm (DX170 and DX430). a) At each of the
four corner fixing holes, insert one of the screws provided and use it to attach a fixing lug to the base of the enclosure. b) Each lug can be used in one of two positions as shown in Figure 5.2. c) Attach the lugs to the mounting surface with suitable fasteners. d) Diameters of fixing holes in lugs are 5.5mm (DX070) and 7.0mm (DX170 and DX430) e)
Appropriate fixing hole distances are shown in Figures 5.2. 5 2 4 Cable glanding All cables into the enclosures must be glanded to IP65 standards to maintain this rating for the enclosure as a whole. Cable glands and gland plates are not supplied. Glanding requirements vary for each enclosure as follows: DX070 On the DX070, 'knockout' holes are
provided, in two different sizes (15.5 mm and 21 mm), on the side faces of the base. See Table 5.7 for recommended cable glands. DX170 The DX170 can accommodate one gland plate on each side - see figure 5.2 for details. Table 5.6 lists suppliers of suitable gland plate kits and Table 5.7 lists recommended glands. Table 5 6: Recommended gland plate
kits for the DX170 and DX430 enclosures. Manufacturer/agent Manufacturer's part number Enclosure DX170 Hellermann Tyton TL-27/360 Sarel 21128 Table 5 7: Recommended cable glands for use with DX enclosures. Gland thread size Cable sizes (mm) Gland plate hole size (mm) Weidmuller part nos Sarel part nos Gland Locknut Gland Locknut PG9 5
to 8 15.2 951891 952216 08871 08881 PG13,5 8 to 13 20.4 951893 952218 08873 08883 Weidmuller (UK) http://www.weidmuller.co.uk Sarel (UK) http://www.sarel.co.uk Hellermann Tyton (UK) http://www.hellermantyton.co.uk INM 5500 Rev 1817 5 3 Accessories in enclosures Apart from mounting, there are some other installation details which should be
considered before adding the appropriate interface modules and making the necessary cabling connections. A range of accessories is available to accompany the MTL5500 units (see section 4) and the following points should be observed. 5 3 1 Insulating mounting block (IMB57) A pair of these can be attached to the DIN rail, at either end of the modules,
to provide a mounting for earth rails. Use of mounting blocks will reduce the space available for isolator modules. 5 3 2 Earth rails (ERL7) Earth rail is produced in 1 metre lengths and will require cutting to length before mounting. ERL7 earth rails can be mounted either side of the modules but are typically mounted on the hazardous side of the DIN rail. 5 3
3 Tagging strip (TAG57 and TGL57) Tagging strip is produced in 1 metre lengths and will require cutting to length before mounting. Similarly, the labels will require cutting to fit the tagging strip. 5 4 IS warning label A 'Take Care' IS warning label is provided inside each enclosure. This should be attached to the inside of the transparent lid when its orientation
has been established. INM 5500 Rev 1818 6 UNIT DESCRIPTIONS, SETTING-UP AND CONNECTIONS This section describes the function (briefly), the setting-up procedure and the wiring connections for each MTL5500 unit. For a fuller functional description and a detailed technical specification, refer to the individual datasheets, which can be found on
our website at www.eaton.com or in the current MTL IS catalogue. If a fault is suspected, first check that the power LED is lit (not applicable to loop-powered devices). If necessary, check that all signal and power plugs are properly inserted, that no wires are loose and that the unit is mounted correctly. If operation is still suspect, the unit should be replaced
with a serviceable unit. There are no replaceable parts inside MTL5500 units, so any that appear to be inoperative should be returned to the manufacturer/supplier for repair or replacement. WARNING When disconnecting units for maintenance purposes, take care to segregate hazardous and safe-area cables. • Short circuit hazardous-area cable cores to
an IS earth or insulate and secure the ends. • Insulate and secure safe-area cables. If testing a unit 'in situ' note that the test equipment used MUST be intrinsically safe. The rest of this section is divided into sub-sections based upon the type of module, as follows. 6 1 Digital Input modules MTL5501-SR, MTL5510, MTL5510B, MTL5511, MTL5513,
MTL5514, MTL5514-T, MTL5514D, MTL5516C, MTL5517 6 2 Digital Output modules MTL5521, MTL5521 -T, MTL5522, MTL5523, MTL5523V, MTL5523VL, MTL5524, MTL5525, MTL5526 6-3 Vibration, Pulse and Foundation Fieldbus modules MTL5531, MTL5532, MTL5533, MTL5553 6 4 Analogue Input modules MTL5541, MTL5541-T, MTL5541A,
MTL5541AS, MTL5541S, MTL5541S-T, MTL5544, MTL5544A, MTL5544AS, MTL5544D, MTL5544S 6 5 Analogue Output modules MTL5546, MTL5546Y, MTL5546Y-T, MTL5549, MTL5549Y 6 5 Fire and Smoke interface modules MTL5561 6 7 Temperature Input modules MTL5573, MTL5575, MTL5576-RTD, MTL5576-THC, MTL5581, MTL5582, MTL5582B 6 8 General modules MTL5599, MTL5991 6 9 PCS45/PCL45USB configurator for MTL temperature converters Note: Any LED indicator provided on the modules will display in the following colours: LED label LED colour PWR (power) Green STS (status) Yellow LFD (line fault) Red FLT (fault) Red OPx (o/p status) Yellow INM 5500 Rev 1819 6 1
Digital Input modules The Digital Input (DI) module range offers solid state or relay output switches in a safe area that respond to input switches located in a hazardous area. Single or multiple channel (2 or 4) options are available, as well as Line-Fault Detection (LFD). Modules with LFD can recognise open or short circuit conditions on the input wires going
to the field sensors, and some DI modules have the facility to reverse the effect of the input on the output i.e. phase reversal. These options are chosen with switches located on the edge of the module on the hazardous area terminal side. In some applications it may be easier to set these switches before fitting the module to the DIN-rail. Figure 6 1:
Switches to set LFD and phase reversal 6 1 1 Phase reversal Set the PR switch ON or OFF for the appropriate channel(s). 6 1 2 Line-Fault Detection (LFD) Where fitted, set the LF switch ON or OFF for the appropriate channel(s). Note: LFD is permanently active on the MTL5501-SR. For all DI modules with LFD except for the MTL5501-SR; when using
the LFD facility with a contact input, resistors must be used. Fit 500Ω to 1kΩ (preferred value 680Ω) in with the switch and 20kΩ to 25kΩ (preferred value 22kΩ) in parallel with the switch. For modes of operation of the MTL5510 & MTL5510B that include LFD, resistors should be fitted as described above. For MTL5501-SR use 1k4Ω in and 10kΩ in parallel
with switch contact inputs. For hazardous-area inputs conforming to EN 60947-5-6:2001 (NAMUR), a line fault is judged by the following rules: • Open circuit condition if hazardous-area current 250µA • Short circuit condition if hazardous-area load 360Ω Note: the open circuit window (between 250µA and 50µA), and the short circuit window (between 100Ω
and 360Ω), is not hysteresis. All MTL5500 modules, with inputs conforming to EN 60947-5-6:2001 (NAMUR), will switch between open and complete circuit conditions within these limits. The MTL5501-SR LFD relay de-energises when a fault condition is detected. The MTL5514 and the MTL5517 energise the LFD relay to indicate a fault condition. INM
5500 Rev 1820 6 1 3 MTL5501-SR - Fail-safe Switch/Proximity detector interface Single channel, fail-safe module with line-fault detection The MTL5501-SR enables a fail-safe switch/proximity detector located in the hazardous area to control an isolated fail-safe electronic output. It provides line-fault detection (LFD) alarm contacts and is designed for use
with approved fail-safe sensors in loops that require operation up to SIL3 according to the functional safety standard IEC 61508. Note: For reliable, long-term operation the load on the LFD switching relay should be not less than 50mW, e.g. 10mA at 5V DC. Hazardous area Safe area Vs– Vs+ 20 to 35V dc 10kΩ 1k4Ω + – LFD Failsafe output + –Resistors
must always be fitted for switch inputs 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Terminal Function 1 Input –ve 2 Input +ve 7 Output –ve 8 Output +ve 10 LFD 11 LFD 13 Supply –ve 14 Supply +ve Figure 6 2: Top label for MTL5501-SR Input / output characteristics Input value in sensor circuits Fail–safe output Operation LFD contacts 2.9mA < Is < 3.9mA ON
Normal CLOSED Is 5.1mA OFF Normal CLOSED Is < 50µA OFF Broken line OPEN Rs < 100Ω OFF Shorted line OPEN Correct operation of the fail-safe output and LFD is indicated by the LEDs on the front of the unit. The yellow O/P LED is ON when the fail-safe output is energised. The red LFD LED flashes if a line fault is detected. The fail-safe output
is de-energised (OFF) if the module detects an incorrect sensor current, an open circuit or a short circuit in the sensor circuit. Input signal sensors may be either suitable proximity sensors or switches. The proximity sensor properties are specified in the standard EN60947-5-6:2001; however, when used with MTL5501-SR modules, additional requirements
for the "low-impedance" current of 3.4 ±0.5mA must be met. The list below shows suitable proximity sensors, all manufactured by Pepperl+Fuchs Group, Germany, and specified as usable to SIL3, according to IEC 61508: SJ 2-SN NJ 4-12GK-SN NJ 10-30GK-SN SJ 3,5-SN NJ 5-18GK-SN NJ 15-30GK-SN SJ 3,5-S1N NJ 8-18GK-SN NJ 6S1+U1+N NJ
2-11-SN NJ 5-22-SN NJ 15S+U1+N NJ 2-11-SN-G NJ 6-22-SN-G NJ 20S+U1+N NJ 2-12GK-SN NJ 5-30GK-S1N NJ 40-FP-SN-P1 INM 5500 Rev 1821 6 1 4 MTL5510 & MTL5510B - Switch/Proximity detector interface 4-channel, digital input and multifunction modules These digital modules provide solid state output switches in a safe area that respond to
switches (inputs) located in a hazardous area. The way they respond - their "mode" - can be configured using a bank of four DIL selector switches accessible through the side of the module - see Figure 6.4. Model MTL5510 has an one output channel for each input channel and the user can reverse the output phase if necessary to suit the application.
Model MTL5510B has more varied modes that can, for example, enable one input to affect multiple outputs or create latched outputs, etc.) The channel output transistors - Ch1/Ch2 and Ch3/Ch4 - share a common terminal and can switch +ve or –ve polarity signals. Note that parallel resistors are required for switch inputs with LFD - see Section 6.1.2 for
recommended values. Hazardous area Ch B Vs– Vs+ 20 to 35V dc – + – – + – Ch D Ch C Ch A 1 2 3 4 common common Outputs 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Safe area Terminal Function 1 Input channel A 2 Input channel AB common (+) 3 Input channel B 4 Input channel C 5 Input channel CD common (+) 6 Input channel D 7 Output channel 4 8 Output channel 3/4 common 9 Output channel 3 10 Output channel 2 11 Output channel 1/2 common 12 Output channel 1 13 Supply –ve 14 Supply +ve Figure 6 3: Top labels for MTL5510 & MTL5510B INM 5500 Rev 1822 Figure 6 4: DIL switches for setting mode Tables 6.1 and 6.2 show details of the modes available and the switch settings
required to obtain them. For ease of access, it is recommended that switches are set to the required mode before installation. Table 6.1 indicates whether the output follows the input, or the output is the reverse or antiphase of the input. For example, in mode 0, o/p 1 = chA; so, if channel A switch is closed, then output 1 will also be closed or short circuit.
However, in mode 1, o/p 1 = chA rev., so if channel A switch is closed, then output 1 will be the reverse, i.e. open-circuit. Table 6.2 shows the MTL5510B modes. The logic tables and timing diagrams on the following pages provide more detailed information on these modes. *Mode of operation changed August 2015 MTL5510 & MTL5510B diagnostics If an
internal fault is detected, all outputs and channel LEDs will turn off and the red Fault LED will turn ON. Table 6 2 - MTL5510B mode options Switch settings MODE Function Equivalent 1 2 3 4 OFF OFF OFF OFF 0 4-ch switch input (see MTL5510 mode 0) MTL5510 ON OFF OFF OFF 1 2-ch each channel one input, two outputs OFF ON OFF OFF 2* Same
as mode 1 with all outputs phase reversed ON ON OFF OFF 3 2-ch, 2-pole changeover output OFF OFF ON OFF 4 1-ch with line fault output MTL5014 ON OFF ON OFF 5 As mode 4 with changeover outputs OFF ON ON OFF 6 1-ch with start-stop latch MTL2210B ON ON ON ON OFF 7* As mode 2 with LFD enabled OFF OFF OFF ON 8 4-ch switch input,
see MTL5510 mode 8 MTL5510 ON OFF OFF ON 9 2-ch with line fault output MTL5017 OFF ON OFF ON 10 As mode 9 with LFD changeover ON ON OFF ON 11 As mode 10 with channel phase reversed OFF OFF ON ON 12 3-ch with normally-open LFD output ON OFF ON ON 13 3-ch with normally-closed LFD output OFF ON ON ON 14 2-ch
monostable, pulse stretcher ON ON ON ON 15 4-ch switch input, see MTL5510 mode 15 MTL5510 Table 6 1 - MTL5510 mode options Switch setting MODE o/p 1 o/p 2 o/p 3 o/p 4 i/p type 1 2 3 4 OFF OFF OFF OFF 0 chA chB chC chD switch / prox. detector ON OFF OFF OFF 1 chA rev. chB chC chD OFF ON OFF OFF 2 chA chB rev. chC chD ON ON
OFF OFF 3 chA chB chC rev. chD OFF OFF ON OFF 4 chA chB chC chD rev. ON OFF ON OFF 5 chA rev. chB chC rev. chD OFF ON ON OFF 6 chA chB rev. chC chD rev. ON ON ON OFF 7 chA rev. chB rev. chC rev. chD rev. OFF OFF OFF ON 8 chA chB chC chD Switch/ prox. detector + LFD ON OFF OFF ON 9 chA rev. chB chC chD OFF ON OFF ON
10 chA chB rev. chC chD ON ON OFF ON 11 chA chB chC rev. chD OFF OFF ON ON 12 chA chB chC chD rev. ON OFF ON ON 13 chA rev. chB chC rev. chD OFF ON ON ON 14 chA chB rev. chC chD rev. ON ON ON ON 15 chA rev. chB rev. chC rev. chD rev. INM 5500 Rev 1823 MTL5510B modes The following logic and timing diagrams are provided
to assist the user in understanding the behaviour of the MTL5510B module when a specific mode is chosen. The open switch ( ) and closed switch ( ) symbols are used to represent both the input conditions of Ch A, Ch B, Ch C or Ch D and then the output conditions of o/p 1, 2, 3 or 4. Note that in certain modes a Line Fault can cause an override of the
output. How to use these mode tables - examples The logic tables for Mode 1 represent Ch A controlling outputs 1 & 3, while Ch C controls outputs 2 & 4. Output 1 & 3 are shown following input Ch A (open or closed) while Outputs 2 & 4 follow input Ch C. Mode 2 however shows o/p 1, 2, 3 and 4 being in antiphase to their inputs. Mode 9 operates with both

outputs for each channel being in antiphase to their inputs. Mode 3: 2 ch, 2 pole c/o output i/p - Ch A i/p - Ch C o/p 1 - - o/p 2 - - - - o/p 3 - - o/p 4 i/p - Ch A No fault Line fault No fault Line fault o/p 1 Mode 4: 1 ch with line fault output No fault Line fault No fault Line fault o/p 3 i/p - Ch A No fault Line fault No fault Line fault o/p 1 o/p 2 Mode 5: As mode 4 with
c/o outputs No fault Line fault No fault Line fault LFD o/p 3 LFD o/p 4 A Start B Stop i/p Ch A i/p Ch B o/p 2&4 o/p 1&3 BRes et * * i/p Ch A can be open or closed when i/p Ch B opens to stop latch Latching Ch C closed * i/p Ch A can be open or closed when i/p Ch B opens to stop latch o/p 2&4 o/p 1&3 (enable) i/p Ch A i/p Ch B Non-latching Ch C open
Mode 1: 2 ch, each ch 1 input 2 outputs i/p - Ch A i/p - Ch C o/p 1 - - - - o/p 2 o/p 3 - - - - o/p 4 Mode 2: As mode 1 with all outputs phase reversed i/p - Ch A i/p - Ch C o/p 1 - - - - o/p 2 o/p 3 - - - - o/p 4 Mode 7: As mode 2 with LFD enabled i/p Ch C Non-latching i/p Ch B Enable i/p Ch A o/p 1 o/p 2 o/p 3 o/p 4 Mode 6: 1 ch with start/stop latch OR i/p Ch C
Latching i/p Ch A i/p Ch B No effect o/p 1 o/p 2 o/p 3 o/p 4 Start Reset Stop i/p - Ch A No fault Line fault No fault Line fault o/p 1 o/p 3 i/p - Ch C o/p 2 o/p 4 INM 5500 Rev 1824 MTL5510B modes - continued Mode 14 This mode provides a two channel pulse stretcher for in- puts A and C. Outputs 1 and 2 respond to Ch A, while 3 and 4 respond to Ch C.
Input B (or D) being open or closed affects the input i/p A (C) o/p 2 (4) o/p 1 (3) Initiate 1sec (min.) Endi/p B (D) 1sec (min.) i/p A (C) o/p 2 (4) o/p 1 (3) i/p B (D) Initiate End transition and the output polarity as shown in the timing diagrams below. When triggered by A (or C) the outputs hold the change of state for a minimum of 1 second or as long as the
input (A or C) remains in the same triggered state. Input Ch B (or D) closed Input Ch B (or D) open Mode 9: 2 ch with line fault output i/p - Ch A No fault Line fault No fault Line fault o/p 1 No fault Line fault No fault Line fault LFD o/p 3 i/p - Ch C No fault Line fault No fault Line fault o/p 2 No fault Line fault No fault Line fault LFD o/p 3 LFD o/p 4 Mode 10: As
mode 9 with line fault c/o i/p - Ch A No fault Line fault No fault Line fault o/p 1 i/p - Ch C No fault Line fault No fault Line fault o/p 2 No fault Line fault No fault Line fault LFD o/p 3 LFD o/p 4 Mode 11: As mode 10 with ch phase reversed i/p - Ch A No fault Line fault No fault Line fault o/p 1 i/p - Ch C No fault Line fault No fault Line fault o/p 2 No fault Line fault
No fault Line fault LFD o/p 4 Mode 12: 3 ch with common LFD output i/p - Ch A No fault Line fault No fault Line fault o/p 1 i/p - Ch B No fault Line fault No fault Line fault o/p 2 i/p - Ch C No fault Line fault No fault Line fault o/p 3 Mode 13: As mode 12 but with LFD o/p 4 reversed No fault Line fault No fault Line fault LFD o/p 4 INM 5500 Rev 1825 6 1 5
MTL5511 - Switch/Proximity detector interface Single channel, with line-fault detection The MTL5511 contains a changeover relay, which enables a safe-area load to be controlled by a switch or proximity detector located in a hazardous-area. When selected, the line-fault detect (LFD) facility detects open or short circuit conditions in the field wiring and also
indicates this on the top of the module. Line-Fault Detect and Phase Reversal for the channel are selected by DIL switches on the side of the module and output is provided by the changeover relay contacts. See page 19 for LFD and PR switch details. Channel 1 only switch settings apply. For switch sensor inputs, with LFD selected, make sure resistors
(22kΩ and 680Ω) are fitted. Note: For reliable, long-term operation the load on the output switching relay should be not less than 50mW, e.g. 10mA at 5V DC. Vs– Vs+ 20 to 35V dc 22kΩ 680Ω + – Output Switch-type sensors require resistors if LFD is selected 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Hazardous area Safe area Terminal Function 1 Input –ve 2 Input
+ve 10 Output normally-closed contact 11 Output common 12 Output normally-open contact 13 Supply –ve 14 Supply +ve Figure 6 5: Top label for MTL5511 INM 5500 Rev 1826 6 1 6 MTL5513 - Switch/Proximity detector interface Two-channel, with line-fault detection and phase reversal The MTL5513 enables two solid-state outputs in the safe area to be
controlled by two switches or proximity detectors located in the hazardous area. The Ch1/Ch2 output transistors share a common terminal and can switch +ve or -ve polarity signals. Line-Fault Detect and Phase Reversal for the channel are selected by DIL switches on the side of the module. LFD indication is provided on the top of the module. See page 19
for LFD and PR switch details. Channel 1 & 2 switch settings apply. For switch sensor inputs, with LFD selected, make sure resistors (22kΩ and 680Ω) are fitted. Vs– Vs+ 20 to 35V dc Ch 1 Ch 2 Outputs + – 22kΩ 680Ω + – Switch-type sensors require resistors if LFD is selected 22kΩ 680Ω 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Hazardous area Safe area
Terminal Function 1 Input –ve (Ch 1) 2 Input +ve (Ch 1) 4 Input –ve (Ch 2) 5 Input +ve (Ch 2) 10 Output (Ch 2) 11 Output (Ch 1/Ch 2) 12 Output (Ch 1) 13 Supply –ve 14 Supply +ve Figure 6 6: Top label for MTL5513 INM 5500 Rev 1827 6 1 7 MTL5514(-T)/MTL5514D - Switch/Proximity detector interface Single channel, with line-fault detection and phase
reversal The MTL5514(-T) enables a safe-area load to be controlled, through a relay, by a proximity detector or switch located in a hazardous area. Line faults are signalled through a separate relay and indicated on the top of the module. The MTL5514D provides signal duplication, enabling two safe-area loads to be controlled by a single device in a
hazardous area. Both relay outputs reflect the input signal instead of one showing the line fault condition as in the MTL5514. Line- Fault Detect and Phase Reversal for the channel are selected by DIL switches on the side of the module and output is provided by changeover relay contacts. See page 19 for LFD and PR switch details. Channel 1 only switch
settings apply. For switch sensor inputs, with LFD selected, make sure resistors (22kΩ and 680Ω) are fitted. Note: For reliable, long-term operation the load on the output switching relays should be not less than 50mW, e.g. 10mA at 5V DC. Terminal Function MTL5514 (-T) MTL5514D 1 Input –ve (Ch 1) 2 Input +ve (Ch 1) 7 LFD Output contact N.C. Output
2 contact N.C. 8 LFD Output common Output 2 common 9 LFD Output contact N.O. Output 2 contact N.O. 10 Output contact N.C. Output 1 contact N.C. 11 Output common Output 1 common 12 Output contact N.O. Output 1 contact N.O. 13 Supply –ve 14 Supply +ve Figure 6 7: Top label for MTL5514 (-T) & MTL5514D Hazardous area Safe area Vs– Vs+
20 to 35V dc 22kΩ 680Ω + – O/P LFD Switch-type sensors require resistors if LFD is selected 6 5 4 3 2 1 7 8 9 10 11 12 13 14 LFD O/P1 O/P2 7 8 9 10 11 12 INM 5500 Rev 1828 6 1 8 MTL5516C - Switch/Proximity detector interface Two channel, with line-fault detection The MTL5516C contains two changeover relays, which enable two safe-area loads to
be controlled by switches or proximity detectors located in a hazardous-area. When selected, the line-fault detect (LFD) facility detects open or short circuit conditions in the field wiring and also indicates this on the top of the module. Line-Fault Detect and Phase Reversal for the channel are selected by DIL switches on the side of the module and output is
provided by the changeover relay contacts. See page 19 for LFD and PR switch details. Channel 1 & 2 switch settings apply. For switch sensor inputs, with LFD selected, make sure resistors (22kΩ and 680Ω) are fitted. Note: For reliable, long-term operation the load on the output switching relays should be not less than 50mW, e.g. 10mA at 5V DC. Vs–
Vs+ 20 to 35V dc + – + – Ch 2 Ch 1 22kΩ 680Ω 22kΩ 680Ω Switch-type sensors require resistors if LFD is selected 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Hazardous area Safe area Terminal Function 1 Input –ve (Ch 1) 2 Input +ve (Ch 1) 4 Input –ve (Ch 2) 5 Input +ve (Ch 2) 7 Normally-closed contact (Ch 2) 8 Common (Ch 2) 9 Normally-open contact (Ch 2)
10 Normally-closed contact (Ch 1) 11 Common (Ch 1) 12 Normally-open contact (Ch 1) 13 Supply –ve 14 Supply +ve Figure 6 8: Top label for MTL5516C INM 5500 Rev 1829 6 1 9 MTL5517 - Switch/Proximity detector interface Two channel, with line-fault detection and phase reversal The MTL5517 enables two safe-area loads to be controlled, through a
relay, by switches or proximity detectors located in a hazardous-area. When selected, the line-fault detect (LFD) is signalled through a separate relay and indicated on the top of the module. Line-Fault Detect and Phase Reversal for the channel are selected by DIL switches on the side of the module and output is provided by the relay
contacts. See page 19
for LFD and PR switch details. Channel 1 & 2 switch settings apply. For switch sensor inputs, with LFD selected, make sure resistors (22kΩ and 680Ω) are fitted. Note: For reliable, long-term operation the load on the output switching relays should be not less than 50mW, e.g. 10mA at 5V DC. Vs– Vs+ 20 to 35V dc LFD + – + – Switch-type sensors require
resistors if LFD is selected Ch 2 Ch 1 LFD 22kΩ 680Ω 22kΩ 680Ω 6 5 4 3 2 1 7 8 9 10 11 12 13 14 LFD Hazardous area Safe area Terminal Function 1 Input –ve (Ch 1) 2 Input +ve (Ch 1) 4 Input –ve (Ch 2) 5 Input +ve (Ch 2) 7 Line-fault detection 8 Output (Ch 2) 9 Output (Ch 2) 10 Line-fault detection 11 Output (Ch 1) 12 Output (Ch 1) 13 Supply –ve 14
Supply +ve Figure 6 9: Top label for MTL5517 INM 5500 Rev 1830 6 2 Digital Output modules The single channel Digital Output (DO) module range enables on/off devices in a hazardous area to be controlled from the safe area. Some units are loop powered while others enable solid-state switching by providing independent power supplies. 6 2 1
MTL5521(-T) - Solenoid Alarm driver Single channel, loop powered, IIC The MTL5521(-T) is a loop-powered module that enables a device located in the hazardous area (IIC gas group) to be controlled from the safe area. The MTL5521(-T) can drive a certified intrinsically safe low-power load, as well as non-energy-storing simple apparatus such as an
LED. 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Solenoid, alarm or other IS device 20 – 35Vdc – + + – To earth leakage detector * Hazardous area Safe area Terminal Function 1 Output –ve 2 Output +ve 11 Supply –ve 12 Supply +ve Figure 6 10: Top label for MTL5521(-T) INM 5500 Rev 1831 6 2 2 MTL5522 - Solenoid Alarm driver Single channel, loop powered,
IIB The MTL5522 is a loop-powered module which enables a device located in the hazardous area (IIB gas group) to be controlled from the safe area. The MTL5522 can drive a certified intrinsically safe, low-power load as well as non-energy-storing simple apparatus such as an LED. 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Solenoid, alarm or other IS device 20 –
35Vdc – + + – Hazardous area Safe area Terminal Function 1 Output –ve 2 Output +ve 11 Supply –ve 12 Supply +ve Figure 6 11: Top label for MTL5522 INM 5500 Rev 1832 Hazardous area Safe area 6 2 3 MTL5523 - Solenoid Alarm driver Single channel, with line-fault detection, IIC The MTL5523 interface controls an on/off device in a hazardous area
using a volt-free contact or logic signal in the safe area, and is suitable for driving loads such as solenoids. Line-Fault Detection (LFD) operates independently of the output state and is signalled by a safe-area, solid-state switch output which, when a field line is open or short-circuited, becomes de- energised. Earth-fault detection can be provided by
connecting an earth leakage detector to terminal 3. 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Solenoid, alarm or other IS device + – Vs– Vs+ 20 to 35V dc + – LFD + ‡ ‡ link to reverse output phase Control Terminal Function 1 Output –ve 2 Output +ve 7 Line fault signal -ve 8 Phase reversal link 9 Phase reversal link 10 Line fault signal +ve 11 Control –ve 12
Control +ve 13 Supply –ve 14 Supply +ve Figure 6 12: Top label for MTL5523 INM 5500 Rev 1833 6 2 4 MTL5523V/MTL5523VL - Solenoid Alarm driver Single channel, voltage controlled with line-fault detection, IIC With the MTL5523V or MTL5523VL interface, an on/off device in a hazardous area can be controlled by a voltage signal in the safe area. It is
suitable for driving loads such as solenoids. Line fault detection (LFD), which operates irrespective of the output state, is signalled by a safe- area, solid-state switch which energises if a field line is open or short–circuited. The VL version has a lower current capability to suit alternative load requirements - see datasheet. Hazardous area Safe area Terminal
Function 1 Output –ve 2 Output +ve 7, 8, 9 Line fault signal –ve 10 Line fault signal +ve 11 Control –ve 12 Control +ve 13 Supply –ve 14 Supply +ve 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Solenoid, alarm or other IS device + – Vs– Vs+ 20 to 35V dc + – LFD + ControlV PWR STS MTL5523V PWR STS MTL5523VL Figure 6 13: Top labels for MTL5523V &
MTL5523VL INM 5500 Rev 1834 Hazardous area Safe area 6 2 5 MTL5524 - Solenoid Alarm driver Single channel, powered, logic drive with phase reversal The MTL5524 enables an on/off device in a hazardous area to be controlled by a volt-free contact or logic signal in the safe area. It can drive loads such as solenoids, alarms, LEDs and other low
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power devices that are certified as intrinsically safe or are classified as non-energy- storing simple apparatus. 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Solenoid, alarm or other IS device + – Vs– Vs+ 20 to 35V dc + – Control ‡ ‡ use link to reverse phase Terminal Function 1 Output –ve 2 Output +ve 8 Phase reversal link 9 Phase reversal link 11 Control –ve 12
Control +ve 13 Supply –ve 14 Supply +ve Figure 6 14: Top label for MTL5524 INM 5500 Rev 1835 6 2 6 MTL5525 - Solenoid Alarm driver Single channel, low current, loop powered, IIC The MTL5525 enables an on/off device in a hazardous area (IIC gas group) to be controlled by a switch or voltage change in the safe area. It can drive loads such as
solenoids, alarms, LEDs and other low power devices that are certified as intrinsically safe or are classified as non-energy-storing simple apparatus. Similar in function to the MTL5521, this module provides lower power output and corresponding reduced safety description. 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Solenoid, alarm or other IS device 20 – 35Vdc – + +
– Hazardous area Safe area Terminal Function 1 Output –ve 2 Output +ve 11 Supply –ve 12 Supply +ve Figure 6 15: Top label for MTL5525 INM 5500 Rev 1836 6 2 7 MTL5526 - Switch Operated Relay Two channel, output The MTL5526 enables two separate IS circuits in a hazardous area to be relay-contact controlled by two on-off switches or logic
signals in a safe area. Applications include the calibration of strain–gauge bridges; changing the polarity (and thereby the tone) of an IS sounder; the testing of IS fire alarms; and the transfer of safe-area signals into an annunciator with IS input terminals not segregated from each other. The output–relay contacts are certified as non–energy–storing
apparatus, and can be connected to any IS circuit without further certification, provided that separate IS circuits are such that they would remain safe if connected together. 1 2 3 4 5 6 7 8 9 10 11 12 13 14 IS relay IS relay 1 Vs– Vs+ 20 to 35V dc + – 2 + – Control 20 to 35V dc + – + – Loop powered Contact inputs All contacts shown in normal position
(relays de-energised) 1 2 Sw4 Hazardous area Safe area Terminal Function 1 IS relay output 1 (normally open) 2 IS relay output 1 (normally closed) 3 IS relay output 1 (common) 4 IS relay output 2 (common) 5 IS relay output 2 (normally closed) 6 IS relay output 2 (normally open) 8 Relay 1 control +ve 9 Relay 1 control –ve 10 Relay 2 control +ve 11 Relay
2 control –ve 13 Supply –ve 14 Supply +ve OFF position ON position 1 2 3 4 Table 6 3: Switch settings for modes Mode Function SW1 SW2 SW3 SW4 Contact/Logic Input 2 ch Off On On On 1in2out On On On On Loop Powered 2 ch Off Off Off Off Figure 6 16: Top label for MTL5526 INM 5500 Rev 1837 6 3 Pulse, Vibration and Foundation Fieldbus
modules Single and dual channel modules are available to transfer vibration probe signals from a hazardous area to a safe one. Similarly, pulses from a switch, proximity detector, current pulse transmitter or voltage pulse transmitter, located in the hazardous area, can be safely transferred to the safe area. 6 3 1 MTL5531 - Vibration Transducer Interface
Single channel The MTL5531 repeats a signal from a vibration sensor in a hazardous area, providing an output for a monitoring system in the safe area. The interface is compatible with 3-wire, eddy-current probes and accelerometers or 2-wire current sensors, and selection of the mode is made with a switch located on the side of the module Hazardous
area Safe area 6 5 4 3 2 1 7 8 9 10 11 12 13 14 COM SIG V– Vibration transducer Vibration transducer Vs– Vs+ 20 to 35V dc –ve 0V Monitor 3- wire 2 1 3 Terminal Function 1 Transducer power V– 2 Signal 3 Common 11 Signal output –ve 12 Signal output 0V 13 Supply –ve 14 Supply +ve OFF position ON position 2-/3-wire 2-/3-wire transducer
setting switch Mode SW 2-wire (3 3mA)* OFF 3-wire (20mA) ON * Note: When using 2-wire sensors, ensure that terminals 1 and 2 are linked as shown in the wiring diagram above. WARNING - Revision status 05 and below* To enable optimum heat dissipation the recommended orientation for mounting is with the module vertical, i e with the vents in the
case at the top and bottom This enables air to flow through the module In any other orientation, i e with the module horizontal, then the maximum ambient temperature is limited to: • Close packed = 45°C • Minimum of 10mm spacing = 55°C Eaton produce the MS010 DIN rail module spacer for this purpose (packs of 5 - see Section 4 3) *Revision status is
the 2 digits after the +++ in the barcode number Figure 6 17: Top label for MTL5531 INM 5500 Rev 1838 6 3 2 MTL5532 - Pulse Isolator Pulse & 4/20mA current outputs The MTL5532 isolates pulses from a switch, proximity detector, current pulse transmitter or voltage pulse transmitter located in a hazardous area. It is ideal for applications involving high
pulse rates and fast response times, by repeating the pulses into the safe area, and the transistors used on the pulse output will switch +ve or –ve polarity signals. It may be used immediately in simple or legacy mode, or it may be software configured for more specific applications - see next page for either option. With configuration, an analogue output
proportional to frequency is available, together with a relay output, which may act as an alarm. Note: For reliable, long-term operation the load on the output switching relay should not be less than 50mW, e.g.10mA at 5VDC. Hazardous area Safe area 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Vs– Vs+ 20 to 35V dc 3-wire current pulse 4/20 mA – + 3-wire voltage
pulse 5 4 1 2-wire current pulse Voltage pulse Current pulse 5 1 Inhibit Load Alarm 4/20mA Configuration socket – + 1 4 + Pulse – + Pulse 4 3 V 4/20 mA 3 1 3 4/20 mA Terminal Function 1 Common input –ve 2 Switch/proximity input +ve 3 Current pulse input +ve 4 Transmitter supply +ve 5 Voltage pulse input +ve 6 Inhibit input +ve 7 Alarm output 8
Current output –ve 9 Current output +ve 10 Alarm output 11 Pulse output –ve 12 Pulse output +ve 13 Supply –ve 14 Supply +ve Vsp SW1 SW2 3V ON ON 6V ON OFF 12V OFF OFF OFF position ON position 1 2 3 4 SW1 SW2 SW3 SW4 Vsp Vsp LFD Mode LFD SW3 OFF OFF ON ON Switches located on the edge of the module define the mode of
operation. Figure 6 18: Top label for MTL5532 INM 5500 Rev 1839 Switch input operation If switch contacts are used for this Pulse Input (terminals 1 & 2), then and parallel resistors must be fitted - see Section 6.1.2 for recommended values. Simple or Legacy mode - SW4 - OFF If simple “pulse-in/pulse-out” operation is required or, if a replacement for the
earlier MTL5032 pulse isolator is required, then SW4 should be set to OFF. The input switching point voltage (Vsp) thresholds can then be defined by Switches 1 & 2, and the LFD operation can be set with Switch 3. When Switch 3 is ON, the Alarm output (terminals 11 & 12) become active. Configurable mode - SW4 - ON In this mode, analogue, alarm and
pulse outputs are available but the module must be software configured to define its operating mode. In this mode, software controls the LFD function and Switch 3 has no effect. Switches 1 & 2 continue to define the switching point threshold (Vsp). Configuration requires a personal computer, a PCL45USB interface and PCS45 software. See Section 6.9 for
details of the configurator. Alarm inhibiting The Inhibit input is provided to inhibit alarm output operation. This facility is useful, for example, during power-up, when pulse rates are below the alarm threshold. When normal operational values are established the inhibit can be disabled. Such a facility is sometimes referred to as a
start-up delay. Inhibit is
enabled by connecting a switch or proximity detector between terminals 6 and 3. If switch contacts are used for this input, then and parallel resistors must be fitted - see Section 6.1.2 for recommended values. LED indicators Use the following LED information to understand the module status. LED Description PWR Power (green) ON - Power OK OFF - No
power or insufficient voltage O/P Output (yellow) The LED will follow the pulse output state. If the output is pulsing then the LED brightness will pulse. If the pulsing is rapid or very short, the LED may dim if it is unable to respond to such changes. If the output is high, the LED will be ON. STS Status (red - flashing) In legacy mode a line fault will cause the
LED to turn ON. In mC mode, the LED is programmable to display a line fault or an Alarm trip operation. In the event, it will also indicate a mC fault condition. INM 5500 Rev 1840 6 3 3 MTL5533 - Vibration Transducer Interface (Reference use only: Terminated product, use 2 x MTL5531) Two channel The MTL5533 repeats signals from vibration sensors in
a hazardous area, providing outputs for monitoring systems in the safe area. The interface is compatible with 3-wire eddy-current probes and accelerometers or 2-wire current sensors, and selection of the mode for each channel is made with the switches on the side of the module. Hazardous area Safe area Vibration transducer Vibration transducer
Vibration transducer Vibration transducer COM SIG V– COM SIG V– Vs– Vs+ 20 to 35V dc –ve 0V Monitor 3- wire 2 1 3- wire 2- wire 5 4 2- wire Monitor –ve 0V 3 6 Ch 1 Ch 2 Ch 1 Ch 2 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Terminal Function 1 Transducer power V– (Ch1) 2 Signal (Ch1) 3 Common (Ch1) 4 Transducer power V– (Ch2) 5 Signal (Ch2) 6
Common (Ch2) 8 Signal output –ve (Ch2) 9 Signal output 0V (Ch2) 11 Signal output –ve (Ch1) 12 Signal output 0V (Ch1) 13 Supply –ve 14 Supply +ve OFF position ON position Ch 1 Ch 2 2-/3-wire transducer setting switches Mode SW 2-wire (3 3mA) OFF 3-wire (20mA) ON * Note: When using 2-wire sensors, ensure that terminals 1 & 2 and 4 & 5 have
wiring links as shown in the wiring diagram above. WARNING! To enable adequate heat dissipation from the MTL5533 modules, they must be installed on the DIN rail with a 10mm space between adjacent units Eaton produce the MS010 DIN rail module spacer for this purpose (packs of 5 - see Section 4 3), and these then enable operation in ambient
temperatures of up to 50°C in vertical or horizontal orientation Figure 6 19: Top label for MTL5533 INM 5500 Rev 1841 6 3 4 MTL MTL5553 isolator/power supply for 31 25kbit/s fieldbuses The MTL5553 has been specifically developed to extend 31.25kbit/s (H1) fieldbus networks into hazardous areas. It provides power, communication and IS isolation to
devices powered through the signal conductors. The MTL5553 complies with the requirements of Fieldbus Foundation™ specified power supply Type 133 (IS power supply). To comply with fieldbus standards, each bus must be terminated at both ends. MTL's FBT1-IS or FCS-MBT fieldbus terminators (see section 6.33?) can be supplied for this purpose or,
for installations in which the safe-area bus length is small, the MTL5553 includes an internal safe-area terminator which is enabled by making a link between terminals 7&8 on the top of the unit. For network and termination criteria, check applicable fieldbus standards and specification IEC 61158-2, ISA-S50.02 for 31.25kbit/s fieldbus systems, Foundation™
Fieldbus 31.25kbit/s Physical LayerProfile Specification FF-816 and MTL's Application Brief AB002.) Hazardous area Safe area 20-35V dc Vs+ Vs- +ve -ve +ve -ve Host (31.25kbit/s) Terminator 1 2 4 5 +ve -ve +ve -ve Field (31.25kbit/s) 6 3 2.6W Max 8 9 T 14 13 11 10 7 12 Link 7- 8 for Terminator Terminal Function 1 Hazardous-area fieldbus device(s)
connection –ve 2 Hazardous-area fieldbus device(s) connection +ve 4 Optional HHC connection –ve 5 Optional HHC connection +ve 7 Link to 8 to enable internal terminator 8 & 11 Safe-area fieldbus device(s) connection –ve 9 & 12 Safe-area fieldbus device(s) connection +ve 13 Supply –ve 14 Supply +ve Note: To assist the process of terminating cable
screens, screw terminals have been provided in terminals 3, 6, and 10. Please note, however, that there is no internal connection for these terminals so they are not earthed. NOTE To allow adequate heat dissipation under all likely thermal conditions, it is recommended that MTL5553s are installed on a horizontal DIN-rail mounted on a vertical surface* with
a 10mm space between adjacent units. MTL MS010 10mm DIN-rail module spacers are available for this purpose. * If an MTL5553 is mounted in a non-optimum orientation, the maximum operating temperature is reduced to 45°C. INM 5500 Rev 1842 6 4 Analogue Input modules The analogue input (AI) modules support 2-wire or 3-wire 4/20mA or HART
transmitters located in a hazardous area; repeating the current in other circuits to drive safe-area loads. 6 4 1 MTL5541/MTL5541-T/MTL5541S (-T) - Repeater Power Supply Single channel, for 4/20mA HART® for 2- or 3-wire transmitters The MTL5541 provides a fully-floating dc supply for energising a conventional 2- or 3-wire 4/20mA transmitter which is
located in a hazardous area, and repeats the current in another floating circuit to drive a safe-area load. For HART 2-wire transmitters, the unit allows bi- directional communications signals superimposed on the 4/20mA loop current. Alternatively, the MTL5541S (-T) acts as a current sink for a safe-area connection rather than driving a current into the load.
Separately powered current sources, such as 4-wire transmitters, can be connected but will not support HART communication. Hazardous area Safe area 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Vs– Vs+ 20 to 35V dc 4/20mA MTL5541 MTL5541S – 4/20mA Load+ Load + — + Com Tx+ Input I I Terminal Function 1 Current input 2 Transmitter supply +ve 3
Common 10 Output +ve via 220Ω for HART apps. 11 Output –ve (+ve current sink) 12 Output +ve (–ve current sink) 13 Supply –ve 14 Supply +ve Figure 6 20: Top labels for MTL5541 & MTL5541S S INM 5500 Rev 1843 6 4 2 MTL5541A/MTL5541AS - Repeater Power Supply Single channel, for 4/20mA, HART® for 2- or 3-wire transmitters The MTL5541A
provides an input for separately powered 4/20mA transmitters and also allows bi–directional transmission of HART communication signals superimposed on the 4/20mA loop current. Alternatively, the MTL5541AS acts as a current sink for a safe-area connection rather than driving a current into the load. Hazardous area Safe area Vs– Vs+ 20 to 35V dc – 4/20mA Load +– + MTL5541A MTL5541AS Load + — + 4/20mA 6 5 4 3 2 1 7 8 9 10 11 12 13 14 I I Terminal Function 1 Input –ve 2 Input +ve 11 Output –ve (+ve current sink) 12 Output +ve (–ve current sink) 13 Supply –ve 14 Supply +ve Figure 6 21: Top labels for MTL5541A & MTL5541AS INM 5500 Rev 1844 6 4 3 MTL5544/MTL5544S - Repeater
Power Supply Two channel, for 4/20mA HART® for 2- or 3-wire transmitters The MTL5544 provides fully-floating dc supplies for energising two conventional 2-wire or 3-wire 4/20mA or HART transmitters located in a hazardous area, and repeats the current in other circuits to drive two safe-area loads. For HART transmitters, the unit allows bi-directional
transmission of digital communication signals superimposed on the 4/20mA loop current. Alternatively, the MTL5544S acts as a current sink for a safe-area connection rather than driving a current into the load. Separately powered current sources, such as 4-wire transmitters, can be connected but will not support HART communication. Hazardous area
Safe area Vs– Vs+ 20 to 35V dc – 4/20mA Load + – 4/20mA Load + Ch 2 Ch 1 MTL5544 MTL5544S Load + – Load + – 4/20mA 4/20mA Ch 2 Ch 1 Com Tx+ Input Com Tx+ Input 6 5 4 3 2 1 7 8 9 10 11 12 13 14 I I I I Terminal Function 1 Ch1 current input 2 Ch1 transmitter supply +ve 3 Ch1 common 4 Ch2 current input 5 Ch2 transmitter supply +ve 6
Ch2 common 7 Ch2 output +ve via 220Ω for HART apps. 8 Ch2 output –ve (+ve current sink) 9 Ch2 output +ve (–ve current sink) 10 Ch1 output +ve via 220Ω for HART apps. 11 Ch1 output –ve (+ve current sink) 12 Ch1 output +ve (–ve current sink) 13 Supply –ve 14 Supply +ve Hazardous area Safe areaThe MTL5544 or MTL5544S can also be used to
drive two safe-area loads from a single 2-wire transmitter (i.e. 1 in, 2 out) by interconnecting the input channels as shown in the diagram (right). Note: In this mode the HART data is transferred via channel 1 output only. See also the MTL5544D. Vs– Vs+ 20 to 35V dc – 4/20mA Load + – 4/20mA Load + Ch 2 Ch 1 MTL5544 MTL5544S Load + – Load + – + –
–4/20mA 6 5 4 3 2 1 7 8 9 10 11 12 13 14 I I I I Figure 6 22: Top labels for MTL5544 & MTL5544S INM 5500 Rev 1845 6 4 4 MTL5544A/MTL5544AS - Current Repeater Two channel, for 4/20mA passive input for HART® transmitters The MTL5544A provides an input for separately powered 4/20mA transmitters and also allows bi–directional transmission of
HART communication signals superimposed on the 4/20mA loop current. Alternatively, the MTL5544AS acts as a current sink for a safe-area connection rather than driving a current into the load. Hazardous area Safe area Vs– Vs+ 20 to 35V dc + – Ch 2 Ch 2 Ch 1 + – Ch 1 4/20mA 4/20mA 6 5 4 3 2 1 7 8 9 10 11 12 13 14 I I I I MTL5544A MTL5544AS –
4/20mA Load+ Load + — + – 4/20mA Load+ Load + — + Terminal Function 1 Ch1 input –ve 2 Ch1 input +ve 4 Ch2 input –ve 5 Ch2 input +ve 8 Ch2 output –ve (+ve current sink) 9 Ch2 output +ve (–ve current sink) 11 Ch1 output –ve (+ve current sink) 12 Ch1 output +ve (–ve current sink) 13 Supply –ve 14 Supply +ve Figure 6 23: Top labels for
MTL5544A & MTL5544AS INM 5500 Rev 1846 6 4 5 MTL5544D - Repeater Power Supply Two channel, for 4/20mA HART® for 2- or 3-wire transmitters, two outputs The MTL5544D provides a fully-floating dc supply for energising a conventional 2- or 3-wire 4/20mA transmitter located in a hazardous area, and repeats the current in other circuits to drive
two safe-area loads. For HART 2-wire transmitters, the unit allows bi-directional transmission of digital communication signals superimposed on the 4/20mA loop current via channel 1 only.Separately powered current sources, such as 4-wire transmitters, can be connected but will not support HART communication. Hazardous area Safe area Vs– Vs+ 20 to

35V dc Ch 2 Ch 1 – 4/20mA Load+ – 4/20mA Load+4/20mA 6 5 4 3 2 1 7 8 9 10 11 12 13 14 Com Tx+ Input I I I Terminal Function 1 Current input 2 Transmitter supply +ve 3 Common 7 Ch2 output +ve via 220Ω HART not supported. 8 Ch2 output –ve 9 Ch2 output +ve 10 Ch1 output +ve via 220Ω for HART apps. 11 Ch1 output –ve 12 Ch1 output +ve 13
Supply –ve 14 Supply +ve NOTE: For correct operation of the module, a suitable load must be present on both output channels. This is of particular importance during testing, commissioning or maintenance activities when the temporary disconnection, or absence, of a load can affect the transfer accuracy of the analogue variable. Figure 6 24: Top label for
MTL5544D INM 5500 Rev 1847 6 5 Analogue Output modules The analogue output (AO) modules accept 4/20mA floating signals from safe-area controllers to drive current/pressure converters (or any other load up to 800Ω) in a hazardous area. 6 5 1 MTL5546/MTL5546Y(-T) - Isolating Driver Single channel, for 4/20mA HART® valve positioners with linefault detection The MTL5546 accepts a 4/20mA floating signal from a safe-area controller to drive a current/ pressure converter (or any other load up to 800Ω) in a hazardous area. For HART valve positioners, the module also permits bi-directional transmission of digital communication signals so that the
device can be interrogated either from the operator
station or by a hand-held communicator. Process controllers with a readback facility can detect open or short circuits in the field wiring: if these occur, the current taken into the terminals drops to a preset level. The MTL5546Y(-T) is very similar to the MTL5546 except that it provides open circuit detection only (i.e. no short-circuit detection). Hazardous area
Safe area Terminal Function 1 Output –ve 2 Output +ve 11 Input –ve 12 Input +ve 13 Supply –ve 14 Supply +ve Input characteristics Field wiring state MTL5546 MTL5546Y Normal <6.0V <6.0V Open-circuit <0.9mA <0.5mA Short-circuit <0.9mA N.A. Figure 6 25: Top labels for MTL5546 & MTL5546Y INM 5500 Rev 1848 6 5 2 MTL5549/ MTL5549Y -
Isolating Driver Two channel, for 4/20mA HART® valve positioners with line-fault detection The MTL5549 accepts 4/20mA floating signals from safe-area controllers to drive 2 current/ pressure converters (or any other load up to 800Ω) in a hazardous area. For HART valve positioners, the module also permits bi-directional transmission of digital
communication signals so that the device can be interrogated either from the operator station or by a hand-held communicator. Process controllers with a readback facility can detect open or short circuits in the field wiring: if these occur, the current taken into the terminals drops to a preset level. The MTL5549Y is very similar to the MTL5549 except that it
provides open circuit detection only (i.e. no short-circuit detection). Hazardous area Safe area Terminal Function 1 Output –ve (Ch 1) 2 Output +ve (Ch 1) 4 Output –ve (Ch 2) 5 Output +ve (Ch 2) 8 Input –ve (Ch 2) 9 Input +ve (Ch 2) 11 Input –ve (Ch 1) 12 Input +ve (Ch 1) 13 Supply –ve 14 Supply +ve Input characteristics Field wiring state MTL5549
MTL5549Y Normal <6.0V <6.0V Open-circuit <0.9mA 16.5V. + – + – +– V1 i/p o/p RV1 10kΩ Iin. A1 250Ω 24V + – I oli A2 + – INM 5500 Rev 1863 8 3 3 Modules: MTL5541A & MTL5544A Figure 8 7: AI test circuit #3 “active i/p” Output Measurements 1. Adjust RV1 to vary the current (A1) through the range 4 to 20mA. 2. The measured current imbalance (A2) over this range
should not exceed ± 20mA 8 3 4 Modules: MTL5541AS & MTL5544AS Figure 8 8: AI test circuit #4 “active i/p - o/p sinking” Output Measurements 1. Adjust RV1 to vary the current (A1) through the range 4 to 20mA. 2. The measured current imbalance (A2) over this range should not exceed ± 20mA INM 5500 Rev 1864 8 3 5 Module: MTL5581
Figure 8 9: AI test circuit #5 “mV input” Note: V1 should be capable of measurement to within 1mV. Output Measurements 1. With the LINK connected, vary output V2 between 0 and 50mV using RV1. V1 should show +50mV with the switch set to ‘+’, or 19V. Vary the potentiometer setting and check that the reading on voltmeter V varies by no more than
±100mV. + – + – A2 + – A1 o/p i/p current source +– 470Ω load I oli INM 5500 Rev 1866 8 5 2 Testing MTL5553 - Isolator/power supply for 31 25kbits/s fieldbuses Make the safe and hazardous-area connections shown in figure 10.2 and, substituting appropriate resistors at Rtest, carry out the following checks. Rtest Voltage across terminals 2 and 1 (V1)
Open-circuit 17.8 < V1 < 19V 220Ω 11.5V < V1 < 13.5V 10Ω V1 < 5V 20-35V dc Vs- Vs+ -ve +ve -ve Host (31.25kbit/s) Terminator 1 2 4 5 6 3 2.6W Max 8 9 T 14 13 11 10 7 12 Link 7- 8 for Terminator Hazardous Area Safe Area V1 R test + - Top Label, MTL5553 Test circuit for MTL5553 INM 5500 Rev 1867 9 APPLICATIONS INVOLVING ZONE 2 AND/
OR ZONE 22 HAZARDOUS AREAS IMPORTANT: See page iv at the front of this manual for important additional information regarding the use of these products in countries governed by the ATEX Directive. The European Community permits Category 3G equipment, such as the MTL5500 , to be installed in, or connected to, Zone 2 flammable
atmospheres provided it meets the requirements of the ATEX Directive. MTL5500 Category 3 products have been designed to meet, and carry approval markings for, Ex nC and/or Ex nA. In general, meeting the relevant requirements of the appropriate European (CENELEC) standards is considered the most appropriate method of demonstrating
compliance with the ATEX directive. However, Eaton often has its products approved by other national bodies, such as FM and CSA and, because national, European, and international standards are converging, it is generally possible to use other national approvals as supporting evidence for the ATEX Technical File. In the context of this document, Zone
2 (Division 2) and Zone 22 hazardous areas are those that may become potentially explosive through the presence of flammable gases, vapours and dusts for periods of up to 10 hours per year. It is recommended that the current version of the standards is consulted for detailed information on the requirements applicable to the particular installation. As a
consequence of their IS approvals, MTL5500 products may also be connected into Zone 22 hazardous areas. Consult individual module approvals for further details. Unless otherwise specified, the following ambient conditions apply: Ambient Temperature range –20°C to +60°C Pollution Degree 2 (See EN 61010-1) Measurement Category II (See EN
61010-1) 9 1 Enclosure EN 60079-15 specifies the minimum required degree of protection to be IP54, but generally this is provided by the external enclosure in which the product is mounted. The user must refer to the specific certificates relating to the products being installed within the hazardous area to check that all special conditions of safe use have
been complied with. INM 5500 Rev 1868 10 APPENDIX 1 10 1 MTL5000 Many modules in the MTL5000 Isolating Interface Units range have now been superceded by their equivalent in the MTL5500. For new applications the MTL5500 modules are recommended, these offer all the benefits of greater efficiency, new multichannel modules and new
functionality. A number of the products in the MTL5000 will continue to provide key functionality as part of MTL DIN rail isolator range and are described within this Appendix. Important • Make sure that all installation work is carried out in accordance with all relevant local standards, codes of practice and site regulations. • When planning the installation of
MTL5000 isolators it is essential to make sure that intrinsically safe and non-intrinsically safe wiring is segregated, and that units are installed as required by a nationally accepted authority or as described in EN 60079-14, ISA RP 12.6 or DIN VDE-165. • Check that the hazardous-area equipment complies with the descriptive system document. • If in doubt,
refer to the certificate/catalogue for clarification of any aspects of intrinsic safety or contact Eaton's MTL product line or your local representative for assistance. • Make sure the correct hazardous-area connector (field-wiring plug) is plugged into the corresponding isolator. It is recommended that the connector is identified by the same tag number as the
matching isolator. Mount all MTL5000 isolators on low-profile (7mm) or high-profile (15mm) type T35 (top-hat) DIN-rail to EN50022, BS5584, DIN46277. This is available from Eaton, in 1 metre lengths (THR2 - DIN rail). Install isolators within the safe area unless they are enclosed in approved flameproof, pressurised or purged enclosures and ensure that
the local environment is clean and free of dirt and dust. Note the ambient temperature considerations of section 3.1.4. It is recommended that, in normal practice, the DIN rail should be earthed/grounded to ensure the safety of personnel in the event of a.c. mains (line) power being applied accidentally to the rail. Power connectors 104 115 110 16 16.2mm
PITCH HAZ SAFE Hazardous-area connections Non-hazardous (safe) area connections INM 5500 Rev 1869 10 2 MTL5018AC single-pole, changeover relay, two-channel, switch/proximity detector with line fault detection and phase reversal The MTL5018AC modules enable each of two safe-area loads to be relay-controlled by switches or proximity
detectors in a hazardous area. Line fault detection (LFD) and output phase reversal facilities are included (see section 6.1). 10 2 1 Wiring connections See figure 10.1 for wiring connections. Note: Reactive loads must be adequately suppressed. 10 2 2 Line fault detection (See section 6.1 for definition of a line fault) On each channel, input line faults (openor short-circuit) are indicated by an LED and the de-energising of the output. LFD is enabled/disabled by switches located on the top of the module. Note: that if the LFD facility is enabled for switch inputs, the resistors shown in 10.1 and 10.2 MUST be fitted. Terminal Function 1 Input –ve (Ch 1) 2 Input +ve (Ch 1) 3 4 Input –ve (Ch 2) 5 Input +ve (Ch 2) 6 7
Normally-closed contact (Ch 2) 8 Common (Ch 2) 9 Normally-open contact (Ch 2) 10 Normally-closed contact (Ch 1) 11 Common (Ch 1) 12 Normally-open contact (Ch 1) 13 Supply N 14 Supply L Hazardous area Safe area Figure 10 1: MTL5018AC wiring diagram and connections INM 5500 Rev 1870 10 2 3 Testing Make the safe- and hazardous-area
connections shown in figure 10.2, and check the status of the output contacts for each channel in turn (with a 22kΩ resistor connected to the other channel) as shown in the table 10.1. Phase reverse switch Line fault detection Input switch (SW) Output relay (11-12, 8-9) Output relay (10-11, 7-8) Channel status LED (yellow) Line fault LED (red) Normal Off a
Closed Open On Off Reverse Off ISC = 7 _ 9mA Open Closed Off Off Reverse Off Open Closed Open Off Off Normal On VOC = 7.5 _ 9.5V Open Closed Off On Normal On a Open Closed Off On Normal On b Open Closed Off Off Normal On c Closed Open On Off Figure 10 2: Test circuit for MTL5018AC Table 10 1 INM 5500 Rev 1871 10 3 MTL5051
serial data comms isolator The MTL5051provides either bi-directional serial data communications from a computer system in a safe area to instrumentation in a hazardous area or data communications across a hazardous area. It is used to provide a fully floating dc supply for, and serial data communications to MTL640 text displays and MTL650 text and
graphics terminals or to other IS and non-IS instrumentation and keyboards. 10 3 1 Wiring connections See the figures 10.3 and 10.4 and the terminal specifications in tables 10.2 and 10.3 for wiring connections. Figure 10.3: MTL5051 wiring diagram (to a hazardous area) Hazardous area Safe area Safe areaHazardous area Figure 10.4: MTL5051 wiring
diagram (across a hazardous area) INM 5500 Rev 1872 10 3 2 Hazardous-area interfacing Displays/terminals: For details of interfacing with MTL640 and MTL650 displays/terminals (as an alternative to the MTL696 communications interface) see the appropriate product instruction manual. Table 10 2 MTL5051 Terminals MTL640 mode MTL650 mode
Comms mode Other IS devices 1 Common Common Common Common 2 V signal 12V - 5V/12V 3 I return Rx Rx - 4 - Tx Tx - 5 - - - Tx 6 - - - Rx Switch 1a On Off Off Off 1b On On On Off/On Table 10 3 Terminals RS232 mode TTL mode RS422 mode 7 - - Rx- 8 - - Rx+ 9 - Tx Tx+ 10 Tx - Tx- 11 Common Common Common 12 Rx Rx - 13 Supply -ve
Supply -ve Supply -ve 14 Supply +ve Supply +ve Supply +ve Switch 2a Off On On 2b On Off Off Across hazardous areas: For communication across hazardous areas MTL5051 devices are used in pairs to transfer bi-directional full duplex data across hazardous areas, as shown in figure 10.4. Current switching is used to minimise the bandwidth-limiting
effects of long cables. The maximum baud rate in this mode is the lesser of 19.2k baud or the cable-related rate produced by the following formula. Remote signalling baud rate formula, for back-to-back mode across a hazardous area: max baud rate = K/(RxCxL2) where K = 0.25 (constant) R = cable resistance (Ω/m) C = cable capacitance (F/m) L = length
(m) For example, with a 2km cable of 100pF/m capacitance and 40mΩ/m resistance, the maximum baud rate = 0.25/(40mΩ x 100pFx 2km2) = 15k baud. This assumes that the cable is 2 cores plus screen, with the screen used for the ‘common’ connection. RS232-level devices: Communication with RS232-level interfaces, such as a suitably certified IS
keyboard, mouse, etc, is achieved by using one or more MTL5051 units as required by the IS device.(TTL level interfaces are accommodated by the TTL compatibility of RS232 receivers.) The supply to IS equipment at terminal 2 can be set to either 5V or 12V, by a switch located on top of the unit, as follows: +12V mode 12.0V ±5% (load 23mA to 23mA to

<80% load 93.75 at 100% load, 250 at 80% load Nominal battery voltage (VDC) 480 Nominal float voltage (VDC) 546 End of discharge voltage (full load) (VDC) 384 End of discharge voltage (no load) (VDC) 420 Battery current at full load and nominal battery voltage (A) 1362 Battery current at full load and minimum battery voltage (A) 1703 Maximum short
circuit rating 50 kA Maximum battery backup time Unlimited Temperature compensation (per cell) -3.3 mV per °C for T ≥ 25 °C, 0 mV per °C for T < 25 °C Ripple current < 5% C20 (5-minute backup time) Battery test Manual/automatic (selectable) Deep discharge protection Yes Recharge according to battery temperature Yes 34 990-5451K-001 480 V UPS
System Facility Planning 23. Per NEC 250.30. 24. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. 25. 125% for 480 V. 26. Minimum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. 27. Maximum short circuit rating for output takes backfeeding
energy through the bypass of parallel UPSs into consideration. Specifications for 750 kW UPS Voltage (V) 380 400 415 440 480 Input Connections IEC: L1, L2, L3, PE 28 UL: L1, L2, L3 + G 29 Input voltage range (V)30 340-456 340-480 353-498 374-528 408-576 Frequency (Hz) 40-70 Nominal input current (A) 1225 1162 1119 1050 969 Maximum input
current (A)31 1381 1327 1278 1199 1136 Input current limitation (A) 1335 1248 1140 Minimum short circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 100 kA RMS Total harmonic distortion (THDI) <3% at 100% load,
20% load, 0.97 at >10% load Protection Contactors Ramp-in Adaptive 1-300 seconds Bypass Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N, PE or L1, L2, L3, PE 32 UL 1250 kW I/O: L1, L2, L3, G or L1, L2, L3, N, G UL 1500 kW I/O33: L1, L2, L3, G Bypass voltage range (V) 342-418 360-440 374-457 396-484 432-528
Frequency (Hz) 50 or 60 Frequency range (Hz) Programmable: ±0.1, ±3, ±10. Default is ±3 Nominal bypass current (A) 1220 1159 1117 1054 964 Minimum short circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 1250 kW I/O: 100 kA Icw 1500
kW I/O: 100 kA RMS (conditioned by an internal molded switch with 90 kA peak magnetic trip) Thyristor I²t (kA²s²) 1250 kW I/O: 9680 1500 kW I/O: 16245 1250 kW I/O: 9165 1500 kW I/O: 16245 BF2 magnetic trip 1250 kW I/O: 39 kA 1500 kW I/O: 39 kA Protection 1250 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed
protection 1250 kW I/O with GVXOPT001 installed: Molded switch with trip for backfeed protection 1500 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 990-5451K-001 35 Facility Planning 480 V UPS System 28. TN, TT, and IT power distribution systems are supported. 29. WYE source – solid grounded and
high resistance grounded sources are supported. Corner (line) grounding is not permitted. 30. The system can operate at 600 V for 1 minute. 31. At nominal input voltage and full charge. 32. TN, TT, and IT power distribution systems with no earthed line conductors are supported. 33. 4-wire connection with neutral is not compliant per FCC regulations for
the 1500 kW I/O cabinet. Voltage (V) 380 400 415 440 480 Output Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N, PE or L1, L2, L3, PE UL 1250 kW I/O: L1, L2, L3, G, GEC34 or L1, L2, L3, N, G UL 1500 kW I/O35: L1, L2, L3, G, GEC34 Overload capacity Normal operation: 150% for 1 minute, 125% for 10 minutes Battery operation: 128%
for 10 seconds, 115% for 1 minute Bypass operation: 110%36 continuous, 1000% for 60 milliseconds for systems with 1250 kW I/O cabinet, and 1000% for 100 milliseconds for systems with 1500 kW I/O cabinet Output voltage tolerance Balanced load: ±1%, Unbalanced load: ±3% Dynamic load response ±5% after 2 ms, ±1% after 50 ms Output power
factor 1 Nominal output current (A) 1140 1083 1043 984 902 Minimum short circuit rating37 Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating38 100 kA RMS Inverter output short circuit capabilities Varies with time. See graph and table values in Inverter
Short–Circuit Capabilities (Bypass not Available), page 18. Total harmonic distortion (THDU) <2% at 100% linear load, <3% at 100% non-linear load Output frequency (Hz) 50/60 (synchronized to bypass), 50/60 Hz ±0.1% (free-running) Slew rate (Hz/sec) Programmable: 0.25, 0.5, 1, 2, 4, 6 Output performance classification (according to IEC/ EN62040-3)
Double-conversion: VFI-SS-111 Load crest factor Up to 3 (THDU < 5%) Load power factor 0.7 leading to 0.5 lagging without derating Battery (VRLA) Charging power in % of output power 35% at ≤ 80% load, 12% at 100% load 40% at ≤ 80% load, 15% at 100% load Maximum charging power (kW) 90 at 100% load, 262 at <80% load 112.5 at 100% load,
300 at 80% load Nominal battery voltage (VDC) 480 Nominal float voltage (VDC) 546 End of discharge voltage (full load) (VDC) 384 End of discharge voltage (no load) (VDC) 420 Battery current at full load and nominal battery voltage (A) 1634 Battery current at full load and minimum battery voltage (A) 2043 Maximum short circuit rating 50 kA Maximum
battery backup time Unlimited Temperature compensation (per cell) -3.3 mV per °C for T ≥ 25 °C, 0 mV per °C for T < 25 °C Ripple current < 5% C20 (5-minute backup time) Battery test Manual/automatic (selectable) Deep discharge protection Yes Recharge according to battery temperature Yes 36 990-5451K-001 480 V UPS System Facility Planning 34.
Per NEC 250.30. 35. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. 36. 125% for 480 V. 37. Minimum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. 38. Maximum short circuit rating for output takes backfeeding energy through the bypass of
parallel UPSs into consideration. Specifications for 800 kW UPS Voltage (V) 380 400 415 440 480 Input Connections IEC: L1, L2, L3, PE 39 UL: L1, L2, L3 + G 40 Input voltage range (V)41 340-456 340-480 353-498 374-528 408-576 Frequency (Hz) 40-70 Nominal input current (A) 1307 1239 1193 1120 1033 Maximum input current (A)42 1474 1415 1363
1279 1212 Input current limitation (A) 1424 1331 1216 Minimum short circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 100 kA RMS Total harmonic distortion (THDI) <3% at 100% load, 20% load, 0.97 at
>10% load Protection Contactors Ramp-in Adaptive 1-300 seconds Bypass Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N, PE or L1, L2, L3, PE 43 UL 1250 kW I/O: L1, L2, L3, G or L1, L2, L3, N, G UL 1500 kW I/O44: L1, L2, L3, G Bypass voltage range (V) 342-418 360-440 374-457 396-484 432-528 Frequency (Hz) 50 or 60 Frequency
range (Hz) Programmable: ±0.1, ±3, ±10. Default is ±3 Nominal bypass current (A) 1302 1236 1191 1124 1027 Minimum short circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 1250 kW I/O: 100 kA Icw 1500 kW I/O: 100 kA RMS (conditioned
by an internal molded switch with 90 kA peak magnetic trip) Thyristor I²t (kA²s²) 9680 (1250 kW I/O) 9165 (1250 kW I/O) BF2 magnetic trip 1250 kW I/O: 39 kA 1500 kW I/O: 39 kA Protection 1250 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 1250 kW I/O with GVXOPT001 installed: Molded switch with trip
for backfeed protection 1500 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 990-5451K-001 37 Facility Planning 480 V UPS System 39. TN, TT, and IT power distribution systems are supported. 40. WYE source – solid grounded and high resistance grounded sources are supported. Corner (line) grounding is
not permitted. 41. The system can operate at 600 V for 1 minute. 42. At nominal input voltage and full charge. 43. TN, TT, and IT power distribution systems with no earthed line conductors are supported. 44. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. Voltage (V) 380 400 415 440 480 Output
Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N, PE or L1, L2, L3, PE UL 1250 kW I/O: L1, L2, L3, G, GEC45 or L1, L2, L3, N, G UL 1500 kW I/O46: L1, L2, L3, G, GEC45 Overload capacity Normal operation: 150% for 1 minute, 125% for 10 minutes Battery operation: 128% for 10 seconds, 115% for 1 minute Bypass operation: 110%47
continuous, 1000% for 60 milliseconds for systems with 1250 kW I/O cabinet, and 1000% for 100 milliseconds for systems with 1500 kW I/O cabinet Output voltage tolerance Balanced load: ±1%, Unbalanced load: ±3% Dynamic load response ±5% after 2 ms, ±1% after 50 ms Output power factor 1 Nominal output current (A) 1216 1155 1113 1050 962
Minimum short circuit rating48 Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating49 100 kA RMS Inverter output short circuit capabilities Varies with time. See graph and table values in Inverter Short–Circuit Capabilities (Bypass not Available), page 18.
Total harmonic distortion (THDU) <2% at 100% linear load, <3% at 100% non-linear load Output frequency (Hz) 50/60 (synchronized to bypass), 50/60 Hz ±0.1% (free-running) Slew rate (Hz/sec) Programmable: 0.25, 0.5, 1, 2, 4, 6 Output performance classification (according to IEC/ EN62040-3) Double-conversion: VFI-SS-111 Load
crest factor Up to 3
(THDU < 5%) Load power factor 0.7 leading to 0.5 lagging without derating Battery (VRLA) Charging power in % of output power 35% at ≤ 80% load, 12% at 100% load 40% at ≤ 80% load, 15% at 100% load Maximum charging power (kW) 96 at 100% load, 280 at <80% load 120 at 100% load, 320 at 80% load Nominal battery voltage (VDC) 480 Nominal
float voltage (VDC) 546 End of discharge voltage (full load) (VDC) 384 End of discharge voltage (no load) (VDC) 420 Battery current at full load and nominal battery voltage (A) 1743 Battery current at full load and minimum battery voltage (A) 2179 Maximum short circuit rating 50 kA Maximum battery backup time Unlimited Temperature compensation (per
cell) -3.3 mV per °C for T ≥ 25 °C, 0 mV per °C for T < 25 °C Ripple current < 5% C20 (5-minute backup time) Battery test Manual/automatic (selectable) Deep discharge protection Yes Recharge according to battery temperature Yes 38 990-5451K-001 480 V UPS System Facility Planning 45. Per NEC 250.30. 46. 4-wire connection with neutral is not
compliant per FCC regulations for the 1500 kW I/O cabinet. 47. 125% for 480 V. 48. Minimum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. 49. Maximum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. Specifications for 1000 kW
UPS Voltage (V) 380 400 415 440 480 Input Connections IEC: L1, L2, L3, PE 50 UL: L1, L2, L3 + G 51 Input voltage range (V)52 340-456 340-480 353-498 374-528 408-576 Frequency (Hz) 40-70 Nominal input current (A) 1633 1549 1492 1397 1291 Maximum input current (A)53 1842 1770 1704 1595 1514 Input current limitation (A) 1780 1664 1520
Minimum short circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 100 kA RMS Total harmonic distortion (THDI) <3% at 100% load, 20% load, 0.97 at >10% load Protection Contactors Ramp-in Adaptive
1-300 seconds Bypass Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N, PE or L1, L2, L3, PE 54 UL 1250 kW I/O: L1, L2, L3, G or L1, L2, L3, N, G UL 1500 kW I/O55: L1, L2, L3, G Bypass voltage range (V) 342-418 360-440 374-457 396-484 432-528 Frequency (Hz) 50 or 60 Frequency range (Hz) Programmable: ±0.1, ±3, ±10. Default is ±3
Nominal bypass current (A) 1627 1545 1489 1405 1284 Minimum short circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 1250 kW I/O: 100 kA Icw 1500 kW I/O: 100 kA RMS (conditioned by an internal molded switch with 90 kA peak
magnetic trip) Thyristor I²t (kA²s²) 1250 kW I/O: 9680 1500 kW I/O: 16245 1250 kW I/O: 9165 1500 kW I/O: 16245 BF2 magnetic trip 1250 kW I/O: 39 kA 1500 kW I/O: 39 kA Protection 1250 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 1250 kW I/O with GVXOPT001 installed: Molded switch with trip for
backfeed protection 1500 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 990-5451K-001 39 Facility Planning 480 V UPS System 50. TN, TT, and IT power distribution systems are supported. 51. WYE source – solid grounded and high resistance grounded sources are supported. Corner (line) grounding is not
permitted. 52. The system can operate at 600 V for 1 minute. 53. At nominal input voltage and full charge. 54. TN, TT, and IT power distribution systems with no earthed line conductors are supported. 55. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. Voltage (V) 380 400 415 440 480 Output Connections
IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N, PE or L1, L2, L3, PE UL 1250 kW I/O: L1, L2, L3, G, GEC56 or L1, L2, L3, N, G UL 1500 kW I/O57: L1, L2, L3, G, GEC56 Overload capacity Normal operation: 150% for 1 minute, 125% for 10 minutes Battery operation: 128% for 10 seconds, 115% for 1 minute Bypass operation: 110%58 continuous,
1000% for 60 milliseconds for systems with 1250 kW I/O cabinet, and 1000% for 100 milliseconds for systems with 1500 kW I/O cabinet Output voltage tolerance Balanced load: ±1%, Unbalanced load: ±3% Dynamic load response ±5% after 2 ms, ±1% after 50 ms Output power factor 1 Nominal output current (A) 1519 1443 1391 1312 1203 Minimum short
circuit rating59 Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating60 100 kA RMS Inverter output short circuit capabilities Varies with time. See graph and table values in Inverter Short–Circuit Capabilities (Bypass not Available), page 18. Total harmonic
distortion (THDU) <2% at 100% linear load, <3% at 100% non-linear load Output frequency (Hz) 50/60 (synchronized to bypass), 50/60 Hz ±0.1% (free-running) Slew rate (Hz/sec) Programmable: 0.25, 0.5, 1, 2, 4, 6 Output performance classification (according to IEC/ EN62040-3) Double-conversion: VFI-SS-111 Load crest factor Up to 3 (THDU < 5%)
Load power factor 0.7 leading to 0.5 lagging without derating Battery (VRLA) Charging power in % of output power 35% at ≤ 80% load, 12% at 100% load 40% at ≤ 80% load, 15% at 100% load Maximum charging power (kW) 120 at 100% load, 350 at <80% load 150 at 100% load, 400 at <80% load Nominal battery voltage (VDC) 480 Nominal float voltage
(VDC) 546 End of discharge voltage (full load) (VDC) 384 End of discharge voltage (no load) (VDC) 420 Battery current at full load and nominal battery voltage (A) 2179 Battery current at full load and minimum battery voltage (A) 2724 Maximum short circuit rating 50 kA Maximum battery backup time Unlimited Temperature compensation (per cell) -3.3 mV
per °C for T ≥ 25 °C, 0 mV per °C for T < 25 °C Ripple current < 5% C20 (5-minute backup time) Battery test Manual/automatic (selectable) Deep discharge protection Yes Recharge according to battery temperature Yes 40 990-5451K-001 480 V UPS System Facility Planning 56. Per NEC 250.30. 57. 4-wire connection with neutral is not compliant per FCC
regulations for the 1500 kW I/O cabinet. 58. 125% for 480 V. 59. Minimum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. 60. Maximum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. Specifications for 1100 kW UPS Voltage (V)
380 400 415 440 480 Input Connections IEC: L1, L2, L3, PE 61 UL: L1, L2, L3 + G 62 Input voltage range (V)63 340-456 340-480 353-498 374-528 408-576 Frequency (Hz) 40-70 Nominal input current (A) 1796 1704 1641 1540 1421 Maximum input current (A)64 2026 1947 1874 1759 1666 Input current limitation (A) 1958 1830 1672 Minimum short
circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 100 kA RMS Total harmonic distortion (THDI) <3% at 100% load, 20% load, 0.97 at >10% load Protection Contactors Ramp-in Adaptive 1-300 seconds
Bypass Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N, PE or L1, L2, L3, PE 65 UL 1250 kW I/O: L1, L2, L3, G or L1, L2, L3, N, G UL 1500 kW I/O66: L1, L2, L3, G Bypass voltage range (V) 342-418 360-440 374-457 396-484 432-528 Frequency (Hz) 50 or 60 Frequency range (Hz) Programmable: ±0.1, ±3, ±10. Default is ±3 Nominal
bypass current (A) 1789 1700 1639 1545 1412 Minimum short circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 1250 kW I/O: 100 kA Icw 1500 kW I/O: 100 kA RMS (conditioned by an internal molded switch with 90 kA peak magnetic trip)
Thyristor I²t (kA²s²) 9680 (1250 kW I/O) 9165 (1250 kW I/O) BF2 magnetic trip 1250 kW I/O: 39 kA 1500 kW I/O: 39 kA Protection 1250 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 1250 kW I/O with GVXOPT001 installed: Molded switch with trip for backfeed protection 1500 kW I/O with preinstalled
backfeed breaker BF2: Molded switch with trip for backfeed protection 990-5451K-001 41 Facility Planning 480 V UPS System 61. TN, TT, and IT power distribution systems are supported. 62. WYE source – solid grounded and high resistance grounded sources are supported. Corner (line) grounding is not permitted. 63. The system can operate at 600 V
for 1 minute. 64. At nominal input voltage and full charge. 65. TN, TT, and IT power distribution systems with no earthed line conductors are supported. 66. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. Voltage (V) 380 400 415 440 480 Output Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N,
PE or L1, L2, L3, PE UL 1250 kW I/O: L1, L2, L3, G, GEC67 or L1, L2, L3, N, G UL 1500 kW I/O68: L1, L2, L3, G, GEC67 Overload capacity Normal operation: 150% for 1 minute, 125% for 10 minutes Battery operation: 128% for 10 seconds, 115% for 1 minute Bypass operation: 110%69 continuous, 1000% for 60 milliseconds for systems with 1250 kW I/O
cabinet, and 1000% for 100 milliseconds for systems with 1500 kW I/O cabinet Output voltage tolerance Balanced load: ±1%, Unbalanced load: ±3% Dynamic load response ±5% after 2 ms, ±1% after 50 ms Output power factor 1 Nominal output current (A) 1671 1588 1530 1443 1323 Minimum short circuit rating70 Dependent on upstream protection. See
section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating71 100 kA RMS Inverter output short circuit capabilities Varies with time. See graph and table values in Inverter Short–Circuit Capabilities (Bypass not Available), page 18. Total harmonic distortion (THDU) <2% at 100% linear load, <3% at 100%
non-linear load Output frequency (Hz) 50/60 (synchronized to bypass), 50/60 Hz ±0.1% (free-running) Slew rate (Hz/sec) Programmable: 0.25, 0.5, 1, 2, 4, 6 Output performance classification (according to IEC/ EN62040-3) Double-conversion: VFI-SS-111 Load crest factor Up to 3 (THDU < 5%) Load power factor 0.7 leading to 0.5 lagging without derating
Battery (VRLA) Charging power in % of output power 35% at ≤ 80% load, 12% at 100% load 40% at ≤ 80% load, 15% at 100% load Maximum charging power (kW) 132 at 100% load, 385 at <80% load 165 at 100% load, 440 at <80% load Nominal battery voltage (VDC) 480 Nominal float voltage (VDC) 546 End of discharge voltage (full load) (VDC) 384
End of discharge voltage (no load) (VDC) 420 Battery current at full load and nominal battery voltage (A) 2397 Battery current at full load and minimum battery voltage (A) 2996 Maximum short circuit rating 50 kA Maximum battery backup time Unlimited Temperature compensation (per cell) -3.3 mV per °C for T ≥ 25 °C, 0 mV per °C for T < 25 °C Ripple
current < 5% C20 (5-minute backup time) Battery test Manual/automatic (selectable) Deep discharge protection Yes Recharge according to battery temperature Yes 42 990-5451K-001 480 V UPS System Facility Planning 67. Per NEC 250.30. 68. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. 69. 125% for
480 V. 70. Minimum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. 71. Maximum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. Specifications for 1250 kW UPS Voltage (V) 380 400 415 440 480 Input Connections IEC: L1, L2,
L3, PE 72 UL: L1, L2, L3 + G 73 Input voltage range (V)74 340-456 340-480 353-498 374-528 408-576 Frequency (Hz) 40-70 Nominal input current (A) 2041 1937 1865 1750 1615 Maximum input current (A)75 2303 2212 2130 1999 1893 Input current limitation (A) 2225 2080 1900 Minimum short circuit rating Dependent on upstream protection. See
section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 100 kA RMS Total harmonic distortion (THDI) <3% at 100% load, 20% load, 0.97 at >10% load Protection Contactors Ramp-in Adaptive 1-300 seconds Bypass Connections IEC 1250 kW I/O and 1500 kW I/
O: L1, L2, L3, N, PE or L1, L2, L3, PE 76 UL 1250 kW I/O: L1, L2, L3, G or L1, L2, L3, N, G UL 1500 kW I/O77: L1, L2, L3, G Bypass voltage range (V) 342-418 360-440 374-457 396-484 432-528 Frequency (Hz) 50 or 60 Frequency range (Hz) Programmable: ±0.1, ±3, ±10. Default is ±3 Nominal bypass current (A) 2033 1931 1862 1756 1605 Minimum
short circuit rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 1250 kW I/O: 100 kA Icw 1500 kW I/O: 100 kA RMS (conditioned by an internal molded switch with 90 kA peak magnetic trip) Thyristor I²t (kA²s²) 1250 kW I/O: 9680 1500 kW I/O: 16245
1250 kW I/O: 9165 1500 kW I/O: 16245 BF2 magnetic trip 1250 kW I/O: 39 kA 1500 kW I/O: 39 kA Protection 1250 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 1250 kW I/O with GVXOPT001 installed: Molded switch with trip for backfeed protection 1500 kW I/O with preinstalled backfeed breaker BF2:
Molded switch with trip for backfeed protection 990-5451K-001 43 Facility Planning 480 V UPS System 72. TN, TT, and IT power distribution systems are supported. 73. WYE source – solid grounded and high resistance grounded sources are supported. Corner (line) grounding is not permitted. 74. The system can operate at 600 V for 1 minute. 75. At
nominal input voltage and full charge. 76. TN, TT, and IT power distribution systems with no earthed line conductors are supported. 77. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. Voltage (V) 380 400 415 440 480 Output Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N,
PE or L1, L2, L3,
PE UL 1250 kw I/O: L1, L2, L3, G, GEC78 or L1, L2, L3, N, G UL 1500 kW I/O79: L1, L2, L3, G, GEC78 Overload capacity Normal operation: 150% for 1 minute, 125% for 10 minutes Battery operation: 128% for 10 seconds, 115% for 1 minute Bypass operation: 110%80 continuous, 1000% for 60 milliseconds for systems with 1250 kW I/O cabinet, and
1000% for 100 milliseconds for systems with 1500 kW I/O cabinet Output voltage tolerance Balanced load: ±1%, Unbalanced load: ±3% Dynamic load response ±5% after 2 ms, ±1% after 50 ms Output power factor 1 Nominal output current (A) 1899 1804 1739 1640 1504 Minimum short circuit rating81 Dependent on upstream protection. See section for
‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating82 100 kA RMS Inverter output short circuit capabilities Varies with time. See graph and table values in Inverter Short–Circuit Capabilities (Bypass not Available), page 18. Total harmonic distortion (THDU) <2% at 100% linear load, <3% at 100% non-linear
load Output frequency (Hz) 50/60 (synchronized to bypass), 50/60 Hz ±0.1% (free-running) Slew rate (Hz/sec) Programmable: 0.25, 0.5, 1, 2, 4, 6 Output performance classification (according to IEC/ EN62040-3) Double-conversion: VFI-SS-111 Load crest factor Up to 3 (THDU < 5%) Load power factor 0.7 leading to 0.5 lagging without derating
(VRLA) Charging power in % of output power 35% at ≤ 80% load, 12% at 100% load 40% at ≤ 80% load, 15% at 100% load Maximum charging power (kW) 150 at 100% load, 437 at <80% load 187.5 at 100% load, 500 at <80% load Nominal battery voltage (VDC) 480 Nominal float voltage (VDC) 546 End of discharge voltage (full load) (VDC) 384 End of
discharge voltage (no load) (VDC) 420 Battery current at full load and nominal battery voltage (A) 2724 Battery current at full load and minimum battery voltage (A) 3405 Maximum short circuit rating 50 kA Maximum battery backup time 1 hour Temperature compensation (per cell) -3.3 mV per °C for T ≥ 25 °C, 0 mV per °C for T < 25 °C Ripple current < 5%
C20 (5-minute backup time) Battery test Manual/automatic (selectable) Deep discharge protection Yes Recharge according to battery temperature Yes 44 990-5451K-001 480 V UPS System Facility Planning 78. Per NEC 250.30. 79. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. 80. 125% for 480 V. 81.
Minimum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. 82. Maximum short circuit rating for output takes backfeeding energy through the bypass of parallel UPSs into consideration. Specifications for 1500 kW UPS Voltage (V) 380 400 415 440 480 Input Connections IEC: L1, L2, L3, PE 83
UL: L1, L2, L3 + G 84 Input voltage range (V)85 340-456 340-480 353-498 374-528 408-576 Frequency (Hz) 40-70 Nominal input current (A) 2449 2325 2238 2100 1937 Maximum input current (A)86 2763 2654 2555 2398 2271 Input current limitation (A) 2670 2496 2280 Minimum short circuit rating Dependent on upstream protection. See section for
‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 100 kA RMS Total harmonic distortion (THDI) <3% at 100% load, 20% load, 0.97 at >10% load Protection Contactors Ramp-in Adaptive 1-300 seconds Bypass Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2,
L3, N, PE or L1, L2, L3, PE 87 UL 1250 kW I/O: L1, L2, L3, G or L1, L2, L3, N, G UL 1500 kW I/O88: L1, L2, L3, G Bypass voltage range (V) 342-418 360-440 374-457 396-484 432-528 Frequency (Hz) 50 or 60 Frequency range (Hz) Programmable: ±0.1, ±3, ±10. Default is ±3 Nominal bypass current (A) 2440 2318 2234 2107 1926 Minimum short circuit
rating Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating 1250 kW I/O: 100 kA Icw 1500 kW I/O: 100 kA RMS (conditioned by an internal molded switch with 90 kA peak magnetic trip) Thyristor I²t (kA²s²) 16245 (1500 kW I/O) BF2 magnetic trip 1250 kW I/O:
39 kA 1500 kW I/O: 39 kA Protection 1250 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 1250 kW I/O with GVXOPT001 installed: Molded switch with trip for backfeed protection 1500 kW I/O with preinstalled backfeed breaker BF2: Molded switch with trip for backfeed protection 990-5451K-001 45 Facility
Planning 480 V UPS System 83. TN, TT, and IT power distribution systems are supported. 84. WYE source – solid grounded and high resistance grounded sources are supported. Corner (line) grounding is not permitted. 85. The system can operate at 600 V for 1 minute. 86. At nominal input voltage and full charge. 87. TN, TT, and IT power distribution
systems with no earthed line conductors are supported. 88. 4-wire connection with neutral is not compliant per FCC regulations for the 1500 kW I/O cabinet. Voltage (V) 380 400 415 440 480 Output Connections IEC 1250 kW I/O and 1500 kW I/O: L1, L2, L3, N, PE or L1, L2, L3, PE UL 1250 kW I/O: L1, L2, L3, G, GEC89 or L1, L2, L3, N, G UL 1500 kW I/
O90: L1, L2, L3, G, GEC89 Overload capacity 150% for 1 minute, 125% for 10 minutes (normal operation) 115% for 1 minute (battery operation) 110% continuous,1000% for 100 milliseconds (bypass operation) Output voltage tolerance Balanced load: ±1%, Unbalanced load: ±3% Dynamic load response ±5% after 2 ms, ±1% after 50 ms Output power
factor 1 Nominal output current (A) 2279 2165 2087 1968 1804 Minimum short circuit rating91 Dependent on upstream protection. See section for ‘Recommended upstream protection and cable sizes – IEC’ for details. Maximum short circuit rating92 100 kA RMS Inverter output short circuit capabilities Varies with time. See graph and table values in Inverter
Short–Circuit Capabilities (Bypass not Available), page 18. Total harmonic distortion (THDU) <2% at 100% linear load, <3% at 100% non-linear load Output frequency (Hz) 50/60 (synchronized to bypass), 50/60 Hz ±0.1% (free-running) Slew rate (Hz/sec) Programmable: 0.25, 0.5, 1, 2, 4, 6 Output performance classification (according to IEC/ EN62040-3)
Double-conversion: VFI-SS-111 Load crest factor Up to 3 (THDU < 5%) Load power factor 0.7 leading to 0.5 lagging without derating Battery (VRLA) Charging power in % of output power 35% at ≤ 80% load, 12% at 100% load 40% at ≤ 80% load, 15% at 100% load Maximum charging power (kW) 525 at < 80% load, 180 at 100% load, 600 at <80% load,
225 at 100% load Nominal battery voltage (VDC) 480 Nominal float voltage (VDC) 546 End of discharge voltage (full load) (VDC) 384 End of discharge voltage (no load) (VDC) 420 Battery current at full load and nominal battery voltage (A) 3269 Battery current at full load and minimum battery voltage (A) 4086 Maximum short circuit rating 50 kA Maximum
battery backup time 1 hour Temperature compensation (per cell) -3.3 mV per °C for T ≥ 25 °C, 0 mV per °C for T < 25 °C Ripple current 10 kW) is calculated according to the formula: Weighted efficiency = 25% x Eff25% + 50% x Eff50% + 25% x Eff75% + 0% x Eff100%
Product specific rules (PSR) for 3-phase UPS (continued) Efficiency figures at different load percentages for two operating modes (example: Galaxy VX 1250 kW) Weighted efficiency in double conversion = 25% x 95.6% + 50% X 96% + 25% x 95.7% + 0% x 95.2% = 95.8% Weighted efficiency in eConversion = 25% x 97.9% + 50% X 98.8% + 25% x
98.9% + 0% x 99% = 98.6% Life is On | Schneider Electric Because a UPS operates continuously over its lifetime, the largest contribution to its carbon emissions comes from the “use” stage. While there are significant differences among UPS models in terms of efficiency and the associated electrical losses, electricity consumption is by far the largest
contributor of CO2 e life cycle emissions. Here is an example of how each stage of the lifecycle contributes to the CO2 e emissions of a 3-phase UPS taken from the Galaxy VX PEP. The use stage emissions represent about 93% of the UPS's carbon footprint. Carbon profile of a typical 3-phase UPS Manufacturing 6.2% Distribution 0.1% Installation 0.0%
Use 93.3% End of life 0.4% Galaxy VX UPS 1250 - CO2e emissions per life stage Manufacturing Distribution Installation Use End of life Use 93.3% Breakdown of total carbon footprint for a 3-phase UPS (example: Galaxy VX). Life is On | Schneider Electric UPS carbon footprint comparisons Life is On | Schneider Electric • A sustainability comparison

makes sense only after developing a list of UPS models that meet your functional requirements. • In the case of a UPS, requirements may include kW capacity, physical footprint, efficiency, modularity, etc. Once you have a list of UPSs, then you can quantitatively compare their environmental characteristics. • The most effective way to do this is to compare
their PEPs. • A comprehensive UPS carbon footprint comparison should consider all five of its life cycle stages. This section first explains common errors to avoid when comparing UPSs and then provides step by step guidance on comparing each of the five life cycle stages. • We use two UPSs to demonstrate the comparison. A key theme in this section is
the concept of comparing “apples to apples.” UPS carbon footprint comparisons Common errors to avoid when comparing products While the ISO standards provide the basis for LCAs and PEPs, they don’t eliminate vendor mistakes or ensure valid comparisons. Therefore, end users must be vigilant when comparing PEPs for two or more UPSs, especially
if they’re from different vendors. This section covers the major errors people make when comparing the carbon footprint of two or more UPS. Life is On | Schneider Electric An emission factor is the ratio of greenhouse gas emitted for every kWh of electricity a utility generates. The emission factor is multiplied by the energy (kWh) the UPS uses in its lifetime
to arrive at the use stage emissions from electrical losses. Because a UPS operates continuously over its lifetime, the largest contribution to its carbon emissions comes from the use stage. Even a small difference in emission factors has a major impact on a comparison. This is why you can’t compare UPSs with different grid emission factors. An example
of this frequent error is illustrated here. As shown in the table below, it’s quite possible for a PEP of an inefficient UPS (e.g., UPS X at 94%) to show lower total emissions than a more efficient UPS (e.g., Galaxy VX at 95.8%) with an (erroneously calculated) 980,000 kg CO2 e vs. 2,000,000 kg CO2 e. In reality, only the second and the third line can be used
for an apples-to-apples comparison, which shows that UPS X emissions are much higher than Galaxy VX. How different grid emission factors impact CO2 e emissions declaration. Example: 1250kW UPS Efficiency % Grid Emissions Factor (kgCO2/kWH) Grid geography CO2 emissions declared in PeP (Use phase) in kgCO2 UPS X 94% 0,2 FR 980 000
94% 0,41 EU-27 2 000 000 Galaxy VX 95,8% 0,41 EU-27 1 400 000 2 22kW UPS Comparing “use stage” carbon emissions based on different utility grid emission factorsError #1 When the emission factors are set equal (0.41 kg CO2 e/kWh), the total CO2 e footprint for the low-efficiency UPS is 1.4 times higher than the high-efficiency UPS. This example
was calculated assuming an overall emission factor for the 27 European countries (0.41 kg CO2 e/kWh) compared to that of France (0.2 kg CO2 e/kWh) 6 . 6 This is an older (and higher) value than today’s EU-27 and France values. The program operator, P.E.P. Association, tries to keep this value consistent over the years to avoid publishing PEP
documents based on different emission factors. Life is On | Schneider Electric Example of CO2 footprint comparison between UPS with different emission factors. Because PEPs use codes that can be difficult to understand, an easier way to assess the use stage emissions between two or more UPSs is to compare their efficiencies with the same grid
emission factor. The 3-phase UPS Efficiency Comparison Calculator simplifies this task. 0 500,000 1,000,000 1,500,000 2,000,000 2,500,000 Manufacturing Distribution Installation Use End of life UPS CO2e footprint UPS X - 94% eff using French EF (0.2 kg CO2e/kWh UPS X - 94% eff using European EF (0.4 kg CO2e/kWh GVX - 96% eff using European
EF (0.4 kg CO2e/kWh Incorrect comparison Correct comparison since both UPS use the same emission factor (EF) 2 2 2 Common errors to avoid when comparing products Life is On | Schneider Electric If a UPS has two operating modes, it will have two efficiency curves characterizing each mode. An example of this is illustrated using the Three Phase
UPS Efficiency Comparison Calculator. Example of UPS efficiency curves for two different operating modes. • UPS with two operating modes will have two efficiency curves • Generally cannot compare values from different operating modes • If operator uses high-efficiency for one UPS but double conversion with another, values cannot be compared
Comparing “use stage” carbon emissions with different operating modesError #2 Life is On | Schneider Electric Common errors to avoid when comparing products Declaring a winning attribute that is within the margin of errorError #7 Granting recycling credit without evidence of recycling programError #6 Assuming a PEP includes expected
componentsError #5 Comparing UPS PEPs with different PSR and PCR versionsError #4 Comparing UPSs with different capacitiesError #3 Life is On | Schneider Electric Calculate the weighted UPS efficiency for the operating mode that will actually be used (e.g., double conversion or high-efficiency mode). The typical operating mode is double
conversion. Do this for each UPS you’re comparing using the formula provided below: This step requires: • The total energy consumption (kWh) – sum of all reference test loads from Step 2 • The grid emission factor (kg CO2 e/kWh) – Ideally, the emission factor is the same as that of the electric grid supplying the UPS. This final step sums the emissions
from all five life cycle stages (i.e., manufacturing, distribution, installation, use, and end of life) using the UPS PEP document. If the UPSs have different rated capacities, then you should compare the total carbon footprint using the ‘K- factor’ described above, or use the data from the nearest UPS rating provided in the PEP. This will allow you to see which
UPS has the lowest total carbon footprint. This step requires the following for each UPS you’re comparing: • The efficiencies from Step 1 • The grid emission factor (kg CO2 e/kWh) – Ideally, the emission factor is the same as that of the electric grid supplying the UPS. • The rated capacity of the UPS (kW) • The UPS reference service life (RSL) (15 years)
Step 1: Calculate the weighted efficiency. Step 3: Calculate UPS electricity CO2 emissions. Step 4: Add CO2 emissions from the other life stages. Step 2: Calculate UPS electricity consumption. Four steps for accurate UPS comparisons This section describes the steps required to accurately compare two or more UPSs. UPS life cycle electricity emissions
(kg CO2 e) Weighted efficiency Total energy consumption kWh Emission factor (kg CO2 e/kWh) = = x 25% x Eff25% + 50% x Eff50% + 25% x Eff75% + 0% x Eff100% Life is On | Schneider Electric UPS carbon calculation tool This section describes the excel worksheet that facilitates UPS carbon footprint comparisons using the four steps described in the
previous section. We describe each input that the worksheet uses to calculate the total life cycle carbon footprint for the UPS models you’re comparing. All input cells are highlighted in yellow. Main input cells: UPS carbon footprint comparison tool In Step 1, the set of inputs describe the efficiency of the UPSs you’re comparing. The UPS model and
operating mode inputs are used only to label the efficiency data. The efficiency data should have at least one decimal of precision. Note, you must choose the operating mode that will actually be used at the site (typically double conversion). With the data provided by the Three Phase UPS Efficiency Comparison Calculator, you can enter the efficiencies in
the yellow cells for most Schneider Electric UPSs. Table used to calculate weighted UPS efficiency: In Step 2 & 3, with the data entered thus far, the tool calculates the electricity consumption (kWh) and electricity-based emissions (kg CO2 e) in the green rows. Table used to calculate the electricity consumption (kWh) and electricity-based emissions (kg
CO2 e): Per Step 4, the last part of the worksheet sums the emissions from the remaining life cycle stages (i.e., manufacturing, distribution, installation, and end of life) using the values in the UPS PEP document. The worksheet also calculates the emissions per unit kW of rated UPS capacity in case the UPSs have different rated capacities. Table used to
calculate the total UPS life cycle carbon emissions (kg CO2 e): Life is On | Schneider Electric Conclusion Life is On | Schneider Electric As more companies and consumers seek to reduce their environmental footprint, vendors are responding with claims of environmentally sustainable UPSs. Assessing the environmental sustainability of a UPS is complex
and claims are difficult to ascertain without knowing the underlying assumptions and standards upon which they are made. By understanding the calculations behind the sustainability claims of the UPS you are considering, you can confidently choose a UPS that is better for your operations and the planet. This e-guide defined and covered five life cycle
stages that encompass a UPS’s environmental sustainability performance. We provided explanations for how to calculate the electricity-based UPS emissions. Finally, we offered guidance for how to accurately assess the sustainability of similar UPSs and a tool to help with UPS comparisons. Conclusion 998-23218491_GMA To learn more about addressing your UPS’s environmental sustainability, visit: se.com
Schneider Electric 35 rue
Joseph Monier 92500 Rueil-Malmaison, France Tel : +33 (0)1 41 29 70 00 General 05/2024 EcoStruxure™ Power for EV Battery Manufacturing Plants Utilizing a Digital Twin for Electrical Distribution to Drive Efficient Facilities Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services
SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Purpose of the Document Target Audience This document is intended to address End User Engineering, Operations and Maintenance, Consultants, EPCs (Engineering, Procurement, and Construction)
and Service teams and other qualified personnel. Objective To understand the challenges of designing and operating an EV battery manufacturing plant with an efficient and sustainable electrical distribution strategy. Table of Contents Overview of capabilities Previous Next Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants
General SECTION 3 – Digital Solutions and Services SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Table of Contents SECTION 1: Introduction to the Electrical Vehicle Battery Manufacturing Plants Introduces the context and the challenges of EV
battery manufacturing plants. SECTION 2: How Schneider Electric Can Support Electrical Vehicle Battery Manufacturing Plants Describes the solutions that Schneider Electric and, more specifically EcoStruxure Power provides for EV battery manufacturing plants, with typical electrical and digital architecture. BIBLIOGRAPHY Contains useful documents to
find out more about capabilities. Provides details about Green Premium. SECTION 3: Digital Solutions and Services Gives information about EcoStruxure Power capabilities for EV battery Manufacturing plants, sorted by value proposition: • Transverse Lifecycle Capabilities • Capabilities to Improve Time To Market • Capabilities to Improve Your Process •
Capabilities to Improve Quality • Capabilities to Grow Sustainability Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General WHY READ THIS SECTION? SECTION 1 SECTION 3 – Digital Solutions and Services SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery
Manufacturing Plants BIBLIOGRAPHY EV Battery Market EV Battery Manufacturing Plant Challenges The objective of this section is to: • Introduce the growth, trends and challenges of the EV battery market • Present the 4 pillars to meet the EV battery manufacturing plant challenges. Introduction to the Electrical Vehicle Battery Manufacturing Industry
Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY SECTION 1 – Introduction to the EV Battery Manufacturing Industry EV Battery Market EV Battery Manufacturing Plant Challenges EV
Battery Market An industry driven by the electrical vehicle market 8 EV models Launched by Nissan by the end of 2023. Goal is to be on pace to sell 1M hybrid or electric vehicles per year globally. 15-25% sales of hybrid & EV For BMW by 2025. 20 EV models Launched by Audi by the end of 2025. 27 B$ investment By General Motors in EV infrastructure
through 2025 with the aim of releasing 30 EV vehicles onto the market within the same timeframe 1 M hybrid & electrical vehicles On the road pledged by Volvo by end of 2025. Expectation of 50% of global sales from EVs. 10 EV models Introduced by Mercedes by the end of 2023. Ban of diesel- and gas-powered cars In the UK expected to go into effect
by 2030. Sources https://www.caranddriver.com/news/g35562831/ev-plans-automakers-timeline/ Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY SECTION 1 – Introduction to the EV
Battery Manufacturing Industry EV Battery Market EV Battery Manufacturing Plant Challenges EV Battery Market The market trends: a changing landscape Significant investment in Greenfield and expansions A growing focus on efficiency and sustainability High demand for energy and power to meet battery production capacity Cybersecurity Reference
Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY SECTION 1 – Introduction to the EV Battery Manufacturing Industry EV Battery Market EV Battery Manufacturing Plant Challenges How can we
minimize downtime to increase yield rates and improve production quality? How can we be best-in- class for CO2 emissions per kWh? How to improve the overall energy efficiency of the plant and process? How can we accelerate the design & build of new EV battery plants? EV Battery Manufacturing Plant Challenges Four pillars to drive efficiency,
reliability and sustainability KPIs The strong growth of the EV market leads to an increasing need for battery manufacturing plants. Creating or expanding EV battery manufacturing plants is not without its challenges. Four pillars must be addressed: Grow Sustainability Improve Quality Improve Your Process Improve Time to Market How can we reduce the
cost of finished battery cells? Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General WHY READ THIS SECTION? SECTION 2 SECTION 3 – Digital Solutions and Services SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants
BIBLIOGRAPHY Solutions to Address the Four Pillars Schneider Electric Value Propositions Example of Electrical and Digital Architecture The objective of this section is to: • Present the solutions to address the four pillars to meet the EV battery manufacturing plant challenges • Explain how Schneider Electric EcoStruxure™ Power can support this
industry • Give an example of electrical and digital architectures. How Schneider Electric Can Support Electrical Vehicle Battery Manufacturing Plants Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General Schneider Electric Value Propositions Example of Electrical and Digital Architecture Solutions to Address the Four Pillars
SECTION 3 – Digital Solutions and Services SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Grow Sustainability Improve Quality Improve Your Process Improve Time to Market Solutions to Address the Four Pillars of EV Battery Manufacturing Plants
The four pillars can be addressed by the following solutions: Increase Production Efficiency Reduce Production Hazards Track Sustainability KPIs Use Standardized Architectures Use standardized electrical distribution and IT infrastructures in order to speed up the “design, build and commission” phase of new plants. Digitize and modernize your operations
and turn data into useful business intelligence to empower your workforce, understand the profitability of your production assets and make smart business decisions for your entire ecosystem. Reduce downtimes and manage end-to-end quality to reduce production scrap. Utilize control tower and IoT platforms to collect analytics on processes, settings and
maintenance. Monitor sustainability criteria to accelerate environmental transition and be compliant with sustainability standards and customer expectations. Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 2 – How SE Can Support EV Battery Manufacturing Plants Example of Electrical and Digital
Architecture Solutions to Address the Four Pillars Schneider Electric Value Propositions SECTION 3 – Digital Solutions and Services SECTION 1 – Introduction to the EV Battery Manufacturing Industry BIBLIOGRAPHY Schneider Electric Value Propositions At company level Through its entire organization, Schneider Electric has developed value
propositions to address the four pillars for the different parts of EV battery manufacturing plants: Infrastructure / Facility Manufacturing Process Manufacturing Machine Design and Modeling Digital Automation & IOT Framework EcoStruxure Machine Architecture Energy Efficiency Process Efficiency Machine Performance & Flexibility Power Availability
Predictive Quality Machine Tracking & Monitoring Green House Gas and Energy Compliance Energy Optimization Sustainable Sourcing Grow Sustainability Improve Quality Improve Your Process Improve Time to Market Transverse Lifecycle Capabilities (Cybersecurity, Green Premium, Digital Twin) Reference Guide EcoStruxure™ Power for EV Battery
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Schneider Electric Value Propositions At EcoStruxure Power level This guide focuses more specifically on value propositions provided by EcoStruxure Power: Manufacturing Process Manufacturing Machine Digital Automation & IOT Framework EcoStruxure Machine Architecture Process Efficiency Machine Performance & Flexibility Predictive Quality
Machine Tracking & Monitoring Energy Optimization Sustainable Sourcing Grow Sustainability Improve Quality Improve Your Process Improve Time to Market Transverse Lifecycle Capabilities (Cybersecurity, Green Premium, Electrical Digital Twin) Infrastructure / Facility Design and Modeling Energy Efficiency Power Availability Green House Gas and
Energy Compliance Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 2 – How SE Can Support EV Battery Manufacturing Plants Example of Electrical and Digital Architecture Solutions to Address the Four Pillars Schneider Electric Value Propositions SECTION 3 – Digital Solutions and Services SECTION 1 –
Introduction to the EV Battery Manufacturing Industry BIBLIOGRAPHY Schneider Electric Value Propositions At EcoStruxure Power level EcoStruxure Power helps deliver an end-to-end digital solution for efficient, reliable and sustainable EV Battery Plants. From electrode production to cell finishing, From electrical design to operations and maintenance,
Our collaborative environments, enhanced by the Electrical Distribution Digital Twin of your Plant, enable high productivity operations. Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 2 – How SE Can Support EV Battery Manufacturing Plants Solutions to Address the Four Pillars Schneider Electric Value
Propositions Example of Electrical and Digital Architecture SECTION 3 – Digital Solutions and Services SECTION 1 – Introduction to the EV Battery Manufacturing Industry BIBLIOGRAPHY Example of Electrical and Digital Architecture Typical EV battery manufacturing plant Energy is key, whether for processes or for utilities: specific attention must be
given to the design of the electrical architecture and associated digital architecture which will enable digital solutions and services. EV battery manufacturing plant PROCESS Energy consumption 60 % UTILITY Energy consumption 40 % Cell assembly Utilities – Clean and dry room Ageing/Formation Utilities Infrastructure 3%Mixing Coating and drying
Vacuum drying Calendering Slitting 23 % 2% 2% 2% 2% 26 % 37 % 3% Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 2 – How SE Can Support EV Battery Manufacturing Plants Solutions to Address the Four Pillars Schneider Electric Value Propositions Example of Electrical and Digital Architecture
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Availability High Energy demand = Efficient Energy Management ELECTRODE PRODUCTION • Mixing • Coating & Drying • Calendering • Slitting • Vacuum Drying CELL ASSEMBLY • Electrode shaping • Stacking • Electric contacting • Case insertion • Case closure CELL FINISHING • Electrolyte filling Pre-charging • Filling hole closure • Ageing &
formation INFRASTRUCTURE • Emergency Loads • IT and Control Room • Lightings and other UTILITIES • Dry Room MV Chillers and Dryers • Clean Room MV Chillers • Cooling Water • Waste Treatment • Inert gas (N2) PROCESS UTILITY 60 % 40 % Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 2 –
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battery manufacturing plant Example of Digital Architecture (Detailed View) General Example Digital Architecture (Detailed View) Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General WHY READ THIS SECTION? SECTION 3 SECTION 3 – Digital Solutions and Services Introduction Overview of Digital Solutions and
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gives information about EcoStruxure Power capabilities for EV battery manufacturing plants aligned to the industry challenges. Digital Solutions & Services Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Introduction SECTION 1 – Introduction to the EV Battery
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Improve Quality Improve Your Process Improve Time to Market Introduction EcoStruxure Power provides capabilities to support the challenges of EV battery manufacturing plant throughout the plant lifecycle: These capabilities provide standardized designs and digital architectures, and enable easy simulation, to reduce cost of design and ownership.
These capabilities use digitization to provide intelligent information to the workforce, allowing them to make smart decisions that reduce operating costs and increase efficiency. These capabilities use digitization to reduce unplanned downtime, increase reliability, and thus reduce production waste. These capabilities help track energy consumption and
carbon emissions to meet sustainability requirements. Design, Build, Commission (Consultants & EPC) Operate & Maintain (Operators, maintenance team, service teams) Transverse Lifecycle Capabilities Digital Solutions that support your project from the Design, Build, Commission to Operate & Maintain phases. Reference Guide EcoStruxure™ Power
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Cybersecurity Carbon neutrality consulting services Energy efficiency compliance Greenhouse gas reporting + + + Grow Sustainability Improve Quality Improve Your Process Improve Time to Market Design, Build, Commission (Consultants & EPC) Operate & Maintain (Operators, maintenance team, service teams) Transverse Lifecycle Capabilities AC&DC
electrical network bus design and simulation Electrical network short circuit simulation Network load flow and voltage drop simulation Device coordination and selectivity Arc fault protection and coordination Power quality simulation and modeling Renewable & microgrid energy storage sizing simulation + + + + + + + Asset performance Power quality
monitoring and compliance Continuous thermal monitoring Electrical distribution monitoring and alarming Power event analysis Predictive simulation Power quality and power factor correction + + + + + + + Arc flash protection+ Simulate before Operate+ Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 –
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efficiency compliance Greenhouse gas reporting + + + Grow Sustainability Improve Quality Improve Your Process Improve Time to Market Design, Build, Commission (Consultants & EPC) Operate & Maintain (Operators, maintenance team, service teams) Transverse Lifecycle Capabilities AC&DC electrical network bus design and simulation Electrical
network short circuit simulation Network load flow and voltage drop simulation Device coordination and selectivity Arc fault protection and coordination Power quality simulation and modeling Renewable & microgrid energy storage sizing simulation + + + + + + + Asset performance Power quality monitoring and compliance Continuous thermal monitoring
Electrical distribution monitoring and alarming Power event analysis Predictive simulation Power quality and power factor correction + + + + + + + Arc flash protection+ Simulate before Operate+ Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Transverse Lifecycle Capabilities
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Electrical Digital Twin Maintain a Digital Twin of your electrical distribution Benefits • Intelligent user-interface for all levels of AC and DC networks • Enables users, from the design to operate phases, to model, simulate, analyze and validate electrical power systems to predict their electrical network behavior • Takes the day-to-day system modeling and
design tasks to a new level of speed, accuracy and ease Electrical Digital Twin Transverse Lifecycle Capabilities Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Transverse Lifecycle Capabilities SECTION 2 – How SE Can Support EV Battery Manufacturing Plants
BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery Manufacturing Industry Capabilities to Grow Sustainability Green Premium Manage sustainability from design to end of life
Benefits • Green Premium* products provide detailed information on their regulatory compliance, material content, environmental impact, and circularity attributes. Transverse Lifecycle Capabilities Compliance and transparency (compliance certificates, circularity profiles, environmental footprint, etc.)1 Circular performance
Durability, upgradeability, remanufacture, recycled content, recyclability Well-being performance E.g. free of PVC, mercury, silicone, SVHC, lead, toxic heavy metal and compliant with California Prop 65 4 Resource performance Optimized energy performance Lower carbon emissions 2 3 * The Green Premium label was created to

provide Schneider Electric's customers with more
sustainable products and to be transparent with environmental information. Supporting your efforts for a LEED certified building Helping you achieve Living Building Challenge certification Green Premium Value Proposition Learn more about: • Green Premium Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3
– Digital Solutions and Services Transverse Lifecycle Capabilities SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Improve Quality SECTION 1 – Introduction to the EV
Battery Manufacturing Industry Capabilities to Grow Sustainability Cybersecurity Help secure the digital power distribution system Benefits • Provides a selection of cybersecurity certified products • Provides certified system architectures and solutions • Delivers lifecycle services Transverse Lifecycle Capabilities Learn more about: • Cybersecurity Certified
products developed according to IEC 62443 functional requirements with Secure Development Lifecycle processes. Consulting services from design, implementation, operations and maintenance to tailor your security solutions to your strategy and budget. Lifecycle services Certified secure system architecture according to IEC 62443-3-3 with documented
processes and solutions for a secure system. Cybersecurity system configuration software for consistent security policy deployment. Certified products Certified systems & solutions Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Time to Market
SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Your Process Capabilities to Improve Quality Capabilities to Grow Sustainability
Overview of Digital Solutions and Services Electrical Digital Twin Green Premium Operator training simulation Energy monitoring and usage analysis Energy performance, modeling and verification Capacity management + + + + Cybersecurity Carbon neutrality consulting services Energy efficiency compliance Greenhouse gas reporting + + + Grow
Sustainability Improve Quality Improve Your Process Improve Time to Market Design, Build, Commission (Consultants & EPC) Operate & Maintain (Operators, maintenance team, service teams) Transverse Lifecycle Capabilities AC&DC electrical network bus design and simulation Electrical network short circuit simulation Network load flow and voltage
drop simulation Device coordination and selectivity Arc fault protection and coordination Power quality simulation and modeling Renewable & microgrid energy storage sizing simulation + + + + + + + Asset performance Power quality monitoring and compliance Continuous thermal monitoring Electrical distribution monitoring and alarming Power event
analysis Predictive simulation Power quality and power factor correction Simulate before Operate Arc flash protection + + + + + + + + + Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Time to Market SECTION 1 – Introduction to the EV Battery
Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Your Process Capabilities to Improve Quality Capabilities to Grow Sustainability AC and DC Electrical Network Bus Design and
Simulation Optimize bus design allocation and simulation Primary Department • Design • Construction Benefits • Single solution/environment - Unified AC & DC solution from HV to LV - One unique platform and one database • Efficient profile management - User-defined loading and generation profiles - External data profile based on field measurements •
Scalability - Load growth study for future planning • Event simulations within the calculation period Capabilities to Improve Time to Market ETAP Electrical Network Model Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Time to Market SECTION 1 –
Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Your Process Capabilities to Improve Quality Capabilities to Grow Sustainability Electrical Network
Short Circuit Simulation Design and simulate unbalanced short circuits Primary Department • Design • Construction Benefits • Expedite design studies with a wide range of calculation scenarios, including advanced fault analysis - IEC & ANSI duty calculation for balanced and unbalanced faults - Simultaneous fault at selected nodes - Inclusive 3-Phase and
1-Phase fault analysis - Pre-Fault system loading consideration Electrical Network Short Circuit Simulation in ETAP Capabilities to Improve Time to Market Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Time to Market SECTION 1 – Introduction to
the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Your Process Capabilities to Improve Quality Capabilities to Grow Sustainability Network Load Flow and Voltage Drop
Simulation Perform power flow analysis and voltage drop calculations Primary Department • Design • Construction Benefits • Simulation of bus voltages, branch power factors, currents, system losses, power generation versus loading • Use of ETAP Electrical Digital Twin model with powerful calculation engines and user-friendly interface • Simulation using
multiple loading and generation conditions Network Load Flow and Voltage Drop Simulation in ETAP Capabilities to Improve Time to Market Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Time to Market SECTION 1 – Introduction to the EV Battery
Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Your Process Capabilities to Improve Quality Capabilities to Grow Sustainability Device Coordination and Selectivity Automatically
detect and evaluate the system protection and coordination/selectivity Primary Department • Design • Construction Benefits • Verified and validated libraries • Graphically adjustable device settings • Detailed device settings reporting • Continuous synchronization with one-line and integrated equipment database Device Coordination and Selectivity in ETAP
Capabilities to Improve Time to Market Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Time to Market SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants
BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Your Process Capabilities to Improve Quality Capabilities to Grow Sustainability Arc Fault Protection and Coordination Perform sequence of operation for arc fault and bolted fault Primary Department • Design • Construction
Benefits • Evaluate, verify, and confirm the operation and selectivity of the protective devices for various types of faults for any location directly from the single-line diagram • Animation displayed on the single-line diagram • 3-phase / 1-phase sequence of operation Arc Fault Protection and Coordination in ETAP Capabilities to Improve Time to Market
Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Time to Market SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital
Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Your Process Capabilities to Improve Quality Capabilities to Grow Sustainability Power Quality Simulation and Modeling Evaluate and validate distortion due to harmonics Primary Department • Design • Construction Benefits • Simulate harmonic current and voltage sources: -
To identify potential harmonic problems (report of harmonic voltage and current distortion limit violations) - To identify the need for a harmonics filter • Simulate and analyze the size of the harmonics filter your system will need to optimize performance and reduce nuisance trips Capabilities to Improve Time to Market Power Quality Simulation and Modeling in
ETAP Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Time to Market SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of
Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Your Process Capabilities to Improve Quality Capabilities to Grow Sustainability Renewable and Microgrid Energy Storage Sizing Simulation Design and optimize the microgrid system Primary Department • Design • Construction Benefits • Build renewable energy
models combined with full spectrum power system analysis calculations for: - Accurate simulation - Predictive analysis - Equipment sizing - Field verification of wind, solar farms and other DERs • Enable designers and engineers to conceptualize the collector systems, determine wind penetration and perform grid interconnection studies Microgrid Energy
Storage Sizing Simulation in ETAP Capabilities to Improve Time to Market Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Your Process SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV
Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Quality Capabilities to Grow Sustainability Overview of Digital Solutions and Services Electrical Digital Twin Green Premium Operator training simulation
Energy monitoring and usage analysis Energy performance, modeling and verification Capacity management + + + + Cybersecurity Carbon neutrality consulting services Energy efficiency compliance Greenhouse gas reporting + + + Grow Sustainability Improve Quality Improve Your Process Improve Time to Market Design, Build, Commission (Consultants
& EPC) Operate & Maintain (Operators, maintenance team, service teams) Transverse Lifecycle Capabilities AC&DC electrical network bus design and simulation Electrical network short circuit simulation Network load flow and voltage drop simulation Device coordination and selectivity Arc fault protection and coordination Power quality simulation and
modeling Renewable & microgrid energy storage sizing simulation + + + + + + + Asset performance Power quality monitoring and compliance Continuous thermal monitoring Electrical distribution monitoring and alarming Power event analysis Predictive simulation Power quality and power factor correction Arc flash protection Simulate before Operate + + +
+ + + + + + Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Your Process SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction
Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Quality Capabilities to Grow Sustainability Operator Training Simulation Train new employees and build confidence on new systems Primary Department • Facility Operations & Maintenance Benefits • Practice
operation within a simulated but highly realistic environment to enhance safety and operational efficiency • Track and review trainee actions to analyze and challenge them + Capabilities to Improve Your Process Learn more about: • Operator Training Simulation (IEC / NEMA) Principle of Operator Training Simulation Application Operator Training
Simulation Reference Architecture General Operator Training Simulation Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Your Process SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE
Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Quality Capabilities to Grow Sustainability Energy Monitoring and Usage Analysis Determine where to focus energy conservation initiatives
Primary Department • Facility Operations & Maintenance Benefits • Bring awareness to utility consumption - Turn data into easy-to-interpret graphical dashboards and reports to raise awareness amongst key stakeholders • Identify "quick-win" opportunities for energy savings - By comparing and visualizing energy usage and cost for different utilities over
different time periods - By identifying and prioritizing which areas lend themselves to a high energy-saving return on investment Capabilities to Improve Your Process Energy Usage Analysis Dashboards in EcoStruxure Power Operation Learn more about: • Energy Monitoring (IEC / NEMA) Energy Monitoring and Usage Analysis Reference Architecture
General Energy Monitoring and Usage Analysis Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Your Process SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery
Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Quality Capabilities to Grow Sustainability Energy Performance, Modeling and Verification Analyze the energy performance of a plant against a model baseline
Primary Department • Facility Operations & Maintenance Benefits • Provide energy usage information based on equipment and processes • Compare model versus actual consumption • Compare pre-retrofit versus post-retrofit energy consumption to track improved performance and savings as a result of energy conservation initiatives Capabilities to
Improve Your Process Energy Performance, Modeling and Verification Output in EcoStruxure Power Operation Learn more about: • Energy Performance (IEC / NEMA) • Energy Modeling and verification (IEC / NEMA) Energy Performance, Modeling and Verification Reference Architecture General Energy Performance Modeling and Verification
Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Your Process SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY
Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Quality Capabilities to Grow Sustainability Capacity Management Monitor the capacity of electrical distribution Primary Department • Facility Operations & Maintenance Benefits • Monitor electrical network
capacity • Track and review capacity efficiency • Minimize downtime by tracking the capacity of transformers, circuit breakers, UPSs, generators, etc. Capabilities to Improve Your Process Breaker Capacity Single-line Diagram in EcoStruxure Power Operation Learn more about: • Capacity Management (IEC / NEMA) Capacity Management Reference
Architecture General Capacity Management Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery
Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Grow Sustainability AC&DC electrical network bus design and simulation Electrical network short circuit simulation Network load flow
and voltage drop simulation Device coordination and selectivity Arc fault protection and coordination Power quality simulation and modeling Renewable & microgrid energy storage sizing simulation + + + + + + + Overview of Digital Solutions and Services Electrical Digital Twin Green Premium Operator training simulation Energy monitoring and usage
analysis Energy performance, modeling and verification Capacity management + + + + Cybersecurity Carbon neutrality consulting services Energy efficiency compliance Greenhouse gas reporting + + + Grow Sustainability Improve Quality Improve Your Process Improve Time to Market Design, Build, Commission (Consultants & EPC) Operate & Maintain
(Operators, maintenance team, service teams) Transverse Lifecycle Capabilities Asset performance Power quality monitoring and compliance Continuous thermal monitoring Electrical distribution monitoring and alarming Power event analysis Predictive simulation Power quality and power factor correction + + + + + + + Arc flash protection+ Simulate before
Operate+ Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of
Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Grow Sustainability Predictive Simulation Help employees make better decisions Primary Department • Facility Engineering • Design Engineering Benefits • Reduce safety risks by practicing
emergencies and high-risk situations • Enhance operational efficiency by running "what-if" scenarios • Provide faster analysis response to incidents Capabilities to Improve Quality + Principle of Predictive Simulation Application Predictive Simulation Reference Architecture General Predictive Simulation Application Digital Architecture Reference Guide
EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services
Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Grow Sustainability Simulate Before Operate Empower operators with predictive outcomes Primary Department • Facility Operations & Maintenance Benefits • Provide operators with a list of potential side effects, prior to executing a
command • Empower employees to feel more confident when operating their facilities by providing real time guidance • Reduce human error that could lead to outages or safety concerns Capabilities to Improve Quality Learn more about: • Simulate Before Operate (IEC / NEMA) Principle of Simulate before Operate Application Simulate Before Operate
Reference Architecture General Simulate Before Operate Application Digital Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support
EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Grow Sustainability Electrical Distribution Monitoring and Alarming Monitor and control electrical network Primary
Department • Facility Operations & Maintenance Benefits • Show real-time status of the power distribution • Customized single-line diagram • 24/7 power monitoring and alarm notification Capabilities to Improve Quality Electrical Distribution Monitoring and Alarming Single-line Diagram in EcoStruxure Power Operation Learn more about: • Electrical
distribution monitoring and alarming (IEC / NEMA) • Power Source and Load Control (IEC / NEMA) Electrical Distribution Monitoring and Alarming Reference Architecture General Electrical Distribution Monitoring and Alarming Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants
General SECTION 3 – Digital
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Improve Your Process Capabilities to Grow Sustainability Power Event Analysis Analyze the root causes of electrical events Primary Department • Facility Operations & Maintenance Benefits • Automatically classifies and describes any electrical events • Uses system intelligence to determine root cause and location of events • Shows context and sequence
of events using the timeline analysis interface Event and Alarm Status view in EcoStruxure Power Operation Event and Alarm Status Timeline in EcoStruxure Power Operation Capabilities to Improve Quality Learn more about: • Power Event Analysis (IEC / NEMA) Power Event Analysis Reference Architecture General Power Event Analysis Reference
Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of
Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Grow Sustainability Asset Performance Benefit from a strategic maintenance approach Primary Department • Facility Operations & Maintenance Benefits • Move from reactive or preventive to conditionbased (predictive) maintenance strategies for critical assets like circuit breakers, gensets, transformers, etc. • Provide event details and notification to the operator if a protection setting has been changed • Receive notifications and diagnostics reports from expert service engineers with recommendations to optimize maintenance by asset or site Capabilities
to Improve Quality Aging Diagram for Circuit Breakers in EcoStruxure Power Operation Gigafactory Learn more about: • Asset Performance (IEC / NEMA) Asset Performance Reference Architecture General Asset Performance Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital
Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to
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Improve Your Process Capabilities to Grow Sustainability Power Quality Monitoring and Compliance Gain insights to improve power quality and comply with standards Primary Department • Facility Operations & Maintenance Benefits • Bring awareness of power quality • Enhance operational efficiency by making sure clean power is fed to sensitive process
equipment • Help protect sensitive equipment by tracking power quality problems before they arise Capabilities to Improve Quality Power Quality and Compliance Dashboards in EcoStruxure Power Operation Power Quality and Compliance Report in EcoStruxure Power Operation Learn more about: • Power Quality Monitoring and Compliance (IEC /
NEMA) Power Quality Monitoring and Compliance Reference Architecture General Power Quality Monitoring and Compliance Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery
Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Grow Sustainability Power Quality and Power Factor Correction
Help protect sensitive equipment from power quality issues Primary Department • Facility Operations & Maintenance Benefits • Monitor sensitive process lines and busbars • Provide clean power to sensitive process equipment • Track Power Quality problems to help avoid downtime • Reduce financial impact of power factor on energy bill Capabilities to
Improve Quality Galaxy VM Power Quality Information in EcoStruxure Power Operation Before and After Power Quality and Power Factor Correction ImplementationLearn more about: • Power Quality Correction (IEC / NEMA) • Power Factor Correction (IEC / NEMA) Power Quality and Power Factor Correction Reference Architecture General Power
Quality and Power Factor Correction Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing
Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Grow Sustainability Continuous Thermal Monitoring Help prevent electrical fires and help protect equipment Primary Department • Facility Operations &
Maintenance Benefits • Bring early detection of temperature abnormalities • Help reduce the risk of equipment and electrical room damage and improve service continuity • Enable cost effective maintenance Continuous Thermal Monitoring in the Single-line Diagram of EcoStruxure Power Operation Continuous Thermal Monitoring Reference Architecture
Capabilities to Improve Quality Learn more about: • Continuous Thermal monitoring (IEC / NEMA) General Continuous Thermal Monitoring Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Improve Quality SECTION 1 – Introduction to
the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Grow Sustainability Arc Flash Protection Help
protect employees and equipment Primary Department • Facility Operations & Maintenance Benefits • Help prevent loss of life and reduce the risk of equipment and electrical room damage • Improve maintenance team awareness to help troubleshoot and identify the root cause of arc flash events Capabilities to Improve Quality Learn more about: • Arc
Flash Protection (IEC / NEMA) Arc Flash in a Switchboard Arc Flash Alert and Location in EcoStruxure Power Operation Arc Flash Protection Reference Architecture General Arc Flash Protection Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services
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Capabilities to Improve Quality Overview of Digital Solutions and Services Electrical Digital Twin Green Premium Operator training simulation Energy monitoring and usage analysis Energy performance, modeling and verification Capacity management + + + + Cybersecurity Carbon neutrality consulting services Energy efficiency compliance Greenhouse
gas reporting + + + Grow Sustainability Improve Quality Improve Your Process Improve Time to Market Design, Build, Commission (Consultants & EPC) Operate & Maintain (Operators, maintenance team, service teams) Transverse Lifecycle Capabilities AC&DC electrical network bus design and simulation Electrical network short circuit simulation Network
load flow and voltage drop simulation Device coordination and selectivity Arc fault protection and coordination Power quality simulation and modeling Renewable & microgrid energy storage sizing simulation + + + + + + + Asset performance Power quality monitoring and compliance Continuous thermal monitoring Electrical distribution monitoring and
alarming Power event analysis Predictive simulation Power quality and power factor correction + + + + + + + Arc flash protection+ Simulate before Operate+ Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Grow Sustainability SECTION 1 – Introduction to the

EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Improve Quality Carbon Neutrality Consulting
Services Primary Department • Facility Operations & Maintenance • Sustainability Office Benefits • Get support from our consulting services to define your strategy for achieving carbon neutrality Track and reduce carbon emissions to demonstrate the carbon neutrality of the company Capabilities to Grow Sustainability + Services Carbon neutrality Reduce
Carbon Emissions Produce Renewable Energy Purchase Renewables/Offsets Energy Efficiency • Sustainable building design & operations – HVAC Efficiency – Lighting Efficiency – Operational Efficiency Behind-the-Meter Renewables • Solar Panels / Heating • Wind • Geothermal Purchase Renewables • Renewable Power Purchasing Agreements (PPA) •
Renewable Energy Certificates (REC) • Biofuels Supporting Technologies • Microgrid with Smart Management • Battery Storage • Fuel Cells Purchase Offsets • Carbon Credits – Carbon Capture – Tree Planting 1 2 3 Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services
Capabilities to Grow Sustainability SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process
Capabilities to Improve Quality Energy Efficiency Compliance Primary Department • Facility Operations & Maintenance • Sustainability Office Benefits • Report and show facility compliance to local sustainability requirements - To benefit from tax credits - To gain credibility to participate in new projects Comply with standards related to energy management
systems Capabilities to Grow Sustainability EcoStruxure Power Operation Energy Star Compliance Dashboard EcoStruxure Resource Advisor Dashboard in EcoStruxure Power Operation Sustainable Organizations and Standards Learn more about: • Energy Efficiency Compliance (IEC / NEMA) Energy Efficiency Compliance Reference Architecture
General Energy Efficiency Compliance Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services Capabilities to Grow Sustainability SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can Support EV Battery
Manufacturing Plants BIBLIOGRAPHY Introduction Overview of Digital Solutions and Services Transverse Lifecycle Capabilities Capabilities to Improve Time to Market Capabilities to Improve Your Process Capabilities to Improve Quality Greenhouse Gas Reporting Primary Department • Facility Operations & Maintenance • Sustainability Office Benefits •
Track and report carbon emissions and waste (e.g., water) in one single place • Provide period-over-period usage comparison to detect a drift Track and report carbon emissions Greenhouse Gas Reporting and Dashboard Examples in EcoStruxure Power Operation Capabilities to Grow Sustainability Greenhouse Gas Reporting Reference Architecture
Learn more about: • Greenhouse Gas Reporting (IEC / NEMA) General Greenhouse Gas Reporting Reference Architecture Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General SECTION 3 – Digital Solutions and Services SECTION 1 – Introduction to the EV Battery Manufacturing Industry SECTION 2 – How SE Can
Support EV Battery Manufacturing Plants BIBLIOGRAPHY Reference Documents Legal Information BIBLIOGRAPHY Reference Guide EcoStruxure™ Power for EV Battery Manufacturing Plants General BIBLIOGRAPHY Reference Documents SECTION 3 – Digital Solutions and Services SECTION 1 – Introduction to the EV Battery Manufacturing Industry
SECTION 2 – How SE Can Support EV Battery Manufacturing Plants Legal Information Reference Documents Design Guide IEC EcoStruxure Power Design Guide Ref: ESXP2G001EN 02/2024 Digital Applications for Large Buildings and Critical Facilities The Digital Applications Design Guide provides comprehensive details on the building blocks of
EcoStruxure Power: the IoT applications are driven by a software layer to control the traditional electrical distribution infrastructure. Developed to help engineering consultants and designers, this guide is an invaluable resource for specifying, designing and prescribing EcoStruxure Power architectures capable of performing one or more of the businessdriven applications described within. NEMA EcoStruxure Power Design Guide Ref: 0100DB1802 01/2024 https://www.se.com/ww/en/downl oad/document/ESXP2G001EN/ https://www.se.com/us/en/download/ document/0100DB1802/ Web version PDF version Web version https://go.schneider-electric.com/WW_202004_Digital- Applications-for-LargeBuildings-and- Critical-Facilities_EA-LP.html PDF version https://go.schneider- electric.com/WW_202004_Digital- Applications-Design-Guide_EA-LP.html Landing page: https://www.se.com/ww/en/work/campaign/innovation/power-digital-applications-design-guide.jsp
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Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Status Data 40002 0x0001 1 UPS Status 1 0 UPS operation mode - Battery BOOLEAN 1=UPS operation mode - Battery 1 Battery is below minimum acceptable runtime BOOLEAN 1=Battery is below minimum acceptable runtime 2 Bypass BOOLEAN
1=UPS is in Bypass 3 UPS operation mode - Battery Test BOOLEAN 1=UPS operation mode - Battery Test 4 Reserved BOOLEAN 5 High Efficiency Mode disable by system BOOLEAN 1=High Efficiency Mode (ECO, ECOnversion) disable by system 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Battery fault BOOLEAN
1=Battery fault 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Informational alarm present BOOLEAN 1=Informational alarm present 14 Warning alarm present BOOLEAN 1=Warning alarm present 15 Critical alarm present BOOLEAN 1=Critical alarm present 40003 0x0002 2 Alarm Register 1 0 Lost local network
management interface - to - UPS communication BOOLEAN 1=Lost local network management interface - to - UPS communication 1 Display communication is lost BOOLEAN 1=Main Controller is unable to communicate with the display 2 Parallel communication incorrect on PBUS cable 1 BOOLEAN 1=Parallel communication incorrect on PBUS cable 1 3
Parallel communication incorrect on PBUS cable 2 BOOLEAN 1=Parallel communication incorrect on PBUS cable 2 4 MegaTie activation alarm BOOLEAN 1=MegaTie activation is present 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN
12 Communication cable termination fault BOOLEAN 1=Communication cable termination fault 13 General parallel system incorrect BOOLEAN 1=General parallel system incorrect 14 Lost parallel redundancy BOOLEAN 1=Lost parallel redundancy 15 Reserved BOOLEAN 40004 0x0003 3 Alarm Register 0 Reserved BOOLEAN 1 UPS operation mode -
Requested Static Bypass BOOLEAN 1=UPS operation mode - Requested Static Bypass 2 UPS operation mode - Forced Static Bypass BOOLEAN 1=UPS operation mode - Forced Static Bypass Modbus Register Map:Galaxy VX (3:3 250kW-1500kW) Scale Notes: 1. 16-bit registers are transmitted MSB first (i.e. big-endian). 2. INT32 and UINT32 are mostsignificant word in n+0, least significant word in n+1 (i.e. big-endian). 3. Function codes 3 and 4 are supported 4. Modbus serial RTU and Modbus over TCP is supported. 5. Signed numbers are twos-compliment 6. Status bits are atomic within a single Modbus register. User should not look for consistency across multiple registers, only within a single
register. 7. For ASCII strings less than the maximum length, the unused characters are filled with nulls. 8. Single-register reads of reserved or undefined registers will return an error. Block reads which begin with a valid register will not return an error but will return zeros for undefined registers. 9. Strings are two characters per register, first character in highorder byte, second character in low-order byte. Printable ASCII only. 10. Bit #0 is least significant bit. 11. Data Type column: "INT16"=signed 16-bit integer, "UINT16" = unsigned 16-bit integer, "INT32" = signed 32-bit integer, "UINT32" = unsigned 32-bit integer, "ENUM" is a UINT16 value which maps to a defined list of states, "ASCII" = the printable ASCII
subset from 0x20 - 0x7E. BOOLEAN= a single bit, 0 or 1. 12. "Absolute Starting Register Address" = 0 (the column heading used in this table) is equivalent to "Register 40001" in Modicon terminology, which is address zero when transmitted over the wire. For detailed modbus configuration settings, please refer to the Display or AP9635 User's Guide.
990-5915E May/ 2024 Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 3 UPS operation mode - Maintenance Bypass BOOLEAN 1=UPS operation mode -
Maintenance Bypass 4 Reserved BOOLEAN 5 UPS operation mode - Off BOOLEAN 1=UPS operation mode - Off 6 UPS operation mode - Initialize BOOLEAN 1=UPS operation mode - Initialize 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Input phase sequence incorrect BOOLEAN 1=Input phase
sequence incorrect 12 Input frequency out of range BOOLEAN 1=Input frequency out of range 13 Input voltage out of range BOOLEAN 1=Input voltage is out of range 14 Selftest - Failed BOOLEAN 1=Self test has failed 15 Power cabinet mixed operation mode (Battery and Normal) BOOLEAN 1=Power Cabinet in mixed operation mode (Battery and
Normal) 40005 0x0004 4 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2 Reserved BOOLEAN 3 Bypass frequency out of range BOOLEAN 1=Bypass frequency out of range 4 Bypass phase sequence incorrect BOOLEAN 1=Bypass phase sequence incorrect 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8
Overload on UPS BOOLEAN 1=Overload on UPS 9 Overload on Static bypass switch BOOLEAN 1=Overload on Static bypass switch 10 Ambient temperature out of range BOOLEAN 1=Ambient temperature out of range 11 EPO Switch activated BOOLEAN 1=EPO Switch activated 12 Ground fault detected BOOLEAN 1=Ground fault detected 13
Reserved BOOLEAN 14 Bypass voltage out of range BOOLEAN 1=Bypass voltage is out of range 15 High Efficiency mode is disable due to bypass UTHD BOOLEAN 1=Bypass UTHD is out of range for High Efficiency Mode 40006 0x0005 5 Alarm Register 1 0 System locked in bypass operation BOOLEAN 1=System locked in bypass operation 1
Batteries are discharging BOOLEAN 1=Batteries are discharging 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Continuous Overload on UPS BOOLEAN 1=Overload on UPS present. Load below Continuous Overload Threshold. 5 Charge power is reduced BOOLEAN 1=Charge power is reduced 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8
Reserved BOOLEAN 9 Distributed Energy Reserved Mode activated BOOLEAN 1= Distributed Energy Reserved mode activated 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Battery condition is weak BOOLEAN 1=Battery condition is weak 13 Battery condition is poor BOOLEAN 1=Battery condition is poor 14 Reserved BOOLEAN 15 Battery
capacity is below minimum acceptable level BOOLEAN 1=Battery capacity is below minimum acceptable level 40007 0x0006 6 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved BOOLEAN 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved
BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Power cabinet redundancy lost BOOLEAN 1=Power cabinet redundancy lost 40008 0x0007 7 Alarm Register 1 0 Reserved BOOLEAN 1 Bypass transfert inhibited by relay input activated
BOOLEAN 1= transfert to bypass is inhibited by input relay activated 2 DC ground fault BOOLEAN 1= DC ground fault is present Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid
Response Scale 3 Ambient temperature high BOOLEAN 1 = Ambient temperature is high 4 Overload on UPS due to high ambient temperature BOOLEAN 1 = Overload on UPS due to high ambient temperature 5 Output frequency out of range BOOLEAN 1=Output frequency out of range 6 Output voltage out of range BOOLEAN 1=Output voltage is out of
range 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Overload on installation BOOLEAN 1=Overload on installation 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40009 0x0008 8 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2
Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved BOOLEAN 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 UOB Auxiliary wiring not correct BOOLEAN 1= UOB Aux wiring is not correct 13 Reserved BOOLEAN 14 Reserved
BOOLEAN 15 Reserved BOOLEAN 40010 0x0009 9 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Load bank breaker closed, parallel test mode enabled BOOLEAN 1=Load bank breaker closed, parallel test mode enabled 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved
BOOLEAN 8 Reserved BOOLEAN 9 Unit Unit Breaker (UIB) open BOOLEAN 1=Unit Unit Breaker (UIB) open 10 Unit Ouput Breaker (UOB) open BOOLEAN 1=Unit Ouput Breaker (UOB) open 11 Maintenance Bypass Breaker (MBB) closed BOOLEAN 1=Maintenance Bypass Breaker (MBB) closed 12 System Isolation Breaker (SIB) open BOOLEAN
1=System Isolation Breaker (SIB) open 13 Static Switch Input Breaker (SSIB) open BOOLEAN 1=Static Switch Input Breaker (SSIB) open 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40011 0x000A 10 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved BOOLEAN 5 Reserved
BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Static bypass switch inoperable BOOLEAN 1=Static bypass switch has a critical alarm that prevents it from operating 9 Static bypass switch warning BOOLEAN 1=Static bypass switch has an alarm with severity level warning 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved
BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40012 0x000B 11 RESERVED 2 40014 0x000D 13 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2 Reserved BOOLEAN Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address,
(Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 3 Reserved BOOLEAN 4 Battery room ventilation inoperable BOOLEAN 1=Battery room ventilation inoperable 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10
External battery monitoring alarm BOOLEAN 1=External battery monitoring alarm 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40015 0x000E 14 Alarm Register 1 BOOLEAN 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2 Reserved BOOLEAN 3 High Battery Temperature
Level BOOLEAN 1=Battery temperature above alarm setting 4 Low Battery Temperature Level BOOLEAN 1=Battery temperature below alarm setting 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Battery breaker BB1 open BOOLEAN 1=Battery breaker
BB1 open 12 Battery breaker BB2 open BOOLEAN 1=Battery breaker BB2 open 13 Battery breaker BB3 open BOOLEAN 1=Battery breaker BB3 open 14 Battery breaker BB4 open BOOLEAN 1=Battery breaker BB4 open 15 Delayed transfer from Battery to Normal Operation BOOLEAN 1=The delayed transfer from Battery to Normal Operation is active.
40016 0x000F 15 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved BOOLEAN 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Breaker BF2 open BOOLEAN 1= breaker BF2 open 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12
Reserved BOOLEAN 13 Reserved BOOLEAN 14 Li-Ion AC Supply Breaker BMS:B1/BMS:B2 open BOOLEAN 1=Li-Ion AC Supply Breaker BMS:B1/BMS:B2 open 15 Reserved BOOLEAN 40017 0x0010 16 Alarm Register 1 0 UPS operation mode - Static bypass standby BOOLEAN 1=UPS operation mode - Static bypass standby 1 UPS operation mode -
Inverter standby BOOLEAN 1=UPS operation mode - Inverter standby 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 General UPS settings incorrect BOOLEAN 1=General UPS settings incorrect 5 UPS configuration incorrect BOOLEAN 1=UPS general configuration is incorrect 6 Synchronization unavailable BOOLEAN 1=Synchronization unavailable -
system is free running 7 Fan inoperable BOOLEAN 1=UPS has one or more inoperable fans. Fan redundancy is lost. 8 Inverter is Off due to a request by the user BOOLEAN 1= Inverter is Off due to a request by the user 9 Restricted air flow BOOLEAN 1=Restricted air flow 10 Surveillance detected a fault BOOLEAN 1=Surveillance detected a fault 11
Charger status BOOLEAN 1=Inoperable 12 Inverter status BOOLEAN 1=Inoperable 13 PFC status BOOLEAN 1=Inoperable 14 Battery status BOOLEAN 1=Inoperable 15 Reserved BOOLEAN 40018 0x0011 17 Alarm Register 1 0 Technical check recommended BOOLEAN 1=Technical check recommended 1 Start-up recommended BOOLEAN 1= Secure
start-up recommended 2 Warranty expiring soon BOOLEAN 1=Warranty expiring soon 3 Reserved BOOLEAN Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 4
Air filter check recommened BOOLEAN 1=Air filter check recommened 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40019 0x0012
18 RESERVED 1 40020 0x0013 19 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved BOOLEAN 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved BOOLEAN 5 Not enough UPSs ready to turn on inverter BOOLEAN 1=Not enough UPSs ready to turn on inverter 6 Parallel UPS 1 not present BOOLEAN 1=Parallel UPS 1 not present 7 Parallel
UPS 2 not present BOOLEAN 1=Parallel UPS 2 not present 8 Parallel UPS 3 not present BOOLEAN 1=Parallel UPS 3 not present 9 Parallel UPS 4 not present BOOLEAN 1=Parallel UPS 4 not present 10 Parallel UPS 5 not present BOOLEAN 1=Parallel UPS 5 not present 11 Parallel mixed operation mode BOOLEAN 1=Parallel mixed operation mode 12
Firmware versions in parallel UPS units are not identical BOOLEAN 1=Firmware versions in parallel UPS units are not identical 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40021 0x0014 20 RESERVED 1 40022 0x0015 21 Alarm Register 1 0 System operation mode - Off BOOLEAN 1 = System operation mode - Off 1
System operation mode - Forced static bypass BOOLEAN 1 = System operation mode - Forced static bypass 2 System operation mode - Requested static bypass BOOLEAN 1 = System operation mode - Requested static bypass 3 System operation mode - Maintenance bypass BOOLEAN 1 = System operation mode - Maintenance bypass 4 System
operation mode - Static Bypass Standby BOOLEAN 1 = System operation mode - Static Bypass Standby 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15
Reserved BOOLEAN 40023 0x0016 22 Alarm Register 1 0 Input missing phase BOOLEAN 1=Input is missing a phase 1 Bypass missing phase BOOLEAN 1=Bypass input is missing a phase 2 External sync voltage out of range BOOLEAN 1=External sync voltage is out of range 3 External sync phase sequence incorrect BOOLEAN 1=The phase rotation
on external sync is wrong 4 External sync frequency out of range BOOLEAN 1=External sync frequency is out of range 5 External sync missing phase BOOLEAN 1=External sync is missing a phase 6 External sync temporarily disabled BOOLEAN 1=External sync temporarily disabled 7 Flywheel inoperable BOOLEAN 1=Flywheel inoperable 8 Display
firmware incompatibility detected BOOLEAN 1=Display firmware incompatibility detected 9 NMC 1 firmware incompatibility detected BOOLEAN 1=NMC 1 firmware incompatibility detected 10 NMC 2 firmware incompatibility detected BOOLEAN 1=NMC 2 firmware incompatibility detected 11 10-Inch display incompatibility detected BOOLEAN 1=10 inch
Display firmware incompatibility detected 12 Inverter output is not in phase with bypass input BOOLEAN 1=Inverter output is not in phase with bypass input 13 Engineering Firmware Version detected BOOLEAN 1=Alarm Engineering Firmware Version detected 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40024 0x0017 23 Alarm Register 1 0
Reserved BOOLEAN 1 Reserved BOOLEAN Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved
BOOLEAN 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40025 0x0018 24 Alarm Register 1 0 Reserved BOOLEAN 1 Reserved
BOOLEAN 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved BOOLEAN 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN
40026 0x0019 25 Alarm Register 1 0 Sensor AP9810 - Input contact A in sensor 1 BOOLEAN 1 = Alarm from sensor 1 / contact A 1 Sensor AP9810 - Input contact B in sensor 1 BOOLEAN 1 = Alarm from sensor 1 / contact B 2 Sensor AP9810 - Input contact A in sensor 2 BOOLEAN 1 = Alarm from sensor 2 / contact A 3 Sensor AP9810 - Input contact B
in sensor 2 BOOLEAN 1 = Alarm from sensor 2 / contact B 4 Sensor AP9335T or AP9335TH - temperature alarm in sensor 1 BOOLEAN 1 = temperature alarm in sensor 1 5 Sensor AP9335T or AP9335TH - temperature alarm in sensor 2 BOOLEAN 1 = temperature alarm in sensor 2 6 Sensor AP9335TH - humidity alarm in sensor 1 BOOLEAN 1 =
humidity alarm in sensor 1 7 Sensor AP9335TH - humidity alarm in sensor 2 BOOLEAN 1 = humidity alarm in sensor 2 8 Sensor Communication Lost with sensor 1 BOOLEAN 1 = communication lost with sensor 1 9 Sensor Communication Lost with sensor 2 BOOLEAN 1= communication lost with sensor 2 10 Reserved BOOLEAN 11 Reserved BOOLEAN
12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 40027 0x0020 26 Alarm Register 1 0 Power Cabinet 1 surveillance detected a fault BOOLEAN 1 = Power Cabinet 1 surveillance detected a fault 1 Power Cabinet 2 surveillance detected a fault BOOLEAN 1 = Power Cabinet 2 surveillance detected a fault 2
Power Cabinet 3 surveillance detected a fault BOOLEAN 1 = Power Cabinet 3 surveillance detected a fault 3 Power Cabinet 4 surveillance detected a fault BOOLEAN 1 = Power Cabinet 4 surveillance detected a fault 4 Power Cabinet 5 surveillance detected a fault BOOLEAN 1 = Power Cabinet 5 surveillance detected a fault 5 Power Cabinet 6
surveillance detected a fault BOOLEAN 1 = Power Cabinet 6 surveillance detected a fault 6 Power Cabinet 7 surveillance detected a fault BOOLEAN 1 = Power Cabinet 7 surveillance detected a fault 7 Reserved BOOLEAN 8 Power Cabinet 1 inoperable BOOLEAN 1 = Power cabinet inoperable 9 Power Cabinet 2 inoperable BOOLEAN 1 = Power cabinet
inoperable 10 Power Cabinet 3 inoperable BOOLEAN 1 = Power cabinet inoperable 11 Power Cabinet 4 inoperable BOOLEAN 1 = Power cabinet inoperable 12 Power Cabinet 5 inoperable BOOLEAN 1 = Power cabinet inoperable 13 Power Cabinet 6 inoperable BOOLEAN 1 = Power cabinet inoperable 14 Power Cabinet 7 inoperable BOOLEAN 1 =
Power cabinet inoperable 15 Reserved BOOLEAN 40028 0x0021 27 Alarm Register 1 0 Input dry contact: Genset supplying UPS BOOLEAN 1= a Genset supply the UPS 1 Input dry contact: Battery room ventilation inoperable BOOLEAN 1= Battery room ventilation inoperable 2 Input dry contact: External battery monitoring inoperable BOOLEAN 1=
External battery monitoring inoperable Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 3 Input dry contact: Ground fault detected BOOLEAN 1= Ground fault
detected 4 Input dry contact: UPS locked in static bypass mode is actived BOOLEAN 1= UPS locked in static bypass mode is actived 5 Input dry contact: User-defined input dry contacts 1 BOOLEAN 1= User-defined input dry contacts 1, in alarm position 6 Input dry contact: User-defined input dry contacts 2 BOOLEAN 1= User-defined input dry contacts 2,
in alarm position 7 Input dry contact: Flywheel inoperable BOOLEAN 1= Flywheel inoperable 8 Input dry contact: External energy storage monitoring major alarm BOOLEAN 1= External energy storage monitoring major alarm 9 Input dry contact: External energy storage monitoring minor alarm BOOLEAN 1= External energy storage monitoring minor alarm
10 Input dry contact: Force Charger Off BOOLEAN 1= Force Charger Off 11 Input dry contact: Disable High Efficiency Mode BOOLEAN 1= Disable High Efficiency Mode 12 Input dry contact: Transfer from Battery to Normal Operation delay BOOLEAN 1=Transfer from Battery to Normal Operation delay 13 Input dry contact: Force Battery Operation
BOOLEAN 1=Force Battery Operation 14 Input dry contact: Request Bypass operation BOOLEAN 1=Requested Bypass command from input relay activated 15 Reserved BOOLEAN 40029 0x0022 28 Alarm Register 1 0 Power Cabinet 1 surveillance fault BOOLEAN 1 = Temporized Power Cabinet surveillance fault 1 Power Cabinet 1 inoperable BOOLEAN
1 = Temporized Power Cabinet inoperable 2 Power Cabinet 1 - Power Bloc L1A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 3 Power Cabinet 1 - Power Bloc L2A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 4 Power Cabinet 1 - Power Bloc L3A - Surveillance fault BOOLEAN
1 = Power Bloc from Power Cabinet Surveillance fault 5 Power Cabinet 1 - Power Bloc L1B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 6 Power Cabinet 1 - Power Bloc L2B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 7 Power Cabinet 1 - Power Bloc L3B - Surveillance fault

BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 8 Power Cabinet 2 surveillance fault BOOLEAN 1 = Temporized Power Cabinet surveillance fault 9 Power Cabinet 2 inoperable BOOLEAN 1 = Temporized Power Cabinet inoperable 10 Power Cabinet 2 - Power Bloc L1A - Surveillance fault BOOLEAN 1 = Power Bloc
from Power Cabinet
Surveillance fault 11 Power Cabinet 2 - Power Bloc L2A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 12 Power Cabinet 2 - Power Bloc L3A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 13 Power Cabinet 2 - Power Bloc L1B - Surveillance fault BOOLEAN
1 = Power Bloc from
Power Cabinet Surveillance fault 14 Power Cabinet 2 - Power Bloc L2B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 15 Power Cabinet 2 - Power Bloc L3B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 40030 0x0023 29 Alarm Register 1 0 Power Cabinet 3
surveillance fault
BOOLEAN 1 = Temporized Power Cabinet surveillance fault 1 Power Cabinet 3 inoperable BOOLEAN 1 = Temporized Power Cabinet inoperable 2 Power Cabinet 3 - Power Bloc L1A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 3 Power Cabinet 3 - Power Bloc L2A - Surveillance fault
BOOLEAN 1 = Power Bloc from
Power Cabinet Surveillance fault 4 Power Cabinet 3 - Power Bloc L3A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 5 Power Cabinet 3 - Power Bloc L1B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 6 Power Cabinet 3 - Power Bloc L2B - Surveillance
fault BOOLEAN 1 = Power
Bloc from Power Cabinet Surveillance fault 7 Power Cabinet 3 - Power Bloc L3B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 8 Power Cabinet 4 surveillance fault BOOLEAN 1 = Temporized Power Cabinet surveillance fault 9 Power Cabinet 4 inoperable BOOLEAN 1 = Temporized Power
Cabinet inoperable 10
Power Cabinet 4 - Power Bloc L1A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 11 Power Cabinet 4 - Power Bloc L2A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 12 Power Cabinet 4 - Power Bloc L3A - Surveillance fault BOOLEAN 1 = Power Bloc from
Power Cabinet
Surveillance fault 13 Power Cabinet 4 - Power Bloc L1B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 14 Power Cabinet 4 - Power Bloc L2B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 15 Power Cabinet 4 - Power Bloc L3B - Surveillance fault BOOLEAN
1 = Power Bloc from
Power Cabinet Surveillance fault 40031 0x0024 30 Alarm Register 1 0 Power Cabinet 5 surveillance fault BOOLEAN 1 = Temporized Power Cabinet surveillance fault 1 Power Cabinet 5 inoperable BOOLEAN 1 = Temporized Power Cabinet inoperable 2 Power Cabinet 5 - Power Bloc L1A - Surveillance fault BOOLEAN 1 = Power Bloc
from Power Cabinet
Surveillance fault 3 Power Cabinet 5 - Power Bloc L2A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 4 Power Cabinet 5 - Power Bloc L3A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 5 Power Cabinet 5 - Power Bloc L1B - Surveillance fault BOOLEAN 1 =
Power Bloc from
Power Cabinet Surveillance fault 6 Power Cabinet 5 - Power Bloc L2B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 7 Power Cabinet 5 - Power Bloc L3B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 8 Power Cabinet 6 surveillance fault BOOLEAN 1 =
Temporized Power
Cabinet surveillance fault 9 Power Cabinet 6 inoperable BOOLEAN 1 = Temporized Power Cabinet inoperable 10 Power Cabinet 6 - Power Bloc L1A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 11 Power Cabinet 6 - Power Bloc L2A - Surveillance fault BOOLEAN 1 = Power Bloc from Power
Cabinet Surveillance
fault 12 Power Cabinet 6 - Power Bloc L3A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 13 Power Cabinet 6 - Power Bloc L1B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 14 Power Cabinet 6 - Power Bloc L2B - Surveillance fault BOOLEAN 1 = Power
Bloc from Power
Cabinet Surveillance fault 15 Power Cabinet 6 - Power Bloc L3B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 40032 0x0025 31 Alarm Register 1 Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data
Point Length # register s
Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 0 Power Cabinet 7 surveillance fault BOOLEAN 1 = Temporized Power Cabinet surveillance fault 1 Power Cabinet 7 inoperable BOOLEAN 1 = Temporized Power Cabinet inoperable 2 Power Cabinet 7 - Power Bloc L1A - Surveillance fault BOOLEAN 1 = Power
Bloc from Power
Cabinet Surveillance fault 3 Power Cabinet 7 - Power Bloc L2A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 4 Power Cabinet 7 - Power Bloc L3A - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 5 Power Cabinet 7 - Power Bloc L1B - Surveillance fault
BOOLEAN 1 = Power Bloc
from Power Cabinet Surveillance fault 6 Power Cabinet 7 - Power Bloc L2B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 7 Power Cabinet 7 - Power Bloc L3B - Surveillance fault BOOLEAN 1 = Power Bloc from Power Cabinet Surveillance fault 8 Reserved BOOLEAN 9 Surveillance Limit
Detected on Power Cabinet
1 BOOLEAN 1= SurvLimitDetected on Power Cabinet 1 10 Surveillance Limit Detected on Power Cabinet 2 BOOLEAN 1= SurvLimitDetected on Power Cabinet 2 11 Surveillance Limit Detected on Power Cabinet 3 BOOLEAN 1= SurvLimitDetected on Power Cabinet 3 12 Surveillance Limit Detected on Power Cabinet 4 BOOLEAN 1=
SurvLimitDetected on
Power Cabinet 4 13 Surveillance Limit Detected on Power Cabinet 5 BOOLEAN 1= SurvLimitDetected on Power Cabinet 5 14 Surveillance Limit Detected on Power Cabinet 6 BOOLEAN 1= SurvLimitDetected on Power Cabinet 6 15 Surveillance Limit Detected on Power Cabinet 7 BOOLEAN 1= SurvLimitDetected on Power Cabinet 7
Static Data 44097
0x1000 4096 Display/NMC Model Number 9 ASCII 44106 0x1009 4105 Display/NMC Serial Number 8 ASCII 44114 0x1011 4113 Display/NMC Firmware Revision APP 9 ASCII 44123 0x101A 4122 Display/NMC Hardware Revision 9 ASCII 44132 0x1023 4131 Display/NMC Date of Manufacture 6 ASCII 44138 0x1029 4137 RESERVED 8
44146 0x1031
4145 UPS Serial Number 6 ASCII 44152 0x1037 4151 UPS Firmware Version 12 ASCII 44164 0x1043 4163 Product Name 40 ASCII 44204 0x106B 4203 UPS Serial Number for 14 characters 8 ASCII for new 3-phases UPS, using 14 characters Dynamic Data 44353 0x1100 4352 RESERVED 2 44355 0x1102 4354 Runtime remaining 2
UINT32 1 1
Seconds 44357 0x1104 4356 Estimated charge time 2 UINT32 1 1 Seconds 44359 0x1106 4358 Estimated charge % 1 UINT16 1 1 % 44360 0x1107 4359 RESERVED 8 44368 0x110F 4367 Battery Temperature (for classic battery solution) 1 UINT16 1 1 °C or °F 44369 0x1110 4368 Charger Mode 1 0 Float Charging BOOLEAN 1=Charger
mode is float
charging 1 Boost Charging BOOLEAN 1=Charger mode is boost charging 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved BOOLEAN 5 Equalization Charging BOOLEAN 1=Charger mode is eqalization charging 6 Not Charging BOOLEAN 1=Charger mode is Off 7 Test In Progress BOOLEAN 1=Test is in progress 8 Cyclic
Charging BOOLEAN
1=Charge mode is cyclic charging 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 44370 0x1111 4369 Battery Power 1 UNIT16 0.1 10 kW 44371 0x1112 4370 RESERVED 1 44372 0x1113 4371 Battery Voltage 1
UINT16 0.1 10
Vdc 44373 0x1114 4372 Battery Current, for GVX up to 1000kVA 1 UNIT16 0.1 10 Amps - Caution overflow possible. There is a current limitation [– 3276A, 3276A]. That register can be use for GVX up to 1000KVA. When GVX power rating exceed 1000 kVA (1250KVA and 1500kVA) used register 0x111D 44374 0x1115 4373 RESERVED 1
UINT16 1 1
44375 0x1116 4374 RESERVED 1 UINT16 1 1 44376 0x1117 4375 RESERVED 1 UINT16 1 1 44377 0x1118 4376 RESERVED 1 UINT16 1 1 44378 0x1119 4377 RESERVED 1 UINT16 1 1 44379 0x111A 4378 RESERVED 1 UINT16 1 1 44380 0x111B 4379 RESERVED 1 UINT16 1 1 44381 0x111C 4380 RESERVED 1 UINT16 1 1 Modicon
Standard
Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 44382 0x111D 4381 Battery Current, for all GVX power rating (from 250kVA up to 1500kVA) 1 UNT16 1 1
Amps - Recommended
register for GVX. To be used when UPS power rating exceed 1000 kVA. This register supports all GVX power rating (from 250KVA up to 1500kVA). 44383 0x111E 4382 Battery Test Process Status ENUM 0= Inactive 1= Battery Calibration is In Progress 2= Battery Calibration is Passed 5= Battery Calibration is Aborted 44384 0x111F
4383 Battery
Calibration Process Status ENUM 0= Inactive 1= Battery Calibration is In Progress 2= Battery Calibration is Passed 5= Battery Calibration is Aborted 44385 0x1120 4384 Battery Test Status ENUM 0= Unknown 1= Battery OK 2= Battery CapacityReduced 3= Battery Defect 44609 0x1200 4608 Frequency (input) 1 UINT16 0.1 10 Hz
44610 0x1201 4609
Voltage L1-2 (input) 1 UINT16 1 1 Volts 44611 0x1202 4610 Voltage L2-3 (input) 1 UINT16 1 1 Volts 44612 0x1203 4611 Voltage L3-1 (input) 1 UINT16 1 1 Volts 44613 0x1204 4612 Current L1 (input) 1 UINT16 1 1 amps 44614 0x1205 4613 Current L2 (input) 1 UINT16 1 1 amps 44615 0x1206 4614 Current L3 (input) 1 UINT16 1 1 amps 44616
0x1207
4615 Active power L1 (input) 1 UINT16 1 1 kW 44617 0x1208 4616 Active power L2 (input) 1 UINT16 1 1 kW 44618 0x1209 4617 Active power L3 (input) 1 UINT16 1 1 kW 44619 0x120A 4618 Apparent power L1 (input) 1 UINT16 1 1 kVA 44620 0x120B 4619 Apparent power L2 (input) 1 UINT16 1 1 kVA 44621 0x120C 4620 Apparent power
L3 (input) 1
UINT16 1 1 kVA 44622 0x120D 4621 Total active power (input) 1 UINT16 1 1 kW 44623 0x120E 4622 Total apparent power (input) 1 UINT16 1 1 kVA 44624 0x120F 4623 Voltage L1-N (input) 1 UINT16 1 1 Volts 44625 0x1210 4624 Voltage L2-N (input) 1 UINT16 1 1 Volts 44626 0x1211 4625 Voltage L3-N (input) 1 UINT16 1 1 Volts 44627
0x1212 4626
Maximum RMS Current L1 (input) 2 UINT32 1 1 amps 44629 0x1214 4628 Maximum RMS Current L2 (input) 2 UINT32 1 1 amps 44631 0x1216 4630 Maximum RMS Current L3 (input) 2 UINT32 1 1 amps 44633 0x1218 4632 Power factor L1 (input) 1 UINT16 0.01 100 Unitless 44634 0x1219 4633 Power factor L2 (input) 1 UINT16 0.01 100
Unitless 44635
0x121A 4634 Power factor L3 (input) 1 UINT16 0.01 100 Unitless 44865 0x1300 4864 Frequency (bypass) 1 UINT16 0.1 10 Hz 44866 0x1301 4865 Voltage L1-2 (bypass) 1 UINT16 1 1 Volts 44867 0x1302 4866 Voltage L2-3 (bypass) 1 UINT16 1 1 Volts 44868 0x1303 4867 Voltage L3-1 (bypass) 1 UINT16 1 1 Volts 44869 0x1304 4868 Current
L1
(bypass) 1 UINT16 1 1 amps 44870 0x1305 4869 Current L2 (bypass) 1 UINT16 1 1 amps 44871 0x1306 4870 Current L3 (bypass) 1 UINT16 1 1 amps 44872 0x1307 4871 Active power L1 (bypass) 1 UINT16 1 1 kW 44873 0x1308 4872 Active power L2 (bypass) 1 UINT16 1 1 kW 44874 0x1309 4873 Active power L3 (bypass) 1 UINT16 1 1
kW 44875
0x130A 4874 Apparent power L1 (bypass) 1 UINT16 1 1 kVA 44876 0x130B 4875 Apparent power L2 (bypass) 1 UINT16 1 1 kVA 44877 0x130C 4876 Apparent power L3 (bypass) 1 UINT16 1 1 kVA 44878 0x130D 4877 Total active power (bypass) 1 UINT16 1 1 kW 44879 0x130E 4878 Total apparent power (bypass) 1 UINT16 1 1 kVA 44880
0x130F 4879
Voltage L1-N (bypass) 1 UINT16 1 1 Volts 44881 0x1310 4880 Voltage L2-N (bypass) 1 UINT16 1 1 Volts 44882 0x1311 4881 Voltage L3-N (bypass) 1 UINT16 1 1 Volts 44883 0x1312 4882 Maximum RMS Current L1 (bypass) 2 UINT32 1 1 amps 44885 0x1314 4884 Maximum RMS Current L2 (bypass) 2 UINT32 1 1 amps 44887 0x1316 4886
Maximum
RMS Current L3 (bypass) 2 UINT32 1 1 amps 44889 0x1318 4888 Power factor L1 (bypass) 1 UINT16 0.01 100 Unitless 44890 0x1319 4889 Power factor L2 (bypass) 1 UINT16 0.01 100 Unitless 44891 0x131A 4890 Power factor L3 (bypass) 1 UINT16 0.01 100 Unitless 44892 0x131B 4891 UTHD - Voltage THD L1 (bypass) 1 UINT16 0.1 10
% 44893
0x131C 4892 UTHD - Voltage THD L2 (bypass) 1 UINT16 0.1 10 % 44894 0x131D 4893 UTHD - Voltage THD L3 (bypass) 1 UINT16 0.1 10 % 45121 0x1400 5120 UPS Power Rating 1 UINT16 1 1 kVA 45122 0x1401 5121 Frequency (output) 1 UINT16 0.1 10 Hz 45123 0x1402 5122 Voltage L1-2 (output) 1 UINT16 1 1 Volts Modicon Standard
Register
Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 45124 0x1403 5123 Voltage L2-3 (output) 1 UINT16 1 1 Volts 45125 0x1404 5124 Voltage L3-1 (output) 1 UINT16 1 1
Volts 45126 0x1405
5125 Current L1 (output) 1 UINT16 1 1 amps 45127 0x1406 5126 Current L2 (output) 1 UINT16 1 1 amps 45128 0x1407 5127 Current L3 (output) 1 UINT16 1 1 amps 45129 0x1408 5128 Maximum RMS current L1 (output) 2 UINT32 1 1 amps 45131 0x140A 5130 Maximum RMS current L2 (output) 2 UINT32 1 1 amps 45133 0x140C 5132
Maximum RMS
current L3 (output) 2 UINT32 1 1 amps 45135 0x140E 5134 Active power L1 (output) 1 UINT16 1 1 kW 45136 0x140F 5135 Active power L2 (output) 1 UINT16 1 1 kW 45137 0x1410 5136 Active power L3 (output) 1 UINT16 1 1 kW 45138 0x1411 5137 Apparent power L1 (output) 1 UINT16 1 1 kVA 45139 0x1412 5138 Apparent power L2
(output) 1
UINT16 1 1 kVA 45140 0x1413 5139 Apparent power L3 (output) 1 UINT16 1 1 kVA 45141 0x1414 5140 Apparent power percent L1 (output) 1 UINT16 0.1 10 % 45142 0x1415 5141 Apparent power percent L2 (output) 1 UINT16 0.1 10 % 45143 0x1416 5142 Apparent power percent L3 (output) 1 UINT16 0.1 10 % 45144 0x1417 5143 Total
active power
(output) 1 UINT16 1 1 kW 45145 0x1418 5144 Total apparent power (output) 1 UINT16 1 1 kVA 45146 0x1419 5145 Total Output Percent load 1 UINT16 0.1 10 % 45147 0x141A 5146 Power factor L1 (output) 1 UINT16 0.01 100 power factor 45148 0x141B 5147 Power factor L2 (output) 1 UINT16 0.01 100 power factor 45149 0x141C 5148
Power factor L3
(output) 1 UINT16 0.01 100 power factor 45150 0x141D 5149 Current crest factor L1 (output) 1 UINT16 0.1 10 crest factor 45151 0x141E 5150 Current crest factor L2 (output) 1 UINT16 0.1 10 crest factor 45152 0x141F 5151 Current crest factor L3 (output) 1 UINT16 0.1 10 crest factor 45153 0x1420 5152 Voltage L1-N (output) 1 UINT16 1 1
Volts 45154
0x1421 5153 Voltage L2-N (output) 1 UINT16 1 1 Volts 45155 0x1422 5154 Voltage L3-N (output) 1 UINT16 1 1 Volts 45156 0x1423 5155 Neutral current (output) 1 UINT16 1 1 amps 45157 0x1424 5156 Current THD L1 (output) 1 UINT16 0.1 10 % 45158 0x1425 5157 Current THD L2 (output) 1 UINT16 0.1 10 % 45159 0x1426 5158 Current
THD L3
(output) 1 UINT16 0.1 10 % 45160 0x1427 5159 IOC Power Rating 1 UINT16 1 1 kVA 45161 0x1428 5160 Available UPS Power Rating 1 UINT16 1 1 kVA 45376 0x14FF 5375 RESERVED 1 UINT16 1 1 45377 0x1500 5376 IOC Ambient temperature 1 UINT16 1 1 °C or °F 45378 0x1501 5377 Switch gear status 1 Bit mask For each bit, 0 =
open, 1
=closed 0 Unit Input Breaker (UIB) BOOLEAN 1 Unit Output Breaker (UOB) BOOLEAN 2 Maintenance Bypass Breaker (MBB) BOOLEAN 3 System Isolation Breaker (SIB) BOOLEAN 4 Static Switch Input Breaker (SSIB) BOOLEAN 5 Battery Breaker 1 (for classic battery solution) BOOLEAN 6 Battery Breaker 2 (for classic battery
solution) BOOLEAN 7
Battery Breaker 3 (for classic battery solution) BOOLEAN 8 Battery Breaker 4 (for classic battery solution) BOOLEAN 9 BF2 BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN Modicon Standard Register Number Absolute
Starting Register
Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 45379 0x1502 5378 UPS Operation Mode 1 ENUM 1 = Normal operation 2 = Battery Operation 3 = Battery Test 4 = Requested Static Bypass 5 = Forced
Static Bypass 6 =
Maintenance Bypass 7 = Off 8 = Emergency Static Bypass 9 = Static Bypass Standby 10 = Inverter Standby 11 = Power Saving Mode 12 = Inverter SPoT Mode 13 = ECO Mode 14 = ECOnversion 45380 0x1503 5379 Number of Active Alarms 1 UINT16 1 1 Number of active alarms in the system 45381 0x1504 5380 Highest alarm
severity 1 UINT16 1 1 0
= none 1 = informational 2 = warning 3 = critical 45382 0x1505 5381 System Mode 1 ENUM 1 = Inverter 2 = Requested Static Bypass 3 = Forced Static Bypass 4 = Off 5 = Reserved 6 = Maintenance Bypass 7 = ECO Mode 45383 0x1506 5382 RESERVED 3 45385 0x1508 5384 UPS Redundancy Status 1 UINT16 1 1 45386 0x1509 5385
NMC/UPS Time
4 ASCII hh:mm:ss format 45390 0x150D 5389 NMC/UPS Date 5 ASCII mm/dd/yyyy format 45395 0x1512 5394 Input kWh 2 UINT32 1 1 kWh 45397 0x1514 5396 Output kWh 2 UINT32 1 1 kWh 45399 0x1516 5398 IOC Exhaust Air Temperature 1 UINT16 1 1 °C or °F 45400 0x1517 5399 Ambient Temperature from Power Cabinet [1] 1
UINT16 1 1 °C or
°F 45401 0x1518 5400 Exhaust Temperature from Power Cabinet [1] 1 UINT16 1 1 °C or °F 45402 0x1519 5401 Ambient Temperature from Power Cabinet [2] 1 UINT16 1 1 °C or °F 45403 0x151A 5402 Exhaust Temperature from Power Cabinet [2] 1 UINT16 1 1 °C or °F 45404 0x151B 5403 Ambient Temperature from Power Cabinet [3] 1
UINT16 1 1 °C
or °F 45405 0x151C 5404 Exhaust Temperature from Power Cabinet [3] 1 UINT16 1 1 °C or °F 45406 0x151D 5405 Ambient Temperature from Power Cabinet [4] 1 UINT16 1 1 °C or °F 45407 0x151E 5406 Exhaust Temperature from Power Cabinet [4] 1 UINT16 1 1 °C or °F 45408 0x151F 5407 Ambient Temperature from Power Cabinet [5]
1 UINT16 1 1
°C or °F 45409 0x1520 5408 Exhaust Temperature from Power Cabinet [5] 1 UINT16 1 1 °C or °F 45410 0x1521 5409 Ambient Temperature from Power Cabinet [6] 1 UINT16 1 1 °C or °F 45411 0x1522 5410 Exhaust Temperature from Power Cabinet [6] 1 UINT16 1 1 °C or °F 45412 0x1523 5411 Ambient Temperature from Power Cabinet
[7] 1 UINT16 1 1
°C or °F 45413 0x1524 5412 Exhaust Temperature from Power Cabinet [7] 1 UINT16 1 1 °C or °F 45414 0x1525 5413 Power Cabinet Redundancy Status 1 UINT16 1 1 0 - 7 46401 0x1900 6400 Current L1 (parallel system mains input) 1 UINT16 1 1 amps 46402 0x1901 6401 Current L2 (parallel system mains input) 1 UINT16 1 1 amps
46403 0x1902
6402 Current L3 (parallel system mains input) 1 UINT16 1 1 amps 46404 0x1903 6403 Current L1 (parallel system bypass input) 1 UINT16 1 1 amps 46405 0x1904 6404 Current L2 (parallel system bypass input) 1 UINT16 1 1 amps 46406 0x1905 6405 Current L3 (parallel system bypass input) 1 UINT16 1 1 amps 46407 0x1906 6406
Current L1 (parallel
system output) 1 UINT16 1 1 amps 46408 0x1907 6407 Current L2 (parallel system output) 1 UINT16 1 1 amps 46409 0x1908 6408 Current L3 (parallel system output) 1 UINT16 1 1 amps 46410 0x1909 6409 Total apparent power (parallel system output) 1 UINT16 1 1 kVA 46411 0x190A 6410 Total Percent load (parallel system) 1 UINT16
0.1 10 % 46412
0x190B 6411 Total active power (parallel system output) 1 UINT16 1 1 kW 46413 0x190C 6412 Apparent power percent L1 (parallel system output) 1 UINT16 0.1 10 % 46414 0x190D 6413 Apparent power percent L2 (parallel system output) 1 UINT16 0.1 10 % 46415 0x190E 6414 Apparent power percent L3 (parallel system output) 1
UINT16 0.1 10 %
46416 0x190F 6415 Reserved 46417 0x1910 6416 Reserved 46418 0x1911 6417 Reserved 46419 0x1912 6418 Reserved 46420 0x1913 6419 UPS Operation Modes 1 bit = 1, define current UPS operation mode Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address,
(Decimal) Bit
Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 0 Initialize BOOLEAN 1 Normal Operation BOOLEAN 2 Battery Operation BOOLEAN 3 Battery test or Battery Discharge in Spot Mode BOOLEAN 4 Requested Static Bypass BOOLEAN 5 Forced Static Bypass BOOLEAN 6
Maintenance Bypass
BOOLEAN 7 Off BOOLEAN 8 Emergency Static Bypass BOOLEAN 9 Static Bypass Standby BOOLEAN 10 Inverter standby BOOLEAN 11 Power Saving mode BOOLEAN 12 Inverter SPoT Mode BOOLEAN 13 ECO mode BOOLEAN 14 ECOnvertion Mode mode BOOLEAN 15 Charger SPoT Mode BOOLEAN 46421 0x1914 6420
System Mode 1 bit = 1,
define current System mode 0 Inverter BOOLEAN 1 Requested Static Bypass BOOLEAN 2 Forced Static Bypass BOOLEAN 3 Off BOOLEAN 4 Maintenance Bypass BOOLEAN 5 ECO mode BOOLEAN 6 ECOnversion mode BOOLEAN 7 Static Bypass Standby Operation BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10
Reserved BOOLEAN
11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 46422 0x1915 6421 Reserved 1 UINT16 1 1 46423 0x1916 6422 Reserved 1 UINT16 1 1 46424 0x1917 6423 Reserved 1 UINT16 1 1 46425 0x1918 6424 Reserved 1 UINT16 1 1 46426 0x1919 6425 Reserved 1 UINT16 1
1 46427
0x191A 6426 Reserved 1 UINT16 1 1 46428 0x191B 6427 Reserved 1 UINT16 1 1 46429 0x191C 6428 Reserved 1 UINT16 1 1 46430 0x191D 6429 Reserved 1 UINT16 1 1 46431 0x191E 6430 Sensor temperature in sensor 1 1 UINT16 0.1 10 °C or °F 46432 0x191F 6431 Sensor temperature in sensor 2 1 UINT16 0.1 10 °C or °F 46433 0x1920
6432
Sensor humidity in sensor 1 1 UINT16 0.1 10 % 46434 0x1921 6433 Sensor humidity in sensor 2 1 UINT16 0.1 10 % 46435 0x1922 6434 Sensor (AP9810) input contact status 1 Bit mask For each bit, 0 = open, 1 =closed 0 Sensor dry contact A in sensor 1 BOOLEAN 1 Sensor dry contact B in sensor 1 BOOLEAN 2 Sensor dry contact A
in sensor 2
BOOLEAN 3 Sensor dry contact B in sensor 2 BOOLEAN 4 Reserved BOOLEAN 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved
BOOLEAN
46449 0x1930 6448 User interface - Input Pictogram 1 UINT16 1 1 Inoperable (Red) = 4 Ok and operating (Green) = 2 None of the above (Black) = 0 Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type
Multiply Reading By:
Divide Reading By: Valid Response Scale 46450 0x1931 6449 User interface - PFC Pictogram 1 UINT16 1 1 Inoperable (Red) = 4 Ok and operating (Green) = 2 None of the above (Black) = 0 46451 0x1932 6450 User interface - Battery Pictogram 1 UINT16 1 1 Inoperable (Red) = 4 Ok and operating (Green) = 2 None of the above (Black) =
0 46452
0x1933 6451 User interface - Inverter Pictogram 1 UINT16 1 1 Inoperable (Red) = 4 Ok and operating (Green) = 2 None of the above (Black) = 0 46453 0x1934 6452 User interface - Output Pictogram 1 UINT16 1 1 Inoperable (Red) = 4 Ok and operating (Green) = 2 None of the above (Black) = 0 46454 0x1935 6453 User interface - Bypass
Input
Pictogram 1 UINT16 1 1 Inoperable (Red) = 4 Ok and operating (Green) = 2 None of the above (Black) = 0 46455 0x1936 6454 User interface - Static Bypass Pictogram 1 UINT16 1 1 Inoperable (Red) = 4 Ok and operating (Green) = 2 None of the above (Black) = 0 46456 0x1937 6455 Status for mimic animation 1 UINT16 1 1 0 Aggregated
Battery circuit
breaker status BOOLEAN 0 = open, 1 =closed 1 Reserved BOOLEAN 2 Reserved BOOLEAN 3 Reserved BOOLEAN 4 Reserved BOOLEAN 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13
Reserved
BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 46457 0x1938 6456 Power Cabinet status for UPS detailled view animation 1 UINT16 1 1 0 Warning alarm present in Power Cabinet 1 BOOLEAN 1 = warning alarm present in Power Cabinet 1 (Orange) 1 Critical alarm present in Power Cabinet 1 BOOLEAN 1 = critical alarm
present Power
Cabinet 1 (Red) 2 Warning alarm present in Power Cabinet 2 BOOLEAN 1 = warning alarm present in Power Cabinet 2 (Orange) 3 Critical alarm present in Power Cabinet 2 BOOLEAN 1 = critical alarm present Power Cabinet 2 (Red) 4 Warning alarm present in Power Cabinet 3 BOOLEAN 1 = warning alarm present in Power Cabinet
3 (Orange) 5 Critical

alarm present in Power Cabinet 3 BOOLEAN 1 = critical alarm present Power Cabinet 3 (Red) 6 Warning alarm present in Power Cabinet 4 BOOLEAN 1 = warning alarm present in Power Cabinet 4 (Orange) 7 Critical alarm present in Power Cabinet 4 BOOLEAN 1 = critical alarm present Power Cabinet 4 (Red) 8 Warning alarm
present in Power Cabinet 5
BOOLEAN 1 = warning alarm present in Power Cabinet 5 (Orange) 9 Critical alarm present in Power Cabinet 5 BOOLEAN 1 = critical alarm present Power Cabinet 5 (Red) 10 Warning alarm present in Power Cabinet 6 BOOLEAN 1 = warning alarm present in Power Cabinet 6 (Orange) 11 Critical alarm present in Power Cabinet 6
BOOLEAN 1 = critical
alarm present Power Cabinet 6 (Red) 12 Warning alarm present in Power Cabinet 7 BOOLEAN 1 = warning alarm present in Power Cabinet 7 (Orange) 13 Critical alarm present in Power Cabinet 7 BOOLEAN 1 = critical alarm present Power Cabinet 7 (Red) 14 Reserved BOOLEAN 15 Reserved BOOLEAN 46458 0x1939 6457 Power
Cabinet status for
UPS detailled view animation 1 UINT16 1 1 0 informational alarm present in Power Cabinet 1 BOOLEAN 1 = informational alarm present in Power Cabinet 1 1 informational alarm present in Power Cabinet 2 BOOLEAN 2 = informational alarm present in Power Cabinet 2 2 informational alarm present in Power Cabinet 3 BOOLEAN 3 =
informational alarm
present in Power Cabinet 3 3 informational alarm present in Power Cabinet 4 BOOLEAN 4 = informational alarm present in Power Cabinet 4 4 informational alarm present in Power Cabinet 5 BOOLEAN 5 = informational alarm present in Power Cabinet 5 5 informational alarm present in Power Cabinet 6 BOOLEAN 6 = informational
alarm present in Power
Cabinet 6 6 informational alarm present in Power Cabinet 7 BOOLEAN 7 = informational alarm present in Power Cabinet 7 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN Modicon Standard Register Number
Absolute Starting
Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 14 Reserved BOOLEAN 15 Reserved BOOLEAN Configuratio n Data 48193 0x2000 8192 RESERVED 3 48196 0x2003 8195 RESERVED 1 48198
0x2005 8197
RESERVED 48199 0x2006 8198 RESERVED 48200 0x2007 8199 Breaker settings 1 bit = 1, breaker is present 0 breaker Q1 (UIB) BOOLEAN 1 breaker Q2 (UOB) BOOLEAN 2 Q3 (MBB) BOOLEAN 3 Q4 (SIB) BOOLEAN 4 Q5 (SSIB) BOOLEAN 5 BB1 BOOLEAN 6 BB2 BOOLEAN 7 BB3 BOOLEAN 8 BB4 BOOLEAN 9 BF2 BOOLEAN 10
Reserved
BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 48201 0x2008 8200 Temperature unity 1 ENUM 0 = Celcius 1 = Fahrenheit 48202 0x2009 8201 UPS environment settings 1 0 Input transformer presence BOOLEAN bit = 1, transformer is present 1
Output transformer
presence BOOLEAN bit = 1, transformer is present 2 AC wiring configuration BOOLEAN bit = 0, input cabling 3 wires bit = 1, input cabling 4 wires 3 UPS mains supply by single input BOOLEAN bit = 1, mains supply input is single 4 UPS mains supply by dual input BOOLEAN bit = 1, mains supply input is dual 5 Reserved BOOLEAN
6 Reserved BOOLEAN
7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved BOOLEAN 15 Reserved BOOLEAN 48203 0x200A 8202 SIB breaker label 2 ASCII 4 bytes string = 2 registers, Default value "SIB " 48205 0x200C 8204
UIB breaker label
2 ASCII 4 bytes string = 2 registers, Default value UIB " 48207 0x200E 8206 SSIB breaker label 2 ASCII 4 bytes string = 2 registers, Default value "SSIB" 48209 0x2010 8208 MBB breaker label 2 ASCII 4 bytes string = 2 registers, Default value "MBB " 48211 0x2012 8210 UOB breaker label 2 ASCII 4 bytes string = 2 registers, Default
value "UOB " 48213
0x2014 8212 BF2 breaker label 2 ASCII 4 bytes string = 2 registers, Default value "BF2 " 48215 0x2016 8214 BB breaker label 2 ASCII 4 bytes string = 2 registers, Default value "BB " 48217 0x2018 8216 UPS Name 9 ASCII 18 bytes string = 8 registers 48449 0x2100 8448 Low Battery Alarm Threshold 1 UINT16 1 1 Seconds 48450
0x2101 8449 Battery
Type 1 ENUM 1 1 0=VRLA 1=Open Cell 2=Lithium-Ion 3=NiCd 6=NiZn 48451 0x2102 8450 Battery Solution 1 ENUM 1 1 0=None 1=Classic 2=NA 3=Unknown 48452 0x2103 8451 Deep Discharge Allowed 1 ENUM 1 1 0=No 1=Yes 48453 0x2104 8452 Total Battery Capacity 1 UINT16 1 1 Ah 48454 0x2105 8453 Reserved 1 UINT16 1 1 48455
0x2106
8454 Number of battery bank for Classical battery 1 UINT16 1 1 Unitless Modicon Standard Register Number Absolute Starting Register Address, (Hexa-decimal) Absolute Starting Register Address, (Decimal) Bit Data Point Length # register s Data Type Multiply Reading By: Divide Reading By: Valid Response Scale 48705 0x2200
8704 Nominal Output

Voltage 1 ENUM 1 1 0=380V 1=400V 2=415V 3=480V 4=440V 48706 0x2201 8705 Transfer to Static Bypass Disable 1 ENUM 1 1 0=Disable 1=Enable 48707 0x2202 8706 Reserved 1 ENUM 1 1 48708 0x2203 8707 Automatic Battery Disconnect 1 ENUM 1 1 0=No 1=Yes 48709 0x2204 8708 High Efficiency Mode 1 ENUM 1 1 0=Disable 1=ECO mode
2=ECOnversion 3=ECOnversion Harmonics Compensator 48710 0x2205 8709 Reserved 1 1 1 48711 0x2206 8710 Number of UPS installed in a parallel installation 1 UINT16 48712 0x2207 8711 Number of redundant UPS installed in a parallel installatio 1 UINT16 48713 0x2208 8712 Number of redundant Power Cabinet installed in a UPS 1 UINT16
48714 0x2209 8713 UPSs presence in parallel installation 1 0 UPS 1 presence BOOLEAN bit = 0, UPS 1 not present bit = 1, UPS 1 is present 1 UPS 2 presence BOOLEAN bit = 0, UPS 2 not present bit = 1, UPS 2 is present 2 UPS 3 presence BOOLEAN bit = 0, UPS 3 not present bit = 1, UPS 3 is present 3 UPS 4 presence BOOLEAN bit = 0, UPS 4 not
present bit = 1, UPS 4 is present 4 UPS 5 presence BOOLEAN bit = 0, UPS 5 not present bit = 1, UPS 5 is present 5 Reserved BOOLEAN 6 Reserved BOOLEAN 7 Reserved BOOLEAN 8 Reserved BOOLEAN 9 Reserved BOOLEAN 10 Reserved BOOLEAN 11 Reserved BOOLEAN 12 Reserved BOOLEAN 13 Reserved BOOLEAN 14 Reserved
BOOLEAN 15 Reserved BOOLEAN 48715 0x220A 8714 Frequency Converter Mode 1 ENUM 1 1 0=Disable 1=Enable 48716 0x220B 8715 Energy Storage Type 1 ENUM 1 1 0=None 1=Battery 2=Flywheel48717 0x220C 8716 Number Power Cabinet on the left of IO Cabinet 1 UINT16 1 1 48718 0x220D 8717 Continuous Overload Mode Setting 1 UINT16
1 1 % Worldwide Customer Support Customer support for this or any other product is available at no charge in any of the following ways: * Visit the Schneider Electric Web site to access documents in the Schneider Electric Knowledge Base and to submit customer support requests. – www.schneider-electric.com (Corporate Headquarters) Connect to
localized Schneider Electric Web sites for specific countries, each of which provides customer support information. – www.schneider-electric.com/support/ Global support searching Schneider Electric Knowledge Base and using e-support. * Contact the Schneider Electric Customer Support Center by telephone or e-mail. – Local, country-specific centers: go
to www.schneider-electric.com > Support > Operations around the world for contact information. SCHN-01185-V01.01-EN - PEP ECOPASSPORT®- Galaxy VX UPS System Product Environmental Profile Galaxy VX UPS System #Internal ENVPEP2311001_V2 - SCHN-01185-V01.01-EN 2024/4/23 SCHN-01185-V01.01-EN - PEP ECOPASSPORT®-
Galaxy VX UPS System 3600 kg Plastics Metals Others 22.70% General information Reference product Galaxy VX 1250kVA, 400V, Start up 5x8 - GVX1250K1250NHS Constituent materials This document provides environmental impact and performance of the product based on Life Cycle Assessment (LCA), from cradle to grave (materials, manufacturing,
distribution, installation, use and end of life). Reference product mass including the product, its packaging and additional elements and accessories 4.80% 72.50% Description of the product The Galaxy VX is a scalable, highly efficient 500 - 1500KVA 3 phase Uninterruptible Power Supply (UPS) system that provides seamless power protection for large
sized data centers, industrial and facilities applications. Description of the range Galaxy VX UPS System The representative product is 1250 kW rating (5 Power Cabinets) with 1250 kW I/O Cabinet (GVX1250K1250NHS). The environmental impacts of this referenced product are representative of the impacts of the other products of the range which are
developed with a similar technology. Meanwhile, environmental details of other kVA ratings are available in supplementary information at the end of this document. Functional unit To protect the load of 1250 kW against input power failure during 15 years and switch to the energy storage system to avoid power outage. Steel - 42% Copper - 16.6% Aluminium
- 12.8% Tin - 0.5% Ferrous alloys - 0.3% Brass - 0.3% Electronic components - 16.6% Wood - 3.6% Cardboard - 1.3% Miscellaneous - 0.4% Various - 0.8% PC Polycarbonate - 2.6% UP Polyester - 0.5% PE Polyethylene - 0.5% PA Polyamide - 0.4% Diverse Thermosetting Plastics - 0.4% ABS Acrylonitrile Butadiene Styrene - 0.4% #Internal
ENVPEP2311001_V2 - SCHN-01185-V01.01-EN 2024/4/23 SCHN-01185-V01.01-EN - PEP ECOPASSPORT®- Galaxy VX UPS System RoHS compliance REACH compliance Battery Directive compliance End Of Life 76% Use scenario Power consumption conforms to the requirements in PSR0010-ed1.1-EN-2015_10_16_UPS: The referent UPS can
operate in 2 modes. It has an average energy efficiency of 95.8% in Double Conversion mode and 98.6% in eConversion mode. Total energy losses are calculated to be 3418454 kWh in Double Conversion and 1047094 kWh in eConversion after 15 years. Geographical representativeness Europe Energy model used [A1 - A3] [A5] [B6] [C1 - C4] Electricity
Mix: Production mix; Low voltage; IN Electricity Mix; Production mix; Low voltage; UE-27 Electricity Mix; Production mix; Low voltage; UE-27 Electricity Mix; Production mix; Low voltage; UE-27 Technological representativeness The Modules of Technologies such as material production, manufacturing process and transport technology used in this PEP
analysis (LCA- EIME in this case) are Similar and representative of the actual type of technologies used to make the product in production. Environmental impacts Reference service life time 15 years Installation elements The disposal of the packaging materials is accounted for 6% during the installation phase (including transport to disposal). Substance
assessment Details of ROHS and REACH substances information are available on the Schneider-Electric Green Premium website https://www.se.com/ww/en/work/support/green-premium/ Additional environmental information Recyclability potential: Recyclability rate has been calculated based on REEECY'LAB tool developed by Ecosystem, for
components/materials not covered by the tool, data from the "ECO'DEEE recyclability and recoverability calculation method" was taken. If no data was found a conservative assumption was used (0% recyclability). Products of this range are designed in conformity with the requirements of the RoHS directive (European Directive 2011/65/EU of 8 June 2011)
on restriction of lead, mercury, cadmium, hexavalent chromium or flame retardants -PBB&PBDE or phthalates-DEHP, BBP, DBP, DIBP. Products of this range are designed in conformity with the requirements of the REACH 1907/2006 regulation and its latest updates. The battery within this product range are designed in conformity with the requirements of
the Battery and Accumulator Directive (European Directive 2006/66/EC of 26 September 2006).Average energy efficiency Electricity consumption (kWh over 15 years) Average energy efficiency Electricity consumption (kWh over 15 years) 500 kW with 1250 kW I/O Cabinet 95.6% 1.45E+06 98.6% 4.52E+05 625 kW with 1250 kW I/O Cabinet 95.6%
1.81E+06 98.2% 6.78E+05 750 kW with 1250 kW I/O Cabinet 95.6% 2.17E+06 98.4% 7.51E+05 800 kW with 1250 kW I/O Cabinet 95.7% 2.23E+06 98.3% 8.02E+05 1000 kW with 1250 kW I/O Cabinet 95.8% 2.76E+06 98.6% 8.71E+05 1100 kW with 1250 kW I/O Cabinet 95.9% 2.98E+06 98.6% 9.58E+05 1250 kW with 1250 kW I/O Cabinet 95.8%
3.42E+06 98.6% 1.05E+06 500 kW with 1500 kW I/O Cabinet 96.4% 1.19E+06 99.0% 3.20E+05 750 kW with 1500 kW I/O Cabinet 96.2% 1.90E+06 98.9% 5.05E+05 1000 kW with 1500 kW I/O Cabinet 96.0% 2.65E+06 98.9% 6.73E+05 1250 kW with 1500 kW I/O Cabinet 96.2% 3.20E+06 99.0% 7.60E+05 1500 kW with 1500 kW I/O Cabinet 96.2%
3.84E+06 99.0% 9.12E+05 Type (400V UPS system) Double conversion eConversionAverage energy efficiency Electricity consumption (kWh over 15 years) Average energy efficiency Electricity consumption (kWh over 15 years) 500 kW with 1250 kW I/O Cabinet 95.7% 1.38E+06 98.0% 5.83E+05 625 kW with 1250 kW I/O Cabinet 95.9% 1.61E+06 98.2%
6.78E+05 750 kW with 1250 kW I/O Cabinet 95.9% 1.98E+06 98.4% 7.51E+05 800 kW with 1250 kW I/O Cabinet 95.9% 2.08E+06 98.3% 8.02E+05 1000 kW with 1250 kW I/O Cabinet 96.1% 2.51E+06 98.6% 8.46E+05 1100 kW with 1250 kW I/O Cabinet 96.2% 2.68E+06 98.5% 9.67E+05 1250 kW with 1250 kW I/O Cabinet 96.2% 3.08E+06 98.6%
1.06E+06 500 kW with 1500 kW I/O Cabinet 96.2% 1.23E+06 98.9% 3.20E+05 750 kW with 1500 kW I/O Cabinet 96.3% 1.80E+06 98.9% 5.05E+05 1000 kW with 1500 kW I/O Cabinet 96.3% 2.37E+06 98.9% 6.73E+05 1250 kW with 1500 kW I/O Cabinet 96.4% 2.92E+06 99.0% 7.60E+05 1500 kW with 1500 kW I/O Cabinet 96.3% 3.58E+06 99.0%
9.12E+05 Type (480V UPS system) Double conversion eConversionLoad rate 25% 50% 75% 100% Proportion of time at specified load 0.25 0.5 0.25 0 #Internal ENVPEP2311001_V2 - SCHN-01185-V01.01-EN 2024/4/23 SCHN-01185-V01.01-EN - PEP ECOPASSPORT®- Galaxy VX UPS System Detailed results, including all the optional indicators
mentioned in PCRed4, and the split of the Use Phase (B1 to B7), are available in the LCA report and on demand in a digital format - Country Customer Care Center - http://www.schneider-electric.com/contact kg CO2 eq kg CO2 eq kg CO2 eq kg CO2 eq kg CO2 eq kg CFC-11 eq mol H+ eq kg (PO4)$^{3-}$eq kg N eq mol N eq kg COVNM eq kg Sb eq MJ m3 eq
Additional indicators for the French regulation are available as well MJ MJ MJ MJ MJ kg MJ MJ m³ Contribution to use of non renewable secondary fuels Contribution to net use of freshwater 0.00E+00 2.56E+03 3.77E+02 1.23E+00 1.76E+00 1.15E+03 1.03E+03 -6.12E+03 0.00E+00 0* 0* 0* 0* 0* Contribution to total use of renewable primary energy
resources 6.88E+06 2.29E+04 0* 0* 6.85E+06 0* -9.45E+03 3.68E+07 7.30E+05 1.26E+04 0* 3.57E+07 3.52E+05 -8.62E+06 0.00E+00 0.00E+00 0* 0* 0* 0* 0.00E+00 1.27E+00 1.27E+00 0* 0* 0* 0*Contribution to use of secondary material Contribution to total use of non-renewable primary energy resources Contribution to use of renewable
secondary fuels 3.17E+03 -1.91E+05 Contribution to use of renewable primary energy resources used as raw material 3.89E+03 3.89E+03 0* 0* 0* 0* -7.67E+03 Contribution to use of renewable primary energy excluding renewable primary energy used as raw material 6.88E+06 1.90E+04 0* 0* 6.85E+06 Contribution to use of non renewable primary
energy resources used as raw material 1.19E+04 1.19E+04 0* 0* 0* 3.17E+03 -1.99E+05 Contribution to use of non renewable primary energy excluding non renewable primary energy used as raw material 3.68E+07 7.18E+05 1.26E+04 0* 3.57E+07 3.52E+05 -8.61E+06 Inventory flows Indicators Galaxy VX UPS System - GVX1250K1250NHS Inventory
flows Unit Total Manufact. Distribution Installation Contribution to water use 1.06E+05 1.62E+04 5.26E+01 7.58E+01 4.96E+04 Use End of Life Benefits [A1 - A3] [A4] [A5] [B1 - B7] [C1 - C4] [D] 1.26E-01 -1.07E+02 Contribution to resource use, fossils 3.68E+07 7.30E+05 1.26E+04 0* 3.57E+07 3.52E+05 -8.62E+06 Contribution to resource use, minerals
and metals 7.93E+00 7.70E+00 0* 0* 1.02E-01 3.99E+04 -2.63E+05 Contribution to eutrophication marine 1.01E+03 9.22E+01 2.07E+00 1.66E-01 9.08E+02 7.38E+00 -2.70E+02 Contribution to eutrophication, freshwater 8.49E+00 1.77E-01 0* 2.19E-03 3.84E+00 6.43E+01 -3.10E+03 Contribution to photochemical ozone formation - human health
3.26E+03 3.15E+02 7.36E+00 4.29E-01 2.92E+03 1.94E+01 -1.20E+03 Contribution to eutrophication, terrestrial 1.49E+04 1.18E+03 2.25E+01 0* 1.36E+04 1.08E-04 -7.02E-02 Contribution to acidification 8.89E+03 8.50E+02 4.51E+00 0* 8.00E+03 3.55E+01 -5.07E+03 Contribution to ozone depletion 1.99E-02 1.29E-02 9.16E-04 8.90E-06 5.99E-03
4.48E+00 -9.84E-01 Contribution to climate change-fossil 1.50E+06 9.24E+04 1.04E+03 2.89E+02 1.40E+06 6.12E+03 -4.38E+05 Contribution to climate change 1.50E+06 9.31E+04 1.04E+03 2.18E+02 1.40E+06 1.31E+02 -7.38E+03 Contribution to climate change-land use and land use change 2.27E-03 5.00E-05 0* 1.20E-04 0* 2.10E-03 0.00E+00
Contribution to climate change-biogenic 2.60E+03 6.69E+02 0* 0* 1.87E+03 Impact indicators Unit Total Manufacturing Distribution Installation Use End of Life Benefits [A1 - A3] [A4] [A5] [B1 - B7] [C1 - C4] [D] 6.25E+03 -4.46E+05 Mandatory Indicators Galaxy VX UPS System - GVX1250K1250NHS *Net benefits and loads beyond the system boundaries
stage (module D): potential for reuse, recovery and/or recycling, expressed as net benefits and impacts. #Internal ENVPEP2311001_V2 - SCHN-01185-V01.01-EN 2024/4/23 SCHN-01185-V01.01-EN - PEP ECOPASSPORT®- Galaxy VX UPS System kg kg kg kg kg kg MJ kg de C kg de C Referent product 500 625 750 800 1000 1100 1250 500 750 1000
1250 1500 1 1 1 1 1 1 1 1 1 1 2 3 3 4 4 5 5 2 3 4 5 6 1920 2480 2480 3040 3040 3600 3600 2180 2740 3300 3860 4420 6.37E+05 8.00E+05 9.48E+05 9.86E+05 1.20E+06 1.31E+06 1.50E+06 5.42E+05 8.46E+05 1.17E+06 1.41E+06 1.68E+06 8.86E-03 1.15E-02 1.21E-02 1.42E-02 1.52E-02 1.76E-02 1.99E-02 9.37E-03 1.26E-02 1.59E-02 1.89E-02
2.21E-02 3.79E+03 4.76E+03 5.61E+03 5.87E+03 7.12E+03 7.76E+03 8.89E+03 3.26E+03 5.05E+03 6.93E+03 8.34E+03 9.97E+03 3.74E+00 4.82E+00 5.23E+00 5.96E+00 6.56E+00 7.48E+00 8.49E+00 3.78E+00 5.25E+00 6.76E+00 8.05E+00 9.44E+00 4.30E+02 5.41E+02 6.37E+02 6.68E+02 8.09E+02 8.83E+02 1.01E+03 3.71E+02 5.74E+02
7.88E+02 9.49E+02 1.13E+03 6.35E+03 7.98E+03 9.42E+03 9.84E+03 1.20E+04 1.30E+04 1.49E+04 5.44E+03 8.45E+03 1.16E+04 1.40E+04 1.67E+04 1.39E+03 1.75E+03 2.05E+03 2.15E+03 2.61E+03 2.85E+03 3.26E+03 1.20E+03 1.85E+03 2.54E+03 3.06E+03 3.66E+03 3.61E+00 4.75E+00 4.76E+00 5.90E+00 5.91E+00 7.05E+00 7.93E+00
6.44E+00 5.26E+00 7.59E+00 8.74E+00 1.85E+07 2.32E+07 2.77E+07 2.86E+07 3.52E+07 3.81E+07 3.68E+07 1.55E+07 2.44E+07 3.39E+07 4.09E+07 4.91E+07 4.68E+04 6.00E+04 6.52E+04 7.42E+04 8.19E+04 9.33E+04 1.06E+05 4.68E+04 6.52E+04 8.42E+04 1.00E+05 1.18E+05 2.29E+05 3.36E+05 3.66E+05 4.01E+05 4.29E+05
4.79E+05 5.26E+05 1.83E+05 2.72E+05 3.55E+05 4.04E+05 4.80E+05 500 625 750 800 1000 1100 1250 500 750 1000 1250 1500 1 1 1 1 1 1 1 1 1 1 1 2 3 3 4 4 5 5 2 3 4 5 6 1920 2480 2480 3040 3040 3600 3600 2180 2740 3300 3860 4420 6.09E+05 7.18E+05 8.72E+05 9.27E+05 1.10E+06 1.19E+06 1.35E+06 5.57E+05 8.03E+05 1.05E+06
1.29E+06 1.58E+06 8.74E-03 1.12E-02 1.18E-02 1.40E-02 1.47E-02 1.71E-02 1.78E-02 9.44E-03 1.24E-02 1.55E-02 1.84E-02 2.16E-02 3.62E+03 4.29E+03 5.17E+03 5.53E+03 6.54E+03 7.07E+03 7.99E+03 3.35E+03 4.80E+03 6.28E+03 7.67E+03 9.37E+03 3.66E+00 4.60E+00 5.02E+00 5.80E+00 6.29E+00 7.15E+00 7.59E+00 3.82E+00
5.13E+00
6.45E+00 7.73E+00 9.15E+00 4.12E+02 4.88E+02 5.88E+02 6.29E+02 7.44E+02 8.03E+02 9.09E+02 3.81E+02 5.46E+02 7.13E+02 8.72E+02 1.06E+03 6.07E+03 7.18E+03 8.68E+03 9.26E+03 1.10E+04 1.18E+04 1.34E+04 5.58E+03 8.03E+03 1.05E+04 1.29E+04 1.57E+04 1.33E+03 1.58E+03 1.90E+03 2.03E+03 2.40E+03 2.59E+03 2.93E+03
1.23E+03 1.76E+03 2.30E+03 2.81E+03 3.43E+03 Contribution to hazardous waste disposed Contribution to radioactive waste disposed Contribution to non hazardous waste disposed 0* 0.00E+00 * represents less than 0.01% of the total life cycle of the reference flow Life cycle assessment performed with EIME version v5.9.4, database version 2022-01
in compliance with ISO14044. Detailed results, including all the optional indicators mentioned in PCRed4, and the split of the Use Phase (B1 to B7), are available in the LCA report and on demand in a digital format - Country Customer Care Center - http://www.schneider-electric.com/contact ** Net benefits and loads beyond the system boundaries stage
(module D): potential for reuse, recovery and/or recycling, expressed as net benefits and impacts. Not accounted in the Total. Environmental indicators- 'Total' of Life Cycle Phases (UPS in eConversion mode) Contribution to climate change (kg CO2 eq) 480V UPS system Galaxy VX UPS (kVA) with 1250 kW I/O Cabinet Galaxy VX UPS (kVA) with 1500 kW
I/O Cabinet Product type Product information I/O Cabinet Power Cabinets (250 kW/3U) Weight with Packaging (kg) Compulsory environmental indicators - 'Total' of Life Cycle Phases (UPS in Double conversion mode) Contribution to materials for energy recovery 4.30E-07 4.30E-07 0* 0* 0* 0* 0.00E+00 Please note that the values given above are only
valid within the context specified and cannot be used directly to draw up the environmental assessment of an installation. Extrapolated data 400V UPS system Galaxy VX UPS (kVA) with 1250 kW I/O Cabinet Galaxy VX UPS (kVA) with 1500 kW I/O Cabinet Product type Product information I/O Cabinet Power Cabinets (250 kW/3U) Weight with Packaging
(kg) 0* 0.00E+00 Contribution to biogenic carbon content of the product 0.00E+00 0* 0* 0* 0* 0.00E+00 Contribution to exported energy 9.26E+01 8.71E+00 0* 8.39E+01 0* Contribution to biogenic carbon content of the associated packaging 0.00E+00 0* 0* 0* -2.72E+02 Contribution to components for reuse 0.00E+00 0* 0* 0* 0* 0.00E+00
8.72E+01 4.47E+01 2.06E-01 4.74E-02 4.22E+01 3.11E-02 2.66E+03 0.00E+00Contribution to materials for recycling 2.78E+03 2.87E+00 0* 1.18E+02 0* -8.73E+06 2.33E+05 3.07E+04 0* 4.30E+02 2.02E+05 1.86E+02 -4.45E+05 3.04E+05 2.75E+05 0* 0* 2.62E+04 3.11E+03 Contribution to climate change (kg CO2 eq) Contribution to Ozone depletion
(kg CFC11 eq) Contribution to Acidification (mol H+ eq) Contribution to eutrophication, freshwater (kg PO43- eq) Contribution to eutrophication marine (kg N eq) Contribution to eutrophication, terrestrial (mol N eq) Contribution to photochemical ozone formation - human health (kg COVNM eq) Contribution to resource use, minerals and metals (kgSbeq)
Total use of primary energy (MJ) Contribution to water use (m3 eq) Compulsory environmental indicators - 'Total' of Life Cycle Phases (UPS in Double conversion mode) Contribution to climate change (kg CO2 eq) Contribution to Ozone depletion (kg CFC11 eq) Contribution to Acidification (mol H+ eq) Contribution to eutrophication, freshwater (kg PO43-
eq) Contribution to eutrophication marine (kg N eq) Contribution to eutrophication, terrestrial (mol N eq) Contribution to photochemical ozone formation - human health (kg COVNM eq) #Internal ENVPEP2311001_V2 - SCHN-01185-V01.01-EN 2024/4/23 SCHN-01185-V01.01-EN - PEP ECOPASSPORT®- Galaxy VX UPS System 3.61E+00 4.74E+00
4.76E+00 5.89E+00 5.90E+00 7.04E+00 7.05E+00 4.14E+00 5.29E+00 6.44E+00 7.58E+00 8.74E+00 1.76E+07 2.07E+07 2.54E+07 2.68E+07 3.21E+07 3.44E+07 3.93E+07 1.59E+07 2.31E+07 3.05E+07 3.74E+07 4.59E+07 4.56E+04 5.71E+04 6.25E+04 7.21E+04 7.83E+04 8.90E+04 9.47E+04 4.73E+04 6.37E+04 8.02E+04 9.62E+04 1.14E+05
2.83E+05 3.36E+05 3.66E+05 4.01E+05 4.19E+05 4.83E+05 5.20E+05 1.83E+05 2.72E+05 3.55E+05 4.05E+05 4.81E+05 Internal External 5 years 2024/4/23 CS 30323 F- 92500 Rueil Malmaison Cedex RCS Nanterre 954 503 439 Capital social 896 313 776 € www.se.com Published by Schneider Electric Schneider Electric Industries SAS Country
Customer Care Center http://www.schneider-electric.com/contact 35, rue Joseph Monier ©2023 - Schneider Electric – All rights reserved Independent verification of the declaration and data, in compliance with ISO 14025 : 2010 X The PCR review was conducted by a panel of experts chaired by Julie ORGELET (DDemain) PEP are compliant with XP
C08-100-1 :2016 or EN 50693:2019 The elements of the present PEP cannot be compared with elements from another program. Document in compliance with ISO 14025 : 2010 « Environmental labels and declarations. Type III environmental declarations » Date of issue 2024/4/23 Information and reference documents Registration number : SCHN-01185-
V01.01-EN Drafting rules PEP-PCR-ed4-2021 09 06 Verifier accreditation N° VH08 Supplemented by www.pep-ecopassport.org Validity period PSR-0010-ed1.1-2015 10 16 Environmental indicators- 'Total' of Life Cycle Phases (UPS in eConversion mode) Contribution to climate change (kg CO2 eq) Other Additional information Operating the Galaxy VX in
eConversion mode results in significantly reduced environmental impact, in particular Carbon emissions (up to 65% reduction) compared to operation in Double Conversion mode. This is mainly due to an improved energy efficiency in eConversion of 98.6% (average) compared to an efficiency of 95.8% (average) in Double Conversion mode. For details
about eConversion, consult the Schneider-Electric eConversion page: https://www.se.com/ww/en/work/products/product-launch/econversion-high-efficiency-ups- mode/ Compulsory environmental indicators - 'Total' of Life Cycle Phases (UPS in Double conversion mode) Contribution to resource use, minerals and metals (kgSbeq) Total use of primary
energy (MJ) Contribution to water use (m3 eq) #Internal ENVPEP2311001_V2 - SCHN-01185-V01.01-EN 2024/4/23 No reply 12:32 PM (7 minutes ago) to me Dear Tshingombe fiston, Please find your configuration My Configuration created with the Modicon PLC Configurator application. Your configuration ID: 08b93f14-4d65-41cf-9f4a-a8d9670e17e7 Bill
of Material Build No Reference Description Quantity 1 EALBTP23 licence, Ecostruxure Automation Expert, standard engineering buildtime, v23 1 2 EALBFP23 license, EcoStruxure Automation Expert, professional engineering, buildtime, v23 1 Run No Reference Description Quantity 3 EALDSP license, EcoStruxure Automation Expert, standard device
runtime, add on, v23 6 4 EALDHP license, EcoStruxure Automation Expert, high availability option, runtime, add on, v23 7 5 EALADP license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for M251, M262 dPAC 2 7
EALASP license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for M580 dPAC 1 8 EALALP license, EcoStruxure Automation Expert, run time, application, permannet, 1 user, for M580 dPAC with extensions 1 Run Add-on No Reference Description Quantity 9 EALH1P license, EcoStruxure Automation Expert, run time, HMI,
permanent, 1 user, for Harmony ST6 1 10 EALH2P license, EcoStruxure Automation Expert, run time, HMI, permanent, 1 user, for Harmony iPC 1 Service plan No Reference Description Quantity 11 ECAUTESEAE Service plan for EcoStruxure Automation Expert - Essential 294 ... Software license configurator 1. Software selectionDone License
selectorDone 3. Finalize and shareDone Bill of materials My Configuration Verification No Reference Description Quantity 1 CEGVER01AN license, EcoStruxure Control Engineering, verification, basic, node locked, 1 shot 1 Documentation No Reference Description Quantity 2 CEGDOC01AN license, EcoStruxure Control Engineering, documentation,
basic, node locked, 1 shot 1 Software license configurator 1. Software selectionDone License selectorDone Service plansDone 4. Finalize and shareDone Bill of materials My Configuration Regular No Reference Description Quantity 1 CEXSPUCZSSPAZZ Control Expert S single e-licence 1 2 CEXSPMCZXTPAZZ License, EcoStruxure
Control Expert, Topology Manager & M580 safety add-on for XL, team floating (10 users), digital 1 Service plan No Reference Description Service plan size 3 ECAUTESECE Service plan for EcoStruxure Control Expert - Essential 283 Your configuration has been saved! Copy the configuration ID to your clipboard Send by email Add to my project Export (1)
Export the bill of material in XLS .xls Documentation (2) Product Data Sheet .zip Catalog Configuration Name : My Configuration Configuration ID : f9d295b2-90b2-4164-b665-04551a1f2f54 Date : Sun Mar 09 10:52:15 UTC 2025 Operation Server No Reference Description Quantity 1 EUSOPECZZSPEZZ SW PE OPER SERVER LIC 6 Operation Client No
Reference Description Quantity 2 EUSLCCCZZSPEZZ SW PE CTRL CLIENT LIC 1 3 EUSVCCCZZSPEZZ SW PE VIEW CLIENT LIC 1 4 EUSLRCCZZSPEZZ SW PE RED CTRL CLIENT LIC 1 5 EUSVRCCZZSPEZZ SW PE RED VIEW CLIENT LIC 1 Service plan No Reference Description Quantity 6 ECAUTESEPE Service plan for EPE - Essential 608
Product Selector Tool This tool is designed to assist you through the product selection process. Try our Product Selector Content Training Installed Base Programs Overview Product Configurators PLC Your products have been added to a New Project/BOM View BOM Select your location Tshingombe fiston Software license configurator 1. Software
selectionDone License selectorDone Service plansDone 4. Finalize and shareDone Bill of materials Perpetual My Configuration Design & Build No Reference Description Quantity 1 EALBTP23 licence, Ecostruxure Automation Expert, standard engineering buildtime, v23 1 2 EALBFP23 license, EcoStruxure Automation Expert, professional
engineering, buildtime, v23 1 Operate & Maintain No Reference Description Quantity 3 EALDSP license, EcoStruxure Automation Expert, standard device runtime, add on, v23 6 4 EALDHP license, EcoStruxure Automation Expert, high availability option, runtime, add on, v23 7 5 EALADP license, EcoStruxure Automation Expert,
run time, application,
permanent, 1 user, for ATV dPac 1 6 EALAMP license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for M251, M262 dPAC 2 7 EALASP license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for M580 dPAC 1 8 EALALP license, EcoStruxure Automation Expert, run time, application, permannet, 1
user, for M580 dPAC with extensions 1 Run Add-on No Reference Description Quantity 9 EALH1P license, EcoStruxure Automation Expert, run time, HMI, permanent, 1 user, for Harmony ST6 1 10 EALH2P license, EcoStruxure Automation Expert, run time, HMI, permanent, 1 user, for Harmony iPC 1 Service plan No Reference Description Service plan
size 11 ECAUTESEAE Service plan for EcoStruxure Automation Expert - Essential 294 Your configuration has been saved! Copy the configuration ID to your clipboard Send by email Add to my project Export (1) Export the bill of material in XLS .xls Documentation (2) Product Data Sheet .zip Catalog pdf Feedback Back Go to start page Back Go to start
page mySchneider Terms of Use Privacy Policy Cookie Notice Change your cookie settings ©2025, Schneider Electric mySchneider Design & Build;;; No;Reference;Description;Quantity 1;EALBTP23;licence Ecostruxure Automation Expert standard engineering buildtime v23;1 2;EALBFP23;license EcoStruxure Automation Expert
professional engineering buildtime v23;1 Operate & Maintain;;; No;Reference;Description;Quantity 3;EALDSP;license EcoStruxure Automation Expert standard device runtime add on v23;6 4;EALDHP;license EcoStruxure Automation Expert high availability option runtime add on v23;7 5;EALADP;license EcoStruxure Automation Expert run time application
permanent 1 user for ATV dPac;1 6;EALAMP;license EcoStruxure Automation Expert run time application permanent 1 user for M251 M262 dPAC;2 7;EALASP;license EcoStruxure Automation Expert run time application permanent 1 user for M580 dPAC;1 8;EALALP;license EcoStruxure Automation Expert run time application
permannet 1 user for M580
dPAC with extensions;1 Run Add-on;;; No;Reference;Description;Quantity 9;EALH1P;license EcoStruxure Automation Expert run time HMI permanent 1 user for Harmony ST6;1 10;EALH2P;license EcoStruxure Automation Expert run time HMI permanent 1 user for Harmony iPC;1 Service plan;;; No;Reference;Description;Quantity
11;ECAUTESEAE;Service plan for EcoStruxure Automation Expert - Essential;294 Direct Starter EcoStruxure™ Motor Control Configurator 1. Voltage440 V Motor detailsIE3-55 kW AdjustDone OptionsDone 5. Save & ShareDone My Configuration Technology: direct starter Supply Voltage: 440 V Standard: IEC (kW) Motor power: 55 kW
Coordination type: Coordination type 1 Number of product: 2 products Range: 664 Starter type: Direct Online PLC Control: no Breaking performance Iq: 50 kA Coil Type: Standard Coil voltage: 230 V AC - 50/60 Hz Power terminal connection: Screw Clamp Motor efficiency class: IE3 Breaker GV4P115N Motor circuit breaker, TeSys GV4, 3P, 115A, Icu 50kA,
thermal magnetic, Everlink terminals Accessories GV4AE11 Auxiliary contact, TeSys GV4, 690VAC, 1 NO/NC GV4AE11 Auxiliary contact, TeSys GV4, 690VAC, 1 NO/NC Contactor LC1D115P7 Contactor, TeSys Deca, 3P(3NO), AC-3/AC-3e, Show options (2) Contactor LC1D115P7 Contactor, TeSys Deca, 3P(3NO), AC-3/AC-3e, Show options (1) Your
configuration has been saved! Copy the configuration ID to your clipboard dc5b40a4-bb0a-4e45-b277-b7fa55863d6a Please find a summary of Energy Savings delivered for Drive instead of a fixed speed solution This data is to be considered with assemption Export (2) Print Export Bill of Material (.xls) .xls Documentation (6) Product Data Sheet Bill of
Material - My Configuration - 6b546e9d-8a2e-424f-af3c-939ea886fdcd - Schneider Electric Inbox No reply 12:45 PM (14 minutes ago) to me Dear Tshingombe fiston, Please find your configuration My Configuration created with the Modicon PLC Configurator application. Your configuration ID: 6b546e9d-8a2e-424f-af3c-939ea886fdcd Bill of Material
Verification No Reference Description Quantity 1 CEGVER01AN license, EcoStruxure Control Engineering, verification, basic, node locked, 1 shot 1 Documentation No Reference Description Quantity 2 CEGDOC01AN license, EcoStruxure Control Engineering, documentation, basic, node locked, 1 shot 1 Service plan No Reference Description Quantity ...
[Message clipped] View entire message Bill of Material - My Configuration - 577e9790-a49e-4c0c-9307-f56f18a5ab60 - Schneider Electric Inbox No reply 12:50 PM (10 minutes ago) to me Dear Tshingombe fiston, Please find your configuration My Configuration created with the Modicon PLC Configurator application. Your configuration ID: 577e9790-
a49e-4c0c-9307-f56f18a5ab60 Bill of Material Regular No Reference Description Quantity 1 CEXSPUCZSSPAZZ License, EcoStruxure Control Expert, service pack base, small S, 1 user, node locked, digital license 1 2 CEXSPMCZXTPAZZ License, EcoStruxure Control Expert, with Topology Manager and M580 safety, for XL, node locked, 10 users, digital
1 Service plan No Reference Description Quantity 3 ECAUTESECE Service plan for EcoStruxure Control Expert - Essential 283 ... [Message clipped] View entire message Bill of Material - My Configuration - f9d295b2-90b2-4164-b665-04551a1f2f54 - Schneider Electric Inbox No reply 12:54 PM (6 minutes ago) to me Dear Tshingombe fiston, Please find
your configuration My Configuration created with the Modicon PLC Configurator application. Your configuration ID: f9d295b2-90b2-4164-b665-04551a1f2f54 Bill of Material Operation Server No Reference Description Quantity 1 EUSOPECZZSPEZZ SW PE OPER SERVER LIC 6 Operation Client No Reference Description Quantity 2 EUSLCCCZZSPEZZ
SW PE CTRL CLIENT LIC 1 3 EUSVCCCZZSPEZZ SW PE VIEW CLIENT LIC 1 4 EUSLRCCZZSPEZZ SW PE RED CTRL CLIENT LIC 1 5 EUSVRCCZZSPEZZ SW PE RED VIEW CLIENT LIC 1 Service plan No Reference Description Quantity 6 ECAUTESEPE Service plan for EPE - Essential 608 ... Bill of Material - My Configuration - dc5b40a4-
bb0a-4e45-b277-b7fa55863d6a - Schneider Electric Inbox tshingombe tshitadi 12:58 PM (2 minutes ago) to me Dear tshingombe tshitadi, Please find your configuration created from: EcoStruxureTM Motor Control Configurator Configuration link: My Configuration Your configuration ID: dc5b40a4-bb0a-4e45-b277-b7fa55863d6a Motor Starter parameters
selected Technology: Direct Start Standard: IEC Supply Voltage: 440 V V Motor Power: 55 kW Motor efficiency class: IE3 Breaker Breaking performance Iq: 50 kA Contactor Coil voltage: 230 V AC - 50/60 Hz Power terminal connection: Screw Clamp Coil Type: Standard Bill of Material Devices Options Description Quantity: Breaker GV4P115N Motor circuit

breaker, TeSys GV4, 3P, 115A, Icu 50kA, thermal magnetic, Everlink terminals 1 GV4AE11 Auxiliary contact, TeSys GV4, 690VAC, 1 NO/NC Auxiliary Contact Block > Front Function Sd > 1 NO + 1 NC - SD function 1 GV4AE11 Auxiliary contact, TeSys GV4, 690VAC, 1 NO/NC Auxiliary Contact Block > Front Function On/off > 1 NO + 1 NC - OF function 1
Contactor LC1D115P7 Contactor, TeSys Deca, 3P(3NO), AC-3/AC-3e, Front Clip Position 1 > 10180 s - 1 NO + 1 NC 1 LX1D8P7 Spareparts Voltage440 V Motor detailsIE3-55 kW AdjustDone OptionsDone 1. Save & ShareDone My Configuration Technology: soft starter Supply Voltage: 440 V Standard: IEC (kW) Motor power: 132 kW Segment and process: Machine Manufacturing Application: Standard Machines Service duty: Normal duty Coordination type: Coordination type 1 Range: 5745 Communication module: Modbus SL (embedded) Motor Softstarter connection: In line Integrated bypass: yes With trip unit: yes Breaking capacity: 50 kA Coil Type: without coil Breaker
C40H31M320 Circuit breaker, ComPacT NSX400H, 70kA/415VAC, 3 poles, MicroLogic 1.3M trip unit 320A Contactor LC1F265 Contactor body,TeSys F,3P(3NO)-AC-3, 1 NC 1 LADN11 Auxiliary contact block, TeSys Deca, 1NO+1NC, front mounting, screw clamp terminals Auxiliary Contact For Standard Environment > Front Clip Position 1 > 1 NO + 1 NC 1 LADN13 Auxiliary contact block, TeSys Deca, 1NO+3NC, front mounting, screw clamp terminals Auxiliary Contact For Standard
Environment > Front Clip Position 1 > 1 NO + 3 NC 1 Soft Starter ATS22C25Q soft starter for asynchronous motor, Altistart 22, control 230V, 230 to 440V, 75 to 132kW 1 Bill of Material - My Configuration - 96d5a340-770b-4927-bab7-5c538288d832 - Schneider Electric Inbox tshingombefiston 1:12 PM (9 minutes ago) to me Dear tshingombefiston, Please
find your configuration created from: EcoStruxureTM Motor Control Configurator Configuration link: My Configuration Your configuration ID: 96d5a340-770b-4927-bab7-5c538288d832 Motor Starter parameters selected Technology: Variable Speed Drive Standard: IEC Supply Voltage: 480 V V Motor Power: 132 kW Segment and Process: Machine
Manufacturing Application: Standard machines Heavy Duty selection: no Breaker Breaking capacity: 50 kA With trip unit: yes Contactor Coil voltage: n/a Coil Type: without coil Drive Installation type: wall mounted With braking unit: yes Protection level: IP21 Bill of Material Devices Options Description Quantity: Breaker C40H31M320 Circuit breaker,
ComPacT NSX400H, 3 poles, MicroLogic 1.3M trip unit 320A 1 29452 Low level auxiliary contact, circuit breaker status OF/SD/SDE/SDV, 1 changeover contact type Add-on Auxiliary Contact-low Level > Front Function Sde > SDE function 1 29452 Low level auxiliary contact, circuit breaker status OF/SD/SDE/SDV, 1 changeover contact type
Add-on Auxiliary Contact-low Level > Front Function Sd > SD function 1 29452 Low level auxiliary contact, circuit breaker status OF/SD/SDE/SDV, 1 changeover contact type Add-on Auxiliary Contact-low Level > Front Function On/off > ON/OFF 1 LV432513 Spareparts 1 Contactor LC1F265 Contactor body,TeSys F,3P(3NO)-AC-3, Clip On Rail Mounting >
127240 V AC 1 LADT0 Time delay auxiliary contact block, TeSys Deca, 1NO+1NC, on delay 0.3-3s, front, screw clamp terminals Time On Delay > Front Clip Position 1 > 0.13 s - 1 NO + 1 NC 1 LADT2 Time delay contact block,TeSys Deca,1NO+1NC,on-delay 1-30s,front Time On Delay > Front Clip Position 1 > 0.130 s - 1 NO + 1 NC 1 LA5FH431
Spareparts 1 Drive ATV930C16N4 variable speed drive, Altivar Process ATV900, ATV930, 160kW, 380 to 480V, with braking unit, IP20 1 Bill of Material - My Configuration - 36455ef8-f6c2-460a-91c3-15d69cf9452f - Schneider Electric Inbox No reply 1:16 PM (6 minutes ago) to me Dear Tshingombe fiston, Please find your configuration My Configuration
created with the Modicon PLC Configurator application. Your configuration ID: 36455ef8-f6c2-460a-91c3-15d69cf9452f Bill of Material Bom level Position Reference Description Quantity My Configuration 1 LMC216CAA10000 Motion controller LMC216 16 axis - Acc kit - Basic 1 My Configuration 2 ABL8WPS24200 Regulated switch power supply, modicon
power supply, 3 phases, 380 to 500V AC, 24V, 20A 1 My Configuration 3 GV2ME06 Motor circuit breaker, TeSys Deca, 3P, 1 to 1.6A, thermal magnetic, screw clamp terminals, button control 1 My Configuration 4 ABL8BBU24200 battery control module, phaseo ABL7 ABL8, 24 to 28.8V DC, phaseo ABL7 ABL8, 24V, 20A, for regulated SMPS 1 My
Configuration 5 ABL8BBU24400 battery control module, phaseo ABL7 ABL8, 24 to 28.8V DC, phaseo ABL7 ABL8, 24V, 40A, for regulated SMPS 1 My Configuration 6 BVS480XDPDR Easy UPS control module, 24V DC-DC, DIN Rail, Industrial, 20A 1 My Configuration 7 XB005XPDR Easy UPS battery module, 24V DC-DC, DIN Rail, Industrial, 4.5Ah 1 ...
Bill of Material - My Configuration - 9988cbd9-4fe8-473c-927f-c3473aaf67af - Schneider Electric Inbox No reply 1:21 PM (1 minute ago) to me Dear Tshingombe fiston, Please find your configuration My Configuration created with the Modicon PLC Configurator application. Your configuration ID: 9988cbd9-4fe8-473c-927f-c3473aaf67af Bill of Material Bom
level Position Reference Description Quantity My Configuration 1 TM171ODM22R Controller, Modicon M171/M172/M173, optimized display 22 IO, Modbus 1 My Configuration 2 TM171ACB4OI1M Modicon M171 Optimized LV Connector 1m cable 2 My Configuration 3 TM171ACB4OAO1M Modicon M171 Optimized AO Connector 1m cable 1 My
Configuration 4 TM171ACB4OAO2M Modicon M171 Optimized AO Connector 2m cable 1 My Configuration 5 TM171DLED Modicon M171 Optimized Display LED 1 My Configuration 6 TM171DLCD2U Modicon M171 Optimized Display LCD 1 My Configuration 7 TM171DWAL2U Modicon M171 Optimized Wall thermostat without backlight 1 My
Configuration 8 TM1STNTCRN52015 NTC 1,5m IP68 5x20 -50+110°C Grey 1 My Configuration 9 TM1STNTCRN5201P NTC 1,5m IP68 5x20 -50+110°C Grey 1 My Configuration 10 TM1STNTCRN52030 NTC 3,0m IP68 5x20 -50+110°C Grey 1 My Configuration 11 TM171VEVA2 EEV Driver, Actuator 1 My Configuration 12 TM171VEVD4 EEV Driver,
Autonomous & Hardwired 1 My Configuration 13 TM171VEVM4 EEV Driver, Autonomous & Modbus 1 ... [Message clipped] View entire message www.se.com Catalog | July 2024 Software-defined Automation Software version v24.0 EcoStruxure™ Automation Expert Industrial Automation systems Find your catalog > With just 3 clicks, you can access the
Industrial Automation and Control catalogs, in both English and French > Consult digital automation catalogs at Digi-Cat Online Select your training > Find the right Training for your needs on our Global website > Locate the training center with the selector tool, using this link Quick access to product information Get technical information about your product
Each commercial reference presented in a catalog contains a hyperlink. Click on it to obtain the technical information of the product: – Characteristics, Dimensions and drawings, Mounting and clearance, Connections and schemas, Performance curves – Product image, Instruction sheet, User guide, Product certifications, End of life manual • Up-to-date
catalogs • Embedded product selectors, 360° pictures • Optimized search by commercial references General contents EcoStruxure™ Automation Expert b General presentation v EcoStruxure Automation Expert..... page 2 v Feature overview ..... page 3 b
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integration..... page 5 - EcoStruxure Automation Expert - Libraries ..... page 5 - System requirements..... page 9 v Hardware - Software dPAC ..... page 10 - Edge
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..... page 36 v Modicon M262 dPAC ..... page 37 v Altivar ATV dPAC ..... page 38 b Services..... page 40 b Product reference
index..... page 42 1 2 EcoStruxure™ Automation Expert Industrial automation systems EcoStruxure Automation Expert General presentation Libraries Operator Station Automation Expert HMI Runtime Modicon dPAC Engineering Automation Expert Communications X80 TM3 I/O & Enc M580 dPAC M2xx dPAC
ATV dPAC Soft dPAC Linux/HA Soft dPAC Windows Automation ExpertHistorization Automation Expert Archive Control Room AVEVA System Platform CRD + X80 EcoStruxure Automation Expert consists of a suite of integrated hardware and software solutions: > EcoStruxure Automation Expert build time - engineering, monitoring, and management
environment > Distributed Programmable Automation Controller (dPAC) platforms with the Universalautomation.org Shared Source Runtime engine: b ATV dPAC for Altivar b Modicon M251 dPAC/TM3 I/O b Modicon M262 dPAC/TM3 I/O b Modicon M580 dPAC/X80 I/O > Plus, innovative new software-based controllers: b Soft dPAC for Linux™, for
standalone and high availability configurations b Soft dPAC for Windows™ , for standalone configurations > EcoStruxure Automation Expert - HMI, a fully integrated, object-oriented industrial visualization solution > EcoStruxure Automation Expert - Archive, a centralized solution for the historization of process data, alarms, and trends > Schneider Electric
Libraries, a comprehensive set of hardware-independent libraries, ranging from basic functions up to segment solutions > Asset Link for Bulk Engineering to extract data from engineering tools for automated application generation > Asset Link for AVEVA OMI to create application objects (AppObjects) in the AVEVA System Platform in an automated
workflow Note: UniversalAutomation.org is an independent, non-for-profit association managing the implementation of an industrial automation shared source runtime execution engine, based on the IEC 61499 standard that is an object-oriented further development of IEC 61131 with the cyclical execution model of IEC 61131 replaced by an event-based
model. This new level of shared technology provides the basis for an ecosystem of portable, interoperable, “plug and produce” solutions and creates an entirely new category within industrial automation. EcoStruxure Automation Expert is a software-defined industrial automation system, a new category of industrial automation that leverages innovative
technology to enable industrial operators to realize a step-change improvement over traditional process control systems and deliver significant advancement in productivity, quality, flexibility, and security throughout the entire lifecycle of industrial assets. 3 Feature overview EcoStruxure Automation Expert represents a new approach to designing, building,
operating, and maintaining industrial automation systems that offers a unique technology mix to define a new category of integrated automation systems. Complexity mastered Systems, devices, services, and assets are natively represented as ready-to-use software objects called composite automation types (CATs) that encapsulate internal behaviour and
simplify functional interfaces. An object-oriented approach promotes code reuse, standardization on best practice, and helps manage complexity while providing the fundamental building blocks for the creation of state-of-the-art cyber-physical systems. CAT objects follow a type/instance relation and can be combined to create new objects that encapsulate:
b Control logic b HMI/SCADA visualization b I/O and device communications b Simulation and test rigging b Documentation Decoupling the application from implementation EcoStruxure Automation Expert addresses full automation system engineering and extends the best features of classic PLC and DCS control approaches to a new generation of
automation system that completely decouples the application design from runtime deployment, enabling automation professionals to focus on these tasks independently in their project lifecycle. Applications are portable, reusable, and interoperable across runtime platforms, meaning deployment decisions are made just in time and on the fly, enabling
exceptional system agility. Efficient engineering EcoStruxure Automation Expert build time provides a single, modular engineering environment for all tasks for engineering, monitoring, and managing the complete automation system including hardware and software, control, and visualization. It automates low value engineering and integration tasks,
reducing engineering effort and sources of error by Asset Link to perform digital engineering. Complex functions can be encapsulated into manageable objects, enabling non-technical users to understand and manage complex systems. Cross communications are transparent and implicit regardless of physical location, requiring zero engineering
consideration. Common runtime environment Through the implementation of the shared source Runtime engine provided by universalautomation.org across hardware and software platforms, exceptional re-usability, scalability, and architectural flexibility are now available. Application portability provides cost savings through the decoupling of the lifecycles
of software and hardware systems. Simple system orchestration EcoStruxure Automation Expert was designed with the complete lifecycle of an automation system in mind, with functions to facilitate management and monitoring of multiple assets and devices at scale. With a single user environment covering the entire system scope including third-party
devices, orchestration of complex, heterogenous systems becomes simpler. Native IT integration Modern automation systems generate increased value when coupled with business information and hence wider IT ecosystems. EcoStruxure Automation Expert provides an expandable platform for Industry 4.0 solutions with support for high-level
programming, modular systems design, and open standards. Thanks to event-driven execution and object-oriented design, EcoStruxure Automation Expert applies to IT programming language standards. Cybersecurity EcoStruxure Automation Expert includes robust support for cybersecurity including credential management and secure communications.
User and device credentials are managed by the EcoStruxure Automation Expert build time environment, and secure communications are available between controllers, HMI, SCADA, and third-party devices. Industrial automation systems EcoStruxure Automation Expert General presentation (continued) 4 EcoStruxure Automation Expert Software The
EcoStruxure Automation Expert software offer includes: b The EcoStruxure Automation Expert engineering environment, with add-ons for integration of AVEVA Engineering and AVEVA System Platform software b EcoStruxure Automation Expert HMI Runtime b EcoStruxure Automation Expert Archive b Asset-oriented application libraries EcoStruxure
Automation Expert engineering EcoStruxure Automation Expert is an asset-based, fully-integrated engineering environment that allows portable, IEC 61499-standard-based automation systems to be managed within a single environment. EcoStruxure Automation Expert provides the capability to: b Design and manage asset-based applications using object
libraries based on multifaceted models (asset logic, operating modes, HMI symbols and faceplates (including alarms and trends), I/O interface, and asset documentation) b Design the process based on asset-oriented objects with single line connections b Create rich process displays to monitor and control the process from the control room or line terminal
by dragging and dropping asset-based objects b Manage a single solution independently of the number of controllers and HMI stations b Design the application solution independently of the hardware configuration b Test and simulate the control and HMI for the whole solution b Create and modify procedural automation CATs based on S88 state model with
graphical editor b Support multi-user change management through SVN client integration b Design, configure, and manage network and device topologies b Flexibly deploy applications to multiple hardware or software platforms based on a common runtime b Automatically discover and diagnose compatible runtime devices b Automate bulk generation of
asset instances from AVEVA Engineering or DEXPI files b Automate bulk generation of asset instances for AVEVA System Platform b Embedded AVEVA industrial graphic editor in EcoStruxure Automation Expert build time to create new AVEVA industrial graphics or to reuse graphics from existing applications b Secure the automation system by managing
authentication with encrypted communication and security certificates at solution and devices level EcoStruxure Automation Expert V24.0 build time Industrial automation systems EcoStruxure Automation Expert Software Presentation 5 EcoStruxure Automation Expert Software EcoStruxure Automation Expert – HMI EcoStruxure Automation Expert HMI is
a tightly integrated human-machine interface designed for EcoStruxure Automation Expert applications. Its features include: b Compatibility with WindowsTM OS/LinuxTM OS hardware or Schneider Electric Harmony ST6 b Seamless management of controller and HMI communication b Support for single/multi operator stations with cloning b User
management for access control b Multi-language application b Monitoring of runtime connections The EcoStruxure Automation Expert HMI Client for WindowTM/LinuxTM operating system can be installed on various hardware such as Workstations, Industrial PCs, and Edge Boxes, provided they meet the minimum system
requirements. It ensures highperformance, seamless management of controller and HMI communication. Furthermore, the EcoStruxure Automation Expert HMI Client for Harmony ST6 is compatible with HMIST6200, HMIST6400, HMIST6500, HMIST6600, HMIST6700, HMISTM6400, and HMISTM6200 touch panel screens. It offers seamless management of controller and automatic
HMI communication, particularly ideal for a small number of assets. EcoStruxure Automation Expert – Archive EcoStruxure Automation Expert Archive operates as a highly integrated local data historian, providing minimal engineering effort historization and retrieval of live process data, alarms, and events within Automation Expert HMI and the capability to
integrate with larger enterprise data storage systems by Structured Query Language (SQL). It is compatible with Windows 10, Windows 11, and Linux operating system. EcoStruxure Automation Expert – AVEVA System Platform integration EcoStruxure Automation Expert includes native support for System Platform - AVEVA's real-time operations control
platform for supervisory, HMI, SCADA, and IIoT applications. EcoStruxure Automation Expert is capable of auto-generating OPC UA-based secure communications between platforms and generate AVEVA System Platform-compatible graphics for clean integration. Furthermore, it now embeds the AVEVA Industrial Graphics editor so that users no longer
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
19 of 39 3/11/2025, 1:20 PM
need to move from EcoStruxure Automation Expert buildtime to AVEVA buildtime, providing unpreceeded integration. Automation Expert version Library compatible version Platform version for Asset Link Version for Asset Link and AVEVA Industrial Graphics V23.0 AVEVA System Platform 2020 R2 SP1 AVEVA System Platform 2020 R2 SP1 or later No
AVEVA Industrial Graphics support V23.1 AVEVA System Platform 2023 AVEVA System Platform 2020 R2 SP1 or later (New Galaxy creation is possible only with Library compatible version)* AVEVA System Platform 2023 or later V24.0 AVEVA System Platform 2023 or R2 SP1 AVEVA System Platform 2020 R2 SP1 or later (New Galaxy creation is
possible only with AVEVA System Platform 2023 R2 SP1)* AVEVA System Platform 2023 or later (New Galaxy creation is possible only with AVEVA System Platform 2023 R2 SP1)* *Only Select Existing Galaxy from the configurator is possible if Library compatible version is not available with the user. Embedded AVEVA industrial graphic editor in
EcoStruxure Automation Expert build time Industrial automation systems EcoStruxure Automation Expert Software Presentation (continued) 6 EcoStruxure Automation Expert Software (continued) EcoStruxure Automation Expert – Libraries EcoStruxure Automation Expert includes a set of application libraries with generic process and control modules such
as motors / valves and segment-based libraries with equipment modules that include multiple facets – logic, Automation Expert HMI, AVEVA System Platform template, and documentation within a single package to minimize the engineering time. EcoStruxure Automation Expert also includes a hardware library for easier integration of the most common
Schneider Electric and Technical Partner's field devices through Modbus TCP / Ethernet IP that provides the mapping, HMI, and documentation to be used in the application. With version 24.0 release, the free libraries included are: b Field Device b Base and common process b Sequence management and Phase Management b Liquid food b Water &
Wastewater (including desalination) b Single line power monitoring b Conveying These libraries include HMI objects that are compatible with Windows and Linux Ubuntu native HMI runtime, including the Harmony HMIST6xxx and HMISTM6xxx panels. Additionally, Universal Automation vendors provide specific hardware libraries to deploy EcoStruxure
Automation Expert applications to their offer. Industrial automation systems EcoStruxure Automation Expert Software Presentation (continued) With this release the library updates include: b Elementary blocks with easier customization covering basic application functions like alarms, conditions, owners, and signal conditioning that are used by other
application CATs – SE.App2Base. b Library of application CATs with easier customization to address common process assets or functions like digital I/O, analog I/O, motors, valves, and flowcontrol. There are multiple layers of each object available which can be used and customized for various application purposes – SE.App2CommonProcess. b State
management functionality for generic application (State Manager) as well as ISA-88 based application (Phase Manager). Phase Manager also includes a phase logical interface that accepts commands from external batching interfaces such as AVEVA Batch Management and returns the phase manager status – SE.App2StateManagement. Example of
HWCAT symbol and faceplate on EcoStruxure Automation Expert HMI Example of Application CAT symbol and faceplate on AVEVA OMI Application – Common Process Setpoint, Signal Processing, Motors, Valves, Process Control, Flow Control, Pump Set M580 dPAC CPU, X80 I/O Modules M251 dPAC CPU, TM3 I/O Modules M262 dPAC CPU, TM3 I/O
Modules ATV dPAC Soft dPAC I/O Modbus Read/Write registers Field Device Modbus/TCP ATV, ATS, Lexium, PowerMeter Gateways Modbus Gateway, UDP Gateway HARDWARE SPECIALIZED APPLICATION GENERAL APPLICATION Application – Base Deviation Alarm, Limit Alarm, Range of Change Alarm, State Alarm Conditions, Owner
Application 2 – Base Deviation Alarm, Limit Alarm, Range of Change Alarm, State Alarm Conditions, Owner Application – Sequence Sequence Step, Sequence Action Application 2 – Common Process Setpoint, Signal Processing, Motors, Valves, Process Control, Flow Control, Pump Set Segment Applications WWW, Single Line Power Monitoring,
Conveying, Liquid Food, State Management Segment Applications 2 State Management 7 Industrial automation systems EcoStruxure Automation Expert Software Presentation (continued) EcoStruxure Automation Expert Software (continued) EcoStruxure Automation Expert – Libraries (continued) EcoStruxure Automation Expert libraries Library name
Short description Extended description Runtime.Base Standard blocks This library contains the basic function blocks to be used for: b Runtime management b Arithmetic functions b Logic functions b Format conversion b Event management b etc. SE.AppBase Elementary block of the application Library of application CATs covering basic application
functions like alarms, conditions, owners, and signal conditioning that are used by other application CATs like the ones from SE.AppCommonProcess SE.App2Base Elementary blocks of the application SE.AppBase objects are redesigned to make customization easier. These objects will be used by other redesigned libraries. SE.AppSequence Sequence
control This library has a set of application CATs that allows you to create sequential control algorithms with steps and transitions to command control modules. This library works with both SE.AppCommonProcess and SE.App2CommonProcess. SE.AppCommonProcess Common process applications Library of application CATs to address common
process assets or functions like digital I/O, analog I/O, motors, valves, flow control, etc. These types of object can be used in any industrial application as well as in process control in manufacturing applications SE.App2CommonProcess Common process application SE.AppCommonProcess objects are redesigned to make customization easier. There are
multiple layers of each object available, which can be used and customized for various application purposes. SE.AppConveying Conveying Library of application CATs to address common equipment such as conveyors, sorters, transfer tables, and turntables, typically used in logistic hubs and distribution centers SE.AppLiquidFood Liquid and Food This
library has an application CAT to control the seats of mixproof valves used in Liquid and Food applications SE.SingleLinePowerMonitoring Low and medium power monitoring This library includes templates with common functions for electrical objects such as busbars, sources, infeeds, and loads that can be connected to energy management hardware
CATs SE.AppStateManagement State management This library is used to monitor and manage interface states of the machine: b receiving control commands and providing machine information b managing acting state sequence and transitions SE.App2StateManagement State management This library is used to provide state management functionality for
generic application (State Manager) as well as ISA-88 based application (Phase Manager). Phase Manager also includes a phase logical interface that accepts commands from external batching interfaces such as AVEVA Batch Management and returns the Phase Manager status. SE.AppProcedure Procedure control This library is used to monitor and
manage phases based on ISA-88 associated with sequences in coordination with sequence control blocks from SE.AppSequence. It also includes a phase logical interface that accepts commands from external batching interfaces such as AVEVA Batch Management and returns the phase manager status. SE.AppWWW Waste and wastewater This library
contains blocks used to monitor and manage control sequences like aeration and dual media filter for Water and Wastewater applications SE.DPAC dPAC hardware controllers Library containing the dPAC device types AVEVA.IndustrialGraphicsLibrary Industrial graphics library Industrial Graphics are vector-based graphics that can be scaled, animated,
embedded into application objects, and deployed. The library contains common industrial equipment. You can modify graphics or add graphics to the library by creating new graphics using the Industrial Graphic Editor. SE.EAEPortal AVEVA System Platform Device type The AVEVA System Platform device type is required by Asset Link for establishing
communication and creating the application objects automatically in AVEVA System Platform SE.FieldDevice Field device hardware CATs This library has ready-to-use hardware CATs for motor control, energy management, machine safety, and weighing from Schneider Electric, allowing dPAC communication with these devices by Modbus TCP or Ethernet
IP depending on the device SE.HwCommon Common hardware CAT functions Library of functions used by the various hardware CAT libraries SE.IoATV Variable speed drive I/O services for ATV dPAC Library of hardware CATs for Altivar I/O (local and modules) used for the Altivar dPAC module hardware configuration 8 Industrial automation systems
EcoStruxure Automation Expert Software Presentation (continued) EcoStruxure Automation Expert Software (continued) EcoStruxure Automation Expert – Libraries (continued) EcoStruxure Automation Expert libraries (continued) Library name Short description Extended description SE.IoNet UDP gateway Library of hardware CATs to enable UDP
communication SE.IoTMx TM I/O services for M251d/M262d Library of hardware CATs for TMp I/O modules used for M251d and M262d hardware configuration SE.IoX80 X80 I/O services for M580d Library of hardware CATs for X80 I/O modules used for M580d hardware configuration SE.ModbusGateway Standard Modbus gateway Library of hardware
CATs to enable Modbus TCP communication with import of data description file SE.Standard EcoStruxure Automation Expert HMI device type Library with EcoStruxure Automation Expert HMI device type Standard.IoEtherNetIP Standard Ethernet IP scanner functions Library of hardware CATs used for EIP scanner configuration (Implicit use by the
EcoStruxure Automation Expert system when using the EIP scanner and also to add custom EIP connections) Standard.IoModbus Standard Modbus functions Library of hardware CATs to enable Modbus client communication Standard.IoModbusSlave Standard Modbus server functions Library of hardware CATs to enable Modbus server communication
Standard.OPCUAClient Standard OPC UA client functions Functions to enable OPC UA client connection, monitor, read, and write data Definitions: b CAT object: A composite automation type (CAT) function block includes objects with multiple facets: v Logic to define its operating modes v I/O interfaces to exchange data/events with its environment v
Symbols/faceplates for control and monitoring in the HMI v Documentation that is implicitly part of the project online help b Application CAT: representing application assets or functions b Hardware CAT: representing hardware devices that can be added to the hardware configuration, for device monitoring and control 9 Industrial automation systems

EcoStruxure Automation Expert Software Presentation (continued) EcoStruxure Automation Expert Software (continued) System requirements Windows – Engineering, HMI, and Archive System requirements Minimum Performance Engineering HMI Archive Engineering HMI Archive Processor 1 GHz 2 GHz or higher RAM (1) 2 GB 2 GB 2 GB 4 GB 4 GB 4 GB 4
GB Hard disk free space (1) 1 GB 1 GB 1 GB 10 GB 10 GB 10 GB 10 GB Display resolution 1280x1024 1920x1080 or higher Pointing device Mouse or compatible Network access One Ethernet interface Operating system Microsoft Windows 10 Professional (64-bit) Version 1903 and later, Microsoft Windows 11 Professional Version 21H2 and later, and Microsoft
Server Version 2019 (1809 and later) .NET framework .NET 4.8 .NET 4.8 or higher (1) Requirement is indicated for each software package. More than one software package can be installed on the same device. In this case, you need to add the respective RAM and hard disk free space requirements together. For example, if you install the HMI and Archive
software packages on the same device, the minimum RAM required is 4 GB (2 GB + 2 GB). 10 Industrial automation systems EcoStruxure Automation Expert Hardware Presentation (continued) EcoStruxure Automation Expert Distributed Programmable Automation Controller (dPAC) Platforms EcoStruxure Automation Expert consists of several hardware
components working together to create a complete automation system. Soft dPAC Soft dPAC is an edge computing controller designed to execute an application and interact with field devices. This hardware-agnostic controller is versatile, capable of installation on various hardware such as servers, workstations, industrial PCs, or microcomputers, provided
they meet the necessary hardware and software requirements. Soft dPAC supports both LinuxTM and WindowsTM operating systems: v The Linux SoftdPAC is ideal for real-time control when installed in conjunction with a Linux real-time patch. v The Windows SoftdPAC is best suited for non-critical applications that do not demand real-time control. In a
Linux environment, multiple instances of Soft dPAC can be seamlessly installed on a single host machine, allowing tasks like line expansions to be completed without disrupting ongoing processes. This capability minimizes downtime, thereby enhancing productivity and profitability. For Windows, one Soft dPAC instance can be installed per host machine.
High Availability Soft dPAC High Availability Soft dPAC (HA Soft dPAC) represents a software-based high availability industrial automation system meticulously engineered to operate in a redundant configuration, offering resilience against hardware failures and ensuring continuous operations. This capability effectively minimizes process downtime, making
it ideal for demanding applications where uninterrupted process flows are critical. The integration of the high-availability system with EcoStruxure Automation Expert software plays a pivotal role in enhancing productivity by significantly reducing process downtime. High Availability Soft dPAC is compatible with the following hardwares: v Schneider Electric
Harmony P6 iPC v ASRockTM iEP-5000G Series Industrial IoT Controller v For compatibility with other iPC, please contact your Schneider Electric representative for additional information. Moreover, High Availability Soft dPAC seamlessly integrates with Modicon X80 IOs using the BMECRD0100 Remote I/O module, ensuring comprehensive compatibility
and functionality within industrial automation setups. Essential Edge Controller Essential Edge Controller is part of the Harmony iPC range and runs at the Edge of EcoStruxure. Essential Edge Controller provides customers the flexibility and versatility in products to be used in control and compute applications and helps to enhance the customer's
experience by reducing the time to market and improving the cybersecurity of the solution. Product reference: HMIBX1A0NDA Essential Edge Controller is a versatile and open-to-application edge terminal running Linux Operating software. It is a simple edge device, capable of bringing solid values for and beyond industrial use cases. v Pre-installed
EcoStruxure Automation Expert Soft dPAC, HMI for immediate deployment v Capability to run third-party applications on the same hardware The Essential Edge controller has no embedded I/O; it supports Remote I/O on Modicon TM3, X80 expansion modules with up to 32 devices connected via Modbus TCP/IP or Ethernet IP communication.
Performance Edge Controller Performance Edge Controller is part of the Harmony iPC range and runs at the Edge of EcoStruxure. A cutting-edge iPC-based Edge controller with more performance, designed to revolutionize industrial automation. Equipped with pre-installed Soft dPAC, HMI, and Archive, this powerhouse of a controller offers seamless
integration and unparalleled flexibility. With the ability to install third-party applications on the same hardware, it empowers you to customize and expand functionality to suit your specific needs. Performance Edge Controller operates on the robust and secure Linux operating system, helps to provide a stable and efficient platform for industrial automation.
Linux OS contributes to maintaining consistent performance, enhanced security, and seamless integration with a wide range of industrial applications. Product Reference: HMIP6CTO It is a configure-to-order product, where the user can choose the processor type (Celeron / i3), Memory size, and accessories. The Performance Edge controller has no
embedded I/O; it supports Remote I/O on Modicon TM3, X80 expansion modules with up to 200 devices connected via Modbus TCP/IP or Ethernet IP communication. This innovative Performance Edge controller is an all-in-one solution, streamlining operations and maximizing efficiency. NOTE: Please contact your Schneider Electric representative for
additional information. HMIBX1A0NDA HMIP6CTO 11 Industrial automation systems EcoStruxure Automation Expert Hardware Presentation (continued) EcoStruxure Automation Expert Distributed Programmable Automation Controller (dPAC) Platforms (continued) HA Edge Controller Designed for high availability applications, this HA Edge controller
running on Linux OS helps to maintain a continuous operation, offering a platform for critical industrial processes. Whether in manufacturing, energy management, or process automation, the versatility of our controller combined with Linux OS opens a world of possibilities, improving seamless and efficient operations in demanding industrial environments.
Product Reference: HMIP6CTO It is a configure-to-order product, where the user can choose the processor type (Celeron / i3), Memory size, and accessories. v Pre-installed EcoStruxure Automation Expert HA soft dPAC for immediate deployment v Robust performance for diverse industrial applications The HA Edge controller has no embedded I/O; it
supports Remote I/O on Modicon X80 expansion modules with up to 200 devices connected via Modbus TCP/IP communication. NOTE: Please contact your Schneider Electric representative for additional information. Modicon M580 dPAC A high-performance, rugged distributed field controller based on the widely successful Modicon M580 ePAC platform
with up to 64 MB ECC RAM for programs and data. The Modicon M580 dPAC supports the robust, high-performance Modicon X80 I/O catalog(1) and is available in standard and conformal coated versions. Product references: b BMED581020: Modicon M580 dPAC (standard) b BMED581020C: Modicon M580 dPAC (conformal coated) BMED581020 and
BMED581020C controllers support: v Up to 1,024 discrete I/O channels(2) v Up to 256 analog I/O channels(2) v Up to 4 racks of local I/O Modicon M251 dPAC A cost-optimized, low-footprint distributed controller based on the machine-specialized Modicon M251 Logic Controller platform. The Modicon M251 dPAC provides a single Ethernet port for
fieldbus, switched dual Ethernet ports for peer communications, and supports the field-proven TM3 I/O system(1). Product reference: b TM251MDESE: Modicon M251 dPAC The TM251MDESE controller has no embedded I/O; it supports Modicon TM3 I/O expansion modules: v Up to 448 discrete I/O channels(2) v Up to 112 analog I/O channels(2) v Up to
14 Modicon TM3 expansion modules (7 local modules + 7 remote modules) with Modicon TM3 bus expansion modules (transmitter module and receiver module) It is possible to control up to 4 TeSys U and TeSys D motor starters by connecting a TM3XTYS4 TM3 module to the Modicon M251 dPAC. Modicon M262 dPAC This is the controller for
performance machines. It is powered with a non-isolated 24 V DC power supply, has a built-in overload protection, embeds a dual-core processor and a 256 MB memory capacity and supports RSTP protocol. Product reference: b TM262L01MDESE8T: Modicon M262 dPAC The TM262L01MDESE8T controller has no embedded I/O; it supports Modicon
TM3 I/O expansion modules: v Up to 448 discrete I/O channels(2) v Up to 112 analog I/O channels(2) v Up to 14 Modicon TM3 expansion modules (7 local modules + 7 remote modules) with Modicon TM3 bus expansion modules (transmitter module and receiver module) It is possible to control up to 4 TeSys U and TeSys D motor starters by connecting a
TM3XTYS4 TM3 module to the Modicon M262 dPAC. (1) Expert/specialist modules are not supported in this release. Please refer to the compatibility list on page 28. (2) These values are theoretical limits; the device limits are highly dependent on the event load of the user application. BMED581020 TM251MDESE TM262L01MDESE8T 12 Industrial
automation systems EcoStruxure Automation Expert Hardware Presentation (continued) EcoStruxure Automation Expert Distributed Programmable Automation Controller (dPAC) Platforms (continued) Altivar ATV dPAC module The ATV dPAC module is part of the EcoStruxure Automation Expert distributed controller solution platform, with 12 MB memory
for programs and data. It is intended to be used as a slide-in option for ATV600, ATV900, and ATV340 variable speed drive (VSD) families(1). The Altivar ATV dPAC module is powered by the drive and provides dual Ethernet sockets for connection to peer controllers, distributed I/O, or remote secondary devices. Product references: b VW3A3530D: Altivar
ATV dPAC module b VW3A1111: Graphic display terminal The VW3A3530D dedicated controller has no embedded I/O. However, all standard I/O on the respective Altivar Process and Altivar Machine drives can be used and extended with I/O modules: b Up to 23 discrete I/O b Up to 7 analog I/O b Encoder interfaces (ATV900 and ATV340) It is possible to
control up to 8 Modbus TCP devices, such as Altivar drives and soft starters, TeSys motor starters, remote I/O using a TM3BCEIP bus coupler, PowerLogic meters, or Harmony Hub wireless sensors. For more information about the input/output capability, refer to Altivar dPAC Module VW3A3530D user guide. (1) For details, please refer to the compatibility
table on page 31. VW3A3530D Altivar Process drives slots 13 Industrial automation systems EcoStruxure Automation Expert Hardware Presentation (continued) EcoStruxure Automation Expert Distributed Programmable Automation Controller (dPAC) Platforms (continued) Information Technology (IT)/Operational Technology (OT) Communication Protocols
Platform Soft dPAC High Availability (Linux) Simplex Soft dPAC (Linux) Simplex Soft dPAC (Windows OS) M580 dPAC M262 dPAC M251 dPAC ATV dPAC OPCUA Client – – – – – Server MQTT Pub/Sub – – – – – Modbus TCP Client Server – Modbus RTU Client – – – – – Server – – – – – EtherNet/IP Scanner (Client) – – – PROFIBUS DP Client Through
Modbus TCP third party gateway Through Modbus TCP third party gateway Through Modbus TCP third party gateway Through Modbus TCP third party gateway Through Modbus TCP third party gateway Through Modbus TCP third party gateway Through Modbus TCP third party gateway ASi-5 / ASi-3 Through Modbus TCP third party gateway Through
Modbus TCP third party gateway Through Modbus TCP third party gateway Through Modbus TCP third party gateway Through Modbus TCP third party gateway Through Modbus TCP third party gateway HART – – – – – Open TCP/IP – 14 15 Presentation (continued) EcoStruxure Automation Expert Distributed
Programmable Automation Controller (dPAC) Platforms Selection guide EcoStruxure Automation Expert consists of several hardware components working together to create a complete automation system. High Availability Soft dPAC Simplex Soft dPAC (Linux OS) Simplex Soft dPAC (Windows OS) Modicon M580 dPAC Modicon M262 dPAC Modicon
M251 dPAC Altivar dPAC Applications Type Virtualized device Virtualized device Virtualized device Embedded device Embedded device Embedded device Embedded device Specification For critical applications For real time applications For non-real time applications For robust process application For performance modular machines For small modular
machines For distributed or Variable Speed Drive centric applications, including mini modular machines Max Application size (Mbytes) Scalable(10) Scalable(10) Scalable(10) 100MB 100MB 20MB 12MB Commmunication fieldbus and network performance Embedded OPCUA Server (20000 variables) Modbus TCP Client (60 devices) (1) OPCUA Server
(20000 variables) OPCUA Client EtherNet/IP (32 devices @20ms RPI)(1) Modbus TCP Client (60 devices)(1) Modbus TCP Server (800 variables)(1) OPCUA Server (20000 variables) Modbus TCP Client (60 devices)(1) Modbus TCP Server (800 variables)(1) OPCUA Server (5000 variables) EtherNet/IP (16 devices @20ms RPI)(1) Modbus TCP Client (16
devices)(1) Modbus TCP Server (800 variables)(1) OPCUA Server (5000 variables) EtherNet/IP (16 devices @20ms RPI)(1) Modbus TCP Client (16 devices)(1) Modbus TCP Server (800 variables)(1) Modbus RTU 56kbps OPCUA Server (1000 variables) EtherNet/IP (8 devices @20ms RPI)(1) Modbus TCP Client (16 devices)(1) Modbus TCP Server (800
variables)(1) Modbus RTU 56kbps OPCUA Server (200 variables) OPCUA Client Modbus TCP Client (8 devices)(1) Modbus TCP Server (50 variables)(1) Optional Profibus DP through Modbus TCP third party gateway Asi-5/Asi-3 through Modbus TCP third party gateway Profibus DP through Modbus TCP third party gateway Asi-5/Asi-3 through Modbus
TCP third party gateway Profibus DP through Modbus TCP third party gateway Asi-5/Asi-3 through Modbus TCP third party gateway Profibus DP through Modbus TCP third party gateway Asi-5/Asi-3 through Modbus TCP third party gateway Profibus DP through Modbus TCP third party gateway Asi-5/Asi-3 through Modbus TCP third party gateway
Profibus DP through Modbus TCP third party gateway – Connectivity services – MQTT Pub/Sub Open TCP/IP MQTT Pub/Sub Open TCP/IP Open TCP/IP Open TCP/IP Open TCP/IP I/O Discrete I/O channels 1750(3) 1750(3) – 352(2) 112(2) 112(2) Up to 23 (depending on drive reference) Analog I/O channels 1750(3) 1750(3) – 72 112 112 Up to 7
(depending on drive reference) Compatible expansion I/O module ranges(5) Extension I/O – – – 4 Modicon X80 backplane 14 Modicon TM3 14 Modicon TM3 – Remote I/O 16 Modicon X80 backplane(4) 16 Modicon X80 backplane(4) – – – – – References Hardware agnostic(8) Hardware agnostic(8) Hardware agnostic(9) BMED581020 / BMED581020C
TM262L01MDESE8T TM251MDESE VW3A3530D(6) / VW3A1111(7) (1) Recommended limit (2) Typical architecture – I/O can increase or decrease depending on the I/O scan rate or change rate, and the auxiliary application load with connected devices, such as Modbus. (3) I/O count can increase or decrease depending on the CPU version used on the
host iPC, I/O scan rate or change rate, and the auxiliary application load with connected devices, such as Modbus. The host iPC processor speed greatly affects the performance capabilities of the controller. The performance limits can be increased when using more powerful iPC processors, such as the Intel i5/i7 offerings. (4) BMECRD0100: Ethernet
Remote I/O drop adapter for Automation Expert High Availability (5) Consult the DIA3ED2140109EN and DIA6ED2131203EN catalog for additional information on the I/O compatibility. (6) Altivar ATV dPAC module (7) Graphic display terminal for Altivar ATV340 (8) Reference value based on the Harmony P6 Celeron (2 cores) (9) Minimum requirements
available in the section Windows – Software dPAC (page 13). (10) Maximum application size can increase or decrease depending on the CPU version on the host iPC. Industrial automation systems EcoStruxure Automation Expert Hardware 16 Presentation (continued) Industrial automation systems EcoStruxure Automation Expert Distributed Programmable Automation Controller (dPAC) Platforms (continued) System requirements Linux – Software dPAC System requirements Minimum Performance Required for RT control OS Debian 10.3, Ubuntu 18.04 and 20.04, or Raspbian 32- or 64-bit Ubuntu 20.04 with low-latency patch or other distribution with PREEMPTRT patch Docker Docker 19.03.8 and above CPU X86/ARM 1 GHz or higher Multi-core X86/ARM 1 GHz or higher Dedicated cores RAM 256 MB 1 GB HDD/SSD 16 GB 32 GB Network interface At least one Network Interface Card (NIC) Two NICs to isolate control and device networks One NIC per container for RT fieldbuses Time synchronization NTPv4
client NTPv4 client support with monotonic and drift compensation Linux – Software dPAC, High Availability(1) System requirements Description Note Processor PC Celeron 4305UE, 2 Core, 2 Threads Need Multi-core X86 processor. ARM is not supported for v24.0 RAM SO-DIMM RAM 4 GB Minimum 4GB. ECC support is optional. Memory M.2 SSD
Standard Endurance 128 GB 128 GB is not required. However, it is the lowest that was tested. Network interface RJ45 GbE Ethernet NIC Three NICs are needed for redundant network configuration. • One 1 GB speed NIC for interlink connection • Two 100MB for device network Operating system Linux Ubuntu 20.04 (Harmony P6)/22.04 (ASRock) tested
(1) A set of 2 manageable switches compatible with RSTP and having at least 6 physical ports is also needed. Windows – Software dPAC System requirements Minimum Performance Processor 1 GHz 2 GHz or higher RAM(1) 2 GB 4 GB Hard disk free space(1) 1 GB 10 GB Display resolution 1280x1024 1920x1080 or higher Pointing device Mouse or
compatible Network interface One Ethernet interface Operating system Microsoft Windows 10 Professional (64-bit) Version 1903 and later, Microsoft Windows 11 Professional Version 21H2 and later, and Microsoft Server Version 2019 (1809 and later) .NET framework .NET 4.8 .NET 4.8 or higher (1) Requirement is indicated for each software package.
More than one software package can be installed on the same device. In this case, you need to add the respective RAM and hard disk free space requirements together. For example, if you install the HMI and Archive software packages on the same device, the minimum RAM required is 4 GB (2 GB + 2 GB). 17 Industrial automation systems EcoStruxure
Automation Expert Architecture Presentation (continued) Types of standard architectures EcoStruxure Automation Expert breaks the dependency between the application software and the hardware platform it runs. Together with its distribution capabilities, EcoStruxure Automation Expert is a unique automation solution to be used in any kind of architecture,
from small machines up to complex process architecture. Example of Soft dPAC standard architecture The EcoStruxure Automation Expert architecture for small machines increases engineering efficiency by using the Automatically generated network transparent communications between controller and HMI objects with many-to-many connectivity and
communication protocol for field devices. Example of distributed standard architecture The openness and scalability of the EcoStruxure Automation Expert makes it ready for IT/OT with connectivity AI model by HTTP and apps & analytics in an architecture with distributed controllers. EcoStruxure Automation Expert HMI Switch Field Device Soft dPAC Apps
and Analytics Edge M251 dPAC Connected Devices M262 dPAC Distributed IO XPSMCM TM3 TM5 STB ATV320 ATV340 ATV320WS ATV320 (Flex center) TeSys Island 3rd party roller drives Vision system AS-i Gateway Weighing system Barcode reader Motor Control Sensors 3rd Party Products M580 dPAC AS-i Safety Safety Ethernet/IP Harmony P6
PacDrive M580 CIP safety CIP Safety IO 3rd Party PCHMIBSC HMIBMU EcoStruxure Automation Expert Orchestrated AVEVA Automation Expert HMI ATV dPACCRD 18 Industrial automation systems EcoStruxure Automation Expert Architecture Presentation (continued) Example of complex standard architecture The complex architecture below illustrates
the extensive possibilities of distributed application for the EcoStruxure Automation Expert solution among the different dPACs. This example is focused on a combination of Modicon M580d and Altivar ATVd dPACs. Control Network ATVd Pumps (6) ATVd Motors (4) ATVd Pumps (2) ATVd Pumps (7) ATVd Motors (2) ATVd Pumps (7) Control Room
Standard PC x 1 EAE Embedded HMI x 1 EcoStruxure Automation Expert 19 Industrial automation systems EcoStruxure Automation Expert Architecture Presentation (continued) Types of high-availability architectures The EcoStruxure Automation Expert high-availability system is used for more demanding applications in terms of the availability of the
control/ command system where no interruption of the process can be tolerated. The high-availability system with EcoStruxure Automation Expert software helps increase productivity by minimizing process downtime. High-availability Soft dPAC based on Ethernet RIO architecture The high-availability configuration comprises two identical iPCs (industrial
computers), each hosting a High-Availability Soft dPAC, and configured to run in a Pair where one instance (a Partner) is driving the process while the other Partner is ready to take over control, if the first one stops working. The two Partners check each other's availability by communicating over two links: • A dedicated cable (the HA Interlink), and • The
device network, which also carries commands and diagnostics. In a high-availability Soft dPAC topology based on an Ethernet RIO architecture, devices are hardwired on remote I/O over Ethernet by BMECRD1020 (RIO drop adapter for Modicon X80 I/Os modules). This high-availability system is used for sensitive processes that require a bumpless I/O
control takeover time. 1. Linux-based iPC pair, each hosting an instance of High Availability Soft dPAC 2. HA Interlink: 1GB/s Network Interface Card (NIC)/connection 3. Redundant network: 100MB/s with NIC bonding 4. Linux-based standalone iPC, hosting an instance of non-redundant Soft dPAC 5. Non-redundant Modicon X80 I/O drop with
BMECRD0100 RIO drop adapter and redundant power supplies 6. Non-redundant Modicon X80 I/O drop with BMECRD0100 RIO drop adapter and redundant power supplies 7. Remote I/O RSTP - enabled ring network 8. Workstation running EcoStruxure Automation Expert build time, RSTP configuration software 9. Workstation running AVEVA System
Platform (ASP), AVEVA Operation Management Interface (OMI), and AVEVA historian. Communication is over OPC UA 10. Workstation running EcoStruxure Automation Expert Runtime HMI 11. Managed switches, for example, Modicon switch 20 Industrial automation systems EcoStruxure Automation Expert Architecture Presentation (continued)
Components of a high-availability system High-Availability Soft dPAC pair At the heart of a high-availability architecture are two iPCS - Preferred Primary and Non-Preferred Primary, with identical hardware configurations, based on Linux software connected via a high-speed (1 Gbps) communication link. The Preferred Primary device executes the
application program and controls the I/Os located in Modicon X80 drops. The Non-Preferred Primary remains in the background. In the event of a detected error affecting the Primary device, the Standby system switches over automatically, changing over the execution of the application program and control of the I/O to the Standby device with an up-to-date
data context. Once the changeover is complete, the Standby device becomes the Primary device while the former Primary device is being cleared from the detected error: when clearance is done, the device reconnects to the standby system and acts as the Standby device. The changeover from Primary to Standby is performed smoothly at the outputs and
is completely transparent to the process. Modicon X80 Redundant power supplies and compatible backplanes For high-availability applications, two BMXCPS••02 redundant power supplies can be used on the same rack to increase the availability of power supply. They are supported by 6-slot BMEXBP0602 backplane and 10-slot BMEXBP1002
backplane equipped with dual slots marked CPS1 and CPS2. On CPS1 slot, the power supply is initially set as Primary and on CPS2 slot, as Standby. When power stops being supplied in accordance with expected rate, they switch roles so that power can be continuously delivered. See Modicon X80 modules catalog for more details. Example of complex
high-availability architecture The complex architecture illustrates the extensive possibilities of the High-Availability Soft dPAC in terms of cross-communication, RIO and DIO networks: 1. Linux-based iPC pair, each hosting an instance of High Availability Soft dPAC 2. HA Interlink: 1GB/s NIC/connection 3. Redundant network: 100MB/s with NIC bonding 4.
Remote I/O RSTP enabled ring network 5. Non-redundant X80 I/O drop with: - BMECRD0100 RIO drop adapter - Redundant power supplies on the main backplane - Extended main backplane 6. Distributed I/O connected to field devices (sensors, actuators) 7. Non-redundant Modicon X80 I/O drop with BMECRD0100 RIO drop adapter 8. BMEAHI0812/
BMEAHO0412 Hart I/O modules 9. Modbus TCP devices in an Intelligent power and motor control center (including PM5500 power meter series and MasterPact MTZ) connected to TeSysT motor controllers and Altivar processors 10. Managed switches 11. Workstation running AVEVA System Platform (ASP), AVEVA Operation Management Interface
(OMI), and AVEVA historian Communication is over OPC UA 12. Workstation running EcoStruxure Automation Expert Runtime HMI 13. Cross-communication with Altivar ATVdPAC for motor control 21 Industrial automation systems EcoStruxure Automation Expert Licenses Presentation, references EcoStruxure Automation Expert – Perpetual licensing The
EcoStruxure Automation Expert offer provides a simplified approach to the software licensing model. The offer has two categories of licenses – Build and Run. EcoStruxure Automation Expert – Build license The Build software requires a license per seat to create Automation Expert based applications. The Build engineering license provides the capability to
create, configure, and manage UAO runtime control applications, HMI, archive, and network/device topologies. The Build licenses can be perpetual or subscription-based(1) and are available in four types: b Trial: The engineering software includes a full function demo mode for 42 days unlicensed. b Lite: A basic set of features is included to focus on
machine and small process applications. This license allows the use of machine controller platforms and restricted process control platforms. The limitations of this type of license will be included in future release version 24.1. b Standard: A basic set of features included and can be extended by buying add on licenses to extend functionalities. The add ons
that are available with EcoStruxure Automation Expert Standard licenses are: v Asset Link for AVEVA OMI v High Availability Engineering v Asset Link for Bulk Engineering is already included in the Standard engineering license v24.0 b Professional: This type of license includes all currently available features. Any new features available in future releases
within the first year following the activation date will be included for the software updates. Each commercial license provides: b The capability to design, develop, simulate with HMI, and commission a complete system b Collaborative engineering (SVN client) plugin b Physical topology editor b Free software updates, within the first 12 months from the
activation date b Support desk from 9 am to 5pm b Access to private communities on exchange.se.com for p2p support, libraries, project samples, training material, TVDAs, and so on. (1) For more information, refer to EcoStruxure Automation Expert – Subscription-based licensing Build license compatibility Supported platforms Lite Standard Professional
Soft dPAC 1 Max Soft dPAC High Availability 1 Max ATV dPAC M251 dPAC M262 dPAC M580 dPAC 1 Max Add-ons (per seat) Asset Link for Bulk Engineering – Asset Link for AVEVA OMI – Optional High Availability Engineering Optional Optional BUILD Perpetual Lite License (Incl. Asset Link for Bulk Engineering add-on) Basic features High Availability
add-on Asset Link for AVEVA OMI add-on (Incl. Asset Link for Bulk Engineering + Asset link for AVEVA OMI + High Availability add-ons) HMI - Panel add-on HMI - Operator Station add-on Standard License Professional License Application License for dPAC RUN Perpetual Application License for Soft dPAC Device Small Micro Large Simplex €/Tiered-pack
€/Controller €/User €/User €/Device Version Tiered devices packs *Only for Build = Lite HA 10 Devices* 100 Devices 1000 Devices 5000 Devices 22 Industrial automation systems EcoStruxure Automation Expert Licenses Presentation, references (continued) EcoStruxure Automation Expert – Perpetual licensing (continued) Engineering license references
The Build engineering licenses are available in different types: Lite, Standard, or Professional. Standard and Professional licenses can be perpetual or subscription-based(1) and are currently offered for single seat use only. Reference Description EALBTEP24 Lite Engineering License EALBTC Standard Engineering License EALBFC Professional
Engineering License EALUAOC Engineering license for UAO vendor The standard engineering license includes the "Asset Link for Bulk Engineering" add-on and allows for the addition of the following add-ons: Reference Description EALBATC Add-on for Asset Link for AVEVA OMI EALBAHC Add-on for High Availability 23 Industrial automation systems
EcoStruxure Automation Expert Licenses Presentation, references (continued) EcoStruxure Automation Expert – Perpetual licensing (continued) EcoStruxure Automation Expert – Run licenses In addition to the Build engineering license that is required to create EcoStruxure Automation Expert applications, for the operation and maintenance of the
application, each hardware should have a Run license. The Run licenses will be based on the control type of Schneider Electric dPAC controllers and the number of devices connected for the Soft dPAC PC-based control. The Run application licenses are available in perpetual and subscription-based model. For more information, refer to EcoStruxure
Automation Expert – Subscription-based licensing. For exact calculation of the number of devices and controller type for the application license, a software license configurator for EcoStruxure Automation Expert is available on our website. Run license compatibility Available Licenses Lite Standard Professional Device Micro

