SIEMENS

VarioStack™
Functional Description

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Document No.: 740-01358
Revision: 9

Revision History

Revision	Date	Notes	Author
1	02/17/2019	Initial Release	E. Wilson
2	03/1/2019	Continued Development – Improved I/O List – Improved Logic Definition	E. Wilson
3	3/10/2019	Added content to section 5.8 Safety System Added Phase Monitor as a PLC input. Added component specs in Appendix B	E. Wilson
4	3/19/2019	Resolved To-do items.	J. Zhu
5	3/25/2019	Added remaining safety component specs Added light curtain distance calculation Added “Destacker Object Under Lift PE” Renamed “Destack Confirmation PE” to “Destack Error PE” Added Power Drop definition Redefined E-Stop recovery. Should not include reset button.	E. Wilson
6	4/7/2019	Replaced power connector with 20A version and electrical FLA calculated values	E. Wilson
7	7/6/2019	Updated to reflect latest design after prototype deployment in JAX2 FC. Document has also been modified to better define the system interfaces and capabilities. It now explains less of the design specifics.	E. Wilson
8	4/6/2020	Updated to reflect latest design after pilot deployment to BDL3 FC. Document has also been modified to better define the system interfaces and capabilities. It now explains less of the design specifics.	E. Wilson
9	7/29/2020	Update for 2020 production design. Includes name change to VarioStack	E. Wilson

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1.1 Purpose of VarioStack™ Workstation

The primary purpose of VarioStack™ is to facilitate the manual process of transferring incoming goods from the original packaging into totes that can be used for conveyance to a storage location. To accomplish this, VarioStack must provide:

1. Stable surface for the operator to place the package
2. Access to accessories such as thin client computer, monitor, and hand-scanner for entering tote and item data into customer's computer system. Note VarioStack does not include these items, but must provide proper mounting and power accomodations.
3. Provide an ergonomic placement of an empty tote to be filled by the operator.
4. Manual interface to allow the operator to push the empty tote onto a take-away conveyor.

Figure 1 below depicts an overview of this operation within a customer facility. Notice that a pair of operators are working at a dual-sided workstation. Multiple dual stations (not

shown) would be located along the same “Incoming Packages” conveyor shown in the figure.

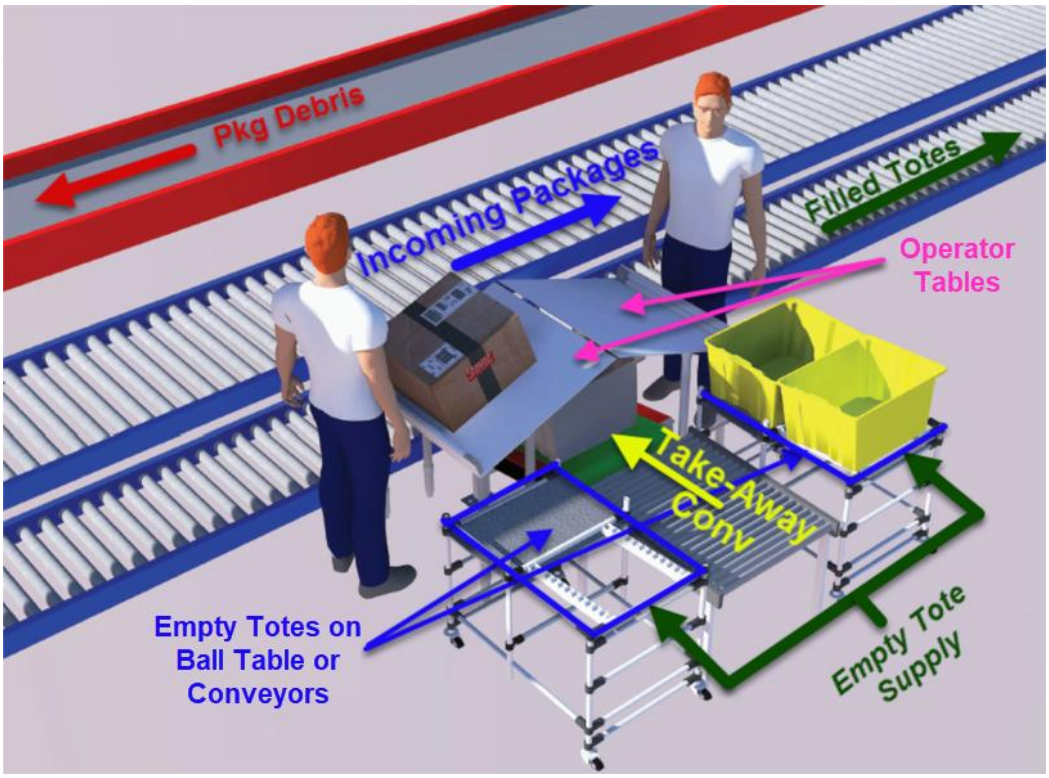


Figure 1. System Overview

Note: The figures in this section are used only to describe the functionality of the system. The system shown is a model of a previously developed prototype and was not developed by Siemens.

Typically, the operator must perform the following tasks.

1. Retrieve package from an incoming conveyor
2. Open the package
3. Scan the license plate on the tote (See Figure 2). This task may be automated using a static mounted scanner over the empty totes.
4. Scan the 1st item from the package and place it in the tote.
5. Repeat until the tote is full.
6. Push the full tote onto the take-away conveyor.
7. Place the empty packaging onto the package debris conveyor
8. VarioStack should present a new empty tote to the operator and the cycle should repeat.

This description is simply to better understand the purpose of the workstation. The actual workflow of the operator may vary.

Figure 2. Typical Tote

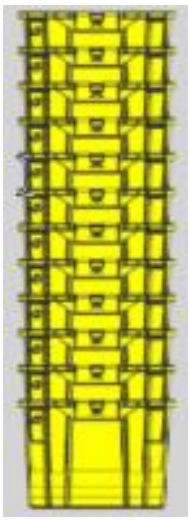


Figure 3. Stack of nested totes

The secondary purpose of VarioStack is to reduce the manual handling of empty totes by converting a stack of up to twelve nested totes to sequentially fed individual totes presented to the operator as needed. Figure 3 shows how these totes nest within each other when stacked properly.

VarioStack is currently designed for tote sizes of approximately 600mm wide x 400mm long x 272mm deep. Because VarioStack interfaces with the tote handles, the dimensions illustrated below are also required. Minor customization to VarioStack may allow compatibility with other tote sizes.

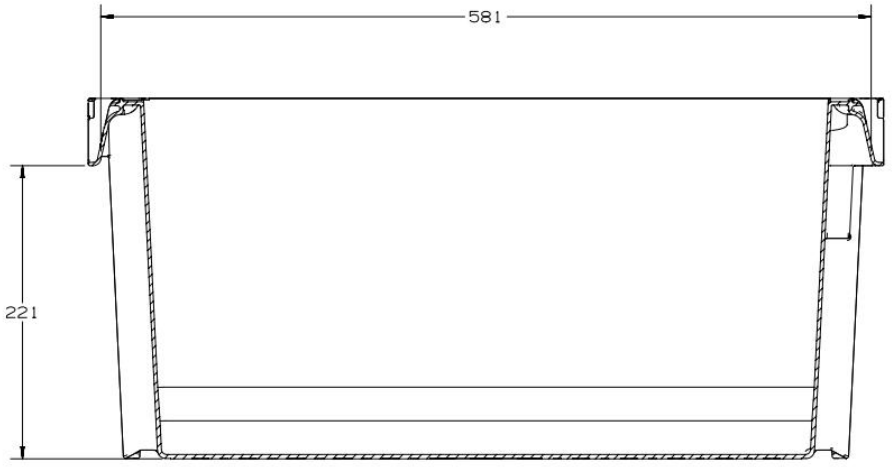


Figure 4. Tote Handle Dimensions (mm)

Two more modules are included with VarioStack to manage the tote stacks: the Buffer Module and the Destacker Module (see Figure 5). Together, these two modules provide automatic replenishment of empty totes to the operator. .

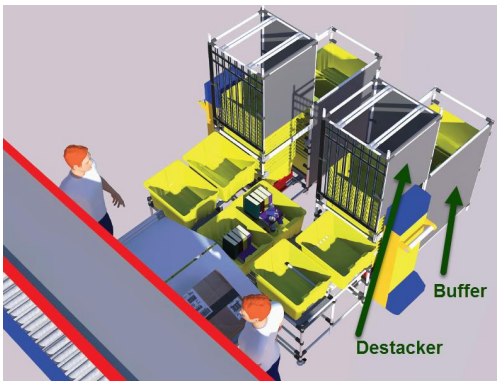


Figure 5. Empty Tote Supply: Buffer and Destacker

2. External Interfaces – Site Requirements

Prior to installing VarioStack within the customer site, the following infrastructure must be in place.

2.1 **Power Drop:**

2.1.1 Power Requirement:

Each VarioStack will require a drop for each control cabinet (Two cabinets per dual sided workstation)

- 208Y120 ±10% VAC, 60 Hz, 3-phase, 5 wire (L1, L2, L3, N, G)

The full load amps (FLA) required for each leg of the supply power are shown below:

LOAD FLA	**L1**	**L2**	**L3**
System DC Power Supply	3.9		3.9
DC Roller Power Supply		3.9	3.9
Servo Power Supply	9.3	9.3	
Convenience Outlet			*8*
Total	**13.2**	**13.2**	**15.8**

Table 1. Full Load Amps

With the assumptions above, each control cabinet is capable of pulling just below 16 Amps. Therefore, a 20A service is required.

2.1.1.1 Power Drop Location:

VarioStack will include a power cord for each unit (2 per dual sided workstation). On the workstation side, the cord will connect to the Power Inlet Enclosure and lay in the cable trough shown below.

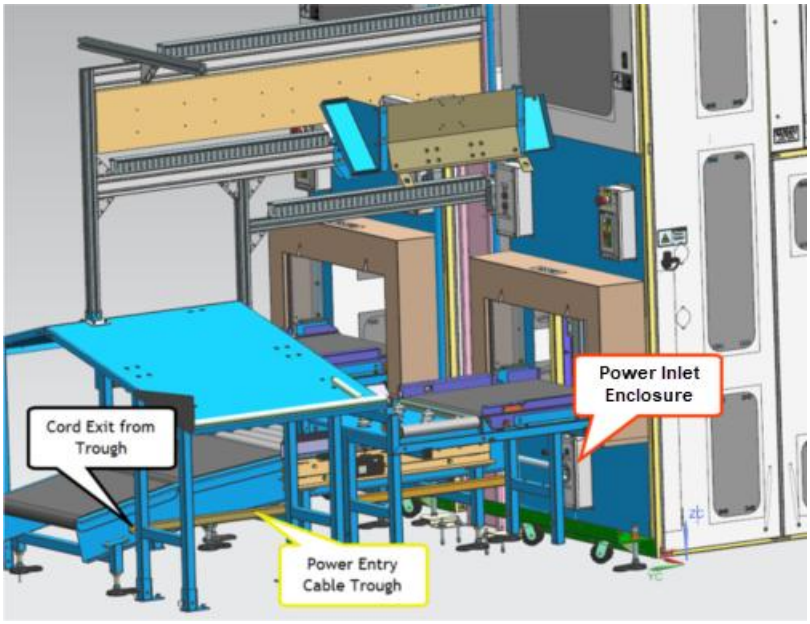


Figure 6. Power Cord Location

Figure 7. Power Inlet Enclosure

The Power Inlet Enclosure shown above is the central location for all external interfaces to VarioStack. This box includes connections to:

- Power cord (provided with VarioStack)
- External ethernet connection
- Dry contact M12 connections for safety signals.