Small Large 10 Pack – – 100
Pack – 1000 Pack – 5000 Pack – The available application licenses for dPAC controllers are: Reference Description EALADP Application license for one dPAC runtime instance, DEVICE EALANP Application license for one dPAC runtime instance, NANO EALAMP Application license for one dPAC runtime instance, MICRO EALASP Application license for
one dPAC runtime instance, SMALL EALALP Application license for one dPAC runtime instance, LARGE Run Application (A+B+C) Control Control Applicaton A SE or UAO Hardware Select type of controller Devices connected via hardwired or any communication protocols (Modbus, EtherNet/IP, OPC-UA, Profibus) Devices connected via any
communication protocols (Modbus, EtherNet/IP, OPC-UA, Profibus) In case of Orchestration or Secondary sensing use cases, EAE Device license = 0.3 * no. of connected devices Control Applicaton B IPC hardware IPC hardware Other Controllers and/or Gateways Control Applicaton C Orchestration DEVICE ATV dPAC M251 dPAC, M262 dPAC M580
dPAC (Ext.Backplane) M580 dPAC (Single Backplane) MICRO SMALL LARGE Tiered devices pack 10 devices* 100 devices 1000 devices 5000 devices EALDXP and EALDHAXP, are only available with Automation Expert Lite Build time EALDXP* EALDCP EALDMP EALDVMP EALDHAXP* EALDHACP EALDHAMP EALDHAVMP Simplex version High
Availability version 24 Industrial automation systems EcoStruxure Automation Expert Licenses Presentation, references (continued) EcoStruxure Automation Expert – Perpetual Licensing (continued) The Automation Expert HMI license includes rights to both HMI and Archive runtimes. All runtime licenses are perpetual. Different license types are required
depending on the platform on which the runtime is installed, as per the following table: EcoStruxure Automation Expert – HMI license Automation Expert Runtime Platform License type HMI(1) Harmony ST6 HMI range 1 license per HMI runtime instance HMI(1) PC-type HMI (Windows 10/Linux) 1 license per HMI runtime instance (1) Each license includes
both Automation Expert HMI and Automation Expert Archive runtime rights. The Automation Expert HMI Runtime licenses are: Reference Description EALH1P Automation Expert HMI Runtime - Panel (ST6) EALH2P Automation Expert HMI Runtime - Operator (iPC) For exact calculation of the number of devices and controller type for the application
license, a software license configurator for Automation Expert is available on se.com. Run application license references Reference Description EALDXP(1) Application Standard 10 Devices EALDCP Application Standard 1000 Devices EALDVMP Application Standard 5000 Devices EALDHAXP(1) Application
High Availability 10 Devices EALDHACP Application High Availability 100 Devices EALDHAMP Application High Availability 1000 Devices EALDHAVMP Application High Availability 5000 Devices (1) Only available with Automation Expert Lite build time. Download the HMIBMI, HMIBMO, and HMIP6 ranges catalog 25 Industrial automation systems
EcoStruxure Automation Expert Licenses Presentation, references (continued) EcoStruxure Automation Expert – Subscription-based licensing To provide customers with more business and economic model flexibility and reduced obsolescence risk, both Build and Run licenses are available under a subscription-based model consisting of 1-year termed
subscriptions. The subscription-based licenses model is available for project business with end-users. Each commercial license provides: b The capability to design, develop, simulate with HMI, and commission a complete system b Collaborative engineering (SVN client) plugin b Physical topology editor b Free software updates b Support desk from 9 am to
5pm b Access to private communities on exchange.se.com for p2p support, libraries, project samples, training material, TVDAs, and so on. Build subscription-based licenses The Build subscription–based licenses are available in three different types: b Trial: The engineering software includes a full function demo mode for 42 days unlicensed. b Standard: A
basic set of features equivalent to Standard perpetual-based license. b Professional: this version includes all available features, including: v Asset Link for AVEVA OMI v High Availability Engineering The Build subscription-based licenses are offered for single-seat use only. A license is needed per user. Reference Description EALBTS1 Build - Standard
Engineering Yearly EALBTS2 Build - Professional Engineering Yearly Run subscription-based licenses The Run subscription-based licenses are available in two different types: b Standard: for simplex applications. b High Availability: for high availability applications. The Run subscription-based licenses are sized per device. A license is needed per device.
To know how to measure the number of devices of your application, refer to the EcoStruxure Automation Expert – Perpetual Licensing. Reference Description EALOMD1 Run - Standard Device Yearly EALOMD2 Run – High Availability Device Yearly Please contact your Schneider Electric representative for additional information. In addition to the
advantages included in Perpetual licenses, subscription-based licenses include: b Access to upcoming software releases and features in the scope of your license b Customer adoption support plan, with a Trusted Advisor that will support you to reduce your time to value with each new release and its features, recommend the appropriate evolutions, and
support you on license lifecycle and renewal process. Build Subscription (1-year term license, per user) Software Standard License Application Design Service Onsite Training, Lifecycle Consulting, Engineering Service Block of Support Service EAE Configuration Training Cybersecurity Assessment Service Application for Standard Device Professional
License (including all options) Included in all packages: Customer Support Plan, Software Assurance, Customer Adoption Management Application for High Availability Device Yearly Services Ad hoc Run Subscription (1-year term license, per device) 26 Presentation, references (continued) Industrial automation systems EcoStruxure Automation Expert
Licenses - Example EcoStruxure Automation Expert Licensing – Architecture Example of single high-availability architecture Build license Reference Description No. of Seats EALBTEP24 Lite Engineering License 1 Reference Description No. of Licenses EALBAHC Add-on for High Availability 1 Run license Unit 1 - High Availability Control 50 devices
Reference Description No. of Licenses EALBAHC Application High Availability 10 Devices 5 Reference Description No. of Licenses EALH2P Automation Expert HMI Runtime Operator 1 50 Field Devices High Availability 27 Industrial automation systems EcoStruxure Automation Expert Licenses - Example EcoStruxure Automation Expert Licensing –
Architecture Example of complex high-availability architecture Build license Reference Description No. of Seats EALBFC Professional Engineering License 1 Run license Unit 1 – High Availability Control 100 devices Reference Description No. of Seats Application High Availability 100 Devices 1EALDHACP Unit 2 – 1 M262d Control 50 devices Reference
Description No. of Licenses EALAMP Application license for one dPAC runtime instance, MICRO 1 Unit 3 – Simplex Control 100 devices Reference Description No. of Licenses EALDCP Application Standard 100 Devices 1 100 Field Devices 100 Field Devices 50 Field Devices High Availability M262d Simplex Control Presentation, references (continued)
28 Compatibility Industrial automation systems EcoStruxure Automation Expert Product compatibility according to dPAC platform List of Modicon X80 hardware compatible with Modicon M580 dPAC, Modicon CRD for Simplex/High Availability Soft dPAC (Linux OS) Type Reference Description Compatibility with Modicon M580 dPAC Compatibility with
Modicon CRD for Simplex/High Availability Soft dPAC (Linux OS) Rack BMEXBP0400 4-slot Ethernet backplane Yes Yes Rack BMEXBP0400H Ruggedized 4-slot Ethernet backplane Yes Yes Rack BMEXBP0602 6-slot Ethernet backplane redundant PS Yes Yes Rack BMEXBP0602H Ruggedized 6-slot Ethernet backplane redundant PS Yes Yes Rack
BMEXBP0800 8-slot Ethernet backplane Yes Yes Rack BMEXBP0800H Ruggedized 8-slot Ethernet backplane Yes Yes Rack BMEXBP1002 10-slot Ethernet backplane redundant PS Yes Yes Rack BMEXBP1002H Ruggedized 10-slot Ethernet backplane redundant PS Yes Yes Rack BMEXBP1200 12-slot Ethernet backplane Yes Yes Rack BMEXBP1200H
Ruggedized 12-slot Ethernet backplane Yes Yes Rack BMXXBC008K Backplane extension cable 0.8 m/2.6 ft Yes Yes Rack BMXXBC015K Backplane extension cable 1.5 m/4.9 ft Yes Yes Rack BMXXBC030K Backplane extension cable 3 m/9.8 ft Yes Yes Rack BMXXBC050K Backplane extension cable 5 m/16.4 ft Yes Yes Rack BMXXBC120K Backplane
extension cable 12 m/39 ft Yes Yes Rack BMXXBE1000 Standard backplane extender Yes Yes Rack BMXXBE1000H Ruggedized standard backplane extender Yes Yes Rack BMXXBE2005 Backplane extender kit Yes Yes Rack BMXXBP0400 4-slot backplane Yes Yes Rack BMXXBP0400H Ruggedized 4-slot backplane Yes Yes Rack BMXXBP0600 6-slot
backplane Yes Yes Rack BMXXBP0600H Ruggedized 6-slot backplane Yes Yes Rack BMXXBP0800 8-slot backplane Yes Yes Rack BMXXBP0800H Ruggedized 8-slot backplane Yes Yes Rack BMXXBP1200 12-slot backplane Yes Yes Rack BMXXBP1200H Ruggedized 12-slot backplane Yes Yes SD card BMXRMS004GPF Optional M580 SD card 4 GB
Yes No Analog I/O BMXAMI0410 4 voltage/current isolated high-speed analog inputs Yes Yes Analog I/O BMXAMI0410H Ruggedized 4 voltage/current isolated high-level analog inputs Yes No Analog I/O BMXAMI0800 8 voltage/current non-isolated fast analog inputs Yes No Analog I/O BMXAMI0810 8 voltage/current isolated fast analog inputs Yes Yes
Analog I/O BMXAMI0810H Ruggedized 8 voltage/current isolated fast analog inputs Yes Yes Analog I/O BMXAMO0410 4 voltage/current isolated analog outputs Yes Yes Analog I/O BMXAMO0410H Ruggedized 4 voltage/current isolated analog outputs Yes Yes Analog I/O BMXAMO0802 8 current non-isolated analog outputs Yes Yes Analog I/O
BMXAMM0600 4 analog inputs - 2 analog outputs Yes No Analog I/O BMXAMM0600H Ruggedized 4 analog inputs - 2 analog outputs Yes No Analog I/O BMXAMO0210 2 isolated analog outputs Yes No Analog I/O BMXAMO0210H Ruggedized 2 voltage/current isolated analog outputs Yes No Analog I/O BMXART0814 8 isolated TC/RTD inputs Yes Yes
Analog I/O BMXART0814H Ruggedized 8 isolated TC/RTD inputs Yes Yes Analog I/O BMEAHI0812 8 current isolated analog inputs, HART No Yes Analog I/O BMEAHO0412 4 current isolated high-level analog outputs, HART No Yes Power BMXCPS2000 Standard AC power supply Yes Yes Power BMXCPS2010 Standard isolated DC power supply Yes
Yes Power BMXCPS3020 High-power isolated 24 to 48 V DC power supply Yes Yes Power BMXCPS3020H Ruggedized high-power isolated 24 to 48 V DC power supply Yes Yes Power BMXCPS3500 High-power AC power supply Yes Yes Power BMXCPS3500H Ruggedized high-power AC power supply Yes Yes Power BMXCPS3522 Redundant 125 V
DC power supply Yes Yes Power BMXCPS3540T High-power 125 V DC power supply Yes Yes Power BMXCPS4002 Redundant AC power supply Yes Yes Power BMXCPS4022 Redundant 24 to 48 V DC power supply Yes Yes Discrete I/O BMXDDI1602 16x 24 V DC sink discrete inputs Yes Yes Discrete I/O BMXDDI1602H Ruggedized 16x 24 V DC sink
discrete inputs Yes Yes Discrete I/O BMXDDI3202K 32x 24 V DC sink discrete inputs Yes No Discrete I/O BMXDDI6402K 64x 24 V DC sink discrete inputs Yes Yes Discrete I/O BMXDDM16025 8x 24 V DC discrete inputs, 8x discrete relay outputs Yes No Discrete I/O BMXDDM16025H Ruggedized 8x 24 V DC discrete inputs, 8x discrete relay outputs Yes
No Discrete I/O BMXDDO1602 16 transistor source 0.5 A discrete outputs Yes Yes 29 Compatibility (continued) Industrial automation systems EcoStruxure Automation Expert Product compatibility according to dPAC platform List of Modicon X80 hardware compatible with Modicon M580 dPAC, Modicon CRD for Simplex/High Availability Soft dPAC (Linux
OS) Type Reference Description Compatibility with Modicon M580 dPAC Compatibility with Modicon CRD for Simplex/High Availability Soft dPAC (Linux OS) Discrete I/O BMXDDO1602H Ruggedized 16 transistor source 0.5 A discrete outputs Yes Yes Discrete I/O BMXDDO6402K 64 transistor source 0.1 A discrete outputs Yes Yes Discrete I/O
BMXDRA0815 8 isolated relay outputs Yes No Discrete I/O BMXDRA0815H Ruggedized 8 isolated relay outputs Yes No Discrete I/O BMXDRA1605 16 discrete relay outputs Yes No Discrete I/O BMXDRA1605H Ruggedized 16 discrete relay outputs Yes No Discrete I/O BMXDAI0814 8x 100…120 V AC isolated inputs Yes No Discrete I/O BMXDAI1604 16x
100…120 V AC capacitive inputs Yes No Discrete I/O BMXDAI1604H Ruggedized 16x 100…120 V AC capacitive inputs Yes No Discrete I/O BMXDAO1605 16x 100…240 V AC triac outputs Yes No Discrete I/O BMXDAO1605H Ruggedized 16x 100…240 V AC triac outputs Yes No Discrete I/O BMXDDM16022 8 inputs - 24 V DC - 8 outputs - solid state Yes
No Discrete I/O BMXDDM16022H 8 inputs - 24 V DC - 8 outputs - solid state- severe environment Yes No Discrete I/O BMXDDM3202K 16x 24 V DC inputs - 16x solid state outputs Yes No Other BMXNRP0200 Fiber converter MM/LC 2-channel, 100 m/328 ft Yes No Other BMXNRP0201 Fiber converter SM/LC 2-channel, 100 m/328 ft Yes No Expert
BMXEHC0800 8 high-speed counter channels Yes No Expert BMXEHC0800H Ruggedized 8 high-speed counter channels Yes No Expert BMXEAE0300 3-channel SSI encoder interface module Yes No Expert BMXEAE0300H Ruggedized 3-channel SSI encoder interface module Yes No 30 List of TM3 hardware compatible with Modicon M251 dPAC and
M262 dPAC Type Reference Description Discrete I/O TM3DI16/TM3DI16G 16 discrete inputs Discrete I/O TM3DI32K 32 discrete inputs, HE10 connection Discrete I/O TM3DI8/TM3DI8A/TM3DI8G 8 discrete inputs Discrete I/O TM3DQ8T/TM3DQ8TG 8x 0.5 A transistor source discrete outputs Discrete I/O TM3DQ16T/TM3DQ16TG 16x 0.5 A transistor
source discrete outputs Discrete I/O TM3DQ16R/TM3DQ16RG 16x 2 A discrete relay outputs Discrete I/O TM3DQ32TK 32x 0.1 A transistor source discrete outputs, HE10 connection Discrete I/O TM3DQ8U/TM3DQ8UG 8x 0.3 A transistor sink discrete outputs Discrete I/O TM3DQ16U/TM3DQ16UG 16x 0.3 A transistor sink discrete outputs Discrete I/O
TM3DQ32UK 32x 0.4 A transistor sink discrete outputs, HE10 connection Analog I/O TM3AI2H/TM3AI2HG 2 high-resolution analog inputs, +-10 V, 0-10 V, 0-20 mA, 4-20 mA, 16-bit, 1 ms Analog I/O TM3AI4/TM3AI4G 4 analog inputs, +-10 V, 0-10 V, 0-20 mA, 4-20 mA, 12-bit, 1 ms Analog I/O TM3AI8/TM3AI8G 8 analog inputs, +-10 V, 0-10 V, 0-20 mA,
4-20 mA, 12-bit, 1 ms Analog I/O TM3AQ2/TM3AQG2G 2 analog outputs, +-10 V, 0-10 V, 0-20 mA, 4-20 mA, 12-bit, 1 ms Analog I/O TM3AQ4/TM3AQ4G 4 analog outputs, +-10 V, 0-10 V, 0-20 mA, 4-20 mA, 12-bit, 1 ms Safety I/O TM3SAC5R/TM3SAC5RG CAT3 Safety, 1 function, max. PL d/SIL3, 3 outputs 6 A relays Safety I/O TM3SAF5R/TM3SAF5RG
CAT4 Safety, 1 function, max. PL e/SIL3, 3 outputs 6 A relays Safety I/O TM3SAFL5R/TM3SAFL5RG CAT3 Safety, 2 functions, max. PL d/SIL3, 3 outputs 6 A relays Safety I/O TM3SAK6R/TM3SAK6RG CAT4 Safety, 3 functions, max. PL e/SIL3, 3 outputs 6 A relays Mixed analog I/O TM3AM6/TM3AM6G 4 analog outputs, 2 analog inputs, +-10 V, 0-10 V,
0-20 mA, 4-20 mA, 12-bit, 1 ms Thermocouple mixed TM3TM3/TM3TM3G 2 temperature inputs + 1 analog output TC (J, K, R, S, B, T, N, E, C, L) RTD (Ni100, Ni1000, PT100, PT1000) (+-10 V, 0-10 V) (0-20 mA, 4-20 mA) 16-bit, 100 ms Thermocouple input TM3TI4/TM3TI4G 4 temperature inputs TC (J, K, R, S, B, T, N, E, C, L) RTD (Ni100, Ni1000,
PT100, PT1000), (+-10 V, 0-10 V) (0-20 mA, 4-20 mA) 16-bit, 100 ms Thermocouple input TM3TI8T/TM3TI8TG 8 temperature inputs, NTC, PTC, and TC (J, K, R, S, B, T, N, E, C, L), 16-bit 100 ms Relay I/O TM3DM8R/TM3DM8RG 8x 2 A relay outputs Relay I/O TM3DM24R/TM3DM24RG 24x 2 A relay outputs Relay I/O TM3DQ8R/TM3DQ8RG 8x 2 A
relays outputs Other TM3XREC1 TM3 remote receiver module Other TM3XTRA1 TM3 remote transmitter module Other TM3XTYS4 TM3 parallel interface for 4 Tesys motor starters Expert TM3XHSC202/TM3XHSC202G High-speed counting, 2 HSC channels, 10 inputs, 8 outputs Compatibility (continued) Industrial automation systems EcoStruxure
Automation Expert Product compatibility according to dPAC platform 31 Compatibility (continued) Industrial automation systems EcoStruxure Automation Expert Product compatibility according to dPAC platform List of Altivar hardware compatible with Altivar ATV dPAC Type Reference Description Compatible Drive ATV340•••N4 Altivar Machine drives Yes
Drive ATV340•••N4E ≤ D22 Altivar Machine drives No Drive ATV340•••N4E ≥ D30 Altivar Machine drives Yes Drive ATV630••••• ATV630•••••F Altivar Process drives Yes Drive ATV650••••• ATV650•••••E ATV650•••••F Altivar Process drives Yes Drive ATV930••••• ATV930•••••C ATV930•••••F Altivar Process drives Yes Drive
ATV950••••• ATV950•••••E ATV950•••••F Altivar Process drives Yes Drive ATV660••••• ATV680••••• Altivar Process drive systems Yes Drive ATV960••••• ATV980••••• Altivar Process drive systems Yes Drive ATV990••••• Altivar Process drive systems Yes Drive ATV6A0••••• ATV6B0••••• Altivar Process Modular drives Yes Drive
ATV9A0••••• ATV9B0••••• Altivar Process Modular drives Yes Drive ATV6L0••••• ATV9L0••••• Altivar Process liquid-cooled drives Yes Other VW3A1111 Graphic display terminal Yes Other VW3A1112 Door mounting kit Yes Mixed I/O VW3A3203 Extended I/O module - 6 digital inputs/ 2 digital outputs/2 analog inputs Yes Mixed I/O VW3A3204
Extended relay module - 3 relay outputs Yes Encoder VW3A3420 Digital encoder interface module for Altivar 340 and Altivar 9pp variable speed drives Yes Encoder VW3A3422 Analog encoder interface module for Altivar 340 and Altivar 9pp variable speed drives Yes Encoder VW3A3423 Resolver interface module for Altivar 340 and Altivar 9pp variable
speed drives Yes Encoder VW3A3424 HTL encoder interface module for Altivar 340 and Altivar 9pp variable speed drives Yes 32 References Modicon M580 dPAC Local I/O capacity Communication ports Service ports Reference Weight kg/lb Up to 1024 discrete I/O Up to 256 analog I/O 64 MB integrated memory 2 1 BMED581020 BMED581020C 0.848/
1.872 Standards and certifications The Modicon M580 dPAC automation platform has been developed to comply with the principal national and international standards concerning electronic equipment for industrial automation systems. b Requirements specific to programmable controllers: functional characteristics, immunity, resistance, etc.: IEC/EN
61131-2 and IEC/EN/UL/CSA 61010-2-201 b Requirements specific to power utility automation systems: IEC/EN 61000-6-5, IEC/EN 61850-3 (with installation restrictions) b Requirements specific to railway applications: EN 50155/IEC 60571 (with installation restrictions) b Ex areas: v For USA and Canada: Hazardous location class I, division 2, groups A,
B, C, and D v For other countries: CE ATEX (2014/34/EU) or IECEx in defined atmosphere Zone 2 (gas) and/or Zone 22 (dust) b Merchant navy requirements of the major international organizations: unified in IACS (International Association of Classification Societies) b Compliance with European Directives for CE marking: v Low voltage: 2014/35/EU v
Electromagnetic compatibility: 2014/30/EU v Machinery: 2006/42/EC Up-to-date information on which certifications have been obtained is available on our website. Modicon M580 dPACs are considered as open equipment and are designed for use in industrial environments, in pollution degree 2, overvoltage category II (IEC 60664-1), and in low-voltage
installations, where the main power branch is protected on both wires by devices such as fuses or circuit breakers limiting the current to 15 A for North America and 16 A for the rest of the world. Industrial automation systems EcoStruxure Automation Expert Modicon M580 dPAC BMED581020 EAE_23643079_OPSPH20002 Characteristics Service
conditions and recommendations relating to the environment Modicon M580 dPAC automation platform Modicon M580 dPAC harsh I/O platform Temperature Operation 0…60 °C/32…140 °F -25…+70 °C/-13…158 °F Storage -40…85 °C/-40…185 °F -40…85 °C/-40…185 °F Relative humidity (without condensation) Cyclical humidity 5…95% up to 55 °C/131 °F
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
20 of 39 3/11/2025, 1:20 PM
5…95% up to 55 °C/131 °F Continuous humidity 5…93% up to 55 °C/131 °F 5…93% up to 60 °C/140 °F Altitude Operation 0…2,000 m/0…6,562 ft (full specification: temperature and isolation) 2,000…5,000 m/6,562…16,404 ft (temperature derating: approx. 1 °C/400 m (33.8 °F/1,312 ft), isolation 150 V/1,000 m (3,281 ft)) For accurate temperature derating
calculation, refer to IEC 61131-2 Ed 4.0 Annex A Modicon X80 I/O power supply modules BMXCPS2010 BMXCPS3020 BMXCPS3020H BMXCPS3540T BMXCPS2000 BMXCPS3500 BMXCPS3500H BMXCPS4002 Supply voltage Nominal voltage 24 V c 24…48 V c 125 V c 100…240 V a 100…240 V a Limit voltages 18…31.2 V c 18…62.4 V c 100…150 V
c 85…264 V a 85…264 V a Nominal frequencies – – – 50/60 Hz 50/60 Hz Limit frequencies – – – 47/63 Hz 47/63 Hz 33 Protective treatment of the Modicon M580 dPAC automation platform The Modicon M580 dPAC platform meets the requirements of “TC” treatment (treatment for all climates). For installations in industrial production workshops or
environments corresponding to “TH” treatment (treatment for hot and humid environments), Modicon M580 dPAC must be embedded in enclosures with minimum IP54 protection. The Modicon M580 dPAC platform offers protection to IP20 level and protection against access to terminals (enclosed equipment) (1). They can therefore be installed without an
enclosure in reserved-access areas that do not exceed pollution level 2 (control room with no dust-producing machine or activity). Pollution level 2 does not take account of more severe environmental conditions: air pollution by dust, smoke, corrosive or radioactive particles, vapors or salts, molds, insects, etc. (1) In cases where a slot is not occupied by a
module, a BMXXEM010 protective cover must be installed. (e): Tests required by European directives (e) and based on IEC/EN 61131-2 standards. Environment tests Immunity to LF interference (e) (1) Name of test Standards Levels Voltage and frequency variations IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11 0.85…1.10 Un - 0.94…1.04 Fn; 4
steps t = 30 min IACS E10; IEC 61000-4-11 0.80 Un…0.90 Fn; 1.20 Un…1.10 Fn; t = 1.5 s/5 s Direct voltage variations IEC/EN 61131-2; IEC 61000-4-29; IACS E10 (PLC not connected to charging battery) 0.85…1.2 Un + ripple: 5% peak; 2 steps t = 30 min Third harmonic IEC/EN 61131-2 H3 (10% Un), 0°/180°; 2 steps t = 5 min Voltage interruptions IEC/
EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11; IEC 61000-4-29; IACS E10 Power supply immunity: b 10 ms for a and c PS2 (20 ms DS criteria) b Check operating mode for longer interruptions up to 5 s, 85% Un b For IACS, 3 times 30 s in 5 min, 85% Un IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11 For a PS2: b 20% Un, t0: ½ period b 40% Un,
cycle 10/12 b 70% Un, cycle 25/30 b 0% Un, cycle 250/300 Voltage shut-down and start-up IEC/EN 61131-2 b Un…0…Un; t = Un/60 s b Umin…0…Umin; t = Umin/5 s b Umin…0.9 Udl…Umin; t = Umin/60 s Magnetic field IEC/EN 61131-2; IEC 61000-4-8 (for MV power stations: IEC 61000-6-5; IEC 61850-3) Power frequency: 50/60 Hz, 100 A/m continuous
...1,000 A/m; t = 3 s; 3 axes IEC 61000-4-10 Oscillatory: 100 kHz...1 MHz, 100 A/m; t = 9 s; 3 axes Conducted common mode disturbances range 0 Hz …150 kHz IEC 61000-4-16 (for MV power stations: IEC 61000-6-5; IEC 61850-3) For remote systems: b 50/60 Hz and c, 300 V, t = 1s b 50/60 Hz and c, 30 V, t = 1 min b 5 Hz…150 kHz, sweep 3 V…30 b
For a: 10 V b For c: 10 V cont. or 100 V, t = 1 s Where: b PS1 applies to PLC supplied by battery, PS2 applies to PLC energized from a or c supplies b Un: nominal voltage; Fn: nominal frequency; Udl: detection level with power on (1) Devices must be installed, wired, and maintained in accordance with the instructions provided in the manual “Grounding
and Electromagnetic Compatibility of PLC Systems”. (2) These tests are performed without an enclosure, with devices fixed on a metal grid and wired as per the recommendations in the manual “Grounding and Electromagnetic Compatibility of PLC systems”. (e): Tests required by European directives (e) and based on IEC/EN 61131-2 standards.
References (continued) Industrial automation systems EcoStruxure Automation Expert Modicon M580 dPAC 34 References (continued) Modicon CRD, I/O bus over Ethernet for Simplex/High Availability Soft dPAC (Linux OS) RSTP Communication ports Service ports Reference Weight kg/lb 2 1 BMECRD0100 BMECRD0100C 0.848/ 1.872 Standards and
certifications The Modicon CRD platform has been developed to comply with the principal national and international standards concerning electronic equipment for industrial automation systems. b Requirements specific to programmable controllers: functional characteristics, immunity, resistance, etc.: IEC/EN 61131-2 and IEC/EN/UL/CSA 61010-2-201 b
Requirements specific to power utility automation systems: IEC/EN 61000-6-5, IEC/EN 61850-3 (with installation restrictions) b Requirements specific to railway applications: EN 50155/IEC 60571 (with installation restrictions) b Ex areas: v For USA and Canada: Hazardous location class I, division 2, groups A, B, C, and D v For other countries: CE ATEX
(2014/34/EU) or IECEx in defined atmosphere Zone 2 (gas) and/or Zone 22 (dust) b Merchant navy requirements of the major international organizations: unified in IACS (International Association of Classification Societies) b Compliance with European Directives for CE marking: v Low voltage: 2014/35/EU v Electromagnetic compatibility: 2014/30/EU v
Machinery: 2006/42/EC Up-to-date information on which certifications have been obtained is available on our website. Modicon CRD is considered as open equipment and are designed for use in industrial environments, in pollution degree 2, overvoltage category II (IEC 60664-1), and in low-voltage installations, where the main power branch is protected
on both wires by devices such as fuses or circuit breakers limiting the current to 15 A for North America and 16 A for the rest of the world. Industrial automation systems EcoStruxure Automation Expert Modicon Ethernet Remote I/O BMECRD0100 BMECRD0100_main Characteristics Service conditions and recommendations relating to the environment
Modicon CRD automation platform Modicon CRD harsh I/O platform Temperature Operation 0…60 °C/32…140 °F -25…+70 °C/-13…158 °F Storage -40…85 °C/-40…185 °F -40…85 °C/-40…185 °F Relative humidity (without condensation) Cyclical humidity 5…95% up to 55 °C/131 °F 5…95% up to 55 °C/131 °F Continuous humidity 5…93% up to 55 °C/131
°F 5…93% up to 60 °C/140 °F Altitude Operation 0…2,000 m/0…6,562 ft (full specification: temperature and isolation) 2,000…5,000 m/6,562…16,404 ft (temperature derating: approx. 1 °C/400 m (33.8 °F/1,312 ft), isolation 150 V/1,000 m (3,281 ft)) For accurate temperature derating calculation, refer to IEC 61131-2 Ed 4.0 Annex A Modicon X80 I/O power
supply modules BMXCPS2010 BMXCPS3020 BMXCPS3020H BMXCPS3540T BMXCPS2000 BMXCPS3500 BMXCPS3500H BMXCPS4002 BMXCPS4002S BMXCPS4002H Supply voltage Nominal voltage 24 V c 24…48 V c 125 V c 100…240 V a 100…240 V a Limit voltages 18…31.2 V c 18…62.4 V c 100…150 V c 85…264 V a 85…264 V a Nominal
frequencies – – – 50/60 Hz 50/60 Hz Limit frequencies – – – 47/63 Hz 47/63 Hz 35 Protective treatment of the Modicon CRD automation platform The Modicon CRD platform meets the requirements of “TC” treatment (treatment for all climates). For installations in industrial production workshops or environments corresponding to “TH” treatment (treatment
for hot and humid environments), Modicon CRD must be embedded in enclosures with minimum IP54 protection. The Modicon CRD platform offers protection to IP20 level and protection against access to terminals (enclosed equipment) (1). They can therefore be installed without an enclosure in reserved-access areas that do not exceed pollution level 2
(control room with no dust-producing machine or activity). Pollution level 2 does not take account of more severe environmental conditions: air pollution by dust, smoke, corrosive or radioactive particles, vapors or salts, molds, insects, etc. (1) In cases where a slot is not occupied by a module, a BMXXEM010 protective cover must be installed. (e): Tests
required by European directives (e) and based on IEC/EN 61131-2 standards. Environment tests Immunity to LF interference (e) (1) Name of test Standards Levels Voltage and frequency variations IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11 0.85…1.10 Un - 0.94…1.04 Fn; 4 steps t = 30 min IACS E10; IEC 61000-4-11 0.80 Un…0.90 Fn; 1.20
Un…1.10 Fn; t = 1.5 s/5 s Direct voltage variations IEC/EN 61131-2; IEC 61000-4-29; IACS E10 (PLC not connected to charging battery) 0.85…1.2 Un + ripple: 5% peak; 2 steps t = 30 min Third harmonic IEC/EN 61131-2 H3 (10% Un), 0°/180°; 2 steps t = 5 min Voltage interruptions IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11; IEC 61000-4-29;
IACS E10 Power supply immunity: b 10 ms for a and c PS2 (20 ms DS criteria) b Check operating mode for longer interruptions up to 5 s, 85% Un b For IACS, 3 times 30 s in 5 min, 85% Un IEC/EN 61131-2; IEC/EN 61000-6-2; IEC 61000-4-11 For a PS2: b 20% Un, t0: ½ period b 40% Un, cycle 10/12 b 70% Un, cycle 25/30 b 0% Un, cycle 250/300
Voltage shut-down and start-up IEC/EN 61131-2 b Un…0…Un; t = Un/60 s b Umin…0…Umin; t = Umin/5 s b Umin…0.9 Udl…Umin; t = Umin/60 s Magnetic field IEC/EN 61131-2; IEC 61000-4-8 (for MV power stations: IEC 61000-6-5; IEC 61850-3) Power frequency: 50/60 Hz, 100 A/m continuous ...1,000 A/m; t = 3 s; 3 axes IEC 61000-4-10 Oscillatory:
100 kHz...1 MHz, 100 A/m; t = 9 s; 3 axes Conducted common mode disturbances range 0 Hz …150 kHz IEC 61000-4-16 (for MV power stations: IEC 61000-6-5; IEC 61850-3) For remote systems: b 50/60 Hz and c, 300 V, t = 1s b 50/60 Hz and c, 30 V, t = 1 min b 5 Hz…150 kHz, sweep 3 V…30 b For a: 10 V b For c: 10 V cont. or 100 V, t =

1 s Where: b
PS1 applies to PLC supplied by battery, PS2 applies to PLC energized from a or c supplies b Un: nominal voltage; Fn: nominal frequency; Udl: detection level with power on (1) Devices must be installed, wired, and maintained in accordance with the instructions provided in the manual “Grounding and Electromagnetic Compatibility
of PLC Systems”. (2)
These tests are performed without an enclosure, with devices fixed on a metal grid and wired as per the recommendations in the manual “Grounding and Electromagnetic Compatibility of PLC systems”. (e): Tests required by European directives (e) and based on IEC/EN 61131-2 standards. References (continued) Industrial
automation systems
EcoStruxure Automation Expert Modicon Ethernet Remote I/O 36 Modicon M251 dPAC Local I/O capacity Device ports Service ports Reference Weight kg/lb No embedded I/O, supporting Modicon TM3 I/O expansion modules 2 1 TM251MDESE 0.848/ 1.872 Standards and certifications b Standards v IEC/EN 61131-2 (Edition 2 2007) v
UL508 v ANSI/ISA
12.12.01-2007 v CSA C22.2 No. 213 and No. 142 b Certifications v e v cULus Listing Mark v RCM v Achilles v UKCA Environmental characteristics Service conditions and recommendations relating to the environment Temperature Operation Vertical installation: -10…35 °C/14…122 °F Horizontal installation: -10…55 °C/14…131 °F
Storage -40…70
°C/-40…158 °F Relative humidity (without condensation) Operation 10...95% Storage Altitude Operation 0…2,000 m/0…6,562 ft: complete specification for temperature and exposure Storage 0…3,000 m (0…9,842 ft) Immunity to mechanical stress 1131 b Rail mounting: v 5…8.4 Hz (amplitude 3.5 mm/0.138 in.) v 8.4…150 Hz
(acceleration 1 g) b Panel
mounting: v 8.7…150 Hz (acceleration 3 g) Merchant Navy 2…13.2 Hz (amplitude 1.0 mm/0.039 in.) 13.2…100 Hz (acceleration 0.7 g) Supply charecteristics Power supply 24 V c Voltage limit Including ripple 19.2...28.8 V c Immunity to micro-cuts Class PS-2 10 ms Max. consumption 45 W References (continued) Industrial automation
systems
EcoStruxure Automation Expert Modicon M251 dPAC TM251MDESE EAE_23643079_OPSPH20005 37 Modicon M262 dPAC Local I/O capacity Device ports Service ports Reference Weight kg/lb No embedded I/O, supporting Modicon TM3 I/O expansion modules 2 1 TM262L01MDESE8T 0.655/ 1.444 Standards and certifications b
Standards v IEC/EN
61131-2 (Edition 2 2007) v UL 61010-1, 61010-2-201 v ANSI/ISA 12.12.01-2007 v CSA C22.2 No. 213, No. 61010-1, No. 61010-2-201 b Certifications v e v cULus, cULus HazLoc Class I Division 2 CSA 22-2 No 213 v RCM v Achilles v KC v EAC Environmental characteristics Service conditions and recommendations relating to the
environment
Temperature Operation Vertical installation: -20…50 °C/-4…122 °F Horizontal installation: -20…60 °C/-4…140 °F Flat mounting: -20…45 °C/-4…113 °F Storage -40…85 °C/-40…185 °F Relative humidity (without condensation) Operation 5...95% Storage Altitude Operation 0…2,000 m/0…6,562 ft Storage 0…3,000 m (0…9,842 ft) Immunity
to mechanical
stress 3.5 mm at 2…8.4 Hz 1 gn at 8.4…200 Hz Supply charecteristics Power supply 24 V c (-15...20%) Voltage limit 20.4...28.8 V c Immunity to micro-cuts 0.01 ms Max. consumption 82 W References (continued) Industrial automation systems EcoStruxure Automation Expert Modicon M262 dPAC Modicon M262 dPAC module
TM262L01MDESE8T_image 38 Altivar ATV dPAC ATV dPAC module Local I/O capacity Device ports Service ports Reference Weight kg/lb Supporting Altivar Drives I/O embedded, expansion and encoder modules: b Up to 23 discrete I/O b Up to 7 analog I/O b 12 MB integrated memory 2 – VW3A3530D 0.020/ 0.044 Standards and
certifications
Depending on the specific drive type used for ATV dPAC integration, the standards and certifications must be checked in the corresponding ATV340/600/900 manual. b Standards v EN/IEC 61800-3 v EN/IEC 61800-5-1 v IEC 61000-3-12 v IEC 60721-3 v IEC 61508 v SEMI F47-0706 v UL508C and UL61800-5-1 v RoHS-2 according to EU
directive
2002/95/EC v REACH according to EU regulation 1907/2006 b Certifications v CE v UL v CSA v RCM v EAC v ATEX v DNV-GL Environmental characteristics Altivar Process and Altivar Machine drives are designed to operate in a variety of environments, including harsh environments. The conditions stated below are general data
and must be verified with
the respective ATV600, ATV900, and ATV340 manuals for the specific drive type used. Service conditions and recommendations relating to the environment Temperature Operation As standard: -15...50 °C/+5...122 °F With derating: -15...60 °C/+5...140 °F Storage and transport -40…70 °C/-40…158 °F Relative humidity (without
condensation) Operation
5...95% Storage Altitude Operation b 0…1,000 m/0…3,281 ft without derating b 1,000…4,800 m/3,281…15,700 ft with derating of 1% per 100 m/328 ft Protection of drives IP20 to IP55 Withstand to harsh environment b Chemical class 3C3 conforming to IEC/EN 60721-3-3 b Mechanical class 3S3 conforming to IEC/EN 60721-3-3 b
Printed circuit boards
with protective coating Environmental characteristics Compliance with electromagnetic compatibility requirements has been incorporated into the design of Altivar Process and Altivar Machine drives. They are e marked according to the European EMC directive (2014/30/EU). Note: Depending on the specific drive type used for ATV
dPAC integration, the
EMC compliance values must be checked in the corresponding ATV340/600/900 manual. References (continued) Industrial automation systems EcoStruxure Automation Expert Altivar ATV dPAC VW3A3530D EAE_23643079_OPSPH20001 39 Graphic display terminal Description Reference Weight kg/lb To be used with ATV340
(ATV600 and ATV900 are
equipped with the graphic display terminal as standard) Display 240 x 160 pixels, 8 lines Real-time clock with 10-year backup battery, to keep time when the drive is powered off Protection IP65 To be procured separately for ATV340 (delivered as standard with ATV600 and ATV900) VW3A1111 0.020/ 0.044 Remote mounting kit
Description Reference
Weight kg/lb Remote mounting kit For remote mounting of graphic display terminal, suitable for ATV340, ATV600, and ATV900 families Protection IP65 VW3A1112 0.020/ 0.044 Remote mounting cordset Description Length (m/ft) Reference Weight kg/lb Remote mounting cordset Equipped with 2 RJ45 connectors for connection of the
graphic display
terminal to the drive 1/ 3.28 VW3A1104R10 0.050/ 0.110 3/ 9.84 VW3A1104R30 0.150/ 0.331 5/ 16.4 VW3A1104R50 0.250/ 0.551 10/ 32.8 VW3A1104R100 0.500/ 1.102 Connector cable Description Length (m/ft) Reference Weight kg/lb USB/Mini B USB cable for connecting the display terminal to a PC – TCSXCNAMUM3P – VW3A1111
VW3A1112
PF130899PF130903 TCSXCNAMUM3P TCSXCNAMUM3P VW3A1104R10 EAE_23643079_OPSPH20003 References (continued) Industrial automation systems EcoStruxure Automation Expert Altivar ATV dPAC 40 Services Industrial automation systems Schneider Electric offers lifecycle services for your industrial automation
systems based on
EcoStruxure Automation Expert. Our lifecycle services include field and digital services. We believe, with our advanced processes and tools, we are your trusted expert in field and digital services to help you achieve greater functional safety, efficiency, sustainabilty, and resilience in your plant operations. We offer services that are
designed to address your
needs as you plan, install, operate, and optimize your industrial automation systems based on EcoStruxure Automation Expert. These include: b Consulting services b Maintenance and support services b Training Services b Migration Services For more information, visit our Industrial Automation Services page. Consulting
services Consulting services are
about bringing our expertise to help find solutions to some of your key operational challenges. Be it about maximizing the business value from your digital transformation initiatives, identifying improvement opportunities in your industrial automation system lifecycle management plans, or improving your cybersecurity posture and
compliance, we can help.
Take a look at some of our consulting offerings: Security consulting Our cybersecurity consultants will help you assess and review your EcoStruxure Automation Expert systems to detect gaps, identify risks, uncover any security malpractices, assess your staff’s security competencies, provide emergency response services, and
more. For more information,
visit our Cybersecurity Services page. IA lifecycle consulting Audits performed by our service team provide insights and recommendations to help improve the maintenance plans of industrial automation assets. This service helps identify potential risks to the reliability and maintainability of these assets and plan mitigation actions.
Watch the video to learn
more about our IA Lifecyle Consulting Service. Maintenance and support services Our maintenance and support offerings help you quickly restore your operations in the event of an unplanned downtime incident. They can also help reduce the risk of occurrence and the associated costs. Take a look at some of our maintenance and
support offerings:
Extended warranty The extended warranty offer gives you the option to extend the warranty of selected Schneider Electric hardware by up to three years. Note: Please contact your Customer Care Center for offer availability. Spare parts, exchanges, and repairs These solutions help you to respond, in the most optimal manner, to
requests for spare parts for
your EcoStruxure Automation Expert system based on Schneider Electric hardware. Services include: b Parts management service: Onsite or shared spares inventory, managed by us, to help ensure parts availability, while optimizing costs. b Repair: Product repairs performed onsite when possible, or at our repair centers. b
Exchange: A refurbished
product is provided in exchange for a product returned with a detected fault. Note: Availability of these services may vary depending on the applicable Schneider Electric hardware. Please contact your Customer Care Center for offer availability. 41 Services (continued) Industrial automation systems Maintenance and support
services (continued)
Maintenance and support contracts Our Support and Maintenance Service Offers, are a simplified and modular annual support services agreements, designed to provide you with the right level of flexibility and confidence to meet your support and maintenance needs for your industrial automation systems based on EcoStruxure
Automation Expert.
Available as Advantage Service Plan (ASP) for Automation Control or as Customer FIRST (CF) Program for Automation Control, they offer a pre-packaged set of services relevant to operating & maintaining an EcoStruxure Automation Expert Systems. For further customization, a set of optional services are available. The following
table provides a
snapshot of the plan: Included Services Support Levels ASP CF Essential Primary Core Support and Services Priority Technical Support Access – NBH(a) SLA(b) SLA (b) mySchneider Portal Access – Premium support Yes Yes Software Version Update(c) Yes Yes Optional services(d) 24/7 Priority Technical Support – Phone Block
of Support Hours (a)
Normal Business Hours (b) Service Level Agreement (c) Excludes labor and hardware (d) Subject to local availability With the enhancements to EcoStruxure Automation Expert V24.0 licensing system, we will progressively offer a more digital experience for customers seeking to maintain the currency of their EcoStruxure
Automation Expert software. With
this experience, customers with our support and maintenance service offers, will be able to update, in a self-service mode, their EcoStruxure Automation Expert software installation, as and when installations are ready. Please contact your Customer Care Center for offer availability. Training services Our training services are
designed for users to take
maximum advantage of our industrial automation systems based on EcoStruxure Automation Expert. Our training catalog includes courses on: b Automation fundamentals b IEC 61499 concepts b EcoStruxure Automation Expert engineering and configuration For more information, please visit our Learning Services Home Page or
send us an email.
Modernization and migration services Over the years, we have been involved in migrating many major automation systems to Schneider Electric. Our migration services, based on this expertise and complemented by a set of dedicated tools, helps to minimize the risks and costs involved in such upgrades to an open EcoStruxure
Automation Expert-based
system. The available set of tools and services are outlined below: Tools and services Source platforms Tools and services Reverse engineering Application conversion service Wiring systems for Modicon X80 Schneider Electric Modicon Premium Yes 2023 Yes Rockwell Automation SLC 500 Yes Yes Yes PLC-5 Yes Yes Yes
ControlLogix Yes 2023 _ In
addition to the above, we can also offer project-specific solutions. Please contact your local service teams for more information. 42 Industrial automation systems EcoStruxure Automation Expert Product reference index Index A ATV340D11N4 31 ATV340D11N4E 31 ATV340D15N4 31 ATV340D15N4E 31 ATV340D18N4 31
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as we celebrate 30 years of the South African Qualifications Authority (SAQA). This landmark event will bring together global education leaders, policymakers, industry experts, ... See More Photo View on Facebook · Share SAQA 1 week ago The South African Qualifications Authority (SAQA) and City of Johannesburg participated in the DHET's Bogus
Institutions Awareness Campaign at the corner of Rissik and Smit streets. SAQA informed the public about the importance of verifying the registration status of a qualification before enrolling and highlighted the various services it provides #KnowyourNQF #bewareofbogusinstitutions #freedo ... See More Photo View on Facebook · Share Can I do SAQA
online? Does SAQA recognise Alison courses? AI Overview Yes, Alison courses are recognized in South Africa and by some South African employers. Some Alison courses have even been provisionally accredited as a SETA NQF Level 3 National Certificate in IT. Explanation Alison is a free online platform that offers courses to help people develop their
skills and careers. Many employers recognize Alison certificates and have helped graduates start their careers, switch jobs, or get promotions. Alison's system of accreditation allows employers to verify what someone knows or doesn't know at Certificate or Diploma levels. Employers can take the same tests that employees have taken, or
watch employees take the same tests again. You can verify your educational qualifications on the National Learners' Records Database (NLRD) via SAQA VeriSearch. Generative AI is experimental. Learn more South Africa - Alison Blog Discover what thousands of Alison's learners across South Africa already know – that free online courses can
empower you with new ... Alison Are alison diplomas accredited in south africa ALISON courses are recognized in South Africa and by South African employers, with some courses even receiving provisional accredi... irp-cdn.multiscreensite.com Verify qualifications | South African Government You can verify your educational qualifications on the National
Learners' Records Database (NLRD) via SAQA VeriSearch at the South ... South African Government Alison Accreditation Explained 'Here and Now' Competency Based Testing. The proof of the currency of Alison courses is with the employers who recognise the value... Alison Is Alison a diploma? Alison offers hundreds of free, online diploma
programmes for those seeking career or vocational training. Our diplomas are available in a wide variety of industries, including healthcare, technology, and business. What's the Difference Between a Diploma vs a Degree? - Alison Alison https://alison.com › diploma-courses › difference-diplom... What is NQF Level 4 equivalent to matric? National Senior
Certificate What is NQF Level 4 Qualification Equivalent to? National Qualifications Framework (NQF) Level 4 corresponds to the National Senior Certificate (NSC), which is achieved upon completing Matric or Grade 12. It is equivalent to the Senior Certificate awarded after passing the Matric exams.29 Jul 2024 What is NQF Level 4? Key to Secondary
Education in SA Regenesys https://www.regenesys.net › reginsights › what-is-nqf-lev... Can I get a job with Alison certificate? AI Overview Yes, you can potentially get a job with an Alison certificate, particularly for entry-level positions or roles where the specific skills gained from the course are highly valued, although it may not guarantee employment on its
own; employers often prioritize practical experience alongside the certification, and the recognition of Alison certificates can vary depending on the industry and location. Key points to consider: Skill demonstration: While an Alison certificate alone might not be enough, it can demonstrate your willingness to learn and acquire new skills in a specific area,
which employers value. Relevant field: Choose Alison courses aligned with your desired career path to showcase relevant skills to potential employers. Combine with experience: Pair your Alison certificate with practical experience, volunteer work, or other certifications to strengthen your application. Where Alison certificates might be beneficial:
Entry-level jobs: For roles where basic skills in a particular area are required, an Alison certificate can be a good starting point. Remote work: Many online-based jobs may consider Alison certifications for digital marketing, customer service, or administrative skills. Upskilling: If you're looking to enhance your existing skillset and demonstrate your
commitment to continuous learning, an Alison certificate can be valuable. Generative AI is experimental. Learn more Can You Get A Job with Alison Certificate in South Africa | TikTok 24 Feb 2025 — 23421w ago. missruguruu. Natasha | SOLO TRAVELER. Replying to @Lisa #remotework can include. •Digital Marketing. •Onli... TikTok I want to know
more about Alison certifications. Does it attract ... 09 Sept 2023 — How good are alison.com courses? Can we add them in our resume? A big Yes! They are definitely helpful and you can def... Quora South Africa - Alison Blog Are Alison Certificates Recognised in South Africa? Yes! Alison is a popular free online skills and career development platform in...
Alison Meet the African Businesses Hiring Alison's Graduates - Alison Blog 22 Mar 2024 — Looking for a job in Kenya, Nigeria, South Africa or beyond? Discover how millions of Alison graduates across Africa ha... Alison I just acquired an IT support certificate on Alison. What remote jobs ... 26 Sept 2024 — In my experience, what matters most to
employers is whether you have the relevant skills and knowledge for the job, re... Quora Did most people get job with Alison certificates. - Facebook 02 Jan 2025 — Guys you can get Employment with a Alison qualification. Where I work there is a Safety Officer with a Alison certifica... Facebook · Alison- Free online courses Alison Graduates Get Jobs
Alison Graduates Get Jobs | Alison Help Center. ... Over 50% of respondents to the Alison Learner and Graduate Survey stated their... Alison Help Center Show more Does an Alison certificate expire? AI Overview No, Alison certificates do not expire. They are lifelong achievements that can be used to highlight your commitment to learning on your CV or
LinkedIn. Explanation Alison certificates are always current because employers can challenge them at any time. Alison certificates are compatible with global CPD requirements and can be used to meet CPD requirements. You can verify your Alison certificate by scanning the QR code on your certificate with a QR code scanner on your
smartphone or tablet. This will redirect you to the Alison website where your certificate will be verified. Additional information Alison offers free online courses and diplomas. Alison also offers a Premium Monthly subscription that includes additional features and benefits, such as ad-free learning and exclusive monthly discounts. To become an
Alison Graduate, you must successfully complete your chosen course and achieve at least 80% in all assessments. Generative AI is experimental. Learn more Alison Accreditation Explained An Alison certification is always current because it can always be challenged by an employer who wishes to test the certificate ho... Alison How do I add my
completed course to LinkedIn? - Alison Help Center Name = Name of course. Issuing Organization = Alison - Free Online Learning. Time period: From = The date you completed the course... Alison Help Center How much does an Alison Certificate cost? | Alison Pricing PREMIUM. Premium Monthly is an optional, affordable monthly subscription that
**unlocks additional features and benefits on Alison. Alison Our Alison Certificates and Diplomas are lifelong achievements that ... 18 Jan 2024 — Our Alison Certificates and Diplomas are lifelong achievements that don't have an expiry date. Perfect for CVs and Link... Instagram · alisonlearning Go Premium with Alison Why upgrade to Premium Monthly? *
Monthly discounts that never expire. Get a 10% discount every month that will never expire. You... Alison How do I get my Certificate? - Alison Help Center Validate/verify completed courses The Certificate or Diploma that you purchased from Alison includes a QR Code. Use a QR code scan... Alison Help Center Are Alison courses accredited/recognised?
This CPD Certification Service provides recognised independent CPD accreditation compatible with global CPD requirements. This mea... Alison Help Center What's the Difference Between a Diploma vs a Degree? - Alison At Alison, our online diploma programmes are more comprehensive than our certificate programmes, focusing on several subjects
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
21 of 39 3/11/2025, 1:20 PM
with... Alison Get your Course Certificate - Alison To become an Alison Graduate you must successfully complete your chosen course, achieving not less than 80% in all assessments. Al... Alison Legal Name of Skills Development Provider(SDP) Qualification information: Qualification / Curriculum Title SAQA ID NQF Level Credits Curriculum Code An
Occupational Qualification consists of three (3) components: Knowledge, Practical and Workplace. By completing this form, the institution should indicate a thorough understanding of how an occupational qualification should be implemented. Please study the relevant qualification document, curriculum document and assessment specification document
before completing this form (available on the QCTO website www.qcto.org.za) 1 PROPOSED DURATION FOR THIS QUALIFICATION: FROM (insert date): TO (insert date): 2 MODULES AND FACILITATORS/LECTURERS: (list all relevant modules; extend table as required to include all modules) Knowledge Modules: Hours on time-table: Module Code:
Facilitator: (Initials & Surname) Highest Qualification: Type of Industry experience & no. of years: Practical Modules: Hours on time-table: Module Code: Facilitator: (Initials & Surname) Highest Qualification: Type of Industry experience & no. of years: Workplace Modules: Curriculum Code: 2 Confirm whether your institution has all the relevant physical
resources for the implementation of this qualification as per curriculum requirements: List of required resources as detailed in the Curriculum: (Extend table as required) Module Name: YES: NO: 3 How would your institution ensure that your staff and learners have a thorough understanding of the occupational qualification, including the final External
Integrated Summative Assessment? 4 Explain how your institution would quality assure occupational qualifications offered: Legal Name of Skills Development Provider(SDP) Qualification information: Qualification / Curriculum Title SAQA ID NQF Level Credits Curriculum Code Although the QCTO is not prescriptive in the form or manner of learning material
that will be used to implement the curriculum, it is nevertheless still important to indicate how the content will be covered. Bear in mind that learning material for this qualification should be aimed at the implementation of all three components that would best benefit the achievement of all competencies, in order for learners to achieve a Statement of Results.
The three components (Knowledge, Practical and Workplace) should not be presented in isolation, but should rather be integrated, and any exercises or applied practicals should be occupationally directed (work tasks). Guidelines on the completion of the below matrix: The name(s) of the learning material or text books to be used should be inserted
vertically in the yellow blocks: Complete the table by indicating on what pages the content will be covered for each item in all modules in the curriculum (extend the table as required to include ALL MODULES) For example: Learning Material: Module CODE: Manual(Page/s Number): Learning Guide Page/s Number): Educational Teaching Aids:
KNOWLEDGE COMPONENT Module 4: Public Service Communication & Administration 334102001-KM-04 Pp 68-94 Pp 59-72 Organisational structure and functions of Departments KM-04-KT01 Pp 68-75 Pp 59-61 Functions and types of policies KM-04-KT02 Pp 76 - 94 Pp 62 – 64 Policy roles and responsibilities KM-04-KT03 Pp 65 - 67
Monitoring & Evaluating Service Delivery KM-04-KT04 Pp 68 - 72 Learning Material: Module CODE: Manual(Page/s Number): Learning Guide Page/s Number): Educational Teaching Aids: KNOWLEDGE COMPONENT PRACTICAL COMPONENT WORKPLACE COMPONENT (may also be in the form of a logbook, covering the competencies required in
the workplace) topics Inbox tshingombe fiston 11:34 AM (51 minutes ago) to me Feedback on Security Service Provider Application and Complaint Process Application for Exemption Terms of Section 23(6) Key Points: Applicant Information: oFull Name: Tshingombe Fiston oDate: January 18, 2025, 6:36 PM oContact: Not provided Application Details:
oTerms of Section 23(6) of the Private Security Industry Regulation Act 56 of 2001. oDespite Section 23(1) and (2), the authority may register any applicant as a security service provider on good cause shown. oRequirements include applicant's age, training, and clearance of any criminal offenses in the last ten years. Particulars of Appellant: Full Name:
Tshingombe Fiston Contact Address: Not provided Refusal Reasons: oRefusal to grant application for registration. oRefusal to renew registration. oCancellation or suspension of registration. oConviction of improper conduct. Complaints Management Process: Statutory Mandate: Derived from the Private Security Regulation Act 56 of 2001.
Complaint Definition: Dissatisfaction reported to PSIRA regarding the quality of service rendered by a private security service provider. Complaint Handling: Complaints are processed, referred, or dealt with by PSIRA in accordance with the code of conduct and statutory mandate. Security Equipment Definition: Types of Equipment: oAlarm systems,
safes, satellite tracking devices. oIntrusion detection, access control, bomb detection, and fire detection devices. oSecurity containers, X-ray, and communication devices. Improper Conduct: Examples: oOperating without registration. oDeploying unregistered security officers. oFailure to meet training and uniform standards. oNon-payment of prescribed
wages and allowances. Complaint Resolution: Time Frame: Standard period to finalize any complaint is 30 to 90 days. Common Complaints: Include wage disputes, improper conduct, and training deficiencies. Digital Records: Last Updated: 12-05-2022 Batch Numbers: oBatch 383731: Pending since June 28, 2024. oBatch 383732: Termination
pending since June 29, 2024. Job Career Information: Current Status: Application for registration as a security officer in progress. Job Requirements: oBasic salary, education qualifications, and employment history. oAbility to work under pressure and interpret legislation. oHigh administrative skills and problem-solving abilities. Investigation and
Complaints: Details of Complaints: oComplainant Name: Tshingombe Fiston oIncident Date: July 14, 2023 oNature of Complaint: Dismissal from job, irregularities in exam processes, and issues with certification. Legal and Administrative Actions: Court Cases: oLabour court cases and appeals. oComplaints lodged with various authorities including the
Office of the Chief Justice. Outcomes: oPending decisions and unresolved issues. oRequests for reviews and rescission rulings. Training and Development: Police Community Support Officer (PCSO) Training: oDuration: One month initial training. oKey Areas: Radio procedures, evidence gathering, crime scene management, human rights, and diversity
awareness. Student Placement Programs: Areas of Placement: oFinancial crime investigation. oEstate and asset management. oConstruction and building engineering. Essential Skills: oPlanning, organization, communication, technical skills, and teamwork. Expression of Interest and Withdrawals: Record of Interest: Successfully withdrawn from
certain roles. Feedback: Encouraged to explore other opportunities within the organization. Freedom of Information Requests: Recent Requests: oRequest for validation and information under the Freedom of Information Act. oRequirements for resubmission and personal data verification. Integrity and Defense: Research Focus: olssues related to
justice, education, and low development. oEmphasis on technological support and criminal investigations. Summary: Feedback: Comprehensive review of the application, complaint process, and training details provided. Emphasis on proper documentation, clear communication, and adherence to statutory mandates. Virus-free.www.avast.com
tshingombe fiston 11:36 AM (48 minutes ago) to me Feedback on Various Topics and Processes NQF Monitoring and Irregularities Key Points: Monitoring Issues: Umalusi monitoring in terms of policy and sections 17 and 18 of the General and Further Education and Training Quality Assurance Act 2001 (Act No. 58 of 2091). Student Records: Integrated
information system to provide proof of qualifications for part-time students. Remuneration and Employment: Governed by the Future Educator Act 2006. Irregularities: National Certificate: SAQA includes part-time qualifications. Portfolio: Collection of evidence for students. Judgement and Assessment Key Points: Judgement Need: Describing
evidence learning view group lecture approach to assessment. Policing Learner Overview: olntroduction to crime information management system. oCrime prevention principles and applied communication in policing. olnvestigative principles and professionalism in policing. Community Policing: Framework: Community policing involves a proactive,
problem-oriented approach with interrelated roles of law enforcement officials. Creative Law Response: Policing strategies and tactics are introduced to address underlying causes of crime. Assessor Training and Work-based Assessment Key Points: Purpose: Guide to learning material and assessment protocols. Work-based Holistic Assessment
Model: Includes planning, activity forms, and witness testimony. Assessment Standards: Emphasize validity, authenticity, reliability, and standardization. Portfolio Assessment: Components: Collection of evidence, assessor comments, and learner reporting. Technical Competency: Shown through project reports and presentations. Research and
Methodology Assessment Key Points: Overview: Research design and methodology for CAPS, NCV, trade, UCPD, SETA, and SASSETA. Participants: Teachers and HODs' responses to research findings. Recommendations: To the Department of Education (DBE) and DHET. Ethical Considerations: Research Design: Includes literature review, data
collection, and analysis. Teacher Roles: Attitudes towards integrating technical subjects in civil technology. Library Research and Grant Proposals Key Points: Grant Proposal: Submission details for non-profit and research proposals. Request for Proposal Template: For qualifications and award certificates. Project Overview: National system
examination and qualifications framework. Case Studies: Electro Energetical Stability: Reports on rural sector safety and resource management. Training Support: For learners in electro energetical systems. Project Goals: Workplace Training: Regulation and irregularity in attendance and outcome criteria. Resource Allocation: Value breakdown and
retrospective cost projections. Summary Feedback: Comprehensive Review: Covering various topics including NQF monitoring, judgement and assessment, assessor training, research methodology, library research, and grant proposals. Documentation: Emphasis on proper documentation, clear communication, and adherence to statutory mandates
and assessment standards. Recommendations: To improve processes and address irregularities in the education and training systems. Virus-free.www.avast.com tshingombe fiston 11:39 AM (45 minutes ago) to me ISC2 Security Congress 2025 Proposal Submission Details Submission Type: Call for Papers Proposals Presentation Proposal Status:
Complete Presentation Proposal ID: 2070815 Presentation Proposal Title: Thesis Master Engineering Thesis Master Doctoral Engineering Electrical Subject Curriculum Framework Qualification Education Technology Speaker Information Speaker Name: Tshingombe Tshi Tshitadi Role: Facilitator Pronouns: He/him/his Presentation Proposal Details
Audience Experience Level General (Everyone will obtain value) Early (0-3 years) Mid (4-9 years) Senior (10+ years) Audience Career Track All Engineering/Architecture Management/Executive Operational/Tactical Preferred Presentation Type Breakout Session Bright Ideas Roundtable Full Description Proposal of Thesis Content / Final
Project Content: 1.Name of Thesis 2.Index 3.Introduction 4.Description 5.General Analyzing Key Differentiator / Originality: Description: At the heart of solutions to framework qualification and national trade implementation sub-sector training. Trainer experimental workplace industrial, more students and institutes, college trade years external internal work
value increase price macro. Content Area: Governance, Risk, and Compliance (GRC) Additional Details/Supporting Information Recommendation/Endorsement: 3.4 Synopsis of Content: The stability design, projection system trade marketing board, information system electrokinematic dynamic physical state engineering science introduction, used to
trade theory electrical, manufacture process inventory low stamp system low stable loadshedding week manufacture. What prompted you to submit a proposal? Email Have you presented this session or content at any other conferences, webinars, or events? Yes If Yes, what other conference(s) or event(s) was this content presented at? 3.4 Synopsis
of Content: The stability design projection system trade marketing board, information system electrokinematic dynamic physical state engineering science introduction, used to trade theory electrical, manufacture process inventory low stamp system low stable loadshedding week manufacture. Prior Speaking Engagements/Experience: Engineering
Webcasts, Podcasts, & Videos: 3.4 Synopsis of Content: The stability design projection system trade marketing board, information system electrokinematic dynamic physical state engineering science introduction, used to trade theory electrical, manufacture process inventory low stamp system low stable loadshedding week manufacture. Books, Papers,
Etc.: 3.4 Synopsis of Content: The stability design projection system trade marketing board, information system electrokinematic dynamic physical state engineering science introduction, used to trade theory electrical, manufacture process inventory low stamp system low stable loadshedding week manufacture. Would you like to be contacted about
additional opportunities to contribute as a speaker or writer for other ISC2 programs? Speaking on Webcasts Speaking at other Virtual Events Speaking at Future Security Congress Speaking at In-Person Events Speaking at ISC2 Chapter Events Authoring Content for Magazine Articles/Newsletter/Blogs Authoring and/or Reviewing Content for
Professional Development Would you like to be part of a speaker database, made available to ISC2 Chapters? Yes Additional Demographics Collection Questions ISC2 is committed to ensuring the cybersecurity profession is as diverse, equitable, and inclusive as the world we serve. Age: 45-54 Nationality: Congolese (DRC)

Gender: Man
Pronouns: He/his Ethnicity/Race (US): American Indian or Alaska Native US: If you selected "Other ethnic group", please list it below: Black Ethnicity/Race (UK): Mixed or Multiple Ethnic Groups (White and Black Caribbean, White and Black African, White and Asian, Any other Mixed or Multiple ethnic background) UK: If you selected "Other ethnic
group", please list it below: UK Highest level of education (US): High school graduate, diploma or the equivalent (for example: GED) Highest level of education (UK): College or university Preferred spoken/written language: English Do you identify as a member of any of the following groups? Veteran or Prior Armed Forces Service Deadline All
submissions must be received no later than 11:59 p.m. ET on Feb. 28, 2025. Deadline subject to change per the discretion of ISC2. Virus-free.www.avast.com tshingombe fiston 11:43 AM (42 minutes ago) to me ISC2 Security Congress 2025: Call for Presentations Your Feedback Submission Details Date Submitted: Dec 27, 2024, 9:10 AM Feedback
ID: [Not provided] Submission Type: Call for Papers Proposals Presentation Proposal Status Status: Complete Presentation Proposal ID: 2070815 Title: Thesis Master Engineering Thesis Master Doctoral Engineering Electrical Subject Curriculum Framework Qualification Education Technology Speaker Information Speaker Name: Tshingombe
Tshitadi Role: Facilitator Pronouns: He/him/his Feedback Content Overview of Topics Submitted Locksmith / Safe Technician Management Skills: General management skills applied to the role of locksmith and safe technician. Health and Safety: Emphasis on applying health and safety standards in the workplace. Traffic Management Vehicle
Identification: Accurate identification of vehicle types and configurations. Operational Procedures: Data captured and assessed according to standard operational procedures and legislation. Road Traffic Management: Includes traffic signal design, installation, and maintenance. Electrical and Electronic Engineering Professional Skills: Usage of digital
electronics, advanced telecommunications, and data transmission systems. Maintenance and Repair: Installation, maintenance, and repair of electrical and electronic systems. Traffic Signal Installation Planning and Design: In-depth planning and design by skilled professionals. Operational Supervision: Effective supervision and control during
installation to ensure compliance with specifications. Security Practice in Education Security Concepts: Introduction to basic security concepts and administrative procedures. Criminal Investigation: Overview of criminal investigation techniques and the role of technology in security. Labour Relations and Mediation Pension Funds Act: Application of the
Pension Funds Act to the administration of retirement funds. Labour Conciliation: Conducting conciliation processes and understanding labour relations legislation. Skill Development in Legislation and Training Sector Training Authorities: Emphasis on skills development and adherence to safety standards. Workshop Tools: Proper use and
maintenance of workshop tools in various engineering tasks. Additional Comments Diversity and Inclusion: Emphasis on ensuring the cybersecurity profession is diverse, equitable, and inclusive. Demographic Information: Collection of demographic data to assess representation and improve processes. Recommendations Continued Education:
Importance of continuing education and skill transfer in various fields. Practical Training: Emphasis on practical training and on-the-job experience to ensure comprehensive skill development. Feedback: Detailed and constructive feedback provided to improve future submissions and ensure alignment with ISC2 standards. Conclusion Thank you for
submitting feedback to ISC2 Security Congress 2025. Your detailed insights and recommendations are highly valued and will contribute to the ongoing improvement of our processes and programs. We look forward to your continued participation and engagement in ISC2 events. Virus-free.www.avast.com tshingombe fiston 11:46 AM (38 minutes ago)
Virus-free.www.avast.com tshingombe fiston 11:50 AM (34 minutes ago) to me ISC2 Security Congress 2025: Call for Presentations Your Feedback Submission Details Date Submitted: Jan 18, 2025 Submission Type: Call for Papers Proposals Presentation Proposal Status Status: Complete Presentation Proposal ID: [Not provided] Speaker
Information Speaker Name: Tshingombe Fiston Role: Project Lead Pronouns: [Not provided] Feedback Content Overview of Topics Submitted Application for Exemption Terms of Section 23(6) Private Security Industry Regulation Act 56 of 2001: Despite provisions of sections 23(1) and (2), the authority may register any applicant as a security
service provider on good cause shown. Applicant Requirements: Includes age, training, and clearance of any criminal offenses in the last ten years. Complaints Management Process Statutory Mandate: Derived from the Private Security Regulation Act 56 of 2001. Complaint Definition: Dissatisfaction reported to PSIRA regarding the quality of service
rendered by a private security service provider. Complaint Handling: Complaints are processed, referred, or dealt with by PSIRA in accordance with the code of conduct and statutory mandate. Security Equipment Definition Types of Equipment: oAlarm systems, safes, satellite tracking devices. oIntrusion detection, access control, bomb detection, and
fire detection devices. oSecurity containers, X-ray, and communication devices. Improper Conduct Examples: oOperating without registration. oDeploying unregistered security officers. oFailure to meet training and uniform standards. oNon-payment of prescribed wages and allowances. Recommendations Continued Education: Importance of continuing
education and skill transfer in various fields. Practical Training: Emphasis on practical training and on-the-job experience to ensure comprehensive skill development. Feedback: Detailed and constructive feedback provided to improve future submissions and ensure alignment with ISC2 standards. Conclusion Thank you for submitting feedback to ISC2
Security Congress 2025. Your detailed insights and recommendations are highly valued and will contribute to the ongoing improvement of our processes and programs. We look forward to your continued participation and engagement in ISC2 events. Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/
request-intellectual-property-ip... 1 of 18 Cookies We use some essential cookies to make our website work. We'd like to set additional cookies so we can remember your preferences and understand how you use our site. You can manage your preferences and cookie settings at any time by clicking on "Customise Cookies" below. For more information on
how we use cookies, please see our Cookies notice. Title Ms Accept cookies Close Progress Review Review Back Review Review Surname tshitadi Your details Your details First name tshingombe Company name Email address Phone number 0725298946 Your request Your details Your request Review Change tshingombefiston@gmail.com Change
Reject cookies Sorry, there was a technical problem. Please try again. Request an intellectual property (IP) licence tshingombe enging/st peace college Customise cookies Your cookie preferences have been saved. You can update your cookie settings at any time on the cookies page. Your cookie preferences have been saved. You can update your cookie
settings at any time on the cookies page. Request an intellectual property (IP) licence To understand how your data is collected and handled read our privacy notice. 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 2 of 18 Your request Select
the option that most applies to you Request an intellectual property (IP) licence to use a trademark belonging to the Met or Mayor's Office for Policing and Crime (MOPAC) for any purpose Details of your enquiry Letter experimental job experience: theoretical practical n diploma, employees learner n diplomat ,basic advance filing ,posted minim cadet junior
senior principle trademarks Workbased - Microsoft certification close Pearson instituts Graduate institute high Education. -Department : DHET high act No,101 of 1997 ,as private.reg high Education reg Certificate No:2004/HE7/004 -accreditation qualities (HEQC),(CHE. continuing and training,act No16 of 2006 amendment,NQF ,act No 67 of 2008 ,as
amended , determination phase N1-N3 term ,sect 42(1)(a) training dhet ,N1-N3 juanert ,2024 , dr zimande trade test ,trade occupation revise.. Record transcription academic , ---------- -bakc log ,Sita -Ref saqa . -pearson instituts/St peace college instituts, Africa police instituts , Intec institute, saqa foreigners institute
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NSC NQF | Exemption certificate usaf ---------- Honours. | A recognised under grad Degree | degree module level ---------- Point institute Pearson NSC%. |90-100%|80-89%|70-79%|60-69% |50-59%||40-49|30-39|---------- Ncv%. | Nated%| Ucpd%| ---------- Faculty humanities :/ Bachelor of arts , Saqa I'd : 62761|NQF level: career opportunities child care communication humanity resource management marketing research , public relations research teaching writing -nated : educare : subject record transcription, personal training facilitator
assessor saqa Ncv abet NC's matric technical record : Lecture - ---------- -bachelor of arty in graphics design saqa ,ID : 99332 ,NQF level : career opportunities advertising branding design ,3 D modelling animation broadcasting copy writing desktop publishing layour and illustrations entrepreneurship web design. -
Nated : drawing engineering,PC business record ---------- Bachelor of arts in journalism saqa I'd : 488832 NQF : level 7 : career opportunities communication editorial work for magazine communication editorial work and news papers journalism , - presenting television social media research . Education actually
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enterprise architecture and open system : - Bachelor of science saqa ,ID 62754,NQF level : Career opportunities business analysis database administrator IT management project management specialist position.it system analyst .. -bachelor science in internet communications saqa ,ID : 6274 NQF : level ,: Career journalism networks administration
technical liason technical writing web editing . - bachelor's of science in biomedical,saw I'd : 6275 NQF , Level: career scientifice communication technical position in laboratory project management academic research. Management science communication technical , - bachelor of science honour information technology , .ID saqa : 84566 ,NQF level 8 .
Career opportunities: academic it manages programming project administrator specialise Technical position position in data mining and entrepreneurship architecture system analyse ---------- Faculty of commerce and low ,saqa 48858 NQF level , admnistration:career opportunities business business consultant economist
entrepreneurs.- bachelor of commerce in accounting: Career auditing budget financial management ,tax consultant account charted financial cost . - bachelor's commerce hr manager consulting personnel consultants recruitment training and development employment relations manager and count. - bachelor's of commerce low business administration
entrepreneurs politics . - saqa I'd commerce in marketing manager I'd 488822 advertising sales manager marketing Anat media ,to - tourism management is eco, tourism planning event strategies, market research bachelor's of commerce in business management,saqa ID 84326 NQF level 8 counseling entrepreneurs management. ---------- Faculty
engineering: Bachelor Nated saqa I'd lecture learner Bachelor nated trade engineering trade Distance :level 7, degree I'd: instituts engineering council engineering electrical instituts engineering Bachelor: Faculty, police police instituts Saqa instituts: level 7, degrees Bachelor:----------trade sector training trainer
bachelor's Serta ,seta career opportunities guide schools leavers , university of technology,and university leaver,and college leavers . Career ICT : information communication , technology ICT: technical skills research design development testing installation commissioning maintained product software prodt modem via media land wireless.. - computer. |
NQF|4|5|6|7|8| total req networking|lev3|. | | Occupation code 263101: developm program 261302 ICT business analyst 261303 ICT customer support officer 313104 computer system technical 263193 system ,test engineering ICT : securite special ICT : project manager ICT : sales represent - systeme representative system analysis project , database
administration telecommunication,web development network _____ ICT Microsoft office Occupation | recommend It| recommend -13510-projec| language,c#,have,ado,asi,nsd Management| Database ,Oracle,htk,sap java,net .. - 31314 , systeme technicienns| hardware at, ICT support engineering PC network and Eng -
description of the top ICT occupation: Project plan organise direct control co-ordinate qualifition account day to day operations of resourcing schedule priority. Task : skill analizing need. - software engineer design modified documents test implementation installation software support with . -ict : assurance ,create maintence manage quality assurance
functionalite performance of PC audit ensuring compliance accreditation scheduled qualifications inspection analysed review system data docut, identified potential risk area in security non compliance with stolen detect. - network ,systt plan deployment test optimisation taking responsibility analizing interpretation data model in developm research
monitoring assessing improve network , provided network performance. - ICT securite special established organisat ICT securite procedures ensure prevention recovery strategy internal exterior , ensure prevet recovery strat . - customer support Offit provide support Education developm maintence infrastructure resolution technical problem issue may work.
- determined hardware response program to meet usase installation appropriate soft , implementation PC network,repairs performance. -business selling compagny using director ,quotat price record order ,monitor client competition active maintenat submitted record business. - continuing and training,act No16 of 2006 amendment,NQF ,act No 67 of 2008
,as amended , determination phase N1-N3 term ,sect 42(1)(a) training dhet ,N1-N3 juanert ,2024 , dr zimande trade test ,trade occupation revise..---------- -testability checklist at the schematic level. - testability checklist at the PCB layout level , - revising design. Win existing ICT creating a test point report
manufacture..PC designer PCB relay project status information,PLC. - PLC wiring ,main breaker switch busbar circuit breaker SMP digital input output analif input terminal. -reaning PLC wiring diagram, profit bus communication PLC , digital input card diagram ,PLC digital -1. requirement: .letter experimental work based log activities theoretical practical
school institutes employees learner , orientation practical school disciplinary didactic work based, -1.1 explanation assessment :trade claim inventory low Triggered: gitlab,/ GitHub /azure Issue test .. -Triggered electronic elektor technologies -Circuit microcontroller ,, -Gitlab ,fail running Issue kananga ,, Engineering tshingombe Project ,committed
contributing ,code source ... 36..Explanation: gitlab ,GitHub azure data ,work Running -projects , pinned , issues,merge , request, contributors analytic , - repository analyse: Manage,plan ,code , building, secure, deployed, operate , monitoring. - measured in byte code exclude generated . - percentage , ,- coverage static for main marx 26-jun 24..
September Bi Weet code covered. Commit statict for main may 09-june 24.-august -total 4 commit , average per day , authoritie. Drag up date kananga5 .. overview commit pipeline., assignment, review milestone,time participate: Issues... Project code source , Marketing ---------- Azure :,work item ,epic printed Pipe line , ,test pipe -
measure in byte: project existing Engineering tshingombe _____ -github : tshingombe Issue contribution, Repository: run project code data source Pipeline: Repository: -Dhet St peace college running projection: Contribution GitHub collectivity; __ ---------- -38.
pratical school: instituts
research and development learner lecture vocational - isita project back log dhet and DBE umalusi : pratical school trade experiemental workbased Teaching learning student assessor , student educator technical trade student trainer training student learner facilitator technical ,student : engineering businesses study, Isita project subject engineering
electrical : national examination learner topics examin: Time table examination ,n3to n6 orientation industrial , plant operations, electrotechnology ,electric trade theory conduct assessment - project isita project total grand : experiemental theoretical and practical,engineering ,orientation industrial trade theory ,orientation industrial plant operations, orientation
industrial electrotechnology -Project low examin rules ,in dhet in high school orientation assessment teaching workplace workshop technologie electrical , technologie construction,technologie ,grade 1to grade 12 technologie, Educational technologie circulum,grade 1,6teach pratical skill trade ,,9-12 teaching orientation technologie electrotechnology,
organisation supervisor planing manager supervisor Phase circulum,module conductor, insulation,matter ,AC ,DC current ,AC machine ,DC machine instrument, transmission rectified -Teaching orientation industrial class: grade period basic workshop Orientation . -workplace experiemental relate: explanation , isita in dhet in DBE teaching workshop work
class engineering vocational career Guidence -Framework work qualification saqa: Undertake material engineering , Teaching qualify n3subject isita project Council trade, orientation industrial trade occupation trade isita workplace manufacture city power power: technology trade electrotechnology letter topics CVS ,, in DBE teaching technical DBE
orientation industrial Eskom ..city power -organisation supervisor duty Eskom city Power Under printed learner assessment self assessment peer in dhet project. ,in dbe teaching grade circulum, orientation industrial Eskom expo science : teaching teach grade electrotechnology orientation, electrotech industrial ,social project computer Back log project skill
fund ,, - orientation industrial CDs ..close tendered-lesson social worker practice Marksheet student orientation industrial time table ,student organisations planing supervisor time table , student educare time time table , student Education,student Engineering studies time table, : student policing traffic , business, pratical office school student marksheet
workplace experiemental learner close bid : close material trade theories in dhet in DBE isita ..umalusi - DBE subject workshop grade to working CVS circulum study in trading isita _____ - teaching and lecture Irregularite Pratical material candidate processing learn Regulation back log after Assessment center -non
attandance subject appear letter application letter workplace in dhet conduct learner project in dhet Afric instituts training shalom traing ,out mark term Non attandance: subject non registered Irregularite material: subject engineering science , mathematics,electrotechnical , industrial electronicien dhet in DBE ,ucpd Record academic years . -Total subject ,to
back log project Management system information learn , policy in DBE trade theory subject registration second additional subject Rwiten subject : extra circular in dhet in DBE pratical regulation . - practice police , orientation life teaching , literature mathematics ncv teach vocational guidance in DBE level 4 certificate pratical skilled panel control wiring
electrical DBE workshop development: teaching workplace to trade in DBE panel ,,teach ucpd irregularity project back log printed ... Introduction technologie,workshop electrotechnology , electrotechnic, electromechanical manufacture process 1.3purpose: -planta d shop layout , -insustrial safety , -ferrous materials , -non ferrous materials. -meeting
furnaces -properties and testing of metals -heat treatment carpentery . -patter. and core making -foundry tools and equipment -mold and core making . -casting -forgi g . -hot working of metals . - cold working , Sheet metal work,lathe machine drilling plane and sloping -powder metalling . - inspection quality 2.explanation :Manufacturing Engineering: process
planing , Claim 2.1 process planing , 2 process sheets, 3 route sheet ,tooling , 5 cutting tools machine tools , traditional,numerical jogs and fixture ,7 jigs and mould ,manufacturing information generation , CNC port program ,10 robor programmers ,11 flexible manufacturing systems ,FM's group , integrated manufacturing cm. -3. Explanation:Production
process : process planing. Manufacture process , classification of manufacture row , -primary shopping process size casting melting . -secondary machining process job understanding operational hot working processing forging rolling hot sprinning extrusion hot drawing. 4.explanation cold working process : Cold forging cold rolling heading cold drawing
wire stretch forming ,sheet metal working Piercy punching lancing notche. ,coming sequence ,deep drawing. -5.explanatiin join process: reffiling assembly, welding platisc or fusion , -soldering reverting screwing welding plastic,press fitting sinter , bonding shrinking fitting ,explosive welding diffusion welding key and cotter ,coupling and nut and bolt joint . -
surface finishing process. -6 explanation:honing IPpi g supper finishing belt grinding, polishing tumbling spraying ,pouring inorganic coatic analizing ,sherodizing parkerzi g galvanizing plastic ,metallic . -7 product simplification and standardization: policy a counting procedure personal policies performance evaluation control of expenditure safety aspect
security procedure regulation,design manufacture material and part supplies ,methods of testing drafting method abbreviations -inspection and quality control ,size shape other dimensions involved measure. -mechanization and autonomy Control device increased productivity reduced cost of labour and dependence on labour short improve quality reduce in
process inventory reduce dependence on operator in tease safety reduce risk humans fixed automation programmables automation flexible automation . -fixed automation cam . -Product system , manufacturing system . Detailed design prototype development test simulation design manufacture. - computer manufactt.- - factory level prodcution
management planing , production management material Requirements planing . - bill of materials capacity planning , inventory - CIM technologt compl networks system design and analysis distribution process , modelling and simulation expert system quality engineering. - CAD :solID modelling variation computer .-meeits of a good plant layout , reduce
machine how workflow process inventory is , manufacture time relatively less floor area is required , material handling is less. - explain types of layout ,fixed or position -men tools component yes , workplace yes ,finished product to store -explanation S.No| line or product layout | process or function Industrial safety ,safety precautions while working different
10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 3 of 18 hand tools . Approved : screw drives wrenches ,hammers files chisel,saw tap -engi seeing material yes = metallic material yes or no. Metallic yes , Metal yes ,feroos or non ferouse , steel
plain carbon ,allot , Cast ion grey while react metalloid ductile, - non ferrous , aluminium copperwood papperleather ,mineral cement class graphic, - -iron ore heanotite Fe304 colore red ,iron 70%, -magneite (Fe203, colore blanc 72% -lemo ite ,colore brown. 62% siderite ,brow,48% _____ -explanation market
forms of steel structure shapes : laball _free cutting ,c=0,13max,MN=0,7-0,12,,S=0.16 -steel quality ,carbon tools steel Anees ,plain carbons , - Properties: application % tensile strength kg/mm.sq -Typical blast furnace: -Blow yes ,yes stove yes ,blast furnace yes ,slag ,oxygen yes ,mixer , .-basic oxygen produce yes carbon yes Stell ,bessirer convert
bessure ,, Basic open heart basic operation , acide open heart ,, electric furnace yes acid , pudding process wraug iron , acide crucible ,steel ,iron ,mealable ,steel , , _____ Tools Plastic plaster ,5wax - factor effecting selection of pattern material,-number of casting to produce metal pattern are prefu required large
in number ,type of mould process methods ,of molding hand or machine ,6 degree of dimensions accuracy surface finishing requirements minimum thickness requirements shapes complexity piece cost of pattern chances repeat order . -types ofpatter : -properties of moulding sand refactoring permeable cohesive green ,found sound casting test moisture
content test clay chemical composition of sonde ground shape and surface texture of sound grand size distribution sans specific water absorption capacity permeability shatter index ---_____ Explanation: welding process ozyfuel gaz ,air acetylene welding oxyacet, oxyaceten ,oxy - hydrogen welding pressure ,-arc
welding process car on arc welding ,sheelded metal arc ,welding , submerged arc welding ,gas tungsten arc welding , resistance welding ,solids state ,welding process theemique radiant energy welding -explanation: claim low machine used in sheet metal shearing machine,bending machine, grooving machines peini g machine ,beading machine ,swaging ,
machine ,blurring machine,double seaming machine. -types of press -method of operations an born press .methods of power source Manuel press mechanical power hydraulic press , -fitting : explain introduction device equipment tools marking tools , measure device measure instruments, supporting tools holding tools striking tools , cutting tools ,tightening
tools .. -explain : inspection and quality control: checking components or product with requirements specification ,tolere Ce on port , interchangeable dimensions. Size numerical value lengthimjte size : .-uppee deviations algebraic difference between the two maximum limited of any size ,low deviations,mean fundamental deviations ,tolerance -fits allowance
fit difference hole size and shaft size allowance. Fits yes clearence fit yes sliding fit yes or running fit yes ,,, Interference fit yes or forcefit yes or strink yes press fit .. -control chart : used quality industrial yes maintenance yes continuous yes evaluation yes , manufacture yes, -statistical control yes ,device cast yes , -surface finish yes ,routines primary yes
,waviness profile ,lay,flow -----_____ 4.1requirement installation electrical guide ,, scheneider electric-explanation : characteristics of particular source and load . - photovoltaic installation , -residential premise and other special location . -WMC guidelines measure. -General rules of electrical installation statutory
regulation ,0V to 1000V ,AC ,,0V to 1500, In public network , compliance with national regulation ,IEC 603643, -installes power load : characteristics values of cos . I=IA.cos$/cos$.. power factor before compensation and cos alpha factor after compensation being the original. - heating factor of 0,8 recommender number consumer ,5 story's apartment
building with 25 consumer ,each having 6 kva installed . - the total installed load the building is 36+24+30+36+24=150kva, -thw apparent power supply required for building ,150×0,46=69Kv, - magnitude of current in different sections of the main feeder supplying vertical rising ground ,level cross section area conventionally spece , 3 floor current entering
the rising main at ground level , -159×0,46×1000÷400×√3=100A -(36+24)×0,63×1000÷400×√3=55A. -Possibivilty of improving power factor ,extension to the installation installation constraint. -In=Pa×1000÷U×√3, Pa=KVa ,rating the transformer. I=phase -to phase voltage at no load in volts (237V or 410V) in ampers , In =Pa×1000÷V=, V= voltage between
LV terminal, Simplified equation for 400v(3phaae load ,) In = kva×1,4 (IEC 60000 power , -explain choice and use MV equipment ,MV / Lv transfo for use of MV , equipment choice of MV /LV ventit in MV substation, - substation including generator and parallel operator of transformer. Generator alone operation not working in parallel with the supply network.
Generator in parallel utility supply parallel operation of transformer , - type and constitution MV/diatrt,-differenr type of substation,indoor substation ,outdoor substation. I'd=Uo÷ZS,,0,8.Uo÷ZC.. I'd=fault current , Uo=nomminal phase . ZS=earth fault current , ZC=fault . _____. 5.Scotland qualifications Explanation -basic
software engineering concept to solving electrical and electronics engineering problem. -writing and testing and documenting I/O. - Program using the basic structure -deaign using flow charts or program design language. -Write test and documents linear programming using I/O statement. - Write test and documents I/O Programmation incorporating
subroutines . -table Boolean expression for logic gate knowledge skil . -hexadecimal number system. -conversion , between hexadecimal and binary gate symbols. -teith table associated Boolean,and /or/not ,exor/and and nor . -combibation logic , expression in sum of products.produxt minimise logic ,draw minimised digital, - sequencw logic .. -bloc diagram
of sequential machine need for memory in sequential machine need memory in sequential logic latch ,JJ and D bistable elements. -asynchronous and synchronisation operation counter and shift register circuit using bistable . -lofic family device characteristics. Circuit . Build and test counter and shift register circuit - evidence requirements should -single
line schematic for 33/11kv substation, -liar standard fault level for local Sister voltage (250MVA at 11KV ,100MVA at 33 KV, -pee unit calcul : concept of infinite busbar by grid system working with ,3phaae short circuit by grid system working with 3 phase short circuit worst case scenario calculate fault level for a fault on an ,11kv feeder fault level , fault 11kv

feeder from a busbar it is expected that the circuit used will smillar to infinite system feeding 33 KV line with inductive reactance and transform per line excepted one generator should be connected to the ,11kv ,, .S1=250MVA,,U1=11kv,,Z= √R.R.+z(w).. V÷I=11÷39,3=0,279,,ohm ,,, =100÷5,24=19,083 ohm .. S,=V.I.√3..
I2=250÷11×3=22,72KA,,,,39,3KA
I1=100×33× √3=3,039==5,24KA.. -explain next generation higher national electrical engineering : utilisation electrical power transmission lines and complex waves, -Performence calculation to determine each Zo ,V ,B .. - Voltage current and power for one fill ZL>Zo,,,ZL> -ID conditions then action ifco dition gold's . -ID conditions then action if condition
holds -else Action if condition does hold. -End if Case condition of Case 1:action for case 1 Case 2:action 3 for case2 Case n : action for case 2 n End case Condition based input portion use of build process such - write . -test condition documents I/O prog using iterative loop statement. -repetition For variable ,from start to finish in steps of value . Do. -
sections to be repeatit perform End for . -fundamental of control system and transducer . -high level Engineering software. -soffward engineering process creating file editing files process constant and variable. -operatoe and -statement :input output documents. - evidence requirements , satisfactory write one linear prog. - input and output statement
different type of variables arithmetic operator . - knowledge skill test and documents. Relation operator =,|=>logical operators -vooleen express. -branxh statement ,if then if ,. Then,,else,,case,,of,,port configuration readings. -outcome 3 : Flowchart pseudo code : for ,do,repeat, until,while,loop. -statement:for do repeat , until while . - looo to manipulable data
array -out put array , data array read port data into . -testing of iterative loops ,test plan and actual . - if then ,else If of either while do or repeat until for next to - Advanced unit specifications: engineering mathematics 1, qualifications Scotland,level6 -outcome outcome provide evidence following skills skill time . -solved 2 problem on degree radian . -
A.sin(nx+-a)=, or ACOs (nx+a)=b -blow , logarithmic -log+logy=logx.y ---logx-logy=logx÷y p.logx =logxP. y=A×lnx y=A×log x..base10 Convert rad =Teta +180×π - A×sin(nx+a)=+-B - A ×cos (nx+alpha=+-B -y=a.expx - explain ,,,x =log .base a inverrse function ,y =a.exp x y=10 .exp x y=e.exo x ,,,x = log . y=e.expx and ..x.exo =log..e y - solve exponential (5
.exp , = 95 ,,,x exo 3.5 =0,1.. log .base 10 (x+2)+log .base (x+4)=0,5 .. -Apply mathematics technique to vector and complex numbers ,2 d d=√(x2-x1)(x2-x1)+(y2-y1)(y2-y1) -D:,,,d=√(x2-x1)(x2-x1)(x2-x1)+(y2-y1)(y2-y2)(y1-y2)+(z1-z1) -scalar ,,,ab = b.a ,,,,a(b+c)=a.b+AC -b.b-&a.c>>, control unite ,>>, temperature sensor,>>>soldering iron temperature, -viewi
g platform.. -explanation: A beam used in the construction of the viewing platform. Calculate the magnitude of the reaction at B , calculate magnitude and direction of the reaction, - calculate the magnitude of reaction at B ,,, Labalked , (24000×1.10m)-(3500×0,30) (F1×L)+(F2×L2)= 264000+10500=35000×L 265050÷35000=75,70m/n
---------- 8.Explanation: A lifting system to allow worker on construction to carry out essential maintenance is being . A warning system that will ,sound an alarm when the platform in motion is two button used to control the upward and downward motion .. -input /output. | Operation-alarm sound | A=0 -Maximum load. |
B=1 -bouton c Pressed, Bouton depressed| C=1,,,D=1.. -propose design has the following specifications condition must be met the alarm z ,will not sound unless the gate (A) is closed will not sound when weight on platform will sound when either button ,c or complete the Boolean equation for the alarm .. ---------- Explanation:
calculate a suitable value for RF: Vi=RF/R1(V2-V1),,, Vin =(Vin+Vin+Vin, O,31+0,53+0,47=1,32 RT=1/33000+1/3099+1/30000=o,ooooo90960 RF=,,RF=Vo×R1/V2-V1=, 1,2×0,09999096/1,32=0,0099910 ---------- Explanation mechanical engineering must design a pneumatic circuit meet the flow,when push button VA and VB not
pressed ,or when. Not pressed lever ,VC state double acting cycling must, outstrok {A`.B.`+C -a short time after cylinder outstrok must instroke automatically an initial design the circuit...---------- The program to control the cylinder must follow criteria oustroke =A`.B`+C the cylinder must remain oustroke 15000 milrsecond
,209 milrsecond after the command to instroke the system start monitoring. ---------- Explanation -An alternative motor with moseft driver in also consider the mosef has a resistance of 2,3ohm fully Saturated and the motor is rated as 0,49 w at 6.0 I=0,40+6,0=0,07 I=V/R=6,9/2,6=2,60,, E=V-IR 6-0,182=5,818V ---------- As part of the car control window are to be open and automatically the following control produced ,by - explain with ref to the circuit above the impact switching out 7 high then output 6 high then output 6 high has on the motor---------- Program below in Pbasic ardwno code is know to
have fault.. - main if pin 3=l then jump If pin 2=l then main If pin 1=0then man Jump:high 7 Pause 15000 High 6 Pause200 Low6 Goto jump -void loop (){if digital read (3)== high {jump();} else if (digital read 2, ==High){loop ();} else if (digital read (1)==Low){ loop();} Void jump (){ Digital write (7,H,G, Delay (15000) Digital write (6,high delay (2000); digital
write) ---------- The camera is placed on the outside car and a talk of clear plastic is place ... ---------- Ligth sensor is used to identify when the plastic is dirty when it sense a value of less than 219 lux a motor spins to move clean plastic In front of the camera the control , - calculate the value of aR1 required to saturated
the op - Amp positive 219 lux , R1=Rcc-R ,,,Vo=(1+RF/R1).v -motir requirements ,55mA of current ti operate the op - amp saturated to 78% of the supply voltage vbe is ,0,70V saturated transistor RF =,,,explan 9,0055A+0,70+0,000795+6÷9,, R1=Rf÷vo÷v2-v1, = 0,01119... ---------- Truck ligth system ,completed logic A,B,C,D,E,F,
---------- Batteries power portable flood light are to be installed the construction site to allow work to be completed in lower ligth ,the battery is rated at 15V,13A,kB hour useful energy is 2,32 MJ Completed the energy audit diagram for the portable floodlight batteries slowing the input and output energy .. ---------- The
diagram below show part of the design for the framework that supports the floodlight. -.calculating using nodal analysis at node A,and B the natural force in ,AB,AE,BD,and BC Member | magnitude. | Natural AB. |. |tie AE. |. | Strut BD. | BC . explanation= L=355×cos 30=321,73nm AE=455×sin39=227,5Nm BE=455×cos 30=227,5 DA=(455×30 sin ×30 sin
)÷(350,sin 39 =321,73÷227,=549,29 ---------- The force w represent the weight exhibition and is acting ,1,4 m from point B ,the distance from A to B is 3,46m Draw a free body diagram of the force acting on the exhibition calculate the force , 650×sin 120° 776×sub 120°-force acting on the connecting ring Q=(530×cos65°)=223,97 P=650×cos 37°=447,2 T=776×cos48=539,054 F1+F2+f3= ---------- d) replacement exhibition is to suspend from ceiling some positions two cable support the new exhibit hanging from the connecting ring are replaced Hallow aluminium.. The 2.7 long tube has a diameter of 72 mm an walk thickness ,,2,5 mm
it support a load of 32,7 N calcul the charge in length tube it is load new exhibit . A= π.d.d÷4= 3,14×72÷4... €°2,6-2,5÷2,7=1,92.. £=F/A=32,7÷56,62=0,62.. ---------- Engineering civil 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip...
4 of 18 compact , calcul the total torque produce by motor , - described an advantage : described the purpose of. -funal design structure used to support the weight the boring . Completed using nodal analyse table of the missing force their nature of the missing force their nature . Member .| AB | AC| BC| BD| CD Force |. |. | 583kn|566kn| Nature | tie | strut |
strut | AB=(550×61)+(550×61(---------++------ Calcul the force that player strikes the ball product a torque of 295 NM (0,34×295)+(0,84×295) Force extension graph ropes Calcul the strain energy in the rope when it experience tensile tension 159 .. ----------__ ----_ An electronic engineering design digital logic circuit for Boolean equation ,
Z=(A`.B`)+(C.D) - draw the digital circuit for the .. Design for an operation amplitude op circuit is Calcul gain for circuit when V input voltage is ,9,11V ,,,\V=7,59÷0,11=69.. Determine appropriate resistor value for E 1,and RF : AV - R1/E1=59-1/R.. Integrator §vout =1/RC.integrator .Vin St ... f=1/2πRc.. 555,timer stable .. Marj = T1=0,7(R1+R2) T2=9,7 R2.c
Freq^ 1.44/R1+2R2c.. ---------- Calculate t output voltage of the difference amplifier amplifier when the ligth ,calculate the minimum output voltage requirements from Amol to cause three , d) described effect adjusting variable resistor will have light level .. - the LEDs ,are at their most offence when current of 52 mA ,flow each they also found 2,3 y
occurrence , Calculate the required resistance for protection resistor ensure maximum efficiency ,VCC for the comparator is set to 8.0 v the comparator saturate at 75% .I'd = 52 mA ,,vs = 23v ,,, ID,= 9,0952÷8=0,93,, 23/0,04=575 ohm ---------- Future solution involving used of microcontroller is also tested an output pin on the microcontroller activate
bank of LEDs .. From sensor input ,microcontrol yes ,,pin 6 ,, 1/R1-RD }+(1/R2+rd2)+(1/R3+Rd3)+(1/R4+Rd4.. ---------- Explain with ref ,to code circut the effect on the LEDs ,when the reading from the analogue sensor rises from,5 to 200 -------- The logic circuit show below control valve that provides water for the plants .. ---------- Explanation
pneumatic circuit need to feed wast into incidence part of a system to produce electricity safety reasons ,be bar material is pushed in the system cylinder outstrokes allows . . càlcul the minimum base current in requirements to switch on the relay ,,,, In =0,7/1,5=0,4667A.. .- calculate the voltage requirements across the resistor assuming vbe is ,07 v
,,,calculate the current through the variable resistor , V=6.0,1.5/2.5 ---------- - by using pulse width modulation the LEDs can be mode appear bright or dim Code for the test is below in Pbasic and ardruuno Main: into sensor =A9 redax Pino,Bo. Int led bank =7 If Bo>>display.. Use , existing design,use existing formula,modify , generator - Vmean at 0°=√2/2π×VRM×(1+cos alpha) √2/2π×240(1+cos 1)=108,038v Meant at 90°=√2/2π×VRM×(1+cos alpha) =√2/2π+240(1+cos90)=54,019v -Vmax=√2×Vrm =√2×240=339,411V IRMs=√2/2×irmax = 10,60.. ---------- P2=√P1.P2 =√104x×800 V1=V1/N=0,4×60/550=0,0436mm. m=P1.P2= 104×0,04364=0,05416kg V2=m.R.T2=0,05416×0,287×292=0,01574m P2,288,44 Vs =v2=m(D2)/4.D=0,01574=m(D2)./4 P=2.n/n-1.P1.V1.[(P2/P1).exp .n-1/n -1] =95,69kw - prerequisite= pact /n = 95,69/0,88=108,74kw -at ,44,8°c ,,h1=188kj/kg at 93,5°c, H2=392kj/kg At 1500kpa , 350 °,, H4=3148kh /kg .. h plant = ms (h4-h1)/mf×hv. ×100/1 =5400(3148-188)/600×3200×100/1=83,25% EE=ms (h4-h1)/mf×2257 =5400(3148-188)/600×2257=11,803kg,steam /kg fuel Qecon = ms (h2-h1)/mf 5400(392-188)/600=1836kj/kg At,1500 kpa ,hf = 846kj/kg and ,hfg = 1946kj/kg = 2595,5kj/kg Q,super = ms (h4-h3)/mf 5400(3148-2595,5)/600=4972,5kg/ Q,flag=m×.cp.×.∆t (15+1)x,1,045(210-24)=3109,92kj/
KJ _____ Qin (KJ/kg) |. out KJ /kg |. %---------- Qfuel=. | Qecon=1836. |5,74 32000. |Q Eva=19831,55. |61,97 |Super. = 4972,5. | 15,54 |Qflugas. =3109,9| 9,72 | Unaccount= 255 |7,03---------- 320. | 3200. |100
---------- ~=C.p/CV=1/0,712=1,4 T2=T1(V1/V2). exp .alpha -1 = 28(13/1) ,exp ,1,4-1 = 806,26k T2=P1(V1/V2)=10,325(13/1),exp = 3674,83kpa. T3=T2.P3/P2=806,26×5000/3674,83=1097k. Q2-3=2/3.QT Q3-4=1/3QT. (2/3).m.c.v(T3-T2)=(1/3).m.c.p(t4-t3) 3×0,712(1097-806,26)=1(t4-1097) T4=1511,01 V4=T4.V3/T1=1,3774m
T5=T4(V4/V5).alpha -1 ASR=1-Ts-T1/(T3-T2)+aplh(T4-T3)×100%=62,47% - explanation cpd, continue professional development , Scotland outcom qualifications,UK qualifications: -13. research on papper libry text book Bibliotech: Reference:resource -uk magazine for electronics technology and computer projects . EPE , everyday pratical electronics
Order book ,8$,,10$,,3euro ,200rans -Projects and circuit,series features, regular and services -Topics : Scotland magazine second voice recorded module: record two ,four eigth different message clean and clutch free line level audio output can feed an amplifier or PA system ,8 bit recording quality user selected bandwidth.. - Scotland:Applied skill
engineering electric , Engineering electronic engineering science , mathematics engineering -Topics : scottland outcom PIR - triggered mains switch ,use a domestic pie system to switch any mains -power device ratesup to 10A..-topics : multti function , intelligent remote , controlles dinner the ultimate dimmer project using a standard handheldsr remote .. -
topics teach in 2011 part :logic circuits - our to be missed introduction to gates and flip flops.. Microchips microsti k development board.. -10.constructional project: Design concepts: Hk828 module record 40,60 -getting the messat : module jump random sequence. - how it works: function heart module architecture -labelle the block diagram of the hk828
voice recorder chip while the recording process relies on audio sampling the audio is not stored digital but used and analoguw sample and hold system the analogue sample stored sample .. -samplung rate : capacity array means that HK store total ,8000samplw per second total ,262,144/8000,,42000 sample ,4200 total ,262,@44/42000, recording
bandwidth fidelity propertionaj sample ,2khz , samples ,just 4khz.. -circuit details , 4,7 if ,,and 220kohn ,19pin preamp and AGC,, circuit vis couple 29,,5,8hz,,47kohn , switch logic signaj teeminaj . -parts list multi message voice : 1,PC board code 797 available Epe pcb service 110mm×57mm. 1).electre microphone insert . 3) ,3 way terminal blocks PC
mounting 1), 2way terminal block PC mounting 3), 2 2- pin section of Sik header strip. 3 jumper shunt 1 ,)28-pin Dik ,ic socket :15,24mm spacing. 1)8-pin Dik ic socket ,7,62mm spacing 1)2.5mm concentric DC power plug ,PC mounty socket ,PC mounting _semiconductors :.1 HK828 voice recorder IC (ic1) 1)LM358 dual op amps (IC2) 1)78L05. +5regulator
,reg1 1) PN2099,PnP transistor Q1. 1) 5mm green led (led1) 1)5mm res Les (led2) 1)1 N4004,1A diode ,D1 -capacitors : 1) 2200uf , 16V, radial wlectr. 1)220uf, 16V radial elect 1)22uf,16 v radial electric 1)10uf,16v 1)4,7 if tag tantalum 1)220nf ,100v MKT metallised polyester. 1)100 nf ,multiyar ,monolithic ceramic , -resistor : 0,24w,1% 1) 470,kohm,
2)100,kohm 9)22k ohm 1)100 k ohm .. 1) 220k ohm 8) 47 k ohm 2) ,10 John 2) 680.ohm 1) 47 ,ohm ---------- 12) constructional project : IR remote control ligth dimmer module,the circuit is based on a PIC 18 F ,1329-U/SI microcontroller ,a triac and and IE detector (IRD1)the two RGB ,LED. give user feedback in the operation and
setting. -power supply: micro synchronisation waveform connecting neutaj ,,derived from the mains via a 1kohm ,5w , resistor and a 470 nf (X2) capacitor and resistor act as current limiting impedance for association ,5,6v zener diode ZD1,the supply works as follows,for positive half cycle of the 230v,AC current flow via zD@,the ,470nf ,, capacitor Nd
1k.ohm ,5w resistor same time , electrolyte capacitor capacitor is charged ,up then for negative half cycle of the mains current flow ,via D1,the 479nf capacitor and the 1 k.ohm resistor ,the results is that the 470,if capacitor is charge to ,5,6v-0,6=5V..DC Impedance of 470 nf ,series 1 kohm ,,,micro,,,5v suplie,up 23ma ,IRD1,, supply bcircuit two RGB LED are
connected six cathode connected to a different I/O pin the common anode two RGB LED connected together 5v,single 1 kohm .. IR remote are amplified filter decoder received module IRD1,,the 1000 ohm ,resistor capacitor are module to decoupled it 5v supplies the data output at pin 1 of IRD#,is connected to pin 10 of ic# and configured.. -construction :
intelligent dimmer is built on a single &sider PC board code ,799, measure 76mm×50mm .. _____ Part list intelligence dimer , 1.PC board code 799,acat from Epe service ,size 76mm×50mm 1. lp65 sealed ABS plast case Witt clear lid ,size ,,,125mm×85mm×55mm(jaycar HB-6246) 1.flush mount ,3 pin main socket
,jaycar ,PS 4094 similar .1. IEC make chassis connect with mounting holes jaycar ,PP-4005 1.)10 MHz crystt(x1) 1)47uf, 5a inductor (jatcar lf-1274 1)4-way Dinklage screw terminals plug ,jaycar ,HM-3124 1(10A,ISC main cord -semiconductors : 1 .pic 1 1.ie receiver 1. -capacitors: 1470 ,16v electrolyte -resistor ,:. o,25w - miscellaneous: 3M3×25mm nylon
screws (to secure PC board. 2M3×15mm,nylon screw ,for IEC connector 3 M3 x12 mm nylon space , 10 M3,nuts -1)1 ok mm of ,0,7 mm dia times copper wire for links ,, 1)200 length ,3-core mains flex (250v,,10A ratt, 1) 4,8 mm res spade conductor,fully insulated , 14,7m yellow spade connector duly ,5)100 cables tie Add,part requirements testing 1)12 AC
,500mA,or 1A plugpacj, 1)12v,,300mA,ligth bulb (jaycard ,SL 2656) -construction project:PIR -triggered main switch: Futer detector ,20m away ,two pair telephone cable , switch unit also provide 12v power PIR detector cable switch main rates relay to switch the power twin 239 AC ,outlet ,relay contact rated 20A, switch. , 10A limited,10 different ,, switch
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
22 of 39 3/11/2025, 1:20 PM
power load any time regardless ,switch units fits ,UB2,size plastt box ,, switch itself battery operated and switch low device if about ,80mA,12v .. :how it wot:block regulated 12 volte power , internal circuit plus unregulated,17C ,DC power virtual contact ,which are normal close ,open when detector Sens movemt. Contact unit also connected ,12 line detector
contact open R1,and it's output switch low ,this action issued set reset ,flip -floo ,normalt resting .. Switches intu set state Q high used a transistor driver circuit energy relay ,power switch 239 AC outlet and loads, at same ,sR flip flop switch to A Output multi stage remove reset counting pulse from simple clock oscillator ,which run 0,9374 the reason odd
frequency clear , the binary counter has 14 stage but make only from internal flip flop 4 to 10 (04-19)and 12 to 14 (012-014) we rotary switch S2 to select one 10 output ,si rotor of S2 kept until the selected counter output switch This happens a soon counter has received the appropriate number of clock pulses,eigth in case 04,16for O5for32,for0664,for 07
switch high after 8192 pulse been counter ,selected counter switch low situation coupled via capacity c1, resistor R# inverses I..-main connector ,three connector ,lex green wire , yellow main wire ,T1 longer ,same wire 160mm , outlet socket .. - insulating shield ,two outlet socket insulation material pvx , -final assembly: step the two plug into socket make
noctch , completed box ,, -Pir : testing or adjust.. In used .. -parts list trigger main switch, PC board code available service size 147mm×69mm 1)ub2-size plastt box ,197mm×113mm×63mm 1)PIR sensor 2)heatsink ,19mm,square t o-220 type , 1pushbutton switch spst (S1) 1 rotary switch,1-pole ,12 position (S2) Point knob with removable pointer insert .
,1)6 - pin R)12 socket ,PC board MTG (con1)or ,3way PC board mounting termi block 1) 14- pin Dik ic socket ,for I 1 16 pin Dik ic socket for , 1) power transformer ,12,6w/2va,2851 type 1)29A mains rated relay ,chassis MTG (RLy1) 1)IEC main plug , panel mounting 2(mains sicker flush mounted 4 main socket ,flusg ,15 mm long ,M3 tapped,. nylon M3
machine screw ,10mm long csk head ,N3 machine ,6mn,long pan ,solder lug ,,nylon cable tie 100m ,25 mm length ,6 mm diamt heatsgrink tubing , -semiconductors: quad scmit band ic1,4093B,,4069 binaicounyer,12 regulatory,PnP transit,led green silicon ,, - capacitor, : resist -capacityi -explanation: Project a plethora of , together with the pic programming
, -PIC training course. , training development course enhanced ,pic programme module,-bool expirmenting . Experimenting with PIC microcontroller,this book introduces pic programming , jumping straight in with four easy knowledge 8 binary. Explanation logic - digital logic , circuit basic building digital circuit and system . - possible , switch and lamp logic , -
lofic gate with inverted output ,, Y=A+B Y=A.B Inverter ,,y=/X.. And gate ,,or gate ,,and gate ,,nor gate. ,exclusive ,incluve gate.-Bistables ..D type bistable , D-yppe bistable,,j-k bistable .. -pratical logic circuit. -build the circuit wizard way : opening to gates , gate number Intruder alarm: real life application of simple logic intruder alarm push to break ,
advance... - ripple counter.. -investigate : a block schematic diagram logic syst ,the system is designed to alert the flight crew visible and audio warning ,door switch logic signal respective door logic 0,when closed warning indicator active low requirements logic 0,to produce a visible audio ,study the circuit carefully and then see if you .. 1.what logic level
appears at point of door closed ,wath logic level appears x,y,z ,,,wath level appears point x,y nose door open other closed .. - circuit surgery : collector feedback theory /bias ,, A=So/Sai,, feed factor,,loop gain ,,Sf'BSo Sai=Sin-beta So -So+beta So=ASin .. AcL=So/Sin=A/(1+beta+A 14. Files system. Record academic and certificate diploma, 1.Pocket
number. Implementation work Data right,met investigation: Project : drawing : Career project : theory circuit Schematic Experimental : workshop workplace school class pratical career guidance National trade examination :theoretical and practical ,n diploma 18month Memo tech , Project drawing: interpretation -Mathematics graphic draw :project Line point -
Electrical trade theory draw labell: Circuit component make: Resistor cell,baterrie ,AC DC circuit current,lighting washing machine , transmission generation AC inspection -insustrial electronics draw labell Circuit component make: -engineering science Graphic and circuit .. - grade total career ,staff theory learn Pratical exam test trade assessment
Engineering electrical. -fault find diagram schematical . Relay -installes rules ,circuit diagram, -lofic system -control system : -15 .experimental,.projects pratical trade framework qualifications marks : certificate diploma 6 month semmester trade.. Trade theory -pratice frame work Component frame ,electrical and electronics Drawing : make circuit tools
process make circuit framework Trade pratical engineering:level5,6,7 Process Design Designation unity| ,component| ,tool trade| -male tool pincil draw Make, resistor ,condensaor charger circuit tools make drawing . -makee installation lighting way switch : -makee transmission ,generation ,drawing ..design. 3.experimental :project drawing City power
Eskom advanced career Drawing workshop and workplace , Library on line project On line. Power engineering,advanced Scheneider,Eaton breaker design -drawing diagrams city : Metering circuit: design Installation city transmission general drawing schematic: Installation: -drawing interpretation: discovery electronics Drawing make: installation security
alarm ,police alarm design intelligence robot circuit timer 555.. Computer electr -4. implementation integration system . Guidelines guidence pratical school Microsoft project azure ..GitHub ,visual studio gith lab Work item : epic item project repository project issue project run project code source readme licence,IP drawing circuit 15.1 Trademarks T Blaser
tableaux Met career police tpm , counter terrism , Engineering systems:met block mark TMP circuit maintenance meeting break Data right .. Cell phone: IP licence book rwiten integration : met career detective ,counter flip flop ,electronics ,CCTV circuit right , cameras phographic right lens zoom circuit , repaired center cellphone city vs transmission
Telecomm office vs Microsoft office vs circuit power vs installation electrique compagny police data certificate copy license copy private police ,,policy city power Eskom policy claim drawing design power cost economic load ,outage circuit . Total ,pratical , policy claim vs claim alarm maintenance total career , Security safety claim nated counter terro record
Irregularity phase circuit complain circuit implementation: -total framework policy vs police record LDR framew not meeting vs Terri counter irregularity vs Total grand :grand council department energy Eskom policy ,city power policy terro counter emet. Irregularity mining company trade mark , telecommunication claim vs customer trade marks compone
maint Tom . -total grand met tblazer Salesforce energy claud metering energy co circuit incidence force sale policy -data right energy metery claim. Vs alarm relay delay dimer switch. Microsoft project azure blue defender Regulatory factor ,limited Freq , energy cost. Bill cost energy Intergration circuit switch. Record total Physical meeting .. script inspection
16..Experience pratical: www elektor .con, Test book Order booking :200rand ,,4eu - microcontrol analogue audio , digital,test measurement. -Pratical: quick to implement reusable multi plat form , fts. -sub long term weather logger . - ATM,18 compass. -j2B universal MMI module using ,arms cortex .. - FT232 ,USB Serie bridges/BOB Chip kit first Arduino
compatible ,23 bit microller development platform,design manufacture. -Parallax : li - ion power pack charger -reflow mate : Supply voltage: 230V/50HZ only Power : 3500w Weight: approx ,29kg Dimensions: 620×245×520mm (w×H×D) Heating method: combined IR radiation and hot air . 10/27/2024, 12:52 PM Request an intellectual property (IP) licence |
Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 5 of 18 Operation: directly using menu buttons and LCD remotely using PC software and USB connection. -menu language : -temlerature range ;25 to 300°C - Maximum PCB size :400×285mm -temperature sensor : 2 internal , Optimal temperature distribution
thank to IR lamps - Drawer opens automatically et end of soldering , - Glass open automatically at end soldering process - interactive commander for data transfer Command | action h =help. | Print available command _____ -Current drawn by entire system at ,3,3 V CPU frequency| sleep mode | current drawn
8Mhz. |Non. | 5.8mA _____ Fuse settings ATmega 88 Fuse | Ext| OxF9| 8MHZ intern oscill (divided hence cpu clock is 1Mhz-$_____ -weather logger operates supply voltage of nommnal 3,3v power over USB ,is available 17 ,VCC of BOB ,FT232R serial -to-usb converter
module for stand alone operation unit power via BT ,, supply voltage between ,3,5v and 30,V regulator ic3 diode detector again accidental reverse polarity connection important employees reduced measure to maximise battery life in stand ,alone operation microcontrol is responsible cincentre measure effort circuit ,3,3 V under various conditions is shown ,
alkalt or NIMH ,AA cell , 4,5 v or 3,6 v nominal capacity of between ,2Ah and 3Ah ..record data for least 1000hours instead of three AA cell free the employee single ,Li - ion Lipo cell supplies ,3,6 or 3,7 ,, on power saving measure is to carry , 100second ,, measure system draws extra about ,2,5 mA ,,120 ms ,when taking reading in between , 10ms
corresponding to the 1hz interrupt the device is from ,power save mode 59 second ,I/o clock micro controller order need to be count the pulse in order , CPU.. Result disping result Test measurement: HH10D humidity sensor module feature . Re Swegethttps://GitHub .com/milkmist)mist rewmaster tools / filter m. Bios serial received firmware download
request from the device. Flyerm uploading Kerbal (83475 bytes Upload completed (9,5kb/s. Booting the device Done Hello - the pattern obtained after numerous iteration of the command pixel [l]=y*y* x>>5.. Testing in development board ,,use serial port to upload application ,,serve a console for displaying the message sent to print f +) the Boras fitted with
a ,3,3 serial port ,located between the ethernet and VGA connector ,pin marked ,board received the data marke tx is used by the board for transmission the GND is obviously ground ,3V3 is a 3.3 V power rail serial long use 3.3 level (not 5v or RS -232) or the combined devdlop - organisation display of the measurements results .. - CMOS compass module:
board .kmz 51 chip ,the resistance variation in resistance cause voltage variation which is amplified,LMC 6036 ,sensor electronics magnetic heading us calculated microntroller bus ,corrected module positions ,pin 7 ,AC power grid in him parameter story EEPROJ - orienteering ,4 load firmware power manufacture ,want to recover the module function
bearing send following by modulating.. Wiring block - digital communications with the robot electronics cmps module Graphical representation of the compass point -circuit diagram the construction file eagle files component list software Keypad : consist 12switcges ,4 to the left of the display ,4 right , rotary encoder switch encode build push button three
encoder space , 9 encoder build in button 27 button ,a5×6 Matrix need connect key I/o scane 4 key free way , function available some function make ,use diode avoided problem phantom key several press ,a situation turning the diodes package .. Different variations on the 2×@6 LCD ,key swiy offset .main function resistor R38,to R 44 board turned using
button S1,s8,s12 key fitting , resistor provide. ,turn key circuit by battery function asymmetric matrix line have limiting resistor (15-R25) is final circuit .. - display: board offers possibility of fitting ,2 line by 16 character (2×16) display ,4 line by 29 (4×29) ,,by 16 character connection ,5v power ..R ,36 ,R 41 is necessary T relay ,R1 ,120package . -Powering :
the board main rail (V+) is 5v microcontrol itself ,3.3 derive,3 ,, are directly connecting the display available on transistor (piooo,6,,Pio 2,8. Etc pad k1 and k2 ,,signal -construction: - implementation : board - twitter message local area network LAN wireless configt.dialog - communication on the dso board. Detec signal the ratio signal generator DSP
,) div,and this ,n level of ,94 db application peak to peak with sinuskidaj ,0,53 to 0,59 time supply average Test measurement: Component list Resistor :.R1=220kohm To R5 -capacitors : C1=4,7uf ,63 radial to C7=470nf. - semiconductor: D1,D2=BAT42, T1=BS170. IC1= Ic2=ATMEG,, Miscellaneous:.S1,S2,S3=6mm switch ,PCB mount S4= single -pole
switch X1=32,768khz quartz crystal LCD 1=DOG @62w.. Mod 1=BoB .. Mod2= humidity sensor HH10D K1=6-pin(2×3) pibheader option iso interface -20-way socket strips SIL for LCD1 ,, 18 -way(2×9) socket for mod @,ic socket for lc1(8-eay and ic2 (28 -eay ,PCB hi Settings and function button S1 to S3 Print circuit board. Humidy sensitive used
transducer elements frequency 6khz to 7khz measured AT mega ,value with calibration par ameyer again stored series module frequently counting the output pulses module over second ,the 16 -bit counter timer , capacity 64 kbyte,,stored,record .. -soffward : firmware for the microcontroller is written in C complied using .. Program in weather station,LCD to
control display .... - construction: double site circuit board diagrams components mounted in board ,socket solder components,fused iso connector ,k1, programmation job ,program used sensor module serial to USB module , switch ,S4 position to select external power ,3,3 - operationel ,: treer button (S1,S2,and S3:,S1 cycle variouse Setting ----
_____ C28=C26/(4Q.Q×(1+Ao)),. R24=2Q/2(wo×C26) R25=(1+So)×R24, R23=(2+So)×R24/So If ,A=0,7071 and So=,these formulas sin plify to , C28=C26/4 R24=1,4142/wo.c26) R23=R25=2×R25.... _____ Basemodu ---- Lab testing ..prototype audio convert implementation: Component list - Resistor= R1=330
ohm R2=680 ohm R3= 470 ohm Capacitor C1=100nf Inductor: tri ,home -semiconductors Led = standard led yellow - miscellaneous, cinch so let ,solder pins ,USB audio - circuit : circuitry design ,signal pin @, coupled resistor impedat former signal (0,5vand 75ohm) coupling transformer provide galvanized cover upper frequently