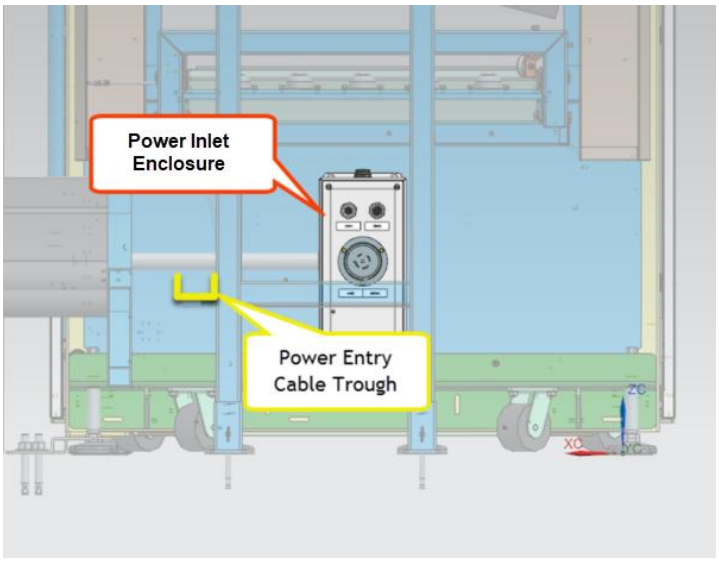


Figure 8. Power Inlet - Front View

2.1.1.2 Power Drop Receptacle/Plug

The site power drop should include following receptacle (not included with VarioStack) for powering each workstation (two per dual workstation). After VarioStacks are installed, the power cord will be connected to this receptacle to provide station power.

Receptacle:
20 Amp, 208Y120 Twist Lock Receptacle is a NEMA type L21-20R

Figure 9. Power Connection Plug provided at customer site

This receptacle should be installed onsite prior to VarioStack installation. It should be located within range of the power cord in the approximate area shown in the figures below, within 20” of the end of the cable trough.

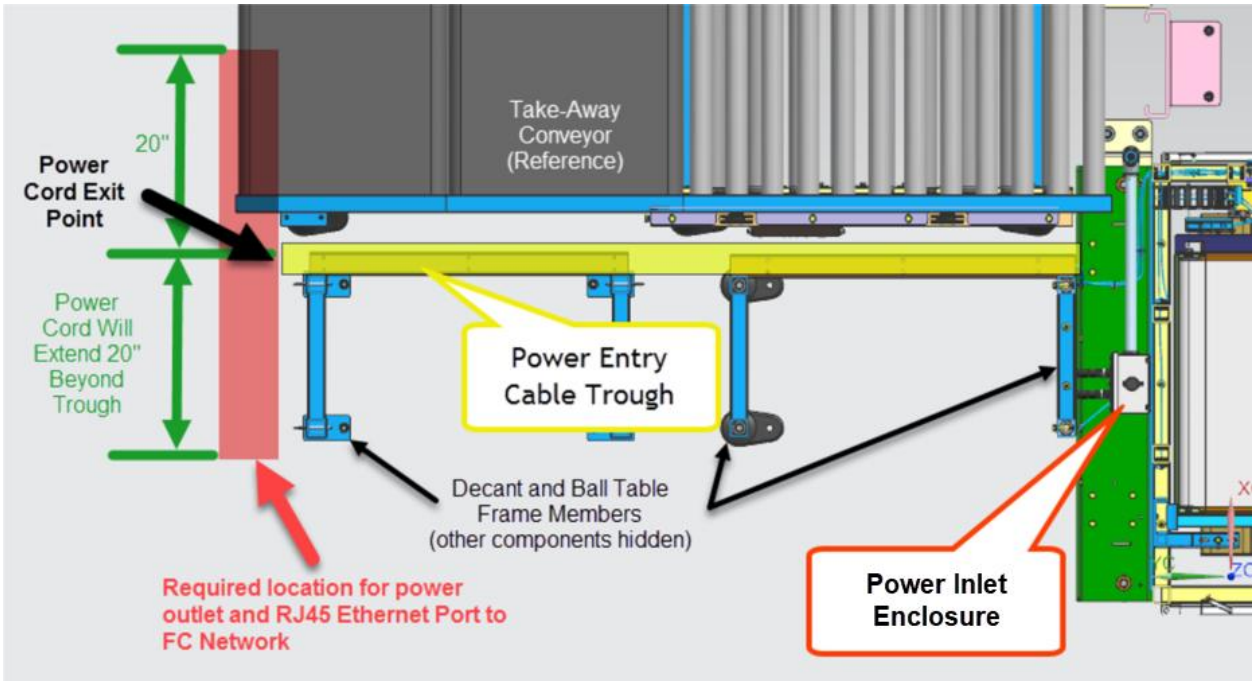


Figure 10. Power Drop - Top View

The power cord (provided with VarioStack) will include the following plug to connect to the site outlet:

20 Amp, 208Y120 Twist Lock Plug is a NEMA type L21-20P (load device)

72120NPB

By Bryant
Catalog ID: 72120NPB
Categories: Insulgrip Twist-Lock

Locking Devices, Industrial, Male Plug, 20A 3- Phase Wye 120/208V AC, 4-Pole 5-Wire Grounding, L21-20P, Screw Terminal, Black and White

Figure 11. Power cord plug included with VarioStack

2.1.2 External Dry Contacts

Dry contact connection points will be provided in each VarioStack unit to provide an external electrical interface for the signals below.

2.1.2.1 Signal Descriptions

- VarioStack Safety Input
  - Purpose: Input signal to each workstation that a higher level e-stop has been initiated. The workstation will treat this input internally as it would

any safety rated signal and bring the machine to a safe, immediate stopped state.

- VarioStack Safety Output
  - Purpose: Notify downstream controllers that one of the E-Stop buttons on the workstation has been pressed. Once an E-Stop is triggered, this signal will not be reset until the “Reset” button is pressed on the station’s control panel.

- VarioStack Enabled
  - Purpose: Output signal from the workstation to notify downstream systems that the workstation is starting. If the site chooses, this signal could be used to start the downstream conveyor line when any workstation is enabled. Alternatively, if no workstations are running, the downstream conveyors can be disabled.

These contacts will be available for each unit (two sets per dual sided workstation)

2.1.2.2 Dry Contact Specification

Contact type	1 PDT
Type of switch contact	Single contact
Contact material	AgNi
Maximum switching voltage	250 V AC/DC (The separating plate PLC-ATP should be installed for voltages larger than 250 V (L1, L2, L3) between identical terminal blocks in adjacent modules. Potential bridging is then carried out with FBST 8-PLC... or ...FBST 500...)
Minimum switching voltage	12 V DC (at 10 mA)
Min. switching current	10 mA (at 12 V)
Maximum inrush current	30 A (300 ms)
Limiting continuous current	10 A
	6 A (value applies to connections 12. If connections 12 are bridged, the normal value applies.)
Interrupting rating (ohmic load) max.	240 W (at 24 V DC)
	58 W (at 48 V DC)
	48 W (at 60 V DC)
	50 W (at 110 V DC)
	80 W (at 220 V DC)
	2500 VA (for 250 V AC)
Interrupting rating (ohmic load) max. bridged	144 W (for 24 V DC. Value applies to connections 12. If connections 12 are bridged, the normal value applies.)
	1500 VA (for 250 V AC. Value applies to connections 12. If connections 12 are bridged, the normal value applies.)
Switching capacity	2 A (at 24 V, DC13)
	0.2 A (at 110 V, DC13)
	0.2 A (at 250 V, DC13)
	6 A (at 24 V, AC15)
	6 A (at 120 V, AC15)
	6 A (at 250 V, AC15)

Table 2. Dry Contact Specification

2.1.2.3 M12 Dry Contact Connections

Each workstation will provide one male and one female M12 connection at the Power Inlet Enclosure. The figure below shows these connectors:

Figure 12. VarioStack Dry Contact Connections

The first connector, CON1 includes the outputs from the station (wiring instructions will be shown below):

- VarioStack Safety Output
- VarioStack Enabled

The other connector, CON2, includes the safety input to the station, “VarioStack Safety Input”.

Below are excerpts from the VarioStack station electrical schematics that define this interface:

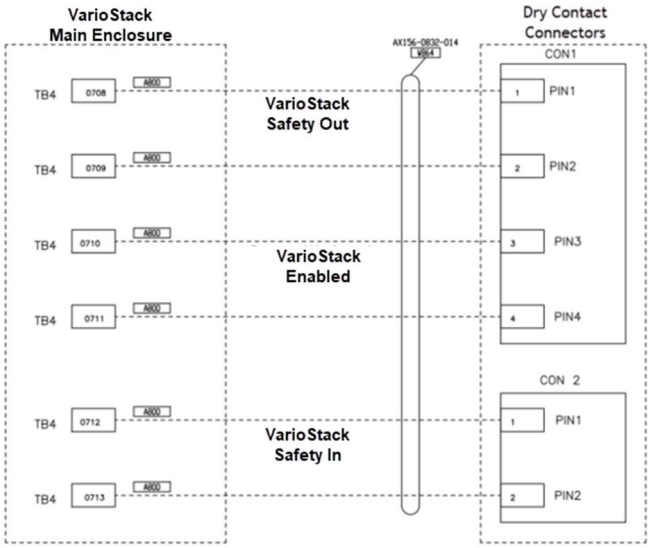


Figure 13. VarioStack Interconnect Diagram - External Interface

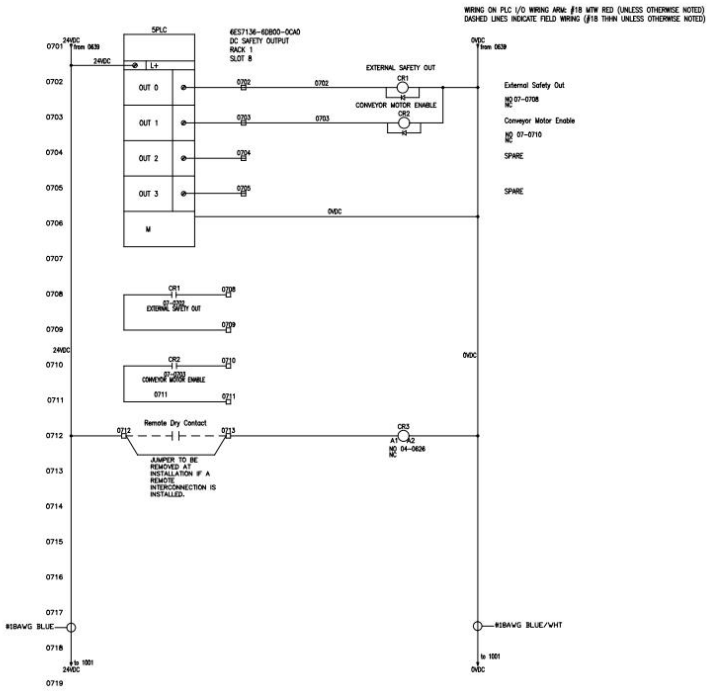


Figure 14. VarioStack Main Panel Schematic - External Interfaces

The site integrator is responsible for providing cables for this interface that are connectorized with the mating M12 connectors. The connectors are defined in the picture below:

Figure 15. Dry Contact Connectors

During installation, these cables can be installed in the Power Inlet Cable Trough, along with the Power Entry Cord. From the “Power Cord Exit Point” location in Figure 10, a minimum cord length of 87” will be required to reach the connection points on the Power Inlet Enclosure.

2.1.3 Site Level Data Interface

The VarioStack controller will be able to report status to the customer site network. A standard RJ45 TCP/IP connection must be provided for this purpose.
For this connection, the workstation provides an Ethernet port as shown below:

Figure 16. Ethernet Connections To Power Entry Enclosure

The site integrator should provide a standard CAT6 cable to this port, routed alongside the power cord described in the previous section.

2.1.3.1 IP Addresses

VarioStack will include an HMI screen to allow on-site maintenance technicians and customer IT specialists to set the IP address for the station.

2.1.3.2 Shared Tags

Each VarioStack will provide a data block which can be accessed through the Ethernet interface using standard OPC UA architecture. This datablock will be called “dbPublicHMI_Statistic[DB25] and will contain status tags for:

- Statistics (See below)
- Error Tags
- PackML Data
- “Overall Equipment Effectiveness” (OEE) data

These statistics are available on the workstation HMI and included in the public tags:

Statistic	Units	Description
State	Machine State	Possible Values: § E-Stop § Fault § Idle § Initialize § Running
Throughput		
Run - Avg	Totes/Minute	Average runtime throughput (since last Reset Statistics). Defined as Totes Out / Runtime (described below).
Run – Max	Totes/Minute	Maximum runtime throughput (since last Reset Statistics)
Unconstrained – Avg	Totes/Minute	Average un-constrained runtime throughput. Defined as Totes Out / Unconstrained time (described below)
Unconstrained – Max	Totes/Minute	Maximum un-constrained runtime throughput (since last Reset Statistics)
Piece Counts		
Totes Out	Totes	Count of totes exiting the machine (since last Reset Statistics). Specifically, counter increments upon completion of successful tote transfer from the Destacker to the Exit Conveyor.
Stacks In	Tote Stacks	Count of tote stacks entering the machine (since last Reset Statistics). Specifically, counter increments upon completion of successful stack transfer from Buffer 1.
Operational Times		
Total	Minutes	Total elapsed minutes since last Reset Statistics.

E-Stop	Minutes	Total time spent in E-stopped condition (since last Reset Statistics) prior to associate pressing Reset button. E-Stop time starts when an E-Stop or Interlock (door open, etc) is detected;
Fault	Minutes	Total time spent in Fault condition (since last Reset Statistics) prior to associate pressing E-Stop, triggering Interlock, or pressing Reset button.
Idle	Minutes	Total time spent in idle condition (since last Reset Statistics). Idle time starts when machine wakes up without fault/estop detected, when machine is taken from Fault or E-Stop condition by associate pressing Reset, or when machine is Stopped while running by associate. It ends when Run is pressed.
Init	Minutes	Total time spent initializing e.g. homing of lifts, etc (since last Reset Statistics). Idle time starts when Run is pressed and ends upon ejection of first tote from Destacker.
Runtime	Minutes	Total time spent in Running state (since last Reset Statistics). Runtime starts when initializing is completed, and ends when operator presses Stop, or a Fault or Estop is detected.
Op Starved	Minutes	Total time (since last Reset Statistics) that the Operator of the DOWNSTREAM equipment was starved, inhibited from being productive: i.e. Ball Table was empty, but Exit Conveyor had no tote yet in place ready to transfer. This is a Key Performance Indicator from a Plant Operations point of view.
Starved	Minutes	Total time spent in Starved state (since last Reset Statistics). That is, VarioStack was prevented from being productive due to lack of available incoming product. Starved time starts when machine is running, Destacker conveyor is in low position ready to accept a tote-stack, but Buffer 2 has none yet in place ready to transfer. Starved time ends upon start of stack transfer from Buffer 2 onto Destacker, or when Run state is ended (e.g. Stop, E-Stop, Fault, etc.)
Blocked	Minutes	Machine ready to discharge (specifically Destacker ready to eject next tote onto Exit Conveyor), but blocked from downstream being not ready (specifically, Exit Conveyor is not yet ready to receive – transferring to or waiting on Ball Table)
Held	Minutes	Total time spent being inhibited from productive operation by lack of timely operator action (since last Reset Statistics). Specifically, Destacker Lift was prevented from moving because the buffer entry light curtain had been breached and operator failed to press start button. Held time

		starts when machine is running, and the lift is ready to move, but prevented to do so by a buffer entry light curtain breach. Held time ends upon pressing start button on Buffer OCP, or when Run state is ended (e.g. Stop, E-Stop, Fault, etc.)
Unconstrained	Minutes	Total Runtime when machine was able to operate productively, unconstrained by being Starved, Blocked, or Held (see above).

Table 3. Definition of Statistics

3. VarioStack Design

3.1 Sub-Modules

The major components of VarioStack are:

- **Buffer Module**
  This module accepts stacks of incoming totes. It is typically loaded manually by another operator referred to as the tote handler in this document. The buffer module can hold two stacks of empty totes and each stack can include up to twelve totes.

- **Destacker Module**
  The destacker will accept a stack of totes. When necessary, it will automatically pull the bottom tote from the stack and convey it to the next module.

- **Exit Module**
  This module provides placement for up to two totes at any given time. In one position, the operator will be placing items into the tote. This position must therefore be ergonomically located near the operator. When the tote is full, the operator will push it onto the takeaway conveyor, leaving the load position open. The other tote position on this module includes an active conveyor. When the load position is empty, the conveyor drives another tote into its position. The destacker is then triggered to eject another empty tote onto the conveyor, where it is buffered until needed at the load position.

- **Operator Table**
  This module is simply to support a package of incoming goods while the operator is loading the tote. This table also provides a location for the operator to store the hand held scanner. There are no active components on this module.

Beyond the major components, the workstation will also include:

- Safe, intuitive interface to the operator and the tote handler
- Control panel for electrical housing
- Mounting provisions for thin client, keyboard, monitor, and hand-scanner.

TakeAway Conveyor

VarioStack will provide space for a takeaway conveyor between the two units in a dual station layout. The takeaway conveyor is not included as a component of VarioStack. It is a part of the downstream conveyor system and has a simple mechanical interface to

VarioStack. The takeaway conveyor should be no longer than 72” and no wider than 28” as shown in the figure below:

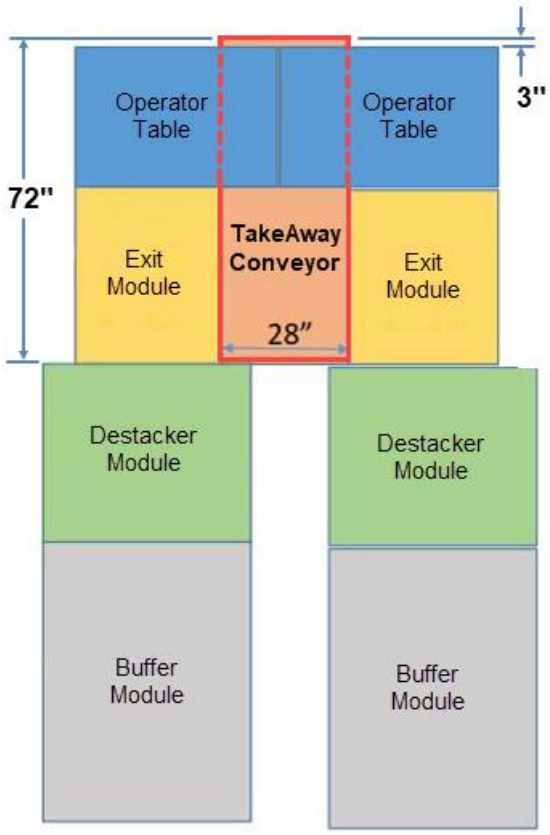


Figure 17. Takeaway Conveyor Max Dimensions

3.2 Layout

As necessary, each submodule within VarioStack will exist in a left-handed and right-handed version. However, all attempts have been made to ensure individual parts on both versions are identical or exact mirror images of each other. Frames, for example, will likely include extra holes to allow components to be assembled on either side, depending on left or right version.

Figure 18 and Figure 19 below define the mechanical layout of the workstation and it's submodules. Figure 20 shows some basic dimensions with a standard layout of a left and a right handed workstation.