transfo limited couplings
toroidaj core material suitable signaj ,50Mhz .. Construction: PCB ---------- - schemat diagram of the flasher - Circuit the time integration module Base e two operational amplifier ,A1 and A2 ,- ,non + input and output,varyyng voltage V1(t) is applied A2 driver integrato ,R c and A2 ,Rc stage ,add resist ---------- Light sensor : With twilight detect: sensiu circuit 9vdc. to .15 VDC..ligth room circuit generate ,lm257 ,R1 and R2,,voltage dived ,,R3 and R 1 circuit , Ooamp ic1 wired buffer voltage LDR suitable R2,voltage pin IC,,,IC1,,, ic2,0 other ,,22kohn R,10two comparators ,ic2and ic 2b compare income p1and p2,0thar
output R 90,be ause ,, determine dark ,ic2. and I 2.. -explanation teach ,in A broad based introduction to electronics: digital to analogue and to digital conversion: electronics studies school college UK ,include byec level 2 award electronics diploma in engineering level 2 experienc - e read ,teach teach learn experience test electronics circuit Learn : - beam
break flash trigger ,build necessary time delay photo flash response IE -Parts list active loop antenna : - @ PC board code 813 (ant loop) 31mm × 94,mm - @ PC board code 814 (rad loop) 58mm×48mm -@weatherproof plastic box ,eg 130×54×83mm plastics box -@8-pin IC socket - semiconductor: 1BA4560 dual op amp (IC@ 1 k8L08 or 78K10 voltage
regulator. 2KDV ,149 varicao diode (D1,D2) -capacitors -3)100uf ,16v electrolyte 5,) 15 nf disc ceramic. -Resistor (0,#5w, 5%) ..micelanot _____ Beam - break flash trigger.: the infrared beam is generated by led1 to led3 and picked up by phodetector diode ,PD2,,op amp ic@ b function as current ti voltage
,while I 1 is wired as non inverting amplifier the latter derives transistor A mosef briefly sait h trigger outbut when the or is interrut . -circuit details: Power isderiver battery in detector unit IRv beam from source unity OD ,3,5 mm jack plug con@ mate ,, detector unit IRv source unit ,IR pgotodetector diode ,is connector diode ground and the inventing input ,out
site,,+1,7 v ,and +4.0v ,IR ligth is falling on OD@ dark , basically ,#2kohm ,,2,7kohn ,,220uf ,, Qrin writing amplifier ,, s -Switching the triggers output: Q1 switched when IR beam falls on PD1 collector voltage is normally,beam interrupted ,mosef .. -parts list : IR source unit : *1 PC board code 808 ,57×26mm 1)UBS size box .8#mm×52mm×31mm 46mm
long untapped spacer ,4 M3,×13mm screw ,counter sink head nylon cable tie ,75mm long 12m length ,8cable 23,5 mm ,monk jack plug cable type , - 35mm IR ,led (led @ to led 3 ,1)820 ohm -detctor unit : 1) PC board ,code ,size ,,122mm×58mm 2UB3-size box ,129mm,×68mm×44 mm 1)SPDT mini toggle switch ,s@ @)PC mounty ,,3,5 mm stereo
jack,socket ,, - PC mount ,15 mm tapped spaced ,8 M3 ,6 mm machine screws pan head - 21 mm PC board terminal pin,, 19v ,,battery clip lead 1)8-pin Dik ,,IC socket .. 1)30mmm length of ,13 mm to ,,15 mm length of ,12 mm to ,15 mm diameter black pvx conduit or brass tubing .. -1 piece of ,IRv- transparent red film ,approx snap connector or , 1×4- way
,AA cell holder , 1×2 way ,AA cell holder - semiconductors: dual op amp (ic1) 1Bc33,nob transistor ,Q1,IR pgotodetector, - capacitor : - detector board final assembly n: construction v -cinverting scanners for ,VHF/UHF discrimination tap socket ,the basic setup for received ,159 MHz signsk ,,,. - PC board is secured to black the lid M3 ×25 mm tapped
keypads pluggi nto machine socket .. -precision resistor: -Lcd module: remaining components installer .. ---------- - digital insulation meter : 1) PC board ,code (main /dis)109mm×84mm 1)PC board code 859 (dc-dc con),70mm×51mm Ub1- size plastic box ,157mm×95mm,53mm 1)LCD modut,2 line ,16 character with
back ligthning. 1 ferrite pot core pair ,26 diameter enameled copper wire , 1) 100mm ,lengtt ,o,7 mm diameter enameled copper 1)8m length of ,0,7mm diameter enameled copper wire 1)100 mm length of ,0,7mm diameter tinned copper 1)10×AA battery holder. 0,7 mm diameter pinned copt 1)2- pole rotart switch ,PC board mounting ,wit 16 mm,S1 1)SPDT
mini toggle switch panel mounting (S3,S3) @ Min Dil relay ,spt switch p with 5v ,2) binding post ,Bana jack (1 red ,1 black . 24 mm solder lug.. 1) ,16 -pin lengi of Sik socket strips 1) 18 pin IC , socket ,4(25 mm ,m$ tapped metal spacers Block diagram of the ,16 ,bit digital potential the desired out voltage is entered via keypad and microcontrol IC 2 the
correct binary number to drive the ,16 relays in the ,R/R ladder networks - arena loop , Experience trade mark , engineering science career ,motoring vehicle,power machine , engineering,trader Compagny,Transnet motoring career , ford career Engineering system and Toyota , nated ,, Magazine collection motoring reviews -rwiten oral relate : Specifications
: - 1.engine: -cylinder : four ,in line transverse - fuel supply : electronics multi point ,injector -bore /stroke : 81,0/96,3mm to 87cm -cubic capacity : 1799 cm cube -compressiin ratio : 10,5 to 1 -valce gear : s-o-h-c ,valve per cylinder , variable valve timing -ignition :five -2Engine output: -Max power iso(kW)103 -power peak (r/Min)6300 3transmission: Forward
speed -low gear: ,3 ,142 to 1. -2end gear :1,869to 1 -3rd gear : 1,235to 1 4th gear : 0,948 to # Top gear : 0,727 to 2 - reverse gears :3,307 to 1 - final drive : 4,294 to # Drive wheels. : front -wheels and type - road wheels : 16×6,5j alloy Tyre make brigestonr turazan , Tyre size : 205/55,R 26 92v Type pressure front : 220 kpa Type pressure rear : 220 kpa -
spare : full ,size disc 5.brakes: Front : 262 ventilated disc Rear : 262 solid disc Hydraulic : ABS , with end and bas. - street : Type : rack and pinion hydraulic ,speed sensitive power assist -lock to lock : 2,7 turns - turning circle : 11,6 metres -suspensiin : Front mac person strut ,lower wisthbor e gas filled dampers anti ,roll bar multi coil gas rear - capacities :
Seating: 4/5 Fuel tank : 50litres Boot space. : 304 dm 3: Utily space :928 .DM cube - warranty and service intervals :. 3 years /1000.000 km warranty. 5 years /100.000km service plan Service every 15000km: Honda civic 1,8 Vxi; Volkswagen Jetta ,1,6 Comfortline ,ford focused ,2,0 trend ,, Toyota corrola ,180i Test claim t 203km/h top ,speed and
acceleration to 100km/h in ,,9,44 second Honda tops at 202 km/h achieve the benchmark sprint in ,9,39 second performance - test data : .Amarok bitid ,4 motion Engine : -Cylinder / capacity : 4/1968 -bore and stroke : 81×91,5mm -compressiin ratio : 26,5 to 2 Fuel supply:common rail Injection - fuel diesel . -max torque : 400nm@1500rpm -max power :120
ke@4000 rpm -transmission: Shift type: 6 - speed manual - first gear : 4810 -second gear :2540 Third gear : 1.590 Fourth gear : 1000 Fifth gear :0,760 Sixth gear : 0,630 Final drive : 4100.reverse : 4.370 Loe-range : 2729 Control 4 WD selection type electron button Wheels : alloys Full-size spare - 2.measurements (mm) -height :1834 - length : 5254 -width :
1944 Wheelbase :3095-fuel consumption: 120 km/h ,,:8,61/km Urban : 9,8/km - calculate range : 688km - performance: 0-100km/h : 20,8 second 100-129 km/h : 4,86 second rpm @ 120km/h : 2100 -recovery point : Front ,,RHS Rear - underbody protect: Transfer case non Fuel tank : plastic guard Rea diff non - odometer 6,248km -load and towing
capabilities (kg) Tare : 1848 GVM : 2829 CVM: 4668 Towing capacity ,unbraked : 750 Towing capacity (braked) - brakes : Front. Ventilated disc Rear. : drums ABS ,yes - load capacity (litre) Load box : 2520 - warranties maintenance and service: Warranty : 3year/ 100000km Corrosion ; 6 years Service plan : 3 years / 90000 km Service intervals: 15000 -
guard motor ,police maintance Record Guard gold platinum ion Eligibility car _____ 17. Specifications:volswat golf Pricing : Test pricing Standard equipment; controle aluminium - general data : Kerb weight:1541 kg -length:4212 mm-width,excl mirror :1779mm -wheelbase :2578mm -weigth distribution front ,n/a -
ground clearance : 132 mm - boot space : 275 litre,,. -utility space : 1305 litre - coefficient drag CD : 0,34 Seating capacity : 5 Headroom front : 987 mm Headroom rear : 979 mm Hatch lift height : 2017 mm - safety -warenty : 3 - years : 120000km -maintenance service : 5 ,years : 900000km -2Engine: Type layout : 4 cyl transverse turbocharge , - valvetraun
: DOHC ,16 ,valve -displacement :1984 cc - bore ,x stroke mm : 82,5×92,8 - compression ratio :92,8 -power kW : 188kw,,6000rpm -torque; NM : 350Nm ,,2500o,,500rpm - power ,to weigh ratio : 121,8 kW/ tonne - fuel injection : direct petrol inject -recommended fuel : 95 unleaded.. - drivetrain : Transmission : six speed - gear : ration 1st : 2,92 2 end : 1,96
3 Rd : 1,4 4 the :1,03 4th: 1,08 6th : Body frame with .. Brake from : 345mm disc - break rear : 310 mm disc - wheels : alloy :tyre : - steerit : servitronjc - steert ratio : 14,96 - turn lock : e Suspt front : 10,9 m - susoenst front : Subjectivjy base averaged weights out Driver ,gearbox ,steering ,vraj ride handling ,exterior styling ,interior styling sear , ergonomic
control ,luggage space , percentage ,price value - Performance: Accelerated: Speed / time 0-60kph / 3,17 sec. 0-80 kph/4,55 sec 0-100kph , :6,27 sec 0-120kph - quarter mil , soeedo calibration ,120 kph ,error ,,116 kph / -3,3% Overtake 60-109kph. / 3,31 sex 80-129/4,24 sex Braking : Average speed to zero 100-0kph / time / distance : 2,77 second /39m. -
fuel economy: Real world test route : 72,3km - fyej used : 6,3 litre -our consumption:8,7 litre / 100km urban cycle claimed : 11,2 litre / 100km Co 2 emissions 195 g/ km Fuel tank size : 55 litre - estimated crying Test conditions: test car odinetr : 5396kn Reading-temperature:21deg ,c Wind Locay ,test note : ---------- Car note Hon payment
calculator based ,19 percentage deposit: 18.explanation: comparative test : Subaru. Specifications:-2Engine: Cylinder : four horizontally ,opposed Fuel supply: electronics multi - point injections -bore stroke : 99,5/79,0mm -cubic capacity : 2457 cm cube - compression ratio : 10,0 to 1 Valvagear : s-o-h-c bank four valve 2 : engine output : -max power iso kW.
123 -power peak (r/Min)5600 Red line (r/Min). 6450 Max torque (N.m) 329 -torque peak (r/Min) 4000 3.transmission : Type cvt Low gear : 3,525to # 2end gear. 2,238 to 2 3rd gear. : #,641to 2 4th gear. : 1,194 to 1 5th gear. : 0,850 to 1 Top gear. : 0,850 to 1 -reversr gear. : 2,358 to 2 -final drive : 3,700to 2 -drive wheel : permanent ASD. 4.WHEEls and tyre:
- road wheels. : 18×7,5j -types make : Bridgestone -tyre size : 225/45,, R2891 w. -Spare ,tyre and location ,spacy 5: brakes: Front : 294 mm ventilated disc Rear. : 286 m ,solid Hydraulic ,ABS. Breaker assist 6.suspension : Front : mac person struts Rear . Capacities: seating:4/5 Fuel tank : 65 litre Boot /utility space :348 DM.cube - warranty and service
intervals: 4 years /100000 km,warranty ,3 years / 63000km maintenance. Test results: Maximum speed (km/h) -true speed. :210 -speedo calibration:60,,80,100,120 -true speed : 54,74,,93,,113 -odometer error :0,9 percent over. *Accelerated,second 0-60. ,5,2# -0-80. , 7,50 0-100. ,14/95 0-120 , 20,74 0-140. , ,1km sprint , 32,15 Terminal speed : 264,4km/h -
overtaking acceleration: second 40-60. ,/ 2,53 60-80/. 3,01 80-100/. 3,65 100-129/. 4,41 - fuel index : Manufacture fig : 9,2 litre /100km Car fuel index :/1 0,92 litre /1000 Estimated tank range : 595 km Taxable CO,2 rating : 214 g/km -braking test : 10 stops from 100km/h measure in second at ,30 second interval on good bitumeise -beat / worst stop :
2,70/2,89 Average of 10 stops rating ,2,79 excell - geardsd speeds ,km/h low gear ; 52 , 60 2 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 6 of 18 Nd gear : 82 ;94 3 Rd. gear. : 11; 128 4th gear : 253 ; 176 5 the gear. ; 299 ; 344. - calculated
at engin power , 5600 r/ Min and red line ,6400 r/ Min - performance factor : Power / mass (w/kg) 80 Power / litre (kW/ litre) 50 Power / litre (ks/litre). 93 Torque/ litre (n.m / litre Engine ,,: 1124 Engine rev/ km - mass tested (kg) - test conditions : Altitude : at see level Ambiy temp / barometric press ,22° c / 2020 hPa Test car odometer : 1765 km
-150000km warenty and five t ,1000000km service Comparative: Test summary class Hyunay test scores,25/29 Mercedes Benz blue efficiency,75/100 Opel Corsa collour - hummer H3 adventure Design and development the TBM ,,700 is singles turboprop engined low wing monoplane aluminium and steel construction the TBN product PT 6 A ,rates at 850
sho (634) ,,522 kW take off and landing cruise flight engin power,859 ,,634 the extra ,,2529 neutical miles (2829) -General characteristics: Crew : 1 or 2 pilots Capacity: 4 to 6 inclus on passenger .cockpit Length : 10,65 m (34 ft 11 in) Wingspan : 12,68 m (42 ft 7 in) Height: 4,36 m (14 ft 3 in Wing area : 18 .m.n (193.7 ft Empty weight : 2132 kg (4699 lb)
Max take off weight : 3354 kg (7394 lb) Max playload : 385 kg (849) - performance: Maximum speed : 593 km/h (320 knot ,368 mph) Cruise speed : 467km/h (252 KTS ,290 mph) Range : 2813 km (1519 NM,,1784 miles Service ceiling : 9450 m (31000 ft) Rate of climb : 12,09 m/s (2380 ft / Min Time to climb to 26000ft ---------- Based . Price : | POA Number of seats and luggage : 2 seat ,34 kg - engine type : Lycoming -fuel burn : 23-30 litre per hour - tank capacity: 136 litre - range and endurance : 2384 km - propeller type and oper: sensenjc -undercarriage: - lead time orders: depend -standard avionics: vrf Panels - Speed |. Size |weigth
Cruise:147 KTS| length 6,2m|MTow:794k Stall:38 KTS. | Wing:85 m| empty :460 kg Vine:171kts| height :1,8m| useful: 334 kg -pulk out plan Explanation VIP. Paint protection that actually works approved by major Manufacturing in South vehicle shield .. -bonnet guard , Headlight,front guard,side guard ,,repaired scratches ,stones Chios ,damage ,film
removed ,film warranted 5years peeling ,bubbling and cracking -_____ Journey|price|engine|power|torque| 27sxt. | Maintenance plan: three years /100000km -fuel tank:78 litre -averagr sales per month -service plan 17..Explanation engine calculation How to calculate bore ,stroke displacement - volymetric efficiency
VE=3456×cfm÷CID× RPM,. -Cubic inch displacement=NOC=Noc×SV - head gasket volume: HGV=HGCT×0,785×BORE: PVD=0,7854×Bore×DPD)+)+(VPD-VPB)= piston deck volume - compression ratio CR=1+0,7854×30RE×strokr÷ccv+HGV+PDV. +ISH=HP/16 : fuel system injector size per horse power.. VE: volume office, Cfm: engine air flow rate cubic
feet per mine. Cid : engine displacement ,size volume cubic -RPM= engine speed revolution per minute . - NOC: number of cylinder -bore =length -stroke = length -HGV= head gasket volume Hgct : head gasket compressed thickness. PDV:piston deck volume DPV: piston distance Or .. SV= sweet volume . CR= compression ration Ccv: combustion
chamber volume Ish = injector size per horse . HP: horse power--_____ 18.Explanation: engineering science ,stress,unity stress,type stress,unit for strain , elasticity ,hook low, straight, ductile material,young module elasticity.. -explanation : applied thermal engineering engine testing: structure .explain performance measurement:. -
basic parameters: -measuremsnt of speed . - fuel consumption measure -measuremsnt of air consumer -measure of exhaust make -measuremsnt emissions. - measure of brake power : -measuremsnt of friction horse power. - performance of si engin -porformence Calculate speed in evaluation performance development : charge load -bp=2πNT+60,
break,,2πrnt/60,, AL ,,N.K/60 -specific output: Specific . Volumetric efficiency n=mass of charge actually scke in÷mass of charge corresponding to the cylinder pond conditions. -relative power air : FR=actual fuel - air motion÷stochiometric fuel -air (bsfc).. - thermal efficiency heat balance .. Brake thermal efficiency:= bo÷ m.f×c - performen e: Heat equivalent
break work rejeter to cooling . - heat career for engin .. Heat balance sheet. Input | kW| %| output | kW | % _____ -explanation: construction techniques:. Petition: record -structure ,model aeriplane. section ;;. Side : Model assembly details: Covering and finishing. Refinement. -------- -construction note Letter : ....
Materials:---------- -letter,|number|name|size. |Masse A. 1. Gear 1/4 , ---------- Seat,frame,back,fender,back,Fook, healings,front,front axle,wheel,gasttank,rivo.. ---------- three wheel motorcycle: motor driven car ,, - simplified concrete
mensonery planning ,mortar ,concrete = A.P/s - ---------_____ - explanation study material and fire arm ,ballatisc Gun Typical muzzle energy of fire arm: _____ -fire arm (except |calibre |muzzle energy -air gun .Ek=1/2×v×v(2ft.LBf/7000gr×32163.f.t.t/s.s E=(m×v.v)+
K=450,95(2×32,1930,700)---------- -spefication -Calibration:9mm ,para ,40s , -ovarall length : 2184 mm. -barrel length :5 - high : 240mm -weigth:0,81k Construction slide Magazine : 24 round sign front ,GPS -test firing results : -Ammunition : group - factor : -41mm. - hand load :51 mm...note accuracy average.group..fired ,25 mm...
---------- -artillerie ,AM×30F@ Characteristics service -types : canon automoteur,utilisation Conflicts. -characteristic equipment : 4 home piece piloted longer left : 10,23 mm Larger weight:13;10mm Hight : 3,17 m Mass in combat : 43,5 tonnes blindage ,size ,case lunch.. ---------- -report installer: - mounting battery
replacement step remote: - connection to the fence -connection , configuration -pc board replacement - service condity -Pc board ,F1,Fu ,18 vac fuse.. -Lcd display,18 LCD ,7,2 output in 500ogm Energy out put .500 ohm ,joule -9000v ,zone monitot,1/2 control display,2 max gate - gate and panic button input time gate ,yes - alarm output ,siren output .. -
power consumpt under normt operational conditions ,18VA -battery time charge ,24h - solar power operational,60 Ah -wire in a Serie : galvanized : @,2 mm : 5 m optimal.. High voltage ,set point :10,00 volt ,set ---------- Balance rate installation: item..design draw element ,security access plan. --------- Card access reader mount
type technologie. -biometric access reader mount type be specific. -keypad device. -keypad,kepead securt. -card reader with key.. - horn siren - weather proof him - horn ,strong - cr reader with turn attandance, Tensile,revolving door -traffic arm. -vehicle ,exit device , -smoke detector, -heat detector. -gaz detector, carbon monoxide,electro lock,
push button ,camerarwite,camera ,with intercom, - security window scret ,heat detect, -window contact,vibrasic,glass,floor,car drivers,overload,dual tech ,contact saity,wall motion,floor motion, -beam fence distribution, - 19. Explanation : pratical school Disciplinary hearing school . trainings system orientation school career guidence : Experience trade
explain: career skill -explanation: safe road usage teacher manual secondary: -explanation the foundation for road : Meaningful maturity,human dignity mordaly depending decisions,making responsible action , identification of criteria, phylosophie of life ,inclucating road safety , various level human , existing in frame of reference,co existing
temporary,relation , - explant:the origin of technology and it's implications Forman ,technology and responsibilities ,Sens of responsibility and Education,the task of the school, requirements of the school,road safety and involved in accident, accident according degree ,type of road user accordt to racial group involved , statistics cost alcok poor vision . -
explain: traffic training secondai ,content of traffic , traffic situation,those involved,road safety , certain criteria for ,traffic training ,certain requirements , content method for ,youth levels ,abuse among , legislation and low enforcement ,vehicle ,trafft ,element , traffic hours . Trainer methods conversation,self , training, Education orientation, -expt differential
teacher road safety education ,basis off teaching from road ,child involved , inequality child different safety Education ,road Education for school undertaking parent school local ,,locak - explanation different road safety education and the secondary: Education concept ,secondary school ,diffet road safety , Education central ,road safety ,road safety
situation, road safety orientation,road saft Education road attitude , secondary child personal,goal diffential road safety,road safety matury, psychopedagogie persscpectuve, fundamental pedagogic perspectt ,social pedagogic , didactic , orthopaedic ,irthopedidact, realisation , opportunity and road safety education, The school , secondary child basic ,, -
explanation:the methodology of road safety,goal of traffic Education , traffic lesson objective,the learning objectives, problem settings and problem solving , - lesson structure and form.. -explan group course lesson , actually preknowled, actually , unlocked of new , evaluation, group discussion,class arrangements,quality teacher ,skill the teacher and
group,how to handle group ,group cohessiob ,criteria for judging the success of .. General methodology guidelines. -chao teaching aid road safety education : Teaching lessons modalities teaching didactic , a schematic presentation of Education , teachings software . Teaching wath look like ,teaching wath , teaching broad ,blackboard ,conograpguc
teaching aid ,poster brochure model.. -thw sons box training ground the overhead projector , - the overhead projector film projector . -selecting teaching a lesson ,nature , didactic consideration, -road: safety ,navyv,point of contact in road safety ,few partie , department transformer provincial authority vlocal , evaluation .. -calcul situation traffic possible,
criteria,test total traffic situation,different large ,self orientation up him self regards world self discovery evaluation accepted road,lesson telling lesson subject road ,time 35 minute ,lesson objecy explain pedestrian ,setting problem pupil ,stopping ,self realisation , instruction control .. Topics :Lesson objective to explain ,learn objective pupils must knowledge
the application legislation and must able to mention aspects which ensures safe , pedestrian. - explain the problem: LinkedIn up knowledge pupi will be led to the realisation that injuries pedestrian behaviour is not only annoying to other dangerouse during lesson phase new content is gradually unlocked , - scheme consider energetic behaviour on
pavement keep try to walk next another , stepping pavement intersection trafficking ligth buses getting out of vehicles. - the course of , actually preknowled the pupils citoyeb Saturday morning ask Unlocked behaviour pointed outcome traffic legislation is explained content , mentioned in problem solving is unlocked b, - explanation : functionalism : practising
of acquired insight by mean model or diagram on the black board may explain how the will intersection as an assignment pupils observations and make annoying and effective behaviour of pedestrian.. -explanation defensive driving; road sign ,warning sign ,guidence , regulation sign , traffic bsign ,hand signals ,flag signal ,overhead lane flashing signals,
road marking, - explanation: rules of road vehicles : control theory test driving.mirror blind spot ,signsk clutch ,speed control breaking ,gear change ,motorcyy ,board inspection , inspection staring , Explain manouvring test moving running left speed control changing ,incline ,turning speed judgement emergency . - the driving test : light motor vehicle, heavy
motor ,the years ,staring procedure ,moving off , inclined ,alley docking ,reversing ,making a left turn ,hand signal , parallel parking ,the road test ligth heaving , light and heady . - changing lanes ,stopping in traffic , stopping parking , turning at intersections, proceedings ,stop traffic sign ,entering a traffic circle, leaving a traffic ,block pedestrian ,level crossing
,overtake,entering, leaving freeway ,overtaking ,on a freeway passing , freeway on Ramp.. - explain test checklist record , faillure manoeuvre point ,exceed time limited 29/18 penalty , roadworthy, violation traffic low , uncontrolled action , dangerous action , collision, 20..Explanation: Management system information: pratical Science motor policy guard -
statement of insurt; statement of the administration,vehicle eligibility, important servit,policy commence date, replacement of components,claim procedures,cover provided this policy , components Covered, benefit: classic,bronze silver ,gold, titanium, polyester ,cerami , additional siluct , transfers it,exclusion form cover ,limit Silver,gold titanium ,limi of
indemnity,wear and tear restrictions, consequences damage,cancellatt,jusdiction currency and dispute,fraude ,quality control,insurer rigth after , service history intarion , statutory notice , resolution. - explanation : road warranty all passenger commercial maximi carrying capacity 200kg , cover the cost service maintenance accident ,petrol engt service
relevat as . -displacement interval .petrol diesels electric maximum service run over if 1000km or 30dats occure RMI repair claim , - policy vehicit schedule still subject to Manufacturing warenty plan motor guard plan. - faillure occuring 39 days . - replace claim process in event of mecanique construction fail occury. - Owen ,policy number , current kilometre
ready,partict of clay ,item cause quotation,address vehicle inspected service record invoice submitted with 45 days , benefits ,5 years ,120000km ,18 years ,160009km - description of good stolen property must descrt very accurate bear it in mind invest official searching good , -makee or manufacture ,modej not years ,years of products, serial number
,registration ,engine and chassis ,size ,colour ,completed ,state midst iteb ,charge that change , _____ - 22. explanation: industrial administration management - explain : general framey historical background complexity of management - general princy and groi of management thought. - growth of management the
pioneers - outline of managet theory : definition - business orgat: organisation the divig of managet, -growth of organisations stage growt ,orgabiy chart , organisation rekatu, - organisation problem : corpsratt planint traditional and modern organit theory future reault , - production marketing and admnistration. - organisat and the manufacturing fynctt stage in
production manufacti,organisation of production the manufacturer functions: -:Products the ancillat functions b; maintent production planning and control store keeping purchasit handlit of materal. - products the advisory functy : work studye time ,method -production the advisory functions : work study time study methods work study , ergonomic ,
operational research inspect. -marketing : marketing's organisat: admnistration area ,personek management wage. - growth of industrial relat: trade union unions emply associt collective bargaining and joint negotiation: - personal managent : motivation of management content of a personal policy achievement of harmony of objectiy: - the person's
department staff recruitment, the manager . - personnel functionalite organisation if personnel department staff recruitment sciencetif selecti - job evaluation and : wage structure determining the wage structure merited rating personnel problem induction training wage and salaries: - personnel problems: disciplinaire promotion safety labour turnover
management by participation personnel statistics ., part four financial management and statisciak .. - financiere management : scope of accounting provist affinaire source of finance. -outline of financial and cost account definition the purpose account , fundamental accounting transit from financial to cost accrost , classification. - of cost controlling cost
absorbing factor .cost miscellaneous overhead absorpty , overhead facially .. -cost account system : process casting batch costing hybrids costing ststt organisation for labour orgat for material cost organisat for overhead .. - method of casting and control : marginal costing decision . - profit and efficiently and loss measure capital expendy decision . -
statistical method : Chart and graph statistics quality control . Designation experimt time Serie published statisic.. - part ,five the industrial environments: The middlege to eight center the industrial revolution from development of large .. - principal development in some ,major : coak iron and steel engineering textile chemical and artift fibre ,scienty research..
- the economic ent:.demands and supply cost of production types of compety resale price maintenat the general economic situation. - general principles of financial and visit low banking and finance trade credibly commerce the merchant bank and issuing house hire finance industi and commercial Indy corporation for industrial negoy instrument. -
government and industry: introt devet of govert organisation of control . - necessity for government control : - element of legaj system : the low modern communities source of low common low system Englanders and Wales legal person the idea and property. - general princiy : of contract princt of contract and commercial law ,contract ,tart liability for
dangerous premise agent sale good , miscellaneous commercial low matter, - elements of industrial low apprenticeship contract of employment factories act Offit premise ,act social insurance industrial arbitration industrial relations general managent division function .. - explain award bid clause ,price industrial minimum salair ,flow manufacture process
lighting tube. Design process: Order ,item price : product case 24. Explain: pratical school regulation and irregularity Vocational guidance theory and practice: -1 vocational guidance , -2 explanation: psychological explanation of occupational trait and factor personality 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan
Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 7 of 18 development , social learning ,decision making autonomy, -3 explain sociological explanation of occupational ,choice class gender ethnicity group , opportunity structure an interdisciplinary framework. 4- explain , the interview: philosophy, structure questions talking
silence , listening ,non verbal communication information and advice. - 5 , explain traite factor client centred , psychodynamic, behaviours problem silvt , fantasy,the place of counseling in vocational guidance. -6 Career Education: explain objective: structure and occupational information the curriculum evaluation. -7. Test interested questionnaire,self help
instrument computer based guide special program - re written career guidence ,total faculty subject total grad time table Admi total grand reason career .-explanation: study of occupational ,self study of occupational. -qualification obtained your present position how college. - how to choose career,: knowledge of occupational finding about occupation , know
yourself. -how to apply find employment,way find . -how to apply for work . -how work relationship, introduction, different kind ,your concept relationship .. - communication ,danger --explain , psychological test : instrument , mechanical and technical aptitude. -qualification| work do to choose career - occupation | social conduct , relation social . Psychometric
-Personality and aptitude profile confitial psychology Name : Interest ,| attitude | verbal reasoning , vocabulary ready completed| factor | personality - test results reported | survey councillors . - profile / v(y) ,, Batteries , _____ -explanation tpm is profitable,direction in production achievement zero breakdown the
parko factory. -RPM challenge limits from four devet stage , definition and distinctive features Tom striving for overall equipment effectiveness tomb,defect prevention system ,between , Tero technology and -explain: maximizing equipment effectiveness , equipment used at half effective. - breaks motor stoppages imped automation

stop acceleration the
deteriore of equipment. - explain preventive maintenance alone cannot eliminate breakdown five counter measure for zero breakdown. - unlicensed operational of automated equipment errors equipment investment, five tpm development. - organising for tpm implementation the twelve step . -step ,announce top management decisions to introduce tpm ,step
2 : launch Education companies. Step 3 : establit create organization's promotion. - established basic Tom police and coak . -formulate master plan for tpm .. Tom , implementation,and stabilzat. Step 6: hold Tom Step 7: improve equipment effectiveness. Step 8 : estabt autonomous , maintence prograyfor operational. -step 8 set up schedule maintenance
program for maintenat. Step conduct improve operation and may skills ,step initial development equipment management. Small group. - integration small ,small group goal coincii with goal , - evaluating the maturity of small group acty the functionalite of top many in small group . 25.Total maintenance product,,meeting police ::---------- -explanation: director social worker practice theory and skill, - explain social work,an overview. Direct practice domain phylosophie and roles . - overview of the helping process. -explain operationalizing cardinal social work. - relationship building skill community with emphasis and authentic. Verbal following
exploring and focusing skill,eliminating counter productive communict pattern multidimenst assessment, - assessing intraperst and environmental system . - assessing family function , forming and assessing therapeutic group,enhancing motivation,with involuntary and ambivat client,negot goal and formulating contract . - change oriented phase ,planing and
implementation change oriented strategies. - enhanced client problem solving skills assertiveness. - modifying envit developing resource and planing ,,additive emphasis interpolation confrontation ,managing individual famili and organizat barrier change. -the termination and evaluation phase , Explain : final phase termination and evaluation of code
ethics,timing and intensity ,of self disclosure. -A paradigm for respond authentic stimulation client message. -Fuel for authentication response.initiated by practionner. - positive feedback form of authenticity response . - relating assertivei to client saying no and setting limit, - exercise in responding authentication and ,client statement model resnse ,in surface
underlying feeling , answer to exercise to discriminate level of emphasize response. - explain: verbal following exploring and focusing skill , maintaining psychopedagogie contact with clients exploring problem. Verbal following furthering response ,paraphrasing response,open and closed end , responding,client statement,seeking concreteness ,modeled
response , summarise response analizing verak following skil , - focussing ,a complex skill selecting topics ,exploring topics depth blending open ended ,empgic response maintained focuy.- evaluation used of focussing , response ..to exercise,answer to exercise identify in close and ended response .. -explanation : eliminated counter productive
communication patterns: impacts of counter productive communication patterns : eliminating non verbal effecty communicay culture nuance of non verbal ,other inventory of non verbal patter of responding -communication barrier eliminate verbal to effectively,gauging effective response the challenge of learning new skills. - multidimensional assessment,
critical role of assessment , -assessment an ongoing process , assessment as product,include strength in assessing,sources of information verbal report.direct observations of non verbal behavt observations interatcliient monitoring collateral source of infot. -psychologi test , -computer assisted personal experience based on direct interat. - the importance of
self awareness. The multimensionaliry of assessment. -the problem identify the clarity ecological factory assessing devetneed stress association. -key factor to be addressed. Manifestation of the problem, participate -explanation: source of information verbal report.direct observations of non verbal behaviour, observations interactive,client self
monitoring,collateral source of information. - psychological test., computer assisted asssessor personalite expression based on direct interaction. -the importance of self awareness. - the multimensionaliry,of assessment,the problem identify the clarifying , ecological factory assessing development, participants and system implicated in the problem how
participate. , development stage and life transitions. - severity of the problem meaning client to problem. - site of problematic behaviour the temporary context of problematic. - frequency of problematic, possible alcohol, substance. - child maltreatment.and spouse abuse . - client emotional coping effort skill strength and skill of client . - cultural and social
class factor questions to be answered assessment other factors . - assessing interpersonal and environmental. -the interaction of multimensionaliry humans the introper system , biophysical characteristics presentation. -physical health cult factor in social support , assessing use and abuse of , alcohol and drug , effect of abuse alcohol dual diagnosis in ,
biophysical social , using interview skill to asses possible , alcohol ,using instrument and procedures assessment . -assessing abuse ,use of instrument and procedures ,conveying assessment finaling client.genetic factor psychiatry. -cognitive , perceptual , intellectual judgement , reality testing, cognitive flexible ,value misconceptions, concept, interaction
between cognition emotional and behavioural, - emotional functionalite, emotional controls ,range of emotional, appropriate of affect ,assessing effects disorder ,bipolar effective, bipolarity ,assessing social,.- : motivation: precipating event and motivation,in volunteering client ,culture norm , different, determined pattern degree of acculturation , bicultural and
mental health .. - fluency with language problem solving , achieved credible, providing immediately benefit attitude ward , environment health and safety factor environment resource universal need identify relevant social , system social support system . - negative social support system assessing reciprocal interactive between individuals , instrument to ,
enviromental need of disabled. - assessing family function the evolution of family system. - system framework for assessing . - family functioning , family home , content process of interaction.. - sequence of interaction employment circulum explanation , assessing problem. - outer boundary internal boundaries and family subsystem family power structure ,
family decision making , family and range feeling ,gosk , family myth cognitive communication styles of member , - forming and assessing therapeutic group ,classication of group formation of therapeutic,group established group purpose,Agence and practitioners perspective. - established specifications individual group goal.. - conducting preliminary
interview. - group composition. -open versus closed group ,size frequently and duration meeting. - voluntary versus involving .. -assesin group process, assessing patterned idify group alliance , group norm value , -enhacing motivation with involved , applying concept from social, initial contracts structure of initial interview.. - using confrontation facilities. -
negotiation a problem search bargaining with clients getting mandate off your back .. - exploring self defeat consequences,resolving ambivalence in family creating incentive culture hope , highlights strengths modifying cognitive self . -negatiatinf goal and formulating an rational contract ,purpose of goal ,type of gosk , guidelines for selecting ,process of
mutually selecting .. ---------- -26. labour relations in education . - termination for labour in education - act and bills for labour low in education . - explain: an historical, clarification of concept the development of labour .-- the of exploitation racial discrimination, Explanation: era of advertisement ,the era code termination
and cooperation. - development of Education labour relations. -sources of labour , labour relations and the constitution. -the common low and labour legislation for Education. -the rules of natural justice., -the contractor of employment,labour relations act and related labour low. - labour legislation for Education - individual employees relation . -defining
employees and employers in education. - employees right of employment in education, - employees right of employment in education , - fundamental right . - duties of educator as employee .-dumie of employees Skill development and Education ,national skills authority ,seta for Education, - learnership in education , - collective labour ,freedom association,
organisation right of trade union ,. -collective bargaining in education,collective agreement,managing industrial action strike and lockout. -responsibilty of manager , - procedure during strike ,duties of manager , established and implementation..- fairness in workplace disciplinaire: - substantive and procedural fairness,fair unfair dismissal , progressive
disciplinaire , - workplace disciplinaire Education: - incapacity ,poor work performance,defining poor work, procedure incapacity, health injury , definitely health ... 29. Explanation : - Principle of commercial low : Large credit ,agree small intermediary, - explain: size of agret, regulation, concellation of registration of credits b, - registration of definitely
counselor credit . - consumer credit policy. - source of the low , statutory low or legislation. - the constitution . -the customer low,judgt of the court ,old authority , foreigners low , case discussion. - the court in republt t constiy court , - the constitution court . The supreme court appeal ,high court officer of superior court duty -officer the supieur court duty
process master . - magistrate court . - doctrine of store decision ,Cree case create judg . -application of the doctrine : - interpretation status : the relationship bet the star decision rules the general principles, - court judgement : ration decides . -:the term : low rules ,meaning low rigth, legal subject legal objt, intellectual,private low , protection , servitude bself
defense provocation . , - term of the contract : essential natural and incidentally,condition ,penalty - contract of sole: the our,chosen is entitled to be protected by seller again b,for content , - indemnity insurance. - determinat of the amount payable non indemnity insurance ,value house ,, - relation diffusion form intellectual, - franchising : mediation,
arbitration,award Statutory arbitration,source of the low of arbitration ,matter excluded form arbitt ,national cause ,matter relating to ,criminal case ,validity of arbitration agree ,the arbitration agree ,the power of court in relation to arbitration agreement,stay of legal proceeding where there is an arbitration agreement appointment of arbitration,power of power
of partie , appointment of arbitration ,power of partie to appoint arbitration to fill , termination of an arbitration , - notice of proceedings partie , summing of witness and recording , evidence manner of arbitration award the act ,time manner and publicat of award refused to sign must does not invalidate order specifications,setting a side of award ,cashing of
cheque,the relationship between card ,issue and card hold traveller ,the low of trust basic feature a ,trust transfer control ,, right consequences of windings the effect of windings, liquidation meeting land proof ...- the low of administration of estate ,the executor ,appoint , furnished of security removal and dischat ,master , preliminary work ,death notice , letter
accept ,band security ,making over in space ,completed sell , redistribution agreement payment to creditor on brief 30. Explain: practice school management -management characteristics of management styles the main components of . - planning: explain planing cycle different level of planned the need for planning policy general guidelines for effective
plan - explaun : step decision making ,routine and innovative. -explain : time management the importt plannit way in which time is wasted making effective . -explan time table drawing time variouse , drawing up time various types of time table .. - the annual programme , purpose of the annual progrt consii drawing, - plannt preparation and record and
keeping. - culture activity in the debat society youth activities religious movements , competition. -explanation sport actuy ,the aim of school ,sport police, - basic requirements for successful organisation and control , organisation of sport various.- the education value wells organised . - Education excursion - officii applit for sport. - officit applit plannit and
organisations, number of excussioner ,prior assssmt ,follow up teach. - follot up after .- teacher and human relations ship ,teacher and authority ,teacher and the princit, teacher and principles,teacher and colleagues,teacher Nd pupils teacher parents .. - class organisation and routine . Definition of class room management.the relation between teaching
class manager , - the important of classroom management. -element if classroom management. Organising the classrt to create atmosphere for learning developing an effect classroit routine. - furnit arrangements changii classing storage and stirat facities.. - laboratory organisation pratical work . Grouping and teaching. - the structure Education
department,head office advisory council for Education and training, regional control , circuit area office board of control ,board of many ,school committee hostel board ,parent teacher . - type of schot secondary school ,special school the . - explain correspondence and filing system: -the prescribed filing system ,subfiles , Directive regard mail ,register The
school journal ,the visitor Matter arising from incoming corresponding. -explain : in service training: in service training for staff development aims the in servit training. -the task the principal: substance a travelling allowance Decentralized in service training role of head office in service . - delagating : What Delagaty means ,who delegates , in the school ,
difference bet ,the of delagatiib . - - co ordination : co ordinating teacher work ,subject meeting , coordination pupils , - performance: perfot appraisal performance appru , performance effective common value ,reviewing and analyse career development.- staring equipment,storeroom ,stick keeping teacher in charge ,papper order book kept number item , -
safe check labo rules maint conductivity head office directorate ...- responsible post school ,power durie . - didactt oriet instruction and learning , Didactic princpt condition ,the currit ,aim of the currit ,the selection and oral,(arraignment of learning .. - dudacting method and each ,lesson presentation evaluation .. - defining didact science pedagt ,,- didact and
other relating teach ,didacic . - the didactic activit ,the didactic situat,general peadagogic andragific . Didactic environment. -tsxhook as didactic nature and structure ,task of the ,teach learning ,tertiary education institutions non firmaj cybernetics ,system theory . -------_____ explain: activity guidance, -explain : self
knowledge psychopedagogie , decision making stage , - choosing partion,examinat,tertair Education ,social conductor ,human relationships,the work. -need that can fulfied through work ,the career attitude towards. - testing: questions such follot may be set nocturak pedestrian shi preferably. -a grupe discussed: stlabutthem courtesy and road usage -the
educational objet:to orientate the pupit in the relationship between coutsey and responsibilities. -the learning objectives:to identify the character of courteous road usage determine level . - to accept a losit attit award the requirements. - explain : solving problem : during the unlaxjinf of new mean of discussion teacher must si that follotbasic fact concerning
courteous road usage trafficking. - pupils Alfred have knowledge: steering : it is difficulties to determine the main character the relation courtesy and is not clear jointly lesson problem is formulated .. - good maneee : unlocki new content pupils asked traffic low pupils matter how disret further points , - dunctt: characteristics of courtesy can applier motorcycle
.. evaluation pupils completed self questions,@= alway, 2 = often ,seldom - 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 8 of 18 traffic ,control - questions: wath is functt if a lesson objective ,his is lease object ,why is formulated of a learning
objectives important in term minimt an skill level of achit. - why is lesson problem import give 4 reason..-what us primary with demonstrate lesson .. - wath is imporly. - during introductory phase of lesson them . - which important prerequisite applies to group ...-----_____ 31. Life training religious,Cristian culture, art
buchellor : Explant: administration Guide master form - explain spread gospel pratical & Admnistrat Guide master form , - questt after asked about . - introduction letter church member... -suggested sheet adver,suggested 1st years scheduled (33 weeks , - application form admnistration, -student address planer, -recors of tests marks and exams ,paymet of
fees register, -attendance register , assignment register. - order for code cost and note ,record of orders, -certificate warding sample in cover ,-bible school survey compus registraty. -please take book apart except the last two sheet important documents read, certificate sample , certificate merited , certt Christian service ,diplome in Christ lead ,certt in word
minister,licenciate in Christian ministries .. ----------..... -32.explanation: marketing reseat the research process and problem . - structural eqt models ,neural networks,social net,- analysis ,factor analyse ,cluster analysis. -cass part , winscon power,stormt equt,canopy of core ,canopy production, food ,transitional housing ,picty word megabyt of ...-
equipment,fabut -research report ,fundamt criteria if form of report the oral grapt presentation. - students guidence to office autimat : . Office start four kinds of infot infirmat processt operational office ,procedure office system office, - example of an office system designing and office ,system the impact of office automation on job. - office automation hard , -
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computer and office how computer work disk drive,work disk driver input output ,device networks other office automation hardware. -the electronics desktop,system siftt ,operating system task operating syst command . - operating envy. -recors keeping : record keet concept ,record keet task ,record keeping application type of record keeping . - software . -
choosing a package. -spreadsheets: - spread sheet and database packau ,spread sheet package other spread sheet facitie and graphs spreadshtappli a.. Item loyal customer te - 32 explain: Educational the Mrs in time perspective. Explain peadagogic and perspective history of Education development .- orientation : Greek idea sophist concepts ,Socratic
idea of knowledge the platonic concept ,Aristotelian idea on the infrastructure of Education ,the stoic Telos formula , - Roman idea , earthing Christianity ,media volbidea ,humanistt ide ,pedagy becomes ,pioneer of peadagogic founder of pedagt become science of historical original and development . - methodology of the history of Education.: orientation
field of reast nature of problem of research ,general methodict,post minded futt ,factuality individual b,open mind , Conte temporality , setting the regret methodology unrestrained complexity present and future ,nomothecity .. +Professional competence personal enrichment.comparaison ,method approach,basic science method of investigation,them design
field ,invesy of contemporary them , hypothesis formulation, investigation ,collecting data making , established information Education ,interprefinger data writing, approach for research, problem historical problem historical anthropology approach Mets bletic , history. - explain : development of higher education in general.comment , concept higher education
a time instituts history functioning ,modern ..-explain college university criticism , justice. - established ,some .. - English education system ,control Education used ,aim content , - note ,the act preamble to the act ..some stipulation---------- Aspect of the provincial Education system : - Education control , religious
instruction,teaching medium . - a natit Education dispensation coordination uniform in education matter , preliminary work for new Education dispensation .. - policy keep with policy principles : change in some important Education matter , preliminary Education primary and secondary , division to schools course , the grouping of school , provincial Education
, ---------- - 35 .explanation :General psychology low - the identification of psychopedagogie two , -method of psychopedagogie test nationalism the experiemental testing the experiemental method the clinak methods, naturalism observations testing ,the functy of theory test verification , modification form of modern theory
. - explanation of behaviour reductions, explanation pattern , psychopedagogie influenced school of psychopedagogie present phylosophie - motivation , : explain motivation questions acquired classifying working . - biological energy recurring need measure activai stimulus transaction - discrimination conditions: other classically conditions response ,
instrumental learning and operant conditioning..- - reward and principal of reinforcement three learnings situation narration rewards non continouse extinction, stimulus generation learner reward negotivr reinforcement and motivation. -learning : selective discrimination learning ,trial and error multimensionaliry learning.. - motor skills learnings motor skills
task distribution of , transfer of training feedbay knowledge. - verbal learning : general procedure verbal rate presentation vfactor some interpretation in verbal learning transfer of learning concept.. -cognition memory: Measurements of two factor of retention,short term memory information processing memory control language, development, hereditary some
genetic principle . - maturation: patterns of development maturation and experience. - some devely topics : perceptual development language development of intelligence development of socisk . - sociality interiors change communication society .. -consumer psychology: attention getting methods effective of advy other aspects of , structure,purpose
Personal patter animal socisk manipulation social acquisition. -motion : emotional in history analyse Lyman emotion physiology functionalite, facial expressions. - acquisition emotional: limitations emotional conditions, learning developing and maturation of emotional,theory.. -psychologicsl stress: selyes ,systt stress psychological stress psychomat.
Perception : receptor function:vision audition ,faction and skin sense kinds, - psychophysic : detectsbily low sublimation perceptions scaling ,.- - organization's : reception audition faction the skin equilibrium. - origin perception: development perception at distance visual depth movement perception,sound locaty colour perception colour their... - subjective
color after effect illusion. - attention : matter orientation Tracy passive stimulation select. -attentiin analyse : neurological attention negotivr didactt listening institute , attention brief stability. - conditioning : the learning concept classical conditioning ,temporal relation extincty recovered higer order classical response .. motivation .. _____&&_&& - learning
and memory at school in Learning psychopedagogie perssccpetive perspectt components of the learning memory. - model , - the affective level of the learning memory process sensory memory. -the cognitive level of t learning memory process Short term memory -the normative level in the memory process long term memory Long term memory epis and
semantic memory why do pupils forget learnings . -learning subject content school -ainm ,learning model for subject content planning phase , planning and preparing subject content effective learn ,planing execution phase.. - step in the learnerinf process with reference to learning pattern level of drilling reinforcement and competency , -product phase ,level
of proficiency,level of structure complex , monitoring the prodtphase. - communication the teacher as the exponey Education in transition teacher communicayteach ,communicat process ,general process. Communicator style noise , - Educationak medit for effective teaching media practice subject : teach computer in education class PC Education use for
teaching - learning purpose :.computer aide instruction single PC managed available and placement of teacher : - social aspect of classroom practice Communication classroom , emotional aspect authority flexibility. - acknowledge of father people motional encounter ,transfer of value personal aspect distance. -function of teacher task directed functionalite
of the teacher the social emoy group . - life orit: explanation competency life skill ,type of skill life orientation study research in respect.- -role : of the the church in realisation the role society . - the role of occupy life in the realisation of wath do emplot exception terrait planing for life skill trait. - explain definition terrain delimitation,the desit of programmtfor
skill training a primary or secondary,CVS develot ,life skill modej ,religit Education theory and lrat. Agraindinf of the subjey ...- - handling of pupils of : Motional assisted.. - benefits the individual , orthopaedic they _____ Explanation: teacing the practice of nursing a text nursing didactic th. - nursing educst the
phylosophie of nursing ,nursing educst . -the scope of practice of a registered nurse . - the scope of the role nurse. - the scope of pratice of enrollment nurse . - the independent and dependent of nurse ..the independent functy of nurse . Phylosophie of nurse ...- the historical of nursing education outline ,:introduy , nights syst, amercain system ,conbtini. -
purpose : and object nursing education.: selected of Education object in nursing ,decide what student ,plan implementation plan , evaluation. - authoritie responsible for providing education . -regulatiin affecting nursi Education: Regulation country council ,RSA ,training registration and enrollment ,types course a Aila le registration, --_---------- Safety
health aid tools hand ,,,. Education safety health occupation,security. ,, ... Explain: what is pedagy importance of pedagogy in teaching and learning process , - what is pedagogy, - what is the pedagy in teaching, - difference between a pedagogical approach pedagogical technical. - type of peadagogic, - role of pedagogie, - pedagogie is method of teaching
in theory pratical understanding student. - pedagogie in teaching in refer educator student lead ,LMS , construction. - teaching quality of teaching, encourage cooperation learn , eliminate mono learning. - pedagical technique ,a pedagogical technique. : defines a set of action performance by the teacher in the classe for teaching include flipped learn
learning computational thing and stepped learning it is more granular Thant . - technological pedagical content knowledge understand of how teaching learning can participate framework an education. - technologiCal pedagogical content knowledge framework integrating knowledge record. _____ - Engineering
pedagogie educating ,focus if view of engineering pedagy is the development teaching concept creation for the preparation of further Engineering leadership roles changing . - explain problem base learning TVET engineering electrical, _____ - explain ,educare qualifications has been designed for people love work with
children be able growth development child phrase .. _____ -explanation psychotechnique ,,: system of actor training preparatory Deve theatre practical test measurement large verbal numerique ,test permis, suspension, permit v. QI. = Quotient intellectual ,age mental /age chronological . recruitment test suit logic. Is used to
determine the degree of extrave Ce emotional stability professionalism ,as employment,is concerned accord board dimensions psychopedagogie. -_____ Psychometric test : the main goal of an aptitude test is to ensure that a candidate passes the amount of skill and cognitive ability to perform the duties of job role
the common skill set measure test numerical verbal and non verbal rea ... 39.Explain: pratical school , orientation industrial trade Pratical nated , - promote standardisation in trade and industry is one the objective of council ,CSIR -orientation industrial in electrotechnology.standard industrial draw and label gate by EIC system gate output,,explain neer
orientation industrial : in electrical trade theory ,domestic appliances: type machine washer , ,.- maintenance out replace element tasg ,replace ,stei pannej ,, - orientation industrial in plant operations theory ,chemestrt and chemical processing ,cellulose fibre material ,manonr,readrvcombustion fuel and thermal insuy,,transfer heat pump, mechanism ,
convection. - orientation industrial advantage close cooperation compagny ,industry ,, Functionalite supervisor control responsibility,the aspect to prevent is to teach workers not tact :teach work Teach worker. Discuss different between Education and training .. governnent instituts. - a supervisor realise account organisation position direction tools ,, -
importance diRectiob stragie ,operationel ,, - supervisor selection worker job tools need , employees training performance - operator is need mechanical workshop machine operator for stocking material - industrial orientation in trade electrical Operator stock material orientation, By protection ,heart, illumination. Application , equation AC ,DC -
_____ -In dbe to isita project to teach workers In dbe teaching worker training direction practice workshop dbe ..compagny corporation City power Eskom : exam national DBE ... Explanation , orientation industrial vs manage supervisor,vs management system information vs manage system information in education
key challenge n Career posting time table counseling: trademarks industrial compagny trade theory license and trade pratical license. Orientation industrial Teach sork disciplinaire work communication skill team study team operational discipline teach counselor assessment and facilitate team value Journal classwork average score Counselor statement ,by
psychometric goal work counselor conduct misconduct coursework engineering Counselor engineering studies creation Portofolio assessment,and planing by ruling courtesy low common . In dhet ,,in DBE workshop technologie Counseling project by orientation checking low outcome workers project isita umalusi electrotech EIC commissioner in job
experience -Minister creation secret arrested ministerial letter appeal step. Minister dhet and DST building infrastructure government system careers creation authoritie building creation, counselor conductor, complain compliance duty Orientation industrial guidelines project workplace disciplinaire, questions number of task number job project marktrad
licensed , -appeal release result irregularity,non accreditation school instituts research trade training to minister ucpd , development isita creating DST ,supplier profile , regulation,minister irregularity creating diploma technologie system DBE and recreating system backlog ista Teach appeal low Education processing learn ,by abscent Clauseoffice ucpd

record learner orientation ministers teaching students practice counseling orientation industrial and marking process presentation ucpd and DBE system was learn job in trainer training . - explain: isita project orientation industrial counseling experiemental - pratical experiemental irregularity assessment. back log ,,time table n4 ,,and time table n3 trade
theory examination .. Irregularite suspension 12month ,n4 rwiten final n6 ,n5 final examination,final soon n4 examin irregularity final Examination assessment years academic final , -Level 5,6 framework qualifition letter no qualifications isita back log . Irregularite: 12 additional information pratical process learner completed: Management system information
Level 1,2,3,4,5 vocational principle police theory ,applied resolved Orientation: principle . information management system: Pratical 12month ,18 month pratical subject pratical exam school . Topics test n 6 .. -in high Education subject assessment moderation project: In dbe subject it orientation vocational guidance: outmark DBE filing pratical Poe s lsita
project student make computer Learning lecturer computer subject , orientation skill training computer system - information system , :computer - quest operating system ,display option control panel gives , - system tool data computer . Option , change display ,system defragmentation display.. - uninstall program system programs feature ,, physical
formatting Calle relative , ram room cache memory ,folder created. - Process of converting or data into prevention b, software , fraudulent vpratice email personal information ,infects . - format pictures style drop ,use ,,spread is opened ,insert formulae .- appropriate spread sheet v. - appropriate functy determinat the price contract router .. - computerised
systeme Create a news set of name select file compagny , - compagny parameter , business - word processing : create services invoice ,use Arial 12 pt , all .. - leave two line space , key ,, - unit and replace word megabity ,save file A,,fibre .. - irregularity,isita project back log record complain subject .. Assessment mathematics: - Orientation industrial and
trade mathematics :teach workers ,trainer workers supervisor ,standard measure -Management supervisor, :mathematics Computer system management -geometrical, algebraic ,limited , dervide function Prove ,radius area high calculate approximate change in volume: V= π.r.r.h -use partial fraction to calculate b.. -determind particular solutions integration.
- sketch the graphs of , the area bounded . determine the length of curve , equation, - calculate surface the curve , x ,y is rotated---------- Engineering ,orientation industrial: engineering physics T# compression : Heat heeded to bring heater , Heat gained ,heat lost - electrostatics: Power = w/t the amount of energy . - heat gained
,atom , frequently ,the energy of each ,,thermionic ,optical ---------- - electrotechnical : DC : excitat motor control obtat adjust, Alternates - power 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 9 of 18 developed,rotor output ,,
Power input = rotor output rotor . Energy Industrial electronics ,transient ,calcul value resistance to allow oscillation , Transducers : standard current ,step .. - ultrasonic x -rays and radii activt: the energy can transmitted the energy genert high , - electronics safety device and electronics ,regulator system. -thyristor device and scr speed . -,programmable
logic controller.. Pratical industrial in dhet high irregularity regulation material project ,, Outmark .. - Counseling: project In dbe project workshop counseling Management supervisor workshop engineering,isita record academic ucpd Create diploma: certificate Counseling industrial electronic electrotechnique mathematics ,in trade theory electrical ,material
irregularity DBE disciplinaire 11month suspension marking progress .appeal minister Pratical, action take occured irregularity and complain address ,, qualifications subject: 18 month technology guidence vocational module. Explanation : career vocational science ,, explanation low Portofilio. The police introduction - section Career orientation profile, -
selection process ; choose career answers. -question reward live leave , professional answers occupation. -student guidance counseling police opportunity,, career understand job sleep skill , duty correlation, - peace officer preami,duty assignment case involy policing ,salary career allowance, duties securite function compagny invesy,older private police no
longer existed replacement ,in function ,police minim case senior college orientation profile,psychometric , polytropic test college Deb employ , task physical , deduction probation life insurance, professional, listening ,career ,profey a matter an amateur career ,Unifor report ,court syst , division Pre trial paralegal ,, - police officer entrance exam police
measure the basic skill ,exN read word duty -what is community oriented in policing range , innovation organisation police improve skill project build communy , procedure,practice , activities residents ... Explanation: irregularity Error test used for diffece between two independent sample satisfactory distributor performance: - service ranking ×1 overall,raking
difference d1=y1-y2,{Bid sum .d.d = s data analyse invest assot agreement irregularity and back log project trademarks nated in job ,step process respond , provisional tax payer and penalty , understand and late submission,file Portofilio education trade , ,maturity date Poe s social award student , coupon rate 14%, internet,tendered bid or submitting 12%,
tendered assumed accepted ,(1009),I R 709 interested,pay + c / 100×d, 3609,c = rate interested order ,d= number of day , 60 day proceed,R,1000=(1000×17,49,, denomination acceptance capital emploie, capital reserve resent taxation total assets liabilities balance sheet,manufacture -pat total retrenct , provided tax liability,salary and interest tax sum tax
norm tax tax free portion award , provisional tax ,income salary overtime , allowance award irregularity plug ,equal renumeration leave,less acceptance of quotation irregularity and back log . _____ 40..Management administration industrial , - products maintence tpm - H: rate of Quality products 98% ,ideal cycle
time=0,8minute, f: actual processing time + j×g=0,8×400 t availability= s/c×100=400/600×100=87% -(m: operating speed rde= I / jx 100+0,5×0,8×100=6,25%,, - net operating rate = f/e ×100=(0,8×400)400×199+80%> I: performance efficiency ,+ m×n .100 +×100=(0,8×4000+80% -net operating rate = file + actual processing / operationek - process amount ×
actual cycle to operating+ 400 item× 0,8 % availability, Avat + operation time / loadsheding time day academic record and Pratical -net ... -time loading,400 Mon × 109+ workplace record accuracy,process running,planned down ,lost process ,time c- d ,, processing time ,, j×g operating time finished , external total, quantity processed ,total including losses
memory , attander ,cycle , actually processing time - time × idee cycle actual appears= 400 item × 0,8 Min /400,, -ovarall ,, - job schedule job , production planning and control schedule date issued , relaxation total,credit 0-4 Min work earned ,1080 per× 0,4+43 Min work Min available work of 100 performance ,432 Min ,, 432/432 days of work = 90 out ,100
performance,Orla ,% is over all relaxation allowance mode rate .. ---------- B. Planned down time per day ,down time accounted for inhere proceed,---------- a.manning meeting +29 minute loading time per day. A-B + 460 minute ,D ,stoppage loss per day ,break down,20 minute stop, 30 minute, adjustment
-20 minute= 60 minute ,operating time per day -C-D= 400 minute ,G : output per day + 400 item file 42-Duty industrial trade college and industrial , - explanation ista project back log computer student make . -document wallet project office , appointment documents access post , -docuy wallet registration form appointment office , register documents
emplomy, information recruitment documents Wallpaper wallet information,database stationery documents wallet ,arch office ,office size mass . - docuy wallet bank account ATM printer ,record book customer revie ,record registry f'd number system , documents wallet Portofilio job career , - database emploie system entry exhib , - emploie record trait job
qualifications graduation training post advertised, - f'd register for customer entry databy job post sale reward , programme logic control custy logiy system f'd programmation language database .. - print f'd frame work student ,print f'd student information ,print f'd ,job duty post ,print task rosta ,price over time print labour .. - explanation: to -electronics digital
analogic circuit: input a,b gate yes = a.B -storage : potentiometer coefficient resulted and reducing voltage integration by factor (6/12(initial ,x= 6/12 chart capacitor input , output and gate Inverter integral circuit dx/St,,6/4 ,13,, Sum,integer,summat,difference,RLC L.di/DT(R,,+2/c , integral.. -construction PC architecture design development: input unit yes
mouse optical keyboard yes , card red,control unity memory RAM ,ROM yes output ,CRT didn't,CPU yes ,room ,yes I/o,year vertical ,8 bit 69 but ,64×#=655336, -memkry systt. -sequencw +3 yes ,0,25 yes ,a+b ,A,B rim , - row yes data ,yes gate output gate , transistor bibpolaire logic diagram ,static RAM ,select ,supplies logic , - booleen algorithm program
read ,yes memory register , printer charge plate ,electrosty digital input ,character ,source ,Lazer mirror ,module ,ribbon tape supply. - data memory time yes, -128 sector memoire ,564 bit sector, input output devices microcomputer converter serial data , parallel decoding microspacev,ram 16×16 bineray yes -disc label plastic with write ed inde hold, -
sectaire track ,2,255 but logic process read digital step motor, -ns ram yes ,ram yes ,ROM yes ,CPU semie conductor yes ,hard dic driver yes ,external yes flopy disc ,data 150 km to 12m,typical machine -3 bit /5bit/ secret,000A,/AAA@/ load AC ,oo#B/BBB - 00/ load output /001,001/ ---------- -pc specifications format
: Intel core 7 , external 975@,3,3ghz ,Intel ,DX58SO motherboard ,6GB,g skill trident DDR-200 channel gaineard ,GTx580 sponsored by vertex ,wD 320 GB ,data iu hard drive ,Intel core ,i7870 ,Gigabyte ,P55-UD6 ,LG flatro ,a essential up grade components AMD,procedure,chip choice the starting dusk x 2550BEb, CPU ,,X4 , 646 upward faster closely
processor direct conflict shoe improvement load processor specific benchmark 3 d tendered video encoder x 264 ,, - graphic upgrade ,new little graphic card up date gaming phenomenon power × 2550 choice graphic card filled card up grade ,sub R1,500 udger choice HD 5770bigger to jumping performance Dx ,10 gaming word in conflict , - platform up
grade ,CPU u grade path for LGA ,775 socket mother PC 3Ghz,core ,3500 CPU ,4 GB of DDR,ram direct ,x9 tessellation performance heaven ,,2,5 / frame per second higher better ,base systeme with sapphire,HD 550/#7 - upgrade to HD 6959 -ditect ,x 9 gaming perfot.. -one the card edge graphic tracker #gb , sapphire 5850 Xtreme ,retailing R2000 ,price
complain 6 pin power connector which PSU hard physical driver installed benchmark away result disappointed ,3 marks improvement word conflict did manage ,lost planet frame wallet being ,R2000 ligth completed reliable, - battery ,g ram ,slot ,#gb,systy memory sticks R150 ,ram benchmark -upgrading memory and processor GB ,test window ,CPU the
HD , -weigth components for the perfect budgy building , perfect machine Mother board F#A75-M-R1.100, processor A8-3859-R1,300,, -ram ,corsair ,4 GB,,:1600mhz-R1000 -graphic ,xFx random:HD6670-R1000, -storage : 750 GB - R 619, opacity ,re R200,PSU corsair ,430w ,R470, chassis : cm elite 343/, total :R5,369 ------- Build test installation CPU
Vital - compot case layer CPU guard lockdown,add cooler and fan fixing bracket underneath ,screw holes fitting connect mbod,fit the ram : open the catch snai lock. Motheboymemory Chanel ,# and 3 operator, Hook connect ,2+4 pin connector to mobo ,the 8 pin EPs cable whichever,. - test the company power that sucker uomturning , screwdriver,striking
the balance corsair ,4 GB ,,1,600 MHz ,DDR3 ,liani ram share system,CPU gaming rate ,2,34 MHz ,and 1,600mhz case , - Pre the case bit ,atz mounting screws install the PSU ,bottoy cable module drop in mother remove CPU from mobo CPU - test it still works connect cable case fab ,tech analysis: 2560×1600 screen Gami surplus frame ,R14,09 flashi
,CPU rendering performance. - cindbonh ,R#1, Test ... 44.Explanation:Technologie compagny: Teasing compagny , requirements market technologie solutions customer product security surveillance network point , - mission : provide technology added value business provide quality products , - valeur accountability ,,. - LCD monitor screen size ,22,5" , 6
viewable image size : 546,86 mm display area : 476.H,,,268,2,v).. mm brightness , typical : 300 CD/mm, contrast ,ratio (typical) 600000:1(DCR) response time (typically) 5 ms , viewing angles 170/169,max ,, - resolution : 2920×1080@ ,60hz -HDCP compatible ,yes ,input signal : analogy ,RGB ,,and user control menu entry image ration source up
,consumption power ,on < 49 standard library tree app data >code user profile 1{ 2} 3 name : build , code
quality 4 name build ,code quality 4. 5 job 6 build 7 8 9 run - on Ubuntu - latest 11 12 step: 13 uses : action) checkout @v1 - name : set up .JD 1.8 - uses : action / setup - with app name : Wze ba) sample token: ${{ secret.APO _ center_ Group Tate File aoo build outmname upload artefac to app center with File aoo / build) outbut) aoj - start- contribution
Module Zejdu / aoo center - gthub action Report abuse Aoo center distributee update note is not certifie by GitHub On Thu, 10 Oct 2024, 20:25 tshingombe fiston, wrote: - continuing and training,act No16 of 2006 amendment,NQF ,act No 67 of 2008 ,as amended , determination phase N1-N3 term ,sect 42(1)(a) training dhet ,N1-N3 juanert ,2024 , dr
zimande trade test ,trade occupation revise.. ----------testability checklist at the schematic level. - testability checklist at the PCB layout level , - revising design. Win existing ICT creating a test point report manufacture.,PC designer PCB relay project status information,PLC. - PLC wiring ,main breaker switch busbar
circuit breaker SMP digital input output analif input terminal. -reaning PLC wiring diagram, profit bus communication PLC , digital input card diagram ,PLC digital Re: for multiple positions Inbox TSHINGOMBEKB TSHITADI Fri, Sep 20, 2:47 PM (20 hours ago) to Thandiwe, me On Thu, 19 Sep 2024, 17:15 Thandiwe at Jobrapido, wrote: Unsubscribe You've
been a little distant lately. Have a look at all the jobs you've let slide Engineering Electrical / Engineering - 15km Apply Now Engineering Electrical Apply Now Remember to keep your searches simple, updated and fully completed EDIT YOUR SEARCHES Help Center | Unsubscribe Jobrapido S.r.l. via Paleocapa, 7 - 20121 Milan - Italy- Tax code and VAT
number: IT11876271005 You are receiving this email because you subscribed to the Job Alert service, accepting Jobrapido's Terms of Service and Privacy Policy . Re: FW: SABS- Online enquiry Inbox info@sabs.co.za Thu, Oct 12, 2023, 11:06 AM to me Good day, Tshingombe Thank you for your e-mail enquiry. According to the information below, your
enquiry has been identify as complaint. Pleaser elaborate more on your subject. Regards, MamtshaliMefane Customer Services T: 0861 27 7227 | T: +27 12 428 7911 | F: +27 12 344 1568 | www.sabs.co.za >-----Original Message----- > From: INFO@sabs.co.za > Sent: Monday, October 9, 2023 6:31 PM > To: > Subject: SABS - Online enquiry > > Online
Enquiry > Subject: Complaint > Name: Tshingombe > Surname: tshingombe > Phone: 0725298946 > EMail: tshingombefiston@gmail.com > Company: Tshingombe assessment engineering electrical > Address: Percy Street 20, Rockview 103 yehovill jhb SABS Client: No Products / Certification: Trade engineering electrical research city power , Education
Engineering electrical > Industry: Other > Comments: Education Engineering electrical subjects nated > DISCLAIMER:This electronic communication is sent from the SABS Group of Companies and complies with the communication requirements of the Companies ACT. For further information please visit http://www.sabs.co.za/Terms/index.asp Your SABS
EMC Department order confirmation Inbox SABS EMC Department Sales Sat, Sep 14, 5:48 PM (7 days ago) to me tshingombe fiston, Thank you for your order from SABS EMC Department. You can check the status of your order by logging into your account. If you have questions about your order, you can email us at emc@sabs.co.za or call us at 012
428 6700. Your Order #4000000618 Placed on Sep 14, 2024, 5:47:42 PM Billing Info tshingombe fiston rockview 103 / yeohvill ,jhb percy street 20 jhb, Gauteng, 1030 South Africa T: 0725298946 Payment Method Bank Transfer / Wire Transfer Direct payments to be paid into: SABS Commercial SOC Ltd, ABSA Brooklyn 40-5322-5013 Branch No: 632-005
Items Qty Price ALABFULLTERM SKU: ALABFULLTERM A-Lab Application ID 14 1 R120,000.00 Subtotal R120,000.00 Grand Total (Excl.Tax) R120,000.00 VAT (@15%) R0.00 Grand Total (Incl.Tax) R120,000.00 Thank you, SABS EMC Department! DISCLAIMER:This electronic communication is sent from the SABS Group of Companies and complies
with the communication requirements of the Companies ACT. For further information please visit http://www.sabs.co.za/Terms/index.asp Disclaimer The information contained in this communication from the sender is confidential. It is intended solely for use by the recipient and others authorized to receive it. If you are not the recipient, you are hereby
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Inbox IEC Sales Department Fri, Sep 20, 1:07 PM (21 hours ago) to me Dear Sir, Thank you for your quotation request. Following your registration to the IEC 62368-1:2023 Academy Masterclass, you will find attached our special offer for the purchase of IEC 62368-1:2023 RLV. Quote Nr. QUO-004536 totalling Swiss Francs CHF 578.40. This quote
remains valid for three months only, after which it will automatically be deleted. Please note that prices in EUR and USD are given for information purposes only and as per today's exchange rate. You may proceed to the payment online through the following payment link. We remain available shall you have any questions. Best regards, IEC Sales
Department T +41 22 919 0211 IEC – International Electrotechnical Commission 3 rue de Varembé, PO Box 131 CH-1211 Geneva 20, Switzerland www.iec.ch Re: Ticket #ZPQDJ: PC format saling magazine Inbox TSHINGOMBEKB TSHITADI Fri, Sep 20, 2:47 PM (20 hours ago) to 6236161+ZPQDJ, me On Mon, 26 Sep 2022, 14:23 , wrote: Your ticket is
now solved! PC format saling magazine Tom Mon, 09/26/22 2:23 pm Hi Fiston, Greetings from Magzter! Please share your query in detail so we could assist you better. Thank you. fiston tshingombe Sun, 09/25/22 5:58 pm Message: PC format electronics Re: Magnum enquiry Inbox TSHINGOMBEKB TSHITADI Fri, Sep 20, 2:47 PM (20 hours ago) to Gail,
me On Mon, 26 Sep 2022, 08:17 Gail Osborne, wrote: Hi Tshingombe, Thank you for communicating with Magnum Magazine. Please clarify what cost you are looking for so that I can provide you with a quote: 1. A subscription to Magnum Magazine - let me know your street address so I can find out if you can receive hand delivery 2. A back issue of
Magnum Magazine - let me know which edition/s you need so I can check on stock 3. A copy of the book "The Lighter Side of Hunting & Shooting" - let me know the name of your nearest Postnet branch 4. A copy of the "Magnum Tactical Guide" - let me know the name of your nearest Postnet branch Thank you. Kind regards, Gail Osborne Senior SubEditor Magnum Magazine PO Box 35204, Northway, 4065, KwaZulu-Natal, South Africa Cell 084-432-1306 Fax 086-520-3711 www.manmagnum.com Your opinion matters: Please complete the evaluation for the course: Maximize Profitability and Operations Efficiency 2/3 Inbox noreply-MyLearningLink@learning.se.com Fri, Sep 20, 3:15 PM (19 hours
ago) to me NB: If you have already completed the evaluation or rated this course, please disregard this email Dear Tshingombe, Congratulations on completing the training Maximize Profitability and Operations Efficiency 2/3! Continue your development journey by putting into action what you learnt: did you know that you will have forgotten 80% of what you
learned if you do not apply it in the following day? • Think about how you can practice what you just learned • Take actions to ensure you succeed: reminders in your calendar, meeting with peers, manager... • Share your learning on Yammer or in the relevant community using #whatdidyoulearntoday Please also tell us what you thought of the training: your
opinion matters! • If the Training has an evaluation, click on the below link to complete the survey: • Review the training using the star ratings For any questions about this training, please open a ticket in support@Schneider Keep on being curious and open to new challenges! #LearnEveryDay Thank you! Your Learning Team #whatdidyoulearntoday Any
Questions? Visit My LearningLink Help or contact your helpdesk CSRe: TopGear Mag | Subscription Form Inbox TSHINGOMBEKB TSHITADI Fri, Sep 20, 2:47 PM (20 hours ago) to mlungisi, me On Wed, 28 Sep 2022, 12:27 Mlungisi Ngwenya | TopGear South Africa, wrote: Good day Thanks for your interest to subscribe to TopGear Magazine, would you
please furnish us with your billing details that we may be able to begin the on-boarding process and send you an invoice. Best regards Mlungisi Ngwenya Re: Sale .buyer trade.. library bibliotech Amazon booking order ticket money market account refund statement conciliation Inbox TSHINGOMBEKB TSHITADI Thu, May 30, 2:26 PM to comments, me,
TSHINGOMBEKB, tshingombetshitadi On Fri, 16 Sep 2022, 07:36 TSHINGOMBEKB TSHITADI, wrote: Hello dear saler tax invoice Ce claim..reclaim sta Application.mr tshingombe tshitadi TSHINGOMBEKB TSHITADI Sun, Aug 25, 1:04 PM On Fri, 16 Sep 2022, 07:36 TSHINGOMBEKB TSHITADI, wrote: Hello dear saler tax invoice Ce claim..reclaim
staApplication.mr tshingombe ts TSHINGOMBEKB TSHITADI Fri, Sep 20, 2:47 PM (20 hours ago) to comments, me Your Internet Archive item has been reviewed Inbox The Internet Archive Thu, Jun 27, 12:22 PM to me Dear Archive Patron: A review was recently written for your item, https://archive.org/details/2-ltter-tshingombe-self-esteme-incidentlogged-on-2024 at the Internet Archive. We thought you might appreciate knowing this and might want to read it by clicking on the link above. -The Internet Archive team. metropolis@abacusemedia.com Sun, Sep 25, 2022, 5:01 PM to me Welcome to Motor Trader Magazine Thank you for registering your details with Motor Trader magazine. You can also
choose from: Daily Newsletter Jobs Newsletter You can change the emails you wish to receive anytime by clicking here I hope that Motor Trader Magazine will keep you informed and entertained and that you will take advantage of the free email services on offer. OD SYSTEM ID: 517377239 On Sun, 23 Oct 2022, 11:45 TSHINGOMBEKB TSHITADI, wrote:
Money market extra savings Inbox TSHINGOMBEKB TSHITADI Mon, Oct 17, 8:23 PM (6 days ago) to help Hello claim extra savings money. 9710085084520751 Amount deposited money for gift receipt cash back magazine resend comments checkers MMA Support via freshdesk.com Tue, Oct 18, 11:15 AM (5 days ago) to me Hi TSHINGOMBEKB
TSHITADI, Please note the amount showing on your slip is to show how much you have saved on goods. This amount cannot be used to buy anything. It is just to show that you have been saving on your groceries. Best, Thelma , TSHINGOMBEKB TSHITADI wrote: Disclaimer: https://www.shopriteholdings.co.za/email-disclaimer.html 1331500:961486
TSHINGOMBEKB TSHITADI Tue, Oct 18, 1:25 PM (5 days ago) Thank you for the clarification. TSHINGOMBEKB TSHITADI Tue, Oct 18, 1:33 PM (5 days ago) to MMA I m asking if can have letter of statement for that account number card confirm saling for that saving account to confirm that balance the saling that grocery or it will be give tendered
statement cashback for saling or pay back returned savings account for the accounts . MMA Support via freshdesk.com Tue, Oct 18, 1:54 PM (5 days ago) to me Hi TSHINGOMBEKB TSHITADI, We cannot provide a statement for Xtra Savings card on our end. Please contact Xtra Sabvings Support on the below number. • Xtra Savings Support: 0800 33 33
85 Best, Thelma 1331500:961486 TSHINGOMBEKB TSHITADI Tue, Oct 18, 5:20 PM (5 days ago) to MMA Yes, I confirm. On Tue, 18 Oct at 1:34 PM , TSHINGOMBEKB TSHITADI wrote: I m asking if can have letter of statement for that account number card confirm saling for that saving account to confirm that balance the saling that grocery or it will be
give tendered statement cashback for saling or pay back returned savings account for the accounts . On Tue, 18 Oct 2022, 13:25 TSHINGOMBEKB TSHITADI, wrote: Thank you for the clarification. On Tue, 18 Oct 2022, 11:15 MMA Support, wrote: Hi TSHINGOMBEKB TSHITADI, Please note the amount showing on your slip is to show how much you
have saved on goods. This amount cannot be used to buy anything. It is just to show that you have been saving on your groceries. Best, Thelma On Mon, 17 Oct at 8:24 PM , TSHINGOMBEKB TSHITADI wrote: Hello claim extra savings money. 9710085084520751 Amount deposited money for gift receipt cash back magazine resend comments checkers
Disclaimer: https://www.shopriteholdings.co.za/email-disclaimer.html Disclaimer: https://www.shopriteholdings.co.za/email-disclaimer.html Corporate Gift Cards | Website Enquiry Inbox TSHINGOMBEKB TSHITADI Oct 18, 2022, 1:58 PM (5 days ago) to giftcards Hi there, I'd like to enquire about your corporate gift cards. Below is my personal information:
Name and surname: tshingombe Tshitadi Contact number:0725298946# Email address Amount of gift cards required: @100000rand to 1000rand Mart Marie Van Antwerpen Oct 18, 2022, 2:52 PM (5 days ago) to me Good day I hope you are doing well Please find attached the policies and procedures which should explain the bulk gift card process. This
document also indicates the discount rates. If you are 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 12 of 18 interested in placing an order, please fill in your details below so we can create your profile for an accurate invoice: Name and
surname of delivery contact :tshingombe Email address of delivery contact :tshingombekb@gmail.vom Telephone number of delivery contact :0725298946 Cell number of delivery contact :0725298946 Company Name :tshingombe trade Delivery address (please include postal code) :103 Company address :rockview yeohvill jhb Postal Code : Company VAT
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tshingombe fiston, We'd love to hear what you think of our customer service. Please take a moment to answer one simple question by clicking either link below: How would you rate the support you received? Good, I'm satisfied Bad, I'm unsatisfied Here's a reminder of what this request was about: Elektor Support Team (Elektor) 16 Sept 2024, 08:44 CEST
EN0202272ID Dear Sir, Thank you for your e-mail. What's your question about the newsletter please? Hopefully we have informed you sufficiently, but if you need anything else, please do not hesitate to contact us again. Our customer service team would be glad to assist you. Kind regards, Marleen Brouwer Customer Support Elektor International Media
www.elektor.com www.elektor.nl www.elektor.de www.elektor.fr Elektor is the media brand of EIM | learn, design & share electronics tshingombe fiston 14 Sept 2024, 16:47 CEST Become a Member My • • Topics • Magazine • Articles • News • Video • Projects • Newsletter • Submit • Store MyLAB EN0202272ID No bio • • • • • • • 0 | Follow user View as
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_____ tshingombe fiston 14 Sept 2024, 16:36 CEST engineering hello my question about published Hi there, a warm welcome from our Elektor community! For your records, below is a copy of the information you submitted to us. • Email: tshingombefiston@gmail.com • First Name: fiston • Last Name: tshingombe
• Birthday: • Country: South Africa • Phone: • Address: Johannesburg, South Africa • Gender: • Company: Engineering tshingombe • Elektor Store: • Elektor Editorial Newsletter: • Elektor Industry Updates: • Vertical: • Education: • Field of Studies: • Field of industry: • Elektor Editorial Newsletter: Subscribe • Elektor Store: Subscribe • Elektor Industry
Updates: Subscribe • Newsletter Subscriptions: Elektor Editorial Newsletter, Elektor Store, Elektor Industry Updates If at any time you wish to stop receiving our emails, you can: unsubscribe here You have questions? Contact us at: service@elektor.com T tshingombe fiston Member since 9/17/2024
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Education technology engineering electrical and computer science data word excell windows school year vertical rising ground floor current location Engineering electrical database Google Account•9/17/2024 Engineering electrical database management system information, 1 reply Application Update Inbox Met Recruitment Team 9:35 AM (1 hour ago) to
me Vacancy: 17878 - Specialist Operations Recovery Driver - Perivale Car Pound Dear tshingombe, Thank you for your application for a new position within the Met. To be eligible to apply for this new position, we have a set of criteria that applicants need to meet. Based on the information you have shared so far; we regret to inform you that you are not
eligible to progress with your application. Your individual answers suggest that you do not meet the application criteria. You can read more about our eligibility criteria on our Careers Website or by reviewing information available on MyHR. We understand that this will be disappointing news for you but would like to thank you for your interest in this position
and wish you all the best for the future. Shared Services Connected Ltd – Delivering services in partnership with the Metropolitan Police Service Phone: 01633 632500 Email: Enquiries.PoliceJobs@police.sscl.com Met Recruitment Team 9:40 AM (1 hour ago) Vacancy: 17952 - Student Placement - Portfolio Office Assistant - Change - 2025/2026 - Counter
Terrorism Policing HQ Met Recruitment Team 9:45 AM (1 hour ago) Vacancy: 17902 - LMS Administrator Met Recruitment Team 9:50 AM (1 hour ago) Vacancy: 17924 - HR Performance and Reporting Lead Met Recruitment Team 9:55 AM (1 hour ago) Vacancy: 17939 - Student Placement - Analysis & Research Assistant - Data & Analysis - 2025/2026-
Counter Terrorism Policing HQ Met Recruitment Team 9:55 AM (1 hour ago) Vacancy: 17957 - Student Placement - Project Support Assistant - Change - 2025/2026 - Counter Terrorism Policing HQ Met Recruitment Team 10:00 AM (1 hour ago) Vacancy: 17951 - Student Placement - Junior DevOps Engineer - Technology - 2025/2026 - Counter Terrorism
Policing HQ Met Recruitment Team 10:00 AM (1 hour ago) Vacancy: 17956 - Student Placement - Junior Service Designer - Technology - 2025/2026 - Counter Terrorism Policing HQ Met Recruitment Team 10:10 AM (1 hour ago) Vacancy: 17942- Student Placement - Borders Assistant - Borders Operations Centre - 2025/2026 Counter Terrorism Policing
HQ Met Recruitment Team 10:10 AM (1 hour ago) Vacancy: 17955 - Student Placement- Junior Project Manager - Technology - 2025/2026 - Counter Terrorism Policing HQ Met Recruitment Team 10:10 AM (1 hour ago) Vacancy: 17941 - Student Placement - Project Support Assistant -Strategy, Performance, and Planning - 2025/2026 - Counter Terrorism
Policing HQ Met Recruitment Team 10:15 AM (1 hour ago) Vacancy: 17908 - Business and Policy Support Officer - Data & Analysis - Counter Terrorism Policing HQ Met Recruitment Team 10:15 AM (1 hour ago) Vacancy: 17947 - Student Placement - Assurance and Standards Team Assistant - Change - 2025/2026 -Counter Terrorism Policing HQ Met
Recruitment Team 10:20 AM (1 hour ago) Vacancy: 17948 - Student Placement - Associate End User Computing Engineer - Technology - 2025/2026 - Counter Terrorism Policing HQ Met Recruitment Team 10:20 AM (1 hour ago) Vacancy: 17823 - SQL Server Database Administrator - Counter Terrorism Policing HQ Met Recruitment Team 10:25 AM (1
hour ago) Vacancy: 17937 - Student Placement - Project / Research Assistant - Data & Analysis - 2025/2026 -Counter Terrorism Policing HQ Met Recruitment Team 10:25 AM (1 hour ago) Vacancy: 18030- Senior MetLaw Officer Met Recruitment Team 10:35 AM (50 minutes ago) Vacancy: 17980 - Police prosecutor Met Recruitment Team 10:35 AM (50
minutes ago) Vacancy: 17752 - Student Placement - Media and Communication Administrator 2025/2026 Met Recruitment Team 10:35 AM (50 minutes ago) Vacancy: 16279 - Experienced Intelligence Analyst Met Recruitment Team 10:40 AM (45 minutes ago) Vacancy: 17949 - Student Placement - Business Change Assistant - Change - 2025/2026 -
Counter Terrorism Policing HQ Met Recruitment Team 10:40 AM (45 minutes ago) Vacancy: 17680 - Student Placement - Forensic Business Assistant 2025/2026 Met Recruitment Team 10:45 AM (40 minutes ago) to me Vacancy: 17959 - Student Placement - Communications Assistant - 2025/2026 - Communications - Counter Terrorism Policing HQ Met
Recruitment Team 10:55 AM (30 minutes ago) Vacancy: 17853 - Enquiry Officer Met Recruitment Team 10:55 AM (31 minutes ago) to me Vacancy: 17830 - Programme Management Office Administrator Met Recruitment Team 10:55 AM (30 minutes ago) to me Vacancy: 16747 - 202402 - MPS Return Scheme Retired Officers Candidate added to Talent
Bank Inbox Met Recruitment Team 9:35 AM (1 hour ago) to me Dear tshingombe, Thank you for registering to speak with the Outreach team. A member of the team will contact you shortly by your preferred method. If you no longer wish to speak to a member of the team, please click here to withdraw from our contact list. Many thanks, The Outreach Team
Phone: 01633 632500 Email: TalkToUs@met.police.uk Outreach Live chat link: https://uk.meetandengage.com/al2rpqdab Your recent submission Inbox no-reply@service.police.uk 9:15 AM (2 hours ago) to me Thank you for completing the form, your reference is: MIP-482-24-0100-000. --- We understand how distressing being affected by crime or antisocial behaviour can be and we are committed to bringing offenders to justice and ensuring that victims of crime receive the support they need from us and from others. We have lots of crime prevention advice which you may also find useful. Consider our environment - please do not print this email unless absolutely necessary. NOTICE - This email and
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online services genuinely helps us to make sure they work as well as possible. If you have a couple of minutes, please complete a quick feedback survey. no-reply@service.police.uk 9:28 AM (1 hour ago) to me Thank you for completing the form, your reference is: FOI-22728-24-0100-000. This email confirms we've got your request. We'll reply within 20
working days if we can. If that's not possible we'll let you know. If you've told us we can respond by email then we'll do that unless the type of information you've asked for means we need to give it to you in a different way. If you've told us you'd prefer us to respond in a different way then we'll do our best, but if it isn't possible we'll contact you by email to
explain. Application Update Inbox Met Recruitment Team Sat, Sep 21, 5:40 PM (17 hours ago) to me Vacancy: 17879 - Electronics Development Engineer Dear tshingombe, Thank you for your application for a new position within the Met. To be eligible to apply for this new position, we have a set of criteria that applicants need to meet. Based on the
information you have shared so far; we regret to inform you that you are not eligible to progress with your application. Your individual answers suggest that you do not meet the application criteria. You can read more about our eligibility criteria on our Careers Website or by reviewing information available on MyHR. We understand that this will be
disappointing news for you but would like to thank you for your interest in this position and wish you all the best for the future. Shared Services Connected Ltd – Delivering services in partnership with the Metropolitan Police Service Phone: 01633 632500 Email: Enquiries.PoliceJobs@police.sscl.com Met Recruitment Team Sat, Sep 21, 5:45 PM (17 hours
ago) to me Vacancy: 17895 - Head of Visits and Events Met Recruitment Team Sat, Sep 21, 5:50 PM (17 hours ago) Vacancy: 17896 - Senior Media Officer Met Recruitment Team Sat, Sep 21, 5:55 PM (17 hours ago) Vacancy: 17897 - Media Officer Met Recruitment Team Sat, Sep 21, 6:00 PM (17 hours ago) Vacancy: 17912 - Communication Planning
Manager Met Recruitment Team Sat, Sep 21, 6:05 PM (17 hours ago) Vacancy: 17918 - Senior Content, Channels and Engagement Officer Met Recruitment Team Sat, Sep 21, 6:05 PM (17 hours ago) Vacancy: 17927 - Head of Data Literacy and Culture Met Recruitment Team Sat, Sep 21, 6:05 PM (17 hours ago) Vacancy: 17874 - Quality Assurance Lead
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
24 of 39 3/11/2025, 1:20 PM
Met Recruitment Team Sat, Sep 21, 6:15 PM (17 hours ago) Vacancy: 17686 - Service Design and Transition Manager - Band C - Technology - Counter Terrorism Policing HQ Met Recruitment Team Sat, Sep 21, 6:15 PM (17 hours ago) Vacancy: 17844 - Senior Project Manager - Change - Counter Terrorism Policing HQ Met Recruitment Team Sat, Sep 21,
6:15 PM (17 hours ago) Vacancy: 16896 - Lead Data Analyst in the Strategic Insight Unit Met Recruitment Team Sat, Sep 21, 6:15 PM (17 hours ago) Vacancy: 17866 - Business Change Manager - Change - Counter Terrorism Policing HQ Met Recruitment Team Sat, Sep 21, 6:20 PM (17 hours ago) Vacancy: 18011 - HOLMES Typist Met Recruitment
Team Sat, Sep 21, 6:30 PM (16 hours ago) Vacancy: 17862 - Junior Data Engineer Met Recruitment Team Sat, Sep 21, 6:30 PM (16 hours ago) Vacancy: 17969 - Business Assurance Junior Manager Met Recruitment Team Sat, Sep 21, 6:30 PM (16 hours ago) Vacancy: 17875 - CTSFO Tactical Advisor Met Recruitment Team Sat, Sep 21, 6:30 PM (16
hours ago) Vacancy: 17834 - Operations Manager Met Recruitment Team Sat, Sep 21, 6:35 PM (16 hours ago) Vacancy: 17877 - Infrastructure Engineer Met Recruitment Team Sat, Sep 21, 6:40 PM (16 hours ago) to me Vacancy: 18001 - Lead Dev Ops Engineer (Cloud Platform) - Technology CSC - Police Staff - Counter Terrorism Policing HQ Thank you
for your Application! Inbox Microsoft Recruiting 6:44 AM (4 hours ago) to me Hi, Fiston Tshingombe teodor, Thank you for applying to the Software Engineer II (Job number:1755381) position at Microsoft! We're glad you're interested in a career at Microsoft and we're here to help you find a perfect fit. You may not receive feedback from us on your
application directly, but please know that it's being evaluated, and you'll hear from us as soon as the review process is complete. If you're selected for an interview, you'll be notified by someone on the recruiting team. You can view your application status updates through your Action Center. If you see the job moved to an Archived state, that means the
position is either no longer open, you withdrew from consideration, or you were not selected for the role. You may notice that we move your application from one role to another. This may happen a few times and is a normal part of our recruiting process. So, if you see the job you applied to in an Archived state, and a new job listed as Active, please know
that this is normal and does not negatively impact your candidacy in any way. How's your profile? A key part of the review process is evaluating your profile in relation to the job requirements, so please make sure your profile is accurate and extensive – it's our first step in getting to know you! You can build your profile anyway you'd like – you can import it
from LinkedIn, manually update it, or import/attach a resume. The most important thing is that your profile tells your story! We encourage you to check back frequently and continue to look for opportunities that match your interests, as new jobs are being posted regularly. Thank you, Microsoft Recruiting This mail is sent from an unmonitored mailbox. Please
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www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 13 of 18 these emails from this company in the future, please go to: https://ms.icims.com/icims2/?r=11B617365170&contactId=116124102 © Microsoft Corporation; One Microsoft Way; Redmond, WA 98052; USA Microsoft Recruiting 6:57 AM (4 hours ago) Hi, Fiston Tshingombe teodor,
Thank you for applying to the Technology Specialist - Modern Work (Job number:1771873) position at Microsoft! We're glad you're in Microsoft Recruiting 7:02 AM (4 hours ago) Hi, Fiston Tshingombe teodor, Thank you for applying to the Principal Software Engineering Manager (Job number:1766765) position at Microsoft! We're glad you're Microsoft
Recruiting 7:06 AM (4 hours ago) Hi, Fiston Tshingombe teodor, Thank you for applying to the Senior Applied Scientist (Job number:1762056) position at Microsoft! We're glad you're interested in Microsoft Recruiting 7:13 AM (4 hours ago) Hi, Fiston Tshingombe teodor, Thank you for applying to the Senior Software Development Engineer (Platform
Firmware & Drivers) (Job number:1738100) position at Microsoft Recruiting 7:16 AM (4 hours ago) Hi, Fiston Tshingombe teodor, Thank you for applying to the Director of Network Supply Chain (Job number:1771684) position at Microsoft! We're glad you're inter Microsoft Recruiting 7:18 AM (4 hours ago) Hi, Fiston Tshingombe teodor, Thank you for
applying to the Senior Director, Cybersecurity Business Strategy Lead (Job number:1770318) position at Microsoft! We Microsoft Recruiting 7:21 AM (4 hours ago) Hi, Fiston Tshingombe teodor, Thank you for applying to the Principal Product Manager (Job number:1736502) position at Microsoft! We're glad you're interested i Microsoft Recruiting 7:26 AM
(4 hours ago) Hi, Fiston Tshingombe teodor, Thank you for applying to the Data Center Technician (Job number:1769625) position at Microsoft! We're glad you're interested in a Microsoft Recruiting 7:28 AM (4 hours ago) Hi, Fiston Tshingombe teodor, Thank you for applying to the Software Engineer-Full Stack- Xbox (Job number:1771329) position at
Microsoft! We're glad you're int Microsoft Recruiting 7:30 AM (3 hours ago) to me Hi, Fiston Tshingombe teodor, Thank you for applying to the Software Engineer II (Job number:1770175) position at Microsoft! We're glad you're interested in a career at Microsoft and we're here to help you find a perfect fit. You may not receive feedback from us on your
application directly, but please know that it's being evaluated, and you'll hear from us as soon as the review process is complete. If you're selected for an interview, you'll be notified by someone on the recruiting team. You can view your application status updates through your Action Center. If you see the job moved to an Archived state, that means the
position is either no longer open, you withdrew from consideration, or you were not selected for the role. You may notice that we move your application from one role to another. This may happen a few times and is a normal part of our recruiting process. So, if you see the job you applied to in an Archived state, and a new job listed as Active, please know
that this is normal and does not negatively impact your candidacy in any way. How's your profile? A key part of the review process is evaluating your profile in relation to the job requirements, so please make sure your profile is accurate and extensive – it's our first step in getting to know you! You can build your profile anyway you'd like – you can import it
from LinkedIn, manually update it, or import/attach a resume. The most important thing is that your profile tells your story! We encourage you to check back frequently and continue to look for opportunities that match your interests, as new jobs are being posted regularly. Thank you, Microsoft Recruiting This mail is sent from an unmonitored mailbox. Please
do not reply. Microsoft respects your privacy. To learn more, please read our Microsoft Data Privacy Notice. Your recent job application for (631) Business Analysis Competency Centre Lead - BSTD - 631 Inbox SARB Talent Acquisition Sat, Sep 21, 7:51 AM (1 day ago) to me Hello, tshitadi, We received your job application for (631) Business Analysis
Competency Centre Lead - BSTD - 631. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Your recent job application
for (642) SHEQ Analyst-RMCD - 642 Inbox SARB Talent Acquisition Sat, Sep 21, 7:48 AM (1 day ago) to me Hello, tshitadi, We received your job application for (642) SHEQ Analyst-RMCD - 642. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job
application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Recruiting Team Your recent job application for (649) Cloud Engineer - BSTD - 649 Inbox SARB Talent Acquisition Sat, Sep 21, 7:45 AM (1 day ago) to me Hello, tshitadi, We received your job application for (649) Cloud Engineer
- BSTD - 649. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your profile, go to your candidate self service page. Your recent job application for (557) End-User Computing Architect - BSTD - 557 Inbox
SARB Talent Acquisition Sat, Sep 21, 7:42 AM (1 day ago) to me Hello, tshitadi, We received your job application for (557) End-User Computing Architect - BSTD - 557. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want
to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Your recent job application for (630) Data Collection Administrator - 630 Inbox SARB Talent Acquisition Thu, Sep 19, 7:08 AM (3 days ago) to me Hello, tshitadi, We received your job application for (630) Data Collection Administrator - 630. If your profile
corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your profile, go to your candidate self service page. Sincerely, Your recent job application for (640) Information Governance Specialist - BSTD - 640 Inbox SARB Talent
Acquisition Thu, Sep 19, 7:13 AM (3 days ago) to me Hello, tshitadi, We received your job application for (640) Information Governance Specialist - BSTD - 640. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to
manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Your recent job application for (635) Reporting Systems Inspector -FinSurv - 635 Inbox SARB Talent Acquisition Thu, Sep 19, 7:06 AM (3 days ago) to me Hello, tshitadi, We received your job application for (635) Reporting Systems Inspector -FinSurv - 635.
If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Your recent job application for (639) Senior Economic Policy
Analyst-IERP - 639 Inbox SARB Talent Acquisition Thu, Sep 19, 6:52 AM (3 days ago) to me Hello, tshitadi, We received your job application for (639) Senior Economic Policy Analyst-IERP - 639. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job
application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Your recent job application for (644) Team Leader - Food and Beverages - CSD - 644 Inbox SARB Talent Acquisition Thu, Sep 19, 6:49 AM (3 days ago) to me Hello, tshitadi, We received your job application for (644) Team
Leader - Food and Beverages - CSD- 644. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Your recent job
application for (643) Associate Trade Settlement Officer – Foreign Markets - FMD -643 Inbox SARB Talent Acquisition Thu, Sep 19, 6:11 AM (3 days ago) to me Hello, tshitadi, We received your job application for (643) Associate Trade Settlement Officer – Foreign Markets - FMD -643. If your profile corresponds to our requirements, a member of our
Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Recruiting Team Your recent job application for (646) Divisional Head: Security Operations -GSMD - 646 Inbox SARB Talent
Acquisition Thu, Sep 19, 6:08 AM (3 days ago) to me Hello, tshitadi, We received your job application for (646) Divisional Head: Security Operations - GSMD - 646. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to
manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Update on your Job application with SARB Inbox SARB Talent Acquisition Mon, Sep 16, 11:05 AM (6 days ago) to me Dear tshitadi tshingombe, Thank you for your interest in the (616) Contractor-Building Engineer -CTC at the SARB, we regret to inform you
that your application was unsuccessful. Regards Thank you for your interest in Microsoft! Inbox Microsoft Recruiting Unsubscribe Thu, Sep 12, 9:26 PM (10 days ago) to me Hi Fiston Tshingombe teodor, Thank you for your interest in a career at Microsoft. Unfortunately, we will not be moving forward with your candidacy for the position of Software Engineer
II (Full stack), 1749784 at this time. However, we'd like to encourage you to continue to explore other career opportunities on Microsoft Careers as we continually update openings on a daily basis. We look forward to considering you for other positions at Microsoft! Thank you, Microsoft Recruiting Microsoft respects your privacy. To learn more, please read
our Microsoft Data Privacy Notice. This mail is sent from an unmonitored mailbox. Please do not reply. Eskom Careers: Confirmation of Application Inbox sharepoint@eskom.co.za Sun, Sep 1, 1:27 PM to me Dear Tshingombe Tshitadi , Job Reference: EMTOPPMT06 Position: Technical Official PPM Mechanical X2 (Distribution) EAL Midrand Region: South
Africa (Gauteng) Industry: Engineering Closing Date: 2024/09/09 Thank you for your interest in a career at Eskom. Your online application was received and will be duly actioned by the Recruitment Practitioner allocated to the position you applied for. Should you not be contacted within 28 days of the closing date of this advertisement, please accept that
your application was unsuccessful Please also note that you only have to register and load your Personal History Profile (PHP) once. You may in future apply for vacancies using the PHP provided. Once the PHP has been completed for a particular vacancy, it can be saved and used for future applications. The PHP may be up-dated, when necessary, for
future applications Best wishes with your future Kind Regards Recruitment Manager Shared Services (HR) FINANCE DIVISION Disclaimer NB: This Email and its contents are subject to the Eskom Holdings SOC Ltd EMAIL LEGAL NOTICE which can be viewed at https://www.eskom.co.za/about-eskom/email-legal-spam-disclaimer/ sharepoint@eskom.co.za Sun, Sep 1, 1:29 PM Dear Tshingombe Tshitadi , Job Reference: EIT X2/GX PrimaryE/MC Position: 1 Learning-Programme-Engineer-in-Training-x-2,-Generation,-Megawatt-Park Region: South sharepoint@eskom.co.za Sun, Sep 1, 1:30 PM Dear Tshingombe Tshitadi , Job Reference: GXMATL- EIT/2024 Position: Learning
Programme Engineer in Trainng x17 GX Matla Power Station Region: South Africa (Mpu sharepoint@eskom.co.za Sun, Sep 1, 1:31 PM Dear Tshingombe Tshitadi , Job Reference: 50515483LM Position: Manager Site Outage Execution, Generation, Tutuka Power Station Closing Date: 2024/09/13 sharepoint@eskom.co.za Sun, Sep 1, 1:31 PM Dear
Tshingombe Tshitadi , Job Reference: 50813227NLee01 Position: Re Advert Snr Technologist Electrical Engineering Substation x2 (National Transmission Compa sharepoint@eskom.co.za Sun, Sep 1, 1:32 PM Dear Tshingombe Tshitadi , Job Reference: 50813227NLee01 Position: Re Advert Snr Technologist Electrical Engineering Substation x2 (
National Transmission Compa sharepoint@eskom.co.za Sun, Sep 1, 1:32 PM Dear Tshingombe Tshitadi , Job Reference: 50861481SN/GX-Koeberg Position: Senior Technician Chemistry x2 (Technical Support and Oils Micro) (Generation) Koeberg sharepoint@eskom.co.za Sun, Sep 1, 1:33 PM Dear Tshingombe Tshitadi , Job Reference: GXMedOMM04
Position: Officer Safety Health Environment X1 Generation Medupi Power Station Region: South Africa (Limpop sharepoint@eskom.co.za Sun, Sep 1, 1:34 PM Dear Tshingombe Tshitadi , Job Reference: Learners OGE Contracts Management Position: Learning Programme Outages x1 - Graduate in Training , Generation, Megawat sharepoint@eskom.co.za Sun, Sep 1, 1:35 PM Position: Learning Programme -Graduate in Training-Quantity Surveyor, Generation, Megawatt Park sharepoint@eskom.co.za Sun, Sep 1, 1:36 PM Dear Tshingombe Tshitadi , Job Reference: Snr Advisor SDL&IPL Position: Senior Advisor Supplier Development, Localisation and Industrialisation x2,
Generation, sharepoint@eskom.co.za Sun, Sep 1, 1:37 PM Dear Tshingombe Tshitadi , Job Reference: DurbanvilleFXGIT2025 Position: Graduate-in-Training (Finance) Industry: Other Closing Date: 2024/09/09 sharepoint@eskom.co.za Sun, Sep 1, 1:38 PM Dear Tshingombe Tshitadi , Job Reference: 50828254NLee01 Position: Re Advert Snr
Draughtsperson Draughting Electrical Substation Engineering x3 NTCSA MWP Closin sharepoint@eskom.co.za Sun, Sep 1, 1:39 PM Dear Tshingombe Tshitadi , Job Reference: PeakingTITDrakensberg2025 Position: Technician-in-Training x2 (1xC+I and 1+Mech) Region: South Africa (Kwa-Zulu Natal) sharepoint@eskom.co.za Sun, Sep 1, 1:39 PM Dear
Tshingombe Tshitadi , Job Reference: GX49002630WK/TUT Position: Snr. Supervisor Tech Instrument x 2 (Generation) Tutuka Power Station Region: South Africa sharepoint@eskom.co.za Sun, Sep 1, 1:40 PM Dear Tshingombe Tshitadi , Job Reference: PeakingLearnersEIT2025 Position: Engineer-in-Training-Control and Instrumentation AND-Auxiliary
and Ancillary-(Peaking sharepoint@eskom.co.za Sun, Sep 1, 1:42 PM Dear Tshingombe Tshitadi , Job Reference: GXMedSTR14.1 Position: Re Advert Senior Technician Configuration X1 (Generation) Medupi Power Station Closing Date: 20 sharepoint@eskom.co.za Sun, Sep 1, 1:43 PM Dear Tshingombe Tshitadi , Job Reference: 50817165NQ Position:
Engineer Prof Eng Quality of Supply (National Transmission Company South Africa) Newscastle Indus sharepoint@eskom.co.za Sun, Sep 1, 1:45 PM Dear Tshingombe Tshitadi , Position: Learning Programme - Graduate in Training x1, Generation, Megawatt Park Region: South Africa (Gauteng) sharepoint@eskom.co.za Sun, Sep 1, 1:45 PM Dear
Tshingombe Tshitadi , Job Reference: Learners OGE Environmental Management Position: Learning-Programme -Graduate-in-Training-x3,-Generation,-1Megawatt-Par sharepoint@eskom.co.za Sun, Sep 1, 1:46 PM Dear Tshingombe Tshitadi , Job Reference: Learners Gx Procurement Position: Learning Programme-Graduate in Training x 3, Generation,
Megawatt Park sharepoint@eskom.co.za Sun, Sep 1, 1:47 PM Dear Tshingombe Tshitadi , Job Reference: Learners OGE Legal Position: Learning Programme-Graduate in Training x 2, Generation, Megawatt Park sharepoint@eskom.co.za Sun, Sep 1, 1:49 PM Dear Tshingombe Tshitadi , Job Reference: 50097836FN Position: Senior Supervisor Technical
Projects (National Transmission Company South Africa)Northwest and sharepoint@eskom.co.za Sun, Sep 1, 1:51 PM Dear Tshingombe Tshitadi , Job Reference: 50861459SCM Position: Snr-Advisor-Applications-Support-(Group-IT-DIVISION)-Megawatt-Park Region: South Africa (Gauteng sharepoint@eskom.co.za Sun, Sep 1, 1:51 PM Dear
Tshingombe Tshitadi , Job Reference: 001 EIT Position: Learning Programme - Engineer in Training x3 (Generation) Engineering MWP Region: South Africa (Gaut sharepoint@eskom.co.za Sun, Sep 1, 1:53 PM Dear Tshingombe Tshitadi , Job Reference: GXKRL-04 Position: Secretary Secretarial (Gx Kriel Power Station) Region: South Africa
(Mpumalanga) sharepoint@eskom.co.za Sun, Sep 1, 1:55 PM Dear Tshingombe Tshitadi , Job Reference: Graduate in Training- Commercial Position: Graduate in Training (Commercial) x1 (Generation) Industry: Human Resources sharepoint@eskom.co.za Sun, Sep 1, 1:58 PM Dear Tshingombe Tshitadi , Job Reference: Graduate in Training- Finance
Position: Graduate in Training (Finance) x1 (Generation) sharepoint@eskom.co.za Sun, Sep 1, 1:58 PM Dear Tshingombe Tshitadi , Job Reference: Engineer-in-Training Nuclear Engineering Position: Engineer in Training (Nuclear Engineering) x9-Generation Koeberg NP sharepoint@eskom.co.za Sun, Sep 1, 2:00 PM Dear Tshingombe Tshitadi , Job
Reference: Learners Gx OMO/SM Position: Learning Programme - Engineer in Training x2, 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 14 of 18 Generation, Megawatt Park Region: South Afr sharepoint@eskom.co.za Sun, Sep 1, 2:01 PM
Dear Tshingombe Tshitadi , Job Reference: 505571133PM/01 Position: Re Advert Senior Engineer Prof Electrical Engineering (Project Integration) NTCSA MWP Region: sharepoint@eskom.co.za Sun, Sep 1, 2:02 PM Dear Tshingombe Tshitadi , Job Reference: 50840435MIR Position: Officer Security (National Transmission Company

South Africa) Bellville
sharepoint@eskom.co.za Sun, Sep 1, 2:04 PM Dear Tshingombe Tshitadi , Job Reference: Gx Arn NN 23/08/24 Position: Officer catering (Generation) Arnot Power Station x1 Region: South Africa (Mpumalanga) In sharepoint@eskom.co.za Sun, Sep 1, 2:05 PM to me Dear Tshingombe Tshitadi , Job Reference: 50842085LRR Position: Re-Advert:
Assistant Officer Security Operations Centre (FINANCE DIVISION) Megawatt Park Region: South Africa (Gauteng) Industry: Other Closing Date: 2024/09/06 Thank you for your Application! Inbox Microsoft Recruiting Sun, Sep 1, 8:55 AM Hi, Fiston Tshingombe teodor, Thank you for applying to the Principal Software Engineer – Teams Platform (Job
number:1726871) position at Microsoft! We're glad Microsoft Recruiting Sun, Sep 1, 8:58 AM Hi, Fiston Tshingombe teodor, Thank you for applying to the Senior Machine Learning Engineer (Job number:1759775) position at Microsoft! We're glad you're inter Microsoft Recruiting Sun, Sep 1, 9:01 AM Hi, Fiston Tshingombe teodor, Thank you for applying to
the Senior Security Technical Program Manager (Job number:1762424) position at Microsoft! We're glad you Microsoft Recruiting Sun, Sep 1, 9:05 AM Hi, Fiston Tshingombe teodor, Thank you for applying to the Data & AI Technical Sales Specialist (Job number:1762311) position at Microsoft! We're glad you're i Microsoft Recruiting Sun, Sep 1, 9:11 AM
Hi, Fiston Tshingombe teodor, Thank you for applying to the Software Engineer II (Full stack) (Job number:1749784) position at Microsoft! We're glad you're inte Microsoft Recruiting Sun, Sep 1, 9:13 AM Hi, Fiston Tshingombe teodor, Thank you for applying to the Customer Success Account Manager (Job number:1762683) position at Microsoft! We're glad
you're inter Microsoft Recruiting Sun, Sep 1, 9:16 AM Hi, Fiston Tshingombe teodor, Thank you for applying to the Principal Technical Program Manager (Job number:1736977) position at Microsoft! We're glad you're in Microsoft Recruiting Sun, Sep 1, 9:19 AM to me Hi, Fiston Tshingombe teodor, Thank you for applying to the Senior Applied AI Engineer
(Job number:1762298) position at Microsoft! We're glad you're interested in a career at Microsoft and we're here to help you find a perfect fit. You may not receive feedback from us on your application directly, but please know that it's being evaluated, and you'll hear from us as soon as the review process is complete. If you're selected for an interview, you'll
be notified by someone on the recruiting team. You can view your application status updates through your Action Center. If you see the job moved to an Archived state, that means the position is either no longer open, you withdrew from consideration, or you were not selected for the role. You may notice that we move your application from one role to
another. This may happen a few times and is a normal part of our recruiting process. So, if you see the job you applied to in an Archived state, and a new job listed as Active, please know that this is normal and does not negatively impact your candidacy in any way. How's your profile? A key part of the review process is evaluating your profile in relation to
the job requirements, so please make sure your profile is accurate and extensive – it's our first step in getting to know you! You can build your profile anyway you'd like – you can import it from LinkedIn, manually update it, or import/attach a resume. The most important thing is that your profile tells your story! We encourage you to check back frequently and
continue to look for opportunities that match your interests, as new jobs are being posted regularly. Thank you, Microsoft Recruiting This mail is sent from an unmonitored mailbox. Please do not reply. Microsoft respects your privacy. To learn more, please read our Microsoft Data Privacy Notice.
_____ This
message was sent to tshingombefiston@gmail.com. If you don't want to receive these emails from this company in the future, please go to: https://ms.icims.com/icims2/?r=11B617365170&contactId=113826735 Your recent job application for Software Engineer FMCD - 34622 Inbox Ford Careers Sun, Sep 1, 8:45 AM to me Hello fiston, Thank you for your
interest in joining the Ford Motor Company team. You've taken the first steps by completing your application and sharing your qualifications for the Software Engineer FMCD -34622 position. We will contact you if we think you're a good fit for that position. In the meantime, keep checking www.careers.ford.com for additional opportunities – we'd love to help
you find your dream job. Sincerely, The Ford Talent Acquisition Team Your recent job application for Cyber Security ISP and Data Analyst - 34582 Inbox Ford Careers Sun, Sep 1, 8:40 AM to me Hello fiston, Thank you for your interest in joining the Ford Motor Company team. You've taken the first steps by completing your application and sharing your
qualifications for the Cyber Security ISP and Data Analyst -34582 position. We will contact you if we think you're a good fit for that position. In the meantime, keep checking www.careers.ford.com for additional opportunities – we'd love to help you find your dream job. Sincerely, The Ford Talent Acquisition Team Your recent job application for Backend
Engineer - 34857 Inbox Ford Careers Sun, Sep 1, 8:37 AM to me Hello fiston, Thank you for your interest in joining the Ford Motor Company team. You've taken the first steps by completing your application and sharing your qualifications for the Backend Engineer - 34857 position. We will contact you if we think you're a good fit for that position. In the
meantime, keep checking www.careers.ford.com for additional opportunities – we'd love to help you find your dream job. Sincerely, The Ford Talent Acquisition Team Your recent job application for Thermal Systems Integration Engineer, HVAC - 34848 Inbox Ford Careers Sun, Sep 1, 8:35 AM to me Hello fiston, Thank you for your interest in joining the Ford
Motor Company team. You've taken the first steps by completing your application and sharing your qualifications for the Thermal Systems Integration Engineer, HVAC - 34848 position. We will contact you if we think you're a good fit for that position. In the meantime, keep checking www.careers.ford.com for additional opportunities – we'd love to help you
find your dream job. Sincerely, The Ford Talent Acquisition Team Your recent job application for STA Site Engineer - 34645 Inbox Ford Careers Sun, Sep 1, 8:30 AM to me Hello fiston, Thank you for your interest in joining the Ford Motor Company team. You've taken the first steps by completing your application and sharing your qualifications for the STA
Site Engineer - 34645 position. We will contact you if we think you're a good fit for that position. In the meantime, keep checking www.careers.ford.com for additional opportunities – we'd love to help you find your dream job. Sincerely, The Ford Talent Acquisition Team Your recent job application for Propulsion Systems Design Release Engineer - 34464
Inbox Ford Careers Sun, Sep 1, 8:28 AM to me Hello fiston, Thank you for your interest in joining the Ford Motor Company team. You've taken the first steps by completing your application and sharing your qualifications for the Propulsion Systems Design Release Engineer - 34464 position. We will contact you if we think you're a good fit for that position. In
the meantime, keep checking www.careers.ford.com for additional opportunities – we'd love to help you find your dream job. Sincerely, The Ford Talent Acquisition Team Your recent job application for HV Battery Build & Test Engineer (Thermal Runaway) - 31563 Inbox Ford Careers Sun, Sep 1, 8:25 AM to me Hello fiston, Thank you for your interest in
joining the Ford Motor Company team. You've taken the first steps by completing your application and sharing your qualifications for the HV Battery Build & Test Engineer (Thermal Runaway) - 31563 position. We will contact you if we think you're a good fit for that position. In the meantime, keep checking www.careers.ford.com for additional opportunities –
we'd love to help you find your dream job. Sincerely, The Ford Talent Acquisition Team Your recent job application for Systems Engineering - 32712 Inbox Ford Careers Sun, Sep 1, 8:23 AM to me Hello fiston, Thank you for your interest in joining the Ford Motor Company team. You've taken the first steps by completing your application and sharing your
qualifications for the Systems Engineering - 32712 position. We will contact you if we think you're a good fit for that position. In the meantime, keep checking www.careers.ford.com for additional opportunities – we'd love to help you find your dream job. Sincerely, The Ford Talent Acquisition Team Your recent job application for Systems Integration, Electrical
Architecture - 32709 Inbox Ford Careers Sun, Sep 1, 8:21 AM to me Hello fiston, Thank you for your interest in joining the Ford Motor Company team. You've taken the first steps by completing your application and sharing your qualifications for the Systems Integration, Electrical Architecture - 32709 position. We will contact you if we think you're a good fit
for that position. In the meantime, keep checking www.careers.ford.com for additional opportunities – we'd love to help you find your dream job. Sincerely, The Ford Talent Acquisition Team our recent job application for (602) Bank Analyst-FCSD - 602 Inbox SARB Talent Acquisition Sat, Aug 31, 2:01 PM to me Hello, tshitadi, We received your job
application for (602) Bank Analyst-FCSD - 602. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Your recent job
application for (608) Lead Policy Analyst - 608 Inbox SARB Talent Acquisition Sat, Aug 31, 1:57 PM to me Hello, tshitadi, We received your job application for (608) Lead Policy Analyst -608. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job
application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Recruiting Team Application acknowledgement Inbox SARS Human Capital and Development Sat, Aug 31, 8:43 AM to me Dear Tshingombe Tshitadi , Job Application: Business Area Lead: Civil Case Select Strategy Reference
code: 9833 Receipt of your application for the advertised post is hereby acknowledged. It may take some time to process your application. Regards, SARS Talent Acquisition Team 31 August 2024 SARS Human Capital and Development Sat, Aug 31, 8:45 AM to me Dear Tshingombe Tshitadi , Job Application: Ops Manager: Facilities Management
Reference code: 9832 SARS Human Capital and Development Sat, Aug 31, 8:46 AM to me Dear Tshingombe Tshitadi , Job Application: Specialist Developer: Information Technology (Adabas) Reference code: 9799 SARS Human Capital and Development Sat, Aug 31, 8:47 AM to me Dear Tshingombe Tshitadi , Job Application: Specialist: Systems
Engineer (Mainframe) Reference code: 9804 SARS Human Capital and Development Sat, Aug 31, 8:48 AM to me Dear Tshingombe Tshitadi , Job Application: Senior Specialist: Database Administration (Adabas) Reference code: 9796 SARS Human Capital and Development Sat, Aug 31, 8:49 AM to me Dear Tshingombe Tshitadi , Job Application: Junior
Specialist: Asset Management (Software) Reference code: 9791 Update Regarding Your Application Inbox Eaton TalentHub Fri, Aug 30, 3:47 PM to me Hi Fiston, Thank you for applying for the position of Senior Field Service Representative – 31188. We appreciate you considering a career at Eaton. After careful review, we have decided to move forward
with other candidates who more closely match the current needs for this team and position. We know that messages like this are disappointing, but we really hope you continue to pursue other opportunities at Eaton. Be sure to check out Eaton.com/careers, where you can find all our open jobs and set up a job alert. Thank you for your interest in Eaton and
wish you all the best! Eaton Talent Acquisition Team Your recent job application for (605) Financial Stability Department - Finstab - 605 Inbox SARB Talent Acquisition Sat, Aug 31, 1:45 PM to me Hello, tshitadi, We received your job application for (605) Financial Stability Department - Finstab - 605. If your profile corresponds to our requirements, a member
of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your profile, go to your candidate self service page. Sincerely, South African Reserve Bank Recruiting Team Your recent job application for (606) Associate Macroprudential Specialist - Finstab - 606 Inbox SARB Talent
Acquisition Sat, Aug 31, 1:49 PM to me Hello, tshitadi, We received your job application for (606) Associate Macroprudential Specialist -Finstab - 606. If your profile corresponds to our requirements, a member of our Recruiting team will contact you. If you were requested to provide additional info about your job application, or if you want to manage your
profile, go to your candidate self service page. Sincerely, South African Reserve Bank Recruiting Team Application Unsuccessful Inbox SARS Human Capital and Development Wed, Aug 28, 2:00 PM to me Dear Tshingombe Tshitadi , Thank you for applying for Specialist: Case Selection (Transfer Pricing). After careful consideration we regret to inform you
that your application was not successful. We wish you everything of the best in your future applications. Yours Sincerely, SARS Talent Acquisition Team • About Us • Our Network • Skills for Work and Life • Knowledge Resources TVET Forum - Connect With a Global TVET Community TVET Forum SDG and TVET Virtual Conferences About the TVET
Forum Terms of Use Help & FAQ Manage Your Account Unsubscribe Contact TVET Forum User profile tshitadi fiston Member since 2023-10-14 5 Postings UNEVOC Centre #3043 h Contact: tshingombefiston@gmail.com User Messages: 2024-09-23 Re: Models of Institutional Effectiveness in VET () 2024-09-23 engineering qualification framework
implentation tvet college , rdc and rsa record system engineering n studie () 2024-09-23 engineering qualification framework implentation tvet college , rdc and rsa record system engineering n studie () 2024-09-23 experimental workbase tvet and institut back log dhet ucpd record st peace college and sita and examination irregularity implentation ()
2024-09-23 experimental career tvet college institu assessment police guidence back log sita and irregularity level 4,5,3,6 ucpd engineering studie diploma certificate () RE: CMS 221043 YS Online form submission: CNP-53345-24-0100-000 Inbox TPMailbox-CMSCCC@met.pnn.police.uk Mon, Sep 23, 12:23 PM (21 hours ago) to me Good Morning, Thank
you for your online submission into the Crime Management Services. The crime reference number is showing in the system as not in existence. Are you the victim? What is the nature of the crime? Do you have a named Officer assigned to the Case? Would you like us to place an update onto the system? Kindest regards, Yvonne - Crime Management
Services Should you require us in an emergency, please dial 999. If you wish to speak to the operator regarding a non-emergency, please dial 101. **********PLEASE DO NOT REPLY TO THIS EMAIL. OUR MAILBOX CANNOT RECEIVE EMAILS DIRECTLY FROM MEMBERS OF THE PUBLIC. AS SUCH, SHOULD YOU WISH TO RESPOND TO THIS
EMAIL, YOU WILL NEED TO VISIT THE FOLLOWING LINK TO RE-SUBMIT THE REPLY********** https://www.met.police.uk/contact/af/contact-us/ -----Original Message----- From: no-reply@service.police.uk Sent: 22 September 2024 08:24 To: TP MAILBOX - CMS CCC Subject: CMS 221043 YS Online form submission: CNP-53345-24-0100-000
********** OFFICIAL - SENSITIVE ********** ----------STEP 1 ---------- First name: fiston ---------- Surname: tshingombe ---------- Date of birth: 10/11/1982 ---------- Email address: tshingombefiston@gmail.com ---------- Telephone number (for international numbers include the country code): +270725298946---------- Postcode: Percy street 1039, Hendrik Potgieter St Johannesburg 1030 ----------Origin: Form ---------- Crime reference number: eg 1234567/17 or 01/00000/24: 2345654/24---------- When did the incident happen?: 02/09/2022 ---------- What is your involvement in this 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 15 of 18 case?: High court London transaction victim Edith ,Mrs basem attorney chamber affidavit
Portofolio evidence low , complain incidence accident transaction money for claim bank work UK from Canada transaction made in RSA , union waster..Asia bank ---------- Please provide us with your update: 10/09/2024 NOTICE - This email and any attachments are solely for the intended recipient and
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email and/or attachments may be read by monitoring staff. Only specified personnel are authorised to conclude binding agreements on behalf of the MPS by email and no responsibility is accepted for unauthorised agreements reached with other personnel. While reasonable precautions have been taken to ensure no viruses are present in this email, its
security and that of any attachments cannot be guaranteed. Application Update Inbox TalkToUs@met.police.com.uk via tal.net Mon, Sep 23, 4:15 PM (18 hours ago) to me Dear tshingombe Good Afternoon Thank you for getting in touch with the Metropolitan Police regarding career opportunities. We apologise if there has been a delay in responding to you
but this is likely to be because of the large amount of interest that the campaign has generated. If you have seen it "change needs you !" We are here to help you with any enquiries or questions that you have about the job or your application form in the hope that you will complete and submit an application but please do let us know if you are no longer
interested. In order to make a start of understanding how we can help you we have a few questions that we would appreciate you answering in reply to this email and if replying on another device the email address to use is TalkToUs@met.police.uk. Are you still interested in a career in the Met? What role are you interested in? What is your highest level of
academic achievement? Are you currently working towards a qualification? Do you have a GCSE or equivalent in English? Have you attended or are you interested in attending an Insight Event? Is there anything that we can help with to encourage your application? Look forward to hearing from you soon Kind Regards Met Police Candidate Engagement
Team. Automated Response Inbox TalkToUs@met.police.uk Mon, Sep 23, 4:25 PM (17 hours ago) to me Thank you for getting in touch to find out more about becoming a Met Police Constable. Due to the high volume of queries, we aim to contact you within 5 working days. We will do our best to reach out to you within your ideal time slot, if provided.
Kindest regards, Talk to Us Team NOTICE - This email and any attachments are solely for the intended recipient and may be confidential. If you have received this email in error, please notify the sender and delete it from your system. Do not use, copy or disclose the information contained in this email or in any attachment without the permission of the
sender. Metropolitan Police Service (MPS) communication systems are monitored to the extent permitted by law and any email and/or attachments may be read by monitoring staff. Only specified personnel are authorised to conclude binding agreements on behalf of the MPS by email and no responsibility is accepted for unauthorised agreements reached
with other personnel. While reasonable precautions have been taken to ensure no viruses are present in this email, its security and that of any attachments cannot be guaranteed. Application Update Inbox Met Recruitment Team 1:05 AM (9 hours ago) to me tshingombe, You've started your application form, but haven't yet finished it. You haven't got much
left to do in this section, and we'd love it if you had five minutes to finish this off. You'll need to log back into the system to continue – Application Centre to pick up where you left off. You can review your progress using the navigation menu on the left hand side of the application form screen – a tick means you're done in each section. If you're stuck and
need help, please give us a call – our telephone details are below. Please don't worry about asking us for assistance, that's what we're here for! If you're having trouble deciding whether you want to continue or not, please do give us a call – we'll be able to help by talking this through with you. Have a great day! Yours sincerely, Shared Services Connected
Ltd – Delivering services in partnership with the Metropolitan Police Service Phone: 01633 632500 Email: Enquiries.PoliceJobs@police.sscl.com Removing Barriers to Officer Accountability Inbox Google Forms 9:49 AM (4 minutes ago) to me Thanks for filling out Removing Barriers to Officer Accountability Here's what was received. Removing Barriers to
Officer Accountability Section 1: Attorney Affirmation is MANDATORY if you wish to receive CLE credit. Section 2: Course Evaluation is ENCOURAGED to inform the state of New York on our program. Email * tshingombefiston@gmail.com Section 1: Attorney Affirmation NY CLE Credit for Webinar To obtain New York CLE credit, please complete and sign
this form and then submit it to the Policing Project at NYU Law. Your participation must be verified by the provider. Experienced New York attorneys (attorneys who have been admitted to the New York bar for more than two years) may earn CLE credit through nontraditional formats. Newly admitted attorneys (attorneys who have been admitted to the New
York Bar for two years or less) should confirm that the format is permissible for the category of credit. New York attorneys should retain a copy of this affirmation. Email * tshingombefiston@gmail.com Format: Webconference Course Code(s) During each session of the conference you will see and/or hear one or more CLE course codes. Please enter the
code(s) in the fields below. If you do not enter the correct code(s), you will not be awarded New York CLE credit. If you did not attend the entire conference, you are able to receive partial credit for the individual sessions you attended in their entirety. List all code(s) for September 24, 2024 * 21-CIP-J / FFPSA & Kinship (Part 1),Date & Time Sep 24, 2024
09:00 PM Johannesburg Webinar ID 912 5168 3181,Tue Sep 24, 2024 9pm – 10pm (SAST) Where https://nyu.zoom.us /w/91251683181?tk=9vyym4gehi0cHxdYwYdOOiYbUw2lCZzZ_IKD0ceCABo.DQcAAAAVPwYvbRZjNTdyNEx1S1NaQzljV2s3NlU2SEdRAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA& uuid=WN_3jfCNZddR7iCjsRfhRXPag
Who Gabby Bayness 30x30 Initiative: Advancing Women in Policing Chicago Neighborhood Policing Initiative Legislation Litigation Regulating Use of Technology in Policing Relmagining Public Safety SAJE Policing Assessment Our Mission: We Partner With Communities And Police To Promote Public Safety Through Transparency, Equity, and Democratic
Engagement. Our work focuses on front-end, or democratic, accountability—meaning the public has a voice in setting transparent, ethical, and effective policing policies and practices before the police or government act. The goal is to achieve public safety in a manner that is equitable, non-discriminatory, and respectful of public values. Broadly speaking,
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acknowledge receipt of the course materials for Removing Barriers to Officer Accountability ✓ I certify that I have listened to and/or viewed Removing Barriers to Officers Accountability in its entirety for the sessions for which I've entered codes. Therefore, I request that I be awarded the applicable number of New York CLE credits for this course. Signature *
tshingombefiston@gmail.com Date of completion of CLE course (New York attorneys earn CLE credit as of the date they complete a CLE course): * MM 09 / DD 25 / YYYY 2024 Attorney email address to receive CLE certificate (if different from the address above): tshingombekb@gmail.com Section 2: Course Evaluation Course evaluations are optional,
but must be offered to all attorneys who participated in today's course. Program Title Thank you for registering for Removing Barriers to Law Enforcement Officer Accountability. You can find information about this webinar below. Removing Barriers to Law Enforcement Officer Accountability Date MM 09 / DD 25 / YYYY 2024 Speaker(s): Removing Barriers
to Law Enforcement Officer Accountability Confirmation Inbox Gabby Bayness AttachmentsSep 24, 2024, 8:15 PM (13 hours ago) to me Sep24Tue Removing Barriers to Law Enforcement … View on Google Calendar When Tue Sep 24, 2024 9pm – 10pm (SAST) Where https://nyu.zoom.us /w/91251683181?
tk=9vyym4gehi0cHxdYwYdOOiYbUw2lCZzZ_IKD0ceCABo.DQcAAAAVPwYvbRZjNTdyNEx1S1NaQzljV2s3NlU2SEdRAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA& uuid=WN_3jfCNZddR7iCjsRfhRXPag Who Gabby Bayness* Agenda Tue Sep 24, 2024 No earlier events 9pm Removing Barriers to Law Enforcement … No later events Hi
Tshingombe tshitadi, Thank you for registering for Removing Barriers to Law Enforcement Officer Accountability. You can find information about this webinar below. Removing Barriers to Law Enforcement Officer Accountability Date & Time Sep 24, 2024 09:00 PM Johannesburg Webinar ID 912 5168 3181 Add to: Google Calendar Outlook Calendar(.ICS)
Yahoo Calendar To edit or cancel your registration details, click here. You can cancel your registration before Sep 24, 2024 09:00 PM. Please submit any questions to: gib7728@nyu.edu Thank you! WAYS TO JOIN THIS WEBINAR Join from PC, Mac, iPad, or Android Join Webinar If the button above does not work, paste this into your browser: https://
nyu.zoom.us/w/91251683181?tk=9vyym4gehi0cHxdYwYdOOiYbUw2lCZzZ_IKD0ceCABo.D Please take a few moments to evaluate this course: Excellent Good Fair Poor N/A Program Content ✓ Instructor Quality ✓ Written Materials ✓ Facility ✓ Technology ✓ Relevence to my practice: assessment police engineering st peace college policing conduct ,
Comments: policing conduct investigate analyse design framework regulatory mendator policing portofolio eveidence low design in order to resolve in good conduct system managemnt low conduct , in court poe s, Create your own Google Form Report Abuse • Our Work • 30x30 Initiative: Advancing Women in Policing • Chicago Neighborhood Policing
Initiative • Legislation • Litigation • Regulating Use of Technology in Policing • Relmagining Public Safety • SAJE Policing Assessment Our Mission: We Partner With Communities And Police To Promote Public Safety Through Transparency, Equity, and Democratic Engagement. Our work focuses on front-end, or democratic, accountability—meaning the
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achieved. Explore our focus areas to learn more about our work. RE: New WFCP Membership Application Inbox WFCP Secretariat 2:15 AM (7 hours ago) to me Hello Tshingombe, Thank you for your interest in joining the WFCP. To confirm, are you applying for institutional membership or association membership? Sincerely, Joanna Andrews Program
Officer, WFCP Secretariat World Federation of Colleges and Polytechnics (WFCP) 1 Rideau Street - Suite 701, Ottawa ON K1N 8S7 Email: secretariat@wfcp.org Website: www.wfcp.org Subscribe to our Newsletter From: Tshingombe Tshitadi Sent: Tuesday, September 24, 2024 1:48 AM To: WFCP Secretariat Subject: New WFCP Membership Application
About the Applicant Are you a: private institution Type of membership requested Association Membership Are you accredited? not applicable Name of Applicant (individual or institution) Tshingombe engineering/St peace college Number of students enrolled in your institution 20 Name of accrediting body St peace sasseta Please share your reasons for
joining WFCP Engineering electrical assessment police officer, Contact Information Contact name Tshingombe Tshitadi Contact email tshingombefiston@gmail.com Contact telephone +270725298946 Website https://tshingombefiston.com Address 20 percy 1030 Rockview 103, Jhb Gauteng South Africa Map It Application Update Inbox Met Recruitment
Team Tue, Sep 24, 2:15 PM (19 hours ago) to me Vacancy: 18023 - Intelligence Manager – Public Order & Public Safety Intelligence - Inspector – MO2 Dear tshingombe, Thank you for your application for a new position within the Met. To be eligible to apply for this new position, we have a set of criteria that applicants need to meet. Based on the
information you have shared so far; we regret to inform you that you are not eligible to progress with your application. Your individual answers suggest that you do not meet the application criteria. You can read more about our eligibility criteria on our Careers Website or by reviewing information available on MyHR. We understand that this will be
disappointing news for you but would like to thank you for your interest in this position and wish you all the best for the future. Shared Services Connected Ltd – Delivering services in partnership with the Metropolitan Police Service Phone: 01633 632500 Email: Enquiries.PoliceJobs@police.sscl.com Met Recruitment Team Tue, Sep 24, 2:20 PM (19 hours

ago) Vacancy: 18028 - Intelligence Manager - Public Order & Public Safety Intelligence - Detective Inspector - MO2 Met Recruitment Team Tue, Sep 24, 2:20 PM (19 hours ago) Vacancy: 17954 - PA to DCS Band E Met Recruitment Team Tue, Sep 24, 2:25 PM (19 hours ago) Vacancy: 17991 - Detective Constable - DASO - Professional Standards Met
Recruitment Team Tue, Sep 24, 2:25 PM (19 hours ago) Vacancy: 17874 - Quality Assurance Lead Met Recruitment Team Tue, Sep 24, 2:30 PM (19 hours ago) Vacancy: 17915 - Complaint Resolution Unit (CRU) - Complaint handler Met Recruitment Team Tue, Sep 24, 2:30 PM (19 hours ago) Vacancy: 17879 - Electronics Development Engineer Met
Recruitment Team Tue, Sep 24, 2:35 PM (19 hours ago) Vacancy: 18014 - Developing Threats Team – PC Met Recruitment Team Tue, Sep 24, 2:35 PM (19 hours ago) Vacancy: 17806 - Licensing Admin Support Officer Met Recruitment Team Tue, Sep 24, 2:40 PM (19 hours ago) Vacancy: 17978 - Professional Standards Unit (MO12/MO4/CRIB) Band D
Met Recruitment Team Tue, Sep 24, 2:40 PM (19 hours ago) Vacancy: 18051 - Operations Lead - Superintendent Met Recruitment Team Tue, Sep 24, 2:45 PM (19 hours ago) Vacancy: 17990 - MO2 Met Intel - ANPR Auditor - Innovation Deployment & Compliance Team Met Recruitment Team Tue, Sep 24, 2:45 PM (19 hours ago) Vacancy: 18033 - Police
Constable DPS - Professional Standard Unit Met Recruitment Team Tue, Sep 24, 2:55 PM (19 hours ago) Vacancy: 18008 - CSC - Offender Management - Central Orders Team Police Constable Met Recruitment Team Tue, Sep 24, 2:55 PM (19 hours ago) Vacancy: 17775 - PSO - Threat Assessment & Intelligence Unit - Intelligence Officer – Researcher
Met Recruitment Team Tue, Sep 24, 2:55 PM (19 hours ago) Vacancy: 18048 - Met Intel PC ANPR Investigations Met Recruitment Team Tue, Sep 24, 3:00 PM (18 hours ago) Vacancy: 18047 - Met Intel DS ANPR Investigations Met Recruitment Team Tue, Sep 24, 3:00 PM (18 hours ago) Vacancy: 17922 - Intelligence Officer -Bomb Data Centre - FMT -
SO15 Met Recruitment Team Tue, Sep 24, 3:10 PM (18 hours ago) Vacancy: 17223 - Digital Engagement Officer Met Recruitment Team Tue, Sep 24, 3:10 PM (18 hours ago) Vacancy: 18042 - Covert Admin (COVAD) Deputy Manager Met Recruitment Team Tue, Sep 24, 3:10 PM (18 hours ago) Vacancy: 17823 - SQL Server Database Administrator -
Counter Terrorism Policing HQ Met Recruitment Team Tue, Sep 24, 3:10 PM (18 hours ago) Vacancy: 18005 - PC - MO6 Public Order Crime Team Met Recruitment Team Tue, Sep 24, 3:15 PM (18 hours ago) Vacancy: 17986 - Driver Assistance Centre Team Leader Met Recruitment Team Tue, Sep 24, 3:15 PM (18 hours ago) Vacancy: 18006 - DS - Public
Order Crime Team Met Recruitment Team Tue, Sep 24, 3:30 PM (18 hours ago) Vacancy: 18050 - Resource Management Office Manager Met Recruitment Team Tue, Sep 24, 3:30 PM (18 hours ago) Vacancy: 17925 - Digital Project Officer - 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/
rqo/request/ipl/request-intellectual-property-ip... 16 of 18 NDES Service 3 - SO15 Met Recruitment Team Tue, Sep 24, 3:30 PM (18 hours ago) Vacancy: 18059 - Detective Sergeant - Complex Investigation Team (CIT) Met Recruitment Team Tue, Sep 24, 3:30 PM (18 hours ago) Vacancy: 18078 - National Counter Terrorism Security Office (NaCTSO) –
Venues and Public Spaces Unit- Detective Inspector - Counter Terrorism Policing HQ Met Recruitment Team Tue, Sep 24, 3:35 PM (18 hours ago) Vacancy: 18015 - Safety Camera Processing Clerk Met Recruitment Team Tue, Sep 24, 3:40 PM (18 hours ago) Vacancy: 18026 - Health & Safety/Accommodation Manager - Band D - Counter Terrorism
Policing HQ Met Recruitment Team Tue, Sep 24, 3:40 PM (18 hours ago) Vacancy: 18081 - MO19 Specialist Firearms Command – Development, Delivery, Equipment & Finance Sergeant Met Recruitment Team Tue, Sep 24, 3:45 PM (18 hours ago) Vacancy: 18095 - Complaint Handler Met Recruitment Team Tue, Sep 24, 3:50 PM (18 hours ago) Vacancy:
17848 - MBS Reporting Senior Analyst Met Recruitment Team Tue, Sep 24, 3:50 PM (18 hours ago) Vacancy: 18067 - Dev Ops Engineer (Cloud Platform) - Technology CSC - Police Staff - Counter Terrorism Policing HQ Met Recruitment Team Tue, Sep 24, 3:55 PM (18 hours ago) Vacancy: 17977 - MetCC Centre Facilities Support Staff Met Recruitment
Team Tue, Sep 24, 4:00 PM (17 hours ago) Vacancy: 17872 - BCU Learning and Development Lead Met Recruitment Team Tue, Sep 24, 4:05 PM (17 hours ago) Vacancy: 17923 - Business Analyst – Strategy, Planning and Performance (SPP) Counter Terrorism Policing HQ Met Recruitment Team Tue, Sep 24, 4:05 PM (17 hours ago) Vacancy: 17987 -
Character Enquiry Centre Team Leader Met Recruitment Team Tue, Sep 24, 4:10 PM (17 hours ago) Vacancy: 18086 - MO7 Taskforce TSG -Police Sergeant Met Recruitment Team Tue, Sep 24, 4:15 PM (17 hours ago) Vacancy: 17229 -Higher Computer Aided Surveyor / 3D Specialist Met Recruitment Team Tue, Sep 24, 4:20 PM (17 hours ago) Vacancy:
18085 - Counter Weapons Threat Team Officer - PC - Counter Terrorism Policing HQ Met Recruitment Team Tue, Sep 24, 4:25 PM (17 hours ago) Vacancy: 18063 - MO19 Specialist Firearms Command - Tactical Firearms Commander Inspector (UNARMED) Met Recruitment Team Tue, Sep 24, 4:40 PM (17 hours ago) Vacancy: 18064 - MO19 Specialist
Firearms Command - Tactical Firearms Commander Detective Inspector (UNARMED) Met Recruitment Team Tue, Sep 24, 9:30 PM (12 hours ago) to me Vacancy: 18085 - Royalty and Specialist Protection - RaSP 400 Inspector Met Recruitment Team Tue, Sep 24, 9:35 PM (12 hours ago) to me Vacancy: 18009 - MO7 Taskforce Mounted Branch Inspector
Met Recruitment Team Tue, Sep 24, 9:35 PM (12 hours ago) to me Vacancy: 16708 - 202402 - MPS Return Scheme Approaching Retirement Met Recruitment Team Tue, Sep 24, 9:40 PM (12 hours ago) to me Vacancy: 18004 - Digital Forensic Manager Met Recruitment Team Tue, Sep 24, 9:45 PM (12 hours ago) to me Vacancy: 17666 - Motor Vehicle
Technician Met Recruitment Team Tue, Sep 24, 9:55 PM (12 hours ago) to me Vacancy: 17392 - Volunteer Police Cadet Leader Google Forms Thu, Sep 26, 9:28 AM (1 day ago) to me Thanks for filling out Removing Barriers to Officer Accountability Here's what was received. Removing Barriers to Officer Accountability Section 1: Attorney Affirmation is
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NYU Law. Your participation must be verified by the provider. Experienced New York attorneys (attorneys who have been admitted to the New York bar for more than two years) may earn CLE credit through nontraditional formats. Newly admitted attorneys (attorneys who have been admitted to the New York Bar for two years or less) should confirm that the
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code(s), you will not be awarded New York CLE credit. If you did not attend the entire conference, you are able to receive partial credit for the individual sessions you attended in their entirety. List all code(s) for September 24, 2024 * Model statute: An Act to Removing Barriers to Accountability and Facilitate Robust Oversight Our model statute gives states
guidance on how to remove barriers to law enforcement officer accountability and oversight commonly found in state or local laws, and/or in police collective bargaining agreements. Advocacy Toolkit: Community Oversight of Police Union Contracts This toolkit by the Legal Defense Fund breaks down accountability-impeding provisions in over 100 police
union contracts, providing a resource for advocates and community members engaging in police collective bargaining agreement reform efforts. Journal Article: Stephen Rushin, Police Union Contracts, 66 Duke Law Journal 1191-1266 (2017) This article collects and analyzes more than 170 police union contracts, showing how provisions in these
agreements serve as barriers to officer accountability. Journal Article: Kevin M. Keenan & Samuel Walker, An Impediment to Police Accountability - An Analysis of Statutory Law Enforcement Officers' Bills of Rights, 14 B.U. PUB. INT. L.J. 185 (2005) This law review article identifies provisions in Law Enforcement Bills of Rights (LEOBORs) from 14 different
states that are impediments to holding officers accountable, focusing on five kinds of provisions that are particularly harmfulVictor Dempsey, Community Organizer, Legal Defense Fund Victor Dempsey is a community organizer at the NAACP's Legal Defense Fund (LDF). Mr. Dempsey has devoted his career to ending police violence through community
organizations, eventually founding his own organization to support and advocate for impacted families called Families are the Frontlines. Reneé Hall, former Chief of the Dallas Police Department Reneé Hall is the former Chief of the Dallas Police Department, the first woman to lead the department. Chief Hall has worked to bridge communities with law
enforcement through the implementation of a civilian oversight board and has been a champion of accountability by establishing a duty to intervene policy when officers witness excessive force. She graduated with masters degrees from the University of Detroit Mercy (M.S.) and Grambling State University (B.S.). Stephen Rushin, Professor of Law at Loyola
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25 of 39 3/11/2025, 1:20 PM
University Chicago School of Law Stephen Rushin is the Associate Dean of Faculty Research and the Judge Hubert Louis Will Professor of Law at Loyola University of Chicago School of Law. He has published a series of articles on police unions and the officer internal disciplinary procedures. His research interests include policing, criminal procedure, and
criminal sentencing. His work has recently appeared in the Stanford Law Review, the University of Pennsylvania Law Review, the California Law Review, the Cornell Law Review, the Duke Law Journal, the Vanderbilt Law Review, the Texas Law Review, the Iowa Law Review, the Minnesota Law Review, the George Washington Law Review, the Fordham
Law Review, the Boston College Law Review, and the Florida Law Review, among other journals. He published the premier article on police union contracts in the Duke Law Journal in 2017. Rushin graduated from Berkeley (J.D. and PhD) and the University of Texas (B.A.). HOST Josh Parker, Deputy Director of Legislative Policy, Policing Project at NYU
Law Josh Parker is the Deputy Director of Legislative Policy at the Policing Project. He is a policing policy and legal expert who co-drafted the Removing Barriers to Accountability model statute and has counseled legislators and agency leaders across the country on how to reform their laws to better address police misconduct. Given his expertise, Josh is
often sought for legislative testimony, media interviews, and public comment on a number of police misconduct topics. He graduated from the University of Chicago Law School (J.D.), where he served as an Articles Editor of the University of Chicago Law Review, and Duke University (B.A.).21-CIP-J / FFPSA & Kinship (Part 1),Date & Time Sep 24, 2024
09:00 PM Johannesburg Webinar ID 912 5168 3181,Tue Sep 24, 2024 9pm – 10pm (SAST) Where https://nyu.zoom.us /w/91251683181?tk=9vyym4gehi0cHxdYwYdOOiYbUw2ICZzZ_IKD0ceCABo.DQcAAAAVPwYvbRZjNTdyNEx1S1NaQzlJV2s3NlU2SEdRAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA& uuid=WN_3jfCNZddR7iCjsRfhRXPag
Who Gabby Bayness 30x30 Initiative: Advancing Women in Policing Chicago Neighborhood Policing Initiative Legislation Litigation Regulating Use of Technology in Policing Relmagining Public Safety SAJE Policing Assessment Our Mission: We Partner With Communities And Police To Promote Public Safety Through Transparency, Equity, and Democratic
Engagement. Our work focuses on front-end, or democratic, accountability—meaning the public has a voice in setting transparent, ethical, and effective policing policies and practices before the police or government act. The goal is to achieve public safety in a manner that is equitable, non-discriminatory, and respectful of public values. Broadly speaking,
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time for a national conversation about what public safety means, and how it is best achieved. Explore our focus areas to learn more about our work.*,. Name of CLE Provider: New York University School of Law - Policing Project Please confirm the following statements by checking the boxes and typing your name in the signature field below * ✓ I
acknowledge receipt of the course materials for Removing Barriers to Officer Accountability ✓ I certify that I have listened to and/or viewed Removing Barriers to Officers Accountability in its entirety for the sessions for which I've entered codes. Therefore, I request that I be awarded the applicable number of New York CLE credits for this course. Signature *
tshingombe tshitadi Date of completion of CLE course (New York attorneys earn CLE credit as of the date they complete a CLE course): * MM 09 / DD 26 / YYYY 2024 Attorney email address to receive CLE certificate (if different from the address above): tshingombekb@gmail.com Section 2: Course Evaluation Course evaluations are optional, but must be
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tk=9vyym4gehi0cHxdYwYdOOiYbUw2ICZzZ_IKD0ceCABo.DQcAAAAVPwYvbRZjNTdyNEx1S1NaQzlJV2s3NlU2SEdRAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA& uuid=WN_3jfCNZddR7iCjsRfhRXPag Who Gabby Bayness 30x30 Initiative: Advancing Women in Policing Chicago Neighborhood Policing Initiative Legislation Litigation
Regulating Use of Technology in Policing Relmagining Public Safety SAJE Policing Assessment Our Mission: We Partner With Communities And Police To Promote Public Safety Through Transparency, Equity, and Democratic Engagement. Our work focuses on front-end, or democratic, accountability—meaning the public has a voice in setting transparent,
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tk=9vyym4gehi0cHxdYwYdOOiYbUw2ICZzZ_IKD0ceCABo.DQcAAAAVPwYvbRZjNTdyNEx1S1NaQzlJV2s3NlU2SEdRAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA& uuid=WN_3jfCNZddR7iCjsRfhRXPag Who Gabby Bayness 30x30 Initiative: Advancing Women in Policing Chicago Neighborhood Policing Initiative Legislation Litigation
Regulating Use of Technology in Policing Relmagining Public Safety SAJE Policing Assessment Our Mission: We Partner With Communities And Police To Promote Public Safety Through Transparency, Equity, and Democratic Engagement. Our work focuses on front-end, or democratic, accountability—meaning the public has a voice in setting transparent,
ethical, and effective policing policies and practices before the police or government act. The goal is to achieve public safety in a manner that is equitable, non-discriminatory, and respectful of public values. Broadly speaking, our work is centered around three focus areas: Front-End Voice in Policing: We believe that in a democratic society, the public must
have a voice in how it is policed. Regulation of Policing Technology: We believe that there must be transparency and public debate around the adoption of new policing technologies. Reimagining Public Safety: We believe it is time for a national conversation about what public safety means, and how it is best achieved. Explore our focus areas to learn more
about our work.*, Please take a few moments to evaluate this course: Excellent Good Fair Poor N/A Program Content ✓ Instructor Quality ✓ Written Materials ✓ Facility ✓ Technology ✓ Relevence to my practice: engineering project assessment police low enforcement portfolio discipline quality management evidence low in order police design thing resolve
order in gov system orientation Comments: god thing on disciplinary conduct code police Job Description Schneider Electric's EcoStruxure™ Automation Expert (EAE) is a software-centric industrial automation system that creates successive improvements throughout your operational lifecycle. The EcoStruxure team supports countries globally in deploying
this solution. Your role: Reporting to the EcoStruxure EMEA Manager (Francisco) and as part of a team of 7 Project Managers, you will participate in the deployment of the EAE automation solution in Europe. You will support our clients (internal and external) during pre-sales and project execution phases. Your main missions: • Promote the technical
benefits of the EAE solution in Europe with Schneider Electric entities in the relevant countries (joint visits, presentations, demonstrations) • Provide technical support to Schneider's local pre-sales teams • Assist in creating technical documents, technical guides, white papers, knowledge base articles, etc. • Support pilot project execution and execution of
key projects for clients (direct and indirect) • Train internal teams in different countries using Schneider's local technical resources • Develop the autonomy of each country in deploying EAE Your profile: • Master's degree in Engineering or equivalent in automation • 3 years of minimum experience in design and automation Your skills: • Understanding of OT
(Operational Technology) and IT (Information Technology) convergence to address client sustainability challenges • Understanding of DCS (Distributed Control Systems) concept and implementation • Mastery of secure, open, interoperable, and scalable control systems • Appreciated knowledge of the IEC61499 standard • Aptitude for assembling software
components to meet customer requirements • Software integration experience • Commercial aptitude, good communication skills, relationship building, collaboration, and teaching • Curiosity, organizational skills, and autonomy • Fluent in English and French We know that skills manifest in many ways and can be based on your life experience. If you do not
necessarily meet all the requirements listed, we still encourage you to apply. We offer you: Our offer includes an attractive remuneration and goes well beyond. If you join Schneider Electric, here's an idea of all that we can offer you to live the best possible experience: • A competitive salary, individual bonus, as well as profit-sharing and participation
bonuses rewarding everyone's efforts • A range of social benefits that make life easier: from CSE to rich catalogs, health insurance that meets all needs, generous savings and retirement plans, an advantageous employee share ownership program • Professional development through training, mobility and internal promotion (local and international), skills
sharing, etc. • An integration journey from your first day 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/request-intellectual-property-ip... 17 of 18 to give you the keys to success at Schneider Electric within a culture that promotes diversity, professional fulfillment, and inclusion
• Work-life balance through our telecommuting policy (up to 48% telecommutable time, equipment included), support for parenthood, inter-company childcare facilities, etc." About Our Company Why us? Schneider Electric is leading the digital transformation of energy management and automation. Our technologies enable the world to use energy in a safe,
efficient and sustainable manner. We strive to promote a global economy that is both ecologically viable and highly productive ob Description Schneider Electric's purpose is to empower all to make the most of our energy and resources, bridging progress and sustainability - we call this Life Is On. Our mission is to be the digital partner for sustainability and
energy efficiency: https://www.youtube.com/watch?v=VbldHPFltQQ Great people make Schneider Electric a great company - and we are currently recruiting for a Budapest-based, Italian speaking Energy Sourcing Analyst to support the sourcing activity in the Italian market. You will be an active member of our energy and sustainability services group, vital
to the future success of the business, and you will play a key role in assisting the team facilitate the delivery of our services to clients across Europe. Please note, this is an Entry level role within the team and this will be a Maternity Cover, starting out as a 2-year-long fixed-term contract with the possibility to extend. Purpose of the job: Deliver effective and
efficient energy procurement services (for electricity and natural gas) for our Clients. Maintain effective working relationships at an operational level with key Internal (Client Management, Data, Solutions, Risk Management) and External Stakeholders (Energy Suppliers). Drive operational excellence by participating in process and service improvements in
response to market developments and business targets. What you will do: • Analyze energy supply contract prices and terms and negotiate with energy suppliers to ensure optimal contracts are secured • Manage client and supplier relationships through excellent formal and informal communication • Work closely with the Client Management and other
internal teams to deliver an exceptional level of service to our clients • Develop and maintain a deep understanding of the Italian energy markets and legislation • Maintain regular contact with energy suppliers in order to ensure flawless service delivery to our client • Effectively create/communicate regional market opinions and knowledge to internal/external
clients • Manage pre-tender activities through collecting data, invoices, contracts, etc. • Manage the tendering, analysis and subsequent contract award and placement processes relating to complex energy supply contracts • Negotiate and utilise quantitative and qualitative techniques to deliver optimal energy supply contract terms and prices for our clients
through regular interaction with the energy suppliers on the related markets • Collaborate with Sourcing leadership to identify, evaluate, and incorporate efficiencies, new services, and innovative ideas/concepts • Participate in budget forecast creation process What we need from you: • Excellent knowledge of MS Excel is a must • University/College degree
preferably in Finance/Economics/Maths/Science or Energy related studies or equivalent experience in energy procurement / client or supplier management / contract management / negotiations • Fluency in English AND Italian is a must • Experience of the energy industry gained either at a supplier or an energy consultancy is a big advantage • Experience
in multinational environment is an advantage Skills, competencies that can make you the successful candidate: • Strong analytical and logical skills • Be an excellent influencer, negotiator and collaborator, forming effective relationships with demanding stakeholders • Great communication skills, capablility of engaging people of varying levels in seniority and
experience • Strong time management and organisational skills • Results focused and self-directed mindset What we offer: • Life, Accident and Health insurance packages (Medicover White Spring) • Cafeteria allowance • Home Office and Utility allowances • Yearly bonus • Global Family Leave • Flexible and hybrid working model • WESOP (World
Employee Share Ownership Plan) to become a shareholder in the company • Engagement groups within the company: get a sneak peek to our company life at https://download.schneider-electric.com/files?p_Doc_Ref=Engagement_groups_HU • Working at the company that ranked #1 in TIME Worlds' Most Sustainable Companies in 2024 • International,
diverse environment and a company culture that encourages raising questions and ideas - to make an impact • Real future career building opportunities locally & globally • Working directly with international customers dustrial / Manufacturing senior Engineering - 00934K • Manage the process flow and qualification in collaboration with BU and GSC to
prepare a successful industrial transfer • Lead the deployment on NPI and capacity increase projects at the facility ensuring consistency between BU & GSC • Work with cross-functional and remote teams to guarantee the deployment of industrial processes • Accountable for decision making and project execution in compliance with project goals, business,
industrial y customer requirements • Accountable for projects requirements: resources, product cost fie, planning & schedule, capacity, SPS and other deliverables • Decision making based on priorities and risk assessment • Ensure the capacities adaptation according to the dedicated tools (CAMA, CORIM, Bridge ..), internal or external • Perform regular
Queue Simulations, using the waiting queue design tool, in order to optimize Lead Times and assure capacity of the lines. • Define & maintain a referential operating time based on measurement tools adapted (MTM-UAS-timer-video analysis.) • Ensure the profitability of investments adapted to the needs of optimization and development process Guide the
choice of designers by providing industrial and logistical requirements • Is the "Time determination & Ergonomics Specialist/Referent" within his perimeter. • Responsible for Productivity action plan in his perimeter (define, implement) • Implement adaptation on the processes and manufacturing workstation for existing products by improving the industrial
performance, in manual process, automatic process & PLC (Programmable Logic Control) using SPS techniques and tools. • Involved in the specifications and quotation of new line architectures and industrial scenarios in order to meet Safety/Quality/Lead Times and productivity requirements. • Optimize Lead Times and assure capacity of the lines. • Write
operator work instructions for training • Study the feasibility & profitability of investments adapted to the needs. • Qualifies means and processes, in plant but also at suppliers' location. Application Update Inbox Met Recruitment Team Sat, Oct 26, 7:40 PM (16 hours ago) to me Vacancy: 18130 - National Referral Mechanism Coordinator Dear tshingombe,
Thank you for your application for a new position within the Met. To be eligible to apply for this new position, we have a set of criteria that applicants need to meet. Based on the information you have shared so far; we regret to inform you that you are not eligible to progress with your application. Your individual answers suggest that you do not meet the
application criteria. You can read more about our eligibility criteria on our Careers Website or by reviewing information available on MyHR. We understand that this will be disappointing news for you but would like to thank you for your interest in this position and wish you all the best for the future. Shared Services Connected Ltd – Delivering services in
partnership with the Metropolitan Police Service Phone: 01633 632500 Email: Enquiries.PoliceJobs@police.sscl.com Incomplete Application Inbox Met Recruitment Team Thu, Oct 24, 10:15 PM (3 days ago) to me Vacancy: 14783 - 202305- Police Community Support Officer (PCSO) tshingombe, We don't think you want to continue with your application,
and are sorry to see you go. We've closed down your application for now, so that we don't keep bothering you if you've decided this isn't the opportunity for you. If we've got this wrong, and you want to carry on, please get in touch and we'll open your application form back up. Our contact details are below if you want to give us a call. Being a Police
Constable isn't for everybody, so we understand that sometimes applicants change their mind. If you've decided this isn't the role for you, but you're still interested in joining the Met, please take a look at the other opportunities we've currently got available - you can view our careers website here. Have a great day tshitadi! Yours sincerely Shared Services
Connected Ltd – Delivering services in partnership with the Metropolitan Police Service Phone: 01633 632500 Email: Enquiries.PoliceJobs@police.sscl.com HCP Open Day with the MPS Inbox Dawn.James@met.police.uk Thu, Oct 24, 3:09 PM (3 days ago) to Dear Healthcare Professional, Thank you for registering your interest to attend our Healthcare
Professional Open Day today at Charing Cross Police Station. Unfortunately you didn't attend, you can however still apply for the role by clicking on the link below, remember to attach a CV and personal statement. Become a custody healthcare practitioner | Metropolitan Police Please do contact me if you have any queries. Kind Regards Dawn Dawn
James | Deputy Healthcare Director (Acting) Met Detention (M09) 07917 586675 | dawn.james@met.police.uk Lambeth HQ, 109 Lambeth Road, London, SE1 7LP NOTICE - This email and any attachments are solely for the intended recipient and may be confidential. If you have received this email in error, please notify the sender and delete it from your
system. Do not use, copy or disclose the information contained in this email or in any attachment without the permission of the sender. Metropolitan Police Service (MPS) communication systems are monitored to the extent permitted by law and any email and/or attachments may be read by monitoring staff. Only specified personnel are authorised to
conclude binding agreements on behalf of the MPS by email and no responsibility is accepted for unauthorised agreements reached with other personnel. While reasonable precautions have been taken to ensure no viruses are present in this email, its security and that of any attachments cannot be guaranteed. to me Dear Fiston, Thank you for applying

for the position of Service Centre Helpdesk Coordinator - 33335. We appreciate the opportunity to consider you for employment with Eaton. This communication is to let you know that this job has been filled. We invite you to visit www.eaton.com/careers and apply to other opportunities that match your current career aspirations. Thank you for your
continued interest in Eaton. Best regards, Tshingombe, will you answer a question for us? Inbox Schneider Electric Sat, Oct 26, 2:30 PM (21 hours ago) to me Hello Tshingombe, Recently, you applied and were considered for a position with Schneider Electric. While the outcome has not resulted in an offer of employment, we would appreciate your time in
answering one final question which will help us understand your lasting impression of Schneider Electric. Our goal is to treat all candidates with fairness and respect and your lasting impression helps us understand if we have achieved our goal. Pulse - One Question Survey Thank you. We look forward to hearing from you! *Please note that all feedback is
confidential and is not associated with any application. Any feedback gathered will not impact any potential employment with Schneider Electric. This email is being sent from an unmonitored email address. Schneider Electric can be reached at the following: 800 Federal Street North Andover, MA 01810 https://www.se.com/us/en/ / (978) 975-9600 Survale
sends surveys on behalf of Schneider Electric at their request and has no involvement with employment decisions. We can be reached at contactus@survale.com. To unsubscribe click here Powered by Survale In Automatic reply: letter explanation theoretical pratical base work , n diplomat award engineering electrical Inbox CallCentre via
dhetgovza.onmicrosoft.com 9:16 AM (8 hours ago) to me Please note that this is an automated response, do not reply to it. Thank you for contacting the Department of Higher Education and Training Call Centre. We appreciate your inquiry. Regarding NN Diploma, Nated, and NCV certificate enquiries: • All applications for new issues, replacements, or
combination requests must be submitted directly to the relevant college. • Please note that there is a minimum waiting period of 3-6 months for diploma applications. • The issuance of NN Diploma is currently paused. We have communicated this to all colleges. • In the meantime, students whose diplomas are finalized but awaiting printing can obtain a
confirmation letter from their college. We apologize for any inconvenience this may cause and appreciate your understanding. MMA support Inbox MMA Support via freshdesk.com Mon, Oct 21, 8:41 AM (2 days ago) to me Hi Tshingombe Thanks so much for reaching out! We know there's nothing worse than sending an email and getting no response. So,
to make sure that you know that we are aware of your email, we have created this handy auto-reply just to let you know that we have your email and we are assigning it to the best person to help you! We like to be quite speedy on our replies, so you should get a response soon. Your experience is our first priority and our agents are here from Monday to
Saturday between 08h00 and 20h00 and on Sundays between 08h00 and 19h00. You can also chat with our agents directly using our live chat on the Shoprite app. In the meantime, if you have general questions about the Money Market Account, check out our website for some handy walk-throughs and answers to some questions you may have. We have
also created some useful videos on how to use the Money Market Account, please click here to view them. If you have any additional information that you think will help us to assist you, please feel free to reply to this email. We look forward to chatting soon! Money Market Account Services Team (no subject) Inbox Ahmed Abdelmonem (International
Supplier) Tue, Oct 22, 1:52 PM (1 day ago) to me Hi Tshingombe, I trust this email finds you in good health. My name is Ahmed Abdelmonem, and I serve as a Customer Lifecycle Manager for Microsoft. My responsibilities include overseeing the SMB segment in the South African market. Within my role, I manage various Microsoft workloads, including: •
Microsoft Azure: Our expansive cloud platform that provides an array of services tailored for the development, deployment, and management of applications. • Microsoft Dynamics: An integrated suite of ERP and CRM software applications designed to streamline business processes. • Modern Workplace: A collection of solutions aimed at enhancing
collaboration and productivity within today's digital-first work environment. • Copilot: Our latest AI-driven platform that assists in code generation and other complex tasks, ensuring efficiency and innovation. I would like to connect with you to discuss your needs and explore the best possible solutions for your organization. Please let me know a convenient
time for us to connect. Thank you for your attention, and I look forward to connecting with you soon. Regards, Ahmed Abdelmonem Customer Lifecycle Manager | SMB South Africa | MEA v-ahmabdelmo@microsoft.com Application Unsuccessful Inbox SARS Human Capital and Development Sat, Oct 26, 9:00 AM (1 day ago) to me Dear Tshingombe
Tshitadi , Thank you for applying for Specialist Advisor: Direct Tax (Legal and Domestic Tax). After careful consideration and review of your profile against the minimum requirements (qualifications and work experience) of the job, we regret to inform you that your application was not successful. We encourage you to visit our career site and search other
available opportunities. Thank you for showing interest and we wish you all the best in your job search. Thank you for applying to Schneider Electric! Inbox Schneider Electric Unsubscribe Sat, Oct 26, 5:22 AM (1 day ago) to me Hi Tshingombe, We appreciate your interest in career opportunities at Schneider Electric! Thank you for taking the time to apply
for the Senior Power Electronics Architect position we have posted online. One of our Talent Acquisition Professionals will review your submission and contact you either by phone or email if you are selected to move forward in the process. We will make every attempt to complete this initial review within 10 – 15 business days; however, we ask for your
understanding if it takes slightly longer due to high volumes. At Schneider Electric, we desire to provide reasonable transparency throughout the process. During the application process, you created an account in which you can log-in to check the status of your application at any time. You can also use this account to update and strengthen your profile.
Thank you, The Schneider Electric Talent Acquisition Team Access My Career Portal Search for Jobs It is the policy of Schneider Electric to provide equal employment and advancement opportunities in the areas of recruiting, hiring, training, transferring and promoting all qualified individuals regardless of race, religion, color, gender, disability, national
origin, ancestry, age, military status, sexual orientation, marital status, or any other legally protected characteristic or conduct. _____ This message was sent to tshingombefiston@gmail.com. If you don't want to receive these emails from this company in the future, please go to: https://se.icims.com/icims2/?
r=6EA61614346& contactId=5749653&pid=17 © Schneider Electric Schneider Electric Sat, Oct 26, 5:26 AM (1 day ago) to me Hi Tshingombe, We appreciate your interest in career opportunities at Schneider Electric! 10/27/2024, 12:52 PM Request an intellectual property (IP) licence | Metropolitan Policehttps://www.met.police.uk/rqo/request/ipl/requestintellectual-property-ip... 18 of 18 Thank you for taking the time to apply for the Digital Power Inside Sales Manager position we have posted online. One of our Talent Acquisition Professionals will review your submission and contact you either by phone or email if you are selected to move forward in the process. We will make every attempt to complete this
initial review within 10 – 15 business days; however, we ask for your understanding if it takes slightly longer due to high volumes. At Schneider Electric, we desire to provide reasonable transparency throughout the process. During the application process, you created an account in which you can log-in to check the status of your application at any time. You
can also use this account to update and strengthen your profile. Thank you, The Schneider Electric Talent Acquisition Team Access My Career Portal Search for Jobs It is the policy of Schneider Electric to provide equal employment and advancement opportunities in the areas of recruiting, hiring, training, transferring and promoting all qualified individuals
regardless of race, religion, color, gender, disability, national origin, ancestry, age, military status, sexual orientation, marital status, or any other legally protected characteristic or conduct. _____ This message was sent to tshingombefiston@gmail.com. If you don't want to receive these emails from this company in
the future, please go to: https://se.icims.com/icims2/?r=6EA61614346&contactId=5749656&pid=17 © Schneider Electric Schneider Electric Sat, Oct 26, 5:27 AM (1 day ago) We appreciate your interest in career opportunities at Schneider Electric! Thank you for taking the time to apply for the EcoStruxure Automation Expert Regional Schneider Electric Sat,
Oct 26, 5:29 AM (1 day ago) to me Hi Tshingombe, We appreciate your interest in career opportunities at Schneider Electric! Thank you for taking the time to apply for the Energy Sourcing Analyst (Italian speaking) -Maternity Cover position we have posted online. One of our Talent Acquisition Professionals will review your submission and contact you
either by phone or email if you are selected to move forward in the process. We will make every attempt to complete this initial review within 10 – 15 business days; however, we ask for your understanding if it takes slightly longer due to high volumes. At Schneider Electric, we desire to provide reasonable transparency throughout the process. During the
application process, you created an account in which you can log-in to check the status of your application at any time. You can also use this account to update and strengthen your profile. Thank you, The Schneider Electric Talent Acquisition Team Tshingombe Tshitadi Dashboard | Log Out My Career Account Options shown include to update your full
profile (helps get important information to our recruiting team), current and past application submissions with current status as well as managing subscription preferences to our talent communities. How can I correct my Personal Information? No need to wait for us, you own and are empowered to correct your data at any time. Just click on 'Update My
Profile' and correct the information. Options Update My Profile View Current Job Opportunities Manage My Interests My Rights Submissions All times are in Eastern European Standard Time. Each row is an application to a Job. The last column contains buttons for actions such as withdrawing or continuing an application if applicable. ID Title Status Last
Update Actions 2023-62576 Energy Sourcing Analyst (Italian speaking) - Maternity Cover Received Submission 10/25/2024 2023-55706 EcoStruxure Automation Expert Regional Consultant Received Submission 10/25/2024 2024-79748 Digital Power Inside Sales Manager Received Submission 10/25/2024 2024-79405 Senior Power Electronics Architect
Received Submission 10/25/2024 2024-79092 Power Systems Medium Voltage Intern Not Selected 10/23/2024 Privacy Notice Schneider Electric Community About Fiston Tshingombe Fiston Company : Tshingombe Engineering engineering electrical st peace college diploma , Cadet Online Community Badges View All 2 Posts 0 Likes Received
0 Likes Given 0 Solutions MY ACTIVITY BOOKMARKS SUBSCRIPTIONS DRAFTS Go to mySchneider Translate to: Please select 1 Help Feedback About Fiston - Schneider Electric Community https://community.se.com/t5/user/viewprofilepage/user-id/153387 1 of 3 10/17/2024, 12:05 PM No Content Available My Content Likes Given Latest Contributions Activity Feed 0 0 0 0 0 0 0 2 My Moderated Posts Understanding Our Pre-Moderation Process: Fostering a Positive Community Environment My Photos Upload An Image Top Tags english scada SCADA software SCADA tutorial SCADA app Telemetry and SCADA ups apc battery smart-ups PowerChute back-ups turkish power shutdown firmware bug Indonesian modbus spacelynk management network software beeping edc communication homelynk NMC network_management_card problem View All Feedback About Fiston - Schneider Electric Community https://community.se.com/t5/user/viewprofilepage/user-id/153387 2 of 3 10/17/2024, 12:05 PM Terms &
Conditions Privacy Notice Change your cookie settings © 2024 Schneider Electric, Inc FORUMS KNOWLEDGE CENTER EVENTS & WEBINARS IDEAS BLOGS GET STARTED | | Feedback About Fiston - Schneider Electric Community https://community.se.com/t5/user/viewprofilepage/user-id/153387 3 of 3 10/17/2024, 12:05 PM Thank you
for your interest in Microsoft! Inbox Microsoft Recruiting Unsubscribe Fri, Oct 25, 5:10 PM (2 days ago) to me Hi Fiston Tshingombe teodor, Thank you for your interest in a career at Microsoft. Unfortunately, we will not be moving forward with your candidacy for the position of Software Engineer II, 1755381 at this time. However, we'd like to encourage you
to continue to explore other career opportunities on Microsoft Careers as we continually update openings on a daily basis. We look forward to considering you for other positions at Microsoft! Thank you, Microsoft Recruiting Microsoft respects your privacy. To learn more, please read our Microsoft Data Privacy Notice. This mail is sent from an unmonitored
mailbox. Please do not reply. Your Application to Schneider Electric - Tshingombe Tshitadi Inbox Schneider Electric Unsubscribe 2:17 PM (2 hours ago) to me Hi Tshingombe, Thank you again for your interest in Schneider Electric and the Power Systems Medium Voltage Intern role we have on our team. We wanted to follow-up on the status of your
candidacy. Your application was impressive; however, you were not selected to continue forward in the process. Please do not take this decision to mean we have no interest in you as a candidate. We will keep your resume in our system and share opportunities that fit your skills and experience. New positions are posted daily, so we encourage you to
continue visiting our career website but also sign-up for our talent pool emails to receive notification of the latest roles that match your profile. We wish you success in your job search and hope we will have the chance to consider you for another role in the future. Best regards, Brock Coffey The Schneider Electric Talent Acquisition Team Access My Career
Portal Search for Jobs _____ This message was sent to tshingombefiston@gmail.com. If you don't want to receive these emails from this company in the future, please go to: https://se.icims.com/icims2/?r=6EA61614346&contactId=5716766 © Schneider Electric Update on Your Job Application for (644) Team
Leader - Food and Beverages - CSD Inbox SARB Talent Acquisition 2:30 PM (2 hours ago) to me Dear tshitadi tshingombe, Thank you for your your application to (644) Team Leader - Food and Beverages - CSD (644). Kindly note that this requisition hiring process currently on hold. Hence selection process will be paused temporarily, we will notify you as
soon as we resume this process. Regards, SARB Talent Acquisition Team Update on your Job application with SARB SARB Talent Acquisition 2:35 PM (2 hours ago) Dear tshitadi tshingombe, Thank you for your interest in the (644) Team Leader - Food and Beverages - CSD at the SARB, we regret to inform you that your application was unsuccessful.
Thank you for your interest in Microsoft! Inbox Microsoft Recruiting Unsubscribe 9:29 AM (7 hours ago) to me Hi Fiston Tshingombe teodor, Thank you for your interest in a career at Microsoft. Unfortunately, we will not be moving forward with your candidacy for the position of Senior Applied AI Engineer , 1762298 at this time. However, we'd like to
encourage you to continue to explore other career opportunities on Microsoft Careers as we continually update openings on a daily basis. We look forward to considering you for other positions at Microsoft! Thank you, Microsoft Recruiting Microsoft respects your privacy. To learn more, please read our Microsoft Data Privacy Notice. This mail is sent from
an unmonitored mailbox. Please do not reply. 11 of 8,039 Application Unsuccessful Inbox SARS Human Capital and Development 8:30 AM (8 hours ago) to me Dear Tshingombe Tshitadi , Thank you for applying for Researcher: Tariff X2. After careful consideration and review of your profile against the minimum requirements (qualifications and work
experience) of the job, we regret to inform you that your application was not successful. We encourage you to visit our career site and search other available opportunities. Thank you for showing interest and we wish you all the best in your job search. Best Regards, SARS Talent Acquisition Team 23 October 2024 SARS Human Capital and Development
10:30 AM (6 hours ago) to me Dear Tshingombe Tshitadi , Thank you for applying for Technical Officer: Tariff Classification. After careful consideration and review of your profile against the minimum requirements (qualifications and work experience) of the job, we regret to inform you that your application was not successful. SARS Human Capital and
Development 10:30 AM (6 hours ago) to me Dear Tshingombe Tshitadi , Thank you for applying for Investigator: Digital Fraud. After careful consideration and review of your profile against the minimum requirements (qualifications and work experience) of the job, we regret to inform you that your application was not successful. Update Around Your
Application Inbox Eaton TalentHub Tue, Oct 22, 2:43 PM (1 day ago) to me Dear Fiston, Thank you for applying for the position of Commercial Finance Manager - 31056. We appreciate the opportunity to consider you for employment with Eaton. This communication is to let you know that this job has been filled. We invite you to visit www.eaton.com/careers
and apply to other opportunities that match your current career aspirations. Thank you for your continued interest in Eaton. Best regards, Eaton TalentHub Tue, Oct 22, 3:47 PM (1 day ago) to me Dear Fiston, Thank you for applying for the position of Service Centre Helpdesk Coordinator - 33335. We appreciate the opportunity to consider you for
employment with Eaton. This communication is to let you know that this job has been filled. We invite you to visit www.eaton.com/careers and apply to other opportunities that match your current career aspirations. Thank you for your continued interest in Eaton. Best regards, Please tell us the name of the officer or member of staff you are working with in
relation to this request Become a Member My Elektor Topics Magazine Articles News Video Projects Newsletter Submit Store You are now logged in. MyLAB EN0202272ID No bio 0 | Follow user View as visitor: My Groups Coming soon My Stats 0 Published projects Views 0 Followers 0 Star(s) on average 0
Comments 0 Comments My Projects No projects Following Not following any project Subscribe to the e-zine Elektor is an international platform for applied electronics, providing engineers, makers, and startups with expert content, practical knowledge, and industry insights. Since the 1960s, we've empowered a global community to design, build, and
share real-world solutions. Members get exclusive project access, store discounts, and opportunities to collaborate with top innovators. Whether you're learning, designing, or scaling a business, Elektor helps you connect, create, and grow. Become a member CUSTOMER SERVICE Privacy Policy Terms of business Copyright Contact us
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Newsletter Submit Store Elektor Account My Account My Address Details My Membership My PDF's & Courses My Projects My tag alert preferences My Newsletter preferences My Loyalty Coupons Logout My Account Avatar Upload your profile picture here JPEG, PNG or GIF file - 5 MB file size limit (please note this picture may be
used with your online publications on our websites). Gender First Name Last Name Nickname Date of Birth My DVD settings Email address tshingombefiston@gmail.com Primary Add email address Invoice emailaddress Phone numbers Add phone number Change password Subscribe to the e-zine Elektor is an international platform for applied
electronics, providing engineers, makers, and startups with expert content, practical knowledge, and industry insights. Since the 1960s, we've empowered a global community to design, build, and share real-world solutions. Members get exclusive project access, store discounts, and opportunities to collaborate with top innovators. Whether you're learning,
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Tachogenerator 535B JANUARY & FEBRUARY BONUS EDITION 2025 | ELEKTORMAGAZINE.COM EDITION DIGITAL FOCUS ON Power & Energy 1 9 6 1 100k S I N C 240210-002 PIC GND OPI EXT D7a BZX84C2V7-TP C13 100n D1a BAS21 R9 4k7 R7 1k R8 EOne partner, unlimited technology solutions. fortec-integrated.de fortec-power.de •
Embedded • HMI systems • Power supplies • Displays and TouchCONTENTS Elektor January/February 2025 Bonus Edition Elektor Magazine is published 8 times a year by Elektor International Media b.v. PO Box 11, 6114 ZG Susteren, The Netherlands Phone: +31 46 4389444 elektor.com | elektormagazine.com For all your questions service@elektor.com Become a Member elektormagazine.com/membership Advertising & Sponsoring Büsra Kas Tel. +49 (0)241 95509178 busra.kas@elektor.com elektormagazine.com/advertising Copyright Notice © Elektor International Media b.v. 2025 The circuits described in this magazine are for domestic and educational use only. All drawings,
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Abate Content Director, Elektor Bonus Edition Power & Energy Solutions Looking for more power- and energy-related content? This bonus edition of ElektorMag features additional content to inspire you to design your own solutions. As usual, we include articles on other interesting topics as well. Is your grid supply steadily available? The article, “Mains
Power Outages Monitor,” details a circuit that constantly monitors mains power and signals outages. Before high-power semiconductor-based rectifiers, converting AC to DC in industrial and transportation applications was a signifi cant challenge. Devices were bulky, fragile, used polluting materials, and demanded frequent maintenance. Check out the
article, “Mercury Rectifiers,” to learn about mercury arc rectifiers and more. Brush-type DC motors are often replaced by brushless (BLDC) and stepper motors, but their simpler control still has advantages. The article, “Speed Control of a Brushed DC Motor,” explores maintaining constant speed regardless of torque — without a tachometer generator. We
hope you enjoy these articles and rest of the content in the Bonus edition. As you work on your own projects, be sure to document your progress on the Elektor Labs platform (www.elektormagazine.com/labs)! International Editor-in-Chief: Jens Nickel | Content Director: C. J. Abate | International Editorial Staf : Asma Adhimi, Roberto Armani, Eric Bogers,
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Patrick Wielders | Publisher: Erik Jansen | Technical questions: editor@elektor.com The Team COLOPHON EDITORIAL The January/ February 2025 edition of ElektorMag is available at newsstands and in the Elektor Store. 3 Colophon 4 Speed Control of a Brushed DC Motor EMF Measurement Instead of Tachogenerator 10 8-Bit Companion for the
Raspberry Pi Power Saving Made Easy 12 From Life's Experience Micromanagement 14 Peculiar Parts Mercury Rectifiers 16 Infographics: Power and Energy 18 Mains Power Outages Monitor Is Your Grid Supply Steadily Available? January & February 2025 3 One partner, unlimited technology solutions. fortec-integrated.de fortec-power.de • Embedded •
HMI systems • Power supplies • Displays and Touchgenerator unit is larger and more expensive than a tacholess version of a motor. If the motor is operated with a pulsed voltage (PWM), however, the speed is proportional to the duty cycle. At the same time, the motor operates as a generator in the off-phase of the PWM voltage so that its speed can be
measured in this phase. In the past, in the analog age, the electronic effort for such a control was not insignificant, as can be seen from the schematic diagram in Figure 5. A rectangle generator, a voltage-controlled pulse width modulator, a sample-and-hold circuit to measure the actual speed value, and a PI controller were required. In the digital world, the
principle remains the same, but the effort required is consid erably reduced thanks to the use of a microcontroller. By Rainer Schuster (Germany) Brush-type DC motors are increasingly being replaced by their brushless (BLDC) and stepper motor competitors. However, their use still makes some sense, as the control effort is considerably lower. This article
shows how to keep the speed of a DC motor with brushes constant regardless of the torque – and without a tachometer generator. In the simplest case, a DC motor is connected to a variable voltage supply, as shown in Figure 1. The speed is (theoretically) propor tional to the supply voltage VM, but only as long as the torque is constant. Unfortu nately, the
equivalent circuit diagram of the DC motor looks like Figure 2. The motor winding not only has an inductance LM, but also an ohmic resistance of the copper wire, which is designated by RM. The higher the torque, the more voltage drops across RM, until finally there is no more voltage across the inductance LM and the motor stops (Figure 3). Control with
Tachogenerator or EMF Measurement To compensate for these torque-dependent speed fluctuations, the motor was once usually coupled to a tachogenerator, which in turn supplied a voltage proportional to the speed (Figure 4). However, a motor-tacho Speed Control of a Brushed DC Motor EMF Measurement Instead of Tachogenerator basics 4 Bonus
Edition January & February 2025 www.elektormagazine.comRPM ~ VM M VM Figure 1: In an ideal world, the speed is proportional to the motor voltage. I ~ N V = V – R x I RPM ~ V L RM M M M M M M M M VM Figure 2: In practice, the ohmic resistance of the motor winding joins its inductance. U/min I M NM Figure 3: The higher the torque, the slower the
motor turns. Rev. target value Differential amplifier Tacho generator Motor Voltage regulator Power supply M Figure 4: Block diagram of a motor control system with tachogenerator. PI-Regler Drehzahl Sollwert Sample & Hold-Schaltung MOSFET-Schalter Spannungsgesteuerter Pulsbreitenmodulator NF-Rechteck Generator Strom versorgung Motor M
Figure 5: Block diagram of a motor control with EMF measurement. January & February 2025 5 Practical Implementation of an EMF Control As the complete circuit diagram in Figure 6 shows, an ATtiny45 microcon troller from Microchip with 4 kB of flash memory is used for control. The controller has only eight pins, but is perfectly suited for this application.
It can be programmed “in system” via SV2 using an ISP program ming device. The microcontroller is supplied with 5 V by the voltage regulator IC2, which is why the input voltage (and thus the motor voltage) must not exceed 24 V. Q1 and Q2 control the motor. Q2 is a PMOS transistor of the type IRF4905, which can theoretically handle a motor current of
74 A, but only if a sufficiently dimensioned heat sink is used. Figure 7 shows what happens at the motor terminals during the different phases of the PWM signal: After the ON phase of the PWM signal, a demagnetization period follows in the OFF phase; then the motor generates an EMF voltage that is propor tional to the speed. This voltage is fed to the
ADC2 analog-to-digital converter of the microcontroller via the R4/R5 voltage divider. R5 should be dimensioned so that the voltage at ADC2 does not exceed 5 V. VB R5 12 V 4k7 24 V 2k2 The setpoint speed, which is set by the RPM potentiometer or an external voltage of 0…5 V at X6, is sent to ADC1 of the micro controller. Diode D1 is absolutely neces
sary because when the control voltage is switched off, the inductance of the motor discharges, which results in a negative voltage spike that D1 limits to about 0.7 V. Figure 8 shows a suggested printed circuit board layout for the motor control with EMF measurement; the required compo nents are listed in the Component List. Software I The software for
the ATtiny45 was written in BASCOM. The controller is operated inter nally at 8 MHz. Timer0 is operated as a PWM timer in Phase Correct PWM Timer mode. Demagnetization Switch-o phase Switch-on phase Figure 7: The speed is measured in the switch-off phase after demagnetization. EMF = actual motor speed 240486-009 see text ISP RPM +5V +5V
MOSI GND Reset SCK MISO +5V +24V max. +24V max. X2 Power PB5(RESET/ADC0) PB3(ADC3) PB2(SCK-ADC1) PB4(ADC2) PB1(MISO) PB0(MOSI) IC1 ATtiny45 GND VCC 4 1 2 3 8 7 6 5 1 3 5 2 4 6 SV1 C1 1n X1 C2 100n C3 100n Motor D1 1N4004 Q2 IRF4905 G D S R1 2k2 47k R3 1M Q1 G S D BS170 R4 R5 IC2 78L05 C4 100n C5 100µ 35V
R6 10k X3 C6 10µ 16V R7 Figure 6: Practical circuit of the EMF motor control. 6 Bonus Edition January & February 2025 www.elektormagazine.com 10k 10k 10kWith a prescaler of N = 64, the PWM frequency is: At 8 MHz, this results in a frequency of 245 Hz. The pulse width is set via register PWM0A from 0 to 255. Depending on the motor type, the
prescaler may need to be set to 256, for example if the induction phase is longer than or the same length as the switch-off phase. This results in a PWM frequency of approxi mately 60 Hz. In the main program loop, the speed setpoint is constantly read in at ADC1. The actual value is read in at ADC2 during the off-phase (Pwm_Pin=0) and summed up.
When the motor is switched on again, the average of the actual value is calculated. To implement the PI controller, there is the constant Ti (integration time), together with the time constant of Timer1 and Kp (proportional gain), which must be adapted to the motor used. The interrupt time of Timer1 is set using the TCCR1 register:

TCCR1 Timer1 Interrupt 4
250 µs 5 500 µs 6 1 ms 7 2 ms When Ti has expired (Timer1-Interrupt × Ti), the speed deviation is calculated, added to the previous value (taking into account the sign) and multiplied by Kp. The result is output directly as the new switch-on duration. Control Using RI Compensation Another practical solution can be what is known as RI compensation. As
mentioned at the beginning, the speed fluctuation of a DC motor is due to the ohmic resistance of its copper winding. If the current through the motor is measured, this resistance can be compensated. To do this, only the coil resistance of the motor needs to be known, which can be easily measured. The circuit in Figure 9 is similar to that in Figure 6, except
that the motor current is measured as a voltage drop across R5. R5 is to be dimensioned so that a maximum of 0.5 V is dropped across R5 at maximum motor current. The power dissipation in watts must be equal to R5 × motor current squared. Figure 10 shows a suggested layout for the motor control with RI compensation. 1 6 C1 C2 C3 C4 R3 R4 R5
SV1 C5 C6 R1 R7 1 n 1 00n 1 00n 1 00n 1 M 1 0k TINY45 1 00u/35 1 0u/1 6 1 0k 1 0k Figure 8: Proposal for a circuit board layout for the EMF control. 1 6 C1 C2 C3 C4 R1 R3 R5 SV1 C5 C6 R7 1 n 1 00n 1 00n 1 00n 1 0k 1 M TINY45 1 00u/35 1 0u/1 6 1 0k Figure 10: Proposed circuit board layout for the control with RI compensation. Figure 9: The
motor control with RI compensation differs only in one detail. 240486-009 see text ISP RPM +5V +5V MOSI GND Reset SCK MISO +5V +24V max. +24V max. X2 Power PB5(RESET/ADC0) PB3(ADC3) PB2(SCK-ADC1) PB4(ADC2) PB1(MISO) PB0(MOSI) IC1 ATtiny45 GND VCC 4 1 2 3 8 7 6 5 1 3 5 2 4 6 SV1 C1 1n X1 C2 100n C3 100n Motor D1
1N4004 Q2 IRF4905 G D S R1 R2 47k R3 Q1 G S D BS170 R4 R5 IC2 78L05 C4 100n C5 100µ 35V R6 10k X3 C6 10µ 16V Software II The software for the RI compensation is also written in BASCOM. Timer0 is config ured as a PWM timer with a frequency of 245 Hz. In contrast to the EMF control, the control here is designed as a pure P controller. To
do this, the coil resistance of the motor and the supply voltage must be known and specified as constants RM and U0 in the program. The motor current is now measured during the switch-on phase of the PWM signal. The effective value of the current is calcu lated from the switch-on duration: The duty cycle is then increased by the corresponding value.
Two Options There are several ways to control a DC motor without a tachogenerator. Each of these options has different advantages and disadvantages: > For the EMF control, a PI controller is required, the parameters of which January & February 2025 7 A1 7,5mm 1 2 1 2 - OI 1 2 3 D1 IC2 Q1 Q2 R2 X1 X2 X3 IC1 R6 1 N4004 78L05 BS1 70 IRF4905
47k 1 0k A1 7,5mm 1 2 1 2 - OI 1 2 3 D1 IC2 Q1 Q2 R2 X1 X2 X3 IC1 R4 1 N4004 78L05 BS1 70 IRF4905 47k 1 0k 10k 10k 10kmust be adapted to the motor used in order to optimize over- and under shoot. To do this, voltage fluctu ations in the supply voltage are compensated. > With RI compensation, there are no overshoots or undershoots, but voltage
fluctuations in the supply voltage are not compensated. The schematics, layouts, and software for both controllers can be downloaded from the Elektor Labs project page at [1]. Translated by Jörg Starkmuth — 200486-01 About the Author Rainer Schuster 's fascination with electronics began at the age of 13, when he received the Philips EE1 electronics
experiment kit from his parents for Christ mas in 1970. In September 1971, he bought his first issue of Elektor magazine and has remained loyal to it to this day. After study ing electrical engineering at the Munich University of Applied Sciences, he worked for 37 years as an engineer in electronics development at Agfa in Munich. He has been writing articles
for Elektor since 2009. Now that he is retired, he also has his own YouTube channel (www.youtube. com/@rainerschuster5722), where he posts his projects. Questions or Comments? Do you have questions or comments about this article? Email the author at rainerschuster@mnet-mail.de, or contact Elektor at editor@elektor.com.
Related Product > Motor
Control Development Bundle www.elektor.com/20534 [1] Elektor Labs page about this project: https://tinyurl.com/2004486-01 [2] YouTube video: https://www.youtube.com/watch?v=6IEVBQyKIF4 WEB LINKS Component List for RI Compensation Controller Resistors: R1, R6, R7 = 10 kΩ R2 = 47 kΩ R3 = 1 MΩ R5 = see text Capacitors: C1 = 1 nF C2…C4 =
100 nF C5 = 100 µF/35 V C6 = 10 µ/16 V Semiconductors: D1 = 1N4004 Q1 = BS170 Q2 = IRF4905 IC1 = ATtiny45 IC2 = 78L05 Miscellaneous: SV1 = 2 × 3-pin header X1,X2 = 2-pin PCB terminal, 5 mm pitch X3 = 3-pin PCB terminal, 5 mm pitch Component List for EMF Controller Resistors: R1, R4, R6, R7 = 10 kΩ R2 = 47 kΩ R3 = 1 MΩ R5 = see text
Capacitors: C1 = 1 nF C2…C4 = 100 nF C5 = 100 µF/35 V C6 = 10 µF/16 V Semiconductors: D1 = 1N4004 Q1 = BS170 Q2 = IRF4905 IC1 = ATtiny45 IC2 = 78L05 Miscellaneous: SV1 = 2 × 3-pin header X1, X2 = 2-pin PCB terminal, 5 mm pitch X3 = 3-pin PCB terminal, 5 mm pitch 8 Bonus Edition January & February 2025 www.elektormagazine.com
January & February 2025 9 LUCKY YOU! Not a subscriber yet? Sign up for our free e-zine newsletter at elektormagazine.com/ezine-24 LUCKY YOU! An e-zine subscriber never misses the monthly 'reverse project' GET FREE DOWNLOADDEVELOPER ZONE The MCU obviously requires a separate power supply that is independent of the EN input; due
to the low-energy requirement, a linear regulator is the most economical solution here. In general, the concept is completely component-agnostic; the author likes to use modern PIC16F derivatives from Microchip. Figure 2 shows the sub-circuit that informs the PIC when the SBC (OPI = Orange Pi) is supplied by the external switching regulator (EXT). D1a,
R9 and D7a implement a more or less "classic" attenuator, which breaks down input voltages in the range of up to 20 V to a value that is "manageable" for the inputs of process computer and microcontroller. Splitting the series resistor into the values R7 and R9 is necessary because single board computers sometimes become a low-impedance load or
have a residual voltage when they are switched o" — without the resistor, this Single-board computers with Unix capability facilitate the development of complex control systems. Especially in scenarios with high demands on GUI and data process ing, they are superior to microcontrollers (MCUs). Unfortu nately, power consumption and real-time capability
leave some room for improvement. But why not combine the best of both worlds? If you want to trim an o" -the-shelf single-board computer to be economical, you can achieve this with an eight-bitter as a partner. As an example, we want to implement a system that adheres to programmed downtimes and carries out an "alarm start" in response to a specific
external event. The Circuit Concept In principle, the circuit works as shown in the flowchart (Figure 1). The voltage regulator acting as the main supply for the process computer (usually a switching regulator) is controlled by the microcontroller via its Enable input (EN). By Tam Hanna (Hungary) Raspberry Pis and other SBCs are ideal for sophisticated
process control, but require signi! cantly more power than microcontrollers. Why not combine the best of both worlds? Here we show you how to get an 8-bit PIC to switch on a Raspberry Pi whenever it is needed. 8-Bit Companion for the Raspberry Pi Power Saving Made Easy Figure 1: This circuit design significantly reduces energy consumption in standby mode. Figure 2: The R7 resistor can save both costs and headaches. 240210-002 PIC GND OPI EXT D7a BZX84C2V7-TP C13 100n D1a BAS21 R9 4k7 R7 1k R8 10 Bonus Edition January & February 2025 www.elektormagazine.com 100kwould cause the power management microcontroller (connected via the PIC terminal) to see strange or invalid
values. R7 is an additional protective element — the inputs of the process computer are connected to the supply voltage and ground via protective diodes. When very high voltage levels occur, R7 ensures that the current flowing into these diodes is limited and the process computer is not damaged — C13 and R8 provide a small additional debouncing
function. It should be noted that the circuit shown here with its EXT input was connected "directly" to the vehicle electrical system in various school buses. As there are now several thousands of such systems on the market without failures, it has been proven to work. The role of diode D1a as reverse polarity protection is also helpful — please believe the
author, who also works in the logistics sector, that connecting batteries the wrong way round is one of the classic "sports" of a mechanic. The Software Is the Key Communication via I2C is generally unproblematic (but don't forget the necessary pull-ups). The "secret" of this system lies in the software. The PIC implements a kind of state machine that is
based on the states shown in Figure 3. The implementation of the shutdown process is of partic ular importance. Unixoid operating systems tend not to react very kindly to rough shutdowns. A convenient and practical way to solve the problem is to implement a countdown timer: The SBC activates this countdown and then starts the shutdown of the
operating system. After the (generously dimensioned) period of time has elapsed, the process computer is "inertialized" and can be disconnected from the power supply. Of course, the PIC can also perform other tasks. In addition to storing serial numbers and other informa tion (in order to make it harder to manipulate), it is also possible, for example, to
perform basic control tasks on the PIC. Of course, more complex implementations are also possible: A complex MSR task, for example, would make a 32-bit MCU appear reasonable as the second ary controller. Practical Experience Trackers based on the circuit concept shown here are now being used in tens of thousands by one of the author's
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
26 of 39 3/11/2025, 1:20 PM
customers, demonstrating the practical value of the design. Instead of a stand-by power consumption of around 200 mA, the system now gets by with just a few milliamperes. The author's AN4121, published by Microchip, is available at [1] and provides further infor mation on the topic. Translated by Jörg Starkmuth — 240210-01 Questions or Comments?
Do you have questions or comments about this article? Email the author at tamhan@tamoggemon.com or contact Elektor at editor@elektor.com. Figure 3: Also helpful in the embedded sector: the state machine. [1] Usha Ganesh and Tam Hanna, "Using PIC16F Microcontrollers for System Power Supply Control," Microchip Application Note AN4121, 2021:
https://www.microchip.com/en-us/application-notes/an4121 WEB LINK About the Author Ing. Tam Hanna has been working with electronics, computers, and software for more than 20 years; he is a freelance developer, book author, and journalist (www.instagram.com/tam.hanna). In his spare time, Tam's interests include 3D printing and the distribution of
cigars. January & February 2025 11DEVELOPER'S ZONE installation on the roof or engage in energy sharing with the owner of an installation at another location. For a communal instal lation, you need a two-thirds majority of the co-owners, good luck with that, I would say; as a tenant, you should try to convince your landlord eventually. And regarding
energy sharing, that is hardly appealing because it is complex, cumbersome and above all expensive. It is possible to have a small PV installation in Belgium, but you have to follow the same procedures as for traditional larger installations. With a "xed connection to a separate group in the distri bution cabinet, the necessary inspections and bureaucracy,
the costs rise considerably, and your pro" ts melt like snow in the sun. However, there is light at the end of the tunnel and from May 2025, plug-in solar panels would — "nally — be allowed in Belgium after all. The question, of course, is how strict the conditions and modalities will be. With a bit of bad luck, you will have to be able to present an inspection
report of your electrical installation, and you run the risk of having a "smart" meter shoved down your throat. Belgians are rather risk-avoiding, and this is also re# ected at the policy and regula tory level. In my opinion, it would be better to ban extension cords with a power strip, electric bikes, electric scooters and hover boards. These have been in the news
several times in the context of house "res and with the last two devices, you can have serious accidents too. I was reminded of this after last summer's commotion around a well-known Belgian DIY store that had o$ ered plug-in solar panels with the best of intentions but had to remove them from its shelves again, to its shame. Speed Camera While in
neighbouring countries "plug-in solar panels" have been used trouble-free for years (Figure 1), a Belgian user organi zation and sector federation for renewable energy ODE — apart from the fact that it is forbidden — seem to be particularly disliking of balcony PV installations [3]. According to them, these are potentially unsafe, which may have a short lifes
pan, and hardly financially interesting. They have a clear preference for larger PV installations, including for #at dwellers. The latter should just install a communal By Ilse Joostens (Belgium) I have read with interest the Elektor articles from 2021 and 2024 on balcony PV installations by Dr. Thomas Scherer [1] [2], and I am entirely convinced by the idea of
covering your home's "quiescent power consumption" with solar energy. In Germany, you even get a subsidy for this; but unfortunately, I live in Belgium where this kind of installation is strictly forbidden by Synergrid technical regulation C10/11 due to — alleged — "re and electrocution danger. From Life's Experience
Micromanagement Source: Adobe Stock
/ EtiAmmos. developer's zone 12 Bonus Edition January & February 2025 www.elektormagazine.com Tips & Tricks, Best Practices and Other Useful InformationDEVELOPER'S ZONE heating systems and which car we drive. Similarly, the sale of numerous "hazard ous" substances to individuals has been restricted. Even lead-based solder is becom ing
harder and harder to "nd, and there are already suppliers in Europe that no longer sell this stu$ to individuals because it contains lead. Just imagine working on older electronic equipment for the hobby. This kind of micromanagement also curtails entrepreneurship because many companies start small, perhaps as a few students who have discovered a gap
in the market and are working on a product in a garage (Figure 2). Even giants like Microsoft, Google [6], HP and Amazon once started this way [7]. The website "Nanny State Index" [8] charts the patronization by various governments when it comes to eating, drinking, smoking, and vaping and, as far as I am concerned, may be expanded to include more
criteria. I dare to plead for less interference, fewer and clearer regulations and, above all, more juridical certainty. Nobody can be against that. Translated by Hans Adams — 240608-01 Politicians usually have a legal background and within that education one appar ently sees no point in ill-considered ad hoc legislation. They just act according to the
delusion of the day or based on #ash politics, resulting in unclear "# ip-# op legis lation." Premiums for electric cars have already been introduced and abolished twice, and because of twists and turns in the law, users of electric company cars who charge them at home will soon be allowed to pay a lot more taxes. Belgium does not have a monopoly on
absurdities, and in the Netherlands I hear rumours about grid operators secretly increasing the voltage taps on district transformers to limit feed-in from solar panels. In Zeeland, an experi ment has even started where homeowners are asked to switch o$ their solar panels on sunny days for a fee. It shouldn't get any crazier after years of pushing people to
install solar panels anyway. Patronizing The government is increasingly interfer ing in all aspects of our lives, and unfortu nately this goes beyond energy, our home, That smart meter hasn't been out of the news recently, "rst because of the virtual rollback or not for solar panel owners and later in the context of the introduction of the capacity tari$. With that
tari$, your smart meter becomes more like a speed camera that mercilessly charges you every time you have a few too many devices powered on at once in a moment of inattention. And the regulation on the roll-back counter, from which owners with solar panels could bene" t for another 15 years, was rejected by the Constitutional Court in 2021 because
the Flemish government had gone beyond its authority. After "erce protests, the same government was obliged to compensate the duped owners of solar panels. Flipflop You will no doubt be familiar with mathematician and computer scientist Edsger Dijkstra [4] who took issue with the excessive use of goto instructions in higher programming languages [5].
During my training, the ban on goto instructions was enforced to avoid an untidy "spaghetti code." [1] Dr. Thomas Scherer, "Balcony Power Plant," Elektor 9-10/2021: https://www.elektormagazine.com/magazine/elektor-183/59831 [2] Dr. Thomas Scherer, "Optimizing Balcony Power Plants," Elektor 1-2/2024: https://www.elektormagazine.com/magazine/
elektor-324/62631 [3] VRT nws: Are solar panels on your balcony a good idea?: https://www.vrt.be/vrtnws/en/2022/10/18/are-solar-panels-on-your-balcony-a-good-idea/ [4] Wikipedia: Edsger Dijkstra: https://en.wikipedia.org/wiki/Edsger_W._Dijkstra [5] Mathematics & Computer Science Centre: Edsger Dijkstra: Go To Statement Considered Harmful: https://
homepages.cwi.nl/~storm/teaching/reader/Dijkstra68.pdf [6] Inside Google's original garage, 1998-style: https://blog.google/products/maps/inside-googles-original-garage-1998-style/ [7] Business Pundit: 11 famous garage startups that now rule the world: https://www.businesspundit.com/11-famous-garage-startups-that-rule-the-world/ [8] The Nanny State
Index: https://nannystateindex.org/ WEB LINKS Figure 2: Even large companies once started small. Source: Adobe Stock / Gorodenko" . Figure 1: Balcony PV power plant — banned in one country, subsidized in another. Source: Adobe Stock / Ronald Rampsch. January & February 2025 13PECULIAR THE SERIES Rectifiers — those are like diodes,
right? Well, yes. But these are not the kind of diodes you'd use in your crystal radio. Or even for your Raspberry Pi power supply. Or even for that super-duper 200 W per channel amplifier you've been building. Think electric trains, subway systems, broadcast transmitters. BIG stu" . As Crocodile Dundee might say, "That's not a rectifier, THIS is a rectifier!"
Liquid Mercury Mercury-Arc rectifiers make use of the fact that if a pool of liquid mercury with some mercury vapor is used as a cathode, an arc can be drawn from a carbon anode above it, but the process does not work the other way around. Hence, rectification. This is su" iciently electronic to justify their inclu sion in this column, even though they're not
the kind of component that's ever been used in an Elektor project. Mercury-arc rectifiers were invented in 1902 by Peter Cooper Hewitt, an American electrical engineer who had invented mercury vapor lamps (the forerunners of our fluorescent lamps) in 1901. They were developed in the early 1900s and rapidly became the go-to solution for high-voltage,
high current rectification. The arc voltage is around 20…30 V, and the simplicity of their construction makes them e" icient and reliable. They were used up to the 1970s, when semiconductor rectifiers and thyristors that were up to the same job became available. Some were used until 2012. A typical 6-phase rectifier operating is shown in Figure 1. Mercury
Recti! ers By David Ashton (Australia) Before the advent of high-power semiconductor-based recti! ers, transforming alternating current to DC in industrial and transportation ! elds was no mean task! The devices were huge, fragile, contained highly polluting materials, and required frequent maintenance. Figure 1: A 6-phase, high-power mercury-arc
rectifying tube at work. (Source: Wikimedia Commons, https://commons.wikimedia.org/wiki/ File:Quecksilberdampfgleichrichter_in_Betrieb.JPG) Ignitor Electrode Ignition has to be started by an ignitor electrode, which usually has to briefly come into contact with the mercury. This is done by a number of means, including electromagnets, bimetallic strips,
etc. Once the arc has been struck to cause mercury vapor to form, rectification can take place. Most mercury-arc rectifiers were 3 or 6-phase, but single-phase recti fiers needed an excitation electrode to keep the process going. The whole assembly is built within a large glass bulb, which allows the 14 Bonus Edition January & February 2025
www.elektormagazine.comFigure 2: Functional schematic of a mercury-arc rectifying tube (Source: Wikimedia commons, https://commons.wikimedia.org/w/index. php?curid=4577899) mercury vapor to condense and flow back to the cathode pool. The construction of a typical rectifier is shown in Figure 2. A typical 6-phase, 150 A rectifier was around 600
mm tall and about 300 mm round. Above 500 A steel tanks were used with ceramic insula tors for the electrodes, and these were rated up to several thousand amps. Ratings up to several kV were available, higher with special construction techniques, but these required frequent maintenance. The mercury arcs emit a lot of ultraviolet light, you could get
sunburned while working around them. Additionally, the noise from them and the associated transformers was considerable. Mercury is highly toxic and extensive clean-up work is often needed to remove traces of mercury when decommissioning them. 240624-01 Questions or Comments? If you have technical questions or comments about this article, feel
free to contact the Elektor editorial team by email at editor@elektor.com. About the Author David Ashton was born in London, grew up in Rhodesia (now Zimbabwe), lived and worked in Zimbabwe, and now lives in Australia. He has been interested in electronics since he was "knee-high to a grasshopper." Rhodesia was not the center of the electronics
universe, so adapting, substituting, and scrounging components were skills he acquired early (and still prides himself on). He has run an electronics lab, but has worked mainly in telecommunications. They trust us, do you? We love electronics and projects, and we do our utmost to fulfill the needs of our customers. The Elektor Store: Never Expensive,
Always Surprising!' Check out more reviews on our Trustpilot page: www.elektor.com/TP/en Or make up your own mind by visiting our Elektor Store, www.elektor.com January & February 2025 15 elektor.comPower and Energy Elektor infographic Smart Grids: Enabling the Energy Transition Solar Energy: Innovations Shaping the Future The global solar
energy market is on a positive growth trajectory as the solar energy industry is in a constant state of evolution. By 2030, installed renewable electricity generation capacity under the IRENA 1.5°C Scenario (see textbox on next page) is expected to more than double, with solar PV contributing 49% of the total capacity compared to 40% in 2023 [1]. This
translates to an increase from 4,085 GW in 2023 to 11,173 GW by 2030, driven by annual additions averaging 558 GW per year. Challenges and Opportunities Achieving the 2030 targets will require robust innovation and investment. The solar sector's ability to sustain its current momentum hinges on continued advancements in technologies like bifacial
panels, floating solar farms, and AI-optimized energy systems. These innovations will enhance e! ciency and integration, ensuring solar's key role in a clean energy future. > Perovskite Solar Cells: These a! ordable and e! icient alternatives to silicon cells are transforming solar accessibility. Lab e! ciencies of up to 25% suggest they could become a
cornerstone of future solar technologies. > Transparent Solar Panels: Integrating photovoltaics into windows o! ers a revolutionary way to harvest energy without compromising aesthetics. Early-stage transparent panels are achieving e! ciencies around 10%. > Floating Solar Farms: By utilizing water surfaces, floating solar farms optimize land use while
benefiting from natural cooling, which enhances panel e! ciency. > AI-Optimized Energy Systems: AI is transforming solar operations, helping precise energy prediction, smarter grid integration, and real-time optimization. > Solar Skins: Customizable appearances for solar panels allow ideal integration into residential and commercial designs, addressing
aesthetic concerns [5]. Global Solar Market: A Bright Outlook to 2030 Source: SolarPower Europe (2024), IRENA (2024) Source: Bartz/Stockmar (M), CC BY 4.0 Global Installed Renewable Electricity Generation Capacity in the 1.5°C Scenario, 2023 and 2030 [1]. • Solar PV • Hydro • Wind • Other RE 2023 4,085 GW 2030 11,173 GW 40% 25% 4% 6%
31% 13% 49% 32% Yesterday few large power plants production market transmission distribution consumer centralized, mostly national based on large power lines and pipelines top to bottom passive, only paying Tomorrow many small power producers decentralized, ignoring boundaries including small-scale transmission and regional supply
compensation both directions active, participating in the system 16 Bonus Edition January & February 2025 www.elektormagazine.com[1] SolarPower Europe, "Global Market Outlook," June 2024: https://tinyurl.com/solar-outlook-2024 [2] IRENA, "World Energy Transitions Outlook 2024: 1.5°C Pathway," November 2024: https://www.irena.org/
Publications/2024/Nov/World-Energy-Transitions-Outlook-2024 [3] IRENA, Hydrogen: https://www.irena.org/Energy-Transition/Technology/Hydrogen [4] Zurich, "How blue and green hydrogen can help solve the climate crisis," July 2024: https://www.zurich.com/media/magazine/2022/is-hydrogen-the-fuel-that-can-save-our-planet [5] Tamesol, "The Future of
Solar Energy," January 2024: https://tamesol.com/future-of-solar-energy/ WEB LINKS 240640-01 Green hydrogen production, conversion, and end uses. [3] Another critical enabler has emerged for sectors that are challenging to electrify, such as heavy industry and long-haul transport, and that one is hydrogen. According to IRENA, hydrogen could fulfill
12% of global energy demand under the 1.5°C Scenario [3], with applications spanning transport, power generation, and heating. However, its production methods vary widely in environmental impact, earning the labels grey, blue, and green depending on the CO2 emissions involved. Currently, 96% of global hydrogen production relies on fossil fuels (grey
hydrogen), underscoring the need for a rapid transition to cleaner methods [4]. The high costs of production for green hydrogen, and substantial energy losses during production, storage, and conversion make it less e! icient than alternatives like batteries, while increasing blue hydrogen depends on costly carbon capture technologies. Hydrogen: Main
Ingredient for Decarbonization 12% of global energy demand could be fulfilled by hydrogen under the 1.5°C Scenario. 96% of current share of hydrogen is produced from fossil fuels (grey hydrogen). What Is IRENA's 1.5°C Scenario? IRENA stands for the International Renewable Energy Agency, an intergovernmental organization that promotes the
adoption and sustainable use of renewable energy worldwide. The IRENA 1.5°C Scenario in the World Energy Transitions Outlook presents a pathway to achieve the 1.5°C climate target by 2050 [2]. Achieving this target requires substantial investments in clean energy technologies, such as solar, wind, and storage, to decarbonize global energy systems.
PRODUCTION TRANSFORMATION TRANSPORT END USE Renewable energy Electrolysis Shipping Trucks Pipeline Storage Sustainable CO2 capture Synthetic Fuels* TRANSFORMATION NO TRANSFORMATION Green ammonia + H2 H2 H2 INDUSTRY H2 HEATING H2 POWER GENERATION H2 CO2 + H2 N2 NH2 TRANSPORT H2 NH2
Chemical industry Shipping Refineries Trucks Aviation Cars Rail Buses Steel industry January & February 2025 17This design addresses the need to monitor service interruptions, whether caused by technical issues — such as infrastructure mainte nance — or by malicious intruders tampering with the external meter switch to disconnect the power supply.
Such an action could deplete the alarm system's backup batteries, leaving the home vulnerable. Triggering an alarm as soon as a disconnection is detected enhances overall home security. To prevent unnecessary activations, a delay (or tolerance) time of a few seconds has been implemented. This helps avoid false alarms caused by brief interruptions. In
addition to the basic version (see Table 1), the digital version o" ers enhanced features: it tracks mains voltage drop events, allows adjustment of alarm and delay times, and automatically deactivates the signal once the preset alarm duration has elapsed. Furthermore, by configuring two DIP switches on the PCB, you can enable a beep function and a
power-restoration notification. These additional features will be discussed in detail later. Di! erences Between the Analog and Digital Versions Analog Version As can be seen from the diagram in Figure 1, the power supply section has no transformer, which we will find in the digital version instead. Therefore, greater care must be taken during testing, since
the whole circuit is connected to the mains voltage, with danger of electrocution in case of contact! In the case of the digital version, this danger is limited to the small part of the circuit connected to the primary of the transformer, which nevertheless requires a high level of attention during the testing phases! After the AC rectification and 24 V DC limiting
section, consisting of diodes D1…D4 diodes and Zener diode D5, we note the split of that voltage source into two leads. One heads to the D6-C2 series, the other goes to the base of Q1. The D6-C2 series network produces a stabilized PROJECT By Stefano Purchiaroni (Italy) In areas where mains power is unstable and/or there may be safety issues, it
may be useful to have a circuit that constantly monitors its presence and signals the outages in a timely manner to an external system. In this article, two design solutions are presented: one basic analog and a digital, microcontroller-based version, to monitor the presence of the power grid voltage at home and also perform the outages count. Mains Power
Outages Monitor Is Your Grid Supply Steadily Available? Table 1: Available Functions in analog and digital Version. Function Analog Digital Delay (tolerance time) against short interruptions × × Delay time adjustment - × Alarm stop after a preset time - × Alarm time adjustment - × Counting and display of outages number - × Selectable pulse or permanent
activation × × Signaling of mains power return - × 18 Bonus Edition January & February 2025 www.elektormagazine.comwill have to be implemented downstream of the circuit, or it must be part of the siren or other controlled device of choice. In addition to permanent signaling, the Pulse Mode of about 2 s can be selected through the other position of

switch SW1 (closed contacts 5-2 and 4-3). In the absence of mains voltage, C3 gradually discharges, reducing the voltage across the base of Q1 until it is brought into conduction. Q1 thus lets current flow from C2 to the relay, passing through C4. The relay is energized, activating the alarm. After about half a second, C4 is fully charged, reducing the current
flow on the relay coil until the relay is de-energized, approximately 2 s later. The values of the capacitors and resistors are already calculated to make sure that the charge of C2 can sustain the whole cycle. When the power returns, Q1 will go o" again, the relay will not change its state, and C2 will be charged once more and will be able to support new
cycles. Note the important function of diode D6 in this mode, which acts as a "check valve" preventing the base of Q1 from remaining high due to the accumulated charge in C2, and the relay from staying o" . Digital Version The digital version's greater complexity is immediately apparent from the schematic in Figure 2. The circuit is supplied through a trans
former with a 6 V output, which feeds two rectifier bridges, BR1 and BR2. The latter, followed by the stabilization section — consisting of C3, a small, 5 V linear voltage regulator U1 and C4 at the output — provides power for microcontroller U2, a versatile PIC16F1827 by Microchip. In the event of no mains voltage, 1.5 F supercapacitor C5 will continue to
provide enough power to the PIC for a considerable time. Management of the supercapacitor is achieved by blocking diodes D2, D3 and D4, which isolate it during ordinary operation but ensure its charge. 23.3 V output, used to activate the relay via path 4-6 (steady mode) of the DPDT switch SW1. When the mains voltage fails, the relay returns to the o"
position, thus closing the COM-NC contact. Please note: In the circuit diagram, the relay is drawn in its de-energized state, which means the alarm is on. This is valid only when SW1 is in Steady Mode, in the position represented on the schematic. In the other position of the switch (4-3/5-2/Pulse Mode) the relay gets energized just for 1 to 2 seconds (which
means then the alarm is on). When the mains voltage fails in Steady Mode, the alarm is activated with about a 3-to-4-second delay, due to the energy stored by the large electrolytic capacitor C2 being discharged. When power comes back on, the deactivation of the alarm will occur with about a 2 s delay, the time it takes C2 to charge and provide a high
enough voltage to activate the relay again. Capacitor C5, initially discharged, allows the relay to be instanta neously activated at full voltage, but once charged, the current to keep it activated is supplied through R5, and reduced slightly, yet remaining at a level more than enough to hold the relay contacts in the closed position. This technique greatly
extends the life of the relay, which remains slightly underpowered most of the time. The relay should be a DPDT type, with a 24 V coil and an internal resis tance of 1,600 Ω. Any mains disconnection that lasts less than the delay time mentioned earlier will not produce an alarm activation, since C2 will not have discharged enough to drop the voltage
supplied to the relay below its Vo" , measured experimentally at around 4 V. This delay avoids unnecessary alarms in case short interruptions might occur. In this analog version, the delay time is not adjustable. Another down side concerns the alarm time: Once C2 is discharged — and still no mains voltage is present at the input — the relay goes o"
permanently, leaving the alarm active indefinitely. Management of a maximum time 240559-003 RL1 24V Alarm Mains 0W5 1W 4x 1N4007 0W5 0W5 D3 D2 D1 D4 D5 24V R1 1M R2 820Ω C1 470n D6 1N4007 C2 2200µ 35V C3 100µ 35V C4 100µ 35V C5 100µ 35V R3 R4 4k7 R5 680Ω Q1 BC557 D7 5V1 D8 1N4148 J2 J1 SW1 6 3 4 5 1 2
Figure 1:
Schematic of the mains power outage analog version. January & February 2025 19 18kThe interrupts then wake the microcontroller for program execution every second, basically to count the seconds elapsed and decide if it is time to act on the relay — comparing the second counter with the reading of the two resistive trimmers RV1 and RV2. A further
reduction in power consumption is made possible by connect ing the hot side of the two trimmers not directly to the supply voltage, but to digital output pin RA2, which will be set to logic high level only during the reading of the two trimmers, taken via analog inputs AN3 and AN4 (pin 2 and 3 of U1, RA3, and RA4, respectively).
Mains voltage drop detection
is done by the section starting at BR1, which has no high capacitance downstream, but is equipped with a circuit that generates 5.1 V when mains power is present. Note jumper JP1, provided for removing and reprogramming of the PIC without it being powered by the supercapacitor. To avoid excessive voltage drops, diodes D2 and D4 were chosen to be
Schottky types, with a direct threshold voltage VDS as little as 0.2 V. This allows C5 to be charged up to 4.8 V, and to get 4.6 V for the backup power supply to the PIC, which has a minimum operating voltage of only 2.8 V for the chosen model. When the supercapacitor supplies the circuit, the reduction of the microcontroller's power consumption is
achieved by software-enabling the "Nanowatt" mode, introduced by Microchip on most of its micro controllers. It sends the controller into a low-power state, where only the 32,768 Hz oscillator remains on, reactivating the code execution only at the interrupts coming from the timer associated with that oscillator. X1 = 26+] 240559-007 TOL ALM BKBP
RESET OnOff Stat +V1 +V2 6(16(0W5 Mains W04G Alarm +V1 3V TP1 +V2 6(16(+V1 RA5/MCLR RA0 RA1 RA2 RA3 RA4 RA6 RA7 VSS VDD RB0 RB1 RB2 RB3 RB4 RB5 RB6 RB7 17 18 15 16 14 10 11 12 13 1 2 3 4 5 6 7 8 9 U1 U1 = PIC16F1827 C6 100n RV1 22k RV2 22k DSW1 SW1 C7 22p C8 22p X1 R5 D5 Yellow R7 D7 Red R9 D9 Green R6
4k7 Q1 BC547 R8 4k7 Q2 BC547 RL1 D8 1N4148 J2 BR2 W04G BR1 TR1 J1 R1 R2 1k R3 R4 22Ω C1 47µ 16V C2 100n C3 1000µ 16V C4 47µ 16V C5 15) 5V5 D1 5V1 U2 78L05 D4 SB140 D2 SB140 D3 1N4007 JP1 D6 1N4148 Figure 2: Schematic of the microcontroller-based, digital design. 20 Bonus Edition January & February 2025
www.elektormagazine.com 470Ω 470Ω 6V, 1VA5 22k 10k 470Ωvoid SetAlm() { // Activate the alarm and count the event in EEPROM // Activate the alarm ALMOFF=0; ALMON=1; delay_ms(RlyTim); ALMON=0; curs = 0; // Reset the second counter } The following interrupt() function constitutes the entry-point of the PIC's interrupt service routine, ISR. It is
invoked by the interrupt generated by Timer1 when the second expires, even in low-power mode. An output is provided on the circuit board on test point TP1 to verify with a frequency meter or oscilloscope the operation of the oscillator. TP1's level toggles every second, producing a 0.5 Hz signal. The ground for the measurement is available on the
respective GND-labeled test point. The main purpose of the interrupt procedure is to count the elapsed seconds using the 32-bit variable, curs. The interrupt for the next cycle is enabled again downstream of the function: void interrupt() { // Interrupt Service Routine. // It is called every second by Timer1 overflow. // --------- TMR1 --------- // Manage Timer1
overflow (each 1s) // to count seconds if (PIR1.TMR1IF == 1) { CLKOUT ^= 1; // Provide 0.5 Hz to Pin 1 // for checks curs++; // Update the current // second counter TMR1H = TMR1H_INI; // Reload counter high byte TMR1L = TMR1L_INI; // Reload counter low byte PIR1.TMR1IF = 0; // Clear TMR1 Interrupt flag } } After hardware setup and initialization of
variables, main() function handles events according to the logic of a finite-state automaton. The current state of the automaton is set in the Mode variable. First, pressing on the SW1 button is verified, to reset the event counter and for restarting the microcontroller via the reset assembler instruction. At the first power-up with a blank microcontroller, and only
then, it will be necessary to press the SW1 button to set the alarm count in EEPROM to zero. At the execution of setup(), following the button press, it will also be forced to turn o" the alarm control relay, in case (for any reason) it had remained active. In the event of an outage, the SENSE-tagged output voltage drops quickly, communicating the event to
digital input pin RB1 (AN11), which interprets a voltage less than 0.8 V as a binary "0"; with the component values in this section, this threshold is reached about half a second after the mains voltage drop. By mounting optional resistor R3, this delay can be further reduced. Based on the high or low level of pin RB1, the management software activates the
alarm, according to the settings of the two potentiome ters RV1 and RV2, which allow you to adjust the delay time between 0…10 s, and the alarm time from 0…2 min. As mentioned earlier, second-counting is handled by the PIC's internal low-power oscillator, fitted with the small external 32,768 Hz watch crystal, X1. Again, to minimize power consumption,
the relay chosen is a bistable, 3 V, double-coil DPDT type. The two sets of contacts are connected in parallel to increase the current carrying capacity, which, however, may not exceed 5 A. The two turn-on and turn-o" coils are driven by Q1 and Q2 transistors, whose bases head to the PIC's RA6 and RA7 pins. The microcontroller will thus be able to turn
the relay on and o" with short positive pulses on those pins. This chip is also connected to a dual DIP switch, which enables the two optional functions, Beep and Back. The former limits the alarm on to about one second, to provide a brief but intense warning to those in the house, for example, alert ing them to the voltage drop without disturbing the
neighborhood. The Back function provides two short pulses to indicate the return of mains voltage. However, this function is limited by the maximum energy delivery time provided by supercapacitor C5, which is about a couple of hours. Finally, we note button SW1 and LED D5. The latter has the task of using short flashes to indicate the drop events that
have occurred. If, for example, a power failure has occurred twice, D5 will cycle two flashes, followed by a pause of about 3 s. To reset the count, simply press the Reset button SW1. This switch also performs a full restart of the PIC, and a forced disable of the relay, which is useful in case of problems. The two LEDs, D7 and D9, indicate the output of the
short command to enable and disable the relay, which, if not followed by the clicking sound of the relay, help to identify a failure of this electromechanical component. Software Let us focus on the main functions, SetAlm(), interrupt(), and main(). The SetAlm function shown below provides for the activa tion of the alarm device connected to J2 output
terminals by direct pulses to the bistable relay. The persistence time of the pulse to the relay control coils is defined by the constant RlyTim, currently set to 200 ms. The coils head to pins RA6 and RA7 of the microcontroller, which energizes them through Q1 and Q2 transistors. January & February 2025 21 // the MCU is powered just by supercapa curs = 0;
// Start seconds count STSLED = 0; // Force Ststus Led off Mode = Mode_TOL; // Enter the Tolerance Mode } break; In the Mode_TOL state handled by the following section, one of two possible events is awaited: the return of mains voltage before the delay time expires, to return again to the Mode_SBY state, or the overrun of that time. The condition to be
met for the latter case is slightly complicated by the management of the optional Beep mode activated via the first of the two DIP switches. Depending on the state of this switch, either the ttol limit time defined first by the RV1 trimmer reading, or the MinTol time set by the initial code definitions, corresponding to 2 s, will be selected. Exceeding the limit time
brings the automaton into the Mode_ALM state. The continuation of the code is always bound to the Timer1 interrupt, since it continues to operate in low-power mode: case Mode_TOL: // Waiting ttol time // before activating the alarm if (POWER == 1) { // Mains is back // before the alarm activation Mode = Mode_SBY; // Just go // back to Standby Mode }
else { // Check end // of Tolerance time if (((BeepMode==FALSE)&&(curs>=ttol)) ||((BeepMode==TRUE)&&(curs>=MinTol))) { SetAlm(); // Start the // alarm, IncAlm(); // Increment // the alarms counter, Mode = Mode_ALM; // Enter in // the Alarm Mode } } break; This part handles the Mode_ALM state. It waits for the mains voltage to return, to reset the alarm
and return to Standby by permanently exiting the low-power mode. Or one waits for the exhalation of the maximum alarm time, chosen from the talm value set by the analog reading of the RV2 trimmer, or from the MinAlm value preset to 1 s at the beginning of the program. It remains in low power in that case, to handle the return of the line voltage to the
Mode_BACK state: case Mode_ALM: // Wait talm seconds before Alarm activation events are counted in the AlmCnt variable. Note that — in case the return of mains voltage is very late and the capacity to support operations provided by supercapacitor C5 is exceeded — in order not to lose the alarm count, the value of AlmCnt is saved in EEPROM. The
setup() function requires it to be read again when the microcontroller is restarted: void main() { setup(); // Initialization while(1) { // Forever Loop if (Button(&PORTB,4,1,0)){ // Reset button pressed STSLED = 1; Delay_ms(500); STSLED = 0; AlmCnt = 0; EEPROM_Write(CNTADDR, AlmCnt); // Raz the Alarms counter in EEPROM curms = 0; // Raz the
elapsed ms for Blink cycle BlkSts = 0; // Reset the Blink automaton {asm{reset}}; // Reset the MCU // (the program will restart) } In the following excerpt, the voltages on the analog pins connected to the slider of the two resistive trimmers are read; they are dedicated to adjusting the delay and alarm times. The reading is made possible by activating the hot
side of the two trimmers via the digital output pin RA2, referred to here as DIVPOW. Since the microcontroller has a 10-bit A/D converter, the two readings will consist of a value between 0 and 1,023, between limits defined by configurable parameters that by default limit the delay time to between 0…10 seconds, and the alarm time to between 0…2
minutes. In default state Mode_SBY, managed by the block that follows, the automaton waits for the mains voltage drop event, communicated by the SENSE line through pin RB1 (AN11) referred to here using the POWER definition. If it goes to logic level 0, then second-counting will start, setting the PIC to low-power mode. Please keep in mind that from
then on, power is provided solely by supercapacitor C5. The new state is Mode_TOL: // Automaton switch (Mode) { case Mode_SBY: // Nominal Mode. // Wait for a Power Down event if (POWER == 0) { // The Main power gone down, 22 Bonus Edition January & February 2025 www.elektormagazine.com if (((BeepMode==FALSE)&& (curs>=talm)) ||
((BeepMode==TRUE)&&(curs>=MinAlm))) { ResetAlm(); // Suspend the alarm Mode = Mode_BACK; // Wait for the // Power Up event } } break; // to stop the alarm if (POWER == 1) { // Mains is back during Alarm ResetAlm(); // Stop the alarm if (BackMode==TRUE) Signal(); // Signal "Mains is back" if requested Mode = Mode_SBY; // Manage the Power Up
event } else { // Check end of Alarm time Listing 1: Main Blink Sequence and Mains Monitoring Routine. // On power presence, signal the occurred alarms (one blink per each alarm) if ((POWER == 1) && (AlmCnt > 0)) { switch (BlkSts) { case 0: // Initialize a new Blinks cycle n = AlmCnt; STSLED=1; curms = 0; // Start ms counting BlkSts = 1; // Go to "Wait to
turn off the LED" break; case 1: // Wait CNTBLINK ms to turn off the LED if (curms >= CNTBLINK) { STSLED=0; n--; // Decrement residual Blinks counter curms = 0; // Start ms counting if (n > 0) BlkSts = 2; // Go to "Wait to turn on the LED" else BlkSts = 3; // Go to "Wait for next Blinks cycle" } break; case 2: // Wait CNTBLINK ms to turn on the LED if
(curms >= CNTBLINK) { STSLED=1; curms = 0; // Start ms counting BlkSts = 1; // Go to "Wait to turn off the LED" } break; case 3: // Wait CNTINTERV for next Blinks cycle if (curms >= CNTINTERV) { curms = 0; // Start ms counting BlkSts = 0; // Initialize a new cycle } break; } if (BlkSts > 0) curms += TIC; // Increment the elapsed time counter (ms) } #ifdef
LOWPOW // If no external power is present, go in Low Power Mode if (POWER == 0) {asm{sleep};} // Sleep. Awake on Timer1 interrupt. #endif Delay_ms(TIC); // Introduce a cycle delay January & February 2025 23The 1.5 F supercapacitor is a special component, but nevertheless readily available. In this version, the alarm output is provided via a threeway terminal, which allows the user to choose NC or NO activa tion type, depending on the intended use. This is not possible in the analog version, due to circuit limitations. The digital version thus o" ers greater versatility and ease of use than the analog one, thanks to the ability to configure the alarm output according to one's needs. However, the analog
version retains a struc tural simplicity that may be advantageous in some specific applica tions. The choice between the two versions will therefore depend on the user's needs and the features of the signaling system to which the device will be connected. 240559-01 Questions or Comments? Do you have technical questions or comments about this article?
You may write to the author at info@purchiaroni.com or to Elektor's editorial team at editor@elektor.com. About the Author Passionate about electronics and programming, Stefano Purchiaroni shares his works by publishing projects, and also o" ers free robotics lessons for teens at a popular school. He is currently employed in Telespazio and works in a
satellite center near the Italian capital. Related Product > OWON XDM1141 Multimeter www.elektor.com/20671 In Mode_BACK, it waits for the mains voltage to return and signals the event by triggering the alarm for two short consecutive pulses if provided by the Back DIP switch. Until the grid returns, the PIC is left in low-power mode: case Mode_BACK:
// Waiting for the mains power // to come back again if (POWER == 1) { // Mains // is back: exit to Standby mode ResetAlm(); // Force // alarm off if (BackMode==TRUE) Signal(); // Signal "Mains is back" if requested Mode = Mode_SBY; } break; After the main automaton, a second four-state automaton was imple mented just to manage D5 connected to
RA0. This LED is intended to show the current count of voltage drop events of duration longer than the delay time. The AlmCnt counter is reset table by pressing SW1, managed in the first lines of code of the main cycle, seen above. The handling of flashes by an automaton is dictated by the need to not interrupt the main cycle with simple delays, which
would block any other actions during their execution. Flashing times are defined by the constants CNTBLINK set to 200 ms, and CNTINTERV, which defines the pause between two blocks of flashes, set to 3 s (Listing 1). Printed Circuit Boards For both the analog and digital versions, two single-sided, jumperless printed circuit boards have been designed.
This will undoubtedly facil itate their creation using the classic methods of photoengraving, or hot transfer. You can download the Gerber files needed for DIY from the Elektor Labs page for this article [1]. Assembly In the analog version shown in the assembly plan, the SW1 switch for mode selection is wired to a six-way connector on the printed circuit
board. You can connect a lever switch to it, or any DPDT switch. The digital version of the device, which can be seen in the mounting plan, involves socket-mounting the microcontroller, two miniature-type trimmers, a two-way dip-switch, and a jumper. [1] Elektor Labs page for this article: https://elektormagazine.com/labs/mains-power-outages-monitor WEB
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Preamplifier Elevate your audio experience with the Douk Audio P6 mini Tube Preamplifier, a perfect blend of modern connectivity, HiFi sound quality, and vintage charm. Whether you're an audiophile or just starting your journey into high-quality audio, this compact yet powerful preamp offers everything you need. Raspberry Pi 500 (US) The Raspberry Pi
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MPP trackers and inverters; construct a notebook power bank; update the AmpVolt to measure up to 70 V and 100 A. In addition to power-related articles, we also cover subjects such as EMC compatibility, medical robots, and creating applications with the Elektor Audio DSP FX Processor Board. Check out the magazine! Member Download Free
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and Inverters Measurement Components and Circuits Latest News Solar and Wind Energy Top Wind Power: Wise Move or Waste of Time? The UK Government recently announced the world's biggest ever expansion in wind energy. So how realistic is this scheme? What are the pitfalls, technical and otherwise, and how viable is it economically? It's time to
look at wind generation in the round.Wind is simply air in motion, with mass and energy. It has been used for centuries, the most obvious example being windmills. In 1850 the American Daniel Halliday developed the 'multi-bladed' farm windmill, a relatively simple device that inspired the first attempts to convert wind into a form of energy that could be either
stored for future use, or applied elsewhere. Download article Balcony Power Plant: DIY Solar Balcony = Speedy Payback! You don't need to cover a whole roof with PV solar panels before the installation becomes both economically and ecologically viable. The idea of a grid-tie PV installation on your balcony is starting to gain traction with so many office
workers now working from home, any energy input from sunlight can help offset the additional domestic power usage during daylight hours. These mini power plants are quite cheap and even benefit from subsidies in some European cities. I looked into the regulations governing them, did some research on the equipment and went ahead with the
installation. Download free article Solar Power Made Simple: Solar Charging With and Without a Controller Complicated charge controllers and inverter circuits can be used to squeeze the last drop of energy out of a solar panel. Contrary to popular belief, however, it is also possible simply to connect the battery directly to the panel. Download article
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Building an Augmented Reality app for HoloLens 2 Completed on 9/24/2024 Badge Designing for mixed reality Completed on 9/24/2024 Badge Introduction to mixed reality Completed on 9/24/2024 Badge Configure 3D assets for mixed reality in Unity Completed on 9/24/2024 Badge Build a 3D Scene for mixed reality in Unity Completed on 9/24/2024 Badge Set up a mixed reality project for Azure Digital Twins in Unity Completed on 9/24/2024 Badge Connect IoT data to mixed reality with Azure Digital Twins and Unity Completed on 9/24/2024 Badge Introduction to Polyglot Notebooks Completed on 9/24/2024 Badge Create a web UI with ASP.NET Core Completed on 7/20/2024 Badge Learn the basics of web accessibility Completed on 7/20/2024 Badge Get started with web development using Visual Studio Code Completed on 7/20/2024 Badge Publish a web app to Azure with Visual Studio Completed on 7/20/2024 Badge Create a web API with ASP.NET Core controllers Completed on 7/20/2024 Badge Work with files and directories in a .NET app Completed on 7/20/2024 Badge Interactively debug .NET apps with the Visual Studio Code debugger Completed on 7/20/2024 Badge Create a new .NET project and work with dependencies Completed on 7/20/2024 Badge Introduction to .NET Completed on 7/20/2024 Badge Deploy and manage Active Directory Domain Services domain controllers Completed on 7/20/2024 Badge Manage Microsoft Entra identities Completed on 7/19/2024 Badge Understand Microsoft Entra ID Completed on 7/19/2024 Badge Evaluate deployment methods Completed on 7/19/2024 Badge Get tips and tricks for teaching DP-100: Designing and implementing a data science solution on Azure Completed on 5/13/2024 Badge Learn best practices from Microsoft Technical Trainers Completed on 5/13/2024 Badge Microsoft Learn for Educators preparing for course delivery Completed on 5/13/2024 Badge Get tips and tricks for teaching AZ-104 Microsoft Azure Administrator Completed on 5/13/2024 Badge Learn best practices from Microsoft Technical Trainers Completed on 5/13/2024 Badge Microsoft Learn for Educators course planning Completed on 5/13/2024 Badge Microsoft Learn for Educators Course Preparation Completed on 5/13/2024 Badge Onboard to Microsoft Learn for Educators program Completed on 5/13/2024 Badge Introduction to Microsoft Learn for Educators program Completed on 5/13/2024 Badge Microsoft Learn for Educators student certification Completed on 5/13/2024 Badge Build a Form Recognizer custom skill for Azure Cognitive Search Completed on 5/3/2024 Badge Create a composed Form Recognizer model Completed on 5/3/2024 Badge Extract data from forms with Form Recognizer Completed on 5/3/2024 Badge Use prebuilt Form Recognizer models Completed on 5/3/2024 Badge Plan an Azure AI Document Intelligence solution Completed on 5/3/2024 Badge Perform vector search and retrieval in Azure AI Search Completed on 5/3/2024 Badge Perform search re-ranking with semantic ranking in Azure AI Search Completed on 5/3/2024 Badge Maintain an Azure AI Search solution Completed on 5/3/2024 Badge Search data outside the Azure platform in Azure AI Search using Azure Data Factory Completed on 5/3/2024 Badge Build an Azure Machine Learning custom skill for Azure AI Search Completed on 5/3/2024 Badge Implement advanced search features in Azure AI Search Completed on 5/3/2024 Badge Enrich your data with Azure AI Language Completed on 5/3/2024 Badge Create a knowledge store with Azure AI Search Completed on 5/3/2024 Badge Create an Azure AI Search solution Completed on 5/3/2024 Badge Create a custom skill for Azure AI Search Completed on 5/3/2024 Badge Get started with Data Activator in Microsoft Fabric Completed on 3/19/2024 Badge Get started with Real-Time Analytics in Microsoft Fabric Completed on 3/19/2024 Badge Administer Microsoft Fabric Completed on 3/19/2024 Badge Create and manage a Power BI deployment pipeline Completed on 3/19/2024 Badge Load data into a Microsoft Fabric data warehouse Completed on 3/19/2024 Badge Organize a Fabric lakehouse using medallion architecture design Completed on 3/19/2024 Badge Ingest data with Spark and Microsoft Fabric notebooks Completed on 3/19/2024 Badge Detect objects in images Completed on 3/12/2024 Badge Classify images Completed on 3/12/2024 Badge Analyze video Completed on 3/12/2024

Badge Read Text in images and documents with the Azure AI Vision Service Completed on 3/12/2024 Badge Detect, analyze, and recognize faces Completed on 3/12/2024 Badge Image classification with custom Azure AI Vision models Completed on 3/12/2024 Badge Enhance teaching and learning with Microsoft Copilot Completed on 2/14/2024 Badge Equip and support learners with AI tools from Microsoft Completed on 2/14/2024 Badge Teach cybersecurity concepts with Minecraft Education Completed on 2/14/2024 Badge Lead forward: Integrate the best strategies from remote, hybrid, and blended learning for school leaders Completed on 1/16/2024 Badge Build a question answering solution Completed on 1/16/2024 Badge Analyze text with Azure AI Language Completed on 1/16/2024 Badge Translate speech with the Azure AI Speech service Completed on 1/16/2024 Badge Create speech-enabled apps with Azure AI services Completed on 1/16/2024 Badge Translate text with Azure AI Translator service Completed on 1/16/2024 Badge Create a custom named entity extraction solution Completed on 1/16/2024 Badge Create a custom text classification solution Completed on 1/16/2024 Badge Build a question answering solution Completed on 1/16/2024 Badge Extract insights from text with the Azure AI Language service Completed on 1/16/2024 Badge Build a conversational language understanding model Completed on 1/16/2024 Badge Custom named entity recognition Completed on 1/16/2024 Badge Get started with the SharePoint Framework Completed on 12/28/2023 Badge Use Change Notifications and Track Changes with Microsoft Graph Completed on 12/28/2023 Badge Access Files with Microsoft Graph Completed on 12/28/2023 Badge Manage Group Lifecycle with Microsoft Graph Completed on 12/28/2023 Badge Access User Data from Microsoft Graph Completed on 12/28/2023 Badge Optimize network traffic with Microsoft Graph Completed on 12/28/2023 Badge Optimize data usage when using Microsoft Graph with query parameters Completed on 12/28/2023 Badge Get started with Microsoft Graph Toolkit Completed on 12/28/2023 Badge Access user photo information by using Microsoft Graph Completed on 12/28/2023 Badge Configure a JavaScript application to retrieve Microsoft 365 data by using Microsoft Graph Completed on 12/28/2023 Badge What is Microsoft Graph? Completed on 12/28/2023 Badge Introduction to Office client customization with add-ins Completed on 12/28/2023 Badge Introduction to customizing and extending SharePoint Completed on 12/28/2023 Badge Introduction to building apps for Microsoft Teams Completed on 12/28/2023 Badge Understand Actionable Messages in Outlook fundamentals Completed on 12/28/2023 Badge Automate Microsoft Defender for Cloud Apps with Power Automate Completed on 12/18/2023 Badge Discover additional resources for Microsoft Defender for Cloud Apps Completed on 12/18/2023 Badge Configure advanced scenarios in Microsoft Defender for Cloud Apps Completed on 12/18/2023 Badge Microsoft Defender for Cloud Apps SIEM integration Completed on 12/18/2023 Badge Leading for equity 101—Prepare your school for equity Completed on 12/18/2023 Badge Explore identity synchronization Completed on 12/16/2023 Badge Manage secure user access in Microsoft 365 Completed on 12/16/2023 Badge Manage synchronized identities Completed on 12/16/2023 Badge Implement directory synchronization tools Completed on 12/16/2023 Badge Prepare for identity synchronization to Microsoft 365 Completed on 12/16/2023 Badge Prevent data loss Completed on 12/16/2023 Badge Analyze your Microsoft 365 workplace data using Microsoft Viva Insights Completed on 12/16/2023 Badge Deploy Microsoft 365 Apps for enterprise Completed on 12/16/2023 Badge Manage tenant health and services in Microsoft 365 Completed on 12/16/2023 Badge Configure administrative roles in Microsoft 365 Completed on 12/16/2023 Badge Capture Web Application Logs with App Service Diagnostics Logging Completed on 12/15/2023 Badge Improve incident response with alerting on Azure Completed on 12/15/2023 Badge Analyze your Azure infrastructure by using Azure Monitor logs Completed on 12/15/2023 Badge Write multi-table queries by using Kusto Query Language Completed on 12/15/2023 Badge Gain insights from your data by using Kusto Query Language Completed on 12/15/2023 Badge Write your first query with Kusto Query Language Completed on 12/15/2023 Badge Explore the fundamentals of data analysis using Kusto Query Language (KQL) Completed on 12/15/2023 Badge Generate batch predictions using a deployed model in Microsoft Fabric Completed on 12/15/2023 Badge Train and track machine learning models with MLflow in Microsoft Fabric Completed on 12/15/2023 Badge Preprocess data with Data Wrangler in Microsoft Fabric Completed on 12/15/2023 Badge Explore data for data science with notebooks in Microsoft Fabric Completed on 12/15/2023 Badge Get started with data science in Microsoft Fabric Completed on 12/15/2023 Badge Get started with data warehouses in Microsoft Fabric Completed on 12/15/2023 Badge Ingest Data with Dataflows Gen2 in Microsoft Fabric Completed on 12/15/2023 Badge Use Data Factory pipelines in Microsoft Fabric Completed on 12/15/2023 Badge Work with Delta Lake tables in Microsoft Fabric Completed on 12/15/2023 Badge Use Apache Spark in Microsoft Fabric Completed on 12/15/2023 Badge Get started with lakehouses in Microsoft Fabric Completed on 12/15/2023 Badge Introduction to end-to-end analytics using Microsoft Fabric Completed on 12/4/2023 Badge Manage leads with Dynamics 365 Sales Completed on 11/21/2023 Badge Set up and configure Dynamics 365 Sales Completed on 11/21/2023 Badge Get started with Dynamics 365 Sales Completed on 11/21/2023 Badge Analyze images Completed on 11/21/2023 Badge Automate Power BI solution management Completed on 11/21/2023 Badge Enforce data permissions for Power BI embedded analytics Completed on

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11/21/2023 Badge Integrate content with Power BI client APIs Completed on 11/21/2023 Badge Embed Power BI content Completed on 11/21/2023 Badge Set up permissions to embed Power BI content Completed on 11/21/2023 Badge Select a Power BI embedded analytics product Completed on 11/21/2023 Badge Introduction to Power BI embedded analytics Completed on 11/21/2023 Badge Assess and convert SQL Server databases using the Data Migration Assistant (DMA) Completed on 11/20/2023 Badge SQL Server Discovery using the Microsoft Assessment and Planning (MAP) toolkit Completed on 11/20/2023 Badge Introduction to upgrading SQL Server Completed on 11/20/2023 Badge Use the SQL Server Query Tuning Assistant Completed on 11/20/2023 Badge Test and optimize SQL Server databases using the Database Experimentation Assistant (DEA) Completed on 11/20/2023 Badge Assess SQL Server databases for migration to Azure SQL Completed on 11/20/2023 Badge Design a SQL Server migration strategy Completed on 11/20/2023 Badge 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SAP HANA on Azure (Large Instances) Completed on 11/20/2023 Badge Monitor and troubleshoot SAP HANA on Azure (Large Instances) Completed on 11/20/2023 Badge Manage SAP HANA on Azure (Large Instances) Completed on 11/20/2023 Badge Implement and deploy SAP HANA on Azure (Large Instances) Completed on 11/20/2023 Badge Examine backup security licensing and support considerations for SAP HANA on Azure (Large Instances) Completed on 11/20/2023 Badge Plan SAP HANA on Azure (Large Instances) high availability and disaster recovery Completed on 11/20/2023 Badge Plan SAP HANA on Azure (Large Instances) deployments Completed on 11/20/2023 Badge Examine SAP HANA on Azure (Large Instances) sample architecture Completed on 11/20/2023 Badge Identify SAP HANA on Azure (Large Instances) certified offerings Completed on 11/20/2023 Badge Design data integration Completed on 11/20/2023 Badge Design a data storage solution for relational data Completed on 11/20/2023 Badge Design a data storage solution for 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Completed on 11/20/2023 Badge Apply basic performance optimization in finance and operations apps Completed on 11/20/2023 Badge Build workspaces in finance and operations apps Completed on 11/20/2023 Badge Build reports for finance and operations apps Completed on 11/20/2023 Badge Create classes in finance and operations apps Completed on 11/20/2023 Badge Build forms and optimize form performance in finance and operations apps Completed on 11/20/2023 Badge Build data models in finance and operations apps Completed on 11/20/2023 Badge Build extended data types and enumerations for finance and operations apps Completed on 11/20/2023 Badge Develop object-oriented code in finance and operations apps Completed on 11/20/2023 Badge Get started with development using X++ in finance and operations apps Completed on 11/20/2023 Badge Start developing for finance and operations apps by using Visual Studio Completed on 11/20/2023 Badge Set up a VHD for finance and operations apps Completed on 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with Azure AI Personalizer Completed on 11/20/2023 Badge Classify and moderate text with Azure Content Moderator Completed on 11/20/2023 Badge Support reading fluency practice with Reading Progress Completed on 11/20/2023 Badge Introduction to Azure Logic Apps Completed on 11/20/2023 Badge Create and deploy an Azure Logic Apps workflow using Azure Resource Manager templates Completed on 11/20/2023 Badge Call an API from an Azure Logic Apps workflow using a custom connector Completed on 11/20/2023 Badge Route and process data automatically using Azure Logic Apps Completed on 11/20/2023 Badge Create serverless logic with Azure Functions Completed on 11/20/2023 Badge Expose hybrid services securely with Azure Relay Completed on 11/20/2023 Badge Implement message-based communication workflows with Azure Service Bus Completed on 11/20/2023 Badge Choose a messaging model in Azure to loosely connect your services Completed on 11/20/2023 Badge React to state changes in your Azure services by using Event Grid Completed on 11/20/2023 Badge Enable reliable messaging for Big Data applications using Azure Event Hubs Completed on 11/20/2023 Badge Communicate between applications with Azure Queue storage Completed on 11/20/2023 Badge Work with Azure Blob storage Completed on 11/20/2023 Badge Manage the Azure Blob storage lifecycle Completed on 11/20/2023 Badge Explore Azure Blob storage Completed on 11/20/2023 Badge Explore Azure App Service deployment slots Completed on 11/20/2023 Badge Scale apps in Azure App Service Completed on 11/20/2023 Badge Configure web app settings Completed on 11/20/2023 Badge Explore Azure App Service Completed on 11/20/2023 Badge Design a solution for backup and disaster recovery Completed on 11/19/2023 Badge Describe high availability and disaster recovery strategies Completed on 11/19/2023 Badge Implement canary releases and dark launching Completed on 11/19/2023 Badge Implement blue-green deployment and feature toggles Completed on 11/19/2023 Badge Introduction to deployment patterns Completed on 11/19/2023 Badge Manage application configuration data Completed on 11/19/2023 Badge Integrate with identity management systems Completed on 11/19/2023 Badge Implement A/B testing and progressive exposure deployment Completed on 11/19/2023 Badge Manage alerts, blameless retrospectives and a just culture Completed on 11/19/2023 Badge Design processes to automate application analytics Completed on 11/19/2023 Badge Share knowledge within teams Completed on 11/19/2023 Badge Develop monitor and status dashboards Completed on 11/19/2023 Badge Implement tools to track usage and flow Completed on 11/19/2023 Badge Manage Git repositories Completed on 11/19/2023 Badge Plan foster inner source Completed on 11/19/2023 Badge Explore Git hooks Completed on 11/19/2023 Badge Identify technical debt Completed on 11/19/2023 Badge Collaborate with pull requests in Azure Repos Completed on 11/19/2023 Badge Manage Git branches and workflows Completed on 11/19/2023 Badge Structure your Git Repo Completed on 11/19/2023 Badge Introduction to data protection and privacy Completed on 11/19/2023 Badge Discover the potential of Azure for government Completed on 11/19/2023 Badge Support data classification with private and hybrid clouds Completed on 11/19/2023 Badge Safeguard public sector data with Azure Completed on 11/19/2023 Badge Describe the identity protection and governance capabilities of Microsoft Entra Completed on 11/19/2023 Badge Describe access management capabilities of Microsoft Entra ID Completed on 11/19/2023 Badge Describe the authentication capabilities of Microsoft Entra ID Completed on 11/19/2023 Badge Describe the function and identity types of Microsoft Entra ID Completed on 11/19/2023 Badge Describe identity concepts Completed on 11/19/2023 Badge Describe security and compliance concepts Completed on 11/19/2023 Badge Describe analytics capabilities of Microsoft 365 Completed on 11/19/2023 Badge Describe endpoint modernization, management concepts, and deployment options in Microsoft 365 Completed on 11/19/2023 Badge Describe collaboration solutions of Microsoft 365 Completed on 11/19/2023 Badge Describe productivity solutions of Microsoft 365 Completed on 11/19/2023 Badge What is Microsoft 365? Completed on 11/19/2023 Badge Use Azure AI Services for Language in a Microsoft Copilot Studio bot Completed on 11/19/2023 Badge Set up a Microsoft Copilot Studio bot for voice Completed on 11/19/2023 Badge Manage Power Virtual Agents Completed on 11/19/2023 Badge Build effective bots with Microsoft Copilot Studio Completed on 11/19/2023 Badge Enhance Microsoft Copilot Studio bots Completed on 11/19/2023 Badge Work with entities and variables in Microsoft Copilot Studio Completed on 11/19/2023 Badge Manage topics in Microsoft Copilot Studio Completed on 11/19/2023 Badge Get started with Microsoft Copilot Studio bots Completed on 11/19/2023 Badge Create calculation groups Completed on 11/19/2023 Badge Use DAX time intelligence functions in Power BI Desktop models Completed on 11/19/2023 Badge Create Power BI model relationships Completed on 11/19/2023 Badge Use tools to optimize Power BI performance Completed on 11/19/2023 Badge Enforce Power BI model security Completed on 11/19/2023 Badge Publish and share in Power BI Completed on 11/19/2023 Badge Explore data in Power BI Completed on 11/19/2023 Badge Use visuals in Power BI Completed on 11/19/2023 Badge Model data in Power BI Completed on 11/19/2023 Badge Get started building with Power BI Completed on 11/19/2023 Badge Discover data analysis Completed on 11/19/2023 Badge Operate a guide in Dynamics 365 Guides Completed on 11/19/2023 Badge Author a guide in Dynamics 365 Guides Completed on 11/19/2023 Badge Dynamics 365 Guides for administrators Completed on 11/19/2023 Badge Get started with Dynamics 365 Guides Completed on 11/19/2023 Badge Embed 21st century skills with 21st century learning design Completed on 11/19/2023 Badge Deepen educational experiences with the 21CLD ICT for learning dimension Completed on 11/19/2023 Badge Develop learner executive function with the 21CLD self-regulation dimension Completed on 11/19/2023 Badge Improve communication skills with the 21CLD skilled communication dimension Completed on 11/19/2023 Badge Innovate learning with the 21CLD real-world problem solving and innovation dimension Completed on 11/19/2023 Badge Practice collaborative skills with the 21CLD collaboration dimension Completed on 11/19/2023 Badge Develop critical thinking skills with the 21CLD knowledge construction dimension Completed on 11/19/2023 Badge Transform learning with 21st century learning design Completed on 11/19/2023 Badge Set up number series and trail codes in Dynamics 365 Business Central Completed on 11/18/2023 Badge Set up general ledger configuration options in Dynamics 365 Business Central Completed on 11/18/2023 Badge Set up inventory replenishment in Dynamics 365 Business Central Completed on 11/18/2023 Badge Plan items in Dynamics 365 Business Central Completed on 11/18/2023 Badge Set up inventory planning in Dynamics 365 Business Central Completed on 11/18/2023 Badge Demand Driven Material Requirements Planning in Dynamics 365 Supply Chain Management Completed on 11/18/2023 Badge Use master planning in Dynamics 365 Supply Chain Management Completed on 11/18/2023 Badge Set up Master Planning in Dynamics 365 Supply Chain Management Completed on 11/18/2023 Badge Create bill of materials in Dynamics 365 Supply Chain Management Completed on 11/18/2023 Badge Create products and product masters in Dynamics 365 Supply Chain Management Completed on 11/18/2023 Badge Use inventory reports in Dynamics 365 Supply Chain Management Completed on 11/18/2023 Badge Configure and work with inventory management in Dynamics 365 Supply Chain Management Completed on 11/18/2023 Badge Get started with Dynamics 365 Supply Chain Management Completed on 11/18/2023 Badge Introduction to scripting in PowerShell Completed on 11/18/2023 Badge Write your first PowerShell code Completed on 11/18/2023 Badge Connect commands into a pipeline Completed on 11/18/2023 Badge Discover commands in PowerShell Completed on 11/18/2023 Badge Introduction to PowerShell Completed on 11/18/2023 Badge Write your first program in C++ Completed on 11/18/2023 Badge Create a Bot with the Bot Framework Composer Completed on 11/17/2023 Badge Create a bot with the Bot Framework SDK Completed on 11/17/2023 Badge Deploy Azure AI services in containers Completed on 11/17/2023 Badge Monitor Azure AI services Completed on 11/17/2023 Badge Secure Azure AI services Completed on 11/17/2023 Badge Create and consume Azure AI services Completed on 11/17/2023 Badge Prepare to develop AI solutions on Azure Completed on 11/17/2023 Badge Understand the MySQL storage engine Completed on 11/17/2023 Badge Understand client-server communication in MySQL Completed on 11/17/2023 Badge Explore MySQL Architecture Completed on 11/17/2023 Badge Understand concurrency in MySQL Completed on 11/17/2023 Badge Secure MySQL Completed on 11/17/2023 Badge Beneath the surface: Device details for IT administrators Completed on 11/17/2023 Badge Analyze DevOps Continuous Planning and Continuous Integration Completed on 11/15/2023 Badge Route system feedback to development teams Completed on 11/15/2023 Badge Explain DevOps Continuous Delivery and Continuous Quality Completed on 11/15/2023 Badge Characterize DevOps Continuous Collaboration and Continuous Improvement Completed on 11/15/2023 Badge Introduce the foundation pillars of DevOps: Culture and Lean Product Completed on 11/15/2023 Badge Assess your existing software development process Completed on 11/15/2023 Badge Manage Agile software delivery plans across teams Completed on 11/15/2023 Badge Choose an Agile approach to software development Completed on 11/15/2023 Badge Introduction to Azure DevOps Completed on 11/15/2023 Badge Introduction to Git Completed on 11/15/2023 Badge Edit code through branching and merging in Git Completed on 11/15/2023 Badge Collaborate with Git Completed on 11/15/2023 Badge How to create and modify a Git project Completed on 11/15/2023 Badge Enhance creativity to advance learning with Windows 11 and Microsoft 365 tools Completed on 11/14/2023 Badge Increase productivity with Office, OneNote, and Edge browser in Windows 11 Completed on 11/14/2023 Badge Build community with Teams and OneNote Completed on 11/14/2023 Badge Transition to and prepare for fundamentals-level security, compliance, and identity course Completed on 11/14/2023 Badge Develop search strategies with Search Coach and Search Progress Completed on 11/14/2023 Badge Perform hyperparameter tuning with Azure Machine Learning Completed on 11/14/2023 Badge Track model training with MLflow in jobs Completed on 11/14/2023 Badge Run a training script as a command job in Azure Machine Learning Completed on 11/14/2023 Badge Deploy a model to a batch endpoint Completed on 11/14/2023 Badge Deploy a model to a managed online endpoint Completed on 11/14/2023 Badge Run pipelines in Azure Machine Learning Completed on 11/14/2023 Badge Find the best classification model with Automated Machine Learning Completed on 11/14/2023 Badge Make data available in Azure Machine Learning Completed on 11/14/2023 Badge Build a machine learning model Completed on 11/14/2023 Badge Data collection and manipulation Completed on 11/14/2023 Badge Introduction to rocket launches Completed on 11/14/2023 Badge Digital citizenship: Prepare today’s learners for online success Completed on 11/14/2023 Badge Extract invoice data with AI Builder’s prebuilt model Completed on 11/14/2023 Badge Automate the processing of documents with the AI Builder prepackaged solution Completed on 11/14/2023 Badge Manage models in AI Builder Completed on 11/14/2023 Badge Get started with AI Builder Completed on 11/14/2023 Badge Use text generation in AI Builder Completed on 11/14/2023 Badge Introduction to expressions in Power Automate Completed on 11/14/2023 Badge Upload, download, and manage data with Azure Storage Explorer Completed on 11/13/2023 Badge Control access to Azure Storage with shared access signatures Completed on 11/13/2023 Badge Configure Azure Storage with tools Completed on 11/13/2023 Badge Configure Azure Files and Azure File Sync Completed on 11/13/2023 Badge Configure Azure Storage security Completed on 11/13/2023 Badge Find commands and Get-Help in Windows PowerShell Completed on 11/13/2023 Badge Understand the command syntax in Windows PowerShell Completed on 11/13/2023 Badge Review Windows PowerShell Completed on 11/13/2023 Badge Manage mail flow rules Completed on 11/13/2023 Badge Troubleshoot mail flow Completed on 11/13/2023 Badge Manage mail flow Completed on 11/13/2023 Badge Troubleshoot audio, video, and client issues Completed on 11/13/2023 Badge Configure auto attendants and call queues Completed on 11/13/2023 Badge Configure and manage voice users Completed on 11/13/2023 Badge Configure and deploy Teams Phone Completed on 11/13/2023 Badge Plan for Teams Phone Completed on 11/13/2023 Badge Configure, deploy, and manage Teams devices Completed on 11/13/2023 Badge Plan for Microsoft Teams Rooms and Surface Hub Completed on 11/13/2023 Badge Manage meetings and events experiences Completed on 11/13/2023 Badge Introduction to Teams meetings and calling Completed on 11/13/2023 Badge Monitor your Microsoft Teams environment Completed on 11/13/2023 Badge Implement lifecycle management and governance for Microsoft Teams Completed on 11/13/2023 Badge Plan and deploy Microsoft Teams Completed on 11/13/2023 Badge Explore Microsoft Teams Completed on 11/13/2023 Badge Examine Azure Identity Protection Completed on 11/13/2023 Badge Examine Privileged Identity Management Completed on 11/13/2023 Badge Examine Microsoft Secure Score Completed on 11/13/2023 Badge Explore security solutions in Microsoft 365 Defender Completed on 11/13/2023 Badge Explore the Zero Trust security model Completed on 11/13/2023 Badge Examine threat vectors and data breaches Completed on 11/13/2023 Badge Use OneDrive in Microsoft 365 Completed on 11/13/2023 Badge Configure client connectivity to Microsoft 365 Completed on 11/13/2023 Badge Add a custom domain in Microsoft 365 Completed on 11/13/2023 Badge Manage groups in Microsoft 365 Completed on 11/13/2023 Badge Manage users, licenses, and mail contacts in Microsoft 365 Completed on 11/13/2023 Badge Configure your Microsoft 365 experience Completed on 11/13/2023 Badge Implement compliance for Microsoft Teams Completed on 11/13/2023 Badge Implement security for Microsoft Teams Completed on 11/13/2023 Badge Manage access for external users Completed on 11/13/2023 Badge Plan and configure network settings for Microsoft Teams Completed on 11/13/2023 Badge Support social and emotional learning with Microsoft tools Completed on 11/12/2023 Badge Keep students engaged: Build strong student/teacher connections in a remote learning environment Completed on 11/12/2023 Badge Stay connected with remote learning through Microsoft Teams and Office 365 Completed on 11/12/2023 Badge Hybrid learning in the primary classroom Completed on 11/12/2023 Badge Hybrid learning: A new model for the future of learning Completed on 11/12/2023 Badge Hybrid learning for the adolescent learner Completed on 11/12/2023 Badge Hybrid learning in the intermediate classroom Completed on 11/12/2023 Badge Accessibility, special education, and online learning: Supporting equity in a remote learning environment Completed on 11/12/2023 Badge Differentiation in the classroom using the built-in tools in Office 365 and Windows Completed on 11/12/2023 Badge Simplify cloud procurement and governance with Azure Marketplace Completed on 11/12/2023 Badge Design a program launch strategy Completed on 11/12/2023 Badge Prepare for a program approval event Completed on 11/12/2023 Badge Design degree program curricula that implement certification Completed on 11/12/2023 Badge Define academic and industry requirements for implementing certifications in degree programs Completed on 11/12/2023 Badge Work with data source limits (delegation limits) in a Power Apps canvas app Completed on 11/11/2023 Badge Work with relational data in a Power Apps canvas app Completed on 11/11/2023 Badge Use custom connectors in a Power Apps canvas app Completed on 11/11/2023 Badge Connect to other data in a Power Apps canvas app Completed on 11/11/2023 Badge Use and understand Controls in a canvas app in Power Apps Completed on 11/11/2023 Badge Document and test your Power Apps application Completed on 11/11/2023 Badge Build a mobile-optimized app from Power Apps Completed on 11/11/2023 Badge Manage apps in Power Apps Completed on 11/11/2023 Badge Navigation in a canvas app in Power Apps Completed on 11/11/2023 Badge How to build the UI in a canvas app in Power Apps Completed on 11/11/2023 Badge Customize a canvas app in Power Apps Completed on 11/11/2023 Badge Get started with Power Apps canvas apps Completed on 11/11/2023 Badge How to build your first model-driven app with Dataverse Completed on 11/11/2023 Badge Configure forms, charts, and dashboards in model-driven apps Completed on 11/11/2023 Badge Get started with model-driven apps in Power Apps Completed on 11/11/2023 Badge Create tables in Dataverse Completed on 11/11/2023 Badge Validation of Teams apps extensible across Microsoft 365 Completed on 11/10/2023 Badge Add significant value to your Teams app Completed on 11/10/2023 Badge Publish Teams apps in Microsoft Teams store Completed on 11/10/2023 Badge Azure Health Bot built-in scenarios Completed on 11/10/2023 Badge Language understanding in Azure Health Bot Completed on 11/10/2023 Badge Azure Health Bot case studies Completed on 11/10/2023 Badge Basic Azure Health Bot Completed on 11/10/2023 Badge Introduction to Azure Health Bot Completed on 11/10/2023 Badge Channelized Azure Health Bot Completed on 11/10/2023 Badge Integrate Azure Health Bot with a database Completed on 11/10/2023 Badge Enhanced Azure Health Bot Completed on 11/10/2023 Badge Azure Health Bot scenario templates Completed on 11/10/2023 Badge Deploy a customer service bot Completed on 11/10/2023 Badge Create a chatbot to help students learn geography Completed on 11/10/2023 Badge Introduction to responsible bots Completed on 11/10/2023 Badge Detect objects in images with Azure AI Custom Vision Completed on 11/10/2023 Badge Translate text and speech with Azure AI services Completed on 11/10/2023 Badge Classify images with Azure AI Custom Vision Completed on 11/10/2023 Badge Challenge project - Add image analysis and generation capabilities to your application Completed on 11/10/2023 Badge Challenge project - Work with variable data in C# Completed on 11/10/2023 Badge Guided project - Work with variable data in C# Completed on 11/10/2023 Badge Modify the content of strings using built-in string data type methods in C# Completed on 11/10/2023 Badge Format alphanumeric data for presentation in C# Completed on 11/10/2023 Badge Perform operations on arrays using helper methods in C# Completed on 11/10/2023 Badge Convert data types using casting and conversion techniques in C# Completed on 11/10/2023 Badge Choose the correct data type in your C# code Completed on 11/10/2023 Badge Challenge project - Create a mini-game Completed on 11/10/2023 Badge Guided project - Plan a Petting Zoo Visit Completed on 11/10/2023 Badge Create C# methods that return values Completed on 11/10/2023 Badge Create C# methods with parameters Completed on 11/10/2023 Badge Write your first C# method Completed on 11/10/2023 Badge Challenge project - Debug a C# console application using Visual Studio Code Completed on 11/10/2023 Badge Guided project - Debug and handle exceptions in a C# console application using Visual Studio Code Completed on 11/10/2023 Badge Create and throw exceptions in C# console applications Completed on 11/10/2023 Badge Implement exception handling in C# console applications Completed on 11/10/2023 Badge Implement the Visual Studio Code debugging tools for C# Completed on 11/10/2023 Badge Review the principles of code debugging and exception handling Completed on 11/10/2023 Badge Evaluate Boolean expressions to make decisions in C# Completed on 11/10/2023 Badge Challenge project - Develop branching and looping structures in C# Completed on 11/10/2023 Badge Guided project - Develop conditional branching and looping structures in C# Completed on 11/10/2023 Badge Add looping logic to your code using the do-while and while statements in C# Completed on 11/10/2023 Badge Iterate through a code block using for statement in C# Completed on 11/10/2023 Badge Control variable scope and logic using code blocks in C# Completed on 11/10/2023 Badge Branch the flow of code using the switch-case construct in C# Completed on 11/10/2023 Badge Get started with Jupyter notebooks for Python Completed on 11/9/2023 Badge Python error handling Completed on 11/9/2023 Badge Python functions Completed on 11/9/2023 Badge Manage data with Python dictionaries Completed on 11/9/2023 Badge Use 'while' and 'for' loops in Python Completed on 11/9/2023 Badge Introduction to lists in Python Completed on 11/9/2023 Badge Use mathematical operations in Python Completed on 11/9/2023 Badge Use strings in Python Completed on 11/9/2023 Badge Use Boolean logic in Python Completed on 11/9/2023 Badge Create and manage projects in Python Completed on 11/9/2023 Badge Write your first Python programs Completed on 11/9/2023 Badge Get started with Python in Visual Studio Code Completed on 11/9/2023 Badge Using GitHub Copilot with Python Completed on 11/9/2023 Badge Using GitHub Copilot with JavaScript Completed on 11/9/2023 Badge Introduction to GitHub Copilot for Business Completed on 11/9/2023 Badge Introduction to GitHub Copilot Completed on 11/9/2023 Badge Deploy a model with GitHub Actions Completed on 11/9/2023 Badge Work with environments in GitHub Actions Completed on 11/9/2023 Badge Work with linting and unit testing in GitHub Actions Completed on 11/9/2023 Badge Trigger GitHub Actions with feature-based development Completed on 11/9/2023 Badge Trigger Azure Machine Learning jobs with GitHub Actions Completed on 11/9/2023 Badge Use an Azure Machine Learning job for automation Completed on 11/9/2023 Badge Train and evaluate regression models Completed on 11/9/2023 Badge Explore and analyze data with Python Completed on 11/9/2023 Badge Train and evaluate deep learning models Completed on 11/9/2023 Badge Train and evaluate clustering models Completed on 11/9/2023 Badge Train and evaluate classification models Completed on 11/9/2023 Badge Measure and optimize model performance with ROC and AUC Completed on 11/9/2023 Badge Confusion matrix and data imbalances Completed on 11/9/2023 Badge Select and customize architectures and hyperparameters using random forest Completed on 11/9/2023 Badge Create and understand classification models in machine learning Completed on 11/9/2023 Badge Refine and test machine learning models Completed on 11/9/2023 Badge Train and understand regression models in machine learning Completed on 11/9/2023 Badge Introduction to data for machine learning Completed on 11/9/2023 Badge Build classical machine learning models with supervised learning Completed on 11/9/2023 Badge Introduction to machine learning Completed on 11/9/2023 Badge Create a clustering model with Azure Machine Learning designer Completed on 11/9/2023 Badge Create a classification model with Azure Machine Learning designer Completed on 11/9/2023 Badge Create a regression model with Azure Machine Learning designer Completed on 11/9/2023 Badge Use Automated Machine Learning in Azure Machine Learning Completed on 11/9/2023 Badge Explore developer tools for workspace interaction Completed on 11/9/2023 Badge Explore Azure Machine Learning workspace resources and assets Completed on 11/9/2023 Badge Explore Azure Storage for non-relational data Completed on 11/8/2023 Badge Explore fundamentals of Azure Cosmos DB Completed on 11/8/2023 Badge Explore relational database services in Azure Completed on 11/8/2023 Badge Explore fundamental relational data concepts Completed on 11/8/2023 Badge Fundamentals of Azure AI services Completed on 11/8/2023 Badge Fundamentals of machine learning Completed on 11/8/2023 Badge Fundamental AI Concepts Completed on 11/8/2023 Badge Fundamentals of Knowledge Mining with Azure Cognitive Search Completed on 11/8/2023 Badge Fundamentals of Azure AI Document Intelligence Completed on 11/8/2023 Badge Introduction to Computer Vision with PyTorch Completed on 11/8/2023 Badge Introduction to PyTorch Completed on 11/8/2023 Badge Introduction to audio classification with PyTorch Completed on 11/8/2023 Badge Introduction to Natural Language Processing with PyTorch Completed on 11/8/2023 Badge Transcribe large amounts of audio data with Batch Transcription Completed on 11/8/2023 Badge Fundamentals of optical character recognition Completed on 11/8/2023 Badge Fundamentals of Facial Recognition Completed on 11/8/2023 Badge Fundamentals of Computer Vision Completed on 11/8/2023 Badge Introduction to Azure Bot Service and Bot Framework Composer Completed on 11/8/2023 Badge Fundamentals of question answering with the Language Service Completed on 11/8/2023 Badge Fundamentals of Text Analysis with the Language Service Completed on 11/8/2023 Badge Fundamentals of Azure AI Speech Completed on 11/8/2023 Badge Fundamentals of conversational language understanding Completed on 11/8/2023 Badge Use your own data with Azure OpenAI Service Completed on 11/8/2023 Badge Generate images with Azure OpenAI Service Completed on 11/8/2023 Badge Generate code with Azure OpenAI Service Completed on 11/8/2023 Badge Apply prompt engineering with Azure OpenAI Service Completed on 11/8/2023 Badge Build natural language solutions with Azure OpenAI Service Completed on 11/8/2023 Badge Get started with Azure OpenAI Service Completed on 11/8/2023 Badge Fundamentals of Responsible Generative AI Completed on 11/8/2023 Badge Fundamentals of Azure OpenAI Service Completed on 11/8/2023 Badge Fundamentals of Generative AI Completed on 11/8/2023 Badge Describe monitoring tools in Azure Completed on 11/8/2023 Badge Describe features and tools for managing and deploying Azure resources Completed on 11/8/2023 Badge Describe features and tools in Azure for governance and compliance Completed on 11/8/2023 Badge Describe cost management in Azure Completed on 11/8/2023 Badge Align requirements with cloud types and service models in Azure Completed on 11/8/2023 Badge Move Azure resources to another resource group Completed on 11/8/2023 Badge Control and organize Azure resources with Azure Resource Manager Completed on 11/8/2023 Badge Create custom roles for Azure resources with role-based access control (RBAC) Completed on 11/8/2023 Badge Manage access to an Azure subscription by using Azure role-based access control (Azure RBAC) Completed on 11/8/2023 Badge Secure your Azure resources with Azure role-based access control (Azure RBAC) Completed on 11/8/2023 Badge Create Azure users and groups in Microsoft Entra ID Completed on 11/8/2023 Badge Configure role-based access control Completed on 11/8/2023 Badge Configure Azure Policy Completed on 11/8/2023 Badge Configure subscriptions Completed on 11/8/2023 Badge Configure user and group accounts Completed on 11/8/2023 Badge Configure Microsoft Entra ID Completed on 11/8/2023 Badge Allow users to reset their password with Microsoft Entra self-service password reset Completed on 11/8/2023 Badge Manage device identity with Microsoft Entra join and Enterprise State Roaming Completed on 11/8/2023 Badge Secure Microsoft Entra users with multifactor authentication Completed on 11/8/2023 Badge Implement and manage hybrid identity Completed on 11/8/2023 Badge Implement and manage external identities Completed on 11/8/2023 Badge Create, configure, and manage identities Completed on 11/8/2023 Badge Implement initial configuration of Microsoft Entra ID Completed on 11/8/2023 Badge Investigate threats by using audit features in Microsoft 365 Defender and Microsoft Purview Standard Completed on 11/8/2023 Badge Manage insider risk in Microsoft Purview Completed on 11/8/2023 Badge Respond to data loss prevention alerts using Microsoft 365 Completed on 11/8/2023 Badge Utilize Vulnerability Management in Microsoft Defender for Endpoint Completed on 11/8/2023 Badge Configure for alerts and detections in Microsoft Defender for Endpoint Completed on 11/8/2023 Badge Configure and manage automation using Microsoft Defender for Endpoint Completed on 11/8/2023 Badge Perform evidence and entities investigations using Microsoft Defender for Endpoint Completed on 11/8/2023 Badge Perform actions on a device using Microsoft Defender for Endpoint Completed on 11/8/2023 Badge Perform device investigations in Microsoft Defender for Endpoint Completed on 11/8/2023 Badge Implement Windows security enhancements with Microsoft Defender for Endpoint Completed on 11/8/2023 Badge Deploy the Microsoft Defender for Endpoint environment Completed on 11/8/2023 Badge Protect against threats with Microsoft Defender for Endpoint Completed on 11/8/2023 Badge Challenge project - Develop foreach and if-elseif-else structures to process array data in C# Completed on 11/8/2023 Badge Guided project - Develop foreach and if-elseif-else structures to process array data in C# Completed on 11/8/2023 Badge Create readable code with conventions, whitespace, and comments in C# Completed on 11/8/2023 Badge Store and iterate through sequences of data using Arrays and the foreach statement in C# Completed on 11/8/2023 Badge Add decision logic to your code using `if`, `else`, and `else if` statements in C# Completed on 11/8/2023 Badge Call methods from the .NET Class Library using C# Completed on 11/8/2023 Badge Install and configure Visual Studio Code Completed on 11/8/2023 Badge Perform basic string formatting in C# Completed on 11/8/2023 Badge Store and retrieve data using literal and variable values in C# Completed on 11/8/2023 Badge Write your first C# code Completed on 11/8/2023 Badge Guided project - Calculate final GPA Completed on 11/8/2023 Badge Guided project - Calculate and print student grades Completed on 11/8/2023 Badge Perform basic operations on numbers in C# Completed on 11/8/2023 Badge Explore Windows Editions Completed on 11/8/2023 Badge Explore the Enterprise Desktop Completed on 11/8/2023 Badge Examine data security and compliance in Microsoft 365 Copilot Completed on 11/8/2023 Badge Implement Microsoft 365 Copilot Completed on 11/8/2023 Badge Examine the Microsoft 365 Copilot design Completed on 11/8/2023 Badge Manage records in Microsoft Purview Completed on 11/8/2023 Badge Manage data retention in Microsoft 365 workloads Completed on 11/8/2023 Badge Manage the data lifecycle in Microsoft Purview Completed on 11/8/2023 Badge Configure DLP policies for Microsoft Defender for Cloud Apps and Power Platform Completed on 11/8/2023 Badge Prevent data loss in Microsoft Purview Completed on 11/8/2023 Badge Manage data loss prevention policies and reports in Microsoft 365 Completed on 11/8/2023 Badge Apply and manage sensitivity labels Completed on 11/8/2023 Badge Protect information in Microsoft Purview Completed on 11/8/2023 Badge Deploy Microsoft Purview Message Encryption Completed on 11/8/2023 Badge Understand Microsoft 365 encryption Completed on 11/8/2023 Badge Create and manage sensitive information types Completed on 11/8/2023 Badge Classify data for protection and governance Completed on 11/8/2023 Badge Introduction to information protection and data lifecycle management in Microsoft Purview Completed on 11/8/2023 Badge Design an application architecture Completed on 11/8/2023 Badge Design an Azure compute solution Completed on 11/8/2023 Badge Design migrations Completed on 11/8/2023 Badge Design network solutions Completed on 11/8/2023 Badge Design a solution to log and monitor Azure resources Completed on 11/8/2023 Badge Design authentication and authorization solutions Completed on 11/8/2023 Badge Design governance Completed on 11/8/2023 Badge Save money with Azure Reserved Instances Completed on 11/8/2023 Badge Introduction to analyzing costs and creating budgets with Microsoft Cost Management Completed on 11/8/2023 Badge Microsoft Azure Well-Architected Framework - Cost optimization Completed on 11/8/2023 Badge Introduction to the Microsoft Azure Well-Architected Framework Completed on 11/8/2023 Badge Microsoft Cloud Adoption Framework for Azure Completed on 11/8/2023 Badge Describe Azure identity, access, and security Completed on 11/8/2023 Badge Describe Azure storage services Completed on 11/8/2023 Badge Describe Azure compute and networking services Completed on 11/8/2023 Badge Describe the core architectural components of Azure Completed on 11/8/2023 Badge Describe cloud service types Completed on 11/8/2023 Badge Describe the benefits of using cloud services Completed on 11/8/2023 Badge Describe cloud computing Completed on 11/8/2023 Badge 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Manage Azure updates Completed on 11/8/2023 Badge Audit the security of Windows Server IaaS Virtual Machines Completed on 11/8/2023 Badge Configure and monitor Microsoft Sentinel Completed on 11/8/2023 Badge Enable and manage Microsoft Defender for Cloud Completed on 11/8/2023 Badge Configure and manage Azure Monitor Completed on 11/8/2023 Badge Improve your cloud security posture with Microsoft Defender for Cloud Completed on 11/8/2023 Badge Secure your cloud apps and services with Microsoft Defender for Cloud Apps Completed on 11/8/2023 Badge Safeguard your environment with Microsoft Defender for Identity Completed on 11/8/2023 Badge Remediate risks with Microsoft Defender for Office 365 Completed on 11/8/2023 Badge Protect your identities with Microsoft Entra ID Protection Completed on 11/8/2023 Badge Mitigate incidents using Microsoft 365 Defender Completed on 11/8/2023 Badge Introduction to Microsoft 365 threat protection Completed on 11/8/2023 Badge Configure Azure Load Balancer Completed on 11/7/2023 Badge Configure network routing and endpoints Completed on 11/7/2023 Badge Configure Azure Virtual Network peering Completed on 11/7/2023 Badge Configure Azure DNS Completed on 11/7/2023 Badge Configure network security groups Completed on 11/7/2023 Badge Configure virtual networks Completed on 11/7/2023 Badge Improve application scalability and resiliency by using Azure Load Balancer Completed on 11/7/2023 Badge Manage and control traffic flow in your Azure deployment with routes Completed on 11/7/2023 Badge Host your domain on Azure DNS Completed on 11/7/2023 Badge Distribute your services across Azure virtual networks and integrate them by using virtual network peering Completed on 11/7/2023 Badge Design an IP addressing schema for your Azure deployment Completed on 11/7/2023 Badge Configure Azure Application Gateway Completed on 11/7/2023 Badge Design an enterprise governance strategy Completed on 11/7/2023 Badge Configure Microsoft Entra Privileged Identity Management Completed on 11/7/2023 Badge Deploy Microsoft Entra ID Protection Completed on 11/7/2023 Badge Implement hybrid identity Completed on 11/7/2023 Badge Secure Azure solutions with Microsoft Entra ID Completed on 11/7/2023 Badge Functional Consultant skills Completed on 11/7/2023 Badge Use knowledge articles to resolve Dynamics 365 Customer Service cases Completed on 11/7/2023 Badge Search and filter knowledge articles by using Dynamics 365 Customer Service Completed on 11/7/2023 Badge Create knowledge management solutions in Dynamics 365 Customer Service Completed on 11/7/2023 Badge Translate Dynamics 365 apps and documentation with Dynamics 365 Translation Service Completed on 11/7/2023 Badge Challenge project - Architecting solutions for a new product line for customers Completed on 11/7/2023 Badge Perform fit gap analysis Completed on 11/7/2023 Badge Work with requirements for Microsoft Power Platform and Dynamics 365 Completed on 11/7/2023 Badge Propose a solution as a Solution Architect for Microsoft Power Platform and Dynamics 365 Completed on 11/7/2023 Badge Discover customer needs as a Solution Architect for Dynamics 365 and Microsoft Power Platform Completed on 11/7/2023 Badge Becoming a solution architect for Dynamics 365 and Microsoft Power Platform Completed on 11/7/2023 Badge Integration design for Dynamics 365 solutions Completed on 11/7/2023 Badge Review the security model for your Dynamics 365 solutions Completed on 11/7/2023 Badge Create a data migration strategy for Dynamics 365 solutions Completed on 11/7/2023 Badge Gap solution design for Dynamics 365 solutions Completed on 11/7/2023 Badge Business intelligence and analytics design for Dynamics 365 solutions Completed on 11/7/2023 Badge Design data models for Dynamics 365 solutions Completed on 11/7/2023 Badge Plan a testing strategy for your Dynamics 365 solution Completed on 11/7/2023 Badge Create a solution blueprint for Dynamics 365 solutions Completed on 11/7/2023 Badge Get started with Success by Design for Dynamics 365 Completed on 11/7/2023 Badge Post go-live strategy for Dynamics 365 solutions Completed on 11/7/2023 Badge Cutover strategy for Dynamics 365 solutions Completed on 11/7/2023 Badge Implement a performance strategy for Dynamics 365 solutions Completed on 11/7/2023 Badge Dual-write implementation for Dynamics 365 solutions Completed on 11/7/2023 Badge Implement common integration features in finance and operations apps Completed on 11/7/2023 Badge Personalize finance and operations apps Completed on 11/7/2023 Badge Work with workflows in finance and operations apps Completed on 11/7/2023 Badge Set up batch jobs in finance and operations apps Completed on 11/7/2023 Badge Plan and implement legal entities in finance and operations apps Completed on 11/7/2023 Badge Plan and configure the global address book in finance and operations apps Completed on 11/7/2023 Badge Feature management in finance and operations apps Completed on 11/7/2023 Badge Prepare to go-live with finance and operations apps Completed on 11/7/2023 Badge Implement role-based security in finance and operations apps Completed on 11/7/2023 Badge Plan and implement security in finance and operations apps Completed on 11/7/2023 Badge Work with performance and monitoring tools in finance and operations apps Completed on 11/7/2023 Badge Updates and upgrades for finance and operations apps Completed on 11/7/2023 Badge Design and build mobile apps for finance and operations apps Completed on 11/7/2023 Badge Describe building automation with Microsoft Power Automate Completed on 11/7/2023 Badge Identify foundational components of Microsoft Power Platform Completed on 11/7/2023 Badge Describe how to build applications with Microsoft Power Apps Completed on 11/7/2023 Badge Describe the business value of the Microsoft Power Platform Completed on 11/7/2023 Badge Work with analytics and reporting in finance and operations apps Completed on 11/7/2023 Badge Data integrations with finance and operations apps Completed on 11/7/2023 Badge Identify data integration patterns and scenarios in finance and operations apps Completed on 11/7/2023 Badge Consume business events in finance and operations apps Completed on 11/7/2023 Badge Explore extensions and the extension framework in finance and operations apps Completed on 11/7/2023 Badge Implement application lifecycle management in finance and operations apps Completed on 11/7/2023 Badge Prepare data for migration to finance and operations apps Completed on 11/7/2023 Badge Work with data management in finance and operations apps Completed on 11/7/2023 Badge Perform user acceptance testing in finance and operations apps Completed on 11/7/2023 Badge Design and plan an implementation of finance and operations apps Completed on 11/7/2023 Badge Get started with Lifecycle Services for finance and operations apps Completed on 11/7/2023 Badge FastTrack Customer Success Program for finance and operations Completed on 11/7/2023 Badge Get started with a finance and operations implementation project Completed on 11/7/2023 Badge Use approval workflows in Dynamics 365 Business Central Completed on 11/7/2023 Badge Create workflows in Dynamics 365 Business Central Completed on 11/7/2023 Badge Migrate on-premises data to Dynamics 365 Business Central Completed on 11/7/2023 Badge Migrate data to Business Central Completed on 11/7/2023 Badge Create new companies in Business Central Completed on 11/7/2023 Badge Administer Dynamics 365 Business Central online Completed on 11/7/2023 Badge Integrate Business Central with Outlook Completed on 11/7/2023 Badge Set up email in Dynamics 365 Business Central Completed