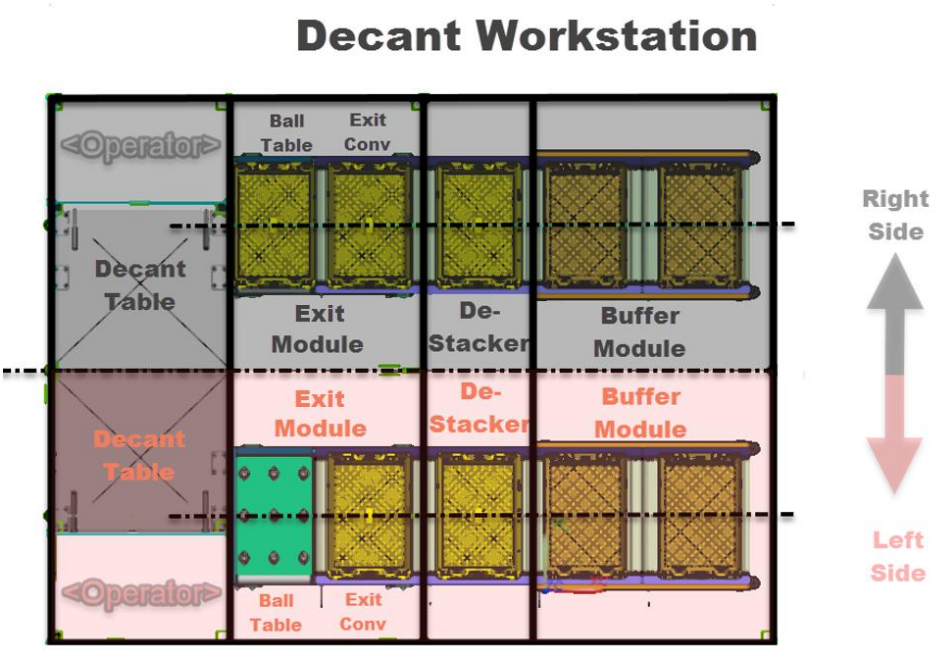


Figure 18. Top View Layout

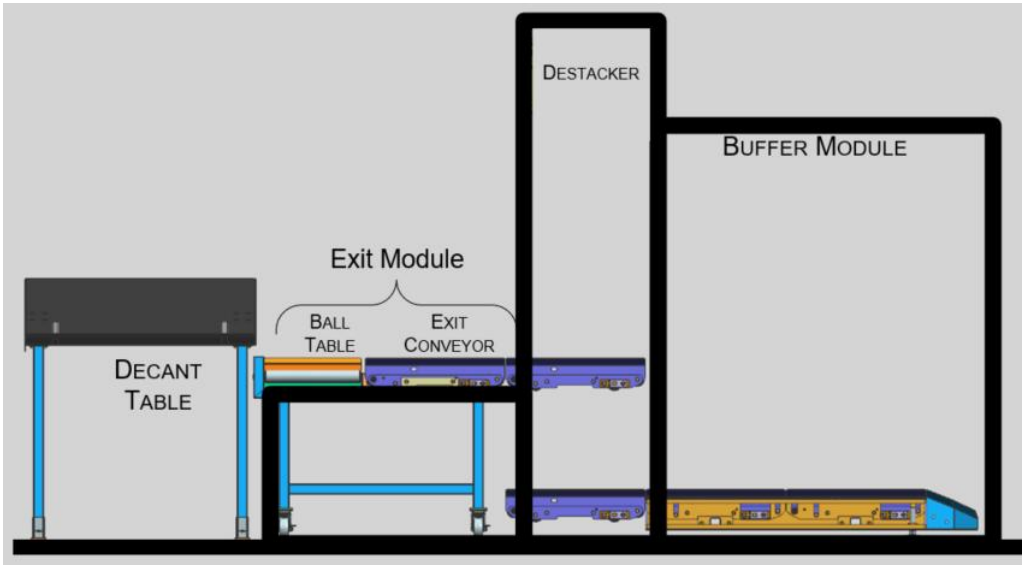


Figure 19. Side View Layout

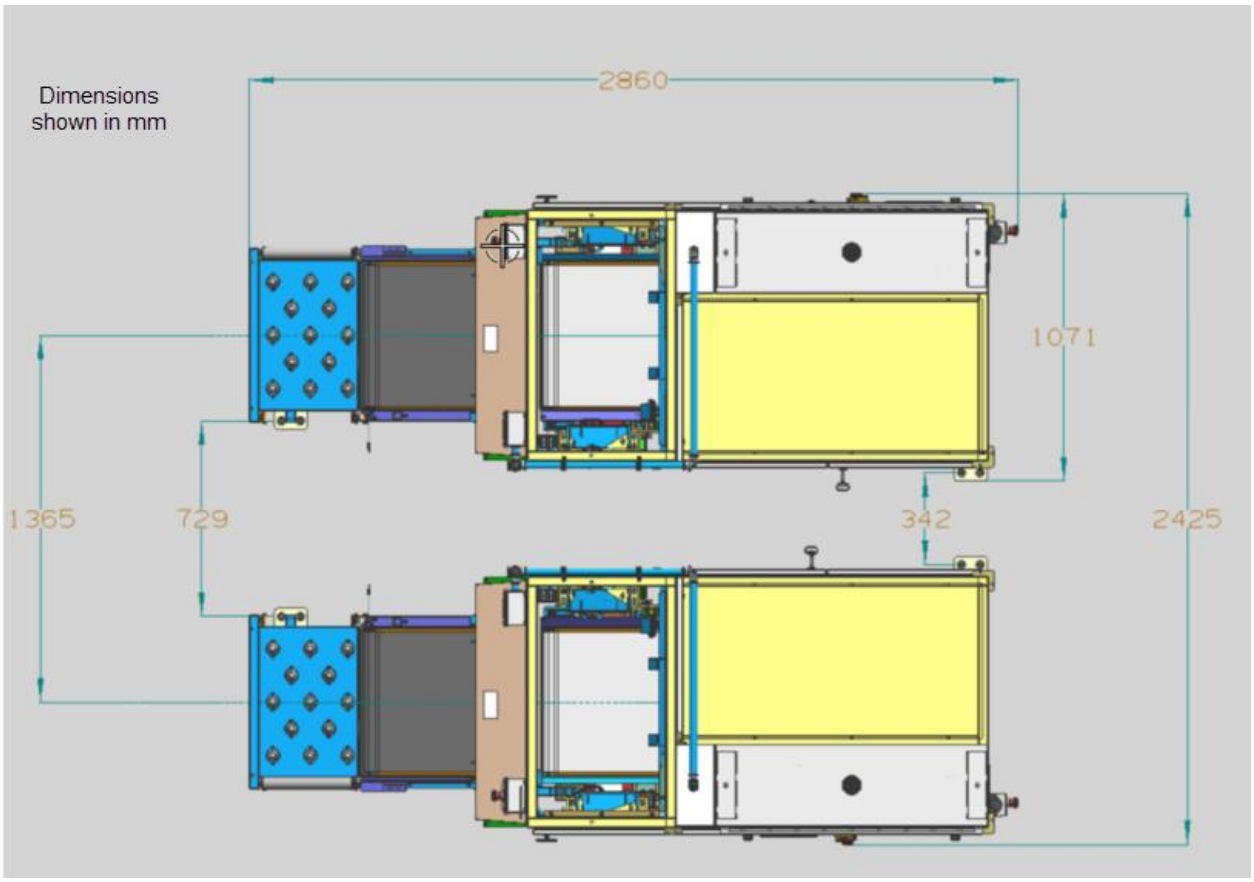


Figure 20. Dimensioned Top View Layout

3.3 Safety System

This section describes the high level concept the safety system and related hardware components. Detailed specifications of individual components can be found in Appendix B – Section 10 of this document.

3.3.1 Safety PLC and Safety I/O

Component descriptions of the PLC and I/O modules provided in this section were taken directly from Siemens online brochure:
https://w3.siemens.com/mcms/distributed-io/en/ip20-systems/et-200sp/failsafe-io/pages/default.aspx

Figure 21. Siemens ET200SP Fail-Safe CPU (6ES7512-1SK01-0AB0)

- The fail-safe SIMATIC controllers enable the processing of standard and safety programs on a single controller.
- The CPU 1512SP F fail-safe controllers are extended standard ET 200SP CPUs.
- They are certified according to EN 61508 (2nd Edition) for functional safety and are suitable for use in safety-related applications up to SIL 3 according to IEC 62061 and PL e according to ISO 13849.
- The CPUs 1512SP F can be expanded both centrally with standard and fail-safe ET 200SP modules, and distributed via PROFINET/PROFIsafe with any ET 200 systems.

3.3.1.1 Fail-safe digital input module (F-DI)

Figure 22. PROFINET Safety Input Module (6ES7136-6BA00-0CA0)

- F-DI 8x24VDC High Feature
- 8 fail-safe inputs (SIL 3, PL e)
- Integrated discrepancy evaluation with 2v2 signals
- Devices connected:
  - E-Stops
  - Safety Interlocks (detects present of doors and critical frames)
  - Safety Light Curtains
  - External Safety In Signal - 24V dry contact signal from external system. Used to trigger safety stop when other adjacent equipment is E-Stopped as deemed necessary by customer or integrator Safety teams

3.3.1.2 Fail-safe digital output module (F-DQ)

Figure 23. . PROFINET Safety Output Module (6ES7136-6DB00-0CA0)

- F-DQ 4x24V DC/2A PM High Feature
- 4 fail-safe outputs
- 2-channel F-control (P/M-switching) of actuators up to 2A
- Devices connected:
  - External Safety Out signal – 24V dry contact signal to external system. Used to trigger safety stop of other equipment located adjacent to VarioStack as deemed necessary by necessary by customer or integrator Safety teams
  - Conveyor Motor Enable – Provides safe shut down of all VarioStack conveyor motors.

When any device connected to one of the 8 inputs of the F-DI (safety input) module is activated, the following actions will occur to ensure a safe shutdown of the VarioStack unit.

- All devices connected F-DQ (safety output) module will immediately drop power.
  - Conveyor motors stop
  - External dry contact sends the safety E-Stop signal to any external devices connected to it.
- The Lift motor controller will immediately receive the STO command (described below) and will come to an immediate controlled stop.

3.3.2 PROFIsafe and PROFIdrive

PROFIsafe is a comprehensive network-based safety communication technology suitable for safety functions up to SIL3 according to international standard IEC 61508 and IEC 61784-3-3. PROFIsafe uses a standard communication fieldbus (Ethernet) and implements the following safety measures to ensure safe, reliable operation:

- The consecutive numbering of the PROFIsafe messages ("sign-of-life")
- A time expectation with acknowledgement ("watch-dog")

- A codename between sender and receiver ("F-Address")
- Data integrity checks (CRC = cyclic redundancycheck)

PROFIsafe will enable VarioStack to safely and reliably shut off all safety outputs when any safety input is activated or fails.

The safety PLC will communicate safety signals to the Lift motor controller via PROFIdrive. PROFIdrive safety features are defined IEC 61800-5-2 for drives with integrated safety. The two PROFIdrive features used on VarioStack are:

3.3.2.1 Safe Torque Off (STO)

- When STO is activated, a brake is applied and the torque power cannot reach the drive (de-energize), thus stopping and preventing any motor shaft rotation
- The STO will not be cleared from the lift until the operator presses the “Reset” push button on the Buffer OCP.