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on 11/7/2023 Badge Manage users and implement security in Business Central Completed on 11/7/2023 Badge Administer Microsoft Power Platform subscriptions Completed on 11/7/2023 Badge Manage Microsoft Power Platform deployments Completed on 11/7/2023 Badge Use administration options for Dataverse Completed on 11/7/2023 Badge Get started with security roles in Dataverse Completed on 11/7/2023 Badge Authentication and user management in Power Pages Completed on 11/7/2023 Badge Integrate Power Pages with web-based technologies Completed on 11/7/2023 Badge Power Pages administration Completed on 11/7/2023 Badge Power Pages maintenance and troubleshooting Completed on 11/7/2023 Badge Run a Power Automate for desktop flow in unattended mode Completed on 11/7/2023 Badge Use the Teams connector in Power Automate Completed on 11/7/2023 Badge Use AI Builder to process invoice forms in Power Automate Completed on 11/7/2023 Badge Integrate desktop flows with Outlook connector in Power Automate for 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11/7/2023 Badge Describe types of source control systems Completed on 11/7/2023 Badge Introduction to source control Completed on 11/7/2023 Badge Plan Agile with GitHub Projects and Azure Boards Completed on 11/7/2023 Badge Choose the DevOps tools Completed on 11/7/2023 Badge Describe team structures Completed on 11/7/2023 Badge Choose the right project Completed on 11/7/2023 Badge Introduction to DevOps Completed on 11/7/2023 Badge Independent learning with math tools in OneNote Completed on 11/6/2023 Badge OneNote Class Notebook: A teacher's all-in-one notebook for students Completed on 11/6/2023 Badge Converse, collaborate, and build community in Teams Completed on 11/6/2023 Badge Organize content, create assignments, and assess learners' understanding in Teams Completed on 11/6/2023 Badge Collaborate with colleagues through live Teams meetings and OneNote Completed on 11/6/2023 Badge Work collaboratively with Staff and PLC Teams Completed on 11/6/2023 Badge Assemble learners and 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foundation for inclusive learning Completed on 11/6/2023 Badge Teach forward: Best strategies for hybrid, remote, and blended learning Completed on 11/6/2023 924. 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module assessment result column means either the module assessment doesn't exist or there's no pass record for it. All modules in this table are complete. Module title Description Completed on Duration Module Assessment Result Introduction to Azure Load Balancer This module explains what Azure Load Balancer does, how it works, and when you

should choose to use Load Balancer as a solution to meet your organization's needs. Jan 10, 2025 18 min N/A Enhance your service availability and data locality by using Azure Traffic Manager Discover how Azure Traffic Manager provides DNS load balancing for your application to improve the performance and availability of your application. Jan 10, 2025

29 min N/A Improve your reliability with modern operations practices: An introduction Discover a map for navigating reliability challenges and sustainably achieving the appropriate level of reliability in your systems, services, and products. Jan 10, 2025 10 min N/A Expand your AI skills based on your role Get ready to use Copilot and build AI apps. Discover

the transformational experiences you can implement by using Microsoft's AI apps and services. Select a role to explore focused skilling resources. Developer Business or technical leader Business user IT professional Data scientist Data professional Low-code developer Security professional Developer Accelerate app development by using

GitHub Copilot Find out how to use GitHub Copilot to interpret and document code, author new code features more efficiently, and refactor, debug, and test code. Build AI apps with Azure Services and best practices Get the details on designing and building a cloud-native AI app, developing a back-end database, and integrating Azure AI services into

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Website. Register for exam Effective Date: September 2024 SSCP Certification Exam Outline View and download the latest PDF version of the SSCP Certification Exam Outline in the following languages: SSCP - English | SSCP - Japanese | SSCP - Spanish About SSCP The Systems Security Certified Practitioner (SSCP) is the ideal certification for those
with proven technical skills and practical, hands-on security knowledge in operational IT roles. It provides confirmation of a practitioner's ability to implement, monitor and administer IT infrastructure in accordance with information security policies and procedures that ensure data confidentiality, integrity and availability. The broad spectrum of topics included
in the SSCP Common Body of Knowledge (CBK) ensure its relevancy across all disciplines in the field of information security. Successful candidates are competent in the following domains: Security Concepts and Practices Access Controls Risk Identification, Monitoring, and Analysis Incident Response and Recovery Cryptography Network and
Communications Security Systems and Application Security Experience Requirements Candidates must have a minimum of one year cumulative work experience in one or more of the domains of the SSCP CBK. A one year prerequisite pathway will be granted for candidates who received a degree (bachelors or masters) in a cybersecurity program. A
candidate that doesn't have the required experience to become an SSCP may become an Associate of ISC2 by successfully passing the SSCP examination. The Associate of ISC2 will then have two years to earn the one year required experience. You can learn more about SSCP experience requirements and how to account for part-time work and
internships at www.isc2.org/Certifications/SSCP/SSCP-Experience-Requirements. Accreditation SSCP is in compliance with the stringent requirements of ANSI/ISO/IEC Standard 17024. Job Task Analysis (JTA) ISC2 has an obligation to its membership to maintain the relevancy of the SSCP. Conducted at regular intervals, the Job Task Analysis (JTA) is a
methodical and critical process of determining the tasks that are performed by security professionals who are engaged in the profession defined by the SSCP. The results of the JTA are used to update the examination. This process ensures that candidates are tested on the topic areas relevant to the roles and responsibilities of today's practicing
information security professionals. SSCP Examination Information Length of exam 3 hours Number of items 125 Item format Multiple choice Passing grade 700 out of 1000 points Language availability English, Japanese and Spanish Testing center Pearson VUE Testing Center SSCP Examination Weights Domains Average Weight 1. Security Concepts
and Practices 16% 2. Access Controls 15% 3. Risk Identification, Monitoring and Analysis 15% 4. Incident Response and Recovery 14% 5. Cryptography 9% 6. Network and Communications Security 16% 7. Systems and Application Security 15% Total 100% Domains 1.1 - Comply with codes of ethics ISC2 Code of Ethics Organizational code of ethics
1.2 - Understand security concepts Confidentiality Integrity Availability Accountability Non-repudiation Least privilege Segregation of duties (SoD) 1.3 - Identify and implement security controls Technical controls (e.g., firewalls, intrusion detection systems (IDS), access control list (ACL) Physical controls (e.g., mantraps, cameras, locks)
Administrative controls (e.g., security policies, standards, procedures, baselines) Assessing compliance requirements Periodic audit and review 1.4 - Document and maintain functional security controls Deterrent controls Preventative controls Detective controls Corrective controls Compensating controls 1.5 - Support and implement asset
management lifecycle (i.e., hardware, software, and data) Process, planning, design and initiation Development /Acquisition (e.g., DevSecOps, testing) Inventory and licensing (e.g., open source, closed-source) Implementation/Assessment Operation/Maintenance/End of Life (EOL) Archival and retention requirements Disposal and destruction
1.6 - Support and/or implement change management lifecycle Change management (e.g., roles, responsibilities, processes, communications, audit) Security impact analysis Configuration management (CM) 1.7 - Support and/or implement security awareness and training (e.g., social engineering/phishing/tabletop exercises/awareness
communications) 1.8 - Collaborate with physical security operations (e.g., data center/facility assessment, badging and visitor management, personal device restrictions) 2.1 - Implement and maintain authentication methods Single/Multi-factor authentication (MFA) Single sign-on (SSO) (e.g., Active Directory Federation Services (ADFS), OpenID
Connect) Device authentication (e.g., certificate, Media Access Control (MAC) address, Trusted Platform Module (TPM)) Federated access (e.g., Open Authorization 2 (OAuth2), Security Assertion Markup Language (SAML)) 2.2 - Understand and support internetwork trust architectures Trust relationships (e.g., 1-way, 2-way, transitive, zero) Internet,
intranet, extranet, and demilitarized zone (DMZ) Third-party connections (e.g., application programming interface (API), app extensions, middleware) 2.3 - Support and/or implement the identity management lifecycle Authorization Proofing Provisioning/De-provisioning Monitoring, Reporting, and Maintenance (e.g., role changes, new security
standards) Entitlement (e.g., inherited rights, resources) Identity and access management (IAM) systems 2.4 - Understand and administer access controls Mandatory Discretionary Role-based (e.g., subject-based, object-based, Privileged Access Management (PAM)) Rule-based Attribute-based 3.1 - Understand risk management Risk
visibility and reporting (e.g., risk register, sharing threat intelligence, indicators of Compromise (IOC), Common Vulnerability Scoring System (CVSS), socialization, MITRE/ATT&CK model) Risk management concepts (e.g., impact assessments, threat modeling, scope) Risk management frameworks Risk tolerance (e.g., appetite, risk quantification)
Risk treatment (e.g., accept, transfer, mitigate, avoid) 3.2 - Understand legal and regulatory concerns (e.g., jurisdiction, limitations, privacy) 3.3 - Perform security assessments and vulnerability management activities Risk management frameworks implementation Security testing Risk review (e.g., internal, supplier, architecture) Vulnerability
management lifecycle (e.g., scanning, reporting, analysis, remediation) 3.4 - Operate and monitor security platforms (e.g., continuous monitoring) Source systems (e.g., applications, security appliances, network devices, hosts) Events of interest (e.g., errors, omissions, anomalies, unauthorized changes, compliance violations, policy failures) Log
management (e.g., policy, integrity, preservation, architectures, configuration, aggregation, tuning) Security information and event management (SIEM) (e.g., real-time monitoring, analysis, tracking, audit) 3.5 - Analyze monitoring results Security baselines and anomalies (e.g., correlation, noise reduction) Visualizations, metrics, and trends (e.g.,
notifications, dashboards, timelines) Event data analysis Document and communicate findings (e.g., escalation) 4.1 - Understand and support incident response lifecycle (e.g., National Institute of Standards and Technology (NIST), International Organization for Standardization (ISO)) Preparation (e.g., defining roles, training programs) Detection,
analysis, and escalation (e.g., incident communication, public relations) Containment Eradication Recovery (e.g., incident documentation) Post incident activities (e.g., lessons learned, new countermeasures, continuous improvement) 4.2 - Understand and support forensic investigations Legal (e.g., civil, criminal, administrative) and ethical
principles Evidence handling (e.g., first responder, triage, chain of custody, preservation of scene) Reporting of analysis Organization Security Policy Compliance 4.3 - Understand and support business continuity plan (BCP) and disaster recovery plan (DRP) Emergency response plans and procedures (e.g., information system contingency,
pandemic, natural disaster, crisis management) Interim or alternate processing strategies Restoration planning (e.g., Restore Time Objective (RTO), Restore Point Objectives (RPO), Maximum Tolerable Downtime (MTD)) Backup and redundancy implementation Testing and drills (e.g., playbook, tabletop, disaster recovery exercises, scheduling) 5.1
- Understand reasons and requirements for cryptography Confidentiality Integrity and authenticity Data sensitivity (e.g., personally identifiable information (PII), intellectual property (IP), protected health information (PHI)) Regulatory and industry best practice (e.g., Payment Card Industry Data Security Standards (PCI-DSS), International
Organization for Standardization (ISO)) Cryptography entropy (e.g., quantum cryptography, quantum key distribution) 5.2 - Apply cryptography concepts Hashing Salting Symmetric/Asymmetric encryption/Elliptic curve cryptography (ECC) Non-repudiation (e.g., digital signatures/certificates, Hash-based Message Authentication Code (HMAC),
audit trails) Strength of encryption algorithms and keys (e.g., Advanced Encryption Standards (AES), Rivest-Shamir-Adleman (RSA) Cryptographic attacks and cryptanalysis 5.3 - Understand and implement secure protocols Services and protocols Common use cases (e.g., credit card processing, file transfer, web client, virtual private network
(VPN), transmission of PII data) Limitations and vulnerabilities 5.4 - Understand public key infrastructure (PKI) Fundamental key management concepts (e.g., storage, rotation, composition, generation, destruction, exchange, revocation, escrow) Web of Trust (WOT) (e.g., Pretty Good Privacy (PGP), GNU Privacy Guard (GPG), blockchain) 6.1 -
Understand and apply fundamental concepts of networking Open Systems Interconnection (OSI) and Transmission Control Protocol/Internet Protocol (TCP/IP) models Network topologies Network relationships (e.g., peer-to-peer (P2P), client server) Transmission media types (e.g., wired, wireless) Software-defined networking (SDN) (e.g.,

Software-Defined Wide Area Network (SD-WAN), network virtualization, automation) Commonly used ports and protocols 6.2 - Understand network attacks (e.g., distributed denial of service (DDoS), man-in-the-middle (MITM), Domain Name System (DNS) cache poisoning) Countermeasures (e.g., content delivery networks (CDN), firewalls, network
access controls, intrusion detection and prevention systems (IDPS)) 6.3 - Manage network access controls Network access controls, standards and protocols (e.g., Institute of Electrical and Electronics Engineers (IEEE) 802.1X, Remote Authentication Dial-In User Service (RADIUS), Terminal Access Controller Access-Control System Plus (TACACS+))
Remote access operation and configuration (e.g., thin client, virtual private network (VPN), virtual desktop infrastructure) 6.4 - Manage network security Logical and physical placement of network devices (e.g., inline, passive, virtual) Segmentation (e.g., physical/logical, data/control plane, virtual local area network (VLAN), access control list (ACL),
firewall zones, micro-segmentation) Secure device management 6.5 - Operate and configure network-based security appliances and services Firewalls and proxies (e.g., filtering methods, web application firewall (WAF), cloud access security broker (CASB)) Network intrusion detection/prevention systems Routers and switches Traffic-shaping
devices (e.g., wide area network (WAN) optimization, load balancing) Network Access Control (NAC) Data Loss Prevention (DLP) Unified Threat Management (UTM) 6.6 - Secure wireless communications Technologies (e.g., cellular network, Wi-Fi, Bluetooth, Near-Field Communication (NFC)) Authentication and encryption protocols (e.g., Wi-Fi
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
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Protected Access (WPA), Extensible Authentication Protocol (EAP), Wi-Fi Protected Access 2 (WPA2), Wi-Fi Protected Access 3 (WPA3)) 6.7 Secure and monitor Internet of Things (IoT) (e.g., configuration, network isolation, firmware updates, End of Life (EOL) management) 7.1 - Identify and analyze malicious code and activity Malware (e.g., rootkits,
spyware, scareware, ransomware, trojans, virus, worms, trapdoors, backdoors, fileless, app/code/operatin3 system (OS)/mobile code vulnerabilities) Malware countermeasures (e.g., scanners, anti-malware, containment and remediation, software security) Types of malicious activity (e.g., insider threat, data theft, distributed denial of service (DDoS),
botnet, zero-day exploits, web-based attacks, advanced persistent threat (APT)) Malicious activity countermeasures (e.g., user awareness/training, system hardening, patching, isolation, data loss prevention (DLP)) Social engineering methods (e.g., SPAM email, phishing/smishing/vishing, impersonation, scarcity, whaling) Behavior analytics (e.g.,
machine learning, Artificial Intelligence (AI), data analytics) 7.2 - Implement and operate endpoint device security Host-based intrusion prevention system (HIPS) Host-based intrusion detection system (HIDS) Host-based firewalls Application white listing Endpoint encryption (e.g., full disk encryption) Trusted Platform Module (TPM) (e.g.,
hardware security module management) Secure browsing (e.g., digital certificates) Endpoint detection and response (EDR) 7.3 - Administer and manage mobile devices Provisioning techniques (e.g., corporate owned, personally enabled (COPE), Bring Your Own Device (BYOD), Mobile Device Management (MDM)) Containerization Encryption
Mobile application management 7.4 - Understand and configure cloud security Deployment models (e.g., public, private, hybrid, community) Service models (e.g., Infrastructure as a Service (IaaS), Platform as a Service (PaaS) and Software as a Service (SaaS)) Virtualization (e.g., hypervisor, Virtual Private Cloud (VPC)) Legal and regulatory
concerns (e.g., privacy, surveillance, data ownership, jurisdiction, eDiscovery, shadow information technology (IT)) Data storage, processing, and transmission (e.g., archiving, backup, recovery, resilience) Third-party/Outsourcing requirements (e.g., service-level agreement (SLA), data portability/ privacy/destruction/auditing) Shared responsibility
model 7.5 - Operate and maintain secure virtual environments Hypervisor (i.e., Type 1 (e.g., bare metal), Type 2 (e.g., software)) Virtual appliances Containers Continuity and resilience Storage management (e.g., data domain) Threats, attacks, and countermeasures (e.g., brute-force attack, virtual machine escape, threat hunting) Additional
Examination Information Supplementary References Candidates are encouraged to supplement their education and experience by reviewing relevant resources that pertain to the CBK and identifying areas of study that may need additional attention. View the full list of supplementary references at www.isc2.org/certifications/References. Examination
Policies and Procedures ISC2 recommends that SSCP candidates review exam policies and procedures prior to registering for the examination. Read the comprehensive breakdown of this important information at www.isc2.org/Register-for-Exam. A safe and secure cyber world The Center for Cyber Safety & EducationISC2 CareersCommunityBlog
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required: Show two (2) valid, unexpired forms of personal ID (examples include: government issued ids, passports, etc.). Both must have your name (exactly as it appears in your exam registration) and signature, and one of the two must have your photo. For more information about acceptable IDs please visit: https://www.isc2.org/Exams/Exam-Day and
look under What You Need to Bring to the Test Center tab for more information. oUnacceptable form of ID: Digital IDs (A digital ID is an electronic representation of personally identifying information that may be used to verify the identity of a person) For additional information regarding the Aadhaar ID, please visit Aadhaar ID Policy for Pearson VUE.
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Pearson customer support team to reschedule, you must do so at least 24 hours prior to your appointment. If you do not reschedule your exam appointment without proper advanced notice, as outlined above, it will result in a no-show, and you will forfeit your exam fee. If you used the ISC2 Candidate promo code, as part of the One Million Certified in
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must do so at least 24 hours prior to your appointment. If you do not cancel your exam appointment without proper advanced notice, as outlined above, it will result in a no-show, and will forfeit your exam fee. If you used the ISC2 Candidate promo code, as part of the One Million Certified in Cybersecurity initiative, you will not be able to register again with
that code. Additional Information ISC2 Terms and Conditions ISC2 requires that all candidates for certification read and accept the terms and conditions set forth here: https://www.isc2.org/uploadedFiles/Certification_Programs/CBT-Examination-Agreement.pdf. Candidates that do not agree to the terms and conditions will not be permitted to sit for any
ISC2 examination. Non-Disclosure Agreement (NDA) Failure to read or accept the ISC2 NDA agreement within the allotted five minutes will result in exam termination and forfeiture of exam appointment. Forfeiture of exam appointment also includes forfeiture of all exam fees. To take the examination at a later date you will be required to re-register for the
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results. For the small number of candidates affected by this process, it is expected that candidates will receive their results within 6 -8 weeks following the exam. ISC2 offers two types of computer-based exams – linear and adaptive – however neither exam type allows for candidates to skip an item, nor can items be returned to later during administration.
Once an answer is confirmed it cannot be changed, reviewed, or revisited. Frequently asked questions (FAQs) and answers for common inquiries that can be found here: https://www.isc2.org/Frequently-Asked-Questions. Accommodations Policy ISC2 provides reasonable and appropriate accommodations for people who have a documented need for
exam accommodations. Accommodations must be requested and approved by ISC2 prior to scheduling your examination. If you wish to request an accommodation, please visit https://www.isc2.org/Register-for-Exam and look under the Requesting Special Accommodations tab for information and instructions on how to request an accommodation. Test
accommodations are individualized and considered on a case-by-case basis. Once an accommodation is approved, ISC2 will inform the Pearson VUE Accommodations team. Please allow up to three business days for Pearson VUE to receive this information. Then, contact Cart Collapsed, toggle side navigation to expand Edit my profile Tshingombe
Tshingombe Tshitadi ISC2 ID: 1907033 Dashboard My Profile Sign out Almost there... back to previous step Confirm Order Details Description Details Price Exam CC: Certified in Cybersecurity (CC) Language: English Length: 120 minutes Appointment Friday, March 14, 2025 Start time: 8:00 AM Africa/Johannesburg - SAST Location Pearson
Professional Centers-Johannesburg Pearson VUE 6th Floor Sandton City Office Tower Sandton City Shopping Centre 158 5th Street, SANDTON Johannesburg 2146 South Africa 199.00 Payment Details Exams for Name: Tshingombe Tshingombe Tshitadi ISC2 ID: 1907033 Order Total Subtotal: 199.00 Tax: 0.00 TOTAL DUE: USD 199.00 USD 199.00
Pearson VUE, so you can schedule your exam, contact information can be found at www.pearsonvue.com/isc2/contact. Accommodations are not a guarantee of improved performance or exam completion. Once an initial exam appointment is scheduled, there may be a US$50 fee to reschedule an exam with an approved accommodation. Agree to ISC2
policies Top of Form back to previous step Bottom of Form Top of Form CCSP: Certified Cloud Security Professional (CCSP) CGRC: Certified in Governance Risk and Compliance CISSP: Certified Information Systems Security Professional CSSLP: Certified Secure Software Lifecycle Professional ISSAP: Information Systems Security Architecture
Professional ISSMP: Information Systems Security Management Professional SSCP: Systems Security Certified Practitioner Certification Exam Outline Effective Date: November 15, 20222 ISSMP Certification Exam Outline About CISSP-ISSMP The Information Systems Security Management Professional (ISSMP) is a CISSP who specializes in
establishing, presenting and governing information security programs and demonstrates management and leadership skills. CISSP-ISSMPs direct the alignment of security programs with the organization's mission, goals and strategies in order to meet enterprise financial and operational requirements in support of its desired risk position. The broad
spectrum of topics included in the CISSP-ISSMP Common Body of Knowledge (CBK®) ensure its relevancy across all disciplines in the field of information security management. Successful candidates are competent in the following six domains: • Leadership and Business Management • Systems Lifecycle Management • Risk Management • Threat
Intelligence and Incident Management • Contingency Management • Law, Ethics and Security Compliance Management Experience Requirements Candidates must be a CISSP in good standing and have two years cumulative paid work experience in one or more of the six domains of the CISSP-ISSMP CBK. You can learn more about CISSP-ISSMP
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Total: 100%4 ISSMP Certification Exam Outline Domain 1: Leadership and Business Management 1.1 Establish security's role in organizational culture, vision and mission » Define information security program vision and mission » Align security with organizational goals, objectives and values » Define security's relationship to the overall business
processes » Define the relationship between organizational culture and security 1.2 Align security program with organizational governance » Identify and navigate organizational governance structure » Validate roles of key stakeholders » Validate sources and boundaries of authorization » Advocate and obtain organizational support for security initiatives
1.3 Define and implement information security strategies » Identify security requirements from business initiatives » Evaluate capacity and capability to implement security strategies » Manage implementation of security strategies » Review and maintain security strategies » Prescribe security architecture and engineering theories, concepts and methods
1.4 Define and maintain security policy framework Determine applicable external standards » Determine applicable external standards » Determine data classification and protection requirements » Establish internal policies » Advocate and obtain organizational support for policies » Develop procedures, standards, guidelines and baselines » Ensure
periodic review of security policy framework5 ISSMP Certification Exam Outline » Define roles and responsibilities » Determine and manage team accountability » Build cross-functional relationships » Resolve conflicts between security and other stakeholders » Identify communication bottlenecks and barriers » Integrate security controls into human
resources processes » Evaluate service management agreements (e.g., risk, financial) » Govern managed services (e.g., infrastructure, cloud services) » Manage impact of organizational change (e.g., mergers and acquisitions, outsourcing) » Ensure that appropriate regulatory compliance statements and requirements are included in contractual
agreements » Monitor and enforce compliance with contractual agreements 1.5 Manage security requirements in contracts and agreements 1.6 Manage security awareness and training programs » Promote security programs to key stakeholders » Identify needs and implement training programs by target segment » Monitor and report on effectiveness of
security awareness and training programs 1.7 Define, measure and report security metrics » Identify Key Performance Indicators (KPI) » Associate Key Performance Indicators (KPI) to the risk posture of the organization » Use metrics to drive security program development and operations 1.8 Prepare, obtain and administer security budget » Prepare and
secure annual budget » Adjust budget based on evolving risks and threat landscape » Manage and report financial responsibilities 1.9 Manage security programs 1.10 Apply product development and project management principles » Incorporate security into project lifecycle » Identify and apply appropriate project management methodology » Analyze
project time, scope and cost relationship6 ISSMP Certification Exam Outline 2.1 Manage integration of security into Systems Development Life Cycle (SDLC) » Integrate information security gates (decision points) and requirements into lifecycle » Implement security controls into system lifecycle » Oversee security configuration management (CM)
processes 2.2 Integrate new business initiatives and emerging technologies into the security architecture » Integrate security into new business initiatives and emerging technologies » Address impact of new business initiatives on security posture 2.3 Define and oversee comprehensive vulnerability management programs (e.g., vulnerability scanning,
penetration testing, threat analysis) » Identify, classify and prioritize assets, systems and services based on criticality to business » Prioritize threats and vulnerabilities » Manage security testing » Manage mitigation and/or remediation of vulnerabilities based on risk 2.4 Manage security aspects of change control » Integrate security requirements with
change control process » Identify and coordinate with the stakeholders » Manage documentation and tracking » Ensure policy compliance (e.g., continuous monitoring) Domain 2: Systems Lifecycle Management 7 ISSMP Certification Exam Outline Domain 3: Risk Management 3.1 Develop and manage a risk management program » Identify risk
management program objectives » Communicate and agree on risk management objectives with risk owners and other stakeholders » Determine scope of organizational risk program » Identify organizational security risk tolerance/appetite » Obtain and verify organizational asset inventory » Analyze organizational risks » Determine countermeasures,
compensating and mitigating controls » Perform cost-benefit analysis (CBA) of risk treatment options 3.2 Conduct risk assessments » Identify risk factors 3.3 Manage security risks within the supply chain (e.g., supplier, vendor, third-party risk) » Identify supply chain security risk requirements » Integrate supply chain security risks into organizational risk
management » Validate security risk control within the supply chain » Monitor and review the supply chain security risks8 ISSMP Certification Exam Outline 4.1 Establish and maintain threat intelligence program » Aggregate threat data from multiple threat intelligence sources » Conduct baseline analysis of network traffic, data and user behavior » Detect
and analyze anomalous behavior patterns for potential concerns » Conduct threat modeling » Identify and categorize an attack » Correlate related security event and threat data » Create actionable alerting to appropriate resources 4.2 Establish and maintain incident handling and investigation program » Develop program documentation » Establish incident
response case management process » Establish incident response team » Apply incident management methodologies » Establish and maintain incident handling process » Establish and maintain investigation process » Quantify and report financial and operational impact of incidents and investigations to stakeholders » Conduct root cause analysis (RCA)
Domain 4: Threat Intelligence and Incident Management 9 ISSMP Certification Exam Outline 5.1 Facilitate development of contingency plans » Identify and analyze factors related to the Continuity of Operations Plan (COOP) » Identify and analyze factors related to the business continuity plan (BCP) (e.g., time, resources, verification) » Identify and analyze
factors related to the disaster recovery plan (DRP) (e.g., time, resources, verification) » Coordinate contingency management plans with key stakeholders » Define internal and external crisis communications plans » Define and communicate contingency roles and responsibilities » Identify and analyze contingency impact on business processes and
priorities » Manage third-party contingency dependencies » Prepare security management succession plan 5.2 Develop recovery strategies » Identify and analyze alternatives » Recommend and coordinate recovery strategies » Assign recovery roles and responsibilities 5.3 Maintain contingency plan, Continuity of Operations Plan (COOP), business
continuity plan (BCP) and disaster recovery plan (DRP) » Plan testing, evaluation and modification » Determine survivability and resiliency capabilities » Manage plan update process 5.4 Manage disaster response and recovery process » Declare disaster » Implement plan » Restore normal operations » Gather lessons learned » Update plan based on
lessons learned Domain 5: Contingency Management 10 ISSMP Certification Exam Outline 10 6.1 Identify the impact of laws and regulations that relate to information security 6.2 Adhere to the (ISC) 2 Code of Ethics as related to management issues 6.3 Validate compliance in accordance with applicable laws, regulations and industry best practices 6.4
Coordinate with auditors and regulators in support of the internal and external audit processes 6.5 Document and manage compliance exceptions » Identify and document compensating controls and workarounds » Report and obtain authorized approval of risk waiver Domain 6: Law, Ethics and Security Compliance Management » Identify applicable
privacy laws » Identify legal jurisdictions the organization and users operate within (e.g., trans-border data flow) » Identify export laws » Identify intellectual property (IP) laws » Identify applicable industry regulations » Identify and advise on non-compliance risks » Inform and advise senior management » Evaluate and select compliance framework(s) »
Implement the compliance framework(s) » Define and monitor compliance metrics » Plan » Schedule » Coordinate audit activities » Evaluate and validate findings » Formulate response » Validate implemented mitigation and remediation actions11 ISSMP Certification Exam Outline Additional Examination Information Supplementary References Candidates
are encouraged to supplement their education and experience by reviewing relevant resources that pertain to the CBK and identifying areas of study that may need additional attention. View the full list of supplementary references at www.isc2.org/certifications/References. Examination Policies and Procedures (ISC)2 recommends that CISSP-ISSMP
candidates review exam policies and procedures prior to registering for the examination. Read the comprehensive breakdown of this important information at www.isc2.org/Exams/Before-Your-Exam. Legal Info For any questions related to (ISC) 2 's legal policies, please contact the (ISC)2 Legal Department at legal@isc2.org. Any Questions? (ISC)2
Americas Tel: +1.866.331.ISC2 (4722) Email: info@isc2.org (ISC)2 Asia-Pacific Tel: +(852) 28506951 Email: isc2asia@isc2.org (ISC)2 EMEA Tel: +44 (0)203 300 1625 Email: info-emea@isc2.org 11 v222Certification Exam Outline Effective Date: November 13, 20202 ISSEP Certification Exam Outline About CISSP-ISSEP The Information Systems
Security Engineering Professional (ISSEP) is a CISSP who specializes in the practical application of systems engineering principles and processes to develop secure systems. An ISSEP analyzes organizational needs, defines security requirements, designs security architectures, develops secure designs, implements system security, and supports system
security assessment and authorization for government and industry. The broad spectrum of topics included in the ISSEP Common Body of Knowledge (CBK®) ensure its relevancy across all disciplines in the field of security engineering. Successful candidates are competent in the following five domains: • Systems Security Engineering Foundations • Risk
Management • Security Planning and Design • Systems Implementation, Verification and Validation • Secure Operations, Change Management and Disposal Experience Requirements Candidates must be a CISSP in good standing and have two years cumulative paid work experience in one or more of the five domains of the CISSP-ISSEP CBK. You can
learn more about CISSP-ISSEP experience requirements and how to account for part-time work and internships at www.isc2.org/Certifications/CISSP-ISSEP/experience-requirements. Accreditation CISSP-ISSEP is in compliance with the stringent requirements of ANSI/ISO/IEC Standard 17024. Job Task Analysis (JTA) (ISC)² has an obligation to its
membership to maintain the relevancy of the ISSEP. Conducted at regular intervals, the Job Task Analysis (JTA) is a methodical and critical process of determining the tasks that are performed by security professionals who are engaged in the profession defined by the ISSEP. The results of the JTA are used to update the examination. This process ensures
that candidates are tested on the topic areas relevant to the roles and responsibilities of today's practicing information security professionals.3 ISSEP Certification Exam Outline CISSP-ISSEP Examination Information CISSP-ISSEP Examination Weights Length of exam Number of items Item format Passing grade Exam availability Testing center 3 hours
125 Multiple choice 700 out of 1000 points English Pearson VUE Testing Center Domains Weight 1. Systems Security Engineering Foundations 25% 2. Risk Management 14% 3. Security Planning and Design 30% 4. Systems Implementation, Verification and Validation 14% 5. Secure Operations, Change Management and Disposal 17% Total: 100%4
ISSEP Certification Exam Outline Domain 1: Systems Security Engineering Foundations 1.1 Apply systems security engineering fundamentals 1.2 Execute systems security engineering processes 1.3 Integrate with applicable system development methodology 1.4 Perform technical management 1.5 Participate in the acquisition process 1.6 Design Trusted
Systems and Networks (TSN) » Understand systems security engineering trust concepts and hierarchies » Identify the relationships between systems and security engineering processes » Apply structural security design principles » Integrate security tasks and activities » Verify security requirements throughout the process » Integrate software assurance
methods » Perform project planning processes » Perform project assessment and control processes » Perform decision management processes » Perform risk management processes » Perform configuration management processes » Perform information management processes » Perform measurement processes » Perform Quality Assurance (QA)
processes » Identify opportunities for security process automation » Identify organizational security authority » Identify system security policy elements » Integrate design concepts (e.g., open, proprietary, modular) » Prepare security requirements for acquisitions » Participate in selection process » Participate in Supply Chain Risk Management (SCRM) »
Participate in the development and review of contractual documentation5 ISSEP Certification Exam Outline Domain 2: Risk Management 2.1 Apply security risk management principles 2.2 Address risk to system 2.3 Manage risk to operations » Establish risk context » Identify system security risks » Perform risk analysis » Perform risk evaluation »
Recommend risk treatment options » Document risk findings and decisions » Determine stakeholder risk tolerance » Identify remediation needs and other system changes » Determine risk treatment options » Assess proposed risk treatment options » Recommend risk treatment options » Align security risk management with Enterprise Risk Management

(ERM) » Integrate risk management throughout the lifecycle6 ISSEP Certification Exam Outline 3.1 Analyze organizational and operational environment 3.2 Apply system security principles 3.3 Develop system requirements 3.4 Create system security architecture and design Domain 3: Security Planning and Design » Capture stakeholder requirements »
Identify relevant constraints and assumptions » Assess and document threats » Determine system protection needs » Develop Security Test Plans (STP) » Incorporate resiliency methods to address threats » Apply defense-in-depth concepts » Identify fail-safe defaults » Reduce Single Points of Failure (SPOF) » Incorporate least privilege concept »
Understand economy of mechanism » Understand Separation of Duties (SoD) concept » Develop system security context » Identify functions within the system and security Concept of Operations (CONOPS) » Document system security requirements baseline » Analyze system security requirements » Develop functional analysis and allocation » Maintain
traceability between specified design and system requirements » Develop system security design components » Perform trade-off studies » Assess protection effectiveness7 ISSEP Certification Exam Outline Domain 4: Systems Implementation, Verification and Validation 4.1 Implement, integrate and deploy security solutions 4.2 Verify and validate security
solutions » Perform system security implementation and integration » Perform system security deployment activities » Perform system security verification » Perform security validation to demonstrate security controls meet stakeholder security requirements8 ISSEP Certification Exam Outline Domain 5: Secure Operations, Change Management and
Disposal 5.1 Develop secure operations strategy 5.2 Participate in secure operations 5.3 Participate in change management 5.4 Participate in the disposal process » Specify requirements for personnel conducting operations » Contribute to the continuous communication with stakeholders for security relevant aspects of the system » Develop continuous
monitoring solutions and processes » Support the Incident Response (IR) process » Develop secure maintenance strategy » Participate in change reviews » Determine change impact » Perform verification and validation of changes » Update risk assessment documentation » Identify disposal security requirements » Develop secure disposal strategy »
Develop decommissioning and disposal procedures » Audit results of the decommissioning and disposal process9 ISSEP Certification Exam Outline Additional Examination Information Supplementary References Candidates are encouraged to supplement their education and experience by reviewing relevant resources that pertain to the CBK and
identifying areas of study that may need additional attention. View the full list of supplementary references at www.isc2.org/certifications/References. Examination Policies and Procedures (ISC)² recommends that ISSEP candidates review exam policies and procedures prior to registering for the examination. Read the comprehensive breakdown of this
important information at www.isc2.org/Register-for-Exam. Legal Info For any questions related to (ISC)²'s legal policies, please contact the (ISC)2 Legal Department at legal@isc2.org. Any Questions? (ISC)² Americas Tel: +1-866-331-ISC2(4722) Email: membersupport@isc2.org (ISC)² Asia Pacific Tel: +852-2850-6951 Email: membersupportapac@isc2.org (ISC)² EMEA Tel: +44-203-960-7800 Email: membersupportemea@isc2.org 9 Attachments Rate this Details Lenovo and Intel are Driving AI Innovation at the Edge Flynn Maloy, Chief Marketing Officer of Lenovo ISG Jan 23 2025| 0 mins Lenovo and Intel's long-standing partnership is transforming industries by bringing
cutting-edge AI solutions to the edge and beyond. From PCs to data centers, our collaboration has consistently pushed technological boundaries. The strength of Lenovo's ThinkEdge portfolio is enabling AI-driven applications in manufacturing sites, retail stores, schools, and more. Join @Flynn Maloy, Chief Marketing Officer of Lenovo ISG, as he details
how Lenovo and Intel® are leading the way in AI innovation: - Comprehensive solutions for diverse industries: From computer vision in manufacturing to advanced AI in education and retail, Lenovo and Intel's joint solutions empower a variety of applications. - Next-gen AI with CPUs: Not every AI workload requires massive GPUs. Intel's CPUs are driving
the next wave of edge AI, particularly in inferencing and delivering efficient and accessible AI solutions. - Scalable and powerful edge portfolio: Lenovo's edge clients and servers, powered by Intel, are designed to meet the demands of modern businesses, offering flexibility and performance across workloads. - A partnership that drives innovation: With a
shared vision for the future of AI, Lenovo and Intel continue to push the boundaries of what's possible for our customers. Together, Lenovo and Intel are leading the charge in making AI more accessible, scalable, and impactful for businesses worldwide. State of Cloud 2025: Navigating EMEA's Cloud Revolution John Bradshaw, Director of Cloud Computing
Technology and Strategy, EMEA, Akamai & Bryan Glick, Editor in Chief, Computer Weekly Feb 27 2025| 18 mins Boris Cipot, Senior Security Engineer Sep 05 2024| 30 mins Python is a fast, platform-agnostic, and easy-to-learn programming language that is suited for beginners and experienced developers alike. Ever since its first release in 1991, Python
has had a constant presence in the computer world and has become a go-to language thanks to its easy-to-understand code and versatility. Today, Python can boast a wide array of libraries and frameworks, and they are the cornerstone of fast and easy Python programming—the so-called Pythonic way of development. But like all programming languages,
Python is not immune to security threats. Secure coding best practices must be adopted to avoid risks from attackers. In this webinar, we'll explore Python security best practices that should employed when building secure application. One-Stop DevOps: Simplifying Toolchains with GitLab and Google Cloud Nate Avery, Outbound Product Manager - Google
| Jackie Porter, Director of Product - Gitlab | Torsten Volk, Principal Analyst - ESG Dec 04 2024| 28 mins Seamless Edge Deployment and Management with Lenovo and Intel Blake Kerrigan, Senior Director, ThinkEdge Business Group Jan 23 2025| 1 mins Sort by Career Opportunity Senior Applied Scientist – Copilot Team Posted: March 3, 2025 Location:
Beijing, China Research Area(s): Artificial intelligence We are inviting you to join the Copilot Team, where we are redefining the future of AI-powered experiences. The Copilot Team is at the forefront of innovation, building intelligent solutions that empower users across devices… Career Opportunity Senior Applied AI Engineer – Microsoft Security AI
Research team Posted: March 3, 2025 Location: Remote (within US) Research Area(s): Artificial intelligence, Security, privacy, and cryptography Join the vanguard of cybersecurity innovation with the Microsoft Security AI Research team. We are on the lookout for an Applied Scientist to spearhead the research and development of functional autonomous
agents for security scenarios.… Career Opportunity Data Scientist II – Microsoft Security Posted: March 1, 2025 Location: Remote (within US); United States Research Area(s): Artificial intelligence, Data platforms and analytics, Human-computer interaction, Security, privacy, and cryptography The AI Personalization, Feedback, and Analytics team ensures
that Security Copilot, Microsoft's GenAI platform, delivers adaptive and intelligent experiences by leveraging feedback loops, analytics, and personalization techniques. We are seeking a Data Scientist to help… Career Opportunity Senior Applied Scientist – Power Apps Posted: March 1, 2025 Location: Redmond, WA, US; Remote (within US) Research
Area(s): Algorithms, Artificial intelligence, Data platforms and analytics The Power Apps team at Microsoft is looking to hire a Senior Applied Scientist. As a team, we are very customer focused and driven by curiosity, creativity, teamwork, agility, accountability and desire to learn everyday.… Career Opportunity Applied Scientist II – Power Apps Posted:
March 1, 2025 Location: Redmond, WA, US; Remote (within US) Research Area(s): Algorithms, Artificial intelligence, Data platforms and analytics, Programming languages and software engineering The Power Apps team at Microsoft is looking to hire an Applied Scientist II. As a team, we are very customer focused and driven by curiosity, creativity, team
work, agility, accountability and desire to learn everyday. If… Career Opportunity Principal Applied Scientist – Advanced Autonomy and Applied Robotics Posted: March 1, 2025 Location: Redmond, WA, US Research Area(s): Artificial intelligence, Hardware and devices, Human-computer interaction, Technology for emerging markets Within Microsoft's
Strategic Missions and Technologies (SMT) division, the Advanced Autonomy and Applied Robotics team is seeking a Principal Applied Scientist.The role involves building the future platform for human-robot-agent teaming. This individual will leverage cutting-edge AI and robotics technologies… Career Opportunity Senior Applied Scientist – Advanced
Autonomy and Applied Robotics Posted: March 1, 2025 Location: Redmond, WA, US Research Area(s): Artificial intelligence, Hardware and devices, Human-computer interaction, Technology for emerging markets Within Microsoft's Strategic Missions and Technologies (SMT) division, the Advanced Autonomy and Applied Robotics team is seeking a Senior
Applied Scientist. The role involves building the future platform for human-robot-agent teaming. This individual will leverage… Career Opportunity Principal Researcher – Generative AI – Microsoft Research AI Frontiers Posted: March 1, 2025 Location: New York, NY, US; Redmond, WA, US Research Area(s): Artificial intelligence We are seeking a Principal
Researcher to join our team and lead efforts on the advancement of Generative AI and Large Language Models (LLMs) technologies. As a Principal Researcher, you will play a crucial role in leading,… Career Opportunity Senior Applied Scientist Posted: March 1, 2025 Location: Cairo, Egypt Research Area(s): Artificial intelligence In shaping the future of
monetization for personalized AI assistants and pioneering innovation in the advertiser agentic space, as a Senior Applied Scientist, you will collaborate with engineers, data scientists, and product managers to develop… Career Opportunity Principal Data Scientist – Real-Time Intelligence team Posted: February 28, 2025 Location: Redmond, WA, US
Research Area(s): Artificial intelligence, Data platforms and analytics, Systems and networking Microsoft Fabric's Real-Time Intelligence team is leading the transformation of real-time analytics in the world of data. We are hiring a Principal Data Scientist to tackle challenges in both open-source and proprietary technologies related to engineering Inbox
tshingombe fiston Mon, Mar 3, 3:19 PM (18 hours ago) to me namics 365 Community / My Profile CU03031227-0 Stats 0 Comments 0 Posts 1 Likes 0 Questions My activity Achievements Personal information Achievements Notifications Notification settings Quick responses Personal information Email tshingombefiston@gmail.com Confirmation Registration details Name tshingombe tshitadi Status Registered Registration ID 102231646 Quick Links Go to the Microsoft Research Forum Website Registration support Cancel registration Please note: event emails will be sent to the email address you provided during registration. If you are not receiving event communications, please
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599,00/year Buy now Or buy at R159,00/month Office Home 2024 One-time purchase for PC or Mac R2 299,00 Buy now Microsoft 365 Family Microsoft 365 Personal Office Home 2024 Number of users 1 to 6 people 1 person One PC or Mac Number of accounts 1 to 6 1 One PC or Mac Cloud storage Up to 6 TB (1 TB per person) 1 TB Multiple devices
and platforms Included Included Word, Excel, PowerPoint Included Included Included Included OneNote Included Included Included Outlook Included Included Ongoing technical support Included Included Microsoft Defender Included Included Microsoft Editor Included Included Clipchamp Included Included Microsoft Teams Included Included Access (PC only)
Included Included Microsoft Forms Included Included Learn more Learn more Learn more Office Home & Business 2024 One-time purchase for one PC or Mac Classic 2024 desktop versions of Word, Excel, PowerPoint, Outlook and OneNote Access to support resources Buy now Learn more Frequently asked questions | 4 is sold as a onetime purchase, which means you pay a single, up-front cost to get Office apps for one computer. One-time purchases are available for both PCs and Macs. However, there are no upgrade options, which means if you plan to upgrade to the next major release, you'll have to buy it at full price. Microsoft 365 Personal and Microsoft 365 Family are
subscriptions that include powerful productivity apps and creativity tools with AI-powered features. In addition to premium desktop versions of popular Microsoft 365 apps like Word, PowerPoint, Excel and Outlook, you also get spacious cloud storage and cloud-connected features that let you collaborate on files in real time. With a subscription, you'll always
have the latest features, fixes and security updates along with ongoing tech support at no extra cost. You can choose to pay for your subscription on a monthly or yearly basis, and use your apps on multiple PCs, Macs, tablets and phones. Additionally, the Microsoft 365 Family plan lets you share your subscription with up to five more people. Everyone gets
their own apps and storage. (AI features only available to subscription owner and cannot be shared; AI usage limits apply; minimum age limits may apply to subscription activation and use of AI features. Learn more.) Microsoft 365 is compatible with PC, Mac, Android and iOS. See system requirements for compatible versions of your devices, and for
other feature requirements. No. Microsoft 365's applications are tailored for each platform and each operating system. The applications available for Mac users and the specific features included may be different from those available for PC users. With Microsoft 365, you can be flexible. With your account, you are not limited to exclusively Mac or
exclusively PC, so you can transition across devices. Yes. Documents that you have created belong fully to you. You can choose to store them online on OneDrive or locally on your PC or Mac. Internet access is required to install and activate all the latest releases of apps and services included in all Microsoft 365 subscription plans. Note that if
you are an existing subscriber, you do not need to reinstall or purchase another subscription. For Microsoft 365 plans, internet access is also needed to manage your subscription account, for example to install Office apps on other PCs or to change billing options. Internet access is also required to access documents stored on OneDrive, unless you install
the OneDrive desktop app. You should also connect to the internet regularly to keep your version of Microsoft 365 up to date and to benefit from automatic upgrades. If you do not connect to the internet at least every 31 days, your apps will go into reduced functionality mode, which means that you can view or print your documents but cannot edit the
documents or create new ones. To reactivate your apps, simply reconnect to the internet. You do not need to be connected to the internet to use the Office apps, such as Word, Excel and PowerPoint, because the apps are fully installed on your computer. Your Microsoft account is the combination of an email address and password that you use to sign
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with up to five other people. Each person you share your subscription with can install Microsoft 365 on all their devices and sign in to five devices at the same time. To add someone to your subscription, sign in to your Microsoft account and follow the on-screen instructions to add a user. Each person you add will receive an email with the steps they need to
follow. Once they have accepted and completed the steps, their information, including the installs they are using, will appear on their My Account page. You can stop sharing your subscription with someone or remove a device they are using by logging into your Microsoft account. Visit learn more about free apps. Microsoft Defender is a crossdevice security app that helps individuals and families protect their data and devices by continuously scanning the web for threats to your identity and personal data (US only). Defender also helps you stay safer online with malware protection, real-time security notifications and security tips. Download the Microsoft Defender app. Microsoft Defender is
a new cross-device app that helps people and families stay safer online. Microsoft Defender adds new features and a simplified user interface. Microsoft Defender also brings valuable device protection to iOS, Android, Windows and Mac, with malware protection, web protection, real-time security notifications and security tips. Microsoft Defender is
available in the Apple, Google and Microsoft app stores and requires a Microsoft 365 Personal or Family subscription to use. Windows Security, formerly known as Windows Defender Security Centre, is built-in security on Windows PCs to protect your device and data. Windows Security is pre-installed and automatically enabled. Windows Security includes
Microsoft Defender Antivirus software that protects your Windows device and data against viruses, ransomware, trojans and other malware unless non-Microsoft antivirus software is active. A free in-browser video editing platform designed to make video creation accessible for everyone. AI features included in Microsoft 365 Family plans are only
available to the subscription owner and cannot be shared with others. To use Copilot in Word, Excel, PowerPoint, OneNote and Outlook, make sure you have the latest version of Microsoft 365 installed. If you're signed in, have the latest updates installed, and still don't see Copilot, please restart your Microsoft 365 apps. Learn more about why I am not
seeing Copilot in my apps. Microsoft 365 supports Arabic, Chinese Simplified, Chinese Traditional, Czech, Danish, Dutch, English, Finnish, French, German, Hebrew, Hungarian, Italian, Japanese, Korean, Norwegian, Polish, Portuguese, Russian, Spanish, Swedish, Thai and Turkish. Some Designer features, like inline editing capabilities, are available
only in English. We plan to add more languages soon. You can also learn more about Copilot supported languages here: Copilot for Microsoft 365 supported languages – Microsoft Support. Visit our Copilot help & learning site to start using Copilot today. Microsoft Designer is a graphic design and image editing app powered by AI. Create eyecatching images with your words, craft next-level designs that pop and even edit photos like an expert. Designer is integrated across your favourite Microsoft apps like Word and PowerPoint to help you create when and where you need it. Beyond the Microsoft Designer web and mobile app, certain Designer features are integrated across some of your
favourite Microsoft apps like Word and PowerPoint, helping spark creativity where and when you need it. For Windows users, Designer is also integrated into Microsoft Photos. Usage limits apply to AI-powered features, including Copilot and Designer. Your Microsoft 365 Personal or Family subscription unlocks AI credits to experience and engage with
Copilot across Microsoft 365 apps and beyond. Learn more about credits. Microsoft 365 Business Basic, Business Standard and Business Premium are tailored for businesses, offering professional email with a custom domain, admin controls for managing access and devices and scalability to add additional users as your business grows. They include
advanced security features like Exchange Online Protection to guard against phishing and malware, with Business Premium adding Microsoft Defender for Business for ransomware protection and advanced threat management. Plus, you can access professional collaboration tools like Microsoft Teams with meeting recordings, transcription and team
workspaces, while business apps such as Microsoft Bookings can simplify meeting and appointment scheduling. Additionally, Microsoft 365 Copilot, an AI-powered assistant for work, is available as an add-on to boost productivity and creativit Lenovo is simplifying edge computing deployment and management with Lenovo Open Cloud Automation (LOC-A),
a powerful tool that provides our customers with the efficiency and ease they've come to expect from data center management – now applied to distributed edge environments. Join @blake Kerrigan, Senior Director, ThinkEdge Business Group, as he details how Lenovo and Intel® are enabling businesses to deploy and scale edge solutions faster, while
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Lenovo and Intel, edge computing has never been more accessible, scalable, and powerful.Enterprise Strategy Group (ESG) data shows that 65% of developers' time is consumed by overhead tasks related to context switching, pipeline integration, compliance, monitoring and logging, managing secrets, and so on. This avalanche of tasks—not to mention
the dozen or more tools involved to execute them—slows down productivity, increases the risk of security vulnerabilities, and complicates automated deployment in the DevSecOps pipeline. In this webinar, ESG Principal Analyst Torsten Volk joins Nate Avery, Google's Outbound Product Manager, and Jackie Porter, GitLab's Product Marketing Director, to
explain how to deliver code faster, enhance developer productivity, and improve security across the DevOps tool chain and into the cloud. Save your seat to discover how to resolve pressing DevSecOps pain points like tool sprawl, and how GitLab and Google's integration greatly assists with this process, reducing manual developer tasks and unifying
security automation.Watch our on-demand panel discussion with Bryan Glick, Editor in Chief at Computer Weekly, as we explore the key trends shaping cloud innovation in 2025. Discover how AI integration, edge-native applications, and distributed cloud are transforming strategies across EMEA. Gain actionable insights on application modernisation, cost
optimisation, and real-world success stories to help your organisation thrive. Key Takeaways: - How regional challenges are driving cloud adoption - Distributed cloud's role in AI and performance optimisation - Strategies for modernising applications and cutting costs Watch now on-demand! Bottom of Form Course Microsoft Azure AI Fundamentals Course
AI-900T00-A: Microsoft Azure AI Fundamentals At a glance Level Beginner Product Azure Role AI Engineer Languages English Arabic Chinese (Simplified) Chinese (Traditional) French German Indonesian Italian Japanese Korean Portuguese (Brazil) Russian Spanish Course Duration 1 day Related certifications Microsoft Certified: Azure AI
Fundamentals Overview This course introduces fundamentals concepts related to artificial intelligence (AI), and the services in Microsoft Azure that can be used to create AI solutions. The course is not designed to teach students to become professional data scientists or software developers, but rather to build awareness of common AI workloads and the
ability to identify Azure services to support them. The course is designed as a blended learning experience that combines instructor-led training with online materials on the Microsoft Learn platform (https://azure.com/learn). The hands-on exercises in the course are based on Learn modules, and students are encouraged to use the content on Learn as
reference materials to reinforce what they learn in the class and to explore topics in more depth. Audience Profile The Azure AI Fundamentals course is designed for anyone interested in learning about the types of solution artificial intelligence (AI) makes possible, and the services on Microsoft Azure that you can use to create them. You don't need to have
any experience of using Microsoft Azure before taking this course, but a basic level of familiarity with computer technology and the Internet is assumed. Some of the concepts covered in the course require a basic understanding of mathematics, such as the ability to interpret charts. The course includes hands-on activities that involve working with data and
running code, so a knowledge of fundamental programming principles will be helpful. Course Syllabus You can prepare in instructor-led training or self-paced study Learning Path Microsoft Azure AI Fundamentals: AI Overview o3 Modules oBeginner oAI Engineer oAzure AI Bot Service 70% Learning Path Microsoft Azure AI Fundamentals: Computer Vision 3 Modules Beginner AI Engineer Azure 97% Learning Path Microsoft Azure AI Fundamentals: Natural Language Processing 5 Modules Beginner AI Engineer Azure Portal 95% Learning Path Microsoft Azure AI Fundamentals: Document Intelligence and Knowledge Mining 2 Modules Beginner AI Engineer Azure Completed Learning Path Microsoft Azure AI Fundamentals: Generative AI 1 of 4 modules completed Beginner AI Engineer Azure OpenAI Service 20% Course Microsoft Azure AI Fundamentals Course AI-900T00-A: Microsoft Azure AI Fundamentals At a glance Level Beginner Product Azure Role AI Engineer Languages English Arabic Chinese (Simplified) Chinese (Traditional) French German Indonesian Italian Japanese Korean Portuguese (Brazil) Russian Spanish Course Duration 1 day Related certifications Microsoft Certified: Azure AI Fundamentals Overview This course introduces fundamentals concepts related
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AI Fundamentals: AI Overview o3 Modules oBeginner oAI Engineer oAzure AI Bot Service 70% Learning Path Microsoft Azure AI Fundamentals: Computer Vision 3 Modules Beginner AI Engineer Azure 97% Learning Path Microsoft Azure AI Fundamentals: Natural Language Processing 5 Modules Beginner AI Engineer Azure Portal 95% Learning Path Microsoft Azure AI Fundamentals: Document Intelligence and Knowledge Mining 2 Modules Beginner AI Engineer Azure Completed Learning Path Microsoft Azure AI Fundamentals: Generative AI 1 of 4 modules completed Beginner AI Engineer Azure OpenAI Service 20% 1000 XP Embrace
responsible AI principles and practices 51 min Module 9 Units Beginner Business Owner Business User Azure Dynamics 365 Microsoft 365 This module is designed to help you adopt responsible AI practices. It offers an overview of the principles, governance system, and procedures followed at Microsoft, but we encourage you to develop your own AI
strategy. Learning objectives In this module, you will: Prepare for the implications of responsible AI Describe principles of responsible AI Establish a system for AI governance Take actions for AI governance Engage across teams and organizations to implement responsible AI principles Take inspiration from ho Fundamentals of

Generative AI 9
min remaining Module 11 Units Beginner AI Engineer Developer Solution Architect Student Azure OpenAI Service Azure In this module, you explore the way in which language models enable AI applications and services to generate original content based on natural language input. You also learn how generative AI enables the creation of agents that
can assist humans in creative tasks. Learning objectives By the end of this module, you are able to: Understand generative AI's place in the development of artificial intelligence. Understand language models and their role in intelligent applications. Describe examples of Microsoft Copilot, agents, and good prompts. Knowledge check Completed 200
XP Module assessment 3 minutes 1. What are Large Language Models? Models that detect additional meaning in paragraphs of text. Lists of words and code that computers use to generate text. Models that use deep learning to process and understand natural language on a massive scale. 2. Which Microsoft Copilot should a customer support agent
use to research and resolve a support issue? Microsoft Copilot for Microsoft Edge Microsoft Copilot in Dynamics 365 Customer Service Copilot for Security 3. Which tool should a professional developer use to build a custom copilot and deploy it as a service endpoint in Azure? Copilot for Azure Microsoft Copilot Studio Microsoft Azure AI Foundry All units
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30 of 39 3/11/2025, 1:20 PM
complete: Having an issue? We can help! 3. 3900 XP Craft effective prompts for Microsoft 365 Copilot 2 hr 10 min Learning Path 0 of 4 modules completed At a glance Level Beginner Skill Create effective prompts for Microsoft Copilot for Microsoft 365 Product Microsoft Copilot Microsoft 365 Microsoft 365 Apps Word PowerPoint Excel Outlook
Microsoft Teams OneNote Role Business User Subject Business applications Productivity Artificial intelligence Discover ways to craft effective and contextual prompts for Microsoft 365 Copilot that create, simplify, transform, and compile content across Microsoft 365 applications. Learn the importance of providing a clear goal, context, source, and
expectation in your prompt for the best results. This course covers real world scenarios and examples using Copilot in Microsoft 365 apps like Word, Excel, PowerPoint, Teams, Outlook, OneNote, and Chat. Note This content was partially created with the help of AI. An author reviewed and revised the content as needed. Read more. Prerequisites Learners
should have completed the following content prior to this course: Fundamentals of Generative AI Get started with Microsoft 365 Copilot Developer Accelerate app development by using GitHub Copilot Find out how to use GitHub Copilot to interpret and document code, author new code features more efficiently, and refactor, debug, and test code. Build
AI apps with Azure Services and best practices Get the details on designing and building a cloud-native AI app, developing a back-end database, and integrating Azure AI services into applications. Build and extend copilots with Microsoft Copilot Studio Use Microsoft Copilot Studio to create conversational AI solutions, and learn how to build actions that
extend Microsoft 365 Copilot. Extend Microsoft 365 Copilot (for developers) Use Copilot Studio actions, and learn about building plugins and connectors for Microsoft 365 Copilot. Discover how to choose the right option for your u Business or technical leader Transform your business with Microsoft AI In this learning path, business leaders will find the
knowledge and resources to adopt AI in their organizations. Explore planning, strategizing, and scaling AI projects in a responsible way. Implement data integration and model grounding with Azure AI Foundry and Microsoft Fabric Discover how to create advanced AI solutions, ground models in their data, connect and integrate data from various sources,
and use OneLake in Microsoft Fabric. Accelerate gen AI model selection, evaluation, and multimodal integration with Azure AI Foundry Find out how to benchmark models, apply multimodal models to help enhance customer satisfaction, and complete evaluations to help ensure performance and safety. Unlocking business potential with AI solutions Learn
how to initiate your organization's AI strategy, assess infrastructure readiness, and understand the business impact of AI Business user Design a dream destination using Microsoft Copilot Bring your personal creativity and passion to dream up a novel destination and create the content to help tell its story. Interact with Microsoft Copilot to learn about the
capabilities of generative AI. Build your Microsoft 365 Copilot skills (for end users) Find out how to create effective prompts in Microsoft 365 Copilot to help boost your productivity. Explore real-world prompts for specific use case scenarios. Work smarter with AI Get more done and unleash your creativity with Microsoft Copilot. In this learning path, you'll
explore how to use Microsoft Copilot to help you research, find information, and generate Data scientist Make your data AI ready with Microsoft Fabric Discover how to implement large-scale data engineering, lakehouse, and warehouse solutions using Microsoft Fabric. Build the skills to use Fabric to effectively manage and analyze data. Run data analytics
solutions with Azure Databricks Work with Apache Spark and Azure Databricks to run large data engineering workloads in the cloud, and use Azure Databricks for comprehensive data analytics solutions. IT professional Get AI-Ready with Microsoft 365 Admin This content helps admins ensure that Microsoft 365 tenants are set up and configured for AI so
that future AI features can be integrated as seamlessly as possible. Discover Microsoft 365 Copilot (for administrators) Focus on security and compliance features to configure in your Microsoft 365 tenant to help protect your organizational data before you implement Microsoft 365 Copilot. Low-code developer Create Power Platform solutions with AI and
Copilot Learn to use Copilot to set up Dataverse, create Power Apps, and build Automated Processes. Explore what Microsoft Copilot Studio can do to help you build and extend custom copilots. Accelerate AI development with Low Code Learn how to develop on Dataverse, Power Apps, and Power Automate. This curated content will also cover creation of
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conversational AI solutions, and learn how to build actions that extend Microsoft 365 Copilot. ecurity professional Help secure your data in the age of AI Work with Microsoft Purview, Microsoft Sentinel, and Microsoft Copilot for Security, and learn how to effectively manage, protect, and govern sensitive information in AI-driven environments. Plan Help
secure your data in the age of AI 3 milestones This Plan is designed to offer you interactive experience working with Microsoft technologies, including Microsoft Purview, Microsoft Sentinel, and Microsoft Copilot for Security, so you can effectively manage, protect, and govern sensitive information in AI-driven environments. Discover how to create a secure
and compliant data estate that can easily adapt to AI.• Access Control and Identity Management, 3rd Ed. by Mike Chapple. Publisher: Jones and Bartlett Learning. (Sep, 2020). _____ • Building an Informati Published on 3/4/2025 Created by 46307064 Accelerate app development by using GitHub Copilot 3
milestones This Plan is designed to help you enhance your coding efficiency and accuracy. Find out how to use GitHub Copilot to interpret and document code, so you can quickly ramp up on unfamiliar or complex codebases. Learn to author new code features more efficiently by using GitHub Copilot autocompletion and chat features. Additionally, get the
details on refactoring, debugging, and testing code with GitHub Copilot. Published on 3/4/2025 Created by 46307064 Tell us about your PDF experience. Install C and C++ support in Visual Studio Article • 12/09/2021 If you haven't downloaded and installed Visual Studio and the Microsoft C/C++ tools yet, here's how to get started. Visual
Studio 2022 Installation Welcome to Visual Studio 2022! In this version, it's easy to choose and install just the features you need. And because of its reduced minimum footprint, it installs quickly and with less system impact. 7 Note This topic applies to installation of Visual Studio on Windows. Visual Studio Code is a lightweight, cross-platform
development environment that runs on Windows, Mac, and Linux systems. The Microsoft C/C++ for Visual Studio Code extension supports IntelliSense, debugging, code formatting, auto-completion. Visual Studio for Mac doesn't support Microsoft C++, but does support .NET languages and cross-platform development. For installation instructions,
see Install Visual Studio for Mac. Want to know more about what else is new in this version? See the Visual Studio release notes. Ready to install? We'll walk you through it, step-by-step. Step 1 - Make sure your computer is ready for Visual Studio Before you begin installing Visual Studio: 1. Check the system requirements. These requirements help you know whether your computer supports Visual Studio 2022. 2. Apply the latest Windows updates. These updates ensure that your computer has both the latest security updates and the required system components for Visual Studio.3. Reboot. The reboot ensures that any pending installs or updates don't hinder the Visual
Studio install. 4. Free up space. Remove unneeded files and applications from your %SystemDrive% by, for example, running the Disk Cleanup app. For questions about running previous versions of Visual Studio side by side with Visual Studio 2022, see the Visual Studio 2022 Platform Targeting and Compatibility page. Step 2 - Download Visual
Studio Next, download the Visual Studio bootstrapper file. To do so, choose the following button to go to the Visual Studio download page. Select the edition of Visual Studio that you want and choose the Free trial or Free download button. Download Visual Studio Step 3 - Install the Visual Studio installer Run the bootstrapper file you downloaded
to install the Visual Studio Installer. This new lightweight installer includes everything you need to both install and customize Visual Studio. 1. From your Downloads folder, double-click the bootstrapper that matches or is similar to one of the following files: vs_community.exe for Visual Studio Community vs_professional.exe for Visual Studio
Professional vs_enterprise.exe for Visual Studio Enterprise If you receive a User Account Control notice, choose Yes to allow the bootstrapper to run. 2. We'll ask you to acknowledge the Microsoft License Terms and the Microsoft Privacy Statement . Choose Continue. Step 4 - Choose workloads After the installer is installed, you can use it to
customize your installation by selecting the workloads, or feature sets, that you want. Here's how. 1. Find the workload you want in the Installing Visual Studio screen.For core C and C++ support, choose the "Desktop development with C++" workload. It comes with the default core editor, which includes basic code editing support for over 20
languages, the ability to open and edit code from any folder without requiring a project, and integrated source code control. Additional workloads support other kinds of development. For example, choose the "Universal Windows Platform development" workload to create apps that use the Windows Runtime for the Microsoft Store. Choose "Game
development with C++" to create games that use DirectX, Unreal, and Cocos2d. Choose "Linux development with C++" to target Linux platforms, including IoT development. The Installation details pane lists the included and optional components installed by each workload. You can select or deselect optional components in this list. For example, to
support development by using the Visual Studio 2017 or 2015 compiler toolsets, choose the MSVC v141 or MSVC v140 optional components. You can add support for MFC, the experimental Modules language extension, IncrediBuild, and more. 2. After you choose the workload(s) and optional components you want, choose Install. Next, status
screens appear that show the progress of your Visual Studio installation. Tip At any time after installation, you can install workloads or components that you didn't install initially. If you have Visual Studio open, go to Tools > Get Tools andFeatures... which opens the Visual Studio Installer. Or, open Visual Studio Installer from the Start menu. From
there, you can choose the workloads or components that you wish to install. Then, choose Modify. Step 5 - Choose individual components (Optional) If you don't want to use the Workloads feature to customize your Visual Studio installation, or you want to add more components than a workload installs, you can do so by installing or adding
individual components from the Individual components tab. Choose what you want, and then follow the prompts. Step 6 - Install language packs (Optional) By default, the installer program tries to match the language of the operating system when it runs for the first time. To install Visual Studio in a language of your choosing, choose the Language
packs tab from the Visual Studio Installer, and then follow the prompts. Change the installer language from the command line Another way that you can change the default language is by running the installer from the command line. For example, you can force the installer to run in English by using the following command: vs_installer.exe --locale
en-US . The installer will remember this setting when it's run the next time. The installer supports the following language tokens: zh-cn, zh-tw, cs-cz, en-us, es-es, fr-fr, de-de, it-it, ja-jp, ko-kr, pl-pl, pt-br, ru-ru, and tr-tr.Step 7 - Change the installation location (Optional) You can reduce the installation footprint of Visual Studio on your system drive. You
can choose to move the download cache, shared components, SDKs, and tools to different drives, and keep Visual Studio on the drive that runs it the fastest. 〉Important You can select a different drive only when you first install Visual Studio. If you've already installed it and want to change drives, you must uninstall Visual Studio and then
reinstall it. Step 8 - Start developing 1. After Visual Studio installation is complete, choose the Launch button to get started developing with Visual Studio. 2. On the start window, choose Create a new project. 3. In the search box, enter the type of app you want to create to see a list of available templates. The list of templates depends on the
workload(s) that you chose during installation. To see different templates, choose different workloads. You can also filter your search for a specific programming language by using the Language drop-down list. You can filter by using the Platform list and the Project type list, too. 4. Visual Studio opens your new project, and you're ready to code!
When Visual Studio is running, you're ready to continue to the next step. Next Steps Create a C++ projectWhat is Visual Studio? Article • 06/19/2024 Visual Studio is a powerful developer tool that you can use to complete the entire development cycle in one place. It's a comprehensive integrated development environment (IDE) that you can
use to write, edit, debug, and build code. Then deploy your app. Visual Studio includes compilers, code completion tools, source control, extensions, and many other features to enhance every stage of the software development process. With the variety of features and languages support in Visual Studio, you can grow from writing your first "Hello
World" program to developing and deploying apps. For example, build, debug, and test .NET and C++ apps, edit ASP.NET pages in the web designer view, develop cross-platform mobile and desktop apps with .NET, or build responsive Web UIs in C#. To install Visual Studio, select the following button, and choose the edition of Visual Studio to
download. Download Visual Studio Why use Visual Studio? Visual Studio provides developers a feature rich development environment to develop high-quality code efficiently and collaboratively. Workload-based installer - install only what you need Powerful coding tools and features - everything you need to build your apps in one placeMultiple
language support - code in C++, C#, JavaScript, TypeScript, Python, and more Cross-platform development - build apps for any platform Version control integration - collaborate on code with team mates AI-assisted development - write code more efficiently with AI assistance Discover Visual Studio Visual Studio supports different parts of the
software development cycle. Develop your code Visual Studio IDE provides many features that make it easier for you to write and manage your code with confidence. For example, code quickly and accurately with AI assisted development tools. These tools include GitHub Copilot and IntelliCode. Make quick improvements to your code using light
bulbs that suggest actions, or expand/collapse blocks of code using outlining. Organize and explore your code with the Solution Explorer that shows your code organized by files or the Class View that shows your code organized by classes. Learn more about all the features in the IDE that help you organize and edit content: Code editor
Personalize the IDE and the editor Organize code Tips and tricks AI-assisted development GitHub Copilot, GitHub Copilot Chat, and IntelliCode assist developers in writing code faster and with greater accuracy, help develop a deeper understanding of the codebase, and help with other development tasks such as writing unit tests, debugging,
and profiling. Learn more about AI-assisted development in Visual Studio: Get started with GitHub Copilot in Visual Studio: Install and manage GitHub Copilot Use GitHub Copilot Completions in Visual Studio Use GitHub Copilot Chat in Visual Studio Debug with CopilotBuild your app You can compile and build your applications to create
builds immediately and test them in a debugger. You can run multi-processor builds for C++ and C# projects. Visual Studio also provides several options that you can configure when you build applications. You can create a custom build configuration in addition to the built-in configurations, hide certain warning messages, or increase build output
information. Learn more about how to compile and build in Visual Studio: Create build configurations for your project Build an application Debug your code Integrated debugging in Visual Studio enables you to debug, profile, and diagnose with ease. You step through your code and look at the values stored in variables, set watches on variables
to see when values changes, examine the execution path of your code. Visual Studio offers other ways to debug your code while it runs. Learn more about debugging effectively in Visual Studio: Debug your app Debugging techniques and tools Measure app performance Debug with Copilot Tips and tricks Test your code You can write highquality code with comprehensive testing tools in Visual Studio. Unit tests give developers and testers a quick way to find logic errors in code. You can analyze how much code you're testing and see instant results in a test suite. Know the impact of every change you make with advanced features that test code while you type. Learn more about the
testing tools available in Visual Studio: Use testing tools in Visual Studio Create and run unit tests Analyze code coverage Version controlWith the integrated Git features in Visual Studio, you can clone, create, or open your own repositories. The Git tool window has everything you need to commit and push changes, manage branches, and
resolve merge conflicts. If you have a GitHub account, you can manage those repos directly within Visual Studio. Learn more about version control in Visual Studio: Version control with Git Visual Studio and GitHub Collaborate with others Visual Studio Live Share enables real-time collaborative development. With Live Share you can share your
project with your peers, no matter the language or platform. Get to the bottom of an issue fast by allowing your team to connect, navigate, set break points, and type in your editor session. Learn more about how to collaborate with Live Share: Collaborate with Live Share Common use cases Deploy your app By deploying an application, service,
or component, you distribute it for installation on other computers, devices, or servers, or in the cloud. You can choose the appropriate method in Visual Studio for the type of deployment that you need. Share your apps and code by publishing to the web or Azure, or by deploying to a network share or a local folder. Learn more about how to deploy
your app using Visual Studio: Deploy your app from Visual Studio Deploy your app to a folder, a web server, Azure, or another destination Choose your Visual Studio edition There are three editions of Visual Studio: Community - free, fully featured IDE for students, open-source developers, and individual developers. Professional - a
subscription based option for individual developers or small teams.Feedback Was this page helpful? Provide product feedback | Ask the community Enterprise - a subscription based option for small to large business and enterprise organizations. Compare features across Visual Studio editions and acquire the Visual Studio edition that best
fits your needs. Select the following button to install Visual Studio, and choose the edition of Visual Studio. Dive into coding with one of the following language-specific tutorials: Create a simple C# console app Get started with Python Create a simple VB console app Create a C++ console app Create a Node.js and Express app To develop
any type of app, or learn a language, you work in the feature rich Visual Studio Integrated Development Environment (IDE). Explore Visual Studio further with one of these introductory articles: Tour the IDE to get familiar with the IDE features and to learn how to use it for basic tasks. Cover the basics in this Learn module: Introduction to Visual
Studio Install Visual Studio Download Visual Studio Get started Related content Yes NoCreate a C++ console app project Article • 07/06/2023 The usual starting point for a C++ programmer is a "Hello, world!" application that runs on the command line. That's what you create in Visual Studio in this step. Prerequisites Have Visual Studio with the Desktop development with C++ workload installed and running on your computer. If it's not installed yet, see Install C++ support in Visual Studio. Create your app project Visual Studio uses projects to organize the code for an app, and solutions to organize your projects. A project contains all the options, configurations, and rules
used to build your apps. It manages the relationship between all the project's files and any external files. To create your app, first, create a new project and solution. 1. In Visual Studio, open the File menu and choose New > Project to open the Create a new Project dialog. Select the Console App template that has C++, Windows, and Console
tags, and then choose Next.2. In the Configure your new project dialog, enter HelloWorld in the Project name edit box. Choose Create to create the project. Visual Studio creates a new project. It's ready for you to add and edit your source code. By default, the Console App template provides source code for a "Hello World" app, like this: When the
code looks like this in the editor, you're ready to go on to the next step and build your app.I ran into a problem. Next steps Build and run a C++ project Troubleshooting guide Come here for solutions to common issues when you create your first C++ project. Create your app project: issues The New Project dialog should show a Console App
template that has C++, Windows, and Console tags. If you don't see it, there are two possible causes. It might be filtered out of the list, or it might not be installed. First, check the filter dropdowns at the top of the list of templates. Set them to C++, Windows, and Console. The C++ Console App template should appear; otherwise, the Desktop
development with C++ workload isn't installed. To install Desktop development with C++, you can run the installer right from the New Project dialog. Choose the Install more tools and features link at the bottom of the template list to start the installer. If the User Account Control dialog requests permissions, choose Yes. In the installer, make sure the
Desktop development with C++ workload is checked. Then choose Modify to update your Visual Studio installation. If another project with the same name already exists, choose another name for your project. Or, delete the existing project and try again. To delete an existing project, delete the solution folder (the folder that contains the helloworld.sln
file) in File Explorer. Go back.Build and run a C++ console app project Article • 07/01/2024 In Create a C++ console app project you created a C++ console app project and entered your code. Now you can build and run it within Visual Studio. Then, run it as a stand-alone app from the command line. Prerequisites Have Visual Studio with the
Desktop development with C++ workload installed and running on your computer. If it's not installed, follow the steps in Install C++ support in Visual Studio. Create a "Hello, World!" project. By default, it contains code to print Hello World! . If you haven't done this step yet, follow the steps in Create a C++ console app project. If Visual Studio looks
like this, you're ready to build and run your app: Build and run your code in Visual Studio1. To build your project, from the main menu choose Build > Build Solution. The Output window shows the results of the build process. 2. To run the code, on the menu bar, choose Debug, Start without debugging. A console window opens and then runs your
app. When you start a console app in Visual Studio, it runs your code, then prints "Press any key to continue . . ." to give you a chance to see the output.Congratulations! You created your first "Hello, world!" console app in Visual Studio! Press a key to dismiss the console window and return to Visual Studio. I ran into a problem. Run your code in a
command window Normally, you run console apps at the command prompt, not in Visual Studio. Once Visual Studio builds your app, you can run it from a command window. Here's how to find and run your new app in a command prompt window. 1. In Solution Explorer, select the HelloWorld solution (not the HelloWorld project) and right-click to
open the context menu. Choose Open Folder in File Explorer to open a File Explorer window in the HelloWorld solution folder. 2. In the File Explorer window, open the x64 folder and then the Debug folder. This folder contains your app, HelloWorld.exe , and debugging files. Hold down the Shift key and right-click on HelloWorld.exe to open the
context menu. Choose Copy as path to copy the path to your app to the clipboard. If you see HelloWorld.exe.recipe , it's because you did the Open Folder in File Explorer step on the HelloWorld project instead of the HelloWorld solution. Navigate up a level in File Explorer to get to the solution folder. This folder also contains a x64\Debug\ folder,
where HelloWorld.exe is. 3. To open a command prompt window, press Windows+R to open the Run dialog. Enter cmd.exe in the Open textbox, then choose OK to run a command prompt window. 4. In the command prompt window, right-click to paste the path to your app into the command prompt. Press Enter to run your app.Congratulations,
you built and ran a console app in Visual Studio! I ran into a problem. Next Steps Once you build and run this simple app, you're ready for more complex projects. For more information, see Using the Visual Studio IDE for C++ Desktop Development. It has more detailed walkthroughs that explore the capabilities of Microsoft C++ in Visual Studio.
Troubleshooting guide Come here for solutions to common issues when you create your first C++ project. Build and run your code in Visual Studio: issues If red squiggles appear under anything in the source code editor, the build may have errors or warnings. Check that your code matches the example in spelling, punctuation, and case. Go
back. Run your code in a command window: issuesFeedback Was this page helpful? Provide product feedback | Get help at Microsoft Q&A If the path shown in File Explorer ends in \HelloWorld\HelloWorld , you opened the HelloWorld project instead of the HelloWorld solution. You won't see your app in the x64\Debug folder. Navigate up a
level in File Explorer to get to the solution folder, the first HelloWorld in the path. This folder also contains a x64\Debug folder, where your app is. You can also navigate to the solution x64\Debug folder at the command line to run your app. Your app won't run from other directories without specifying the path to the app. However, you can copy your
app to another directory and run it from there. It's also possible to copy it to a directory specified by your PATH environment variable, then run it from anywhere. If you don't see Copy as path in the shortcut menu, dismiss the menu, and then hold down the Shift key while you open it again. This command is just for convenience. You can also copy
the path to the folder from the File Explorer search bar, and paste it into the Run dialog, and then enter the name of your executable at the end. It's just a little more typing, but it has the same result. Go back. Yes NoWelcome back to C++ - Modern C++ Article • 11/07/2022 Since its creation, C++ has become one of the most widely used
programming languages in the world. Well-written C++ programs are fast and efficient. The language is more flexible than other languages: It can work at the highest levels of abstraction, and down at the level of the silicon. C++ supplies highly optimized standard libraries. It enables access to low-level hardware features, to maximize speed and
minimize memory requirements. C++ can create almost any kind of program: Games, device drivers, HPC, cloud, desktop, embedded, and mobile apps, and much more. Even libraries and compilers for other programming languages get written in C++. One of the original requirements for C++ was backward compatibility with the C language. As a
result, C++ has always permitted C-style programming, with raw pointers, arrays, null-terminated character strings, and other features. They may enable great performance, but can also spawn bugs and complexity. The evolution of C++ has emphasized features that greatly reduce the need to use C-style idioms. The old C programming facilities are
still there when you need them. However, in modern C++ code you should need them less and less. Modern C++ code is simpler, safer, more elegant, and still as fast as ever. The following sections provide an overview of the main features of modern C++. Unless noted otherwise, the features listed here are available in C++11 and later. In the

Microsoft C++ compiler, you can set the /std compiler option to specify which version of the standard to use for your project. Resources and smart pointers One of the major classes of bugs in C-style programming is the memory leak. Leaks are often caused by a failure to call delete for memory that was allocated with new . Modern C++
emphasizes the principle of resource acquisition is initialization (RAII). The idea is simple. Resources (heap memory, file handles, sockets, and so on) should be owned by an object. That object creates, or receives, the newly allocated resource in its constructor, and deletes it in its destructor. The principle of RAII guarantees that all resources get
properly returned to the operating system when the owning object goes out of scope. To support easy adoption of RAII principles, the C++ Standard Library provides three smart pointer types: std::unique_ptr, std::shared_ptr, and std::weak_ptr. A smart pointer handles the allocation and deletion of the memory it owns. The following examplesshows a
class with an array member that is allocated on the heap in the call to make_unique() . The calls to new and delete are encapsulated by the unique_ptr class. When a widget object goes out of scope, the unique_ptr destructor will be invoked and it will release the memory that was allocated for the array. C++ Whenever possible, use a smart pointer
to manage heap memory. If you must use the new and delete operators explicitly, follow the principle of RAII. For more information, see Object lifetime and resource management (RAII). C-style strings are another major source of bugs. By using std::string and std::wstring, you can eliminate virtually all the errors associated with C-style strings. You
also gain the benefit of member functions for searching, appending, prepending, and so on. Both are highly optimized for speed. When passing a string to a function that requires only read only access, in C++17 you can use std::string_view for even greater performance benefit. The standard library containers all follow the principle of RAII. They
provide iterators for safe traversal of elements. And, they're highly optimized for performance and have been thoroughly tested for correctness. By using these containers, you eliminate the potential #include class widget { private: std::unique_ptr data; public: widget(const int size) { data = std::make_unique(size); } void do_something() {}
}; void functionUsingWidget() { widget w(1000000); // lifetime automatically tied to enclosing scope // constructs w, including the w.data gadget member // ... w.do_something(); // ... } // automatic destruction and deallocation for w and w.data std::string and std::string_view std::vector and other Standard Library containersfor bugs or inefficiencies that might be introduced in custom data structures. Instead of raw arrays, use vector as a sequential container in C++. C++ vector apples; apples.push_back("Granny Smith"); Use map (not unordered_map) as the default associative container. Use set, multimap, and multiset for degenerate and multi cases. C++ map apple_color; // ... apple_color["Granny Smith"] = "Green"; When performance optimization is needed, consider using: Unordered associative containers such as unordered_map. These have lower per element overhead and constant-time lookup, but they can be harder to use correctly and efficiently. Sorted vector . For more information, see
Algorithms. Don't use C-style arrays. For older APIs that need direct access to the data, use accessor methods such as f(vec.data(), vec.size()); instead. For more information about containers, see C++ Standard Library Containers. Standard Library algorithms Before you assume that you need to write a custom algorithm for your program, first
review the C++ Standard Library algorithms. The Standard Library contains an ever growing assortment of algorithms for many common operations such as searching, sorting, filtering, and randomizing. The math library is extensive. In C++17 and later, parallel versions of many algorithms are provided. Here are some important examples:
for_each , the default traversal algorithm (along with range-based for loops). transform , for not-in-place modification of container elements find_if , the default search algorithm. sort , lower_bound , and the other default sorting and searching algorithms.To write a comparator, use strict < and use named lambdas when you can. C++ C++11
introduced the auto keyword for use in variable, function, and template declarations. auto tells the compiler to deduce the type of the object so that you don't have to type it explicitly. auto is especially useful when the deduced type is a nested template: C++ C-style iteration over arrays and containers is prone to indexing errors and is also tedious
to type. To eliminate these errors, and make your code more readable, use range-based for loops with both Standard Library containers and raw arrays. For more information, see Range-based for statement. C++ auto comp = [](const widget& w1, const widget& w2) { return w1.weight() < w2.weight(); } sort(v.begin(), v.end(), comp); auto i =
lower_bound(v.begin(), v.end(), widget{0}, comp); auto instead of explicit type names map::iterator i = m.begin(); // C-style auto i = m.begin(); // modern C++ Range-based for loops #include #include int main() { std::vector v {1,2,3}; // C-style for(int i = 0; i < v.size(); ++i) { std::cout << v[i]; }Macros in C and C++ are tokens
that are processed by the preprocessor before compilation. Each instance of a macro token is replaced with its defined value or expression before the file is compiled. Macros are commonly used in C-style programming to define compile-time constant values. However, macros are error-prone and difficult to debug. In modern C++, you should prefer
constexpr variables for compile-time constants: C++ In modern C++, you can use brace initialization for any type. This form of initialization is especially convenient when initializing arrays, vectors, or other containers. In the following example, v2 is initialized with three instances of S . v3 is initialized with three instances of S that are themselves
initialized using braces. The compiler infers the type of each element based on the declared type of v3 . C++ // Modern C++: for(auto& num : v) { std::cout < x && i x && i Options > Debugging > General and ensure that Require source files to exactly match the original version is checked. Create your app
project Visual Studio uses projects to organize the code for an app, and solutions to organize one or more projects. A project contains all the options, configurations, and rules used to build an app. It also manages the relationship between all the project's files and any external files. To create your app, first, create a new project and solution. 1. Start
Visual Studio--the Visual Studio Start dialog box appears. Select Create a new project to get started.2. In the Create a new project dialog, set the language dropdown to C++, set the platform dropdown to Windows, select Console App from the list of project types, then select Next.) Important Make sure you select the C++ version of the Console
App template. It has the C++, Windows, and Console tags, and the icon has "++" in the corner.3. In the Configure your new project dialog box, select the Project name text box, name your new project CalculatorTutorial, then select Create. An empty C++ Windows console application 'Hello World' app is created. Console applications use a Windows
console window to display output and accept user input. In Visual Studio, an editor window opens and shows the generated code: C++ // CalculatorTutorial.cpp : This file contains the 'main' function. Program execution begins and ends there. // #include int main() { std::cout Start Debugging menu // Tips for Getting Started: // 1. Use the Solution Explorer window to add/manage files // 2. Use the Team Explorer window to connect to source control // 3. Use the Output window to see build output and other messages // 4. Use the Error List window to view errors // 5. Go to Project > Add New Item to create new code files, or Project > Add Existing Item to add existing code files to the project// 6. In the future, to open this project again, go to File > Open > Project and select the .sln file Verify that your new app builds and runs The template for a new Windows console application creates a simple C++ "Hello World" app. At this point, you can see how Visual Studio
builds and runs the apps you create right from the IDE. 1. To build your project, select Build Solution from the Build menu. The Output window shows the results of the build process. 2. To run the code, on the menu bar, select Debug > Start without debugging (Ctrl+F5).A console window opens and your app runs within it. When you start a
console app in Visual Studio, it runs your code, then prints "Press any key to close this window . . ." to give you a chance to see the output. Congratulations! You created your first "Hello, world!" console app in Visual Studio! 3. Press a key to dismiss the console window and return to Visual Studio. You now have the tools to build and run your app
after every change, to verify that the code still works as you expect. Later, we show you how to debug it if it doesn't. Now let's modify the code in this template to be a calculator app. 1. Replace the contents of the CalculatorTutorial.cpp file with the following code so that it matches this example: C++ Edit the code // CalculatorTutorial.cpp : This
file contains the 'main' function. Program execution begins and ends there. // #include using namespace std; int main() { cout << "Calculator Console Application" << endl << endl; cout << "Please enter the operation to perform. Format: a+b | a-b |Understanding the code: The #include statement brings in code in other files. Sometimes, you
may see a filename surrounded by angle brackets like . The angle brackets instruct the compiler to look for the iostream header file first in the standard system directories, and if not found, to look in directories specific to the project. Other times, you may see a filename surrounded by quotes like "someHeader.h" . The quotes instruct the compiler
to skip looking in the standard system directories and instead only look in directories specific to the project. The using namespace std; tells the compiler to expect code from the C++ Standard Library to be used in this file. Without this line, each keyword from the library would have to be preceded with std:: to denote its scope. For instance, without
that line, each reference to cout would be written as std::cout . The using statement is added to make it more convenient to access code in another namespace. The cout keyword is used to print to standard output in C++. The << operator tells the compiler to send whatever is to the right of it to the standard output. The endl keyword is like the
Enter key; it ends the line and moves the cursor to the next line. It's a better practice to put a \n inside the string (contained by "") to do the same thing because endl always flushes the buffer which can hurt the performance of the program. But since this is a very small app, endl is used instead. All C++ statements must end with semicolons and all
C++ applications must contain a main() function. This function is what the program runs at a*b | a/b" Start Debugging menu // Tips for Getting Started: // 1. Use the Solution Explorer window to add/manage files // 2. Use the Team Explorer window to connect to source control
// 3. Use the Output window to see build output and other messages // 4. Use the Error List window to view errors // 5. Go to Project > Add New Item to create new code files, or Project > Add Existing Item to add existing code files to the project // 6. In the future, to open this project again, go to File > Open > Project and select the .sln filethe start.
All code must be accessible from main() in order to be used. 2. To save the file, press Ctrl+S, or select the floppy disk icon in the toolbar under the menu bar. 3. To run the application, press Ctrl+F5 or go to the Debug menu and select Start Without Debugging. You should see a console window appear that looks like this. 4. Close the console
window when you're done. Add code to do some math A class is like a blueprint for an object that does something. In this case, we define a calculator class to contain the math logic. Add a Calculator class 1. Go to the Project menu and select Add Class. In the Class Name edit box, enter Calculator. Select OK. Two new files get added to your
project. To save all your changed files at once, press Ctrl+Shift+S. It's a keyboard shortcut for File > Save All. There's also a toolbar button for Save All, an icon of two floppy disks, found beside the Savebutton. In general, it's good practice to do Save All frequently, so you don't miss saving any changes. The Add Class wizard creates .h and .cpp
files that have the same name as the class. You can see a full list of your project files in the Solution Explorer window, visible on the side of the IDE. If the window isn't visible, open it from the menu bar via View > Solution Explorer. You can open a file by double-clicking it in the Solution Explorer window. Double click Calculator.h to open it. 2.
Replace the contents of Calculator.h with the following code so that the file now looks like this: C++ Understanding the code This code declares a new function called Calculate , which handles math operations for addition, subtraction, multiplication, and division. #pragma once class Calculator { public: double Calculate(double x, char
oper, double y); };C++ code is organized into header (.h) files and source (.cpp) files. Some other file extensions are supported by various compilers, but these are the main ones to know about. Functions and variables are normally declared, that is, given a name and a type, in header files, and implemented, or given a definition, in source files.
To access code defined in another file, you can use #include "filename.h" , where filename.h is the name of the file that declares the variables or functions you want to use. It's good practice to organize your code into different files based on what it does, so it's easy to find the code you need later. In our case, we define the Calculator class
separately from the file containing the main() function, but we plan to reference the Calculator class in main() . 3. A green squiggle appears under Calculate because although the Calculate function is declared, it isn't defined. Hover over Calculate , click the down arrow on the screwdriver icon, and select Create definition of 'Calculate' in
Calculator.cpp . This code is added to Calculator.cpp :Currently, it just returns 0.0. Let's change that. 4. Switch to the Calculator.cpp file in the editor window. Replace the contents of Calculator::Calculate(double x, char oper, double y) with: C++ Understanding the code The function Calculate takes a number, an operator, and a second number.
Then it performs the requested operation on the two numbers. The switch statement checks which operator was provided, and executes the case corresponding to that operation. The default: case is a fallback double Calculator::Calculate(double x, char oper, double y) { switch(oper) { case '+': return x + y; case '-': return x - y; case '*':
return x * y; case '/': return x / y; default: return 0.0; } }in case the user types an operator that isn't handled by any of the preceding case statements. It's best to handle invalid user input in a more elegant way, but this is beyond the scope of this tutorial. The double keyword denotes a type of number that supports decimals. This type of
number is called a floating-point number, and double means a floating point number that has extra precision. This way, the calculator can handle both decimal math and integer math. The Calculate function is required to always return a double-precision floating point number due to the double at the start of the code (this denotes the function's return
type), which is why we return 0.0 in the default case. The .h file declares the function prototype, which tells the compiler upfront what parameters it requires, and what return type to expect from it. The .cpp file has all the implementation details of the function. If you build and run the code again at this point, it immediately exits after asking which
operation to perform. So, modify the main function to do multiple calculations. 1. Update the main function in CalculatorTutorial.cpp as follows: C++ Call the Calculator class member functions // CalculatorTutorial.cpp : This file contains the 'main' function. Program execution begins and ends there. // #include #include "Calculator.h" using
namespace std; int main() { double x = 0.0; double y = 0.0; double result = 0.0; char oper = '+'; cout << "Calculator Console Application" << endl << endl; cout << "Please enter the operation to perform. Format: a+b | a-b | a*b | a/b" x >> oper >> y; result = c.Calculate(x, oper, y); cout << "Result " << "of " << x << oper << y << " is: " << result Autos. To see all of the variables from that function, switch to the Locals window. Because this is a small function, the Autos and Locals window show the same variables. But you can modify the values of these variables in the Locals window while debugging to see what effect they would have on the program. In this case, we leave them alone. Open the Locals window by selecting Locals at the bottom of the Autos window, or by selecting from the main menu Debug > Windows > Locals.You can also hover over variables in the code to see their current values at the point where execution is currently paused. Make sure the editor window is in focus by clicking on it first.
Continue debugging 1. The yellow arrow on the left shows the current point of execution. The current line calls Calculate , so press F11 to Step Into the function. Now you're executing code in the body of the Calculate function. Be careful with Step Into because it steps into any functions on the line you're on, including standard library functions. It's
fine to step into the standard library, but you may be more interested in focusing on your code instead of library code. 2. Now that the point of execution is at the start of the Calculate function, press F10 to move to the next line in the program's execution. F10 is also known as Step Over. You can use Step Over to move from line to line, without
delving into the details of what is occurring in each part of the line. In general, you should use Step Over instead of Step Into unless you want to dive more deeply into code that is being called from elsewhere (as you did to reach the body of Calculate). 3. Continue using F10 to Step Over each line until you get back to the main() function in the
other file, and stop on the cout line.The program is doing what's expected: it takes the first number, and divides it by the second. On the cout line, hover over the result variable or take a look at result in the Autos window. Its value is inf , which doesn't look right. Let's fix it. The cout line outputs whatever value is stored in result , so when you step one
more line forward using F10, the console window displays: This result is because division by zero is undefined, so the program doesn't have a numerical answer for the requested operation. Fix the "divide by zero" error Let's handle division by zero more gracefully so that it's easier for the user to understand the problem. 1. Make the following
changes in CalculatorTutorial.cpp . You can leave the program running as you edit, thanks to a debugger feature called Edit andContinue. Add an if statement following cin >> x >> oper >> y; to check for division by zero and output a message to the user if it happens. Otherwise, the result is printed. C++ 2. Press F5 once. Program execution
continues until it has to pause to ask for user input. Enter 10 / 0 again. Now, a more helpful message is printed. The user is asked for more input, and the program continues executing normally. // CalculatorTutorial.cpp : This file contains the 'main' function. Program execution begins and ends there. // #include #include "Calculator.h" using
namespace std; int main() { double x = 0.0; double y = 0.0; double result = 0.0; char oper = '+'; cout << "Calculator Console Application" << endl << endl; cout << "Please enter the operation to perform. Format: a+b | a-b | a*b | a/b" x >> oper >> y; if (oper == '/' && y == 0) { cout << "Math error: Attempted to divide by zero!" << endl; continue; } else { result = c.Calculate(x, oper, y); } cout << "Result " << "of " << x << oper << y << " is: " << result General needs to be enabled..." To fix this, from the main menu select Tools > Options > Debugging > General and ensure that Require source files to exactly match the original version is checked. Understanding
the Run and Debug shortcuts F5, or Debug > Start Debugging, starts a debugging session, if one isn't already active, and runs the program until a breakpoint is hit or the program needs user input. If no user input is needed and no breakpoint is available to hit, the program terminates and the console window closes itself when the program finishes
running. If your program outputs to the console, use Ctrl+F5 or set a breakpoint before you press F5 to keep the window open. Ctrl+F5, or Debug > Start Without Debugging, runs the application without going into debug mode. This is slightly faster than debugging, and the console window stays open after the program finishes executing. F10,
known as Step Over, lets you iterate through code, line-by-line, and visualize how the code is run and what variable values are at each step of execution.F11, known as Step Into, works similarly to Step Over, except it steps into any functions called on the line of execution. For example, if the line being executed calls a function, pressing F11 moves
the pointer into the body of the function, so you can follow the function's code being run before coming back to the line you started at. Pressing F10 steps over the function call and just moves to the next line; the function call still happens, but the program doesn't pause to show you what it's doing. Close the app If it's still running, close the
console window to stop the calculator app. Add Git source control Now that you've created an app, you might want to add it to a Git repository. We've got you covered. Visual Studio makes that process easy with Git tools you can use directly from the IDE. Tip Git is the most widely used modern version control system, so whether you're a
professional developer or you're learning how to code, Git can be very useful. If you're new to Git, the https://git-scm.com/ website is a good place to start. There, you can find cheat sheets, a popular online book, and Git Basics videos. To associate your code with Git, you start by creating a new Git repository where your code is located. Here's
how: 1. In the status bar at the bottom-right corner of Visual Studio, select Add to Source Control, and then select Git. 2. In the Create a Git repository dialog box, sign in to GitHub.The repository name auto-populates based on your folder location. By default, your new repository is private, which means you're the only one who can access it. Tip
Whether your repository is public or private, it's best to have a remote backup of your code stored securely on GitHub. Even if you aren't working with a team, a remote repository makes your code available to you from any computer. 3. Select Create and Push. After you create your repository, status details appear in the status bar. The first
icon with the arrows shows how many outgoing/incoming commits are in your current branch. You can use this icon to pull any incoming commits or push any outgoing commits. You can also choose to view these commits first. To do so, select the icon, and then select View Outgoing/Incoming.Feedback Was this page helpful? Provide product
feedback | Get help at Microsoft Q&A The second icon with the pencil shows the number of uncommitted changes to your code. You can select this icon to view those changes in the Git Changes window. To learn more about how to use Git with your app, see the Visual Studio version control documentation. Congratulations! You completed the
code for the calculator app, built and debugged it, and added it to a repo, all in Visual Studio. Learn more about Visual Studio for C++ The finished app Next steps Yes NoGet started with C++/WinRT Article • 02/13/2023) Important For info about setting up Visual Studio for C++/WinRT development—including installing and using the C++/WinRT Visual Studio Extension (VSIX) and the NuGet package (which together provide project template and build support)—see Visual Studio support for C++/WinRT. To get you up to speed with using C++/WinRT, this topic walks through a simple code example based on a new Windows Console Application (C++/WinRT) project. This
topic also shows how to add C++/WinRT support to a Windows Desktop application project. 7 Note While we recommend that you develop with the latest versions of Visual Studio and the Windows SDK, if you're using Visual Studio 2017 (version 15.8.0 or later), and targeting the Windows SDK version 10.0.17134.0 (Windows 10, version 1803),
then a newly created C++/WinRT project may fail to compile with the error "error C3861: 'from_abi': identifier not found", and with other errors originating in base.h. The solution is to either target a later (more conformant) version of the Windows SDK, or set project property C/C++ > Language > Conformance mode: No (also, if /permissive- appears
in project property C/C++ > Language > Command Line under Additional Options, then delete it). A C++/WinRT quick-start Create a new Windows Console Application (C++/WinRT) project. Edit pch.h and main.cpp to look like this. C++/WinRT // pch.h #pragma once #include C++/WinRT Let's take the short code example above piece by
piece, and explain what's going on in each part. C++/WinRT With the default project settings, the included headers come from the Windows SDK, inside the folder %WindowsSdkDir%\include\cppwinrt\winrt . Visual Studio includes that path in its IncludePath macro. But there's no strict dependency on the #include #include // main.cpp
#include "pch.h" using namespace winrt; using namespace Windows::Foundation; using namespace Windows::Web::Syndication; int main() { winrt::init_apartment(); Uri rssFeedUri{ L"https://blogs.windows.com/feed" }; SyndicationClient syndicationClient; syndicationClient.SetRequestHeader(L"User-Agent", L"Mozilla/5.0 (compatible;
MSIE 10.0; Windows NT 6.2; WOW64; Trident/6.0)"); SyndicationFeed syndicationFeed = syndicationClient.RetrieveFeedAsync(rssFeedUri).get(); for (const SyndicationItem syndicationItem : syndicationFeed.Items()) { winrt::hstring titleAsHstring = syndicationItem.Title().Text(); // A workaround to remove the trademark symbol from the title
string, because it causes issues in this case. std::wstring titleAsStdWstring{ titleAsHstring.c_str() }; titleAsStdWstring.erase(remove(titleAsStdWstring.begin(), titleAsStdWstring.end(), L'™'), titleAsStdWstring.end()); titleAsHstring = titleAsStdWstring; std::wcout << titleAsHstring.c_str() << std::endl; } } #include #include Windows SDK,
because your project (via the cppwinrt.exe tool) generates those same headers into your project's ${GeneratedFilesDir} folder. They'll be loaded from that folder if they can't be found elsewhere, or if you change your project settings. The headers contain Windows APIs projected into C++/WinRT. In other words, for each Windows type, C++/WinRT
defines a C++-friendly equivalent (called the projected type). A projected type has the same fully-qualified name as the Windows type, but it's placed in the C++ winrt namespace. Putting these includes in your precompiled header reduces incremental build times.) Important Whenever you want to use a type from a Windows namespaces, you
must #include the corresponding C++/WinRT Windows namespace header file, as shown above. The corresponding header is the one with the same name as the type's namespace. For example, to use the C++/WinRT projection for the Windows::Foundation::Collections::PropertySet runtime class, include the winrt/Windows.Foundation.Collections.h header. It is common for a C++/WinRT projection header to automatically include related namespace header files. For example, winrt/Windows.Foundation.Collections.h includes winrt/Windows.Foundation.h . But you shouldn't rely on this behavior, since it's an implementation detail that changes over time. You
must explicitly include any headers that you need. C++/WinRT using namespace winrt; using namespace Windows::Foundation; using namespace Windows::Web::Syndication; The using namespace directives are optional, but convenient. The pattern shown above for such directives (allowing unqualified name lookup for anything in the winrt
namespace) is suitable for when you're beginning a new project and C++/WinRT is the only language projection you're using inside of that project. If, on the other hand, you're mixing C++/WinRT code with C++/CX and/or SDK application binary interface (ABI) code (you're either porting from, or interoperating with, one or both of those models),
then see the topics Interop between C++/WinRT and C++/CX, Move to C++/WinRT from C++/CX, and Interop between C++/WinRT and the ABI. C++/WinRTwinrt::init_apartment(); The call to winrt::init_apartment initializes the thread in the Windows Runtime; by default, in a multithreaded apartment. The call also initializes COM. C++/WinRT
Uri rssFeedUri{ L"https://blogs.windows.com/feed" }; SyndicationClient syndicationClient; Stack-allocate two objects: they represent the uri of the Windows blog, and a syndication client. We construct the uri with a simple wide string literal (see String handling in C++/WinRT for more ways you can work with strings). C++/WinRT SyndicationFeed
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
31 of 39 3/11/2025, 1:20 PM
syndicationFeed = syndicationClient.RetrieveFeedAsync(rssFeedUri).get(); SyndicationClient::RetrieveFeedAsync is an example of an asynchronous Windows Runtime function. The code example receives an asynchronous operation object from RetrieveFeedAsync, and it calls get on that object to block the calling thread and wait for the result
(which is a syndication feed, in this case). For more about concurrency, and for non-blocking techniques, see Concurrency and asynchronous operations with C++/WinRT. C++/WinRT for (const SyndicationItem syndicationItem : syndicationFeed.Items()) { ... } SyndicationFeed.Items is a range, defined by the iterators returned from begin and end
functions (or their constant, reverse, and constant-reverse variants). Because of this, you can enumerate Items with either a range-based for statement, or with the std::for_each template function. Whenever you iterate over a Windows Runtime collection like this, you'll need to #include . C++/WinRT winrt::hstring titleAsHstring = syndicationItem.Title().Text(); // Omitted: there's a little bit of extra work here to remove the trademark symbol from the title text.std::wcout << titleAsHstring.c_str() Windows Desktop Application project. You can optionally install the C++/WinRT Visual Studio Extension (VSIX) and the NuGet package. For details, see Visual Studio support for C++/WinRT. Set project properties Go to project property General > Windows SDK Version, and select All Configurations and All Platforms. Ensure that Windows SDK Version is set to 10.0.17134.0 (Windows 10, version 1803) or greater. Confirm that you're not affected by Why won't my new project compile?. Because C++/
WinRT uses features from the C++17 standard, set project property C/C++ > Language > C++ Language Standard to ISO C++17 Standard (/std:c++17).The precompiled header The default project template creates a precompiled header for you, named either framework.h , or stdafx.h . Rename that to pch.h . If you have a stdafx.cpp file, then
rename that to pch.cpp . Set project property C/C++ > Precompiled Headers > Precompiled Header to Create (/Yc), and Precompiled Header File to pch.h. Find and replace all #include "framework.h" (or #include "stdafx.h") with #include "pch.h" . In pch.h , include winrt/base.h . C++/WinRT // pch.h ... #include Linking The C++/WinRT language projection depends on certain Windows Runtime free (non member) functions, and entry points, that require linking to the WindowsApp.lib umbrella library. This section describes three ways of satisfying the linker. The first option is to add to your Visual Studio project all of the C++/WinRT MSBuild properties and targets. To do this, install
the Microsoft.Windows.CppWinRT NuGet package into your project. Open the project in Visual Studio, click Project > Manage NuGet Packages... > Browse, type or paste Microsoft.Windows.CppWinRT in the search box, select the item in search results, and then click Install to install the package for that project. You can also use project link
settings to explicitly link WindowsApp.lib . Or, you can do it in source code (in pch.h , for example) like this. C++/WinRT #pragma comment(lib, "windowsapp") You can now compile and link, and add C++/WinRT code to your project (for example, code similar to that shown in the A C++/WinRT quick-start section, above). The three main scenarios

for C++/WinRTAs you use and become familiar with C++/WinRT, and work through the rest of the documentation here, you'll likely notice that there are three main scenarios, as described in the following sections. Consuming Windows APIs and types In other words, using, or calling APIs. For example, making API calls to communicate using
Bluetooth; to stream and present video; to integrate with the Windows shell; and so on. C++/WinRT fully and uncompromisingly supports this category of scenario. For more info, see Consume APIs with C++/WinRT. Authoring Windows APIs and types In other words, producing APIs and types. For example, producing the kinds of APIs described
in the section above; or the graphics APIs; the storage and file system APIs; the networking APIs, and so on. For more info, see Author APIs with C++/WinRT. Authoring APIs with C++/WinRT is a little more involved than consuming them, because you must use IDL to define the shape of the API before you can implement it. There's a walkthrough of
doing that in XAML controls; bind to a C++/WinRT property. XAML applications This scenario is about building applications and controls on the XAML UI framework. Working in a XAML application amounts to a combination of consuming and authoring. But since XAML is the dominant UI framework on Windows today, and its influence over the
Windows Runtime is proportionate to that, it deserves its own category of scenario. Be aware that XAML works best with programming languages that offer reflection. In C++/WinRT, you sometimes have to do a little extra work in order to interoperate with the XAML framework. All of those cases are covered in the documentation. Good places to
start are XAML controls; bind to a C++/WinRT property and XAML custom (templated) controls with C++/WinRT. Sample apps written in C++/WinRT See Where can I find C++/WinRT sample apps?. Important APIsFeedback Was this page helpful? Provide product feedback | Get help at Microsoft Q&A SyndicationClient::RetrieveFeedAsync
method SyndicationFeed.Items property winrt::hstring struct winrt::hresult-error struct C++/CX Error handling with C++/WinRT Interop between C++/WinRT and C++/CX Interop between C++/WinRT and the ABI Move to C++/WinRT from C++/CX String handling in C++/WinRT Related topics Yes NoFeedback Was this page helpful? Get help at Microsoft Q&A Get Started with Win32 and C++ Article • 01/27/2022 The aim of this Get Started series is to teach you how to write a desktop program in C++ using Win32 and COM APIs. In the first module, you'll learn step-by-step how to create and show a window. Later modules will introduce the Component Object
Model (COM), graphics and text, and user input. For this series, it is assumed that you have a good working knowledge of C++ programming. No previous experience with Windows programming is assumed. If you are new to C++, learning material is available in the C++ language documentation . Topic Description Intro to Win32 programming in C++ This section describes some of the basic terminology and coding conventions used in Windows programming. Module 1. Your First Windows Program In this module, you will create a simple Windows program that shows a blank window. Module 2. Using COM in Your Windows Program This module introduces the
Component Object Model (COM), which underlies many of the modern Windows APIs. Module 3. Windows Graphics This module introduces the Windows graphics architecture, with a focus on Direct2D. Module 4. User Input This module describes mouse and keyboard input. Sample Code Contains links to download the sample code for
this series. In this section 7 Yes ⊦ NoCreate a simple Universal Windows Platform (UWP) game with DirectX Article • 10/20/2022 In this set of tutorials, you'll learn how to use DirectX and C++/WinRT to create the basic Universal Windows Platform (UWP) sample game named Simple3DGameDX. The gameplay takes place in a simple firstperson 3D shooting gallery. 7 Note The link from which you can download the Simple3DGameDX sample game itself is Direct3D sample game. The C++/WinRT source code is in the folder named cppwinrt . For info about other UWP sample apps, see Sample applications for Windows development. These tutorials cover all of the major parts of
a game, including the processes for loading assets such as arts and meshes, creating a main game loop, implementing a simple rendering pipeline, and adding sound and controls. You'll also see UWP game development techniques and considerations. We'll focus on key UWP DirectX game development concepts, and call out Windows-Runtimespecific considerations around those concepts. Objective To learn about the basic concepts and components of a UWP DirectX game, and to become more comfortable designing UWP games with DirectX. What you need to know For this tutorial, you need to be familiar with these subjects. C++/WinRT. C++/WinRT is a standard modern C++17
language projection for Windows APIs, implemented as a header-file-based library, and designed to provide you with first-class access to the modern Windows APIs. Basic linear algebra and Newtonian physics concepts. Basic graphics programming terminology. Basic Windows programming concepts. Basic familiarity with the Direct2D and
Direct3D 11 APIs.The Simple3DGameDX sample game implements a simple first-person 3D shooting gallery, where the player fires balls at moving targets. Hitting each target awards a set number of points, and the player can progress through 6 levels of increasing challenge. At the end of the levels, the points are tallied, and the player is awarded a
final score. The sample demonstrates these game concepts. Interoperation between DirectX 11.1 and the Windows Runtime A first-person 3D perspective and camera Stereoscopic 3D effects Collision-detection between objects in 3D Handling player input for mouse, touch, and Xbox controller controls Audio mixing and playback A basic
game state-machine Topic Description Set up the game project The first step in developing your game is to set up a project in Microsoft Visual Studio. After you've configured a project specifically for game development, you could later re-use it as a kind of template. Define the game's UWP app framework The first step in coding a Universal Windows Platform (UWP) game is building the framework that lets the app object interact with Windows. Game flow management Define the high-level state machine to enable player and system interaction. Learn how UI interacts with the overall game's state machine and how to create event handlers for UWP games. Direct3D
UWP shooting gallery sampleTopic Description Define the main game object Now, we look at the details of the sample game's main object and how the rules it implements translate into interactions with the game world. Rendering framework I: Intro to rendering Learn how to develop the rendering pipeline to display graphics. Intro to
rendering. Rendering framework II: Game rendering Learn how to assemble the rendering pipeline to display graphics. Game rendering, set up and prepare data. Add a user interface Learn how to add a 2D user interface overlay to a DirectX UWP game. Add controls Now, we take a look at how the sample game implements movelook controls in a 3-D game, and how to develop basic touch, mouse, and game controller controls. Add sound Develop a simple sound engine using XAudio2 APIs to playback game music and sound effects. Extend the sample game Learn how to implement a XAML overlay for a UWP DirectX game.Create a console calculator in C++
Article • 10/08/2024 The usual starting point for a C++ programmer is a "Hello, world!" application that runs on the command line. You start with that in this article, and then move on to something more challenging: a calculator app. Prerequisites Visual Studio with the Desktop development with C++ workload installed and running on your
computer. To install it, see Install C++ support in Visual Studio. This tutorial demonstrates a feature called edit and continue which allows you to make changes to your code while the app is running. To enable edit and continue, from the main menu select Tools > Options > Debugging > General and ensure that Require source files to exactly match
the original version is checked. Create your app project Visual Studio uses projects to organize the code for an app, and solutions to organize one or more projects. A project contains all the options, configurations, and rules used to build an app. It also manages the relationship between all the project's files and any external files. To create your
app, first, create a new project and solution. 1. Start Visual Studio--the Visual Studio Start dialog box appears. Select Create a new project to get started.2. In the Create a new project dialog, set the language dropdown to C++, set the platform dropdown to Windows, select Console App from the list of project types, then select Next.) Important
Make sure you select the C++ version of the Console App template. It has the C++, Windows, and Console tags, and the icon has "++" in the corner.3. In the Configure your new project dialog box, select the Project name text box, name your new project CalculatorTutorial, then select Create. An empty C++ Windows console application 'Hello World'
app is created. Console applications use a Windows console window to display output and accept user input. In Visual Studio, an editor window opens and shows the generated code: C++ // CalculatorTutorial.cpp : This file contains the 'main' function. Program execution begins and ends there. // #include int main() { std::cout Start Debugging menu // Tips for Getting Started: // 1. Use the Solution Explorer window to add/manage files // 2. Use the Team Explorer window to connect to source control // 3. Use the Output window to see build output and other messages // 4. Use the Error List window to view
errors // 5. Go to Project > Add New Item to create new code files, or Project > Add Existing Item to add existing code files to the project// 6. In the future, to open this project again, go to File > Open > Project and select the .sln file Verify that your new app builds and runs The template for a new Windows console application creates a simple C++
"Hello World" app. At this point, you can see how Visual Studio builds and runs the apps you create right from the IDE. 1. To build your project, select Build Solution from the Build menu. The Output window shows the results of the build process. 2. To run the code, on the menu bar, select Debug > Start without debugging (Ctrl+F5).A console
window opens and your app runs within it. When you start a console app in Visual Studio, it runs your code, then prints "Press any key to close this window . . . " to give you a chance to see the output. Congratulations! You created your first "Hello, world!" console app in Visual Studio! 3. Press a key to dismiss the console window and return to Visual
Studio. You now have the tools to build and run your app after every change, to verify that the code still works as you expect. Later, we show you how to debug it if it doesn't. Now let's modify the code in this template to be a calculator app. 1. Replace the contents of the CalculatorTutorial.cpp file with the following code so that it matches this
example: C++ Edit the code // CalculatorTutorial.cpp : This file contains the 'main' function. Program execution begins and ends there. // #include using namespace std; int main() { cout << "Calculator Console Application" << endl << endl; cout << "Please enter the operation to perform. Format: a+b | a-b |Understanding the code: The
#include statement brings in code in other files. Sometimes, you may see a filename surrounded by angle brackets like . The angle brackets instruct the compiler to look for the iostream header file first in the standard system directories, and if not found, to look in directories specific to the project. Other times, you may see a filename surrounded by
quotes like "someHeader.h" . The quotes instruct the compiler to skip looking in the standard system directories and instead only look in directories specific to the project. The using namespace std; tells the compiler to expect code from the C++ Standard Library to be used in this file. Without this line, each keyword from the library would have to be
preceded with std:: to denote its scope. For instance, without that line, each reference to cout would be written as std::cout . The using statement is added to make it more convenient to access code in another namespace. The cout keyword is used to print to standard output in C++. The << operator tells the compiler to send whatever is to the right
of it to the standard output. The endl keyword is like the Enter key; it ends the line and moves the cursor to the next line. It's a better practice to put a \n inside the string (contained by "") to do the same thing because endl always flushes the buffer which can hurt the performance of the program. But since this is a very small app, endl is used
instead. All C++ statements must end with semicolons and all C++ applications must contain a main() function. This function is what the program runs at a^b | a/b" Start Debugging menu // Tips for Getting Started: // 1. Use the Solution Explorer window to add/manage files // 2. Use the Team Explorer window to connect to source control // 3. Use the Output window to see build output and other messages // 4. Use the Error List window to view errors // 5. Go to Project > Add New Item to create new code files, or Project > Add Existing Item to add existing code files to the project // 6. In the future, to open this project
again, go to File > Open > Project and select the .sln filethe start. All code must be accessible from main() in order to be used. 2. To save the file, press Ctrl+S, or select the floppy disk icon in the toolbar under the menu bar. 3. To run the application, press Ctrl+F5 or go to the Debug menu and select Start Without Debugging. You should see a
console window appear that looks like this. 4. Close the console window when you're done. Add code to do some math A class is like a blueprint for an object that does something. In this case, we define a calculator class to contain the math logic. Add a Calculator class 1. Go to the Project menu and select Add Class. In the Class Name edit
box, enter Calculator. Select OK. Two new files get added to your project. To save all your changed files at once, press Ctrl+Shift+S. It's a keyboard shortcut for File > Save All. There's also a toolbar button for Save All, an icon of two floppy disks, found beside the Savebutton. In general, it's good practice to do Save All frequently, so you don't miss
saving any changes. The Add Class wizard creates .h and .cpp files that have the same name as the class. You can see a full list of your project files in the Solution Explorer window, visible on the side of the IDE. If the window isn't visible, open it from the menu bar via View > Solution Explorer. You can open a file by double-clicking it in the
Solution Explorer window. Double click Calculator.h to open it. 2. Replace the contents of Calculator.h with the following code so that the file now looks like this: C++ Understanding the code This code declares a new function called Calculate , which handles math operations for addition, subtraction, multiplication, and division. #pragma once
class Calculator { public: double Calculate(double x, char oper, double y); };C++ code is organized into header (.h) files and source (.cpp) files. Some other file extensions are supported by various compilers, but these are the main ones to know about. Functions and variables are normally declared, that is, given a name and a type, in
header files, and implemented, or given a definition, in source files. To access code defined in another file, you can use #include "filename.h" , where filename.h is the name of the file that declares the variables or functions you want to use. It's good practice to organize your code into different files based on what it does, so it's easy to find the
code you need later. In our case, we define the Calculator class separately from the file containing the main() function, but we plan to reference the Calculator class in main() . 3. A green squiggle appears under Calculate because although the Calculate function is declared, it isn't defined. Hover over Calculate , click the down arrow on the
screwdriver icon, and select Create definition of 'Calculate' in Calculator.cpp . This code is added to Calculator.cpp :Currently, it just returns 0.0. Let's change that. 4. Switch to the Calculator.cpp file in the editor window. Replace the contents of Calculator::Calculate(double x, char oper, double y) with: C++ Understanding the code The function
Calculate takes a number, an operator, and a second number. Then it performs the requested operation on the two numbers. The switch statement checks which operator was provided, and executes the case corresponding to that operation. The default: case is a fallback double Calculator::Calculate(double x, char oper, double y) { switch(oper)
{ case '+': return x + y; case '-': return x - y; case '*': return x * y; case '/': return x / y; default: return 0.0; } }in case the user types an operator that isn't handled by any of the preceding case statements. It's best to handle invalid user input in a more elegant way, but this is beyond the scope of this tutorial. The double keyword denotes a type of number that supports decimals. This type of number is called a floating-point number, and double means a floating point number that has extra precision. This way, the calculator can handle both decimal math and integer math. The Calculate function is required to always return a double-precision floating point number due to the
double at the start of the code (this denotes the function's return type), which is why we return 0.0 in the default case. The .h file declares the function prototype, which tells the compiler upfront what parameters it requires, and what return type to expect from it. The .cpp file has all the implementation details of the function. If you build and run the
code again at this point, it immediately exits after asking which operation to perform. So, modify the main function to do multiple calculations. 1. Update the main function in CalculatorTutorial.cpp as follows: C++ Call the Calculator class member functions // CalculatorTutorial.cpp : This file contains the 'main' function. Program execution begins
and ends there. // #include #include "Calculator.h" using namespace std; int main() { double x = 0.0; double y = 0.0; double result = 0.0; char oper = '+'; cout << "Calculator Console Application" << endl << endl; cout << "Please enter the operation to perform. Format: a+b | a-b | a*b | a/b" x >> oper >> y; result = c.Calculate(x, oper, y); cout << "Result " << "of " << x << oper << y << " is: " << result Autos. To see all of the variables from that function, switch to the Locals window. Because this is a small function, the Autos and Locals window show the same variables. But you can modify the values of these variables in the Locals window while debugging to see what effect they would have on the program. In this case, we leave them alone. Open the Locals window by selecting Locals at the bottom of the Autos window, or by selecting from the main menu Debug > Windows > Locals.You can also hover over variables in the code to see their current values at the point where execution is currently
paused. Make sure the editor window is in focus by clicking on it first. Continue debugging 1. The yellow arrow on the left shows the current point of execution. The current line calls Calculate , so press F11 to Step Into the function. Now you're executing code in the body of the Calculate function. Be careful with Step Into because it steps into any
functions on the line you're on, including standard library functions. It's fine to step into the standard library, but you may be more interested in focusing on your code instead of library code. 2. Now that the point of execution is at the start of the Calculate function, press F10 to move to the next line in the program's execution. F10 is also known as
Step Over. You can use Step Over to move from line to line, without delving into the details of what is occurring in each part of the line. In general, you should use Step Over instead of Step Into unless you want to dive more deeply into code that is being called from elsewhere (as you did to reach the body of Calculate). 3. Continue using F10 to
Step Over each line until you get back to the main() function in the other file, and stop on the cout line.The program is doing what's expected: it takes the first number, and divides it by the second. On the cout line, hover over the result variable or take a look at result in the Autos window. Its value is inf , which doesn't look right. Let's fix it. The cout
line outputs whatever value is stored in result , so when you step one more line forward using F10, the console window displays: This result is because division by zero is undefined, so the program doesn't have a numerical answer for the requested operation. Fix the "divide by zero" error Let's handle division by zero more gracefully so that it's
easier for the user to understand the problem. 1. Make the following changes in CalculatorTutorial.cpp . You can leave the program running as you edit, thanks to a debugger feature called Edit andContinue. Add an if statement following cin >> x >> oper >> y; to check for division by zero and output a message to the user if it happens. Otherwise,
the result is printed. C++ 2. Press F5 once. Program execution continues until it has to pause to ask for user input. Enter 10 / 0 again. Now, a more helpful message is printed. The user is asked for more input, and the program continues executing normally. // CalculatorTutorial.cpp : This file contains the 'main' function. Program execution
begins and ends there. // #include #include "Calculator.h" using namespace std; int main() { double x = 0.0; double y = 0.0; double result = 0.0; char oper = '+'; cout << "Calculator Console Application" << endl << endl; cout << "Please enter the operation to perform. Format: a+b | a-b | a*b | a/b" x >> oper >> y; if (oper == '/' && y == 0) { cout << "Math error: Attempted to divide by zero!" << endl; continue; } else { result = c.Calculate(x, oper, y); } cout << "Result " << "of " << x << oper << y << " is: " << result General needs to be enabled..." To fix this, from the main menu select Tools > Options > Debugging > General and ensure that Require source
files to exactly match the original version is checked. Understanding the Run and Debug shortcuts F5, or Debug > Start Debugging, starts a debugging session, if one isn't already active, and runs the program until a breakpoint is hit or the program needs user input. If no user input is needed and no breakpoint is available to hit, the program
terminates and the console window closes itself when the program finishes running. If your program outputs to the console, use Ctrl+F5 or set a breakpoint before you press F5 to keep the window open. Ctrl+F5, or Debug > Start Without Debugging, runs the application without going into debug mode. This is slightly faster than debugging, and
the console window stays open after the program finishes executing. F10, known as Step Over, lets you iterate through code, line-by-line, and visualize how the code is run and what variable values are at each step of execution.F11, known as Step Into, works similarly to Step Over, except it steps into any functions called on the line of execution. For
example, if the line being executed calls a function, pressing F11 moves the pointer into the body of the function, so you can follow the function's code being run before coming back to the line you started at. Pressing F10 steps over the function call and just moves to the next line; the function call still happens, but the program doesn't pause to
show you what it's doing. Close the app If it's still running, close the console window to stop the calculator app. Add Git source control Now that you've created an app, you might want to add it to a Git repository. We've got you covered. Visual Studio makes that process easy with Git tools you can use directly from the IDE. Tip Git is the
most widely used modern version control system, so whether you're a professional developer or you're learning how to code, Git can be very useful. If you're new to Git, the https://git-scm.com/ website is a good place to start. There, you can find cheat sheets, a popular online book, and Git Basics videos. To associate your code with Git, you start by
creating a new Git repository where your code is located. Here's how: 1. In the status bar at the bottom-right corner of Visual Studio, select Add to Source Control, and then select Git. 2. In the Create a Git repository dialog box, sign in to GitHub.The repository name auto-populates based on your folder location. By default, your new repository is
private, which means you're the only one who can access it. Tip Whether your repository is public or private, it's best to have a remote backup of your code stored securely on GitHub. Even if you aren't working with a team, a remote repository makes your code available to you from any computer. 3. Select Create and Push. After you create
your repository, status details appear in the status bar. The first icon with the arrows shows how many outgoing/incoming commits are in your current branch. You can use this icon to pull any incoming commits or push any outgoing commits. You can also choose to view these commits first. To do so, select the icon, and then select View Outgoing/
Incoming.Feedback Was this page helpful? Provide product feedback | Get help at Microsoft Q&A The second icon with the pencil shows the number of uncommitted changes to your code. You can select this icon to view those changes in the Git Changes window. To learn more about how to use Git with your app, see the Visual Studio version
control documentation. Congratulations! You completed the code for the calculator app, built and debugged it, and added it to a repo, all in Visual Studio. Learn more about Visual Studio for C++ The finished app Next steps Yes NoGet started with C++/WinRT Article • 02/13/2023 ⟩ Important For info about setting up Visual Studio for C++/WinRT development—including installing and using the C++/WinRT Visual Studio Extension (VSIX) and the NuGet package (which together provide project template and build support)—see Visual Studio support for C++/WinRT. To get you up to speed with using C++/WinRT, this topic walks through a simple code example based on a new
Windows Console Application (C++/WinRT) project. This topic also shows how to add C++/WinRT support to a Windows Desktop application project. 7 Note While we recommend that you develop with the latest versions of Visual Studio and the Windows SDK, if you're using Visual Studio 2017 (version 15.8.0 or later), and targeting the
Windows SDK version 10.0.17134.0 (Windows 10, version 1803), then a newly created C++/WinRT project may fail to compile with the error "error C3861: 'from_abi': identifier not found", and with other errors originating in base.h. The solution is to either target a later (more conformant) version of the Windows SDK, or set project property C/C++ >
Language > Conformance mode: No (also, if /permissive- appears in project property C/C++ > Language > Command Line under Additional Options, then delete it). A C++/WinRT quick-start Create a new Windows Console Application (C++/WinRT) project. Edit pch.h and main.cpp to look like this. C++/WinRT // pch.h #pragma once #include C++/WinRT Let's take the short code example above piece by piece, and explain what's going on in each part. C++/WinRT With the default project settings, the included headers come from the Windows SDK, inside the folder %WindowsSdkDir%\Include\cppwinrt\winrt . Visual Studio includes that path in its IncludePath macro. But
there's no strict dependency on the #include #include // main.cpp #include "pch.h" using namespace winrt; using namespace Windows::Foundation; using namespace Windows::Web::Syndication; int main() { winrt::init_apartment(); Uri rssFeedUri{ L"https://blogs.windows.com/feed" }; SyndicationClient syndicationClient; syndicationClient.SetRequestHeader(L"User-Agent", L"Mozilla/5.0 (compatible; MSIE 10.0; Windows NT 6.2; WOW64; Trident/6.0)"); SyndicationFeed syndicationFeed = syndicationClient.RetrieveFeedAsync(rssFeedUri).get(); for (const SyndicationItem syndicationItem : syndicationFeed.Items()) { winrt::hstring titleAsHstring = syndicationItem.Title().Text(); // A workaround to remove the trademark symbol from the title string, because it causes issues in this case. std::wstring titleAsStdWstring{ titleAsHstring.c_str() }; titleAsStdWstring.erase(remove(titleAsStdWstring.begin(), titleAsStdWstring.end(), L'™'), titleAsStdWstring.end()); titleAsHstring = titleAsStdWstring;
std::wcout << titleAsHstring.c_str() << std::endl; } } #include #include Windows SDK, because your project (via the cppwinrt.exe tool) generates those same headers into your project's $(GeneratedFilesDir) folder. They'll be loaded from that folder if they can't be found elsewhere, or if you change your project settings. The headers contain
Windows APIs projected into C++/WinRT. In other words, for each Windows type, C++/WinRT defines a C++-friendly equivalent (called the projected type). A projected type has the same fully-qualified name as the Windows type, but it's placed in the C++ winrt namespace. Putting these includes in your precompiled header reduces incremental build
times. ⟩ Important Whenever you want to use a type from a Windows namespaces, you must #include the corresponding C++/WinRT Windows namespace header file, as shown above. The corresponding header is the one with the same name as the type's namespace. For example, to use the C++/WinRT projection for the Windows::Foundation::Collections::PropertySet runtime class, include the winrt/Windows.Foundation.Collections.h header. It is common for a C++/WinRT projection header to automatically include related namespace header files. For example, winrt/Windows.Foundation.Collections.h includes winrt/Windows.Foundation.h . But you shouldn't rely on
this behavior, since it's an implementation detail that changes over time. You must explicitly include any headers that you need. C++/WinRT using namespace winrt; using namespace Windows::Foundation; using namespace Windows::Web::Syndication; The using namespace directives are optional, but convenient. The pattern shown above
for such directives (allowing unqualified name lookup for anything in the winrt namespace) is suitable for when you're beginning a new project and C++/WinRT is the only language projection you're using inside of that project. If, on the other hand, you're mixing C++/WinRT code with C++/CX and/or SDK application binary interface (ABI) code
(you're either porting from, or interoperating with, one or both of those models), then see the topics Interop between C++/WinRT and C++/CX, Move to C++/WinRT from C++/CX, and Interop between C++/WinRT and the ABI. C++/WinRTwinrt::init_apartment(); The call to winrt::init_apartment initializes the thread in the Windows Runtime; by
default, in a multithreaded apartment. The call also initializes COM. C++/WinRT Uri rssFeedUri{ L"https://blogs.windows.com/feed" }; SyndicationClient syndicationClient; Stack-allocate two objects: they represent the uri of the Windows blog, and a syndication client. We construct the uri with a simple wide string literal (see String handling in C+
+/WinRT for more ways you can work with strings). C++/WinRT SyndicationFeed syndicationFeed = syndicationClient.RetrieveFeedAsync(rssFeedUri).get(); SyndicationClient::RetrieveFeedAsync is an example of an asynchronous Windows Runtime function. The code example receives an asynchronous operation object from RetrieveFeedAsync, and it calls get on that object to block the calling thread and wait for the result (which is a syndication feed, in this case). For more about concurrency, and for non-blocking techniques, see Concurrency and asynchronous operations with C++/WinRT. C++/WinRT for (const SyndicationItem syndicationItem : syndicationFeed.Items()) { ... } SyndicationFeed.Items is a range, defined by the iterators returned from begin and end functions (or their constant, reverse, and constant-reverse variants). Because of this, you can enumerate items with either a range-based for statement, or with the std::for_each template function. Whenever you iterate over a
Windows Runtime collection like this, you'll need to #include . C++/WinRT winrt::hstring titleAsHstring = syndicationItem.Title().Text(); // Omitted: there's a little bit of extra work here to remove the trademark symbol from the title text.std::wcout << titleAsHstring.c_str() Windows Desktop Application project. You can optionally install the C++/WinRT Visual Studio Extension (VSIX) and the NuGet package. For details, see Visual Studio support for C++/WinRT. Set project properties Go to project property General > Windows SDK Version, and select All Configurations and All Platforms. Ensure that Windows SDK Version is set to 10.0.17134.0 (Windows 10,
version 1803) or greater. Confirm that you're not affected by Why won't my new project compile?. Because C++/WinRT uses features from the C++17 standard, set project property C/C++ > Language > C++ Language Standard to ISO C++17 Standard (/std:c++17).The precompiled header The default project template creates a precompiled header
for you, named either framework.h , or stdafx.h . Rename that to pch.h . If you have a stdafx.cpp file, then rename that to pch.cpp . Set project property C/C++ > Precompiled Headers > Precompiled Header to Create (/Yc), and Precompiled Header File to pch.h. Find and replace all #include "framework.h" (or #include "stdafx.h") with #include
"pch.h" . In pch.h , include winrt/base.h . C++/WinRT // pch.h ... #include Linking The C++/WinRT language projection depends on certain Windows Runtime free (non member) functions, and entry points, that require linking to the WindowsApp.lib umbrella library. This section describes three ways of satisfying the linker. The first option