3.3.2.2 Safe Operating Stop (SOS)

- When SOS is activated, the controller can use the full torque power available to bring the motor to a stop.
- The drive will have a set time to stop and will then monitor to ensure it holds position.
- The SOS will remain in effect until the safety PLC clears it (after verifying the safety concern is gone).
- As long as the drive stops and remains stopped, the drive will not fault out. However, if the drive fails to stop within the allotted time, or does no hold position, the drive will respond with an STO (as previously described) and will fault.

3.3.3 E-Stop buttons

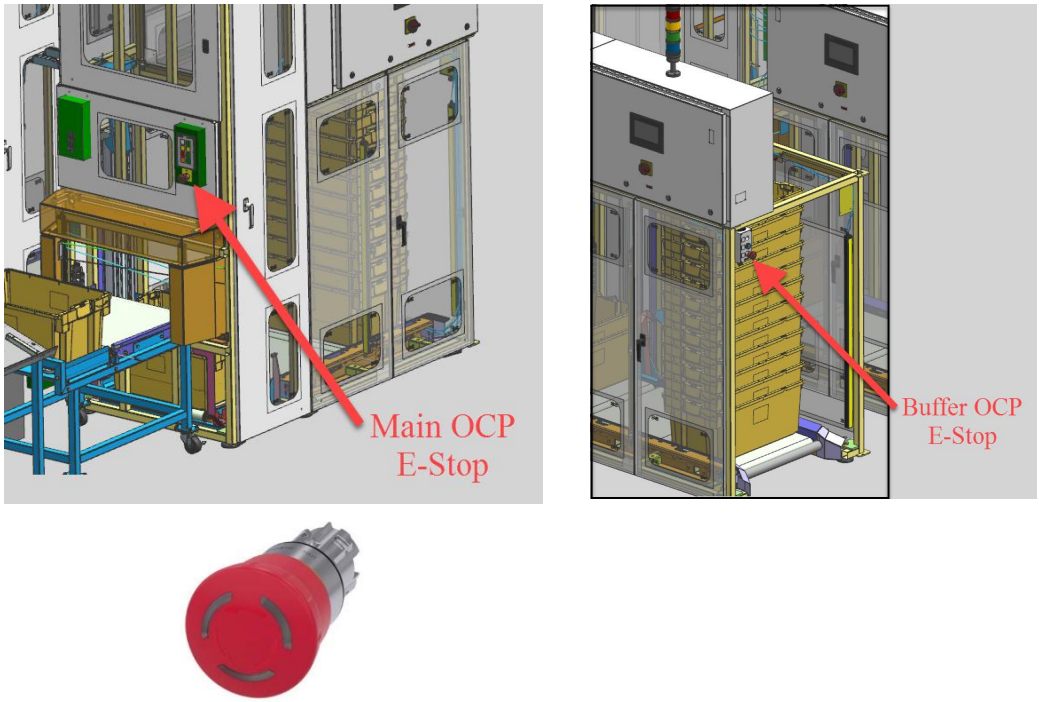


Figure 24. E-Stop and E-Stop Locations

VarioStack has an E-Stop on each end of the machine. The E-Stop on the Main OCP is to be within reach distance (36 inches) to the operator. The Buffer OCP E-Stop is located next to the tote stack entry doorway for use by the tote loader.

Device Description:
EMERGENCY STOP mushroom pushbutton, illuminable, 22 mm, round, metal, shiny, red, 40 mm, **positive latching**, acc. to EN ISO 13850, **rotate-to-unlatch.** Protection class to IP67.

There are 2 E-Stop pushbuttons: one on the Buffer Entry Operator Panel and another on the Main Operator Panel. Both E-Stop signals will be connected to the Fail-safe digital input module (F-DI) and will therefore trigger fail-safe response from the control system. The E-Stop triggers STO to Lift servo and turns off all safety outputs (conveyor motors and external dry contact). All motion will stop immediately. These inputs also trigger the external safety output signal to be off and potentially cause an E-Stop condition on surrounding systems (depending on site implementation).

The E-Stop state is not cleared until all E-Stop buttons are twisted back to normal position. The machine will not restart until the operator presses the Reset button on the main control panel and the Start button. At startup, the safety horn will sound.

3.3.4 Safety Interlocks

VarioStack provides two doors on the Buffer Module and one on the Destacker Module to allow for simple access for clearing jams, etc. These doors (shown in the figure below) can be opened with a simple, unlocked door latch. However, opening these doors will activate a safety interlock switch that will be treated by the system as an E-Stop.The lift will be issued an STO command. The external safety output signal will not be affected by safety interlock signals.

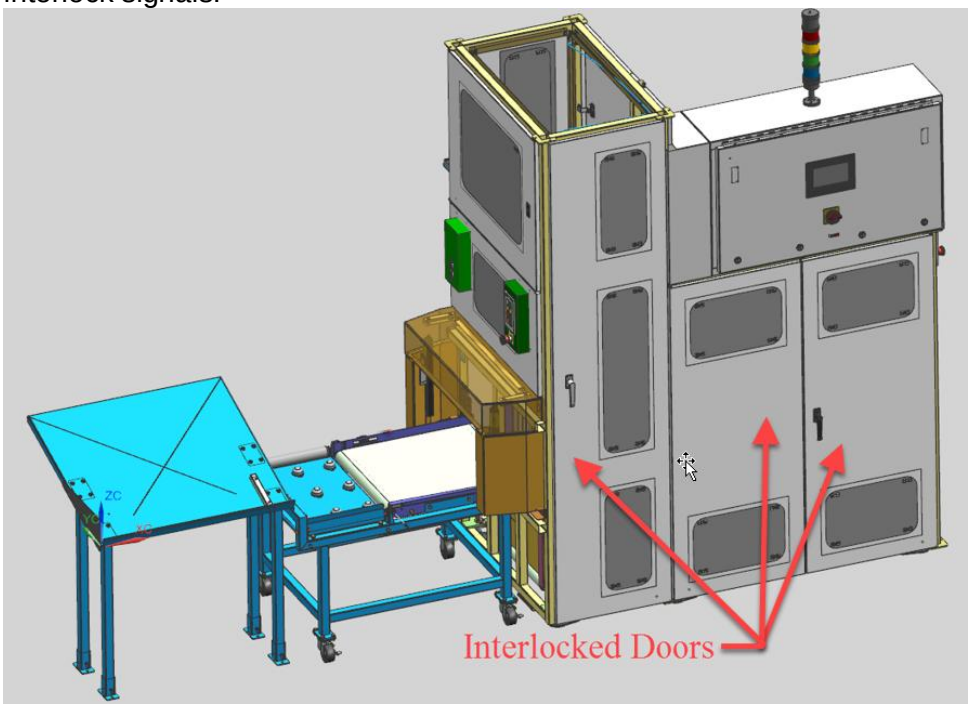


Figure 25. Door and Frame Interlock Switches

The HMI will display intuitive information to indicate which interlock sensor was activated.

3.3.5 Tote Entry Safety Curtain Logic

Within the buffer module, a safety rated light curtain will guard the open entry into the Destacker as shown in the figure below.

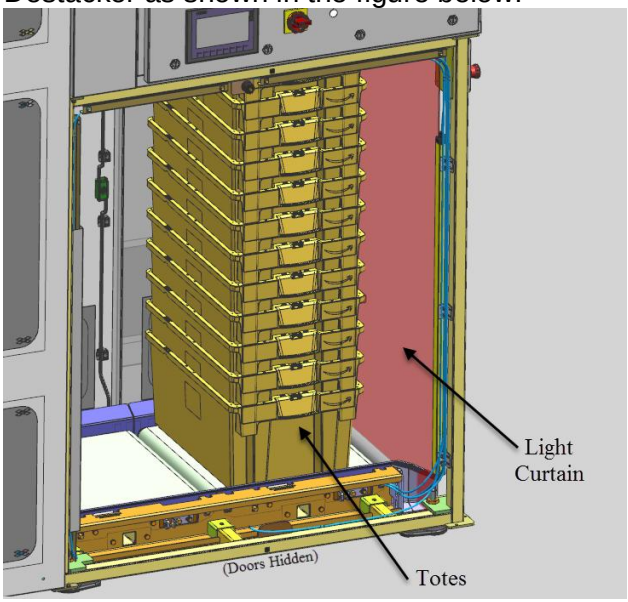


Figure 26. Tote Entry Safety Curtain

This light curtain is intended to protect operators from the vertical motion of the lift in the Destacker. This device will meet or exceed the safety certifications shown below.

Safety classification		
ISO 13849-1		category 2, PL e
IEC 61508		SIL 3
IEC 62061		SILCL 3
Mission time TM	[h]	175200
Safety-related reliability PFHD	[1/h]	8.2E-09

Figure 27. Tote Entry Safety Curtain Classification

Anytime this curtain is breached by any object, an STO will be issued to the lift motor drive as previously described in section 3.3.2.1.

As a part of normal operation, the tote handler will regularly breach this light curtain as totes are loaded into Buffer 1. Until the condition is manually cleared by the tote handler (using the Buffer OCP), conveyors will remain active, but the lift will not move. It is important for the operator to reset the system as soon as conditions are safe to maximize utilization of the system.

After 30 seconds, an audible signal will be triggered to remind operator of the need to reset. The HMI will also log a warning for this condition.

3.3.6 Tote Exit Safety Curtain Logic

Another light curtain will guard the exit end of the Destacker. This device will meet or exceed the safety certifications shown below.

Safety classification		
ISO 13849-1		Category 4, PL e
IEC 61508		SIL 3
IEC 62061		SILCL 3
MIssion time TM	[h]	175200
Safety-related reliability PFHD	[1/h]	1.5E-08

Figure 28. Tote Exit Safety Curtain Classification

As with the Entry Safety Curtain, standard machine operation will require totes to pass through this device. Unlike with tote entry, however, stopping the Lift motor will not impact system performance at the exit end of the Destacker. For this reason, the PLC will choose between SOS and STO (both are safety rated stop mechanisms) anytime the safety curtain is blocked. The decision between SOS and STO will depend on whether the PLC is expecting a tote to convey through. If a tote is expected, an SOS will be issued. As previously described, unexpected behavior during an SOS could trigger the STO. Any other time the curtain is breached, an STO will be issued.

Using this approach, non-safety rated PLC logic is only being used to choose between the two different safety rated stopping mechanisms (STO vs SOS, with STO being the default) to ensure the motor stops and remains stopped anytime the curtain is blocked.

Any unexpected breach of the exit safety curtain (resulting in an STO to the lift), will be treated by the control system as an E-Stop condition except the external safety output signal will not be affected.

3.3.6.1 Tote Exit Safety Curtain Position

The minimum distance between the exit safety curtain and the danger point within the lift is calculated according to the following formula:

The safety distance (Ds) from the sensing field to the point of operation should be greater than the distance determined by the following formula:

Ds = (63 inches/seconds) X (Ts) +Dpf

Where:

Ds = minimum safety distance (inches)

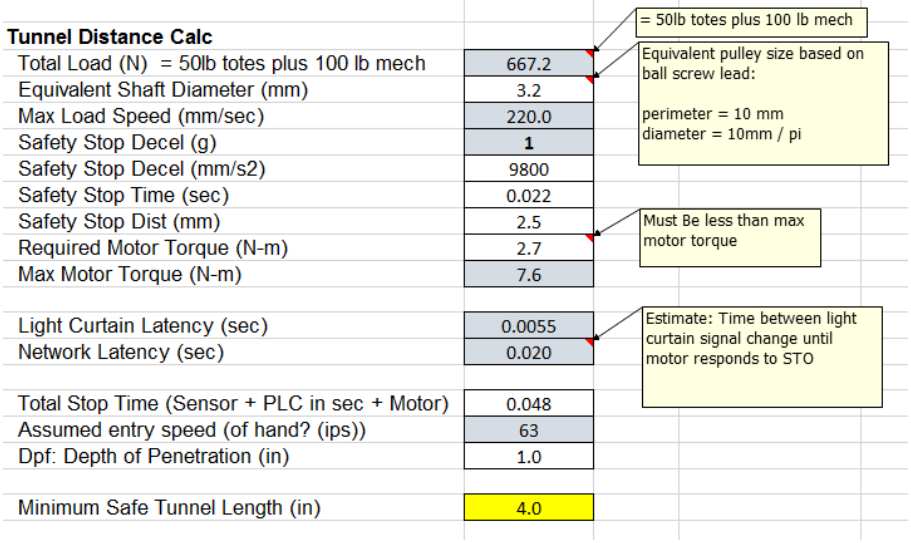
63 inches/second = hand speed constant

Ts = stopping time

Dpf: Maximum travel towards the hazard within the presence sensing safety guarding device field that may occur before a stop is signaled. Also known as Depth of penetration.

Figure 29. Safety Distance Calculation

Using the actual loads on the lift and the lift motor performance parameters, the following calculations were used to determine the minimum safe distance between the light curtain and the pinch point between at the lift mechanism would be no less than 4.0 inches:



Tunnel Distance Calc	
Total Load (N) = 50lb totes plus 100 lb mech	667.2
Equivalent Shaft Diameter (mm)	3.2
Max Load Speed (mm/sec)	220.0
Safety Stop Decel (g)	1
Safety Stop Decel (mm/s2)	9800
Safety Stop Time (sec)	0.022
Safety Stop Dist (mm)	2.5
Required Motor Torque (N-m)	2.7
Max Motor Torque (N-m)	7.6
Light Curtain Latency (sec)	0.0055
Network Latency (sec)	0.020
Total Stop Time (Sensor + PLC in sec + Motor)	0.048
Assumed entry speed (of hand? (ips))	63
Dpf: Depth of Penetration (in)	1.0
Minimum Safe Tunnel Length (in)	4.0

Figure 30. Exit Light Curtain Position Calculation

Figure 31 below shows the current distance from the light curtain to the pinch point between the Destacker Lift Conveyor and the Exit Conveyor.

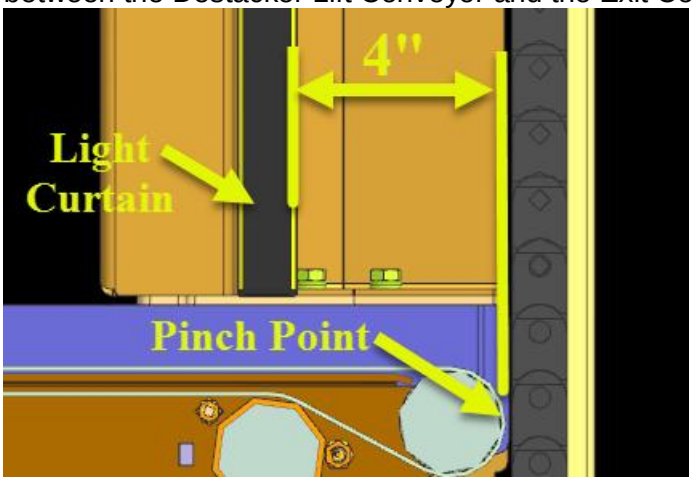


Figure 31. Light Curtain Configuration

4. Spare Parts

A recommended spare parts list is provided with the Proposal for the Customer to purchase. This list includes most active components

The recommended Spares list includes a limited number of the consumable wear items (e.g. Belts, etc.). It is recommended that these items be monitored closely for replacement rate and adequate stock kept in house.

Siemens keeps limited stock of all these parts for sale upon request.

5. Training

Siemens offers onsite training to the Customer. Siemens can provide training to Customer's designated employees to operate and maintain the units so that Customer's employees will have the capability to (1) operate, (2) diagnose the reasons for failures, (3) identify defective components, (4) remove the defective components, and (5) install new or repaired components. The cost for the training is as set forth in the Proposal.

6. Exclusions

The Proposal (NOT this document) is the official document listing what is included and not included in the purchase of a Siemens VarioStack.

This document (Functional Description) is for reference as a guide for planning use of a Siemens VarioStack within a logistics facility.

7. Software Limited Warranty and License

Siemens warrants that the software provided by Siemens ("Software") under a purchase order will conform to its published specifications and will not prevent the RUBUS® from achieving the performance criteria and guarantees set forth in the Functional Requirements Specification for a period of one (1) year from the date of acceptance. Siemens shall pass through any additional or extended warranties provided by the original manufacturer or other third-party software provider to the extent permitted by the terms of Siemens's license with the third-party manufacturer or software provider.

8. Warranty Disclaimer

Siemens makes no warranty, express or implied, regarding the software sold under the price schedule other than the warranties expressly set forth in this functional specification. Without limitation and to the maximum extent permitted by law, Siemens makes no and expressly disclaims any warranty of merchantability or fitness for a particular purpose. Without waiving or modifying Siemens's warranty obligations under the functional specifications, Siemens further disclaims any warranty that operation of the software or any third-party software will be uninterrupted or error free.

9. Appendix A – Footprint Requirements

The combined length requirement of the Operator Table, Exit Module, Destacker, and Buffer Module is assumed to be no more than 3,488mm based on the lengths of components described below.

The overall width requirement of 2,780mm is based on the width and spacing of the two destackers. These dimensions are also further described below.

9.1 Length Requirement For Operator Table And Exit Module

The dimensions below were extracted from initial customer requirements.

A file called “Station Design V11.pdf”, referenced within the original describes the layout of the Operator Table and Roller Table.

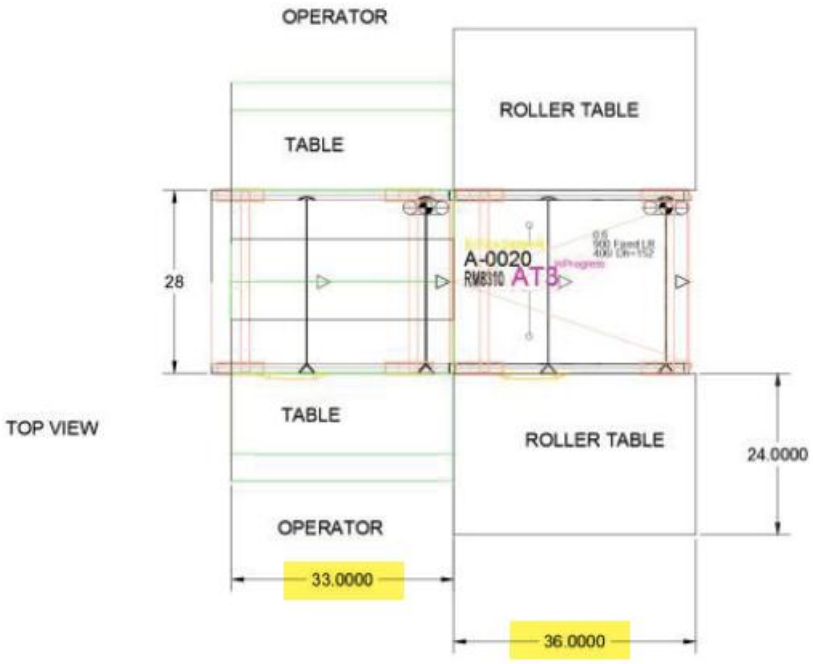


Figure 32. RFP Definition of Operator Table and Roller Table Dimentions (In Inches)

Siemens will replace the Roller Table in this figure with a driven belt conveyor section along with a passive ball table. These two components will be the Exit Module. Siemens designed the Exit Module to fit in the same footprint as the Roller Table defined above.

9.2 Length Requirement For Destacker And Buffer Module

Siemens later received Autocad layouts that defined the overall size of the Destacker and Buffer Modules to be no more than 2780mm wide and 1735mm long (direction of tote travel). This is also shown below in Figure 33.