is to add to your Visual Studio project all of the C++/WinRT MSBuild properties and targets. To do this, install the Microsoft.Windows.CppWinRT NuGet package into your project. Open the project in Visual Studio, click Project > Manage NuGet Packages... > Browse, type or paste Microsoft.Windows.CppWinRT in the search box, select the item in
search results, and then click Install to install the package for that project. You can also use project link settings to explicitly link WindowsApp.lib . Or, you can do it in source code (in pch.h , for example) like this. C++/WinRT #pragma comment(lib, "windowsapp") You can now compile and link, and add C++/WinRT code to your project (for
example, code similar to that shown in the A C++/WinRT quick-start section, above). The three main scenarios for C++/WinRTAs you use and become familiar with C++/WinRT, and work through the rest of the documentation here, you'll likely notice that there are three main scenarios, as described in the following sections. Consuming Windows
APIs and types In other words, using, or calling APIs. For example, making API calls to communicate using Bluetooth; to stream and present video; to integrate with the Windows shell; and so on. C++/WinRT fully and uncompromisingly supports this category of scenario. For more info, see Consume APIs with C++/WinRT. Authoring Windows APIs
and types In other words, producing APIs and types. For example, producing the kinds of APIs described in the section above; or the graphics APIs; the storage and file system APIs; the networking APIs, and so on. For more info, see Author APIs with C++/WinRT. Authoring APIs with C++/WinRT is a little more involved than consuming them,
because you must use IDL to define the shape of the API before you can implement it. There's a walkthrough of doing that in XAML controls; bind to a C++/WinRT property. XAML applications This scenario is about building applications and controls on the XAML UI framework. Working in a XAML application amounts to a combination of
consuming and authoring. But since XAML is the dominant UI framework on Windows today, and its influence over the Windows Runtime is proportionate to that, it deserves its own category of scenario. Be aware that XAML works best with programming languages that offer reflection. In C++/WinRT, you sometimes have to do a little extra work in
order to interoperate with the XAML framework. All of those cases are covered in the documentation. Good places to start are XAML controls; bind to a C++/WinRT property and XAML custom (templated) controls with C++/WinRT. Sample apps written in C++/WinRT See Where can I find C++/WinRT sample apps?. Important APIsFeedback
Was this page helpful? Provide product feedback | Get help at Microsoft Q&A SyndicationClient::RetrieveFeedAsync method SyndicationFeed.Items property winrt::hstring struct winrt::hresult_error struct C++/CX Error handling with C++/WinRT Interop between C++/WinRT and C++/CX Interop between C++/WinRT and the ABI Move to C++/WinRT from C++/CX String handling in C++/WinRT Related topics Yes NoFeedback Was this page helpful? Get help at Microsoft Q&A Get Started with Win32 and C++ Article • 01/27/2022 The aim of this Get Started series is to teach you how to write a desktop program in C++ using Win32 and COM APIs. In the first module, you'll learn step-by-step how to create and show a window. Later modules will introduce the Component Object Model (COM), graphics and text, and user input. For this series, it is assumed that you have a good working knowledge of C++ programming. No previous experience with Windows programming is assumed. If you are new to
C++, learning material is available in the C++ language documentation . Topic Description Intro to Win32 programming in C++ This section describes some of the basic terminology and coding conventions used in Windows programming. Module 1. Your First Windows Program In this module, you will create a simple Windows program that
shows a blank window. Module 2. Using COM in Your Windows Program This module introduces the Component Object Model (COM), which underlies many of the modern Windows APIs. Module 3. Windows Graphics This module introduces the Windows graphics architecture, with a focus on Direct2D. Module 4. User Input This module describes mouse and keyboard input. Sample Code Contains links to download the sample code for this series. In this section ? Yes ⊦ NoCreating an MFC Application Article • 02/14/2023 An MFC application is an executable application for Windows that is based on the Microsoft Foundation Class (MFC) Library. MFC executables
generally fall into five types: standard Windows applications, dialog boxes, forms-based applications, Explorer-style applications, and Web browser-style applications. For more information, see: Using the Classes to Write Windows Applications Creating and Displaying Dialog Boxes Creating a Forms-Based MFC Application Creating a File
Explorer-Style MFC Application Creating a Web Browser-Style MFC Application The MFC Application Wizard generates the appropriate classes and files for any of these types of applications, depending on the options you select in the wizard. The easiest way to create an MFC application is to use the MFC Application Wizard (MFC App project in
Visual Studio 2019). To create an MFC console application (a command line program that uses MFC libraries but runs in the console window), use the Windows Desktop Wizard and choose the Console Application and MFC Headers options. To create an MFC forms or dialog-based application 1. From the main menu, choose File > New > Project.
2. Enter "MFC" into the search box and then choose MFC App from the result list. 3. Modify the defaults as needed, then press Create to open the MFC Application Wizard. 4. Modify the configuration values as needed, then press Finish. For more information, see Creating a forms-based MFC application.To create an MFC console application An
MFC console application is a command-line program that uses MFC libraries but runs in the console window. 1. From the main menu, choose File > New > Project. 2. Enter "Desktop" into the search box and then choose Windows Desktop Wizard from the result list, then press Next. 3. Modify the project name and location as needed, then press
Create to open the Windows Desktop Wizard. 4. Check the MFC Headers box and set other values as needed, then press OK.Once your project is created, you can view the files created in Solution Explorer. For more information about the files the wizard creates for your project, see the project generated file ReadMe.txt. For more information about
the file types, see File Types Created for Visual Studio C++ projects. See also Adding Functionality with Code Wizards Property PagesWalkthrough: Create and use your own Dynamic Link Library (C++) Article • 12/10/2021 This step-by-step walkthrough shows how to use the Visual Studio IDE to create your own dynamic link library (DLL)
written in Microsoft C++ (MSVC). Then it shows how to use the DLL from another C++ app. DLLs (also known as shared libraries in UNIX-based operating systems) are one of the most useful kinds of Windows components. You can use them as a way to share code and resources, and to shrink the size of your apps. DLLs can even make it easier to
service and extend your apps. In this walkthrough, you'll create a DLL that implements some math functions. Then you'll create a console app that uses the functions from the DLL. You'll also get an introduction to some of the programming techniques and conventions used in Windows DLLs. This walkthrough covers these tasks: Create a DLL
project in Visual Studio. Add exported functions and variables to the DLL. Create a console app project in Visual Studio. Use the functions and variables imported from the DLL in the console app. Run the completed app. Like a statically linked library, a DLL exports variables, functions, and resources by name. A client app imports the names to
use those variables, functions, and resources. Unlike a statically linked library, Windows connects the imports in your app to the exports in a DLL at load time or at run time, instead of connecting them at link time. Windows requires extra information that isn't part of the standard C++ compilation model to make these connections. The MSVC compiler
implements some Microsoft-specific extensions to C++ to provide this extra information. We explain these extensions as we go. This walkthrough creates two Visual Studio solutions; one that builds the DLL, and one that builds the client app. The DLL uses the C calling convention. It can be called from apps written in other programming
languages, as long as the platform, calling conventions, and linking conventions match. The client app uses implicit linking, whereWindows links the app to the DLL at load-time. This linking lets the app call the DLL supplied functions just like the functions in a statically linked library. This walkthrough doesn't cover some common situations. The code
doesn't show the use of C++ DLLs by other programming languages. It doesn't show how to create a resource-only DLL, or how to use explicit linking to load DLLs at run-time rather than at load-time. Rest assured, you can use MSVC and Visual Studio to do all these things. Even though the code of the DLL is written in C++, we've used C-style
interfaces for the exported functions. There are two main reasons for this: First, many other languages support imports of C-style functions. The client app doesn't have to be written in C++. Second, it avoids some common pitfalls related to exported classes and member functions. It's easy to make hard-to-diagnose errors when exporting classes,
since everything referred to within a class declaration has to have an instantiation that's also exported. This restriction applies to DLLs, but not static libraries. If your classes are plain old-data style, you shouldn't run into this issue. For links to more information about DLLs, see Create C/C++ DLLs in Visual Studio. For more information about
implicit linking and explicit linking, see Determine which linking method to use. For information about creating C++ DLLs for use with programming languages that use C-language linkage conventions, see Exporting C++ functions for use in C-language executables. For information about how to create DLLs for use with .NET languages, see Calling
DLL Functions from Visual Basic Applications. Prerequisites A computer that runs Microsoft Windows 7 or later versions. We recommend the latest version of Windows for the best development experience. A copy of Visual Studio. For information on how to download and install Visual Studio, see Install Visual Studio. When you run the installer,
make sure that the Desktop development with C++ workload is checked. Don't worry if you didn't install this workload when you installed Visual Studio. You can run the installer again and install it now. An understanding of the basics of using the Visual Studio IDE. If you've used Windows desktop apps before, you can probably keep up. For an
introduction, seeVisual Studio IDE feature tour. An understanding of enough of the fundamentals of the C++ language to follow along. Don't worry, we don't do anything too complicated. Create the DLL project In this set of tasks, you create a project for your DLL, add code, and build it. To begin, start the Visual Studio IDE, and sign in if you need
to. The instructions vary slightly depending on which version of Visual Studio you're using. Make sure you have the correct version selected in the control in the upper left of this page. To create a DLL project in Visual Studio 2019 1. On the menu bar, choose File > New > Project to open the Create a New Project dialog box. 2. At the top of the
dialog, set Language to C++, set Platform to Windows, and set Project type to Library. 3. From the filtered list of project types, select Dynamic-link Library (DLL), and then choose Next. 4. In the Configure your new project page, enter MathLibrary in the Project name box to specify a name for the project. Leave the default Location and Solution
name values. Set Solution to Create new solution. Uncheck Place solution and project in the same directory if it's checked. 5. Choose the Create button to create the project.When the solution is created, you can see the generated project and source files in the Solution Explorer window in Visual Studio. Right now, this DLL doesn't do very much.
Next, you'll create a header file to declare the functions your DLL exports, and then add the function definitions to the DLL to make it more useful. To add a header file to the DLL 1. To create a header file for your functions, on the menu bar, choose Project > Add New Item. 2. In the Add New Item dialog box, in the left pane, select Visual C++. In
the center pane, select Header File (.h). Specify MathLibrary.h as the name for the header file.3. Choose the Add button to generate a blank header file, which is displayed in a new editor window. 4. Replace the contents of the header file with this code: C++ // MathLibrary.h - Contains declarations of math functions #pragma once #ifdef
MATHLIBRARY_EXPORTS #define MATHLIBRARY_API __declspec(dllexport) #else #define MATHLIBRARY_API __declspec(dllimport) #endif // The Fibonacci recurrence relation describes a sequence F // where F(n) is { n = 0, a // { n = 1, bThis header file declares some functions to produce a generalized Fibonacci sequence, given two
initial values. A call to fibonacci_init(1, 1) generates the familiar Fibonacci number sequence. Notice the preprocessor statements at the top of the file. The new project template for a DLL project adds _EXPORTS to the defined preprocessor macros. In this example, Visual Studio defines MATHLIBRARY_EXPORTS when your MathLibrary DLL
project is built. When the MATHLIBRARY_EXPORTS macro is defined, the MATHLIBRARY_API macro sets the __declspec(dllexport) modifier on the function declarations. This modifier tells the compiler and linker to export a function or variable from the DLL for use by other applications. When MATHLIBRARY_EXPORTS is undefined, for
example, when the header file is included by a client application, MATHLIBRARY_API applies the __declspec(dllimport) modifier to the declarations. This modifier optimizes the import of the function or variable in an application. For more information, see dllexport, dllimport. 1. In Solution Explorer, right-click on the Source Files node and choose Add
> New Item. Create a new .cpp file called MathLibrary.cpp, in the same way that you added a new header file in the previous step. // { n > 1, F(n-2) + F(n-1) // for some initial integral values a and b. // If the sequence is initialized F(0) = 1, F(1) = 1, // then this relation produces the well-known Fibonacci // sequence: 1, 1, 2, 3, 5, 8, 13, 21, 34, ...
// Initialize a Fibonacci relation sequence // such that F(0) = a, F(1) = b. // This function must be called before any other function. extern "C" MATHLIBRARY_API void fibonacci_init(const unsigned long long a, const unsigned long long b); // Produce the next value in the sequence. // Returns true on success and updates current value and index;
// false on overflow, leaves current value and index unchanged. extern "C" MATHLIBRARY_API bool fibonacci_next(); // Get the current value in the sequence. extern "C" MATHLIBRARY_API unsigned long long fibonacci_current(); // Get the position of the current value in the sequence. extern "C" MATHLIBRARY_API unsigned fibonacci_index(); To add an implementation to the DLL2. In the editor window, select the tab for MathLibrary.cpp if it's already open. If not, in Solution Explorer, double-click MathLibrary.cpp in the Source Files folder of the MathLibrary project to open it. 3. In the editor, replace the contents of the MathLibrary.cpp file with the following code: C++
// MathLibrary.cpp : Defines the exported functions for the DLL. #include "pch.h" // use stdafx.h in Visual Studio 2017 and earlier #include #include #include "MathLibrary.h" // DLL internal state variables: static unsigned long long previous_; // Previous value, if any static unsigned long long current_; // Current sequence value static unsigned
index_; // Current seq. position // Initialize a Fibonacci relation sequence // such that F(0) = a, F(1) = b. // This function must be called before any other function. void fibonacci_init(const unsigned long long a, const unsigned long long b) { index_ = 0; current_ = a; previous_= b; // see special case when initialized } // Produce the next value in the sequence. // Returns true on success, false on overflow. bool fibonacci_next() { // check to see if we'd overflow result or position if ((ULLONG_MAX - previous_ 0) { // otherwise, calculate next sequence value previous_ += current_; } std::swap(current_, previous_); ++index_; return true; }To verify that everything works so far, compile the dynamic link library. To compile, choose Build > Build Solution on the menu bar. The DLL and related compiler output are placed in a folder called Debug directly below the solution folder. If you create a Release build, the output is placed in a folder called Release. The output should look something like this: Output Congratulations, you've created a DLL using Visual Studio! Next, you'll create a client app that uses the functions exported by the DLL. When you create a DLL, think about how client apps may use it. To call the functions or access the data exported by a DLL, client source code must have the declarations available at compile time. At link time, the
linker requires information to resolve the function calls or data accesses. A DLL supplies this information in an import library, a file that contains information about how to find the functions and data, instead of the actual code. And at run time, the DLL must be available to the client, in a location that the operating system can find. // Get the current
value in the sequence. unsigned long long fibonacci_current() { return current_; } // Get the current index position in the sequence. unsigned fibonacci_index() { return index_; } 1>------ Build started: Project: MathLibrary, Configuration: Debug Win32 --- --- 1>pch.cpp 1>dllmain.cpp 1>MathLibrary.cpp 1>Generating Code... 1> Creating library C:\Users\username\Source\Repos\MathLibrary\Debug\MathLibrary.lib and object C:\Users\username\Source\Repos\MathLibrary\Debug\MathLibrary.exp 1>MathLibrary.vcxproj -> C:\Users\username\Source\Repos\MathLibrary\Debug\MathLibrary.dll ========== Build: 1 succeeded, 0 failed, 0 up-to-date, 0 skipped ==========
Create a client app that uses the DLLWhether it's your own or from a third-party, your client app project needs several pieces of information to use a DLL. It needs to find the headers that declare the DLL exports, the import libraries for the linker, and the DLL itself. One solution is to copy all of these files into your client project. For third-party DLLs
that are unlikely to change while your client is in development, this method may be the best way to use them. However, when you also build the DLL, it's better to avoid duplication. If you make a local copy of DLL files that are under development, you may accidentally change a header file in one copy but not the other, or use an out-of-date library.
To avoid out-of-sync code, we recommend you set the include path in your client project to include the DLL header files directly from your DLL project. Also, set the library path in your client project to include the DLL import libraries from the DLL project. And finally, copy the built DLL from the DLL project into your client build output directory. This
step allows your client app to use the same DLL code you build. To create a client app in Visual Studio 1. On the menu bar, choose File > New > Project to open the Create a new project dialog box. 2. At the top of the dialog, set Language to C++, set Platform to Windows, and set Project type to Console. 3. From the filtered list of project types,
choose Console App then choose Next. 4. In the Configure your new project page, enter MathClient in the Project name box to specify a name for the project. Leave the default Location and Solution name values. Set Solution to Create new solution. Uncheck Place solution and project in the same directory if it's checked. 5. Choose the Create
button to create the client project.A minimal console application project is created for you. The name for the main source file is the same as the project name that you entered earlier. In this example, it's named MathClient.cpp. You can build it, but it doesn't use your DLL yet. Next, to call the MathLibrary functions in your source code, your project must
include the MathLibrary.h file. You could copy this header file into your client app project, then add it to the project as an existing item. This method can be a good choice for third party libraries. However, if you're working on the code for your DLL and your client at the same time, the header files could get out of sync. To avoid this issue, set the
Additional Include Directories path in your project to include the path to the original header. To add the DLL header to your include path 1. Right-click on the MathClient node in Solution Explorer to open the Property Pages dialog. 2. In the Configuration drop-down box, select All Configurations if it's not already selected. 3. In the left pane,
select Configuration Properties > C/C++ > General. 4. In the property pane, select the drop-down control next to the Additional Include Directories edit box, and then choose Edit.5. Double-click in the top pane of the Additional Include Directories dialog box to enable an edit control. Or, choose the folder icon to create a new entry. 6. In the edit
control, specify the path to the location of the MathLibrary.h header file. You can choose the ellipsis (...) control to browse to the correct folder. You can also enter a relative path from your client source files to the folder that contains the DLL header files. If you followed the directions to put your client project in a separate solution from the DLL, the
relative path should look like this: ..\..\MathLibrary\MathLibrary If your DLL and client projects are in the same solution, the relative path might look like this: ..\MathLibrary When the DLL and client projects are in other folders, adjust the relative path to match. Or, use the ellipsis control to browse for the folder. 7. After you've entered the path to
the header file in the Additional Include Directories dialog box, choose the OK button. In the Property Pages dialog box, choose the OK button to save your changes. You can now include the MathLibrary.h file and use the functions it declares in your client application. Replace the contents of MathClient.cpp by using this code: C++This code can be
compiled, but not linked. If you build the client app now, the error list shows several LNK2019 errors. That's because your project is missing some information: You haven't specified that your project has a dependency on the MathLibrary.lib library yet. And, you haven't told the linker how to find the MathLibrary.lib file. To fix this issue, you could copy
the library file directly into your client app project. The linker would find and use it automatically. However, if both the library and the client app are under development, that might lead to changes in one copy that aren't shown in the other. To avoid this issue, you can set the Additional Dependencies property to tell the build system that your project
depends on MathLibrary.lib. And, you can set an Additional Library Directories path in your project to include the path to the original library when you link. 1. Right-click on the MathClient node in Solution Explorer and choose Properties to open the Property Pages dialog. 2. In the Configuration drop-down box, select All Configurations if it's not
already selected. It ensures that any property changes apply to both Debug and Release builds. 3. In the left pane, select Configuration Properties > Linker > Input. In the property pane, select the drop-down control next to the Additional Dependencies edit box, and then choose Edit. // MathClient.cpp : Client app for MathLibrary DLL. //
#include "pch.h" Uncomment for Visual Studio 2017 and earlier #include #include "MathLibrary.h" int main() { // Initialize a Fibonacci relation sequence. fibonacci_init(1, 1); // Write out the sequence values until overflow. do { std::cout << fibonacci_index() << ": " << fibonacci_current() << std::endl; } while (fibonacci_next()); // Report count of values written before overflow. std::cout << fibonacci_index() + 1 << " Fibonacci sequence values fit in an " << "unsigned 64-bit integer." General. In the property pane, select the drop-down control next to the Additional Library Directories edit box, and then choose Edit.7. Double-click in the top pane of the Additional Library
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
32 of 39 3/11/2025, 1:20 PM
Directories dialog box to enable an edit control. In the edit control, specify the path to the location of the MathLibrary.lib file. By default, it's in a folder called Debug directly under the DLL solution folder. If you create a release build, the file is placed in a folder called Release. You can use the $(IntDir) macro so that the linker can find your DLL, no
matter which kind of build you create. If you followed the directions to put your client project in a separate solution from the DLL project, the relative path should look like this: ..\..\MathLibrary\$(IntDir) If your DLL and client projects are in other locations, adjust the relative path to match.8. Once you've entered the path to the library file in the
Additional Library Directories dialog box, choose the OK button to go back to the Property Pages dialog box. Choose OK to save the property changes. Your client app can now compile and link successfully, but it still doesn't have everything it needs to run. When the operating system loads your app, it looks for the MathLibrary DLL. If it can't find
the DLL in certain system directories, the environment path, or the local app directory, the load fails. Depending on the operating system, you'll see an error message like this: One way to avoid this issue is to copy the DLL to the directory that contains your client executable as part of the build process. You can add a Post-Build Event to your project,
to add a command that copies the DLL to your build output directory. The command specified here copies the DLL only if it's missing or has changed. It uses macros to copy to and from the Debug or Release locations, based on your build configuration. To copy the DLL in a post-build event 1. Right-click on the MathClient node in Solution Explorer
and choose Properties to open the Property Pages dialog.2. In the Configuration drop-down box, select All Configurations if it isn't already selected. 3. In the left pane, select Configuration Properties > Build Events > Post-Build Event. 4. In the property pane, select the edit control in the Command Line field. If you followed the directions to put
your client project in a separate solution from the DLL project, then enter this command: xcopy /y /d "..\..\MathLibrary\$(IntDir)MathLibrary.dll" "$(OutDir)" If your DLL and client projects are in other directories, change the relative path to the DLL to match. 5. Choose the OK button to save your changes to the project properties. Now your client app
has everything it needs to build and run. Build the application by choosing Build > Build Solution on the menu bar. The Output window in Visual Studio should have something like the following example depending on your version of Visual Studio: Output 1>------ Build started: Project: MathClient, Configuration: Debug Win32 ---- --1>MathClient.cpp 1>MathClient.vcxproj ->C:\Users\username\Source\Repos\MathClient\Debug\MathClient.exe 1>1 File(s) copied ========== Build: 1 succeeded, 0 failed, 0 up-to-date, 0 skipped ========== Congratulations, you've created an application that calls functions in your DLL. Now run your application to see what it does. On the
menu bar, choose Debug > Start Without Debugging. Visual Studio opens a command window for the program to run in. The last part of the output should look like: Press any key to dismiss the command window. Now that you've created a DLL and a client application, you can experiment. Try setting breakpoints in the code of the client app, and
run the app in the debugger. See what happens when you step into a library call. Add other functions to the library, or write another client app that uses your DLL. When you deploy your app, you must also deploy the DLLs it uses. The simplest way to make the DLLs that you build, or that you include from third parties, available is to put them in the
same directory as your app. It's known as app-local deployment. For more information about deployment, see Deployment in Visual C++. See also Calling DLL Functions from Visual Basic ApplicationsWalkthrough: Create and use a static library Article • 10/29/2021 This step-by-step walkthrough shows how to create a static library (.lib file) for
use with C++ apps. Using a static library is a great way to reuse code. Rather than reimplementing the same routines in every app that requires the functionality, you write them one time in a static library and then reference it from the apps. Code linked from a static library becomes part of your app—you don't have to install another file to use the
code. This walkthrough covers these tasks: Create a static library project Add a class to the static library Create a C++ console app that references the static library Use the functionality from the static library in the app Run the app Prerequisites An understanding of the fundamentals of the C++ language. Create a static library project
The instructions for how to create the project vary depending on your version of Visual Studio. To see the documentation for your preferred version of Visual Studio, use the Version selector control. It's found at the top of the table of contents on this page. To create a static library project in Visual Studio 1. On the menu bar, choose File > New >
Project to open the Create a New Project dialog. 2. At the top of the dialog, set Language to C++, set Platform to Windows, and set Project type to Library.3. From the filtered list of project types, select Windows Desktop Wizard, then choose Next. 4. In the Configure your new project page, enter MathLibrary in the Project name box to specify a
name for the project. Enter StaticMath in the Solution name box. Choose the Create button to open the Windows Desktop Project dialog. 5. In the Windows Desktop Project dialog, under Application type, select Static Library (.lib). 6. Under Additional options, uncheck the Precompiled header check box if it's checked. Check the Empty project box.
7. Choose OK to create the project. 1. To create a header file for a new class, right-click to open the shortcut menu for the MathLibrary project in Solution Explorer, and then choose Add > New Item. 2. In the Add New Item dialog box, select Visual C++ > Code. In the center pane, select Header File (.h). Specify a name for the header file—for
example, MathLibrary.h—and then choose the Add button. A nearly blank header file is displayed. 3. Add a declaration for a class named Arithmetic to do common mathematical operations such as addition, subtraction, multiplication, and division. The code should resemble: C++ Add a class to the static library To add a class to the static
library // MathLibrary.h #pragma once namespace MathLibrary { class Arithmetic { public: // Returns a + b static double Add(double a, double b); // Returns a - b static double Subtract(double a, double b);4. To create a source file for the new class, open the shortcut menu for the MathLibrary project in Solution Explorer, and then choose
Add > New Item. 5. In the Add New Item dialog box, in the center pane, select C++ File (.cpp). Specify a name for the source file—for example, MathLibrary.cpp—and then choose the Add button. A blank source file is displayed. 6. Use this source file to implement the functionality for class Arithmetic . The code should resemble: C++ // Returns
a * b static double Multiply(double a, double b); // Returns a / b static double Divide(double a, double b); }; } // MathLibrary.cpp // compile with: cl /c /EHsc MathLibrary.cpp // post-build command: lib MathLibrary.obj #include "MathLibrary.h" namespace MathLibrary { double Arithmetic::Add(double a, double b) { return a + b; } double Arithmetic::Subtract(double a, double b) { return a - b; } double Arithmetic::Multiply(double a, double b) { return a * b; } double Arithmetic::Divide(double a, double b) { return a / b; } }7. To build the static library, select Build > Build Solution on the menu bar. The build creates a static library, MathLibrary.lib, that can be used by other programs. 7 Note When you build on the Visual Studio command line, you must build the program in two steps. First, run cl /c /EHsc MathLibrary.cpp to compile the code and create an object file that's named MathLibrary.obj. (The cl command invokes the compiler, Cl.exe, and the /c option specifies compile without linking.

For more
information, see /c (Compile Without Linking).) Second, run lib MathLibrary.obj to link the code and create the static library MathLibrary.lib. (The lib command invokes the Library Manager, Lib.exe. For more information, see LIB Reference.) Create a C++ console app that references the static library To create a C++ console app that references
the static library in Visual Studio 1. In Solution Explorer, right-click on the top node, Solution 'StaticMath', to open the shortcut menu. Choose Add > New Project to open the Add a New Project dialog. 2. At the top of the dialog, set the Project type filter to Console. 3. From the filtered list of project types, choose Console App then choose Next. In
the next page, enter MathClient in the Name box to specify a name for the project. 4. Choose the Create button to create the client project. 5. After you create a console app, an empty program is created for you. The name for the source file is the same as the name that you chose earlier. In the example, it's named MathClient.cpp . Use the
functionality from the static library in the appTo use the functionality from the static library in the app 1. Before you can use the math routines in the static library, you must reference it. Open the shortcut menu for the MathClient project in Solution Explorer, and then choose Add > Reference. 2. The Add Reference dialog box lists the libraries that
you can reference. The Projects tab lists the projects in the current solution and any libraries they reference. Open the Projects tab, select the MathLibrary check box, and then choose the OK button. 3. To reference the MathLibrary.h header file, you must modify the included directories path. In Solution Explorer, right-click on MathClient to open
the shortcut menu. Choose Properties to open the MathClient Property Pages dialog box. 4. In the MathClient Property Pages dialog box, set the Configuration drop-down to All Configurations. Set the Platform drop-down to All Platforms. 5. Select the Configuration Properties > C/C++ > General property page. In the Additional Include Directories
property, specify the path of the MathLibrary directory, or browse for it. To browse for the directory path: a. Open the Additional Include Directories property value drop-down list, and then choose Edit. b. In the Additional Include Directories dialog box, double-click in the top of the text box. Then choose the ellipsis button (...) at the end of the line.
c. In the Select Directory dialog box, navigate up a level, and then select the MathLibrary directory. Then choose the Select Folder button to save your selection. d. In the Additional Include Directories dialog box, choose the OK button. e. In the Property Pages dialog box, choose the OK button to save your changes to the project. 6. You can
now use the Arithmetic class in this app by including the #include "MathLibrary.h" header in your code. Replace the contents of MathClient.cpp with this code: C++7. To build the executable, choose Build > Build Solution on the menu bar. 1. Make sure that MathClient is selected as the default project. To select it, right-click to open the shortcut
menu for MathClient in Solution Explorer, and then choose Set as StartUp Project. 2. To run the project, on the menu bar, choose Debug > Start Without Debugging. The output should resemble: Output // MathClient.cpp // compile with: cl /EHsc MathClient.cpp /link MathLibrary.lib #include #include "MathLibrary.h" int main() { double a =
7.4; int b = 99; std::cout << "a + b = " << MathLibrary::Arithmetic::Add(a, b) << std::endl; std::cout << "a - b = " << MathLibrary::Arithmetic::Subtract(a, b) << std::endl; std::cout << "a * b = " << MathLibrary::Arithmetic::Multiply(a, b) << std::endl; std::cout << "a / b = " << MathLibrary::Arithmetic::Divide(a, b) Git Global
Settings > Automatically load the solution when opening a Git repository. Open a project locally from a previously cloned GitHub repo 1. Open Visual Studio. 2. On the start window, select Open a project or solution. Visual Studio opens an instance of File Explorer, where you can browse to your solution or project, and then select it to open it.
Tip If you opened the project or solution recently, select it from the Open recent section. Start coding! Use the IDE You can also use the Git menu or the Select Repository control in the Visual Studio IDE to interact with a repository's folders and files.Here's how. To clone a repo and open a project 1. In the Visual Studio IDE, select the Git
menu, and then select Clone Repository. 2. Follow the prompts to connect to the Git repository that includes the files that you're looking for. To open local folders and files 1. In the Visual Studio IDE, select the Git menu, select Local Repositories, and then select Open Local Repository. 2. Follow the prompts to connect to the Git repository that
has the files that you're looking for. Browse to an Azure DevOps repo Here's how to browse to and clone an Azure DevOps repo by using Visual Studio. 1. Open Visual Studio. 2. On the start window, select Clone a repository. 3. In the Browse a repository section, select Azure DevOps. 4. Follow the prompts to clone an Azure DevOps repo
that includes the files that you're looking for, and then open your project. Related content Feel free to dive into any of the following language-specific tutorials:Feedback Was this page helpful? Provide product feedback | Ask the community Visual Studio tutorials | C# Visual Studio tutorials | Visual Basic Visual Studio tutorials | C++ Visual
Studio tutorials | Python Visual Studio tutorials | JavaScript, TypeScript, and Node.js For more information, see: About Git in Visual Studio Brpwse a repo Manage a repo Yes NoLearn to use the code editor Article • 01/24/2025 In this 10-minute introduction to the code editor in Visual Studio, we'll add code to a file to look at some of the ways that Visual Studio makes writing, navigating, and understanding code easier. If you haven't already installed Visual Studio, go to the Visual Studio downloads page to install it for free. This article assumes you're already familiar with a programming language. If you aren't, we suggest you look at one of the programming quickstarts first,
such as create a web app with Python or C#, or create a console app with Visual Basic or C++. Tip To follow along with this article, make sure you have the C# settings selected for Visual Studio. For information about selecting settings for the integrated development environment (IDE), see Select environment settings. Create a new code file
Start by creating a new file and adding some code to it. 1. Open Visual Studio. Select the Esc key, or select Continue without code on the start window, to open the development environment. 2. From the File menu on the menu bar, select New > File, or select the Ctrl+N keys. 3. In the New File dialog box, under the General category, select C#
Class, and then select Open. A new file opens in the editor with the skeleton of a C# class.Use GitHub Copilot GitHub Copilot acts as an AI pair programmer to provide autocomplete-style code completions and context-aware multi-line code suggestions, as you code, in real-time, right in the editor. GitHub Copilot turns natural language prompts
including comments and method names into coding suggestions. You can view and incorporate suggestions from GitHub Copilot directly within the editor. Try GitHub Copilot Let's use Copilot to generate code suggestions: 1. Place your cursor just below the final closing brace } in the file. 2. Type a natural language comment: // Add a method to
add two numbers and Enter. 3. GitHub Copilot generates a code suggestion for you. The suggested implementation shows in gray text. 4. To accept the suggestion, select Tab. Let's use Copilot Chat to submit a coding-related question as a prompt: 1. Select the GitHub Copilot badge in the upper-right corner of the IDE. 2. Select Open Chat
Window from the dropdown. 3. Enter the following prompt in the chat window: Copilot prompt Generate sample code for a simple C# method to add two numbers. 4. Copilot Chat generates sample code in response to your prompt. GitHub Copilot is powered by AI, so surprises and mistakes are possible. For more information, see GitHub Copilot
FAQs . Get started with GitHub Copilot in Visual Studio. Note that it requires Visual Studio 2022 version 17.8 or later. Use code snippetsVisual Studio provides useful code snippets that you can use to quickly and easily generate commonly used code blocks. Code snippets are available for different programming languages including C#, Visual
Basic, and C++. Let's add the C# void Main snippet to our file. 1. Place your cursor just above the final closing brace } in the file, and type the characters svm . A pop-up dialog box appears with information about the svm code snippet. 2. Select the Tab key twice to insert the code snippet. You'll see the static void Main() method signature get
added to the file. The Main() method is the entry point for C# applications. Available code snippets vary for different programming languages. You can look at the available code snippets for your language by choosing Edit > IntelliSense > Insert Snippet or by selecting the Ctrl+K, Ctrl+X keys, and then choosing the folder for your programming
language. For C#, the snippet list looks like this:The list includes snippets for creating a class, a constructor, a for loop, an if or switch statement, and more. The Text Editor toolbar, which is the row of buttons under the menu bar in Visual Studio, helps make you more productive as you code. For example, you can toggle IntelliSense completion
mode, increase or decrease a line indent, or comment out code that you don't want to compile. Let's comment out some code. 1. Paste the following code into the Main() method body. C# Comment out code // someWords is a string array. string[] someWords = { "the", "quick", "brown", "fox", "jumps" };2. We're not using the moreWords variable, but we might use it later so we don't want to delete it. Instead, we'll comment out those lines. Select the entire definition of moreWords down to the closing semicolon, and then choose the Comment out the selected lines button on the Text Editor toolbar. If you prefer to use the keyboard, select Ctrl+K, Ctrl+C. The C# comment
characters // are added to the beginning of each selected line to comment out the code. When you want to uncomment lines, you can select them, and then choose the Uncomment the selected lines button on the Text Editor toolbar. If you prefer to use the keyboard, select Ctrl+K, Ctrl+U. We don't want to see the empty constructor that was
generated for Class1 , so to unclutter our view of the code, let's collapse it. Choose the small gray box with the minus sign inside it in the margin of the first line of the constructor. Or, if you prefer to use the keyboard, place the cursor anywhere in the constructor code and select the Ctrl+M, Ctrl+M keys. string[] moreWords = { "over", "the",
"lazy", "dog" }; // Alphabetically sort the words. IEnumerable query = from word in someWords orderby word select word; Collapse code blocksThe code block collapses to just the first line, followed by an ellipsis (...). To expand the code block again, select the same gray box that now has a plus sign in it, or select Ctrl+M, Ctrl+M again.
This feature is called Outlining and is especially useful when you're collapsing long methods or entire classes. View symbol definitions The Visual Studio editor makes it easy to inspect the definition of a type, method, or variable. One way is to go to the definition, in whichever file has it, by choosing Go to Definition or by selecting the F12 key
anywhere a symbol is referenced. An even quicker way that doesn't move your focus away from the code you're working on is to use Peek Definition. Let's peek at the definition of the string type. 1. Right-click on any occurrence of string and choose Peek Definition from the content menu. Or, select the Alt+F12 keys. A pop-up window appears
with the definition of the String class. You can scroll within the pop-up window, or even peek at the definition of another type from the peeked code. 2. Close the peek definition window by choosing the small box with an "x" at the top right of the pop-up window. Use IntelliSense to complete words IntelliSense is an invaluable resource when you're
coding. It can show you information about available members of a type, or parameter details for different overloads of amethod. You can also use IntelliSense to complete a word after you type enough characters to disambiguate it. Let's add a line of code to print out the ordered strings to the console window, which is the standard place for output
from the program to go. 1. Below the query variable, start typing the following code: C# You'll see an IntelliSense pop-up appear with information about the query symbol. 2. To insert the rest of the word query by using IntelliSense word completion, select the Tab key. 3. Finish off the code block to look like the following code. You can practice
further with code snippets by entering cw and then selecting Tab twice to generate the Console.WriteLine statement. C# Nobody gets code right the first time, and one of the things you might have to change is the name of a variable or method. Let's try out Visual Studio's refactor functionality to rename the someWords variable to unsortedWords
. foreach (string str in qu foreach (string str in query) { Console.WriteLine(str); } Refactor a name1. Place your cursor over the definition of the someWords variable, and choose Rename from the right-click or context menu, or select the F2 key. A Rename dialog box appears at the top right of the editor. 2. Enter the desired name unsortedWords. You'll see that the reference to unsortedWords in the query assignment statement is also automatically renamed. Before you select the Enter key, select the Include comments checkbox in the Rename pop-up box. 3. Select the Enter key. Both occurrences of someWords in your code have been renamed, as well as the text
someWords in your code comment. Next steps Learn about projects and solutionsFeedback Was this page helpful? Provide product feedback | Ask the community GitHub Copilot Completions in Visual Studio GitHub Copilot Chat in Visual Studio Code snippets Navigate code Outlining Go To Definition and Peek Definition Refactoring
Use IntelliSense See also Yes NoCompile and build in Visual Studio Article • 02/03/2025 For a first introduction to building within the IDE, see Walkthrough: Building an application. You can use any of the following methods to build an application: the Visual Studio IDE, the MSBuild command-line tools, and Azure Pipelines: Build Method Benefits IDE - Create builds immediately and test them in a debugger. - Run multi-processor builds for C++ and C# projects. - Customize different aspects of the build system. CMake - Build C++ projects using the CMake tool - Use the same build system across Linux and Windows platforms. MSBuild command line - Build projects without installing Visual Studio. - Run multi-processor builds for all project types. - Customize most areas of the build system. Azure Pipelines - Automate your build process as part of a continuous integration/continuous delivery pipeline. - Apply automated tests with every build. - Employ virtually unlimited cloud-based resources for
build processes. - Modify the build workflow and create build activities to perform deeply customized tasks. The documentation in this section goes into further details of the IDE-based build process. For more information on the other methods, see CMake, MSBuild and Azure Pipelines, respectively. When you create a project, Visual Studio
created default build configurations for the project and the solution that contains the project. These configurations define how the solutions and projects are built and deployed. Project configurations in particular are unique for a target platform (such as Windows or Linux) and build type (such as debug or release). You can edit these configurations
however you like, and can also create your own configurations as needed. / Expand table Building from the IDEFeedback Was this page helpful? Provide product feedback | Ask the community For a first introduction to building within the IDE, see Walkthrough: Building an application. Next, see Building and cleaning projects and solutions in
Visual Studio to learn about the different customizations you can make to the process. Customizations include changing output directories, specifying custom build events, managing project dependencies, managing build log files, and suppressing compiler warnings. From there, you can explore a variety of other tasks: Understand build
configurations Configure projects to target platforms Manage project and solution properties. Specify build events in C# and Visual Basic Set build options Build multiple projects in parallel Building (compiling) website projects CMake projects in Visual Studio Related content Yes NoQuickstart: Debug with C++ using the Visual Studio debugger Article • 01/12/2024 The Visual Studio debugger provides many powerful features to help you debug your apps. This topic provides a quick way to learn some of the basic features. 1. Open Visual Studio and create a project. Press Esc to close the start window. Type Ctrl + Q to open the search box, type c++, choose Templates,
then choose Create new Console App project. In the dialog box that appears, choose Create. If you don't see the Windows Console Application project template, go to Tools > Get Tools and Features..., which opens the Visual Studio Installer. The Visual Studio Installer launches. Choose the Desktop development with C++ workload, then choose
Modify. Visual Studio creates the project. 2. In MyDbgApp.cpp, replace the following code C++ with this code (do not remove #include "stdafx.h"): C++ Create a new project int main() { return 0; } #include #include using namespace std; void doWork() { int c1;A breakpoint is a marker that indicates where Visual Studio should
suspend your running code so you can take a look at the values of variables, or the behavior of memory, or whether or not a branch of code is getting run. It is the most basic feature in debugging. 1. To set the breakpoint, click in the gutter to the left of the doWork function call (or select the line of code and press F9). 2. Now press F5 (or choose
Debug > Start Debugging). The debugger pauses where you set the breakpoint. The statement where the debugger and app execution is paused is indicated by the yellow arrow. The line with the doWork function call has not yet executed. c1.push_back(10); c1.push_back(20); const list c2 = c1; const int &i = c2.front(); const int &j = c2.front(); cout << "The first element is " << i << endl; cout << "The second element is " << j New Project on the shortcut menu to add the project template. It also has options you can configure by using Tools >
Options. For more information, see How to: Use Google Test in Visual Studio. Boost.Test is included as a default component of the Desktop development with C++ workload. It's integrated with Test Explorer, but currently doesn'thave a project template. You must manually configure it. For more information, see How to: Use Boost.Test in Visual
Studio. CTest support is included with the C++ CMake tools component, which is part of the Desktop development with C++ workload. For more information, see How to: Use CTest in Visual Studio. Earlier versions of Visual Studio You can download the Google Test adapter and Boost.Test Adapter extensions on the Visual Studio Marketplace.
Find them at Test adapter for Boost.Test and Test adapter for Google Test . Tip You can also use Copilot /tests slash command to generate unit tests from code. For example, you can type /tests using Boost framework to generate Boost.Test tests. For more information, see Use slash commands in Copilot Chat. Basic test workflow The
following sections show the basic steps to get you started with C++ unit testing. The basic configuration is similar for both the Microsoft and Google Test frameworks. Boost.Test requires that you manually create a test project. Create a test project in Visual Studio 2022 Define and run unit tests inside one or more test projects. A test project creates a
separate app that calls the code in your executable and reports on its behavior. Create test projects in the same solution as the code you want to test. To add a new test project to an existing solution: 1. Right-click on the Solution node in Solution Explorer. 2. In the context menu, choose Add > New Project. 3. Set Language to C++ and type test
in the search box. The following screenshot shows the test projects that are available when the Desktop Development with C++ and the UWP Development workload are installed:Create references to other projects in the solution To enable access to the functions in the project under test, add a reference to the project in your test project. In Solution
Explorer, expand your test project. Right-click References and then select Add > Reference. In the Add Reference dialog box, choose the projects you want to test.Link to object or library files If the test code doesn't export the functions that you want to test, add the output .obj or .lib files to the dependencies of the test project. For more information,
see To link the tests to the object or library files. Don't include object files that have a main function or another standard entry point such as wmain , WinMain , or DllMain . When you add new source files to your project, update the test project dependencies to include the corresponding object files. Add #include directives for header files In your
unit test .cpp file, add an #include directive for any header files that declare the types and functions you want to test. Type #include " , and then IntelliSense activates to help you choose. Repeat for any more headers. Tip To avoid having to type the full path in each include statement in the source file, add the required folders in Project > Properties
> C/C++ > General > Additional Include Directories. Write test methods 7 Note This section shows syntax for the Microsoft Unit Testing Framework for C/C++. For more information, see Microsoft.VisualStudio.TestTools.CppUnitTestFramework API reference. For Google Test documentation, see Google Test primer . For Boost.Test, see Boost
Test library: The unit test framework . The .cpp file in your test project has a stub class and method defined for you. They show an example of how to write test code. The signatures use the TEST_CLASS and TEST_METHOD macros, which make the methods discoverable from the Test Explorer window.TEST_CLASS and TEST_METHOD are part
of the Microsoft Native Test Framework. Test Explorer discovers test methods in other supported frameworks in a similar way. A TEST_METHOD returns void. To produce a test result, use the static methods in the Assert class to test actual results against expected results. In the following example, assume MyClass has a constructor that takes a
std::string . This example shows how you can test that the constructor initializes the class the way you expect: C++ In the previous example, the result of the Assert::AreEqual call determines whether the test passes or fails. The Assert class contains many other methods to compare expected results with actual results. You can add traits to test
methods to specify test owners, priority, and other information. You can then use these values to sort and group tests in Test Explorer. For more information, see Run unit tests with Test Explorer. 1. On the Test menu, choose Test Explorer. The following illustration shows a test project before you run tests. TEST_METHOD(TestClassInit) {
std::string name = "Bill"; MyClass mc(name); Assert::AreEqual(name, mc.GetName()); } Run the tests7 Note CTest integration with Test Explorer is not yet available. Run CTest tests from the CMake main menu. 2. If any of your tests are missing from the window, build the test project by right clicking its node in Solution Explorer and
choosing Build or Rebuild. 3. In Test Explorer, choose Run All, or select the specific tests you want to run. Right click on a test for other options, including running it in debug mode with breakpoints enabled. After all the tests run, the window shows the tests that passed and the ones that failed. For failed tests, the message displays details that help
to diagnose the cause. Right-click on the failing test for a pop-up menu. Choose Debug to step through the function where the failure occurred.For more information on using Test Explorer, see Run unit tests with Test Explorer. For more information on unit testing, see Unit test basics. Use CodeLens Visual Studio 2017 and later (Professional and
Enterprise editions) CodeLens lets you quickly see the status of a unit test without leaving the code editor. Initialize CodeLens for a C++ unit test project in any of the following ways: Edit and build your test project or solution. Rebuild your project or solution. Run tests from the Test Explorer window. After you initialize CodeLens, you can see the
test status icons above each unit test. Choose the icon for more information, or to run or debug the unit test:Feedback Was this page helpful? Provide product feedback | Ask the community Unit test your code Related content Yes NoWalkthrough: Compiling a Native C++ Program on the Command Line Article • 02/08/2022
Visual Studio includes a command-line C and C++ compiler. You can use it to create everything from basic console apps to Universal Windows Platform apps, Desktop apps, device drivers, and .NET components. In this walkthrough, you create a basic, "Hello, World"-style C++ program by using a text editor, and then compile it on the command
line. If you'd like to try the Visual Studio IDE instead of using the command line, see Walkthrough: Working with Projects and Solutions (C++) or Using the Visual Studio IDE for C++ Desktop Development. In this walkthrough, you can use your own C++ program instead of typing the one that's shown. Or, you can use a C++ code sample from another
help article. Prerequisites To complete this walkthrough, you must have installed either Visual Studio and the optional Desktop development with C++ workload, or the command-line Build Tools for Visual Studio. Visual Studio is an integrated development environment (IDE). It supports a full-featured editor, resource managers, debuggers, and
compilers for many languages and platforms. Versions available include the free Visual Studio Community edition, and all can support C and C++ development. For information on how to download and install Visual Studio, see Install C++ support in Visual Studio. The Build Tools for Visual Studio installs only the command-line compilers, tools, and
libraries you need to build C and C++ programs. It's perfect for build labs or classroom exercises and installs relatively quickly. To install only the command-line tools, look for Build Tools for Visual Studio on the Visual Studio Downloads page. Before you can build a C or C++ program on the command line, verify that the tools are installed, and you
can access them from the command line. Visual C++ has complex requirements for the command-line environment to find the tools, headers, and libraries it uses. You can't use Visual C++ in a plain command prompt window without doing some preparation. Fortunately, Visual C++ installs shortcuts for you to launch a developer command prompt
that has the environment set up for command line builds. Unfortunately, the names of the developer command prompt shortcuts and wherethey're located are different in almost every version of Visual C++ and on different versions of Windows. Your first walkthrough task is finding the right one to use. 7 Note A developer command prompt shortcut
automatically sets the correct paths for the compiler and tools, and for any required headers and libraries. You must set these environment values yourself if you use a regular Command Prompt window. For more information, see Use the MSVC toolset from the command line. We recommend you use a developer command prompt shortcut instead
of building your own. Open a developer command prompt 1. If you have installed Visual Studio 2017 or later on Windows 10 or later, open the Start menu and choose All apps. Scroll down and open the Visual Studio folder (not the Visual Studio application). Choose Developer Command Prompt for VS to open the command prompt window. If
you have installed Microsoft Visual C++ Build Tools 2015 on Windows 10 or later, open the Start menu and choose All apps. Scroll down and open the Visual C++ Build Tools folder. Choose Visual C++ 2015 x86 Native Tools Command Prompt to open the command prompt window. You can also use the Windows search function to search for
"developer command prompt" and choose one that matches your installed version of Visual Studio. Use the shortcut to open the command prompt window. 2. Next, verify that the Visual C++ developer command prompt is set up correctly. In the command prompt window, enter cl and verify that the output looks something like this: Output C:
\Program Files (x86)\Microsoft Visual Studio\2017\Enterprise>cl Microsoft (R) C/C++ Optimizing Compiler Version 19.10.25017 for x86 Copyright (C) Microsoft Corporation. All rights reserved. usage: cl [option...] filename... [/link linkoption...] There may be differences in the current directory or version numbers. These values depend on the
version of Visual C++ and any updates installed. If the aboveoutput is similar to what you see, then you're ready to build C or C++ programs at the command line. 7 Note If you get an error such as "'cl' is not recognized as an internal or external command, operable program or batch file," error C1034, or error LNK1104 when you run the cl
command, then either you are not using a developer command prompt, or something is wrong with your installation of Visual C++. You must fix this issue before you can continue. If you can't find the developer command prompt shortcut, or if you get an error message when you enter cl , then your Visual C++ installation may have a problem. Try
reinstalling the Visual C++ component in Visual Studio, or reinstall the Microsoft Visual C++ Build Tools. Don't go on to the next section until the cl command works. For more information about installing and troubleshooting Visual C++, see Install Visual Studio. 7 Note Depending on the version of Windows on the computer and the system
security configuration, you might have to right-click to open the shortcut menu for the developer command prompt shortcut and then choose Run as administrator to successfully build and run the program that you create by following this walkthrough. Create a Visual C++ source file and compile it on the command line 1. In the developer
command prompt window, enter md c:\hello to create a directory, and then enter cd c:\hello to change to that directory. This directory is where both your source file and the compiled program get created. 2. Enter notepad hello.cpp in the command prompt window. Choose Yes when Notepad prompts you to create a new file. This step opens a
blank Notepad window, ready for you to enter your code in a file named hello.cpp. 3. In Notepad, enter the following lines of code:C++ This code is a simple program that will write one line of text on the screen and then exit. To minimize errors, copy this code and paste it into Notepad. 4. Save your work! In Notepad, on the File menu, choose Save.
Congratulations, you've created a C++ source file, hello.cpp, that is ready to compile. 5. Switch back to the developer command prompt window. Enter dir at the command prompt to list the contents of the c:\hello directory. You should see the source file hello.cpp in the directory listing, which looks something like: Output The dates and other
details will differ on your computer. #include using namespace std; int main() { cout << "Hello, world, from Visual C++!" Save As. In the Save As dialog, navigate to your C:\hello folder in the directory tree view control. Then use the Save as type dropdown control to select All Files (*.*). Enter hello.cpp in the File name edit control, and then choose Save to save the file.
6. At the developer command prompt, enter cl /EHsc hello.cpp to compile your program. The cl.exe compiler generates an .obj file that contains the compiled code, and then runs the linker to create an executable program named hello.exe. This name appears in the lines of output information that the compiler displays. The output of the compiler

should look something like: Output c:\hello>cl /EHsc hello.cpp Microsoft (R) C/C++ Optimizing Compiler Version 19.10.25017 for x86 Copyright (C) Microsoft Corporation. All rights reserved. hello.cpp Microsoft (R) Incremental Linker Version 14.10.25017.0 Copyright (C) Microsoft Corporation. All rights reserved. /out:hello.exe hello.obj 7
Note If you get an error such as "'cl' is not recognized as an internal or external command, operable program or batch file," error C1034, or error LNK1104, your developer command prompt is not set up correctly. For information on how to fix this issue, go back to the Open a developer command prompt section. 7 Note If you get a different
compiler or linker error or warning, review your source code to correct any errors, then save it and run the compiler again. Forinformation about specific errors, use the search box to look for the error number. 7. To run the hello.exe program, at the command prompt, enter hello . The program displays this text and exits: Output Hello, world, from
Visual C++! Congratulations, you've compiled and run a C++ program by using the command line tools. Next steps This "Hello, World" example is about as simple as a C++ program can get. Real world programs usually have header files, more source files, and link to libraries. You can use the steps in this walkthrough to build your own C++
code instead of typing the sample code shown. These steps also let you build many C++ code sample programs that you find elsewhere. You can put your source code and build your apps in any writeable directory. By default, the Visual Studio IDE creates projects in your user folder, in a source\repos subfolder. Older versions may put projects in a
Documents\Visual Studio \Projects folder. To compile a program that has additional source code files, enter them all on the command line, like: cl /EHsc file1.cpp file2.cpp file3.cpp The /EHsc command-line option instructs the compiler to enable standard C++ exception handling behavior. Without it, thrown exceptions can result in undestroyed
objects and resource leaks. For more information, see /EH (Exception Handling Model). When you supply additional source files, the compiler uses the first input file to create the program name. In this case, it outputs a program called file1.exe. To change the name to program1.exe, add an /out linker option: cl /EHsc file1.cpp file2.cpp file3.cpp /
link /out:program1.exe And to catch more programming mistakes automatically, we recommend you compile by using either the /W3 or /W4 warning level option:cl /W4 /EHsc file1.cpp file2.cpp file3.cpp /link /out:program1.exe The compiler, cl.exe, has many more options. You can apply them to build, optimize, debug, and analyze your code. For a
quick list, enter cl /? at the developer command prompt. You can also compile and link separately and apply linker options in more complex build scenarios. For more information on compiler and linker options and usage, see C/C++ Building Reference. You can use NMAKE and makefiles, MSBuild and project files, or CMake, to configure and build
more complex projects on the command line. For more information on using these tools, see NMAKE Reference, MSBuild, and CMake projects in Visual Studio. The C and C++ languages are similar, but not the same. The MSVC compiler uses a simple rule to determine which language to use when it compiles your code. By default, the MSVC
compiler treats files that end in .c as C source code, and files that end in .cpp as C++ source code. To force the compiler to treat all files as C++ independent of file name extension, use the /TP compiler option. The MSVC compiler includes a C Runtime Library (CRT) that conforms to the ISO C99 standard, with minor exceptions. Portable code
generally compiles and runs as expected. Certain obsolete library functions, and several POSIX function names, are deprecated by the MSVC compiler. The functions are supported, but the preferred names have changed. For more information, see Security Features in the CRT and Compiler Warning (level 3) C4996. See also C++ Language
Reference Projects and build systems MSVC Compiler OptionsWalkthrough: Compile a C program on the command line Article • 05/10/2022 The Visual Studio build tools include a C compiler that you can use to create everything from basic console programs to full Windows Desktop applications, mobile apps, and more. Microsoft C/C++
(MSVC) is a C and C++ compiler that, in its latest versions, conforms to some of the latest C language standards, including C11 and C17. This walkthrough shows how to create a basic, "Hello, World"-style C program by using a text editor, and then compile it on the command line. If you'd rather work in C++ on the command line, see Walkthrough:
Compiling a Native C++ Program on the Command Line. If you'd like to try the Visual Studio IDE instead of using the command line, see Walkthrough: Working with Projects and Solutions (C++) or Using the Visual Studio IDE for C++ Desktop Development. Prerequisites To complete this walkthrough, you must have installed either Visual Studio or
the Build Tools for Visual Studio and the optional Desktop development with C++ workload. Visual Studio is a powerful integrated development environment that supports a full featured editor, resource managers, debuggers, and compilers for many languages and platforms. For information on these features and how to download and install Visual
Studio, including the free Visual Studio Community edition, see Install Visual Studio. The Build Tools for Visual Studio version of Visual Studio installs only the command-line toolset, the compilers, tools, and libraries you need to build C and C++ programs. It's perfect for build labs or classroom exercises and installs relatively quickly. To install only
the command-line toolset, download Build Tools for Visual Studio from the Visual Studio downloads page and run the installer. In the Visual Studio installer, select the Desktop development with C++ workload (in older versions of Visual Studio, select the C++ build tools workload), and choose Install. When you've installed the tools, there's another
tool you'll use to build a C or C++ program on the command line. MSVC has complex requirements for the command-line environment to find the tools, headers, and libraries it uses. You can't use MSVC in a plain command prompt window without some preparation. You need a developer command prompt window, which is a regular command
prompt window that has all the required environment variables set. Fortunately, Visual Studio installs shortcuts for youto launch developer command prompts that have the environment set up for command line builds. Unfortunately, the names of the developer command prompt shortcuts and where they're located are different in almost every version
of Visual Studio and on different versions of Windows. Your first walkthrough task is to find the right shortcut to use. 7 Note A developer command prompt shortcut automatically sets the correct paths for the compiler and tools, and for any required headers and libraries. Some of these values are different for each build configuration. You must
set these environment values yourself if you don't use one of the shortcuts. For more information, see Use the MSVC toolset from the command line. Because the build environment is complex, we strongly recommend you use a developer command prompt shortcut instead of building your own. These instructions vary depending on which version
of Visual Studio you're using. To see the documentation for your preferred version of Visual Studio, use the Version selector control. It's found at the top of the table of contents on this page. Open a developer command prompt in Visual Studio 2022 If you've installed Visual Studio 2022 on Windows 10 or later, open the Start menu, and choose
All apps. Then, scroll down and open the Visual Studio 2022 folder (not the Visual Studio 2022 app). Choose Developer Command Prompt for VS 2022 to open the command prompt window. If you're using a different version of Windows, look in your Start menu or Start page for a Visual Studio tools folder that contains a developer command prompt
shortcut. You can also use the Windows search function to search for "developer command prompt" and choose one that matches your installed version of Visual Studio. Use the shortcut to open the command prompt window. Next, verify that the developer command prompt is set up correctly. In the command prompt window, enter cl (or CL , case
doesn't matter for the compiler name, but it does matter for compiler options). The output should look something like this: OutputC:\Program Files (x86)\Microsoft Visual Studio\2017\Enterprise>cl Microsoft (R) C/C++ Optimizing Compiler Version 19.10.25017 for x86 Copyright (C) Microsoft Corporation. All rights reserved. usage: cl [option...] [
filename... [/link linkoption...] There may be differences in the current directory or version numbers, depending on the version of Visual Studio and any updates installed. If the above output is similar to what you see, then you're ready to build C or C++ programs at the command line. 7 Note If you get an error such as "'cl' is not recognized as an
internal or external command, operable program or batch file," error C1034, or error LNK1104 when you run the cl command, then either you are not using a developer command prompt, or something is wrong with your installation of Visual Studio. You must fix this issue before you can continue. If you can't find the developer command prompt
shortcut, or if you get an error message when you enter cl , then your Visual Studio installation may have a problem. If you're using Visual Studio 2017 or later, try reinstalling the Desktop development with C++ workload in the Visual Studio installer. For details, see Install C++ support in Visual Studio. Or, reinstall the Build Tools from the Visual
Studio downloads page. Don't go on to the next section until the cl command works. For more information about installing and troubleshooting Visual Studio, see Install Visual Studio. 7 Note Depending on the version of Windows on the computer and the system security configuration, you might have to right-click to open the shortcut menu for the
developer command prompt shortcut and then choose Run as Administrator to successfully build and run the program that you create by following this walkthrough. Create a C source file and compile it on the command line 1. In the developer command prompt window, enter cd c:\ to change the current working directory to the root of your C:
drive. Next, enter md c:\hello to create adirectory, and then enter cd c:\hello to change to that directory. This directory will hold your source file and the compiled program. 2. Enter notepad hello.c at the developer command prompt. In the Notepad alert dialog that pops up, choose Yes to create a new hello.c file in your working directory. 3. In
Notepad, enter the following lines of code: C 4. On the Notepad menu bar, choose File > Save to save hello.c in your working directory. 5. Switch back to the developer command prompt window. Enter dir at the command prompt to list the contents of the c:\hello directory. You should see the source file hello.c in the directory listing, which looks
something like: Output The dates and other details will differ on your computer. If you don't see your source code file, hello.c , make sure you've changed to the c:\hello directory you created, and in Notepad, make sure that you saved your source file in this #include int main() { printf("Hello, World! This is a native C program compiled on the
command line.\n"); return 0; } C:\hello>dir Volume in drive C has no label. Volume Serial Number is CC62-6545 Directory of C:\hello 10/02/2017 03:46 PM . 10/02/2017 03:46 PM .. 10/02/2017 03:36 PM 143 hello.c 1 File(s) 143 bytes 2 Dir(s) 514,900,566,016 bytes freedirectory. Also make sure that you saved the source code with a .c file name extension, not a .txt extension. 6. To compile your program, enter cl hello.c at the developer command prompt. You can see the executable program name, hello.exe, in the lines of output information that the compiler displays: Output c:\hello>cl hello.c Microsoft (R) C/C++ Optimizing Compiler Version 19.10.25017 for x86 Copyright
(C) Microsoft Corporation. All rights reserved. hello.c Microsoft (R) Incremental Linker Version 14.10.25017.0 Copyright (C) Microsoft Corporation. All rights reserved. /out:hello.exe hello.obj 7 Note If you get an error such as "'cl' is not recognized as an internal or external command, operable program or batch file," error C1034, or error
LNK1104, your developer command prompt is not set up correctly. For information on how to fix this issue, go back to the Open a developer command prompt section. If you get a different compiler or linker error or warning, review your source code to correct any errors, then save it and run the compiler again. For information about specific
errors, use the search box at the top of this page to look for the error number. 7. To run your program, enter hello at the command prompt. The program displays this text and then exits: Output Hello, World! This is a native C program compiled on the command line. Congratulations, you've compiled and run a C program by using the command
line.Next steps This "Hello, World" example is about as basic as a C program can get. Real world programs have header files and more source files, link in libraries, and do useful work. You can use the steps in this walkthrough to build your own C code instead of typing the sample code shown. You can also build many C code sample programs
that you find elsewhere. To compile a program that has more source code files, enter them all on the command line: cl file1.c file2.c file3.c The compiler outputs a program called file1.exe . To change the name to program1.exe , add an /out linker option: cl file1.c file2.c file3.c /link /out:program1.exe And to catch more programming mistakes
automatically, we recommend you compile by using either the /W3 or /W4 warning level option: cl /W4 file1.c file2.c file3.c /link /out:program1.exe The compiler, cl.exe, has many more options you can apply to build, optimize, debug, and analyze your code. For a quick list, enter cl /? at the developer command prompt. You can also compile and link
separately and apply linker options in more complex build scenarios. For more information on compiler and linker options and usage, see C/C++ Building Reference. You can use NMAKE and makefiles, or MSBuild and project files to configure and build more complex projects on the command line. For more information on using these tools, see
NMAKE Reference and MSBuild. The C and C++ languages are similar, but not the same. The Microsoft C/C++ compiler (MSVC) uses a basic rule to determine which language to use when it compiles your code. By default, the MSVC compiler treats all files that end in .c as C source code, and all files that end in .cpp as C++ source code. To force
the compiler to treat all files as C no matter the file name extension, use the /TC compiler option. By default, MSVC is compatible with the ANSI C89 and ISO C99 standards, but not strictly conforming. In most cases, portable C code will compile and run as expected. The compiler provides optional support for the changes in ISO C11/C17. To
compile with C11/C17 support, use the compiler flag /std:c11 or /std:c17 . C11/C17 support requires Windows SDK 10.0.20201.0 or later. Windows SDK 10.0.22000.0 or later isrecommended. You can download the latest SDK from the Windows SDK page. For more information, and instructions on how to install and use this SDK for C development,
see Install C11 and C17 support in Visual Studio. Certain library functions and POSIX function names are deprecated by MSVC. The functions are supported, but the preferred names have changed. For more information, see Security Features in the CRT and Compiler Warning (level 3) C4996. See also Walkthrough: Creating a Standard C++
Program (C++) C Language Reference Projects and build systems CompatibilityWalkthrough: Compiling a C++/CX Program on the Command Line Article • 03/01/2023 7 Note For new UWP apps and components, we recommend that you use C++/WinRT, a standard C++17 language projection for Windows Runtime APIs. C++/WinRT is
available in the Windows SDK from version 1803 (10.0.17134.0) onward. C++/WinRT is implemented entirely in header files, and is designed to provide you with first-class access to the modern Windows API. The Microsoft C++ compiler (MSVC) supports C++ component extensions (C++/CX), which has additional types and operators to target the
Windows Runtime programming model. You can use C++/CX to build apps for Universal Windows Platform (UWP), and Windows desktop. For more information, see A Tour of C++/CX and Component Extensions for Runtime Platforms. In this walkthrough, you use a text editor to create a basic C++/CX program, and then compile it on the
command line. (You can use your own C++/CX program instead of typing the one that's shown, or you can use a C++/CX code sample from another help article. This technique is useful for building and testing small modules that have no UI elements.) 7 Note You can also use the Visual Studio IDE to compile C++/CX programs. Because the
IDE includes design, debugging, emulation, and deployment support that isn't available on the command line, we recommend that you use the IDE to build Universal Windows Platform (UWP) apps. For more information, see Create a UWP app in C++. Prerequisites You understand the fundamentals of the C++ language. Compiling a C++/CX
ProgramTo enable compilation for C++/CX, you must use the /ZW compiler option. The MSVC compiler generates an .exe file that targets the Windows Runtime, and links to the required libraries. To compile a C++/CX application on the command line 1. Open a Developer Command Prompt window. For specific instructions, see To open a
developer command prompt window. Administrator credentials may be required to successfully compile the code, depending on the computer's operating system and configuration. To run the command prompt window as an administrator, right-click to open the shortcut menu for the command prompt and then choose More > Run as administrator.
2. Change the current working directory in the command prompt window to a directory you can write to, such as your Documents directory. 3. At the command prompt, enter notepad basiccx.cpp. Choose Yes when you're prompted to create a file. 4. In Notepad, enter these lines: C++ using namespace Platform; int main(Platform::Array^ args)
{ Platform::Details::Console::WriteLine("This is a C++/CX program."); } 5. On the menu bar, choose File > Save. You've created a C++ source file that uses the Windows Runtime Platform namespace namespace. 6. At the command prompt, enter cl /EHsc /ZW basiccx.cpp /link /SUBSYSTEM:CONSOLE . The cl.exe compiler compiles the
Request an intellectual property (IP) licence | Metropolitan Police https://www.met.police.uk/rqo/request/ipl/request-intellectual-property...
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source code into an .obj file, and then runs the linker to generate an executable program named basiccx.exe. The /EHsc compiler option specifies the C++ exception-handling model, and the /link flag specifies a console application. 7. To run the basiccx.exe program, at the command prompt, enter basiccx.The program displays this text and exits:
Output This is a C++/CX program. See also Projects and build systems MSVC Compiler OptionsWalkthrough: Compiling a C++/CLI Program on the Command Line Article • 02/24/2023 You can create Visual C++ programs that target the Common Language Runtime (CLR) and use the .NET Framework, and build them on the command
line. Visual C++ supports the C++/CLI programming language, which has additional types and operators to target the .NET programming model. For general information about the C++/CLI language, see .NET Programming with C++/CLI (Visual C++). In this walkthrough, you use a text editor to create a basic C++/CLI program, and then compile it
on the command line. (You can use your own C++/CLI program instead of typing the one that's shown, or you can use a C++/CLI code sample from another help article. This technique is useful for building and testing small modules that have no UI elements.) Prerequisites You understand the fundamentals of the C++ language. Compiling a C+
+/CLI Program The following steps show how to compile a C++/CLI console application that uses .NET Framework classes. To enable compilation for C++/CLI, you must use the /clr compiler option. The MSVC compiler generates an .exe file that contains MSIL code—or mixed MSIL and native code —and links to the required .NET Framework
libraries. To compile a C++/CLI application on the command line 1. Open a Developer Command Prompt window. For specific instructions, see To open a developer command prompt window. Administrator credentials may be required to successfully compile the code, depending on the computer's operating system and configuration. To run the
command prompt window as an administrator, right-click to open the shortcut menu for the command prompt and then choose More > Run as administrator.2. Change the current working directory in the command prompt window to a directory you can write to, such as your Documents directory. 3. At the command prompt, enter notepad basicclr.cpp
. Choose Yes when you're prompted to create a file. 4. In Notepad, enter these lines: C++ int main() { System::Console::WriteLine("This is a C++/CLI program."); } 5. On the menu bar, choose File > Save. You've created a Visual C++ source file that uses a .NET Framework class (Console) in the System namespace. 6. At the command
prompt, enter cl /clr basicclr.cpp . The cl.exe compiler compiles the source code into an .obj file that contains MSIL, and then runs the linker to generate an executable program named basicclr.exe. 7. To run the basicclr.exe program, at the command prompt, enter basicclr . The program displays this text and exits: Output This is a C++/CLI
program. See also C++ Language Reference Projects and build systems MSVC Compiler Options 2. C++ Standard Library reference (STL) Article 08/17/2022 A C++ program can call on a large number of functions from this conforming implementation of the C++ Standard Library. These functions perform services such as input and output
and provide efficient implementations of frequently used operations. For more information about linking with the appropriate Visual C++ runtime .lib file, see C runtime (CRT) and C++ Standard Library (STL) .lib files. Note Microsoft's implementation of the C++ Standard Library is often referred to as the STL or Standard Template Library. Although C++
Standard Library is the official name of the library as defined in ISO 14882, due to the popular use of "STL" and "Standard Template Library" in search engines, we occasionally use those names to make it easier to find our documentation. From a historical perspective, "STL" originally referred to the Standard Template Library written by Alexander
Stepanov. Parts of that library were standardized in the C++ Standard Library, along with the ISO C runtime library, parts of the Boost library, and other functionality. Sometimes "STL" is used to refer to the containers and algorithms parts of the C++ Standard Library adapted from Stepanov's STL. In this documentation, Standard Template Library (STL)
refers to the C++ Standard Library as a whole. In this section C++ Standard Library overview Provides an overview of the Microsoft implementation of the C++ Standard Library. iostream programming Provides an overview of iostream programming. Header files reference Provides links to reference topics about the C++ Standard Library header files, with
code examples. Use the Microsoft C++ toolset from the command line Article 03/02/2023 In this article 1.Download and install the tools 2.How to use the command-line tools 3.Path and environment variables for command-line builds 4.Developer command prompt shortcuts You can build C and C++ applications on the command line by using tools
that are included in Visual Studio. The Microsoft C++ (MSVC) compiler toolset is also downloadable as a standalone package. You don't need to install the Visual Studio IDE if you don't plan to use it. Note This article is about how to set up an environment to use the individual compilers, linkers, librarian, and other basic tools. The native project build system
in Visual Studio, based on MSBuild, doesn't use the environment as described in this article. For more information on how to use MSBuild from the command line, see MSBuild on the command line - C++. Download and install the tools If you've installed Visual Studio and a C++ workload, you have all the command-line tools. For information on how to
install C++ and Visual Studio, see Install C++ support in Visual Studio. If you only want the command-line toolset, download the Build Tools for Visual Studio. When you run the downloaded executable, it updates and runs the Visual Studio Installer. To install only the tools you need for C++ development, select the Desktop development with C++ workload.
You can select optional libraries and toolsets to include under Installation details. To build code by using the Visual Studio 2015, 2017, or 2019 toolsets, select the optional MSVC v140, v141, or v142 build tools. When you're satisfied with your selections, choose Install. How to use the command-line tools When you choose one of the C++ workloads in the
Visual Studio Installer, it installs the Visual Studio platform toolset. A platform toolset has all the C and C++ tools for a specific Visual Studio version. The tools include the C/C++ compilers, linkers, assemblers, and other build tools, and matching libraries and header files. You can use all of these tools at the command line. They're also used internally by the
Visual Studio IDE. There are separate x86-hosted and x64-hosted compilers and tools to build code for x86, x64, ARM, and ARM64 targets. Each set of tools for a particular host and target build architecture is stored in its own directory. To work correctly, the tools require several specific environment variables to be set. These variables are used to add the
tools to the path, and to set the locations of include files, library files, and SDKs. To make it easy to set these environment variables, the installer creates customized command files, or batch files, during installation. You can run one of these command files to set a specific host and target build architecture, Windows SDK version, and platform toolset. For
convenience, the installer also creates shortcuts in your Start menu. The shortcuts open developer command prompt windows by using these command files for specific combinations of host and target. These shortcuts ensure all the required environment variables are set and ready to use. The required environment variables are specific to your installation
and to the build architecture you choose. They also might be changed by product updates or upgrades. This variability is one reason why we recommend you use an installed command prompt shortcut or command file, instead of setting the environment variables yourself. The toolsets, command files, and shortcuts installed depend on your computer
processor and the options you selected during installation. The x86-hosted tools and cross tools that build x86 and x64 code are always installed. If you have 64-bit Windows, the x64-hosted tools and cross tools that build x86 and x64 code are also installed. If you choose the optional C++ Universal Windows Platform tools, then the x86 and x64 tools that
build ARM and ARM64 code also get installed. Other workloads may install these and other tools. Path and environment variables for command-line builds The MSVC command-line tools use the PATH, TMP, INCLUDE, LIB, and LIBPATH environment variables, and also use other environment variables specific to your installed tools, platforms, and SDKs.
Even a simple Visual Studio installation may set twenty or more environment variables. This complexity is why we strongly recommend that you use a developer command prompt shortcut or one of the customized command files. We don't recommend you set these variables in the Windows environment yourself. To see which environment variables are set
by a developer command prompt shortcut, you can use the SET command. Open a plain command prompt window and capture the output of the SET command for a baseline. Open a developer command prompt window and capture the output of the SET command for comparison. Use a diff tool such as the one built into Visual Studio to highlight the
environment variables set by the developer command prompt. For more information about the compiler and linker environment variables, see CL environment variables. Developer command prompt shortcuts The command prompt shortcuts are installed in a version-specific Visual Studio folder in your Windows Start menu. Here's a list of the base
command prompt shortcuts and the build architectures they support: Developer Command Prompt - Sets the environment to use 32-bit, x86-native tools to build 32-bit, x86-native code. x86 Native Tools Command Prompt - Sets the environment to use 32-bit, x86-native tools to build 32-bit, x86-native code. x64 Native Tools Command Prompt - Sets
the environment to use 64-bit, x64-native tools to build 64-bit, x64-native code. x86_x64 Cross Tools Command Prompt - Sets the environment to use 32-bit, x86-native tools to build 64-bit, x64-native code. x64_x86 Cross Tools Command Prompt - Sets the environment to use 64-bit, x64-native tools to build 32-bit, x86-native code. The Start menu
folder and shortcut names vary depending on the installed version of Visual Studio. If you set one, they also depend on the installation Nickname. For example, suppose you installed Visual Studio 2022, and you gave it a nickname of Latest. The developer command prompt shortcut is named Developer Command Prompt for VS 2022 (Latest), in a folder
named Visual Studio 2022. Note Several command-line tools or tool options may require Administrator permission. If you have permission issues when you use them, we recommend that you open the developer command prompt window by using the Run as Administrator option. Right-click to open the shortcut menu for the command prompt window, then
choose More, Run as administrator. To open a developer command prompt window 1.On the desktop, open the Windows Start menu. In Windows 11, choose the All apps button to open the list of installed apps. In Windows 10, the list is open to the left. Scroll down the list to find and open the folder (not the app) for your version of Visual Studio, for
example, Visual Studio 2022. 2.In the folder, choose the Developer Command Prompt for your version of Visual Studio. This shortcut starts a developer command prompt window that uses the default build architecture of 32-bit, x86-native tools to build 32-bit, x86-native code. If you prefer a non-default build architecture, choose one

of the native or cross
tools command prompts to specify the host and target architecture. For an even faster way to open a developer command prompt, enter developer command prompt in the desktop search box. Then choose the result you want. Note By default, the current working directory in a developer command prompt is the root of your Visual Studio installation in the
Program Files directory. This isn't an appropriate location for your code and projects. Change the current working directory to another location before you create a project. The IDE creates projects in your user directory, typically in %USERPROFILE%\source\repos. Developer command file locations If you prefer to set the build environment in an existing
command prompt window, you can use one of the command files created by the installer. We recommend you set the environment in a new command prompt window. We don't recommend you later switch environments in the same command window. The command file location depends on the version of Visual Studio you installed, and on choices you
made during installation. For Visual Studio 2019, the typical installation location on a 64-bit system is in \Program Files\Microsoft Visual Studio\2022\. The may be Community, Professional, Enterprise, BuildTools, or another nickname you supplied. The primary developer command prompt command file, VsDevCmd.bat, is located in the Common7\Tools
subdirectory. When no parameters are specified, it sets the environment to use the x86-native tools to build 32-bit x86 code. More command files are available to set up specific build architectures. The command files available depend on the Visual Studio workloads and options you've installed. In Visual Studio 2017 and Visual Studio 2019, you'll find them
in the VC\Auxiliary\Build subdirectory. These command files set default parameters and call VsDevCmd.bat to set up the specified build architecture environment. A typical installation may include these command files: Command File Host and Target architectures vcvars32.bat Use the 32-bit x86-native tools to build 32-bit x86 code. vcvars64.bat Use the
64-bit x64-native tools to build 64-bit x64 code. vcvarsx86_amd64.bat Use the 32-bit x86-native cross tools to build 64-bit x64 code. vcvarsamd64_x86.bat Use the 64-bit x64-native cross tools to build 32-bit x86 code. vcvarsx86_arm.bat Use the 32-bit x86-native cross tools to build ARM code. vcvarsamd64_arm.bat Use the 64-bit x64-native cross tools to
build ARM code. vcvarsx86_arm64.bat Use the 32-bit x86-native cross tools to build ARM64 code. vcvarsamd64_arm64.bat Use the 64-bit x64-native cross tools to build ARM64 code. vcvarsall.bat Use parameters to specify the host and target architectures, Windows SDK, and platform choices. For a list of supported options, call by using a /help
parameter. Caution The vcvarsall.bat file and other Visual Studio command files can vary from computer to computer. Do not replace a missing or damaged vcvarsall.bat file by using a file from another computer. Rerun the Visual Studio installer to replace the missing file. The vcvarsall.bat file also varies from version to version. If the current version of
Visual Studio is installed on a computer that also has an earlier version of Visual Studio, do not run vcvarsall.bat or another Visual Studio command file from different versions in the same command prompt window. Use the developer tools in an existing command window The simplest way to specify a particular build architecture in an existing command
window is to use the vcvarsall.bat file. Use vcvarsall.bat to set environment variables to configure the command line for native 32-bit or 64-bit compilation. Arguments let you specify cross-compilation to x86, x64, ARM, or ARM64 processors. You can target Microsoft Store, Universal Windows Platform, or Windows Desktop platforms. You can even specify
which Windows SDK to use, and select the platform toolset version. When used with no arguments, vcvarsall.bat configures the environment variables to use the current x86-native compiler for 32-bit Windows Desktop targets. You can add arguments to configure the environment to use any of the native or cross compiler tools. vcvarsall.bat displays an
error message if you specify a configuration that's not installed, or not available on your computer. vcvarsall syntax vcvarsall.bat [architecture] [platform_type] [winsdk_version] [-vcvars_ver=vcversion] [spectre_mode] architecture This optional argument specifies the host and target architecture to use. If architecture isn't specified, the default build
environment is used. These arguments are supported: architecture Compiler Host computer architecture Build output (target) architecture x86 x86 32-bit native x86, x64 x86 x86_amd64 or x86_x64 x64 on x86 cross x86, x64 x64 x86_arm ARM on x86 cross x86, x64 ARM x86_arm64 ARM64 on x86 cross x86, x64 ARM64 amd64 or x64 x64 64-bit native
x64 x64 amd64_x86 or x64_x86 x86 on x64 cross x64 x86 amd64_arm or x64_arm ARM on x64 cross x64 ARM amd64_arm64 or x64_arm64 ARM64 on x64 cross x64 ARM64 platform_type This optional argument allows you to specify store or uwp as the platform type. By default, the environment is set to build desktop or console apps. winsdk_version
Optionally specifies the version of the Windows SDK to use. By default, the latest installed Windows SDK is used. To specify the Windows SDK version, you can use a full Windows SDK number such as 10.0.10240.0, or specify 8.1 to use the Windows 8.1 SDK. vcversion Optionally specifies the Visual Studio compiler toolset to use. By default, the
environment is set to use the current Visual Studio compiler toolset. Use -vcvars_ver=14.2x.yyyyy to specify a specific version of the Visual Studio 2019 compiler toolset. Use -vcvars_ver=14.29 to specify the latest version of the Visual Studio 2019 compiler toolset. Use -vcvars_ver=14.0 to specify the Visual Studio 2015 compiler toolset. spectre_mode
Leave this parameter out to use libraries without Spectre mitigations. Use the value spectre to use libraries with Spectre mitigations. To set up the build environment in an existing command prompt window 1.At the command prompt, use the CD command to change to the Visual Studio installation directory. Then, use CD again to change to the subdirectory
that contains the configuration-specific command files. For Visual Studio 2019 and Visual Studio 2017, use the VC\Auxiliary\Build subdirectory. For Visual Studio 2015, use the VC subdirectory. 2.Enter the command for your preferred developer environment. For example, to build ARM code for UWP on a 64-bit platform, using the latest Windows SDK and
Visual Studio compiler toolset, use this command line: vcvarsall.bat amd64_arm uwp Create your own command prompt shortcut Open the Properties dialog for a developer command prompt shortcut to see the command target used. For example, the target for the x64 Native Tools Command Prompt for VS 2019 shortcut is something similar to:
%comspec% /k "C:\Program Files (x86)\Microsoft Visual Studio\2019\Community\VC\Auxiliary\Build\vcvars64.bat" The architecture-specific batch files set the architecture parameter and call vcvarsall.bat. You can pass the same options to these batch files as you would pass to vcvarsall.bat, or you can just call vcvarsall.bat directly. To specify parameters
for your own command shortcut, add them to the end of the command in double-quotes. For example, here's a shortcut to build ARM code for UWP on a 64-bit platform, using the latest Windows SDK. To use an earlier compiler toolset, specify the version number. Use something like this command target in your shortcut:
%comspec% /k "C:\Program Files
(x86)\Microsoft Visual Studio\2019\Community\VC\Auxiliary\Build\vcvarsall.bat" amd64_arm uwp -vcvars_ver=14.29 Adjust the path to reflect your Visual Studio installation directory. The vcvarsall.bat file has additional information about specific version numbers. Command-line tools To build a C/C++ project at a command prompt, Visual Studio provides
these command-line tools: CL Use the compiler (cl.exe) to compile and link source code files into apps, libraries, and DLLs. Link Use the linker (link.exe) to link compiled object files and libraries into apps and DLLs. When you build on the command line, the F1 command isn't available for instant help. Instead, you can use a search engine to get information
about warnings, errors, and messages. You can also download and use the offline help files. To use the search in Microsoft Learn, enter your query in the search box at the top of any article. Command-line project management tools By default, the Visual Studio IDE uses native project build systems based on MSBuild. You can invoke MSBuild directly to
build projects without using the IDE. You can also use the devenv command to use Visual Studio to build projects and solutions. Visual Studio also supports build systems based on CMake or NMake. MSBuild Use MSBuild (msbuild.exe) and a project file (.vcxproj) to configure a build and invoke the toolset without loading the Visual Studio IDE. It's
equivalent to running the Build project or Build Solution command in the Visual Studio IDE. MSBuild has advantages over the IDE when you build at the command line. You don't have to install the full IDE on all your build servers and build pipelines. You avoid the extra overhead of the IDE. MSBuild runs in containerized build environments, and supports a
binary logger. DEVENV Use DEVENV (devenv.exe) combined with a command-line switch such as /Build or /Clean to execute certain build commands without displaying the Visual Studio IDE. CMake CMake (cmake.exe) is a cross-platform, open-source tool for defining build processes that run on multiple platforms. CMake can configure and control native
build tools for its supported platforms, such as MSBuild and Make. For more information about CMake, see the CMake documentation. NMAKE Use NMAKE (nmake.exe) to build C++ projects by using a traditional makefile. Note Starting in Visual Studio 2019 version 16.5, MSBuild and DEVENV don't use the command-line environment to control the
toolset and libraries used. In this section These articles show how to build apps on the command line, and describe how to customize the command-line build environment. Some show how to use 64-bit toolsets, and target x86, x64, ARM, and ARM64 platforms. They also describe use of the command-line build tools MSBuild and NMAKE. Walkthrough:
Compiling a native C++ program on the command line Gives an example that shows how to create and compile a C++ program on the command line. Walkthrough: Compile a C program on the command line Describes how to compile a program written in the C programming language. Walkthrough: Compiling a C++/CLI program on the command line
Describes how to create and compile a C++/CLI program that uses the .NET Framework. Walkthrough: Compiling a C++/CX program on the command line Describes how to create and compile a C++/CX program that uses the Windows Runtime. NMAKE reference Provides links to articles that describe the Microsoft Program Maintenance Utility
(NMAKE.EXE). MSBuild on the command line - C++ Provides links to articles that discuss how to use msbuild.exe from the command line. Related sections /MD, /MT, /LD (Use run-time library) Describes how to use these compiler options to use a Debug or Release run-time library. C/C++ compiler options Provides links to articles that discuss the C and
C++ compiler options and CL.exe. MSVC linker options Provides links to articles that discuss the linker options and LINK.exe. Additional MSVC build tools Provides links to the C/C++ build tools that are included in Visual Studio. See also Azure Virtual Desktop Readiness Resources | Microsoft Partner Opportunity and Use Cases Azure Well-Architected
Azure Virtual Desktop Workload Assessment AVD Stories Training Resources Azure Virtual Desktop Academy AVD Academy Resources Azure Virtual Desktop Landing Zone Accelerator (LZA) Roadmap and Best Practices AVD Community Blogs AVD/Citrix/VMware/Azure Stack HCI Bill of Materials AVD Level 300 Customer/Partner Deck ur overall results
EXCELLENT You are all set! Your results look strong and meet the necessary criteria for success. CRITICAL 0-1 Critical: 0 to 1 MODERATE 1-2 Moderate: 1 to 2 EXCELLENT 2-3 Excellent: 2 to 3 Your result: 3/3 3 out of 3 Categories that influenced your results Azure Virtual Desktop Readiness Resources | Microsoft Partner EXCELLENT You can find out
how to improve on individual categories by reviewing the recommendations below in the report. Azure Virtual Desktop | Microsoft Partner - Mar 4, 2025 - 11:55:56 AM Your overall results Excellent '3/3' Azure Virtual Desktop Readiness Resources | Microsoft Partner Excellent '3/3' Category Link-Text Link Priority ReportingCategory ReportingSubcategory
Weight Context CompleteY/N Note Azure Virtual Desktop Readiness Resources | Microsoft Partner Azure Well-Architected Azure Virtual Desktop Workload Assessment https://learn.microsoft.com/en-us/assessments/1ef67c4e-b8d1-4193-b850-d192089ae33d/sessions/6356b690-ba16-4dec-80a3-1e99a2021723?mode=pre-assessment&id=1ef67c4eb8d1-4193-b850-d192089ae33d&session=6356b690-ba16-4dec-80a3-1e99a2021723 High 0 N Azure Virtual Desktop Readiness Resources | Microsoft Partner AVD Stories https://azure.microsoft.com/en-us/products/virtual-desktop/#Customerstories High 0 N Azure Virtual Desktop Readiness Resources | Microsoft Partner Azure Virtual Desktop Academy
https://microsoft.github.io/PartnerResources/skilling/microsoft-infrastructure-academy/avd High 0 N Azure Virtual Desktop Readiness Resources | Microsoft Partner AVD Academy Resources https://microsoft.github.io/PartnerResources/skilling/microsoft-infrastructure-academy/resources/azure-virtual-desktop High 0 N Azure Virtual Desktop Readiness
Resources | Microsoft Partner Azure Virtual Desktop Landing Zone Accelerator (LZA) https://github.com/Azure/avdaccelerator High 0 N Azure Virtual Desktop Readiness Resources | Microsoft Partner AVD Community Blogs https://techcommunity.microsoft.com/t5/azure-virtual-desktop-blog/bg-p/AzureVirtualDesktopBlog High 0 N Azure Virtual Desktop
Readiness Resources | Microsoft Partner AVD/Citrix/VMware/Azure Stack HCI Bill of Materials https://onedrive.live.com/?authkey=%21ACWW%2Deoxp2zM6FQ&id=D242F3D2FC2D88CC%21484&cid=D242F3D2FC2D88CC High 0 N Azure Virtual Desktop Readiness Resources | Microsoft Partner AVD Level 300 Customer/Partner Deck https://1drv.ms/p/
s!AsyILfzS80LSiAa_HEmJ_F5WuZRI?e=Osgzmf High 0 N ---------- Category Question Answers Selected Answer Note Azure Virtual Desktop Readiness Resources | Microsoft Partner Opportunity and Use Cases Azure Well-Architected Azure Virtual Desktop Workload Assessment Azure Well-Architected Azure Virtual Desktop Workload Assessment Azure
Virtual Desktop Readiness Resources | Microsoft Partner Opportunity and Use Cases AVD Stories AVD Stories Azure Virtual Desktop Readiness Resources | Microsoft Partner Training Resources Azure Virtual Desktop Academy Azure Virtual Desktop Academy Azure Virtual Desktop Readiness Resources | Microsoft Partner Training Resources AVD
Academy Resources AVD Academy Resources Azure Virtual Desktop Readiness Resources | Microsoft Partner Training Resources Azure Virtual Desktop Landing Zone Accelerator (LZA) Azure Virtual Desktop Readiness Resources | Microsoft Partner Roadmap and Best Practices AVD Community
Blogs AVD Community Blogs Azure Virtual Desktop Readiness Resources | Microsoft Partner Roadmap and Best Practices AVD/Citrix/VMware/Azure Stack HCI Bill of Materials AVD/Citrix/VMware/Azure Stack HCI Bill of Materials Azure Virtual Desktop Readiness Resources | Microsoft Partner Roadmap and Best Practices AVD Level 300 Customer/
Partner Deck AVD Level 300 Customer/Partner Deck hown below are the assessment's questions and how they were answered. Show all original responses available for each question. Retail Readiness Resources Messaging and Use Cases Microsoft Cloud for Retail Partner Messaging Framework Microsoft Cloud for Retail through-partner AI Narrative
Microsoft Retail Industry Priority Scenarios Microsoft Cloud for Retail Reference architectures Training Resources Get started with Microsoft Cloud for Retail Self-Paced training Get started with Store Operations Assist in Microsoft Cloud for Retail Self-Paced Training Discover Microsoft AI for leaders in retail Self-Paced Training Get started with Smart Store
Analytics in Microsoft Cloud for Retail Self-Paced Training Integrate Store Operations Assist with Microsoft Teams Self-Paced Training Marketplace Offer Development Resources Marketplace Training and Support Resources Sell Through the Commercial Marketplace Microsoft Commercial Marketplace Publisher FAQ Mastering the Marketplace: Office
Hours Retail Cosell Acceleration Resources Go-To-Market Assets & Recommended Seller Training Retail Partner Industry Sales Kits Microsoft Cloud for Retail Partner Assets Recommended Sellers Training: Get started with Microsoft Cloud for Retail Your overall results EXCELLENT You are all set! Your results look strong and meet the necessary criteria
for success. CRITICAL 0-1 Critical: 0 to 1 MODERATE 1-2 Moderate: 1 to 2 EXCELLENT 2-4 Excellent: 2 to 4 Your result: 4/4 4 out of 4 Categories that influenced your results Retail Readiness Resources EXCELLENT Marketplace Offer Development Resources EXCELLENT Retail Cosell Acceleration Resources EXCELLENT You can find out how to
improve on individual categories by reviewing the recommendations below in the report. Microsoft Cloud for Retail Adoption Guide | Microsoft Partners - Mar 4, 2025 - 11:59:59 AM Your overall results Excellent '4/4' Retail Readiness Resources Excellent '4/5' Marketplace Offer Development Resources Excellent '3/3' Retail Cosell Acceleration Resources
Excellent '3/3' https://learn.microsoft.com Category Link-Text Link Priority ReportingCategory ReportingSubcategory Weight Context CompleteY/N Retail Readiness Resources Microsoft Cloud for Retail Partner Messaging Framework https://assetsprod.microsoft.com/mpn/en-us/microsoft-cloud-for-retail-through-partner-messaging-framework.docx High 0 N
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industry-priority-scenarios High 0 N Retail Readiness Resources Overview of Microsoft Cloud for Retail reference architectures https://learn.microsoft.com/en-us/industry/retail/architecture/overview High 0 N Retail Readiness Resources Get started with Microsoft Cloud for Retail Self-Paced training https://learn.microsoft.com/en-us/training/paths/getstarted-retail/ High 0 N Retail Readiness Resources Get started with Store Operations Assist in Microsoft Cloud for Retail Self-Paced Training https://learn.microsoft.com/en-us/training/paths/get-started-store-operations-assist/?source=recommendations High 0 N Retail Readiness Resources Discover Microsoft AI for leaders in retail Self-Paced Training
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Development Resources Microsoft Commercial Marketplace Publisher FAQ https://learn.microsoft.com/en-us/partner-center/marketplace/marketplace-faq-publisher-guide High 0 N Marketplace Offer Development Resources Mastering the Marketplace: Office Hours https://aka.ms/MTMofficehours High 0 N Retail Cosell Acceleration Resources Retail
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Sellers Training: Get started with Microsoft Cloud for Retail https://learn.microsoft.com/en-us/training/paths/get-started-retail/ High 0 N ---------- Shown below are the assessment's questions and how they were answered. Show all original responses available for each question. Sustainability Readiness Resources Opportunity and Use Cases This is AI ...
for Sustainability Microsoft Cloud for Sustainability: ESG and the Future of Business Training Resources Microsoft Cloud for Sustainability Training Collection Pre-sales licenses for Sustainability Manager sandbox Environments for Microsoft Partners Fabric Technical Resources Microsoft Cloud for Sustainability Technical Summit Roadmap and Best
Practices Well-Architected for Microsoft Cloud for Sustainability What's new in Microsoft Cloud for Sustainability overview Marketplace Offer Development Resources Marketplace Training and Support Resources Sell Through the Commercial Marketplace Microsoft Commercial Marketplace Publisher FAQ Mastering the Marketplace: Office Hours Your
overall results EXCELLENT You are all set! Your results look strong and meet the necessary criteria for success. CRITICAL 0-1 Critical: 0 to 1 MODERATE 1-2 Moderate: 1 to 2 EXCELLENT 2-3 Excellent: 2 to 3 Your result: 3/3 3 out of 3 Categories that influenced your results Sustainability Readiness Resources EXCELLENT Marketplace Offer
Development Resources EXCELLENT Sustainability Cosell Acceleration Resources EXCELLENT You can find out how to improve on individual categories by reviewing the recommendations below in the report. Microsoft Cloud for Sustainability Adoption Guide | Microsoft Partners - Mar 4, 2025 - 12:03:23 PM Your overall results Excellent '3/3'
Sustainability Readiness Resources Excellent '3/4' Marketplace Offer Development Resources Excellent '3/3' Sustainability Cosell Acceleration Resources Excellent '2/2' Category Link-Text Link Priority ReportingCategory ReportingSubcategory Weight Context CompleteY/N Note Sustainability Readiness Resources This is AI ... for Sustainability https://
info.microsoft.com/we-landing-this-is-AI-for-sustainability.html?ocid=cmmop4zodtb High 0 N Sustainability Readiness Resources Microsoft Cloud for Sustainability: ESG and the Future of Business https://www.linkedin.com/learning/microsoft-cloud-for-sustainability-esg-and-the-future-of-business High 0 N Sustainability Readiness Resources Microsoft
Cloud for Sustainability Training Collection https://aka.ms/mcfslearningpaths High 0 N Sustainability Readiness Resources Pre-sales licenses for Sustainability Manager sandbox Environments for Microsoft Partners https://experience.dynamics.com/requestlicense/ High 0 N Sustainability Readiness Resources Well-Architected for Microsoft Cloud for
Sustainability https://learn.microsoft.com/en-us/industry/well-architected/sustainability/ High 0 N Sustainability Readiness Resources Roadmap: What's new in Microsoft Cloud for Sustainability overview https://learn.microsoft.com/en-us/industry/sustainability/whats-new High 0 N Sustainability Readiness Resources Fabric Technical Resources https://
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https://learn.microsoft.com/en-us/training/paths/sell-through-commercial-marketplace/ High 0 N Marketplace Offer Development Resources Microsoft Commercial Marketplace Publisher FAQ https://learn.microsoft.com/en-us/partner-center/marketplace/marketplace-faq-publisher-guide High 0 N Marketplace Offer Development Resources Mastering the
Marketplace: Office Hours https://aka.ms/MTMofficehours High 0 N Sustainability Cosell Acceleration Resources Sustainability Marketing Campaigns https://partner.microsoft.com/en-us/asset/collection/sustainability-marketing-campaigns#/ High 0 N Sustainability Cosell Acceleration Resources Recommended Training for Sellers: Get started with Microsoft
Cloud for Sustainability https://learn.microsoft.com/en-us/training/paths/get-started-sustainability/ High 0 N ---------- Category Question Answers Selected Answer Note Sustainability Readiness Resources Opportunity and Use Cases This is AI ... for Sustainability This is AI ... for Sustainability Sustainability Readiness Resources Opportunity and Use
Cases Microsoft Cloud for Sustainability: ESG and the Future of Business Microsoft Cloud for Sustainability: ESG and the Future of Business Sustainability Readiness Resources Training Resources Microsoft Cloud for Sustainability Training Collection Microsoft Cloud for Sustainability Training Collection Sustainability Readiness Resources Training
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What's new in Microsoft Cloud for Sustainability overview What's new in Microsoft Cloud for Sustainability overview Marketplace Offer Development Resources Marketplace Training and Support Resources Sell Through the Commercial Marketplace Sell Through the Commercial Marketplace Marketplace Offer Development Resources Marketplace Training
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English.pdf 257 KB brighttalk-viewing-certificate-lenovo-and-intel-are-driving-ai-innovation-at-th Skip to main content Learn Assessments 1.Learn 2.Assessments 3.Browse Recommendations for your workload. Actionable items to consider implementing to improve your workload across the five pillars of the Microsoft Azure Well Architected Framework. Your overall results EXCELLENT You are all set! Your results look strong and meet the necessary criteria for success. CRITICAL 0-33 Critical: 0 to 33 MODERATE 33-67 Moderate: 33 to 67 EXCELLENT 67-100 Excellent: 67 to 100 Your result: 99/100 99 out of 100 Categories that influenced your results Azure Databricks:
Performance Efficiency EXCELLENT Data Explorer: Reliability EXCELLENT Azure Databricks: Operational Excellence EXCELLENT Azure Databricks: Cost Optimization EXCELLENT Azure Databricks: Security EXCELLENT Azure Databricks: Reliability EXCELLENT ADLS Gen2: Performance Efficiency EXCELLENT Analysis Services: Performance
Efficiency EXCELLENT Analysis Services: Operational Excellence EXCELLENT Analysis Services: Cost Optimization EXCELLENT Analysis Services: Security EXCELLENT Analysis Services: Reliability EXCELLENT You can find out how to improve on individual categories by reviewing the recommendations below in the report. Improve your results Our
recommendations for improving your results are organized by category below. Azure Databricks: Performance Efficiency EXCELLENT 1 recommended action Data Explorer: Reliability EXCELLENT 0 recommended actions Azure Databricks: Operational Excellence EXCELLENT 2 recommended actions Azure Databricks: Cost Optimization EXCELLENT 0
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main content Learn Assessments 1.Learn 2.Assessments 3.Browse Recommendations for your workload. Actionable items to consider implementing to improve your workload across the five pillars of the Microsoft Azure Well-Architected Framework. Shown below are the assessment's questions and how they were answered. Show all original responses available for each question. WAF analytics service selection Which analytics service(s) are you using? Azure Analysis Services Azure Data Explorer Azure Databricks Azure Synapse Analytics Azure Data Lake Storage Gen2 What pillars would you like to evaluate? Reliability Security Cost Optimization Operational Excellence

Performance Efficiency Analysis Services: Reliability What reliability targets and metrics have you defined for your application? Azure Analysis Services RPO (Recovery Point Objective) and RTO (Recovery Time Objective) targets have been defined for the application and/or key scenarios. Availability SLAs (Service Level Agreements) have been defined
for the solution and considered while architecting the solution. Composite SLA (including Azure Analysis Services) has been defined for the service and considered while architecting the solution. None of the above. How have you ensured that your application architecture is resilient to failures? Backup databases from primary server can be restored on
redundant servers. An alias is used for the primary server to avoid having to change the connection strings on reporting clients. The database can be restored using SSMS or PowerShell using backups located in a storage account configured for the server. We use asynchronous refresh with the REST API to prevent the need for long-running HTTP
connections, auto retries, and batched commits. None of the above. How have you ensured required capacity and services are available in targeted regions? We use the Azure Analysis Services resource and object limits as part of the resource governance mechanisms to enforce these limits. We verify that the Azure Analysis Services product is available
in the target region in case that region is not the paired-region. We verify that the target region meets regulatory or governance requirements for the data stored in the data lake (HIPAA, PCI, etc.) None of the above. How are you handling disaster recovery for this workload? We consider the incidents we want to be protected from when choosing the right
redundancy options, and build the backup and disaster recovery plan accordingly: local outage, regional disaster, capacity limitations, and so on. We deploy models to redundant servers in other regions. We complete periodic disaster recovery exercises to ensure the procedure works as planned. We verify end-to-end system performance after failover
occurs. None of the above. How do you monitor and measure workload health? We use the available metrics, logs, and diagnostics with Azure Monitor. We use Azure Monitor metric alerts with dynamic thresholds detection. We use Azure Resource Health events to alert on resource health events. We use Azure Service Health events to alert on applicable
service-level events (service issue, planned maintenance, health advisories, and security advisory). None of the above. Analysis Services: Security What design considerations did you make in your workload with regard to security? We identify and classify business-critical datasets that might adversely affect operations if they're compromised or become
unavailable. We list and document security requirements for the Azure Analysis Services instances. We limit access by following the principle of least privilege, protecting data, and monitoring activities offered by Azure Analysis Services. We define and test operational processes for incident response. We review data compliance requirements and choose
the appropriate regulatory compliance controls for the data. None of the above. What considerations for compliance and governance do you need to take? We use Azure policies to enforce security, compliance, and organizational standards. We activate diagnostic logs and store them in a log analytics workspace. None of the above. How are you managing
encryption for this workload? We rotate the storage key by specifying a key expiration period. We compress and encrypt tabular model backups. None of the above. How are you managing permissions for this workload? User identities are registered within the Microsoft Entra tenant of the subscription. We use Azure Analysis Services role-based access
control (RBAC). We use object-level security, which includes table-level security and column-level security. We implement row-level security as part of tabular model roles. None of the above. How have you secured the network of your workload? We configured a server firewall to filter the inbound traffic. We use gateways for on-premises data sources. We
use gateways for data sources on Azure Virtual Networks. We use DirectQuery mode, where only metadata is stored. None of the above. Analysis Services: Cost Optimization What actions are you taking to optimize cloud costs? We're getting familiar with Analysis Services pricing, in particular, with elements that drive the price calculation: QPUs, memory
(GB), presence of SLA, scale-out instances, tier, uptime, region. We use the Cost Management and Billing tools to analyse and manage costs. Our choice of region in which to deploy the instance in is driven by the data source's location, the users' location, the availability of the SKU and of the query replica feature (if it's planned to be used), and the price.
We choose the right tier and plan for the instance. We use the right upgrade plan that will allow for more query processing units and more cache capacity. We pause the server when not in use, and resume when needed to only pay for what is used. As an existing Power BI Premium Capacity user, we evaluate the use of Power BI Premium that embeds an
Analysis Services instance instead of a standalone Azure Analysis Services server. None of the above. How is your organization modeling cloud costs? We use the cost control feature to set the budget as part of Cost Management for Azure Analysis Services. We lower costs by pausing or scaling the instance to meet performance demands. None of the
above. How are you monitoring your costs? We use the cost analysis feature of Azure Cost Management to monitor costs and create budgets. None of the above. Analysis Services: Operational Excellence How are you designing your applications to take into account DevOps? We use source-control integration as the first step in building a continuous
integration and deployment pipeline. We use continuous integration and deployment for Azure Analysis Services, and build continuous integration and deployment pipeline for data models. None of the above. How are you managing the configuration of your workload? We automate creation of Azure Analysis Services instances with ARM templates,
PowerShell scripts, or Bicep files. We use Dynamic Management Views (DMVs) in Analysis Services to monitor server instances. We monitor server metrics provided by Azure Monitor (memory, CPU usage, number of client connections, query resource consumption, etc.). We enable diagnostic logging for Azure Analysis Services to monitor and send logs
to Azure storage, stream them to Azure Event Hubs, or export them to Azure Monitor logs. We add resource health alerts for metrics such as memory usage, memory limit High, and memory limit Hard. None of the above. What operational considerations are you making regarding the deployment of your workload? We're becoming familiar with Azure
Analysis Services resource and object limits to learn what happens when those resource limits are hit or exceeded, and describe the resource governance mechanisms used to enforce these limits. No routine and manual operational changes are performed outside of IaC (Infrastructure as Code) to prevent configuration drift by enforcing consistency
representing desired environment states. Critical test environments have 1:1 parity with the production environment. None of the above. What processes and procedures have you adopted to optimize workload operability? Specific methodologies, like DevOps, are used to structure the development and operations process. We leverage central Azure
monitoring tools like Azure Monitor. Data analysts, data engineers, development teams, and the operations team collaborate to resolve production issues that are clearly defined and well understood. Operational shortcomings and failures are analyzed, post-mortems are performed and used to improve and refine operational procedures. There are tools or
processes in place, such as Microsoft Entra Privileged Identity Management, to grant access to critical instances on a just-in-time basis. Azure Resource Tags are used to enrich our AAS instance with operational metadata. There are tools and processes, like Azure Policy, in place to govern available services, enforce mandatory operational functionality
and ensure compliance. How are you monitoring for a healthy workload? We use Azure Monitor to perform more in-depth diagnostics, track performance, and identify trends using the platform metrics. We use Azure Diagnostics to offload Platform logs. We use Extended Events. We use Dynamic Management Views (DMVs). Analysis Services:
Performance Efficiency How are you designing your workload to scale? We maintain a healthy workload by automating the scaling of the Azure Analysis Services instances. We use read-only replicas scale-out to have queries return consistent data while processing data. We separate the processing server from the query pool to ensure that client queries
aren't affected by processing operations. None of the above. How are you handling user load? We create a query pool with up to seven additional query replicas (eight total, including the server). We simplify the query or its calculations if the query is too memory intensive. How are you ensuring that you have sufficient memory? We monitor datasets to not
exceed available server resource memory. We monitor the memory usage broken out by database. None of the above. How are you managing your data to handle scale? We use partitioning to take advantage of incremental loads. We refresh (process) in-memory models to update cached data from data sources. We keep the data model as simple as
possible by removing unneeded columns and keeping the size to the minimum, paying attention to the data types. None of the above. How are you monitoring to ensure the workload is scaling appropriately? With Azure service principal support, we perform unattended refresh operations using PowerShell, TOM, TMSL, or REST to make sure our model
data is always up to date. We implement asynchronous refresh with the REST APIs to mitigate long-running operations. None of the above. Data Factory: Reliability Data Factory: Security Data Factory: Cost Optimization Data Factory: Operational Excellence Data Factory: Performance Efficiency Azure Databricks: Reliability How do you implement
reliability Best Practices? We deploy workspaces in multiple subscriptions based on service limits, including Databricks workspace limits and Azure subscription limits. We leverage clusters pools with TTL=60 min, or interactive clusters for job-based scenarios where we expect to spin up or down quickly. We stagger job-based clusters in the same
workspace for scenarios requiring quick spin up and down of job clusters at less than 5 minutes as the recommended interval. We use Cluster Scoped Init scripts rather than global or named scripts. We ensure that we've configured an appropriate level of data redundancy for our use case. None of the above. How do you implement disaster recovery
scenarios? We disable RA-GRS stores in development subscriptions to reduce cost. We use RA-GRS storage accounts only when required to meet disaster planning. We enable soft delete, snapshot, and point in time recovery (PITR) for storage. We perform daily backups of Databricks configuration. We use the cluster log delivery feature to manage logs.
Azure Databricks: Security How do you implement security Best Practices? We store any production data in default Azure Databricks file system (DBFS) folders. We deploy the Databricks workspace in our virtual network. We review and plan to implement controls in Microsoft Blueprints for HiTrust / HIPAA and PCI/DSS. We have a process in place to
periodically regenerate our account keys. We implement a security development lifecycle and threat model to assess risks in our application. We enable advanced threat protection for storage. How do you implement authentication controls? We enable access control lists to configure permissions at the workspace, clusters, pools, jobs, and data tables. We
use credential passthrough to authenticate automatically. We use Azure Key Vault (AKV) to store secrets, including credentials. We enable customer manage keys (CMK) for notebooks and root Databricks File System (DBFS). We enable Oauth authentication. How do you implement encryption on your clusters? We encrypt traffic between clusters and
worker nodes. We set up a minimum transport layer security (TLS) version for all storage accounts to TLS 1.2. We limit shared access signature (third-party tools) tokens to HTTPS connections only. None of the above. How do you implement security at the networking level? We enable IP access lists to restrict access to certain IP addresses. We limit
private IP addresses. We leverage Azure Private Endpoint. We leverage No Public IP (NPIP). We safelist service principals' names and personal access tokens. We enable virtual network (Vnet) injection. None of the above. How do you audit and monitor your Databricks platform for security? We enable audit logging. We ingest log data into a security
information and event manager (SIEM) for security monitoring. We review and reconcile user access. Azure Databricks: Cost Optimization How do you implement cost optimization Best Practices? Users can share autoscaling clusters rather than each user having to create a separate cluster. We leverage the right SKU for the scenario, that is, Jobs
Compute for data engineering and Batch ELT workload with single Jobs Compute cluster. We use chargeback scenarios. We review file formats and compute and network and identify areas for cost optimization. We regularly use the delta optimizer to merge small files into larger files. None of the above. How do you implement cost savings? We prepurchase commit units and reserve VM instances when possible. We choose Azure regions that offer the lowest cost while meeting performance requirements. None of the above. How do you monitor Azure Databricks costs? We monitor costs of clusters using the cost analysis report. We set up budget alerts to monitor costs. We use Databricks
Overwatch. None of the above. Azure Databricks: Operational Excellence How do you implement operational Best Practices? We do regular performance, scalability, and stress testing. We build a process to review Azure Advisor and Azure Security Center recommendations on a regular cadence. We review and address platform changes from the release
notes. We split workspaces for Dev, QA, and Production. We use automated clusters for production jobs instead of interactive clusters. We run auto-optimization to improve performance for the downstream. We optimize and curate delta tables (silver tables). We review the continuous integration and continuous deployment (CI/CD) automation framework.
We run monthly log reviews to validate environment health. We terminate and rebuild clusters on a frequent basis to ensure Databricks clusters are patched by Microsoft. How do you monitor your Databricks platform for operations? We enable logging and alerting for all components in the Databricks platform. We use dashboards to visualize metrics. We
set up any cluster activity monitoring. We enable storage account logging. We put a single point of log aggregation in place. We use Network Watcher to collect and Monitor network activity. We ensure that all application-level monitoring is enabled. We use a single pane of glass with telemetry using Log Analytics logs to EventHub for consumption by other
systems. We consider ingesting selected logs from Azure storage accounts to Azure Monitor. We monitor for 500 errors by Databricks, Blob storage, or other HTTP endpoints. We implement cluster secure management. What components of your Azure environment do you monitor as part of your operations practice? We use approved time synchronization
sources. We configure central security log management. We enable audit logging for Azure resources. We collect security logs from operating systems. We configure security log storage retention. We monitor and review logs. We enable alerts for anomalous activities. We centralize anti-malware logging. We enable DNS query logging. We enable
command-line audit logging. Azure Databricks: Performance Efficiency How do you implement performance Best Practices? We choose the correct cluster size by doing iterative performance testing. We regularly conduct rigorous quality and unit testing to validate performance that meets requirements. We leverage the auto-scaling feature with autoterminate. We turn shuffle off for optimal performance. We check for data skew. We ensure that the file size and format are homogenous. We consistently use DataFrame API and SparkSQL. We avoid user-defined functions (UDFs) , especially in Python or R. We consider and test repartitioning if we need to join large tables. We ensure Azure limits are
increased, for example, Public IP limits and so on. How do you optimize performance efficiency? We reorder skew joins. We optimize for performance with Delta Lake format to get the best price to performance ratio. We partition our data. We check for large shuffle joins and try replacing them with broadcasts. We use Delta Lake with Z-order and optimize
the latest Databricks Runtime (DBR) to get the best performance. We use Parquet file format. We use Delta-Cache. How do you test performance efficiency on the Azure Databricks clusters? We run a proof of concept to determine how often to execute based on data ingestion and query patterns. We engage with Azure Engineers to ensure that capacity
can be handled in the backend and limits get increased. We engage with the networking team during testing. We ensure throttling is not hit by setting up Azure Data Lake Storage Gen 2 limits. We review all Azure and Databricks limits. We develop a medium-sized cluster of 2-8 nodes, with VMs matched to the workload class, as explained earlier. We run
end to end tests on larger representative data while measuring CPU, memory, and I/O used by the cluster at an aggregate level. We optimize the cluster to remove bottlenecks. How do you monitor your Databricks platform for performance efficiency? We troubleshoot performance bottlenecks by using dashboards to identify job and stage latency and
streaming throughput. We validate whether upstream components can sustain the load required to pass through them. We run scheduled optimization on delta tables. We tune shuffle for optimal performance. We use autoscaling methodologies whenever possible. We partition our data following Best Practices. None of the above. How do you support
interactive analytics using shared high-concurrency clusters? We deploy a shared cluster instead of letting each user create their cluster. We create the shared cluster in High Concurrency mode instead of Standard mode. We configure security on the shared high concurrency cluster. None of the above. Data Explorer: Reliability What reliability targets and
metrics have you defined for your application? Ensure that the average CPU is running at 80% capacity or less and cache utilization is 100%. Use Resource Health to monitor the status of Azure Data Explorer. How have you ensured that your application architecture is resilient to failures? This question was left unanswered How are you handling disaster
recovery for this workload? This question was left unanswered How do you monitor and measure application health? This question was left unanswered Data Explorer: Security What action are you taking to meet your compliance and governance requirements? This question was left unanswered How are you protecting data for this workload? This
question was left unanswered How are you managing identity for this workload? This question was left unanswered How do you keep your Azure Data Explorer cluster from being exposed to the internet? This question was left unanswered Data Explorer: Cost optimization What actions are you taking to optimize cloud costs? This question was left
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unanswered How do you ensure that cloud resources are appropriately provisioned? This question was left unanswered How is your organization modeling cloud costs? This question was left unanswered How do you manage the storage footprint of your digital assets? This question was left unanswered How are you monitoring your costs? This question
was left unanswered What tradeoffs have you made to optimize for cost? This question was left unanswered Data Explorer: Operational excellence How are you designing your applications to take DevOps into account? This question was left unanswered How are you managing the configuration of your workload? This question was left unanswered What
considerations are you making around the deployment of your infrastructure? This question was left unanswered Are you using best practices for Kusto queries? This question was left unanswered How are you monitoring your deployments and workload? This question was left unanswered Data Explorer: Performance efficiency How are you designing your
workload to scale? This question was left unanswered How do you optimize Azure Data Explorer workloads for performance? This question was left unanswered How are you ensuring that you have sufficient capacity? This question was left unanswered How are you monitoring to ensure the workload is scaling appropriately? This question was left
unanswered Synapse: Reliability What reliability targets and metrics have you defined for your application? This question was left unanswered How have you ensured that your application architecture is resilient to failures? This question was left unanswered How have you ensured required capacity and services are available in targeted regions? This
question was left unanswered How are you handling disaster recovery for this workload? This question was left unanswered What decisions have been taken to ensure the application platform meets your reliability requirements? This question was left unanswered How does your application logic handle exceptions and errors? This question was left
unanswered What decisions have been taken to ensure networking and connectivity meets your reliability requirements? This question was left unanswered What reliability allowances for scalability and performance have you made? This question was left unanswered What reliability allowances for security have you made? This question was left
unanswered What reliability allowances for operations have you made? This question was left unanswered How do you test the application to ensure it is fault tolerant? This question was left unanswered How do you monitor and measure application health? This question was left unanswered Synapse: Security What design considerations did you make in
your workload in regards to security? This question was left unanswered What considerations for compliance and governance do you need to take? This question was left unanswered How are you managing encryption for this workload? This question was left unanswered How are you managing identity for this workload? This question was left unanswered
How have you secured the network of your workload? This question was left unanswered What tradeoffs do you need to make to meet your security goals? This question was left unanswered How are you ensuring your critical accounts are protected? This question was left unanswered Synapse: Cost Optimization What actions are you taking to optimize
cloud costs? This question was left unanswered How do you ensure that cloud resources are appropriately provisioned? This question was left unanswered How is your organization modeling cloud costs? This question was left unanswered How do you manage the storage footprint of your digital assets? This question was left unanswered How are you
monitoring your costs? This question was left unanswered What trade-offs have you made to optimize for cost? This question was left unanswered Synapse: Operational Excellence How are you designing your applications to take into account DevOps? This question was left unanswered How are you managing the configuration of your workload? This
question was left unanswered What considerations are you making around the deployment of your infrastructure? This question was left unanswered How is development done on this workload? This question was left unanswered How are you monitoring your deployments and workload? This question was left unanswered How are you integrating your
workloads? This question was left unanswered Synapse: Performance Efficiency How are you designing your workload to scale? This question was left unanswered How do you optimize Synapse workloads for performance? This question was left unanswered How are you ensuring you have sufficient capacity? This question was left unanswered How are
you managing your data to handle scale? This question was left unanswered How are you monitoring to ensure the workload is scaling appropriately? This question was left unanswered ADLS Gen2: Reliability How have you ensured that your application architecture is resilient to failures? This question was left unanswered How have you ensured required
capacity and services are available in targeted regions? This question was left unanswered How are you handling disaster recovery for this workload? This question was left unanswered How does your application logic handle exceptions and errors? This question was left unanswered What decisions have been taken to ensure networking and connectivity
meets your reliability requirements? This question was left unanswered How do you monitor and measure application health? This question was left unanswered How do you mitigate accidental deletion of your data? This question was left unanswered How do you ensure the availability of your most critical datasets? This question was left unanswered How
do you ensure that the data is reliable? This question was left unanswered ADLS Gen2: Security What design considerations did you make in your workload with regard to security? This question was left unanswered What considerations for compliance and governance do you need to take? This question was left unanswered How are you managing
encryption for this workload? This question was left unanswered How are you managing identity and authorization for this workload? This question was left unanswered How have you secured the network of your workload? This question was left unanswered What tradeoffs do you need to make to meet your security goals? This question was left
unanswered ADLS Gen2: Cost Optimization What actions are you taking to optimize cloud costs? This question was left unanswered How are you monitoring your costs? This question was left unanswered ADLS Gen2: Operational Excellence What tooling do you leverage to monitor your ADLS accounts? This question was left unanswered What
considerations are you making around the deployment of your workload? This question was left unanswered How are you integrating your workloads? This question was left unanswered What processes and procedures have you adopted to optimize workload operability? This question was left unanswered Has the data been organized in the data lake to
optimize for access, performance, and usability? This question was left unanswered How do you make your data discoverable for users? This question was left unanswered ADLS Gen2: Performance Efficiency How are you designing your workload to scale? This question was left unanswered How do you optimize ADLS workloads for performance? This
question was left unanswered How are you managing your data to handle scale? This question was left unanswered How are you ensuring you have sufficient capacity? Review ADLS Gen2 product limits. Monitor ADLS Gen2 resource utilization, query activity, and other metrics that have limitations. None of the above Previous Versions Blog
Contribute Privacy Terms of Use Trademarks © Microsoft 2025 our overall results LOW Room to improve. It looks like there are key items needing attention. Review the recommendations to see what actions you can take to improve your results. LOW 0-12 Low: 0 to 12 MODERATE 12-23 Moderate: 12 to 23 EXCELLENT 23-35 Excellent: 23 to 35
Your result: 10/35 10 out of 35 Categories that influenced your results Azure AI Fundamentals LOW Designing and Implementing a Microsoft Azure AI Solution MODERATE You can find out how to improve on individual categories by reviewing the recommendations below in the report. Azure AI Fundamentals Fundamental AI Concepts Azure AI Bot
Svice Fundamentals of question answering with the Language Service "Create an empty knowledge base, and then manually copy and paste the FAQ entries into it. Fundamentals of Azure AI Document Intelligence Azure AI Vision resource Fundamentals of Azure OpenAI Service Azure OpenAI is Microsoft's version of ChatGPT, a chatbot that uses
generative AI models. Designing and Implementing a Microsoft Azure AI Solution Prepare to develop AI solutions on Azure Absolutely correct values based on conditional logic. Secure Azure AI services Switch the app to use the secondary key Deploy Azure AI services in containers Client applications must pass a subscription key to the Azure resource
endpoint before using the container. Make recommendations with Azure AI Personalizer In the Azure portal, go to the Monitor page for your AI Personalizer resource, and view the Personalizer average reward. Analyze images Tags Classify images "Image classification (multiclass) Detect, analyze, and recognize faces Location Analyze video Use the
Azure AI Vision service to extract key frames from the video. Build a question answering solution Create an empty knowledge base and manually enter the FAQ questions and answers. Build a conversational language understanding model Intents Develop an app with Azure AI Language Sentiment analysis Create a custom text classification solution A
multiple label classification project Create a custom named entity extraction solution Recall Translate text with the Azure AI Translator service Detect Create speech-enabled apps with Azure AI services The location and one of the keys Translate speech with the Azure AI Speech service SpeechConfig Create an Azure Cognitive Search solution Add a
JSON file that defines an Azure AI Search index to the blob container. Create a custom skill for Azure Cognitive Search Create a custom skill that uses an Azure Machine Learning model to predict the sentiment for a document. Create a knowledge store with Azure Cognitive Search Merge Enrich a search index using Language Studio Conversational
language understanding. Implement advanced search features in Azure Cognitive Search ^ Build an Azure Machine Learning custom skill for Azure Cognitive Search Real-time endpoint Maintain an Azure Cognitive Search Solution Create an Azure Cognitive Search service with a Storage Optimized service tier and at least two replicas. Use semantic
search to get better search results in Azure Cognitive Search As many results as the BM25 ranking function returns. Improve search results using vector search in Azure Cognitive Search To create a search to match text input. Plan an Azure AI Document Intelligence solution A Composed model. Use prebuilt Azure AI Document Intelligence models Read