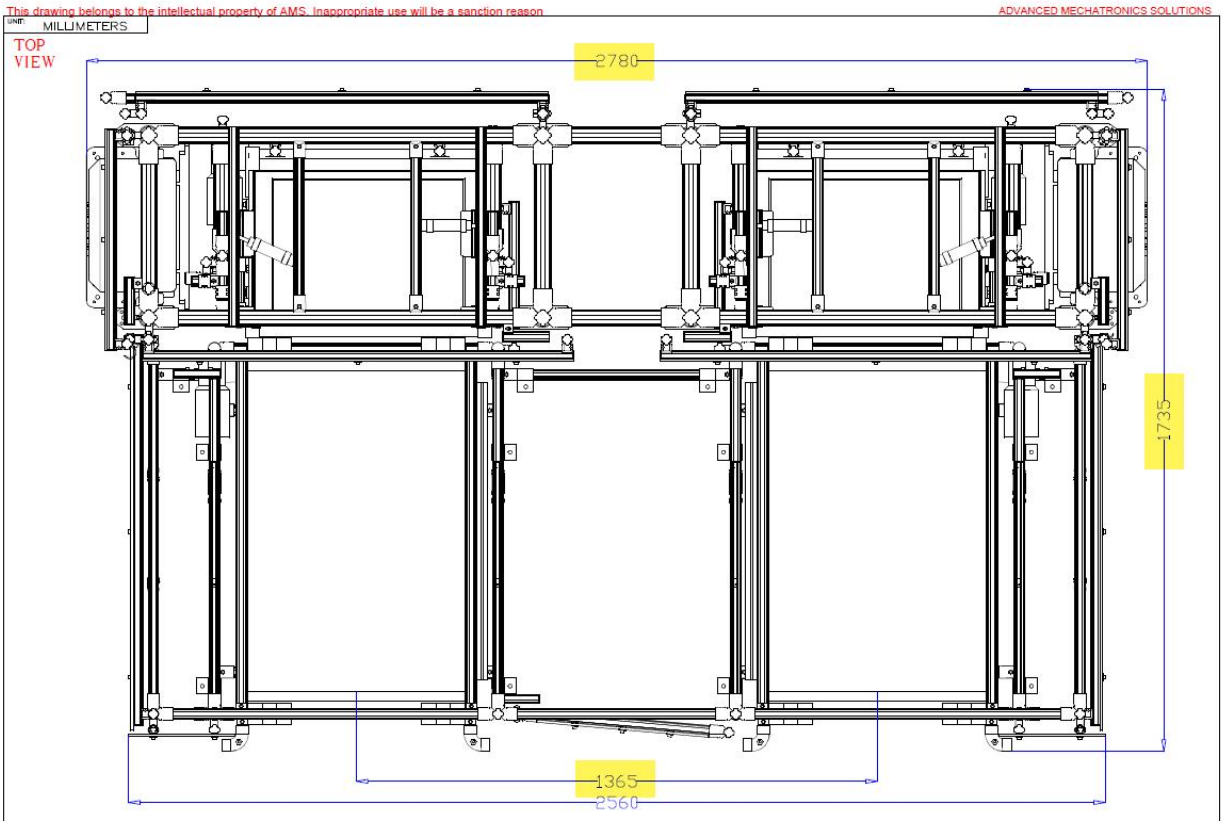
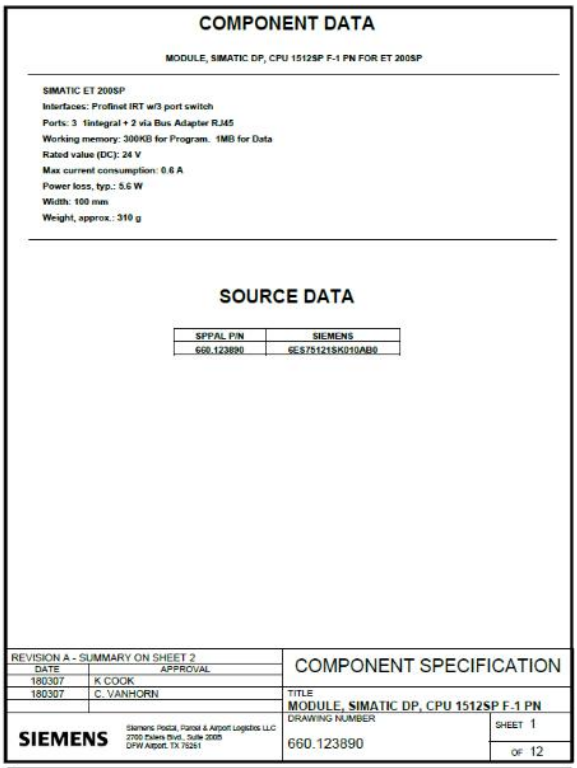


Figure 33. Required outer dimensions (previous Destacker prototype)

10. Appendix B – Safety Components

Individual component specifications can be provided upon request.

10.1 Controller (Safety PLC)



COMPONENT DATA

MODULE, SIMATIC DP, CPU 1512SP F-1 PN FOR ET 200SP

SIMATIC ET 200SP
Interfaces: Profinet IRT w/3 port switch
Ports: 3 1integral + 2 via Bus Adapter RJ45
Working memory: 300KB for Program. 1MB for Data
Rated value (DC): 24 V
Max current consumption: 0.6 A
Power loss, typ.: 5.6 W
Width: 100 mm
Weight, approx.: 310 g

SOURCE DATA

SPPAL P/N	SIEMENS
660.123890	6ES75121SK010AB0

REVISION A - SUMMARY ON SHEET 2

DATE	APPROVAL
180307	K COOK
180307	C. VANHORN

COMPONENT SPECIFICATION

TITLE
MODULE, SIMATIC DP, CPU 1512SP F-1 PN

SIEMENS

Siemens Postal, Parcel & Airport Logistics LLC
2700 Elders Blvd., Suite 2005
DFW Airport, TX 75261

DRAWING NUMBER
660.123890

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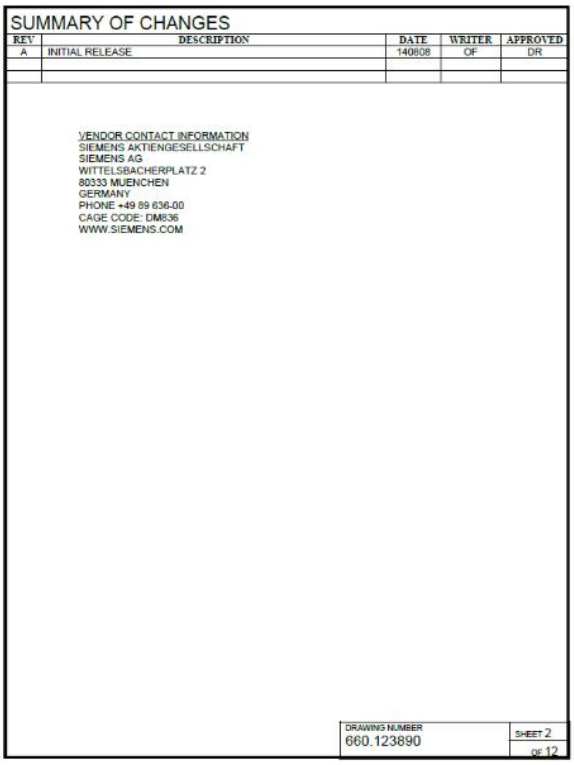

SUMMARY OF CHANGES

REV	DESCRIPTION	DATE	WRITER	APPROVED
A	INITIAL RELEASE	140808	OF	DR

VENDOR CONTACT INFORMATION
SIEMENS AKTIENGESELLSCHAFT
SIEMENS AG
WITTELSBACHERPLATZ 2
80333 MUENCHEN
GERMANY
PHONE +49 89 636-00
CAGE CODE: DM836
WWW.SIEMENS.COM

DRAWING NUMBER
660.123890

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SIEMENS

Data sheet 6ES7512-1SK01-0AB0

SIMATIC DP, CPU 1512SP F-1 PN FOR ET 200SP, CENTRAL PROCESSING UNIT WITH WORKING MEMORY 300 KB FOR PROGRAM AND 1 MB FOR DATA, 1. INTERFACE: PROFINET IRT WITH 3 PORT SWITCH, 48 NS BIT-PERFORMANCE, SIMATIC MEMORY CARD NECESSARY, BUSADAPTER NECESSARY FOR PORT 1 AND 2

General information	
Product type designation	CPU 1512SP F-1 PN
HW functional status	FS01
Firmware version	V1.8
Engineering with	
• STEP 7 TIA Portal configurable/integrated as of version	V13 SP1 Update 4
Configuration control	
via dataset	Yes
Control elements	
Mode selector switch	1
Supply voltage	
Type of supply voltage	24 V DC
permissible range, lower limit (DC)	19.2 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Mains buffering	
• Mains/voltage failure stored energy time	5 ms

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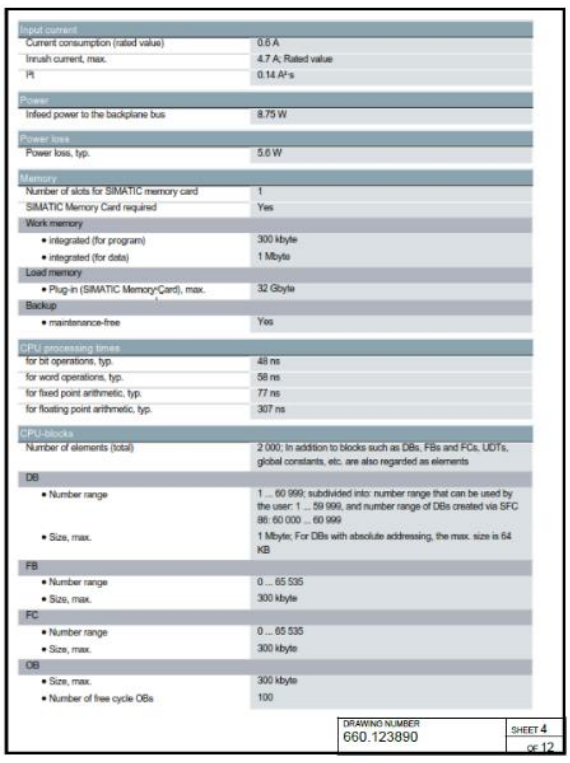

Input current	
Current consumption (rated value)	0.6 A
Inrush current, max.	4.7 A; Rated value
I²t	0.14 A²·s
Power	
Infeed power to the backplane bus	8.75 W
Power loss	
Power loss, typ.	5.6 W
Memory	
Number of slots for SIMATIC memory card	1
SIMATIC Memory Card required	Yes
Work memory	
• integrated (for program)	300 kbyte
• integrated (for data)	1 Mbyte
Load memory	
• Plug-in (SIMATIC Memory Card), max.	32 Gbyte
Backup	
• maintenance-free	Yes
CPU processing times	
for bit operations, typ.	48 ns
for word operations, typ.	58 ns
for fixed point arithmetic, typ.	77 ns
for floating point arithmetic, typ.	307 ns
CPU-blocks	
Number of elements (total)	2 000; In addition to blocks such as DBs, FBs and FCs, UDTs, global constants, etc. are also regarded as elements
DB	
• Number range	1 ... 60 999; subdivided into: number range that can be used by the user: 1 ... 59 999, and number range of DBs created via SFC 86: 60 000 ... 60 999
• Size, max.	1 Mbyte; For DBs with absolute addressing, the max. size is 64 KB
FB	
• Number range	0 ... 65 535
• Size, max.	300 kbyte
FC	
• Number range	0 ... 65 535
• Size, max.	300 kbyte
OB	
• Size, max.	300 kbyte
• Number of free cycle OBs	100