model. Create a composed Form Recognizer model modelId Generate code with Azure OpenAI Service Increase in efficiency and productivity Generate images with Azure OpenAI Service GPT-35-Turbo Fundamentals of Responsible Generative AI To make a legal case that indemnifies you from responsibility for AI Engineer Skill Assessment - Mar 4, 2025
- 1:05:49 PM Your overall results Low '10/35' Azure AI Fundamentals Low '0/4' Designing and Implementing a Microsoft Azure AI Solution Moderate '10/31' Category Link-Text Link Priority ReportingCategory ReportingSubcategory Weight Context CompleteY/N Note Azure AI Fundamentals https://learn.microsoft.com High 0 N Azure AI Fundamentals
Microsoft Azure AI Fundamentals: Computer Vision https://learn.microsoft.com/en-us/training/paths/explore-computer-vision-microsoft-azure/ High 0 N Azure AI Fundamentals Microsoft Azure AI Fundamentals: Natural Language Processing https://learn.microsoft.com/en-us/training/paths/explore-natural-language-processing/ High 0 N Azure AI
Fundamentals Microsoft Azure AI Fundamentals: Document Intelligence and Knowledge Mining https://learn.microsoft.com/en-us/training/paths/document-intelligence-knowledge-mining/ High 0 N Azure AI Fundamentals Microsoft Azure AI Fundamentals: Generative AI https://learn.microsoft.com/en-us/training/paths/introduction-generative-ai/ High 0 N
Designing and Implementing a Microsoft Azure AI Solution https://learn.microsoft.com High 0 N Designing and Implementing a Microsoft Azure AI Solution Get started with Azure AI Services https://learn.microsoft.com/en-us/training/paths/get-started-azure-ai/ High 0 N Designing and Implementing a Microsoft Azure AI Solution Develop decision support
solutions with Azure AI Services https://learn.microsoft.com/en-us/training/paths/develop-decision-support/ High 0 N Designing and Implementing a Microsoft Azure AI Solution Create computer vision solutions with Azure AI Vision https://learn.microsoft.com/en-us/training/paths/create-computer-vision-solutions-azure-ai/ High 0 N Designing and
Implementing a Microsoft Azure AI Solution Develop natural language processing solutions with Azure AI Services https://learn.microsoft.com/en-us/training/paths/develop-language-solutions-azure-ai/ High 0 N Designing and Implementing a Microsoft Azure AI Solution Implement knowledge mining with Azure Cognitive Search https://learn.microsoft.com/
en-us/training/paths/implement-knowledge-mining-azure-cognitive-search/ High 0 N Designing and Implementing a Microsoft Azure AI Solution Develop solutions with Azure AI Document Intelligence https://learn.microsoft.com/en-us/training/paths/extract-data-from-forms-document-intelligence/ High 0 N Designing and Implementing a Microsoft Azure AI
Solution Develop Generative AI solutions with Azure OpenAI Service https://learn.microsoft.com/en-us/training/paths/develop-ai-solutions-azure-openai/ High 0 N ---------- Category Question Answers Selected Answer Note Azure AI Fundamentals Fundamental AI Concepts Azure Machine Learning Azure AI Fundamentals Fundamental AI Concepts Azure
AI Bot Service Azure AI Bot Service Azure AI Fundamentals Fundamental AI Concepts Azure AI Language Azure AI Fundamentals Fundamentals of machine learning Regression Azure AI Fundamentals Fundamentals of machine learning Classification Azure AI Fundamentals Fundamentals of machine learning Clustering Azure AI Fundamentals
Fundamentals of Azure AI services A multi-service resource that includes all the AI services Azure AI Fundamentals Fundamentals of Azure AI services A single-service resource for each AI service Azure AI Fundamentals Fundamentals of Azure AI services It's not possible to see costs for individual AI services Azure AI Fundamentals Fundamentals of
Computer Vision Timestamps in photograph metadata Azure AI Fundamentals Fundamentals of Computer Vision Pixels Azure AI Fundamentals Fundamentals of Computer Vision Image file names Azure AI Fundamentals Fundamentals of Facial Recognition A pair of coordinates for each face, indicating the center of the face Azure AI Fundamentals
Fundamentals of Facial Recognition Two pairs of coordinates for each face, indicating the location of the eyes Azure AI Fundamentals Fundamentals of Facial Recognition A set of coordinates for each face, defining a rectangular bounding box around the face Azure AI Fundamentals Fundamentals of optical character recognition Azure AI Vision Azure AI
Fundamentals Fundamentals of optical character recognition Azure AI services Azure AI Fundamentals Fundamentals of optical character recognition Azure AI Language Azure AI Fundamentals Fundamentals of Text Analysis with the Language Service Sentiment analysis Azure AI Fundamentals Fundamentals of Text Analysis with the Language Service
Key phrase extraction Azure AI Fundamentals Fundamentals of Text Analysis with the Language Service Entity detection Azure AI Fundamentals Fundamentals of question answering with the Language Service "Create an empty knowledge base, and then manually copy and paste the FAQ entries into it. "Create an empty knowledge base, and then
manually copy and paste the FAQ entries into it. Azure AI Fundamentals Fundamentals of question answering with the Language Service Import the existing FAQ document into a new knowledge base. Azure AI Fundamentals Fundamentals of question answering with the Language Service Import a pre-defined chit-chat data source. Azure AI
Fundamentals Fundamentals of conversational language understanding Azure AI Speech Azure AI Fundamentals Fundamentals of conversational language understanding Azure AI Language Azure AI Fundamentals Fundamentals of conversational language understanding Azure AI services Azure AI Fundamentals Fundamentals of Azure AI Speech
Speech Azure AI Fundamentals Fundamentals of Azure AI Speech Language Azure AI Fundamentals Fundamentals of Azure AI Speech Azure AI services Azure AI Fundamentals Fundamentals of Azure AI Document Intelligence Azure AI Vision resource Azure AI Vision resource Azure AI Fundamentals Fundamentals of Azure AI Document Intelligence
Azure AI Document Intelligence or Azure AI services resource. Azure AI Fundamentals Fundamentals of Azure AI Document Intelligence Azure AI Language resource. Azure AI Fundamentals Fundamentals of Knowledge Mining with Azure Cognitive Search CSV Azure AI Fundamentals Fundamentals of Knowledge Mining with Azure Cognitive Search
SQL Azure AI Fundamentals Fundamentals of Knowledge Mining with Azure Cognitive Search JSON Azure AI Fundamentals Fundamentals of Generative AI Models that only work with one language. Azure AI Fundamentals Fundamentals of Generative AI Models that only work with small amounts of data. Azure AI Fundamentals Fundamentals of
Generative AI Models that use deep learning to process and understand natural language on a massive scale. Azure AI Fundamentals Fundamentals of Azure OpenAI Service Azure OpenAI is Microsoft's version of ChatGPT, a chatbot that uses generative AI models. Azure OpenAI is Microsoft's version of ChatGPT, a chatbot that uses generative AI
models. Azure AI Fundamentals Fundamentals of Azure OpenAI Service ChatGPT and OpenAI are chatbots that generate natural language, code, and images. Azure OpenAI provides access to these two chatbots. Azure AI Fundamentals Fundamentals of Azure OpenAI Service OpenAI is a research company that developed ChatGPT, a chatbot that uses
generative AI models. Azure OpenAI provides access to many of OpenAI's AI models. Azure AI Fundamentals Fundamentals of Responsible Generative AI To make a legal case that indemnifies you from responsibility for harms caused by the solution Azure AI Fundamentals Fundamentals of Responsible Generative AI To document the purpose, expected
use, and potential harms for the solution Azure AI Fundamentals Fundamentals of Responsible Generative AI To evaluate the cost of cloud services required to implement your solution Designing and Implementing a Microsoft Azure AI Solution Prepare to develop AI solutions on Azure Absolutely correct values based on conditional logic. Absolutely correct
values based on conditional logic. Designing and Implementing a Microsoft Azure AI Solution Prepare to develop AI solutions on Azure Randomly selected values with an equal chance of selection. Designing and Implementing a Microsoft Azure AI Solution Prepare to develop AI solutions on Azure Probabilistic values based on correlations found in training
data. Designing and Implementing a Microsoft Azure AI Solution Create and consume Azure AI services The application must specify a valid subscription key for the Azure resource. Designing and Implementing a Microsoft Azure AI Solution Create and consume Azure AI services The user of the application must enter a user name and password
associated with the Azure subscription. Designing and Implementing a Microsoft Azure AI Solution Create and consume Azure AI services Access to Azure AI Services is granted to anonymous users by default. Designing and Implementing a Microsoft Azure AI Solution Secure Azure AI services Switch the app to use the secondary key Switch the app to
use the secondary key Designing and Implementing a Microsoft Azure AI Solution Secure Azure AI services Change the resource endpoint Designing and Implementing a Microsoft Azure AI Solution Secure Azure AI services Enable a firewall Designing and Implementing a Microsoft Azure AI Solution Monitor Azure AI services Create an alert. Designing
and Implementing a Microsoft Azure AI Solution Monitor Azure AI services Configure diagnostic settings. Designing and Implementing a Microsoft Azure AI Solution Monitor Azure AI services Create a dashboard. Designing and Implementing a Microsoft Azure AI Solution Deploy Azure AI services in containers Client applications must pass a subscription
key to the Azure resource endpoint before using the container. Client applications must pass a subscription key to the Azure resource endpoint before using the container. Designing and Implementing a Microsoft Azure AI Solution Deploy Azure AI services in containers The container must be able to connect to the Azure resource endpoint to send usage
data for billing. Designing and Implementing a Microsoft Azure AI Solution Deploy Azure AI services in containers All data passed from the client application to the container is forwarded to the Azure resource endpoint. Designing and Implementing a Microsoft Azure AI Solution Make recommendations with Azure AI Personalizer In the Azure portal, go to
the Monitor page for your AI Personalizer resource, and view the Personalizer average reward. In the Azure portal, go to the Monitor page for your AI Personalizer resource, and view the Personalizer average reward. Designing and Implementing a Microsoft Azure AI Solution Make recommendations with Azure AI Personalizer In the Azure portal, go to the
Monitor page for your AI Personalizer resource, and view the Baseline average reward. Designing and Implementing a Microsoft Azure AI Solution Make recommendations with Azure AI Personalizer In the Azure portal, go to the Monitor page for your AI Personalizer resource, and view the Reward achievement ratio. Designing and Implementing a
Microsoft Azure AI Solution Analyze images Tags Tags Designing and Implementing a Microsoft Azure AI Solution Analyze images Description Designing and Implementing a Microsoft Azure AI Solution Analyze images Categories Designing and Implementing a Microsoft Azure AI Solution Classify images "Image classification (multiclass) "Image
classification (multiclass) Designing and Implementing a Microsoft Azure AI Solution Classify images Image classification (multilabel) Designing and Implementing a Microsoft Azure AI Solution Classify images Object detection Designing and Implementing a Microsoft Azure AI Solution Detect objects in images The location and class of specific classes of
object in an image. Designing and Implementing a Microsoft Azure AI Solution Detect objects in images The class of the main subject of an image. Designing and Implementing a Microsoft Azure AI Solution Detect objects in images The file type of an image. Designing and Implementing a Microsoft Azure AI Solution Detect, analyze, and recognize faces
Location Location Designing and Implementing a Microsoft Azure AI Solution Detect, analyze, and recognize faces Type of eye-glasses Designing and Implementing a Microsoft Azure AI Solution Detect, analyze, and recognize faces Occlusion Designing and Implementing a Microsoft Azure AI Solution Read Text in Images and Documents with the Azure
AI Vision Service Only total content and pages of text. Designing and Implementing a Microsoft Azure AI Solution Read Text in Images and Documents with the Azure AI Vision Service Pages, words and lines of text. Designing and Implementing a Microsoft Azure AI Solution Read Text in Images and Documents with the Azure AI Vision Service Total
content, pages, words and lines of text. Designing and Implementing a Microsoft Azure AI Solution Analyze video Use the Azure AI Vision service to extract key frames from the video. Use the Azure AI Vision service to extract key frames from the video. Designing and Implementing a Microsoft Azure AI Solution Analyze video Upload the video to Azure
Video Indexer and index it. Designing and Implementing a Microsoft Azure AI Solution Analyze video Store the video file in an Azure blob store container. Designing and Implementing a Microsoft Azure AI Solution Analyze text with Azure AI Language Use the Azure AI Language service to extract key phrases. Designing and Implementing a Microsoft Azure
AI Solution Analyze text with Azure AI Language Use the Azure AI Language service to perform sentiment analysis of the comments. Designing and Implementing a Microsoft Azure AI Solution Analyze text with Azure AI Language Use the Azure AI Language service to extract named entities from the comments. Designing and Implementing a Microsoft
Azure AI Solution Build a question answering solution Create an empty knowledge base and manually enter the FAQ questions and answers. Create an empty knowledge base and manually enter the FAQ questions and answers. Designing and Implementing a Microsoft Azure AI Solution Build a question answering solution Create a new knowledge base,
importing the existing FAQ document. Designing and Implementing a Microsoft Azure AI Solution Build a question answering solution "Create a new knowledge base, selecting only the Professional chit-chat source. Designing and Implementing a Microsoft Azure AI Solution Build a conversational language understanding model Intents Intents Designing
and Implementing a Microsoft Azure AI Solution Build a conversational language understanding model Utterances Designing and Implementing a Microsoft Azure AI Solution Build a conversational language understanding model Entities Designing and Implementing a Microsoft Azure AI Solution Develop an app with Azure AI Language Sentiment analysis
Sentiment analysis Designing and Implementing a Microsoft Azure AI Solution Develop an app with Azure AI Language Key phrase extraction Designing and Implementing a Microsoft Azure AI Solution Develop an app with Azure AI Language Entity recognition Designing and Implementing a Microsoft Azure AI Solution Create a custom text classification
solution A single label classification project Designing and Implementing a Microsoft Azure AI Solution Create a custom text classification solution A multiple label classification project A multiple label classification project Designing and Implementing a Microsoft Azure AI Solution Create a custom text classification solution A varied label classification project
Designing and Implementing a Microsoft Azure AI Solution Create a custom named entity extraction solution Recall Recall Designing and Implementing a Microsoft Azure AI Solution Create a custom named entity extraction solution Precision Designing and Implementing a Microsoft Azure AI Solution Create a custom named entity extraction solution F1
score Designing and Implementing a Microsoft Azure AI Solution Translate text with the Azure AI Translator service Detect Detect Designing and Implementing a Microsoft Azure AI Solution Translate text with the Azure AI Translator service Translate Designing and Implementing a Microsoft Azure AI Solution Translate text with the Azure AI Translator
service Transliterate Designing and Implementing a Microsoft Azure AI Solution Create speech-enabled apps with Azure AI services The location and one of the keys The location and one of the keys Designing and Implementing a Microsoft Azure AI Solution Create speech-enabled apps with Azure AI services The primary and secondary keys Designing
and Implementing a Microsoft Azure AI Solution Create speech-enabled apps with Azure AI services The endpoint and one of the keys Designing and Implementing a Microsoft Azure AI Solution Translate speech with the Azure AI Speech service SpeechConfig SpeechConfig Designing and Implementing a Microsoft Azure AI Solution Translate speech with
the Azure AI Speech service SpeechTranslationConfig Designing and Implementing a Microsoft Azure AI Solution Translate speech with the Azure AI Speech service AudioConfig Designing and Implementing a Microsoft Azure AI Solution Create an Azure Cognitive Search solution Add a JSON file that defines an Azure AI Search index to the blob
container. Add a JSON file that defines an Azure AI Search index to the blob container. Designing and Implementing a Microsoft Azure AI Solution Create an Azure Cognitive Search solution Enable anonymous access for the blob container. Designing and Implementing a Microsoft Azure AI Solution Create an Azure Cognitive Search solution In an Azure AI
Services resource, and add a data source that references the container where the files are stored. Designing and Implementing a Microsoft Azure AI Solution Create a custom skill for Azure Cognitive Search Create a custom skill that uses an Azure Machine Learning model to predict the sentiment for a document. Create a custom skill that uses an Azure
Machine Learning model to predict the sentiment for a document. Designing and Implementing a Microsoft Azure AI Solution Create a custom skill for Azure Cognitive Search Create a custom skill that calls the Azure AI Language service to predict the sentiment of each document. Designing and Implementing a Microsoft Azure AI Solution Create a custom
skill for Azure Cognitive Search Add the built-in Sentiment skill to the skillset used by the indexer. Designing and Implementing a Microsoft Azure AI Solution Create a knowledge store with Azure Cognitive Search Merge Merge Designing and Implementing a Microsoft Azure AI Solution Create a knowledge store with Azure Cognitive Search Shaper
Designing and Implementing a Microsoft Azure AI Solution Create a knowledge store with Azure Cognitive Search Split Designing and Implementing a Microsoft Azure AI Solution Enrich a search index using Language Studio Conversational language understanding. Conversational language understanding. Designing and Implementing a Microsoft Azure
AI Solution Enrich a search index using Language Studio Analyze sentiment. Designing and Implementing a Microsoft Azure AI Solution Enrich a search index using Language Studio Custom text classification. Designing and Implementing a Microsoft Azure AI Solution Implement advanced search features in Azure Cognitive Search + Designing and
Implementing a Microsoft Azure AI Solution Implement advanced search features in Azure Cognitive Search ^ ^ Designing and Implementing a Microsoft Azure AI Solution Implement advanced search features in Azure Cognitive Search ! Designing and Implementing a Microsoft Azure AI Solution Build an Azure Machine Learning custom skill for Azure
Cognitive Search Real-time endpoint Real-time endpoint Designing and Implementing a Microsoft Azure AI Solution Build an Azure Machine Learning custom skill for Azure Cognitive Search Web service Designing and Implementing a Microsoft Azure AI Solution Build an Azure Machine Learning custom skill for Azure Cognitive Search Batch endpoint
Designing and Implementing a Microsoft Azure AI Solution Search data outside the Azure platform in Azure Cognitive Search using Azure Data Factory You can only upload one document at a time. Designing and Implementing a Microsoft Azure AI Solution Search data outside the Azure platform in Azure Cognitive Search using Azure Data Factory The
JSON can't contain complex data types like arrays. Designing and Implementing a Microsoft Azure AI Solution Search data outside the Azure platform in Azure Cognitive Search using Azure Data Factory You have to define the index in the Azure portal first. Designing and Implementing a Microsoft Azure AI Solution Maintain an Azure Cognitive Search
Solution Create an Azure Cognitive Search service with a Storage Optimized service tier and at least two replicas. Create an Azure Cognitive Search service with a Storage Optimized service tier and at least two replicas. Designing and Implementing a Microsoft Azure AI Solution Maintain an Azure Cognitive Search Solution Create an Azure Cognitive
Search service with any Standard service tier and at least three replicas. Designing and Implementing a Microsoft Azure AI Solution Maintain an Azure Cognitive Search Solution Create an Azure Cognitive Search service with a High-density service tier and one replica. Designing and Implementing a Microsoft Azure AI Solution Use semantic search to get
better search results in Azure Cognitive Search Up to 50. Designing and Implementing a Microsoft Azure AI Solution Use semantic search to get better search results in Azure Cognitive Search As many results as the BM25 ranking function returns. As many results as the BM25 ranking function returns. Designing and Implementing a Microsoft Azure AI
Solution Use semantic search to get better search results in Azure Cognitive Search Up to 25. Designing and Implementing a Microsoft Azure AI Solution Improve search results using vector search in Azure Cognitive Search To create a search to match text input. To create a search to match text input. Designing and Implementing a Microsoft Azure AI
Solution Improve search results using vector search in Azure Cognitive Search When you need to find matches across different types of data. from a search index. Designing and Implementing a Microsoft Azure AI Solution Improve search results using vector search in Azure Cognitive Search To upload and index a document library. Designing and
Implementing a Microsoft Azure AI Solution Plan an Azure AI Document Intelligence solution A Read model. Designing and Implementing a Microsoft Azure AI Solution Plan an Azure AI Document Intelligence solution A Layout model. Designing and Implementing a Microsoft Azure AI Solution Plan an Azure AI Document Intelligence solution A Composed
model. A Composed model. Designing and Implementing a Microsoft Azure AI Solution Use prebuilt Azure AI Document Intelligence models Read model. Read model. Designing and Implementing a Microsoft Azure AI Solution Use prebuilt Azure AI Document Intelligence models General document model. Designing and Implementing a Microsoft Azure AI
Solution Use prebuilt Azure AI Document Intelligence models ID document model. Designing and Implementing a Microsoft Azure AI Solution Extract data from forms with Azure Document Intelligence Train Model and Get Model Labels Designing and Implementing a Microsoft Azure AI Solution Extract data from forms with Azure Document Intelligence
Analyze Invoice and Get Analyze Invoice Result Designing and Implementing a Microsoft Azure AI Solution Extract data from forms with Azure Document Intelligence Create Azure Document Intelligence and Get Analyze Invoice Result Designing and Implementing a Microsoft Azure AI Solution Create a composed Form Recognizer model modelId modelId
Designing and Implementing a Microsoft Azure AI Solution Create a composed Form Recognizer model status Designing and Implementing a Microsoft Azure AI Solution Create a composed Form Recognizer model docType Designing and Implementing a Microsoft Azure AI Solution Build an Azure AI Document Intelligence custom skill for Azure Cognitive
Search formUrl Designing and Implementing a Microsoft Azure AI Solution Build an Azure AI Document Intelligence custom skill for Azure Cognitive Search recordId Designing and Implementing a Microsoft Azure AI Solution Build an Azure AI Document Intelligence custom skill for Azure Cognitive Search formSasToken Designing and Implementing a
Microsoft Azure AI Solution Get started with Azure OpenAI Service text-davinci-003 Designing and Implementing a Microsoft Azure AI Solution Get started with Azure OpenAI Service gpt-35-turbo Designing and Implementing a Microsoft Azure AI Solution Get started with Azure OpenAI Service text-embedding-ada-002 (Version 2) Designing and
Implementing a Microsoft Azure AI Solution Build natural language solutions with Azure OpenAI Service Chat, Embedding, and Completion Designing and Implementing a Microsoft Azure AI Solution Build natural language solutions with Azure OpenAI Service Key, Endpoint, and Deployment name Designing and Implementing a Microsoft Azure AI Solution
Build natural language solutions with Azure OpenAI Service Summary, Deployment name, and Endpoint Designing and Implementing a Microsoft Azure AI Solution Apply prompt engineering with Azure OpenAI Service By using complex instructions that are difficult to understand Designing and Implementing a Microsoft Azure AI Solution Apply prompt
engineering with Azure OpenAI Service By providing clear and descriptive instructions Designing and Implementing a Microsoft Azure AI Solution Apply prompt engineering with Azure OpenAI Service By using vague prompts Designing and Implementing a Microsoft Azure AI Solution Generate code with Azure OpenAI Service Increase in efficiency and
productivity Increase in efficiency and productivity Designing and Implementing a Microsoft Azure AI Solution Generate code with Azure OpenAI Service Increase in bugs and readability Designing and Implementing a Microsoft Azure AI Solution Generate code with Azure OpenAI Service Increase in time spent coding Designing and Implementing a
Microsoft Azure AI Solution Generate images with Azure OpenAI Service DALL-E Designing and Implementing a Microsoft Azure AI Solution Generate images with Azure OpenAI Service GPT-35-Turbo GPT-35-Turbo Designing and Implementing a Microsoft Azure AI Solution Generate images with Azure OpenAI Service Text-Davinci Designing and
Implementing a Microsoft Azure AI Solution Use your own data with Azure OpenAI Service Create their own AI chat models Designing and Implementing a Microsoft Azure AI Solution Use your own data with Azure OpenAI Service Access Azure OpenAI without an approved subscription Designing and Implementing a Microsoft Azure AI Solution Use your
own data with Azure OpenAI Service Use supported AI chat models that can reference specific sources of data Designing and Implementing a Microsoft Azure AI Solution Fundamentals of Responsible Generative AI To make a legal case that indemnifies you from responsibility for harms caused by the solution. To make a legal case that indemnifies you
from responsibility for harms caused by the solution. Designing and Implementing a Microsoft Azure AI Solution Fundamentals of Responsible Generative AI To document the purpose, expected use, and potential harms for the solution. Designing and Implementing a Microsoft Azure AI Solution Fundamentals of Responsible Generative AI To evaluate the
cost of cloud services required to implement your solution. Your overall results EXCELLENT You are all set! Your results look strong and meet the necessary criteria for success. CRITICAL 0-33 Critical: 0 to 33 MODERATE 33-67 Moderate: 33 to 67 EXCELLENT 67-100 Excellent: 67 to 100 Your result: 100/100 100 out of 100 Categories that influenced
your results Azure Machine Learning: Cost Optimization EXCELLENT Azure Machine Learning: Operational Excellence EXCELLENT Azure Machine Learning: Performance Efficiency EXCELLENT Azure Machine Learning: Reliability EXCELLENT Azure Machine Learning: Security EXCELLENT You can find out how to improve on individual categories by
reviewing the recommendations below in the report. Azure Machine Learning: Cost Optimization What steps are you taking to optimize cloud costs in Azure Machine Learning? We use cost management tools to plan and track costs. We identify and use the right-sized compute for machine learning models. We're considering the use of local compute or
remote managed compute for automated machine learning to reduce costs. We optimize our cloud investment with cost management. We use an appropriately sized compute instance and compute cluster for training and inference. None of the above. How does your organization model and monitor cloud costs for Azure Machine Learning? We plan and
manage costs for Azure Machine Learning. We utilize cost alerts for Azure Machine Learning. We create and manage Azure budgets. None of the above. What actions do you typically take for cost optimization in Azure Machine Learning? We configure our training clusters to autoscale. We set quotas on our subscription and workspaces. We set
termination policies on our training job. We use low-priority virtual machines (VMs). We schedule compute instances to shut down and start up automatically. We use an Azure Reserved VM Instance. We train locally. We parallelize training. We set data retention and deletion policies. We deploy resources to the same region. How do you ensure that you
have sufficient capacity? We adhere to Azure Machine Learning subscription limits for compute and pipelines. We review service limits in Azure Machine Learning. We adhere to Azure Machine Learning subscription limits for storage. None of the above. Azure Machine Learning: Operational Excellence How are you managing your machine learning
lifecycle through automation using MLOps? We use machine learning pipelines to orchestrate the workflow. We use GitHub Actions with Azure Machine Learning. We use MLFlow to track and manage ML modeling projects. We use the Team Data Science Process for the data science project lifecycle. None of the above. What considerations are you
making around the deployment of your infrastructure? We segregate environments into development, test, and production workspaces. We understand the Azure subscription limits that might impact this workload. We use the Azure security baseline for Azure Machine Learning. We set up separate workspaces for each publish environment. None of the
above. How is development done on Azure Machine Learning workloads? We use Python SDK or CLI to develop machine learning jobs. We use low-code Azure Machine Learning designer to author experiments. We use the Azure Machine Learning Notebook or Jupyter Notebook to author the experiment. We use Azure Machine Learning automated GUI

to author the experiment. We use ONNX and deep learning libraries, such as Tensorflow, PyTorch, Keras, and others. We use Responsible AI in our development practice. None of the above. How do you monitor your Azure Machine Learning deployments? We monitor a deployed model by collecting and evaluating model data. We enable logging in
machine learning training runs. We use alert rules and events in our application. We analyze Azure Machine Learning platform metrics and logs from Azure Monitor. None of the above. How do you manage the configuration of Azure Machine Learning deployments? We use code-based (SDK or CLI) definitions of our training jobs. We use code-based
definitions of our compute targets. None of the above. How do you test your MLOps infrastructure? We use unit, regression, and integration testing with CI/CD for MLOps. None of the above. Azure Machine Learning: Performance Efficiency How are you designing your Azure Machine Learning training workload to scale? We use data partitioning strategy to
run experiments in parallel, if possible. We use autoscaling on clusters, where appropriate. We use Azure Machine Learning pipeline step to process large amounts of data asynchronously and in parallel. None of the above. How are you designing your Azure Machine Learning service to meet performance requirements? We use appropriate compute SKUs
and sizes for different machine learning workloads. We use the appropriate compute target types based on your workload requirements and environments. We use datastore and dataset mounts for reusability throughout workload. For unstructured files, we optimize performance by mounting data files to the compute target. We use advanced automated ML
options to increase performance/ROI on experiment run time. How do you optimize data processing speeds for Azure Machine Learning workloads? We set up Azure Machine Learning datastores/datasets to connect and access data from various storage services. We use distributed training with Azure Machine Learning, where possible. We use datasets/
datastores to improve manageability, performance, and scale when working with data. How do you monitor model performance and lifecycle activities? We leverage Azure Machine Learning monitoring capabilities, such as model run logs and metrics. We enable logging in Azure Machine Learning training runs. We use Azure Monitor to monitor the
performance of our model. We leverage the Azure Machine Learning workspace job console to track workload progress. How do you autoscale Azure Machine Learning compute resources to handle performance for training and inferencing? We leverage Azure Machine Learning capabilities to autoscale the training compute nodes based on our
benchmarking. We leverage multinode scaling capabilities for model training. We leverage production-grade model deployment and autoscaling inference using Azure Kubernetes Service cluster. Azure Machine Learning: Reliability What reliability considerations have you defined for your Azure Machine Learning workload? We use a Managed Batch
Endpoint for parallel batch processing. We use a Managed Endpoint for scalable, self-managed service. We use Azure Kubernetes Service (AKS) for high-scale production deployments with fast response time. We manage and increase quotas for resources with Azure Machine Learning. None of the above. How do you ensure that your application
architecture is resilient to failures? We version and track Azure Machine Learning datasets. We enable logging in machine learning training runs to support handling exceptions and errors. We publish Azure Machine Learning components and environments. None of the above. What decisions have you made to ensure the application platform meets your
reliability requirements? We use scaling options for applications in Azure Kubernetes Service (AKS). We use a managed endpoint for scalable deployments. We manage a compute cluster in your Azure Machine Learning workspace. We built a failover plan for business continuity and disaster recovery to respond to failures and disasters. None of the above.
How do you monitor and measure both the health of a training run and the health of deployed service? We collect machine learning log files in Application Insights. We version and track Azure Machine Learning datasets. We use native application monitoring. None of the above. What framework do you use to interpret ML models and help train unbiased
models? We check trained models for fairness. We perform error analysis for trained models for reliability and safety. We interpret trained models for transparency. We perform causal analysis to understand how data impacts model decisions. None of the above. Azure Machine Learning: Security What design considerations did you make in your workload
in regard to security? We use role-based access control (RBAC) to manage access to Azure Machine Learning workspaces. We use Microsoft Entra ID for identity management and authentication of Azure Machine Learning users and processes for Azure Machine Learning resources and workflows. We use MLOps practices for security guidance, model
management, deployment, and monitoring with Azure Machine Learning. We use appropriate recommendations for the Azure Machine Learning security baseline to improve security posture. We review and implement appropriate guidelines from Azure Machine Learning best practices for enterprise security. None of the above. What considerations for
compliance and governance have you made for your Azure Machine Learning workload? We implemented a security and governance plan in accordance with guidance. We audit and manage Azure Machine Learning using Azure Policy. None of the above. How do you manage encryption for workloads? We use data encryption with Azure Machine
Learning. None of the above. How do you manage identity for Azure Machine Learning workloads? When running Azure Machine Learning workloads in Azure Kubernetes Service, we use Microsoft Entra Workload ID with Azure Machine Learning. We use managed identities with Azure Machine Learning for access control. None of the above. How have
you secured the network for your workload? We use virtual networks (VNets) to secure an Azure Machine Learning workspace during setup. We use virtual networks (VNets) to secure an Azure Machine Learning training environment. We configured Azure Private Link for Azure Machine Learning to enable private endpoint for inferencing. We secured an
Azure Machine Learning inferencing environment with virtual networks (VNets). We use Azure Machine Learning studio in an Azure virtual network (VNet). We use TLS to secure web service through Azure Machine Learning. None of the above. How do you adhere to responsible ML principles in your design? We use practices to protect users' data privacy
in machine learning. We work on encrypted data with homomorphic encryption. We use model interpretability with Azure Machine Learning. We assess fairness in machine learning models using open-source packages in Azure Machine Learning. We perform causal inference on trained models. Your overall results EXCELLENT You are all set! Your results
look strong and meet the necessary criteria for success. CRITICAL 0-2 Critical: 0 to 2 MODERATE 2-4 Moderate: 2 to 4 EXCELLENT 4-6 Excellent: 4 to 6 Your result: 6/6 6 out of 6 Categories that influenced your results AVS | Readiness Resources EXCELLENT AVS | Marketplace Offer Development Resources EXCELLENT AVS | Specialization
Resources EXCELLENT AVS | Cosell Acceleration Resources EXCELLENT You can find out how to improve on individual categories by reviewing the recommendations below in the report. AVS | Readiness Resources Opportunity and Use Cases Migrating VMware vSphere workloads to Azure VMware Solution Extending hybrid and multi-cloud agility High
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marketplace/plan-consulting-service-offer High 0 N AVS | Marketplace Offer Development Resources Partner Got-To-Market Toolbox http://aka.ms/gtmtoolbox High 0 N AVS | Specialization Resources Specialization Overview https://aka.ms/AVSSpecial High 0 N AVS | Specialization Resources Specialization Video https://aka.ms/AVSAdvSpecVideo High 0
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7.Mar 4 You edited a plan plan Implementing data integration and model grounding with Azure AI Foundry and Microsoft Fabric o13 items 8.Mar 4 You started a plan plan Implementing data integration and model grounding with Azure AI Foundry and Microsoft Fabric o13 items 9.Mar 4 You edited a plan plan Build AI apps with Azure Services and best
practices o20 items 10.Mar 4 You started a plan plan Build AI apps with Azure Services and best practices o20 items 11.Mar 4 You edited a plan plan Accelerate app development by using GitHub Copilot o23 items 12.Mar 4 You started a plan plan Accelerate app development by using GitHub Copilot o33 items 13.Mar 4 You edited a plan plan Help secure
your data in the age of AI o4 items 14.Mar 4 You started a plan plan Help secure your data in the age of AI o4 items 15.Feb 28 You created a Collection collection 46307064's Collection 9 o0 item Your activity feed shows up to 30 interactions over the past 30 days. Previo g data issue rural system information management system education 46307064 0
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While the words "digital transformation" can sometimes seem repetitive, we are indeed in a digital era, where so much of our technology is dramatically changing. Cloud has evolved from being a virtual non-entity to exerting a significant influence on networking, data center, security, analytics, and virtualization. At the same time, cybersecurity has become
critical across all technology sectors and is constantly evolving to counter increasingly sophisticated cyberattacks. Other transforming technologies include the data center, which now plays a central role in the business landscape. The Internet of Things is now vitally important to our digital lives in its ability to connect a staggering amount of data and
devices. And software-defined networking (SDN) has ushered in a sea change in how we can manage networks via automation. But through it all, routing and switching remain the core foundation of knowledge from which IT networking professionals can build their career as they learn to Connect, Secure, and Automate. These vibrant technological
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proceeded to study up and earn several additional certifications. She likes the fact that certifications are a stamp of approval. While she may not have extensive experience that others have, her certifications ensure she has the knowledge to discuss topics and tackle solutions. > Read on for more details about Keisha. “The time and effort that you put into
earning a certification says more about you as a professional than the certification itself.” —Keisha Richardson, Technical Solutions Specialist Versatility: A robust certification portfolio allows you to make forays into different technology arenas, using those added skills to enhance your current strengths and discover new interests. 75 percent of candidates
were able to perform a task or fill a role that they were not able to before certification.10 Benefit 2 | Skill Benefit 3 | Validation Benefit 4 | Credibility Benefit 5 | Responsibility Benefit 6 | Confidence Benefit 7 | Value Benefit 8 | Versatility Benefit 9 | Opportunity Benefit 10 | Hireability Benefit 11 | Advancement Benefit 12 | Salary Benefit 13 | Lifelong Learning
Benefit 1 | Knowledge Why get certified Summary Certification benefits© 2022 Cisco and/or its affiliates. All rights reserved. 12 eBook Cisco Public Meet Ronald Boestfleisch, Jr. Eight years as a help desk rep had brought Ronald Boestfleisch’s career to a standstill. But he was inspired to become a network engineer and used a bachelor’s degree and four
Cisco certifications to propel himself into his chosen field. It was a lot of hard work, but opportunity has knocked as a result. Ronald has now positioned himself for senior network engineering roles. Opportunity: Those who certify and gain new skills and knowledge in the process stand a greater chance of breaking out of possible job silos, taking advantage
of cross-functional team roles, and being in better position for an exciting career change. There are almost a million networking job openings in the US alone.11 Benefit 2 | Skill Benefit 3 | Validation Benefit 4 | Credibility Benefit 5 | Responsibility Benefit 6 | Confidence Benefit 7 | Value Benefit 8 | Versatility Benefit 9 | Opportunity Benefit 10 | Hireability
Benefit 11 | Advancement Benefit 12 | Salary Benefit 13 | Lifelong Learning Benefit 1 | Knowledge > Get the full story on Ronald. “Many employers offer incentives to employees who want to better themselves by getting certifications. That way, they gain employees who have more knowledge and skills, and really know what they’re doing. When I say I’m
certified, employers’ ears perk up. It really helps with marketability and is a benchmark for a career.” —Ronald Boestfleisch, Jr., Network Engineer 2, Managed Services Operations, Ops Control Why get certified Summary Certification benefits Employment of software developers is projected to grow 22 percent from 2019 to 2029.12© 2022 Cisco and/or its
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healthcare provider relies on at night to ensure their critical networks stay running. > Read on for more details about John. “I live with Multiple Sclerosis which is a very debilitating disease, however I have overcome all adversity to achieve my dreams.” —John Warren, Service Desk Analyst II Hireability: Time and time again, we hear that certification is one
of those assets that employers automatically look for when it comes time to seek out new talent. 66 percent of IT managers felt that candidates with IT certifications had a better chance of being selected for interviews.13 Benefit 2 | Skill Benefit 3 | Validation Benefit 4 | Credibility Benefit 5 | Responsibility Benefit 6 | Confidence Benefit 7 | Value Benefit 8 |
Versatility Benefit 9 | Opportunity Benefit 10 | Hireability Benefit 11 | Advancement Benefit 12 | Salary Benefit 13 | Lifelong Learning Benefit 1 | Knowledge Why get certified Summary Certification benefits© 2022 Cisco and/or its affiliates. All rights reserved. 14 eBook Cisco Public Meet Aaron Dubin Early on, Aaron knew that he wanted to expand his skills.
But he didn’t have any mentors to guide him along, telling him what to study and how to prepare. Through the certification process, he was able to get expert advice on how to apply his particular interests, and where he should focus his time. He learned how to avoid going down rabbit holes, and what type of preparation would ultimately help him the most
in his career in technology. > Learn more about Aaron. “The value in certification is not in the piece of paper on your wall. It’s in the skills and the confidence you need to take on new challenges or take that next step in your career.” —Aaron Dubin, Systems Engineer Advancement: Being certified gets you noticed by your employer, who is more likely to
remember your initiative when making decisions about your promotion. 56 percent of candidates earned IT certifications to increase their chances of advancing and being promoted in their current roles, by acquiring new skills and knowledge.14 Benefit 2 | Skill Benefit 3 | Validation Benefit 4 | Credibility Benefit 5 | Responsibility Benefit 6 | Confidence
Benefit 7 | Value Benefit 8 | Versatility Benefit 9 | Opportunity Benefit 10 | Hireability Benefit 11 | Advancement Benefit 12 | Salary Benefit 13 | Lifelong Learning Benefit 1 | Knowledge Why get certified Summary Certification benefits© 2022 Cisco and/or its affiliates. All rights reserved. 15 eBook Cisco Public Meet Shane Woolf Shane Woolf has a lot
happening on the home front—he and his wife have built a blended family of two biological children and six foster children. A good salary has helped him with that commitment, and he credits his CCNA Routing and Switching and CCNA Collaboration certifications as helping to pay dividends and get him to his current level as a Senior Unified
Communications Systems Engineer. > Explore further Shane’s path to success. “Cisco certifications helped me springboard my career to senior level— with more responsibilities, a title, and a salary increase. And it helped my employer, too, by giving them one more person to do the function they’re requesting.” —Shane Woolf, Senior Unified
Communications Systems Engineer Salary: As this list demonstrates, there is much more to certification than a fatter paycheck, but with advancement and career progression, more money can follow. 28 percent received a salary or wage increase after earning a certification.15 Benefit 2 | Skill Benefit 3 | Validation Benefit 4 | Credibility Benefit 5 |
Responsibility Benefit 6 | Confidence Benefit 7 | Value Benefit 8 | Versatility Benefit 9 | Opportunity Benefit 10 | Hireability Benefit 11 | Advancement Benefit 12 | Salary Benefit 13 | Lifelong Learning Benefit 1 | Knowledge Why get certified Summary Certification benefits© 2022 Cisco and/or its affiliates. All rights reserved. 16 eBook Cisco Public Benefit 2 |
Skill Benefit 3 | Validation Benefit 4 | Credibility Benefit 5 | Responsibility Benefit 6 | Confidence Benefit 7 | Value Benefit 8 | Versatility Benefit 9 | Opportunity Benefit 10 | Hireability Benefit 11 | Advancement Benefit 12 | Salary Benefit 13 | Lifelong Learning Benefit 1 | Knowledge 86 percent of candidates are likely to recertify in the next 12 months.16 Why
get certified Summary Certification benefits Each of the Cisco students we profiled has a different story, but they all have one thing in common: the will to take that important first step toward advancing their career. That first step was earning a Cisco certification. With this single act, they broadened their knowledge and skillset. They improved their
understanding of networking. They earned more respect from their peers. And they became more marketable. Stake your claim to the future of technology—and the future you want to build for yourself—with Cisco certifications. Your Cisco certification shows the world you have what it takes to work on today’s most advanced networks. Yet as technology
evolves, so must the skills required to keep pace and maintain active certification. We call this the journey of lifelong learning. To learn more, visit Cisco Recertification Policy and Cisco Continuing Education. The 2020 IT Skills and Salary Report from Global Knowledge concludes that achieving a new certification, on average, leads to a $13,000 salary
increase. Lifelong Learning: Since technology and innovation evolve so quickly, it’s important that you stay ahead of the latest advances and keep your skills up to date. In the digital world, you can never automatically assume that you’re completely caught up and know everything—what’s new today can become outdated in seconds.© 2022 Cisco and/or its
affiliates. All rights reserved. 17 eBook Cisco Public Summary We trust that at least some of the 13 reasons to get certified have resonated with you. Our digital era—with all of its excitement and change—dares us to keep up with it. As many of the individuals highlighted in this book have discovered, the pace of innovation in today’s technology arenas
makes it difficult to earn just a single certification and then rest on one’s laurels. Just as businesses must always stay innovative and one step ahead of the curve to thrive, so must you. For many of us, the pace is motivating. Often the conquering of one certification challenge fires us up for the next one— part of a lifelong learning journey to be the best at
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certification transformed their lives. By learning the latest methods and skills to connect, secure, and automate, they gained the self-confidence from setting goals, then accomplishing them. And that self confidence continues to empower them on their career paths. We hope that training and certification empowers—and transforms—your career too. Cisco
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Certification Employer Report, Pearson VUE 6. 2021 Value of IT Certification Employer Report, Pearson VUE 7. 2021 Value of IT Certification Candidate Report, Pearson VUE 8. 2021 Value of IT Certification Candidate Report, Pearson VUE 9. 2020 IT Skills and Salary Report, Global Knowledge 10. 2021 Value of IT Certification Candidate Report, Pearson
VUE 11. U.S. Bureau of Labor Statistics, Occupational Outlook Handbook (Updated: March 2021) 12. U.S. Bureau of Labor Statistics, Occupational Outlook Handbook, Software Developers (Updated: September 2021) 13. 2021 Value of IT Certification Employer Report, Pearson VUE 14. 2021 Value of IT Certification Candidate Report, Pearson VUE 15.
2021 Value of IT Certification Candidate Report, Pearson VUE 16. 2021 Value of IT Certification Candidate Report, Pearson VUE Whether you’re thinking about your first certification or are re-exploring the possibility of an additional credential, we hope that you have found some goal-setting inspiration in the stories of those who have gone the distance and
gotten trained and certified. Why get certified Summary Certification benefits CCNA Certification Guide Top Cisco resources to plan and prepare for certification Get startedTable of Contents 02 Overview 04 Certifications path 06 Vocabulary 10 Training options 11 Exam overview 12 Resources 13 Next steps Overview Certifications path Vocabulary Training
options Exam overview Resources Next steps ©2024 Cisco and/or its affiliates. All rights reserved. CCNA Certification Guide | Public 01CCNA certification overview If you’re looking to embark on a rewarding and lucrative information technology (IT) career, obtaining your CCNA certification is a great place to start. Earning your CCNA gives you a solid
foundation for any field, role, or specialty you want to pursue in IT. It covers the basics, from IP addressing to security, automation, and AI. A CCNA certification is the perfect start if you know you want to build or support IT infrastructure. You can specialize later. A CCNA can help you prepare for , includingC B Network engineer˙ B Network support
technician˙ B Network administrator˙ B Business roles in IT organizations, from sales and marketing to the management track a wide variety of IT jobs Overview Certifications path Vocabulary Training options Exam overview Resources Next steps ©2024 Cisco and/or its affiliates. All rights reserved. CCNA Certification Guide | Public 02And while you build
your skills, you’re also building your income. Here’s proof. Skillsoft’s Global Knowledge 2023 IT Skills and Salary Report1 examined data from thousands of IT professionals. Eighteen percent estimated that the annual value of being certified is $30,000 or more. Training and certifications pay off— and organizations know it. Over 35% of respondents listed a
boost in productivity as the top benefit of a certified staff. Even more, 34% of respondents believe that certifications close organizational skill gaps. That makes certified candidates stand out in a pool of applicants during the hiring process. The network needs you. The field of IT is full of rewarding, meaningful, challenging work. Earning your CCNA
certification can make your resume stand out and gets your foot in the door. The CCNA arms you with a broad range of career skills. Get started today. Overview Certifications path Vocabulary Training options Exam overview Resources Next steps ©2024 Cisco and/or its affiliates. All rights reserved. CCNA Certification Guide | Public 03 7# Skillsoft, The 20
top-paying certifications going into 2024., https://www.skillsoft.com/ blog/top-paying-it-certifications, November 14, 2023. Automation and programmability IP services Network access Security fundamentals IP connectivity Network fundamentals CCNA ExamOverview Certifications path Vocabulary Training options Exam overview Resources Next steps
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want. It can also keep you competitive in a field where 92 percent of IT professionals hold certifications. Cisco’s certification portfolio offers more options than ever before, empowering you to customize your learning path to meet your career needs, interests, and aspirations. Since every Cisco exam you pass earns you a certification, each of these
milestones you reach tells a new chapter in your story. Here are the different levels of Cisco certifications you can earn: Associate Proof that you’ve mastered the essentials to build your IT career Expert The most prestigious certification you can obtain Professional A core technology track to sharpen your specialized expertise Specialist Advanced
networking knowledge in tech such as security, data center, or video Entry Validate your skills and qualifications for entry-level IT roles Overview Certifications path Vocabulary Training options Exam overview Resources Next steps ©2024 Cisco and/or its affiliates. All rights reserved. CCNA Certification Guide | Public 06 Vocabulary Application
Programming Interfaces (APIs) and REST APIs Attack surface Authentication (Authentication, Authorization, and Accounting [AAA], Radius) APIs are published instructions to interface with a product or service. APIs enable developers to assemble a command or request for a service or data, to submit it, and to receive any output. They are published and
maintained by the vendor. A collection of all the possible paths a hacker or a malware application might follow to compromise protected data. Authentication is how you control access to your network and prevent intrusions, data loss, and unauthorized users. Continuous Integration/Continuous Development (CICD) Data formats A CICD system provides
automated builds and tests for creating software, making configuration changes, or completing other deployment tasks.When using a CICD pipeline, coders can continually merge their changes to a main branch of an existing application, run integration tests on changes, keep changes small, and minimize the potential for problems due to multiple, gated
test result requirements. (XML, JavaScript Object Notation [JSON], YAML Ain t Markup Language [YAML]) Common data formats that are both machine readable and human readable for providing input to programs and applications using interfaces (APIs). Knowing these key terms will help you on your CCNA journey. Overview Certifications path
Vocabulary Training options Exam overview Resources Next steps ©2024 Cisco and/or its affiliates. All rights reserved. CCNA Certification Guide | Public 07 DevOps DNS Infrastructure, containers, and virtual machines A combination of Development (Dev) and Operations (Ops), DevOps focuses on automation, regularly allowing failures that can be
automatically fixed with mitigated risks, as well as connecting business outcomes to the availability goals for a given system. The DevOps movement makes developers responsible for deployment and also has teams use coding workflows and tools to manage infrastructure. The Domain Name Service (DNS) is like a phone book that translates IP
addresses into human readable form. For example, www.facebook.com is 157.240.22.35 (IPv4), or 2001:558:feed::1. Infrastructure is a generic term for the underlying devices, physical or virtual, that provide computing power or storage capacity or networks, used to deliver software or applications. Virtual machines can emulate a computer system and are
typically built as images, providing the same functionality as the physical computer. Containers package up software and dependencies into one descriptive file that contains everything to run an application, regardless of the underlying systems. IP Addresses are like street addresses. Every service or server on the internet has a unique address where it
can be accessed. The process of determining the functionality, origin, and potential impact of a given malware. IPv4 is limited to approximately 4 billion unique addresses. NAT is a scheme that allows a single address for a network (such as a small business) to be shared by all the users and devices on your network. IP address (IPv4 and IPv6, classes,
Open Systems Interconnection [OSI] and TCP/IP networking stack) Malware analysis Network Address Translation (NAT) Overview Certifications path Vocabulary Training options Exam overview Resources Next steps ©2024 Cisco and/or its affiliates. All rights reserved. CCNA Certification Guide | Public 08 Network data models (YANG, RESTCONF,
NETCONF) Packet Python Role-based access control YANG is a data modeling language for configuration and state data for network devices. It stands for Yet Another Next Generation. RESTCONF and NETCONF are protocols defined by a standards body, so that you can manage configuration of network devices modeled with YANG. A unit of data that
can be sent from one network endpoint to another. A packet has headers, footers, and a data payload, or some other information that it carries. The headers encode details about how to route the packet. A general-purpose, interpreted programming language. Python emphasizes code readability with whitespace requirements, so it is approachable and
powerful. Many network automation applications and tutorials are centered around Python. Access to data given to a person based on their job function or role. Router Routing protocols such as Border Gateway Protocol (BGP), Enhanced Interior Gateway Routing Protocol (EIGRP), and Open Shortest Path First (OSPF) Security Incident and Event
Management (SIEM) A router connects different networks together, providing a route between two computers (or servers) in different networks. Routers build the internet. Routing protocols provide the overall map and directions for a packet to find the proper destination. An approach to security management that gathers data from multiple sources (such as
syslog, device events, and error logs), processes the data (including correlation to identify potential threats), and raises an alert or ticket for further investigation if the threat is deemed to be real.Overview Certifications path Vocabulary Training options Exam overview Resources Next steps ©2024 Cisco and/or its affiliates. All rights reserved. CCNA
Certification Guide | Public 09 Security Orchestration and Automation Response (SOAR) Software Development Kit (SDK) Subnet Switch An approach that enables SOC teams to manage tickets raised through SIEM (Security Incident and Event Management) for threat response. SOAR enables automated workflows for responding to the threats. A
platform for writing programs and applications targeting an API. It often includes documentation, configurations, and tools (such as compilers or linkers) to write and execute the code to interface with the API. Subnetting is a scheme for efficiently apportioning or assigning your IP addresses to systems in your organization. A switch is a component that is
used to build a network and to connect hosts and servers within a network. A switch cannot route packets or data between networks. Threat intelligence Threat hunting Time-based access control VLAN Evidence-based knowledge, including context, mechanisms, indicators, implications, and action-oriented advice about an existing or emerging hazard to
assets. The process of proactively and iteratively searching through networks to detect and isolate advanced threats. Temporary access to data given to a person on a need basis for a period of time. A Virtual Local Area Network is a simple scheme to build in access control and restrictions within a network. It allows you to keep “Sales” separate from
“Engineering,” for example, and to prevent inappropriate access to data.Overview Certifications path Vocabulary Training options Exam overview Resources Next steps ©2024 Cisco and/or its affiliates. All rights reserved. CCNA Certification Guide | Public 10 Training options There are several training options to help you prepare¼ Cisco Learning Locator
Cisco Press CCNA 200-301 Official Cert Guide, Volume 2 CCNA Preparation Bundle Implementing and Administering Cisco Solutions | CCNA Cisco Exam Review: CCNA D Use the to find instructor-led courses-both in-person and virtual. D If books are your thing, check out the , a perfect addition to your self-study plan. D The helps you prepare for the
200-301 CCNA exam. For a limited time, save 16 percent off the bundle price. D The Learning Path will build the skills you need to install, operate, configure, and verify basic networks, while you prepare to take the 200-301 CCNA exam.2 D The helps you prepare to take the CCNA exam. You will gain practical experience for exam topics by testing your
key knowledge, skills, and abilities. Regardless of how you prepare for the exam, it s crucial to get your hands on the gear to practice. This is called labbing," as in practicing in a lab environment. Your ability to execute critical tasks will be tested on the exam, so you need to practice. Lab early. Lab often. Then lab some more. Explore Cisco Modeling Labs.
Keep this in mind: when the verb for a topic area is describe," you won t need the same depth of knowledge for that topic as when the verbs are configure," troubleshoot," and design. This is where the real work happens. You ll need two things: the exam topics as well as a strategy for learning, studying, and practicing. The CCNA certification exam topics
are the basis for the exam. They define the contents of both the exam and the official training course, and it should be your roadmap for studying. If you can successfully complete the tasks defined for each topic, you re ready for the exam. Overview Certifications path Vocabulary Training options Exam overview Resources Next steps ©2024 Cisco and/or
its affiliates. All rights reserved. CCNA Certification Guide | Public 11 Exam overview The CCNA exam topics are the basis for the certification exam. They define the contents of both the exam and the official training course, and should be your roadmap for studying. If you can successfully complete the tasks defined for each topic, you're ready for the
exam. And you can take certification exams online, so you can stay on track, even when you can't travel to a testing center. 200-301 CCNA Exam Topics Visit to perform a system check. www.cisco.com/go/ onlinetesting CCNA certification exams are administered by our testing partner, Pearson VUE, as proctored exams. When you take the exam, you'll be
in a controlled environment to ensure fairness and to give you the best, most consistent experience. To view a walk-through demonstration of the various exam question types and how they function, check out the page. Cisco Certification Exam Tutorial VideosOverview Certifications path Vocabulary Training options Exam overview Resources Next steps
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Just as an example the
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it smoothly. This is precisely why we believe right now is the best time to explore how training and certification can keep you focused and help make you a technical superstar in your organization. Earning a CCNA is the gateway to a rewarding and lucrative IT career. With your CCNA, you'll be more knowledgeable and confident about all things IT. Use this
to let your manager know why training and certification is so beneficial for you—and for them. Get the help you need to transform your career, your income, and your skill set. email template But beyond that, training and certification can transform your life. By learning the latest methods and skills in IT, you'll gain the self-confidence that comes from setting
goals, then accomplishing them. And that self-confidence will continue to empower your career. These are exciting times to be working in technology. The IT landscape evolves daily, but through it all, knowledge of routing and switching remain the core foundation on which you can build your career. Ask your manager to sponsor your training. Once they
understand the benefits to your organization, they will be eager to learn more and support you with next steps. Download e-book ©2024 Cisco and/or its affiliates. All rights reserved. CCNA Certification Guide | Public 13Overview Certifications path Vocabulary Training options Exam overview Resources Next steps © 2024 Cisco and/or its affiliates. All rights
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relationship between Cisco and any other company. (1110R) DEC22CS6087-1 08/24 CCNA Certification Guide | Public 14 So many opportunities not to miss Because CCNA covers so many IT fundamentals, it's a great way to stand out no matter where your career takes you. Check out the following pages to add more reasons for getting your CCNA
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who connect, secure, and automate the world while you find out the secrets to their success. Get inspired! View certification success stories. Certifications matter. To employers they indicate the promise of higher productivity and proof of your abilities. For new and current IT professionals, they reflect far more. Find out why. With the rise in the adoption of AI
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nail-on device boxes, panel boards, and fixtures. Phases of residential electrical wiring include rough-in, trim out, testing, and troubleshooting. 2. Commercial Wiring Electrical installations in commercial structures contain many of the same elements as residential installations. The only difference is that in commercial electrical installations, conductors are
typically installed in metal raceways. This aspect of the job requires the electricians installing the devices to be skilled in conduit bending procedures, too. 3. Industrial Wiring Because of the hazardous materials that exist in many industrial facilities, the installation and maintenance of electrical systems in these volatile environments must follow strict
requirements. Conduit systems in volatile environments must be sealed to outside vapors and gases, and any potential sparking or arcing device must be enclosed within a special enclosure or casing to prevent the ignition of hazardous vapors that might be present. Industrial electricians are generally split into two groups: installers and maintenance
personne esidential Wiring Residential electrical system includes an electrical supply, electrical service, nonmetallic-sheathed cable, nail-on device boxes, panel boards, and fixtures. Phases of residential electrical wiring include rough-in, trim out, testing, and troubleshooting. 2. Commercial Wiring Electrical installations in commercial structures contain
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many industrial facilities, the installation and maintenance of electrical systems in these volatile environments must follow strict requirements. Conduit systems in volatile environments must be sealed to outside vapors and gases, and any potential sparking or arcing device must be enclosed within a special enclosure or casing to prevent the ignition of
hazardous vapors that might be present. Industrial electricians are generally split into two groups: installers and maintenance personne Job Requirements in the Electrical Trade Click on the tabs to find out more about them: Residential Electricans Commercial Electricians Industrial Electricians Residential Electricians provide the complete electrical system
in a residential structure, keeping in mind the safety precautions. A lack of safety measures may contribute to injury due to shock or fires. Elements of a residential wiring installation include installing the electrical s The key points from this module are: The electrical trade offers many job opportunities to work in residential, commercial, and industrial
construction. Electricians are responsible for the installation and maintenance of electrical systems and equipment. Electricians working on residential and commercial projects require the same basic set of knowledge and skills. Industrial electricians must know the installation procedure for various types of conduit, large conductors, motors, and controls, as
well as possess strong troubleshooting skills. The electrical wiring system for residential, commercial, and industrial projects varies, and a thorough knowledge of the requirements for each sector is a vital part of the job. Electricians working with industrial wiring and equipment are also required to know the safety procedures for handling hazardous
materials. ervice entrance equipment, branch circuit conductors, device boxes, panel enclosures, over-current protective devices (circuit breakers), and fixtures such as lighting and smoke detectors. Re: Release resultat statement and finalize award diploma./irregularilarity case .re marker tshingombe fiston Mon, Feb 12, 2024 at 11:05 AM To:
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DOCKET NUMBER :2023/1226 INFORMATION MANAGEMENT SYSTEM - INSTITUT COLLEGE NAME :ST PEACE COLLEGE -ID: NUMBER: TIRC0G000910610 -REGISTRATION NUMBER: STUDENT -CO70040101099 -SARS VAT NUMBER: 923228238 -MERSETA : 17_QA/ACC/1311/17 -SAQA REGISTRAR STUDENT NUMBER:210020223812,2004007064382. -email adress: tshingombekb@gmail.com -Alternate email address: tshingombefiston@gmail.com _____ APPEAL DECISSION RESULT RELEASE: APPLICATION NUMBER: Saqa: institut foreign .saqa transcription meeting 71638 dr congo requirements grasuate
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entrance .n diplomat -Qualification title national N diplomat engineering. -nqf level:6 . -date submitted to dhet :1105/2023 -date process . DHET -Timebtable /50111002 -N1:engineering studie -ID:2004007064381 -ID:2100002023812 _____ Dear .mr minister of education dhet and deputy member of dhet .tvet
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MINISTER . MEMBERS OF ACADEMIC RECORD SAQA AND COLLEGE RECTORAT INSTITUT SUB : Dear : my name is tshingimbe and i attended event from to in there rwite to request for my transcript to apply for futher aduation i wish to express my sincer gratitude to your education i wish to express my sincer gratitude to your dhet college thing
which have helped me in my profession. I wish to take studies at foreign institut saqa and college education advanced field continuing assessment professional institution has requirements a full transcript from my former studies to check my eligibility to studie the course i hope saqa to start my studie on and the dealnje to submit the the requested document
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Completed Training Type : Video Training Status : Completed raining Details Training Type: Curriculum Provider: Home and Distribution Academy Version: 30.0 Structure History Training Hours: 3 Hours 39 Minutes Description: Schneider Home Certification training is designed to equip installers with the knowledge and skills required to successfully deploy
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Description Completed on Duration Module Assessment Result Introduction to Azure Load Balancer This module explains what Azure Load Balancer does, how it works, and when you should choose to use Load Balancer as a solution to meet your organization's needs. Jan 10, 2025 18 min N/A Enhance your service availability and data locality by using
Azure Traffic Manager Discover how Azure Traffic Manager provides DNS load balancing for your application to improve the performance and availability of your application. Jan 10, 2025 29 min N/A Improve your reliability with modern operations practices: An introduction Discover a map for navigating reliability challenges and sustainably achieving the
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On Mon, Mar 17, 2025 at 12:44 PM tshingombe fiston wrote:
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PLC, PAC, IOs and Power supplies
Motor Protection & Control
VSD, Soft Starter, Direct Starter and protections
Human-machine interfaces
HMI panels, controllers, software and Industrial PCs
Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 261 204,87
001
License, EcoStruxure Control Expert, service pack base, small S, 1 user, node locked, digital license
R 14 435,28
View Product
002
License, EcoStruxure Control Expert, with Topology Manager and M580 safety, for XL, node locked, 10 users, digital
R 246 769,59
View Product
003
Status Unavailable
Price Unavailable
View Details

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Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 10 234,04
001
license, EcoStruxure Control Engineering, verification, basic, node locked, 1 shot
R 5 582,20
View Details
002
license, EcoStruxure Control Engineering, documentation, basic, node locked, 1 shot
R 4 651,84
View Details

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VSD, Soft Starter, Direct Starter and protections
Human-machine interfaces
HMI panels, controllers, software and Industrial PCs
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Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 331 172,31
001
licence, Ecostruxure Automation Expert, standard engineering buildtime, v23
R 65 100,00
View Details
002
license, EcoStruxure Automation Expert, professional engineering, buildtime, v23
R 157 500,00
View Details
003
license, EcoStruxure Automation Expert, standard device runtime, add on, v23
R 378,00
View Details
004
license, EcoStruxure Automation Expert, high availability option, runtime, add on, v23
R 840,00
View Details
005
license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for ATV dPac
R 777,00
View Product
006
license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for M251, M262 dPAC
R 6 216,70
View Product
007
license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for M580 dPAC
R 15 540,00
View Product
008
license, EcoStruxure Automation Expert, run time, application, permannet, 1 user, for M580 dPAC with extensions
R 56 448,56
View Product
009
license, EcoStruxure Automation Expert, run time, HMI, permanent, 1 user, for Harmony ST6
R 2 625,00
View Product
010
license, EcoStruxure Automation Expert, run time, HMI, permanent, 1 user, for Harmony iPC
R 12 600,35
View Product
011
Status Unavailable
Price Unavailable
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Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
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Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 64 222,36
001
Motion controller LMC100 0 axis - Acc kit - Basic
End of commercialisation: 12/01/2024
Price Unavailable
View Details
002
Regulated switch power supply, modicon power supply, 3 phases, 380 to 500V AC, 24V, 20A
R 13 112,60
View Product
003
battery control module, phaseo ABL7 ABL8, 24 to 28.8V DC, phaseo ABL7 ABL8, 24V, 20A, for regulated SMPS
R 11 849,78
View Product
004
battery control module, phaseo ABL7 ABL8, 24 to 28.8V DC, phaseo ABL7 ABL8, 24V, 40A, for regulated SMPS
R 17 709,70
View Product
005
redundancy module, phaseo ABL7 ABL8, 40A, for regulated SMPS
R 5 529,38
View Product
006
electronic protection module, phaseo ABL7 ABL8, 28 to 28.8V DC, 10A, for regulated SMPS, 2 pole breaking by channel
R 8 177,54
View Product
007
buffer module, phaseo ABL7 ABL8, 24 to 28.8V DC, 40A, for power supply
R 7 843,36
View Product

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Power Control and Protection
Power supplies and transformers
Software License Configurator

Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 13 327,65
001
Bus coupler, TeSys island, 24VDC, Ethernet switch (EtherNet IP / Modbus TCP)
R 8 961,41
View Product
002
Voltage interface module, TeSys island, 690VAC 47-63 Hz, Isolated switching input for safe stop
R 4 366,24
View Product

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Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 13 327,65
001
Bus coupler, TeSys island, 24VDC, Ethernet switch (EtherNet IP / Modbus TCP)
R 8 961,41
View Product
002
Voltage interface module, TeSys island, 690VAC 47-63 Hz, Isolated switching input for safe stop
R 4 366,24
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Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 385 363,62
001
redundant processor, Modicon M580, 8MB, 61 Ethernet devices, 8 local racks, 8 remote IO racks
R 177 037,09
View Product
002
power supply module, Modicon X80, 24V DC, 16.8W
R 7 707,26
View Product
003
connector kit, Modicon M340, 2 removable connectors, cage clamp, for power supply module
R 527,05
View Product
004
connector kit, Modicon M340, 2 removable connectors, spring type, for power supply module
R 561,57
View Product
005
rack, Modicon X80, 8 slots, Ethernet backplane
R 6 848,84
View Product

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open
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On Mon, Mar 17, 2025 at 12:19 PM tshingombe fiston wrote:
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Our entire offer in one central eLearning hub — start your journey with Schneider Electric today.
mySchneider provides a comprehensive collection of short eLearning materials that cover the full scope of Schneider Electric products and solutions. Our offer aims to educate and raise awareness of key Schneider Electric ranges with easily digestible 5-20 minute courses — without requiring a deep technical background. Feel free to access to all the content below, or you can pick and choose which chapters are most relevant to your learning goals. Start your journey with Schneider Electric today for new skills and insights to better serve your customers.
As a bonus, you can also find here access to Sustainability School to enhance your knowledge on sustainability basics like climate science, scope of impact, and tracking metrics to inform your customers and gain a competitive edge.
Expand your presence in Residential market

Fine-tune your skills for the Residential market — join eLearnings today
Grow your skills and your network in the Residential market with the help of Schneider Electric. You'll learn all about key wiring devices and final distribution functions, how to select the right circuit breaker for the job, and of course, the fundamentals for staying safe and secure through these processes. Also you find the basics of eMobility Residential Application.
Discover basic and enriched wiring devices functions in Residential
Understanding overcurrent protection
How to select a Circuit Breaker
How to Protect Against Electrocution
How to select the Type of Residual Current Device according to the application
Discover the Easy9 system
Discover the Acti9 System: M1
Low Voltage solutions for Commercial and Industrial Buildings

Skill up with Schneider Electric today. Enjoy your time!
Learn the essentials of Low Voltage design and Power Distribution. Improve your skills through in-depth video and eLearning lessons. This eLearning experience will help you skill up your knowledge of LV fundamentals. After the completion of this chapter, you will gain the core knowledge in Primary Distribution, Motor Control, Motor Protection and management, cost optimization, and service continuity.
Electrical Installation Design
Motor Starters with Contactors
Motor Protections
Operation and Maintenance Tool
Safety & Availability
Discover EasyPact TVS
Discover ComPacT NSX and ComPacT NSXm Offer
Industrial Automation market solutions

Find new business opportunities in Industrial Automation Market — skill up starting today
Learn more about Schneider Electric products and solutions for Industrial Automation market. Develop the expertise and upskill yourself to be fully equipped with important knowledge to better serve industrial customers. In this chapter, you will find basic short courses introducing an overview on key ranges. eLearnings will help to increase your technical capabilities allowing you to deliver sustainable growth and gain new business perspectives on Industrial Automation market with Schneider Electric.
Drives Basics
Control & Signaling
Basic HMIs
Relays
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Discover the innovative, reliable, and energy-efficient solutions for critical power infrastructure and medium-large edge and data centers. Improve your competencies in UPS technology and the edge network. Explore Schneider's ranges of Single Phase and 3 Phase UPS systems — the fully integrated, end-to-end uninterruptible power supply solutions helping to maintain enterprise-wide networks, data centers, mission-critical systems, and industrial manufacturing processes.
The Schneider Electric UPS Family
The Small Office and Home Office for Sales Associates
Edge Network
Digital Power solutions to increase energy efficiency
Digital Power solutions help you increase electrical system and assets reliability for your customers, avoid downtime by preventing power failures, and save money by reducing energy use and maintenance. In this chapter you will find introductory courses on the technical characteristics, functions, and applications of key product ranges.

Basic Power Metering
Learn about PowerTag, how to promote it, and how it contributes to the different digital systems in each segment. Learn about PM2000, how to install and program these meters
Discover PowerTag Energy Sensors
EasyLogic PM2000

Gateways and Energy Servers
The EcoStruxure Panel Server Portfolio Overview provides the trainee with an overview of SE gateways and energy server offers
EcoStruxure Panel Server

Power Quality and Power Factor Correction
Gain more knowledge in Power Quality and Power Factor Correction in short videos
Power Quality and LV Power Factor Correction
LV Power Factor Correction components
Selection of the right LV Capacitor

Protection Relays
This course provides an overview of offer values and ways to address customer pain points
Easergy P1
Sustainability School

Gain sustainability knowledge and skills
Chapter 1: Gain knowledge
Business and sustainability go hand in hand today. In fact, the survival of our planet depends on it. Sparked by Electricity 4.0 and the rise of electrification and digitalisation, the Schneider Electric Sustainability School is your pathway to in-demand expertise and practical tools. Elevate your brand's reputation and stand apart from the competition. Start with Chapter 1 of Schneider Electric Sustainability school and get a clear understanding of sustainability basics like climate science, scope of impact, and tracking metrics to inform your customers and gain a competitive edge. Chapters 2 and 3 are coming soon.
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Sustainability School for Partners Chapter 2

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The Thermal Management Functions in Electrical Panels: Module 02

30 minutes

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30 minutes

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30 minutes

Video
55 minutes

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30 minutes

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EBO 2023: Engineering EasyLogic

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EBO 2023: Engineering Upgrade

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EcoXpert Smart Grid, Technical, Intermediate: Geographic Information Systems Path

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EcoStruxure Power Foundational 2.0

In Progress
Launch

Event

Advanced Machines with PacDrive 3 [VILT]

20 hours

Online Class

EcoStruxure Building: Graphics Editor Intermediate

In Progress

Online Class

Fundamentals of Thermal Management in Electrical Panels: Module 01

30 minutes

Video

SP_MX_2021_Lanzamiento Square D Easy UPS 3S 10-40 kVA (208V)

55 minutes

Test

IT Solution Provider Certification Test - Select

30 minutes

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o
oEcoXpert Smart Grid, Technical, Intermediate: Geographic Information Systems Path
Due : No Due Date Status : In Progress Training Type : Curriculum Training Status : Active
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oBasic Machines with PacDrive 3 [VILT] (Test)
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oCybersecurity für Schneider Electric Service Partner / Cybersecurity for Schneider Electric Services Partners (German)
Due : No Due Date Status : In Progress Training Type : Online Class Training Status : Active
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oEBO 2023: Engineering EasyLogic
Due : No Due Date Status : In Progress Training Type : Curriculum Training Status : Active
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oService for Lexium [VILT] (Test)
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o20 Mobile Terms You Probably Know
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oEBO 2022: Engineering EBO
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oApplying OWASP 2017 Mitigations Series
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oFundamentals of Threat Modeling
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oBasic Machines with PacDrive 3 (Test)
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oEcoStruxure Building Technical Training For EcoXperts 2023 - Proficient
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oIntroduction to EcoCare : Next Generation Services Membership
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oMotion Block : Part I (Test)
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oTransformers and motor applications in industries
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oPowerLogic P5: Protection Engineering
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Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 1 Total: R 30 687,22
001
Controller, Modicon M171/M172/M173, optimized display 22 IO, Modbus
R 9 888,63
View Product
002
Modicon M171 Optimized LV Connector 1m cable
R 555,78
View Product
003
Modicon M171 Optimized AO Connector 1m cable
R 140,86
View Product
004
Modicon M171 Optimized AO Connector 2m cable
R 201,24
View Product
005
Modicon M171 Optimized Display LED
R 1 802,40
View Product
006
Modicon M171 Optimized Display LCD
End of commercialisation: 12/01/2024
R 3 104,58
View Product
007
Modicon M171 Optimized Wall thermostat without backlight
R 2 170,34
View Product
008
NTC 1,5m IP68 5x20 -50+110°C Grey
R 143,76
View Product
009
NTC 1,5m IP68 5x20 -50+110°C Grey
R 136,69
View Product
010
NTC 3,0m IP68 5x20 -50+110°C Grey
End of commercialisation: 12/01/2024
R 229,99
View Product
011
EEV Driver, Actuator
End of commercialisation: 01/23/2021
R 3 449,54
View Product
012
EEV Driver, Autonomous & Hardwired
End of commercialisation: 01/23/2021
R 3 737,01
View Product
013
EEV Driver, Autonomous & Modbus
End of commercialisation: 12/01/2024
R 4 570,62
View Product

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By product segments / selection tools
Programmable controllers and I/Os
PLC, PAC, IOs and Power supplies
Motor Protection & Control
VSD, Soft Starter, Direct Starter and protections
Human-machine interfaces
HMI panels, controllers, software and Industrial PCs
Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling

Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 30 687,22
001
Controller, Modicon M171/M172/M173, optimized display 22 IO, Modbus
R 9 888,63
View Product
002
Modicon M171 Optimized LV Connector 1m cable
R 555,78
View Product
003
Modicon M171 Optimized AO Connector 1m cable
R 140,86
View Product
004
Modicon M171 Optimized AO Connector 2m cable
R 201,24
View Product
005
Modicon M171 Optimized Display LED
R 1 802,40
View Product
006
Modicon M171 Optimized Display LCD
End of commercialisation: 12/01/2024
R 3 104,58
View Product
007
Modicon M171 Optimized Wall thermostat without backlight
R 2 170,34
View Product
008
NTC 1,5m IP68 5x20 -50+110°C Grey
R 143,76
View Product
009
NTC 1,5m IP68 5x20 -50+110°C Grey
R 136,69
View Product
010
NTC 3,0m IP68 5x20 -50+110°C Grey
End of commercialisation: 12/01/2024
R 229,99
View Product
011
EEV Driver, Actuator
End of commercialisation: 01/23/2021
R 3 449,54
View Product
012
EEV Driver, Autonomous & Hardwired
End of commercialisation: 01/23/2021
R 3 737,01
View Product
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EEV Driver, Autonomous & Modbus
End of commercialisation: 12/01/2024
R 4 570,62
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Add products to Bill of Materials
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By Excel/CSV file (Download sample template)
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By product segments / selection tools
Programmable controllers and I/Os
PLC, PAC, IOs and Power supplies
Motor Protection & Control
VSD, Soft Starter, Direct Starter and protections
Human-machine interfaces
HMI panels, controllers, software and Industrial PCs
Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 51 005,44
001
Motion controller LMC216 16 axis - Acc kit - Basic
End of commercialisation: 12/01/2024
Price Unavailable
View Details
002
Regulated switch power supply, modicon power supply, 3 phases, 380 to 500V AC, 24V, 20A
R 13 112,60
View Product
003
Motor circuit breaker, TeSys Deca, 3P, 1 to 1.6A, thermal magnetic, screw clamp terminals, button control
R 1 709,72
View Product
004
battery control module, phaseo ABL7 ABL8, 24 to 28.8V DC, phaseo ABL7 ABL8, 24V, 20A, for regulated SMPS
R 11 849,78
View Product
005
battery control module, phaseo ABL7 ABL8, 24 to 28.8V DC, phaseo ABL7 ABL8, 24V, 40A, for regulated SMPS
R 17 709,70
View Product
006
Easy UPS control module, 24V DC-DC, DIN Rail, Industrial, 20A
R 3 679,82
View Product
007
Easy UPS battery module, 24V DC-DC, DIN Rail, Industrial, 4.5Ah
R 2 943,82
View Product

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BOM Manager Activity Log Documents
Add products to Bill of Materials
By product reference number #
By Excel/CSV file (Download sample template)
Bill of Materials
Total items selected: 0 Total: R 400 547,09
001
Circuit breaker, ComPacT NSX400H, 70kA/415VAC, 3 poles, MicroLogic 1.3M trip unit 320A
R 14 080,25
View Product
002
Contactor body,TeSys F,3P(3NO)-AC-3, <=440V 265A without coil
End of commercialisation: 12/31/2023
R 28 920,36
View Product
003
variable speed drive, Altivar Process ATV900, ATV930, 160kW, 380 to 480V, with braking unit, IP20
R 334 238,57
View Product
004
Low level auxiliary contact, circuit breaker status OF/SD/SDE/SDV, 1 changeover contact type
R 1 005,92
View Product
005
Low level auxiliary contact, circuit breaker status OF/SD/SDE/SDV, 1 changeover contact type
R 1 005,92
View Product
006
Low level auxiliary contact, circuit breaker status OF/SD/SDE/SDV, 1 changeover contact type
R 1 005,92
View Product
007
torque limiting screws, ComPact NSX400/630, power connections, set of 12 parts
End of commercialisation: 12/01/2024
R 489,96
View Product
008
TeSys F - suppressor module - RC circuit - 127...240 V AC
End of commercialisation: 12/31/2023
R 1 344,07
View Product
009
Time delay auxiliary contact block, TeSys Deca, 1NO+1NC, on delay 0.3-3s, front, screw clamp terminals
R 2 151,05
View Product
010
Time delay contact block,TeSys Deca,1NO+1NC,on-delay 1-30s,front
R 2 151,05
View Product
011
TeSys F - main contact set - 3P
End of commercialisation: 12/31/2023
R 14 154,02
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By product segments / selection tools
Programmable controllers and I/Os
PLC, PAC, IOs and Power supplies
Motor Protection & Control
VSD, Soft Starter, Direct Starter and protections
Human-machine interfaces
HMI panels, controllers, software and Industrial PCs
Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 110 098,24
001
Circuit breaker, ComPacT NSX400H, 70kA/415VAC, 3 poles, MicroLogic 1.3M trip unit 320A
R 14 080,25
View Product
002
Contactor body,TeSys F,3P(3NO)-AC-3, <=440V 265A without coil
End of commercialisation: 12/31/2023
R 28 920,36
View Product
003
soft starter for asynchronous motor, Altistart 22, control 230V, 230 to 440V, 75 to 132kW
R 65 378,96
View Product
004
torque limiting screws, ComPact NSX400/630, power connections, set of 12 parts
End of commercialisation: 12/01/2024
R 489,96
View Product
005
Auxiliary contact block, TeSys Deca, 1NC, front mounting, screw clamp terminals
R 277,79
View Product
006
Auxiliary contact block, TeSys Deca, 1NO+1NC, front mounting, screw clamp terminals
R 350,84
View Product
007
Auxiliary contact block, TeSys Deca, 1NO+3NC, front mounting, screw clamp terminals
R 600,08
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Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator

Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 17 164,53
001
Motor circuit breaker, TeSys GV4, 3P, 115A, Icu 50kA, thermal magnetic, Everlink terminals
Price Unavailable
View Product
002
Contactor, TeSys Deca, 3P(3NO), AC-3/AC-3e, <=440V, 115A, 230V AC 50/60Hz coil, screw clamp terminals
R 9 642,90
View Product
003
Auxiliary contact, TeSys GV4, 690VAC, 1 NO/NC
R 606,49
View Product
004
Auxiliary contact, TeSys GV4, 690VAC, 1 NO/NC
R 606,49
View Product
005
Time delay auxiliary contact block, TeSys Deca, 1NO+1NC, on delay 10-180s, front, screw clamp terminals
R 2 393,92
View Product
006
Contactor coil, TeSys Deca, LX1D8, 230V AC 50/60Hz for 115 and 150A contactor
R 3 914,73
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By product segments / selection tools
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Motor Protection & Control
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Human-machine interfaces
HMI panels, controllers, software and Industrial PCs
Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 261 204,87
001
License, EcoStruxure Control Expert, service pack base, small S, 1 user, node locked, digital license
R 14 435,28
View Product
002
License, EcoStruxure Control Expert, with Topology Manager and M580 safety, for XL, node locked, 10 users, digital
R 246 769,59
View Product
003
Status Unavailable
Price Unavailable
View Details

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Project-21 Untitled
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By Excel/CSV file (Download sample template)
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By product segments / selection tools
Programmable controllers and I/Os
PLC, PAC, IOs and Power supplies
Motor Protection & Control
VSD, Soft Starter, Direct Starter and protections
Human-machine interfaces
HMI panels, controllers, software and Industrial PCs
Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 10 234,04
001
license, EcoStruxure Control Engineering, verification, basic, node locked, 1 shot
R 5 582,20
View Details
002
license, EcoStruxure Control Engineering, documentation, basic, node locked, 1 shot
R 4 651,84
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PLC, PAC, IOs and Power supplies

Motor Protection & Control
VSD, Soft Starter, Direct Starter and protections
Human-machine interfaces
HMI panels, controllers, software and Industrial PCs
Interface, Safety and Control Relays
Electromechanical, Control, Timing and Solid State Relays
Enclosures and Accessories
Enclosures, thermal management, accessories and cabling
Push Buttons, Switches, Pilot Lights and Joysticks
Harmony ranges
Motion Control and Robotics
Move the machine tooling or the part itself in a controlled, rotary or linear manner.
Power Control and Protection
Power supplies and transformers
Software License Configurator
Software License Configurator
Bill of Materials
Total items selected: 0 Total: R 331 172,31
001
licence, Ecostruxure Automation Expert, standard engineering buildtime, v23
R 65 100,00
View Details
002
license, EcoStruxure Automation Expert, professional engineering, buildtime, v23
R 157 500,00
View Details
003
license, EcoStruxure Automation Expert, standard device runtime, add on, v23
R 378,00
View Details
004
license, EcoStruxure Automation Expert, high availability option, runtime, add on, v23
R 840,00
View Details
005
license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for ATV dPac
R 777,00
View Product
006
license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for M251, M262 dPAC
R 6 216,70
View Product
007
license, EcoStruxure Automation Expert, run time, application, permanent, 1 user, for M580 dPAC
R 15 540,00
View Product
008
license, EcoStruxure Automation Expert, run time, application, permannet, 1 user, for M580 dPAC with extensions
R 56 448,56
View Product
009
license, EcoStruxure Automation Expert, run time, HMI, permanent, 1 user, for Harmony ST6
R 2 625,00
View Product
010
license, EcoStruxure Automation Expert, run time, HMI, permanent, 1 user, for Harmony iPC
R 12 600,35
View Product
011
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Price Unavailable
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Project List

Project 2025.03.17#17898
Help
Project 2025.03.17
Total Count: 1
Project 2025.03.17

ATS22C59S6U
soft starter for asynchronous motor, Altistart 22, control 110V, 230 to 575V, 200 to 500hp
Datasheet

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Project List

Project 2025.03.17#17898
Help
Project 2025.03.17
Total Count: 1
Project 2025.03.17

ATS22C59S6U
soft starter for asynchronous motor, Altistart 22, control 110V, 230 to 575V, 200 to 500hp
Datasheet

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en_US.json 2017/10/19 09:44:14
1 item(s) selected:Fundamentals of Health Care Facility Electrical Power Systems
Course Outline

Course Description
With daunting aspects such as ever-changing codes and standards, increasing medical complexity, and dwindling capital budgets, hospitals and health care facilities are among the most challenging building projects. Health care facility electrical systems are complex, difficult to design, expensive to build and subject to a plethora of codes and standards as well as intensely regulated by authorities having jurisdiction over their design and construction. With new medical technologies continuing to arrive on the scene, healthcare facility electrical systems are ever changing.
This course provides an introduction to the topic of healthcare facility electrical systems.
Course Outline
Course Objectives
• Recognize the importance of electrical distribution to health care facilities, and how it differs from other types of buildings
• Identify the codes, standards and guidelines which govern the design of health care facility electrical systems
• Describe the elements of a health care facility's Essential Electrical System
Course Content or Material
1) Introduction
2) Different types of health care facilities have differing needs and code requirements for electrical distribution
a. Hospitals
b. Long-term care facilities
c. Ambulatory surgery facilities
d. Outpatient therapy facilities
e. Outpatient facilities
f. Clinics and physician offices
3) The importance of electrical distribution to hospitals
a. Life support
i. Patients on ventilators
ii. General anesthesia
b. Medical procedures
c. Medical records
d. Comfort
e. Life Safety (fire safety)
i. Illumination of the means of egress
f. Without electrical power, a medical facility will close and/or be evacuated.
4) Codes, standards and guidelines
a. NFPA 101
Fundamentals of Health Care Facility Electrical Power Systems
Course Outline
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b. NFPA 99
c. NFPA 110 and 111
d. NFPA 70
e. NFPA 70E
i. Electrical safety for those who work on electrical gear
f. FGI Guidelines
g. CMS
h. OSHA
5) Essential Electrical System
a. Alternate source of power
i. Classification of the emergency power source
b. Branches of the essential electrical system
i. Example: Type I systems
1. Life Safety Branch
2. Critical Branch
3. Equipment Branch
ii. Type 2 and Type 3 systems
c. Potential failure points within the essential electrical system
6) Assessing the need for providing an alternate source of power
7) Summary

Course Assessment: Test Your Knowledge
Course Survey: We Value Your Opinion

Leaderboard
2350 points 4732nd
1st level 32nd
4 badges
28th
3 completed courses223rd
3 certificates235th

On Mon, Mar 17, 2025 at 11:18 AM tshingombe fiston wrote:

0% completed
Rate this course
Course rating is 4.76 stars

By Language / English
Applying Safety Rules
Student

Duration: 20 minutes

Outline:
In this course, you will learn how to avoid electrical hazards as a professional by ensuring safety on the job site. You will learn about safety equipments and rules to follow to protect the installation, its users and yourself. You will also learn about some of the fundamental concepts of electricity to better understand its dangers and the importance of product sizing.

At the end of this course, you will be able to:
- To define principles safety rules
- To know standard safety equipment and specific PPE
- To memorize gestures and habits to be safe during an intervention

To achieve it, you will get access to a composition of materials as procedure block, flashcards, podcasts, interactive images and professional case studies.

Have a good journey!

This course was made possible thanks to an international collaboration:
• Schneider Electric education team ;
• Eric Dupont, a teacher affiliated with the French Ministry of National Education ;
• ItyCom, a leading provider of digital learning solutions ;
• Cécile Lienaux, a graphic designer ;

Course content
Additional content has been loaded
Discover personal protective equipment
Top of page
Applying safety rules
0% COMPLETE
1.
Discover personal protective equipment
Practical case
Electricity risks
Safety rules for working with electrical equipment
Test your knowledge
Conclusion
6.This lesson is currently unavailable
Must pass quiz before continuing: "Test your knowledge"
Home
Lesson content
Discover personal protective equipment
Lesson 1 of 6
We are happy to have you with us!
To start your safety training, you will learn how to choose the appropriate personal protective equipment in order to reduce the risks of injury and accidents, whether you're at work or at home.
Continued
Personal Protective Equipment (PPE)
What is a Personal Protective Equipment (PPE)?
Personal protective equipment (PPE) is an important aspect of electrical safety, as it helps protect workers from electrical hazards.

Wearing PPE can help prevent injuries and fatalities due to electrical accidents.

It is important for workers to use the appropriate PPE for the task they are performing, and to ensure that it is in good condition and properly maintained.
What to wear to be safe during an installation?
Here is a list of basic personal protective equipment:
Click on each tab below to learn about the different types of personal protective equipment:
Protect the upper body.
When working on energized systems, do not pull up your sleeves.

This equipment is the standard, but it can change depending on the activities.
63% Completed
Unstarted
Unstarted
Unstarted
Unstarted
Must pass quiz before continuing: "Test your knowledge"
Lesson 3 of 6
In this chapter you will learn more about electricity to better understand safety issues.
Continued
Electricity and its dangers
Why is it risky?
Electricity is a form of energy resulting from the presence and movement of charged particles, such as electrons. It is a fundamental force of nature that is responsible for lightning, electric currents, and electromagnetic radiation.

It is generated by the movement of charged particles. For example, in a battery, chemical reactions create a flow of electrons from the negative terminal to the positive terminal, creating a voltage difference.
Electricity can be dangerous:
In most businesses and households, the voltage of the electricity and the available electrical current have sufficient power to cause death by electrocution. Even changing a light bulb without first disconnecting the lamp can be dangerous because coming into contact with the “hot”, “energized”, or “live” part of the outlet could kill a person.
Analyzing Reliability in the Data Center Outline
Course Description:
The growing reliance on information systems that operate 24 hours per day, 7 days per week, has spawned a rapidly growing and developing industry that supplies products and services on demand. The need for these types of information services now reaches into every business office in the world. Unfortunately, events of all kinds including hardware failure, human error, environmental changes, structural failure and external events, can lead to the possibility of unanticipated systems downtime.
Modern data centers do not tolerate planned downtime and strive for no outages in a 10-year mission. Data center operations staffs are faced with the dilemma of either downtime as a result of insufficient physical infrastructure, or incurring extensive costs by designing in more redundancies than is necessary. Targeted reliability solutions allow businesses to meet individual requirements of the data center, while minimizing the total cost of ownership.
In fact, very high reliability is difficult to attain and redundant hardware is only part of the answer.
This course will demonstrate some important performance success factors and overviews best practices for analyzing and optimizing reliability.
Course Outline:
Learning Objectives
At the completion of this course, you will be able to:
Define key terms associated with analyzing reliability risks
Identify some common cause failures in the data center
Describe the benefits of conducting a Probabilistic Risk Assessment (PRA)
Recognize the reliability advantages of utilizing scalable, modular architecture in the data center
Agenda
Introduction
Analyzing risk
Redundancy
Common cause failures
Probabilistic Risk Assessment (PRA)
Case study example
Summary
Course Content or Material:
1) Introduction
a) Information systems need to operate 24 / 7
b) Growing and developing industry supplies products and services on-demand
c) Modern data centers do not tolerate planned downtime and strive for no outages in a 10-year mission
d) Data center operations staffs are faced with
e) The dilemma of downtime as a result of insufficient physical infrastructure
f) Incurring extensive costs by factoring in unnecessary redundancies
g) Targeted reliability solutions allow businesses to meet individual requirements of the data center, while minimizing the total cost of ownership
2) Reliability
a) Understanding how to best define downtime risk
i) Is important to optimizing its reliability
ii) Decreases total cost of ownership
iii) Increases agility
b) Reliability metrics statistically analyze the likelihood of a failure occurring
3) Redundancy
a) While redundancy can increase reliability, there are significant costs and potentially serious drawbacks
b) A redundant system has more components
c) In general, systems with more components will experience more failures
4) Discussing Best Practices
a) The design, manufacture, operation, maintenance and repair of equipment
b) The gathering of data, and the review and publication of component benchmarking results
c) Consistent deployment of the language of reliability, both definitions and assumptions
d) A philosophy addressing the constant pursuit of root causes, common cause failures and relevant data
5) Modularity and Component Count
a) Reliability can be increased through standardization
b) Modularity is a powerful concept
c) Modularizing a system can increase the number of internal components
d) Reliability analysis of modular systems must consider
i) Component design
ii) Function
iii) Dependencies
6) Benefits and Drawbacks
a) Data center testing and maintenance practices often have a significant impact on systems reliability
b) Testing and diagnosis can improve reliability, but may also degrade it
7) UPS: Historical Perspective
a) In most UPSs, utility AC power is rectified to DC
b) The inverter synthesizes an AC voltage free from the effects of spikes, sags, harmonics, and brief utility outages
8) Assessing Reliability
a) Product support engineers
i) Track the products' performance in actual use
ii) Identify and implement changes necessary to correct deficiencies or defects
iii) Benefit from a road map identifying components most likely to fail
b) Deviations from the predictions of the road map would identify new areas for more intensive investigation and possible remedial action

9) The Correct Course of Action: PRA
a) The process of building the logical model results in a comprehensive review
b) The mathematical nature of the calculation limits the logical fallacies that tend to dominate qualitative evaluation of reliability
c) The implication is that if N components are required for success, there is one, two, twice as many, or even twice plus one as many units available
d) Not all redundancy makes the same contribution to reliability
10) Reliability Assessment Case Study
a) The mathematical models that resulted from the analysis were used to answer some key questions
b) The scalable, modular system utilizes redundancy in nearly all components as a means of achieving high reliability
c) MTechnology, Inc's analysis showed that
d) There are both costs and benefits to redundancy
e) Some sub-systems benefit less from redundancy than others
f) Complex mathematical formulas were utilized to calculate the case study failure rates and common cause failures
11) Case study goals
a) To identify potential sources of failure
b) To evaluate the potential for further improvement in the scalable, modular power system's reliability and availability
12) Target of Case Study Analysis
a) Subjects of analysis
i) 14 - 40 kW Scalable, modular, rack based power system with PDU and static bypass
ii) 500 kW central UPS
b) Tools utilized
i) Probabilistic Risk Assessment (PRA)
ii) Fault tree
iii) Event tree analysis
iv) Bayesian updating
13) Reliability Assessment Case Study
a) All actions have both beneficial and negative affects on reliability
b) It helps to support the uptime of the servers but also can represent a point of failure
14) Comparing Modularity to the Central UPS
a) The scalable, modular system loses power to all loads only when
i) The main entrance bus fails
ii) The transfer switch fails to open
b) The probability of all 14 scalable, modular units failing simultaneously due to internal failures is extremely low
c) PDU failure will cause partial load drop
d) Only one circuit breaker after the transfer switch will cause all critical loads to fail
15) Central UPS data
a) Battery failure is a significant contributor of failure in central UPS
b) The central UPS can fail internally, and bypass can fail, causing all loads to fail
c) PDU failure will cause partial load drop
16) Reliability Assessment Case Study: The Findings
a) The calculated reliability of the scalable, modular power system is comparable to data published by vendors of large, central UPSs
b) The scalable, modular power system is significantly less likely to suffer a complete system failure
c) The redundancy provided in the scalable, modular power system definitely improves the product's reliability
17) Conclusions
a) Overall, the scalable, modular architecture had a system failure rate was approximately 40% lower than that of the central UPS system
b) Failure is defined as the loss of power for all critical loads
c) Discounting battery failures, the scalable, modular failure rate is still approximately 18% less than that of a comparable central UPS architecture
d) If failure is defined to include dropping of any single load due to a branch circuit failure, but not UPS failure, the scalable, modular architecture is 6% less likely to fail
e) Scalable, modular power system architecture proved more reliable than the single module UPS with a single battery string
f) The redundant subsystems within the scalable, modular power system successfully reduced the probability of UPS failure
g) The performance of the ATS is often the limiting factor in achieving higher reliability
18) Summary
a) Understanding how to best define downtime risk is important to optimizing its reliability, while decreasing TCO and increasing agility
b) While redundancy can in principle increase reliability, there are significant costs and potentially serious drawbacks
c) Data center professionals need to understand which processes are most critical, and target reliability accordingly
d) PRA is a powerful tool when applied carefully
Course Assessment: Test Your Knowledge
Course Feedback: We Value Your Opinion

An Introduction to Medical Gas and Vacuum Systems
Course Outline

Course Outline
Course Description
This course introduces plumbing and medical gas systems for medical treatment facilities. We will discuss the various types of medical gas and vacuum systems used in health care facilities. The chief purpose of these systems is to provide safe and reliable support to the medical mission. Codes and standards are also discussed.
Course Objectives
• Discuss the purpose of plumbing and medical gas systems for medical treatment facilities
• Identify the various types of medical gas and vacuum systems used in health care facilities
• Review the important codes and standards used for medical gas and vacuum systems
Course Content or Material
1. Introduction
a. Introduction to Medical Gas and Vacuum Systems
2. Types of medical gas and vacuum systems
a. Medical gas systems
i. Oxygen
ii. Medical Air
iii. Nitrous Oxide
iv. Nitrogen
v. Carbon Dioxide
vi. Mixed Gases
vii. Instrument air
b. Vacuum Systems
c. Medical/Surgical Vacuum
d. Waste Anesthetic Gas Disposal
e. Dental Vacuum Systems (Tim will write a script)
3. Codes, standards, regulations and authorities having jurisdiction
a. NFPA 99
b. FGI Guidelines
c. Local or state regulations
d. Enforcement
i. Certificate of occupancy
ii. CMS and accreditation
e. ASSE Standards
4. Categories of medical gas and vacuum systems
a. Introduction to NFPA 99 Categories
b. Category 1
An Introduction to Medical Gas and Vacuum Systems
Course Outline
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c. Category 2
d. Category 3
Course Assessment: Test Your Knowledge
Course Survey: We Value Your Opinion

On Mon, Mar 17, 2025 at 10:39 AM tshingombe fiston wrote:

We will be conducting system maintenance Sunday March 16, 2025 9:00 p.m.-11:00 p.m. EDT. Please note that you will not be able to login at this time.
Course Assessment - Results page
1
2
3
4
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6
7
8
9
10

Question
A/n _____ measures the amount of electrical current flowing through a circuit during a specific time interval.

Ampere
Volt
Ohm
Watt
Question
Materials with _____ resistance require more voltage to make the electricity flow.

Lower
Higher
Slower
Faster
Question
True or false? The electrical load in a data center is the sum of the various pieces of data center equipment which consume and are supplied with electrical power

T
F
Question
The power in Watts is the _____ power drawn by the equipment, while Volt-Amps is called the _____ power.

Electrical, real
Apparent, real
Real, apparent
Real, solar
Question
A circuit breaker may need to switch short circuit currents as high as _____ times its rated current.

30
15
10
5
Question
Circuit breakers can fail in which of the following ways:

Failure to close, or failure to open under fault conditions
Spurious trip
Failure to operate with the time-current specifications for the unit

All of the above
Question
This form of standby power uses electromagnetism to produce electricity

a, Electrochemical generator
Battery
Fuel cell
Mechanical generator
Question
_____ occur when there is a varying quality of connections to the earth at different points in an electrical installation

Ground loops
Power factor corrected power supplies
Ground Fault Circuit Interrupters
Thermal-magnetic circuit breakers
Question
An approach to solve the problem of impulsive transients includes the utilization of which device?

Power Line Conditioners
Uninterruptible Power Supply (UPS)
Voltage Surge Suppressor (TVSS)
Modern harmonic-correction equipment
Question
According to M Technology, Inc., what percentage of the time are circuit breakers involved in a power system failure in data center electrical infrastructure?

10%
40%
70%
50%
Course Assessment - Test
Course Assessment

Number of questions:
10

Questions are shown:
One by one

So far you have done this test 1 time

Previous unit: Online Course
1.4% completed
Lesson Fundamentals of Power
oCourse Overview - Passed
oOnline Course
oCourse Assessment - Current unit
oReference Materials
Course Transcript
Lesson Going Green: Energy Efficiency in the Data Center
oCourse Overview
oOnline Course
oCourse Assessment
oCourse Feedback
oReference Materials
Course Transcript
Lesson Building Controls I: An Introduction to Building Controls
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Combined Heat and Power
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Compressed Air Systems I: An Introduction
oCourse Overview
oOnline Course
oCourse Assessment
oCourse Feedback
oReference Materials
Course Transcript
Lesson Energy Efficiency with Building Automation Systems I
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Energy Procurement I: Options in Regulated and Deregulated Markets
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Energy Procurement II: Introduction to Hedging in Deregulated Markets
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Energy Procurement III: Balanced Hedging Strategies
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Energy Rate Structures I: Concepts and Unit Pricing
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Going Green with Leadership in Energy and Environmental Design
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Maintenance Best Practices for Energy Efficient Facilities
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Steam Systems I: Advantages and Basics of Steam
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Lesson Waste Heat Recovery
oCourse Overview
oOnline Course
oCourse Assessment
oReference Materials
Course Transcript
Previous unit: Online Course

16) Calculating Efficiency and Operating Costs
a) The technical design of the modular, scalable system results in a much higher efficiency
rate running on lightly loaded UPS units
b) The Fortune 500 firm in our case study:
i) Chooses to implement redundant UPS systems and operates each of them at 40%
capacity
ii) Chooses the “install as you grow” approach which accounts for the significant
differences in energy savings, and therefore, lower electrical bills
17) Total Cost of Ownership
a) Capital costs
i) Allow for an initial build out of 27 watts per square foot for the first 5 years
ii) Assume a build-out to 80 watts per square foot for an additional 5 years
b) Electrical costs
i) Load levels will be at 80% of 2 (N+1) capacity
ii) The maximum loading on any one system is 40%
c) Service costs
i) Customer requires 7x24
ii) 4 hour response
iii) 100% coverage on parts and labor
iv) Battery maintenance will not be included
18) Key TCO Components of Payback
19) Summary
a) The green data center features a safe and healthy work environment and operates in an
energy efficient manner
b) Five examples of green approaches in the data center include the proper use of batteries,
UPSs, rightsized solutions, cooling management, and alternative energy sources.
c) TCO analyses can justify investments in green technologies
Course Assessment: Test Your Knowledge
Course Feedback: We Valu

Fundamentals of Power Outline
Course Description
Power is the foundational cornerstone in the data center. Many instances of equipment failure,
downtime, software and data corruption, are the result of a problematic supply of power. It is
imperative that servers are insulated against utility power failures, surges, and other potential
electrical problems. This course will explore the topic of power, and how it is utilized within the data
center.
Course Outline:
Learning Objectives
• Identify basic electricity concepts
• Describe electrical power and its generation
• Differentiate between various power usages in a data center
• Define power factor
• Recognize the importance of electrical safety measures in a data center

• Identify potential problem areas in the data center
Agenda
• Electrical power key terms
• AC and DC power
• Power factor
• Volt configurations, plugs and receptacles
• Circuit breakers and convenience outlets
• Seven common electrical problems
• Components in a data center
Introduction
1) Key Terms
a) Volt (V)
b) Ampere (Amp)
c) Ohm (Ω)
d) Hertz (Hz)
e) Alternating Current (AC)
f) Direct Current (DC)
g) Load
2) Single-phase and 3-phase Power
3) Watts and Volt-Amps

4) Power Factor Correction
a) Power factor of nearly 1
b) Method of offsetting inefficiencies created by electrical loads
5) Plugs and Receptacles
a) The most common plug/receptacle combination for IT equipment is of an IEC design
b) Also common are plugs and receptacles of the twist lock variety
6) International Electro-technical Commission Plugs
7) National Electric Manufacturers Association Plugs
8) Circuit Breakers
a) A type of switch
b) Designed to protect electrical equipment from damage caused by overload or short circuit
c) Designed to trip at a given current level
9) Circuit Breaker Protection
10) Circuit Breaker Sizing
11) GFCI, ELCB, and RCD
a) Ground Fault Circuit Interrupters (GFCI), Earth Leakage Circuit Breakers (ELCI), or
Residual-Current Devices (RCD) trip a circuit if they detect a small amount of ground
current
b) Larger data centers use resistor banks instead of GFCI, ELCB, or RCD
12) Convenience Outlets
a) Used for non-computer devices
b) Allows for other non-computer equipment to be plugged in without taxing the critical load
13) Grounding
a) Safety measure to protect against electric shock
14) 7 Power Problems
a) Impulsive Transients
b) Interruptions
c) Sags and Undervoltages
d) Swells and Overvoltages
e) Waveform Distortion
f) Voltage Fluctuations
g) Power Frequency Variation
15) Standby Power and Distribution

a) Any power source available to the data center that supplies power when utility power is
unavailable
16) Power Distribution Components
a) Primary power source (Utility)
b) Emergency power source (Generator)
c) Circuit/Branch Circuit
d) Uninterruptible Power Supply (UPS)
e) Automatic Transfer Switch
f) Power Distribution Units (PDU)
g) Outlet Strips
h) Server Plug
17) Summary
a) Power infrastructure is critical to uptime
b) Understanding basic power terms helps to better evaluate the interaction between the
utility, standby power equipment, and load
c) Failures can occur at various points in the power infrastructure, but special care should be
given to the condition and coordination of circuit breakers
d) Numerous power anomalies exist that can impact the uptime of data center equipment
e) Understanding the threats and applying practical power solutions can help to minimize risk
Course Assessment: Test Your Knowledge
Course Feedback: We Value Your Opinion
i. The controlling variable is affected by the actions of the controlled
device upon the controlled variable
c. Cascading
i. Used to modify the performance of closed control loops when
required
5) Red Wire & Direct Digital Controls
a. DDC
i. More sophisticated system
ii. Use electronic controllers that support multiple control loops
b. Enable / disable control
i. Another form of electronic control
ii. Simply turns another controller on or off
iii. One controller will determine when another controller is able to
perform its function
6) Summary
a. For an environmental control system to effectively manage the
environment in a building, thereby increasing energy efficiency and
occupant comfort, three things must take place:
i. Data must be measured and provided as input to the system
ii. Measured data then can be compared to a set of desired outcomes
or instructions
iii. An output is produced based on the measured data to change or
maintain the environment
b. A simple control loop is defined as one input to a controller housing the
control logic, which provides an output to one controlled device
c. Inputs and outputs may be analog or digital
d. A controller may contain many control loops, and a control system may
contain many controllers
e. There are three types of control loops
i. Open
ii. Closed
iii. Cascading
f. And there are three common control technologies
i. Pneumatic
ii. Electrical, and
iii. Electronic
g. Electronic controls may be
i. Direct Digital Control, called DDC, or
ii. Enable / Disable Contro
Combined Heat and Power (Cogeneration)
Course Description: Cogeneration today is widely used throughout the world for efficient
production of heat and power. Cogeneration is the simultaneous production of heat and power in
a single thermodynamic process. The purpose of this course is to review the different approaches
for applying technologies to the function of cogeneration. We'll also explore the various issues
and considerations for deployment of the two main types of cogeneration concepts: "Topping
Cycle" plants (including "Combined Cycle" plants), and "Bottoming Cycle" plants.
Pre-Requisites for this course include: Energy Rate Structures I and II.
Learning Objectives:
At the completion of this course, you will be able to:
• Define what cogeneration is along with the primary fuels used in its creation
• Identify the different approaches for applying technology to the function of cogeneration
• Discuss the various factors to consider when evaluating the use of a CHP plant
Course Content or Material
1) Introduction
a) Technology overview
b) Defining "cogeneration"
i) How cogeneration occurs
ii) Primary fuels used
2) Two main approaches for cogeneration technology applications
a) Topping Cycle plants (including Combined Cycle plants)
i) Examples
ii) Overview
b) Bottoming Cycle Plants
i) Examples
ii) Overview
3) Environmental Issues
a) Benefits
b) Concerns
4) Things to Consider When Applying CHP Plant
a) Steam load versus electric load
b) Capital utilization / productivity
c) Reliability requirements (steam and electric)
d) Local electricity rates
e) Efficiency gains versus fuel prices
f) Fuel availability and selection
g) Staffing and training
5) Comparing CHP Technologies
a) Diesel engine
b) Natural gas engine
c) Steam Turbine
d) Gas Turbine
Compressed Air Systems I: An Introduction
Course Description
Compressed air is widely used throughout industry. It is sometimes called the "fourth utility", after
electricity, gas and water. From mining, lumber and paper mills, petroleum, chemical, textile and glass
production to small manufacturing plants and hotels, compressed air provides critical services and can
often represent the majority of the facility energy costs. Since many facilities cannot function without
compressed air, reliability is paramount, but given that sound operating practices can reduce energy
consumption by 20% to 50%, efficiency is high on the agenda.
This is the first in a series of compressed air system courses offered by Energy University. In this course,
we will look at the relative inefficiency of compressed air and examine the components of a compressed
air system.
Course Outline
Course Objectives
Objectives
• Explain basic compressed air terms and concepts
• Describe the relative inefficiency of compressed air as a power source
• Define the supply and demand sides of a compressed air system and
• Identify the components of a compressed air system and explain what they do
Course Content or Material
1) Introduction
2) Supply & Demand
a. Divided into a supply side and a demand side
3) Compressed Air Pros & Cons
4) Compressed Air Inefficiency Examples
a. Metric Unit Example

b. US Customary Unit Example
5) Compressed Air Systems Optimization
a. The efficiency of compressed air systems typically receives little attention
i. Systems are not well understood by plant operations staff
ii. Modifying a system is perceived as a risk to production
iii. Vendors compete in a market where equipment is typically sold on a "lowest first bid", without regard for the cost of operation
b. Optimization leads to
i. Reduced costs
ii. Reduced maintenance
iii. Less downtime
iv. Increased production
v. Improved product quality
6) Equipment Descriptions
a. Fan
b. Blower
c. Compressor
7) Pressure Terminology

a. Pressure
b. Absolute Pressure
c. Gauge Pressure
8) Standard Volume of Air
a. Metric
b. US Customary
9) Volume Flow
a. Inlet flow
b. Actual flow
c. FAD
d. Standard flow
e. Capacity
10) Operating cost
a. Proportional to volume
b. Proportional to pressure ratio
11) Dew Point
a. The temperature at which condensation begins to occur
12) Compressed Air Requirements
a. Cleanliness
b. Dryness
c. Oil content
13) Compressed Air System Components
a. Interactive element
14) Summary
a. Basic compressed air terms and concepts;
b. Compressed air as a source of power is relatively inefficient. However, it can be very useful and necessary at times;
c. Compressed air systems are normally broken down into supply and demand side components;
d. You should now be able to identify basic components of a compressed air system and explain what they do

Energy Efficiency with Building Automation Systems Part 1
Course description:
In this course we will focus on what a building automation system (BAS) is as well as some of the commonly used terminology. We will also look at some of the HVAC strategies used in building automation systems.
Course Outline:
Learning objectives
At the completion of this course you will be able to:
• Define what a building automation system is
• Review the main terminology and components of a Building Automation System and HVAC system
• List the most common HVAC strategies that may be controlled by a Building Automation System
Course content or material
1) Introduction
a. What is building automation
b. What are the functions of building automation systems (BAS)
2) Parts of a BAS
3) Terminology
a. Set point
b. Air
4) Review of HVAC systems
a. Equipment
i. Air handling unit
ii. Chiller
iii. Cooling tower
iv. Flow controller
v. Boiler
vi. Dual duct
vii. Constant volume/variable temperature
viii. Variable air volume
ix. Terminal reheat

Energy Procurement I
Course Description: The procurement of energy (electricity, natural gas, fuel oil, etc.) is becoming a major part of the energy manager's job. Cost effective energy procurement requires understanding of the market, regulatory limitations and opportunities, and contingency planning. The purpose of this course is to raise awareness of the available options for energy procurement.
Learning Objectives:
• Define the roles of the main players in the energy supply chain
• Explain the major differences in regulated and deregulated markets
• List the main options available for optimizing energy procurement
Course Content or Material:
1) Introduction
2) Types of Energy Typically Procured
a) Most common electricity and natural gas
b) Coal, Oil-based fuels, Steam, Compressed air
3) Energy Supply Chain
a) Production, Transmission, Distribution, Supply
b) Gas supply chain
c) Electricity supply chain
4) Regulated and deregulated markets
a) Regulated Markets
b) De-regulated Markets
c) Wholesale versus Retail
d) Equal access to transmission and distribution
e) Drivers of Deregulation
f) Pricing
i) in a regulated market
ii) in a deregulated market
g) Options in a regulated market
i) Natural gas contracts
ii) Power contracts
h) Options in a deregulated market
i) Supplier Options
i) Local distributor
ii) Gas or power marketers
iii) Brokers
iv) LDC Marketing Departments
v) Aggregator
vi) Power Pool and Exchange Operators
vii) Overview of Supplier Options
viii) Pipeline Connects for Large Consumers
5) Procurement pitfalls
a) Exposure to energy price volatility that has not been identified or quantified
b) Energy that is managed locally with no corporate oversight
c) Procurement decisions that are made by personnel without knowledge of the energy market
d) Contracts renewed based on expiration, not market conditions

e) Contract renewals that embed long term risk premiums to vendors
f) A conviction that hedging is speculative in nature
6) Deregulation Growing and Prices are Volatile
a) Hedging
b) Avoiding pitfalls of lowest price and highest risk

Energy Procurement II
Course Description: Unprecedented volatility in today's energy markets has wreaked havoc on the profit margins and bottom lines of many industrial companies. In order to successfully manage costs in this market, it is critical to apply commodity-based market purchasing strategies—or as it is commonly known in the industry: "hedging". Energy price risk management and hedging programs quantify exposure to adverse events and mitigate the impact of those events on financial results. An on-going Energy Risk Management program can provide for more predictable budgeting and insulate future earnings from the unpredictable effects of volatile energy prices. The purpose of this course is to address the hedging process. We will also cover the spot and forward markets as well as fixed and index linked contracts.
Pre-requisites: Energy Procurement I: Options in Regulated and Deregulated Markets.
Learning Objectives:
At the completion of this course, you will be able to:
• Explain the difference between spot and forward markets
• Describe how hedging reduces your risk, and you will be able to
• Define the meaning of fixed and index-linked contracts
Course Content or Material
1) Introduction
a) Brief overview of gas and electricity markets
b) Energy procurement
2) Procurement Pitfalls
a) Common pitfalls in a deregulated market
b) How energy managers remedy common errors in energy procurement
3) Commodity Markets for Energy
a) Commodity exchanges
i. The New York Mercantile Exchange (NYMEX)
ii. The Singapore Commodity Exchange (SICOM)
iii. The former International Petroleum Exchange (IPE) based in London is now part of Intercontinental Exchange (ICE)
iv. Over The Counter
b) Energy buyer options
i. Spot market
ii. Forward market
i. Fixed contract
ii. Index-linked contract
4) Determining Energy Prices
a) Total energy costs
b) Regulated cost components
c) Commodity-based market purchasing strategies

5) Avoiding Pitfalls of Lowest Price and Highest Risk
a) Define energy purchasing strategy
i) Spot purchasing versus fixed price purchasing
ii) Hedging
6) Implementing Hedging
a) Forward contracts
b) Futures market

c) Flattening a position
d) Trading forward contracts
e) Permutations
f) Contract expiration
g) Imbalances upon delivery
7) Hedging Examples
a) Hedging on the forward market
b) Settling contracts on the spot market
8) Fundamental Concept of Hedging
a) Shaves off the extremes
b) Provides predictability
9) Adopting a Balanced Approach to Hedging
a) Full requirements fixed-price
b) Partial fixed-price
c) Partial spot market
d) Staggered fixed-price commitments
Energy Procurement III: Balanced Hedging Strategies
Course Description: Managing energy costs is the key to a successful profit margin and bottom line for many industrial companies. In order to successfully manage costs in this market, it is helpful to apply a balanced hedging strategy. A balanced hedging approach will quantify exposure to adverse events and mitigate the impact of those events on financial results. The purpose of this course is to describe a variety of hedging strategies, and identify the main drivers of energy prices. We will also cover how the commodity market functions to support energy trading.
Pre-requisites: Energy Procurement I and Energy Procurement II.
Learning Objectives:
At the completion of this course, you will be able to:
• Describe a variety of balanced hedging strategies
• List the main drivers of energy price
• Describe how commodity markets function to support energy trading
Course Content or Material
1) Adopt a Balanced Hedging Strategy
a) Brief overview of concepts covered in Energy Procurement II
i) Full requirements fixed-price
ii) Partial fixed-price
iii) Partial spot market
iv) Staggered fixed-price commitments
b) Determination requirements
i) Commitment term
ii) Tolerable price levels
iii) Range of tolerable cost fluctuation and
iv) Minimum/maximum time horizons for making the next commitment
v) Plan of action to mitigate damage for when prices change rapidly
2) Risk Tolerance
a) Definition of hedge ratio
b) Defining risk tolerance
3) Defining a Hedge Ratio and Strategy
a) Riverbanks analogy
b) Examples of hedge ratio and energy purchasing strategies
4) Exchange Operation
a) How commodity exchanges function
b) Commodity exchange regulation
c) Commodity-based market purchasing strategies
5) Terms and Mechanisms
a) The short position – which means you are agreeing to sell
b) The long position – which means you are agreeing to buy
c) The price of the contract
d) The daily account adjustment

e) The final settle price
f) The strip
g) Futures market versus the stock market
h) Final settle
6) Drivers of Energy Prices
a) Supply
b) Demand
c) Seasonality
d) News and Rumors
e) Speculators
7) Commodity Risk Analysis
a) Role of gas and power marketers
b) Role of independent market analysis service providers
8) The Forward Curve
a) Definition
b) Examples
9) Price Forcasting
a) Definition
b) Examples
10) Other Procurement Considerations
a) Price, dependability and service
b) Importance of considering
11) Best Practices
a) Integrates on a continual basis
i) Data
ii) Risk management
iii) Procurement
b) Employs
i) Data driven decisions
ii) Management approach that identifies and quantifies risk before determining the best way to manage it
iii) Procurement optimisation with operations
12) Summary
10) Summary

Energy Rate Structures Part 1: Concepts and Unit Pricing
Course description:
Understanding the forms of energy used at a facility, and the rate structure for each, is key to understanding energy costs and implementing an energy efficiency program. By understanding what you are paying for energy, and how the rate structure controls your bill, you can adopt different strategies for reducing your energy costs. You may even be able to move to a different rate structure that is more cost effective for you. In this course, we will focus primarily on gas and electricity concepts and unit pricing.
Course Outline:
Learning objectives
At the completion of this course you will be able to:
• Define and recognize the difference between consumption and demand
• Identify different forms of energy pricing including
• flat rates, block rates, seasonal pricing, time of use rates, and real time pricing
Course content or material
1) Introduction
a. Understanding different forms of energy
2) Consumption and Demand
a. Difference between consumption and demand
b. Example
3) Energy Pricing
a. Types of energy pricing
i. Flat rate
ii. Block rate
1. Declining
2. Inverted
iii. Seasonal rates
iv. Time-of-Use rates
1. On-peak
2. Off-peak
3. Shoulder/Mid-peak
v. Time of use rates
vi. Real Time Pricing
vii. Other forms of pricing
Going Green with Leadership in Energy and Environmental Design Course Outline
Course Description:
This course defines green buildings, explains the mission of the US Green Building Council and the requirements of the Leadership in Energy and Environmental Design (LEED) rating system. Schneider Electric solutions for meeting the LEED requirements will also be explained.
Course Outline:
Learning Objectives
At the completion of this course, you will be able to:
• Define the characteristics of Green Buildings
• Explain the mission of the US Green Building Council
• Identify the Leadership in Energy and Environmental Design rating system
• Describe Schneider Electric products and services which satisfy LEED requirements
Agenda
• Introduction
• Impacts of US Buildings on the Environment
• Advantages of building green
• Review the Mission of the US Green Building Council
• Discuss the LEED rating system
• Discuss Schneider Electric products and services that satisfy LEED requirements
• Introduce Case Studies
• Summary
Course Content or Material
1) Introduction
a) Green Building
b) Design of Leadership in Energy and Environmental Design (LEED)
c) Who makes up the LEED team
d) LEED reach
e) Point of the LEED point based system
f) Why is there a demand
2) Impacts of US Buildings on the Environment
a) Impacts of US buildings on resources
b) US Energy Consumption
c) US Electricity Consumption
3) Advantages of Building Green

a) Demand for Green Building
b) Perceived Business Benefits
c) Predictions in growth of Green
d) Next Generations impact of perceptions of green build
4) Mission of USGBC
a) Mission statement for USGBC
b) What the USGBC does
c) Membership
5) LEED Rating System
a) LEED addresses complete lifecycle of buildings
b) 4 Levels of LEED
c) 6 Credit Categories
d) Steps to LEED Certification
e) A sample checklist
f) Available resources on line

6) Schneider Electric products and services that satisfy LEED
requirements
a) Maximizing LEED points
b) Building Automation and Control
c) Critical Power and Cooling
d) Engineering Services
e) Field Services
f) Lighting and Lighting Controls
g) Power monitoring
h) Variable Frequency Drives
i) Renewable Energy Systems
j) Available Solutions for Compliance
7) Case Studies
a) Great River Energy Headquarters
b) Genzyme Center
c) Duke Universtiy Smart Home
Maintenance Best Practices for Energy Efficient Facilities
Course Outline
Course Description
Good maintenance saves energy costs! Properly maintained facilities and equipment produce
quality products, reduce downtime and have lower energy costs. This adds up to real money!
This course will address the importance of maintenance in facilities, discuss the savings proper
maintenance can contribute, and identify techniques that can lead to the energy efficient
maintenance of facilities.
Course Outline
Course Objectives
• List organizational problems that lead to inadequate maintenance
• Identify the characteristics of an effective maintenance system
• List examples of energy efficiency costs caused by insufficient maintenance
• Calculate the energy costs associated with various types of maintenance failure (eg in
compressed air, steam, etc)
• Identify simple ways that infrared, vibration analysis, and ultrasonic surveys can contribute to
identifying maintenance needs
Course Content or Material
1) Introduction
2) Organizational problems
i) Common maintenance problem areas
(1) Lack of work order system
(2) Poor reporting of work orders / problems
(3) Poor analysis of work orders – (Pareto analysis)
(4) Inadequate preventative maintenance program
(5) Inadequate maintenance training
(6) Poor control of maintenance efforts
(7) Lack of management attention
3) Characteristics of an effective maintenance system
i) Bring discipline to the maintenance process by ensuring
• Definition of responsibilities
• Adequate training
• Sufficient tools and equipment
• Clear procedures, including evaluation of results, and an emphasis on identifying and
reinforcing best practices
ii) These systems can be simple, manual arrangements, or they can include capability for
inputs from sensors such as differential pressure across filters, equipment
temperatures and vibration
iii) In either case, there are basic requirements for a work order system, work order
analysis, generation of maintenance orders, and performance records of equipment.
4) Examples of energy efficiency costs
i) Steam leaks
ii) Steam trap failures
iii) Compressed air leaks

iv) Uninsulated pipes
5) Tables and charts – Calculating the cost
6) Steam Systems
The steam system maintenance should include:
Steam Trap Survey and Repair
Leak Repair
Insulation Repair
7) Compressed Air Systems
i) An efficient compressed Air System must include a regularly scheduled ultrasonic leak
survey for air leaks.
8) Lighting
.
Once your solution is defined, your maintenance program should cover:
(a) Cleaning
(b) Relamping
(c) Monitoring compliance with expectations
(d) Maintaining standard IESNA light levels
9) Motors
a) Use Premium Energy Efficient motors where possible particularly for replacement of
failed motors
b) Use Variable Speed or Variable Frequency drives
c) Use cogged belts or synchronous belts
i) Properly align motors and drives
(1) Use laser alignment tools for both direct drive and belt drives
(a) This step is crucial to extend motor life.
(i) Design motor bases for easy adjustment
10) Ultrasonic, Infrared and Vibration Analysis
In the last section of this class, let's look at some specific tools and techniques and see how they
can be usefully applied to the energy-efficiency maintenance of the systems we have been
discussing
a) Ultrasonic Leak detectors
i) Air leaks
(1) Survey for air leaks during full production periods
ii) Steam Traps
(1) Survey steam traps during winter heating season
iii) Specialty gas leaks – especially for high cost gases – Nitrogen, Argon, Carbon
Dioxide
iv) Vacuum system leaks
v) Duct work Leakage– particularly insulated duct work
vi) ID and FD fan duct leakage – particularly behind insulation blankets
vii) Can be used in some production leak testing processes
b) Infrared
i) Infrared inspection equipment is widely available and is astonishing cheap
ii) Electrical gear inspection
iii) Insulation hot spots

iv) Roof inspections - Aerial Infrared inspection is a cheap effective method of built up
roof inspection especially identifying leak points / saturated insulation
v) Boiler Lagging / Flue Gas Leaks
(1) Infrared inspection can determine point where the leak starts.
c) Vibration Analysis
i) Motors and Bearings
(1) Motor / Drive bases should have a mass that is 3 times the mass of the rotating
element. Concrete is a cheap method of adding mass.
ii) Fans
(1) Always dynamically balance fans in place upon installation. Although fans are
balanced at the factory, it is common for fans to become damaged and or out of
balance during shipment or installation.
iii) Production machinery
(1) Vibration problems usually have one of three solutions - increase mass of the
machinery, increase rigidity of the machinery, or dynamically balance the rotating
element. Any or all of these methods can be used to reduce or control vibration.
iv) Vibration problems once resolved usually cease to be a problem.
v) Large rotating machinery – Often include vibration sensors for continuous condition
monitoring
Course Assessment: Test Your Knowledge
Course Survey: We Value Your Opinion
Steam Systems I: Advantages and Basics of Steam
Course description:
Steam has come a long way from its traditional associations with locomotives and the Industrial
Revolution. Today, it serves as an integral and essential part of modern technology. This course will
introduce the benefits of utilizing steam in numerous processes and discuss t selecting the appropriate
pressures for each of these different processes.
Course Outline:
Learning objectives
At the completion of this course you will be able to:
● List the advantages of steam
● Describe the formation of steam
● Understand the relationship between pressure, temperature, and energy
Course content or material
1) Introduction
a. Advantages of steam
b. What is steam
c. Definitions
i. Joules
ii. BTUs
iii. Temperature
iv. Saturation
v. Enthalpy
vi. Absolute pressure
vii. Gauge pressure
viii. Differential pressure
ix. Sensible heat
x. Latent heat
xi. Total heat
2) Formation of Steam
a. How steam is created
b. Heat energy transfer
i. Example
c. How a boiler makes steam
3) Relationship between pressure, tem
Waste Heat Recovery
Course Description: Waste heat is present in almost all industries and processes.
Opportunities exist to put this waste heat to use economically in order to reduce the
energy consumption in the plant. The purpose of this course is to identify opportunities to
recover waste heat, and the equipment used to recover waste heat. The process for
calculating waste heat recovery will also be addressed, along with the factors that
influence the feasibility of waste heat recovery.
Learning Objectives:
At the completion of this course, you will be able to:
• List the factors that influence the feasibility of waste heat recovery
• Identify opportunities to recover waste heat, the temperature ranges of heat
recovered and the possible uses
• Perform calculations of waste heat recovery
• Categorize and explain the general operation of the main equipment used to
recover waste heat
Course Content or Material
1) Introduction
2) Benefits of Waste Heat Recovery
a) Direct benefits
i) Reduced energy consumption

ii) Consequent increase in energy efficiency
b) Indirect benefits
i) Reduction in pollution
ii) Reduction in equipment size
iii) Reduction in auxiliary energy consumption
3) Factors Influencing Waste Heat Recovery Feasibility
a) Sufficient quantity
b) Sufficient quality
c) Used economically
d) Location
e) Availability
f) Compatibility
g) Concerns
h) Limits on heat recovery
4) Waste Heat
a) Quality
i) Dependent upon the temperature of waste heat available
ii) Economic recovery would depend upon following factors:
b) Quantity Of Waste Heat
i) Quantity of heat (in kcal) = V x ρ x Cp x Δt
c) Typical Sources Of Waste Heat
i) Heat in waste gases from industrial processes (High temperature)
ii) Combustion flue gas (Medium temperature)
iii) Low temperature heat recovery

iv) Other sources of waste heat
d) Uses of Waste Heat
i) Waste heat can be put to use depending upon the type of plant and category
of heat available particularly with relation to temperature and quantity
ii) Pre heating of combustion air:
iii) Pre heating of boiler feed water:
iv) Vapour Absorption Refrigeration:
v) Pre heating for process requirements:
5) Development Of Waste Heat Recovery System
a) Compatibility of waste heat quality:
b) Scheduling:
c) Location
6) Waste Heat Recovery Devices
a) Recuperators
b) Economizers
c) Waste heat boilers
d) Heat pumps
e) Regenerators
f) Heat Wheels
g) Heat Pipes
h) Other Waste Heat Recovery Devices
7) Sources and Utilization of Waste Heat Summary Chart
8) Matrix of Waste Heat Recovery Devices/Applications
9) Calculating Waste Heat Recovery
a) Overview
b) Case Study Examples
10) Summary
Course Assessment: Test Your Knowledge
Course Survey: We Value Your Opinionperature, and energy

4) Summary

d) Schneider Electric and LEEDs

8) Summary
4) Summary
7) Summary
5) Summary
e) Micro-turbine
f) Fuel cells
6) Summary Skip to main content

1.My Courses
2.Tshingombe fiston (tshingombefiston@gmail.com)

Tshingombe fiston
Learner | tshingombefiston@gmail.com

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On Sun, Mar 16, 2025 at 1:43 PM tshingombe fiston wrote:

Fundamentals of Power Outline
Course Description
Power is the foundational cornerstone in the data center. Many instances of equipment failure, downtime, software and data corruption, are the result of a problematic supply of power. It is imperative that servers are insulated against utility power failures, surges, and other potential electrical problems. This course will explore the topic of power, and how it is utilized within the data center.
Course Outline:
Learning Objectives
• Identify basic electricity concepts
• Describe electrical power and its generation
• Differentiate between various power usages in a data center
• Define power factor
• Recognize the importance of electrical safety measures in a data center
• Identify potential problem areas in the data center
Agenda
• Electrical power key terms
• AC and DC power
• Power factor
• Volt configurations, plugs and receptacles
• Circuit breakers and convenience outlets
• Seven common electrical problems
• Components in a data center
Introduction
1) Key Terms
a) Volt (V)
b) Ampere (Amp)
c) Ohm (Ω)
d) Hertz (Hz)
e) Alternating Current (AC)
f) Direct Current (DC)
g) Load
2) Single-phase and 3-phase Power
3) Watts and Volt-Amps

4) Power Factor Correction
a) Power factor of nearly 1
b) Method of offsetting inefficiencies created by electrical loads
5) Plugs and Receptacles
a) The most common plug/receptacle combination for IT equipment is of an IEC design
b) Also common are plugs and receptacles of the twist lock variety
6) International Electro-technical Commission Plugs
7) National Electric Manufacturers Association Plugs
8) Circuit Breakers
a) A type of switch
b) Designed to protect electrical equipment from damage caused by overload or short circuit
c) Designed to trip at a given current level
9) Circuit Breaker Protection
10) Circuit Breaker Sizing
11) GFCI, ELCB, and RCD
a) Ground Fault Circuit Interrupters (GFCI), Earth Leakage Circuit Breakers (ELCI), or Residual-Current Devices (RCD) trip a circuit if they detect a small amount of ground current
b) Larger data centers use resistor banks instead of GFCI, ELCB, or RCD
12) Convenience Outlets
a) Used for non-computer devices
b) Allows for other non-computer equipment to be plugged in without taxing the critical load
13) Grounding
a) Safety measure to protect against electric shock
14) 7 Power Problems
a) Impulsive Transients
b) Interruptions
c) Sags and Undervoltages
d) Swells and Overvoltages
e) Waveform Distortion
f) Voltage Fluctuations
g) Power Frequency Variation
15) Standby Power and Distribution
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a) Any power source available to the data center that supplies power when utility power is unavailable
16) Power Distribution Components
a) Primary power source (Utility)
b) Emergency power source (Generator)
c) Circuit/Branch Circuit
d) Uninterruptible Power Supply (UPS)
e) Automatic Transfer Switch
f) Power Distribution Units (PDU)
g) Outlet Strips
h) Server Plug
17) Summary
a) Power infrastructure is critical to uptime
b) Understanding basic power terms helps to better evaluate the interaction between the utility, standby power equipment, and load
c) Failures can occur at various points in the power infrastructure, but special care should be given to the condition and coordination of circuit breakers
d) Numerous power anomalies exist that can impact the uptime of data center equipment
e) Understanding the threats and applying practical power solutions can help to minimize risk
Course Assessment: Test Your Knowledge
Course Feedback: We Value Your Opinion

On Sun, Mar 16, 2025 at 1:38 PM tshingombe fiston wrote:
Skip to main content

1.My Courses
2.Course catalog
System Maintenance: Sunday March 3/16 Time: 9pm-11pm EDT

We will be conducting system maintenance Sunday March 16, 2025 9:00 p.m.-11:00 p.m. EDT. Please note that you will not be able to login at this time.

By Language / English
A Comparison of AC and DC Power Distribution in the Data Center (DC0014EN)
Course rating is 4.559724828017511 stars

By Language / English
A Four-Step Path to a Comprehensive Energy Management Action Plan
Course rating is 4.49519890260631 stars

Uncategorized
Abbott Laboratories Energy Efficiency Development Path
Course rating is 4.434782608695652 stars

By Language / English
Accor Energy Awareness Modules
Course rating is 4.595744680851064 stars

By Language / English
Active Energy Efficiency Using Speed Control
Course rating is 4.632653061224 49 stars

By Language / English
AI-Driven Data Centers: Revolutionizing Decarbonization Strategies
Course rating is 4.535714285714286 stars

By Language / German
Aktive Energieeffizienz durch Drehzahlregelung
Course rating is 4.571428571428571 stars

By Language / English
Allergan-GENIUS Team Lead Advanced Training
Course rating is 4.666666666666667 stars

By Language / English
Allergan-GENIUS Team Lead Basic Training
Course rating is 4.625 stars

By Language / English
Allergan-Site Energy Team Member Training
Course rating is 4.954545454545454 stars

By Language / English
Alternative Power Generation Technologies (DC0003EN)
Course rating is 4.576494427558 2575 stars

By Language / English
American Hotel & Lodging Educational Institute
Course rating is 4.866666666666666 stars

By Language / English
An Introduction to Medical Gas and Vacuum Systems (HC0015)
Healthcare
Course rating is 4.6521739130434785 stars

By Language / English
An Overview of Data Center Physical Infrastructure (DC0004EN)
Course rating is 4.717684377478192 stars

By Language / French
Analyse financière des projets I
Course rating is 4.607843137254902 stars

By Language / English
Analyzing Reliability in the Data Center (DC0005EN)
Course rating is 4.670731707317073 stars

By Language / Brazilian Portuguese
Análise Financeira de Projetos I
Course rating is 4.655737704918033 stars

By Language / Spanish
Aplicación de las normas de seguridad - AEA Standards (YT00014SP)
Course rating is 4.8 stars

By Language / Spanish
Aplicación de las normas de seguridad: México (YT00032ES)
Course rating is 4 stars

By Language / Brazilian Portuguese
Aplicando regras de segurança (YT00026BP)
Course rating is 5 stars

By Language / French
Application des règles de sécurité (YT00022FR)
Course rating is 5 stars

By Language / English
Applying Safety Rules (YT00001EN)
Student
Course rating is 4.7644444444444444 stars

By Language / French
Approvisionnement en énergie I
Course rating is 4.295454545454546 stars

By Language / French
Approvisionnement en énergie II
Course rating is 4.636363636363637 stars

By Language / Spanish
Aprender los fundamentos de la electricidad (YT00019ES)
Course rating is 4.631578947368421 stars

Course Catalog
College of Data Center
College of Energy Efficiency
Youth Impact Through Learning
Courses by Topic
Resources
Courses by Language
auf Deutsch
Brasileira
In English
en Espanol
en FranÃ§ais
Nederlands
nell'Italiano
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25

On Sun, Mar 16, 2025 at 1:26 PM tshingombe fiston wrote:

Please tell us the name of the officer or member of staff you are working with in relation to this request
engineering