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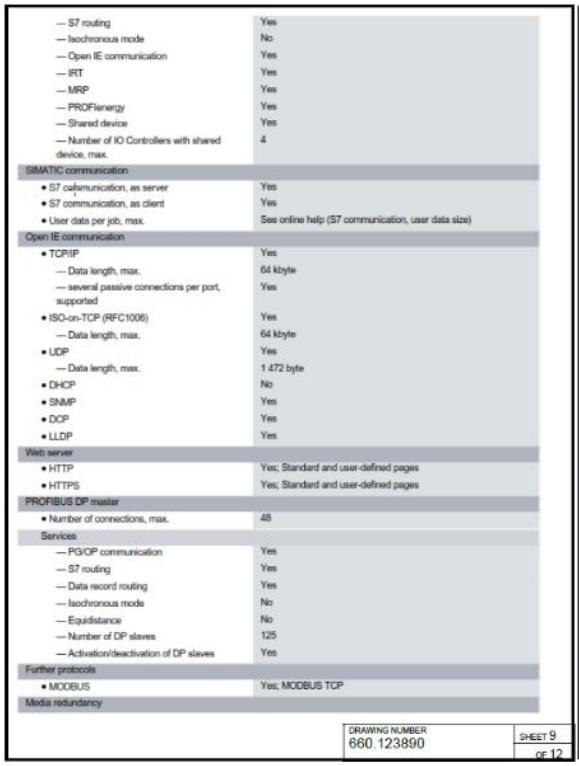
• Number of time alarm OBs	20
• Number of delay alarm OBs	20
• Number of cyclic interrupt OBs	20
• Number of process alarm OBs	50
• Number of DPV1 alarm OBs	3
• Number of isochronous mode OBs	1
• Number of technology synchronous alarm OBs	2
• Number of startup OBs	100
• Number of asynchronous error OBs	4
• Number of synchronous error OBs	2
• Number of diagnostic alarm OBs	1
Nesting depth	
• per priority class	24; Up to 8 possible for F-blocks
Counters, timers and their retentivity	
S7 counter	
• Number	2 048
Retentivity	
— adjustable	Yes
IEC counter	
• Number	Any (only limited by the main memory)
Retentivity	
— adjustable	Yes
S7 times	
• Number	2 048
Retentivity	
— adjustable	Yes
IEC timer	
• Number	Any (only limited by the main memory)
Retentivity	
— adjustable	Yes
Data areas and their retentivity	
retentive data area in total (incl. times, counters, flags), max.	128 kbyte; Available retentive memory for bit memories, timers, counters, DBs, and technology data (axes): 88 KB
Flag	
• Number, max.	16 kbyte
• Number of clock memories	8; 8 clock memory bits, grouped into one clock memory byte
Data blocks	
• Retentivity adjustable	Yes
• Retentivity preset	No
Local data	
• per priority class, max.	64 kbyte; max. 16 KB per block

Address area	
Number of IO modules	2 048; max. number of modules / submodules
I/O address area	
• Inputs	32 kbyte; All inputs are in the process image
• Outputs	32 kbyte; All outputs are in the process image
per integrated IO subsystem	
— Inputs (volume)	8 kbyte
— Outputs (volume)	8 kbyte
per CM/CP	
— Inputs (volume)	8 kbyte
— Outputs (volume)	8 kbyte
Subprocess images	
• Number of subprocess images, max.	32
Address space per module	
• Address space per module, max.	32 byte; For input and output data respectively
Address space per station	
• Address space per station, max.	1 280 byte; for central inputs and outputs; depending on configuration
Hardware configuration	
Number of DP masters	
• Via CM	1
Number of IO Controllers	
• integrated	1
• Via CM	0
Rack	
• Modules per rack, max.	64; CPU + 64 modules + server module (mounting width max. 1 m)
• Rack, number of rows, max.	1
PtP CM	
• Number of PtP CMs	the number of connectable PtP CMs is only limited by the number of available slots
Time of day	
Clock	
• Type	Hardware clock
• Backup time	6 wk; At 40 °C ambient temperature, typically
• Deviation per day, max.	10 s; Typ.: 2 s
Operating hours counter	
• Number	16
Clock synchronization	
• supported	Yes
• to DP, master	Yes; Via CM DP module
• to DP, slave	Yes; Via CM DP module

• in AS, master	Yes
• in AS, slave	Yes
• on Ethernet via NTP	Yes
Interfaces	
Number of PROFINET interfaces	1
Number of PROFIBUS interfaces	1; Via CM DP module
1. Interface	
Interface types	
• Number of ports	3; 1. integr. + 2. via BusAdapter
• integrated switch	Yes
• RJ 45 (Ethernet)	Yes; X1
• Bus adapter (PROFINET)	Yes; Applicable BusAdapters: BA 2x RJ45, BA 2x FC
Functionality	
• PROFINET IO Controller	Yes
• PROFINET IO Device	Yes
• SIMATIC communication	Yes
• Open IE communication	Yes
• Web server	Yes
• Media redundancy	Yes
2. Interface	
Interface types	
• Number of ports	1
• RS 485	Yes; Via CM DP module
Functionality	
• SIMATIC communication	Yes
• PROFIBUS DP master	Yes
• PROFIBUS DP slave	Yes
Interface types	
RJ 45 (Ethernet)	
• 100 Mbps	Yes
• Autonegotiation	Yes
• Autocrossing	Yes
• Industrial Ethernet status LED	Yes
RS 485	
• Transmission rate, max.	12 Mbit/s
Protocols	
Number of connections	
• Number of connections, max.	88
• Number of connections reserved for ES/HMI/web	10

• Number of connections via integrated interfaces	88
• Number of S7 routing paths	16
PROFINET IO Controller	
Services	
— PG/OP communication	Yes
— S7 routing	Yes
— Isochronous mode	Yes
— Open IE communication	Yes
— IRT	Yes
— MRP	Yes; As MRP redundancy manager and/or MRP client; max. number of devices in the ring: 50
— PROFIenergy	Yes
— Prioritized startup	Yes; Max. 32 PROFINET devices
— Number of connectable IO Devices, max.	128; In total, up to 253 distributed I/O devices can be connected via PROFIBUS or PROFINET
— Of which IO devices with IRT, max.	64
— Number of connectable IO Devices for RT, max.	128
— of which in line, max.	128
— Number of IO Devices that can be simultaneously activated/deactivated, max.	8
— Number of IO Devices per tool, max.	8
— Updating times	The minimum value of the update time also depends on communication share set for PROFINET IO, on the number of IO devices, and on the quantity of configured user data
Update time for IRT	
— for send cycle of 250 µs	250 µs to 4 ms
— for send cycle of 500 µs	500 µs to 8 ms
— for send cycle of 1 ms	1 ms to 16 ms
— for send cycle of 2 ms	2 ms to 32 ms
— for send cycle of 4 ms	4 ms to 64 ms
— With IRT and parameterization of "odd" send cycles	Update time = set "odd" send clock (any multiple of 125 µs: 375 µs, 625 µs ... 3 875 µs)
Update time for RT	
— for send cycle of 250 µs	250 µs to 128 ms
— for send cycle of 500 µs	500 µs to 256 ms
— for send cycle of 1 ms	1 ms to 512 ms
— for send cycle of 2 ms	2 ms to 512 ms
— for send cycle of 4 ms	4 ms to 512 ms
PROFINET IO Device	
Services	
— PG/OP communication	Yes



— S7 routing	Yes
— Isochronous mode	No
— Open IE communication	Yes
— IRT	Yes
— MRP	Yes
— PROFIenergy	Yes
— Shared device	Yes
— Number of IO Controllers with shared device, max.	4
SIMATIC communication	
• S7 communication, as server	Yes
• S7 communication, as client	Yes
• User data per job, max.	See online help (S7 communication, user data size)
Open IE communication	
• TCP/IP	Yes
— Data length, max.	64 kbyte
— several passive connections per port, supported	Yes
• ISO-on-TCP (RFC1006)	Yes
— Data length, max.	64 kbyte
• UDP	Yes
— Data length, max.	1 472 byte
• DHCP	No
• SNMP	Yes
• DCP	Yes
• LLDP	Yes
Web server	
• HTTP	Yes; Standard and user-defined pages
• HTTPS	Yes; Standard and user-defined pages
PROFIBUS DP master	
• Number of connections, max.	48
Services	
— PG/OP communication	Yes
— S7 routing	Yes
— Data record routing	Yes
— Isochronous mode	No
— Equidistance	No
— Number of DP slaves	125
— Activation/deactivation of DP slaves	Yes
Further protocols	
• MODBUS	Yes; MODBUS TCP
Media redundancy	

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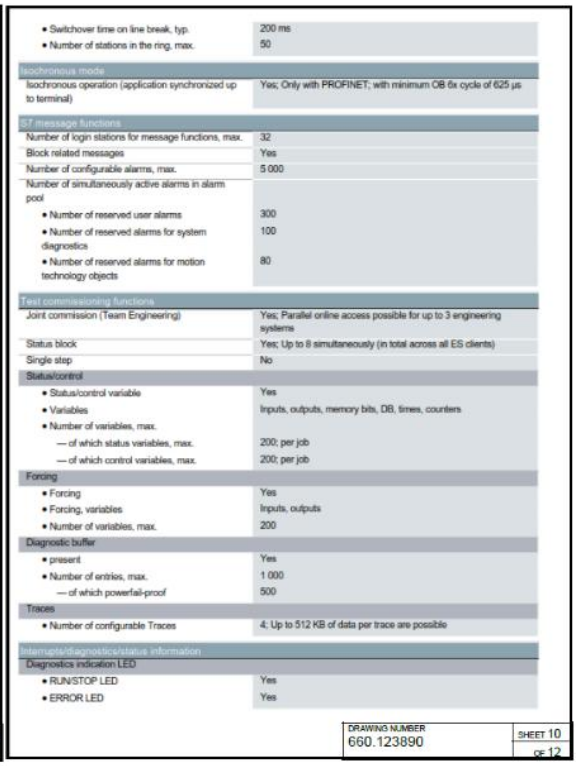

• Switchover time on line break, typ.	200 ms
• Number of stations in the ring, max.	50
Isochronous mode	
Isochronous operation (application synchronized up to terminal)	Yes; Only with PROFINET; with minimum OB 6x cycle of 625 µs
S7 message functions	
Number of login stations for message functions, max.	32
Block related messages	Yes
Number of configurable alarms, max.	5 000
Number of simultaneously active alarms in alarm pool	
• Number of reserved user alarms	300
• Number of reserved alarms for system diagnostics	100
• Number of reserved alarms for motion technology objects	80
Test commissioning functions	
Joint commission (Team Engineering)	Yes; Parallel online access possible for up to 3 engineering systems
Status block	Yes; Up to 8 simultaneously (in total across all ES clients)
Single step	No
Status/control	
• Status/control variable	Yes
• Variables	Inputs, outputs, memory bits, DB, times, counters
• Number of variables, max.	
— of which status variables, max.	200; per job
— of which control variables, max.	200; per job
Forcing	
• Forcing	Yes
• Forcing, variables	Inputs, outputs
• Number of variables, max.	200
Diagnostic buffer	
• present	Yes
• Number of entries, max.	1 000
— of which powerfail-proof	500
Traces	
• Number of configurable Traces	4; Up to 512 KB of data per trace are possible
Interrupts/diagnostics/status information	
Diagnostics indication LED	
• RUN/STOP LED	Yes
• ERROR LED	Yes

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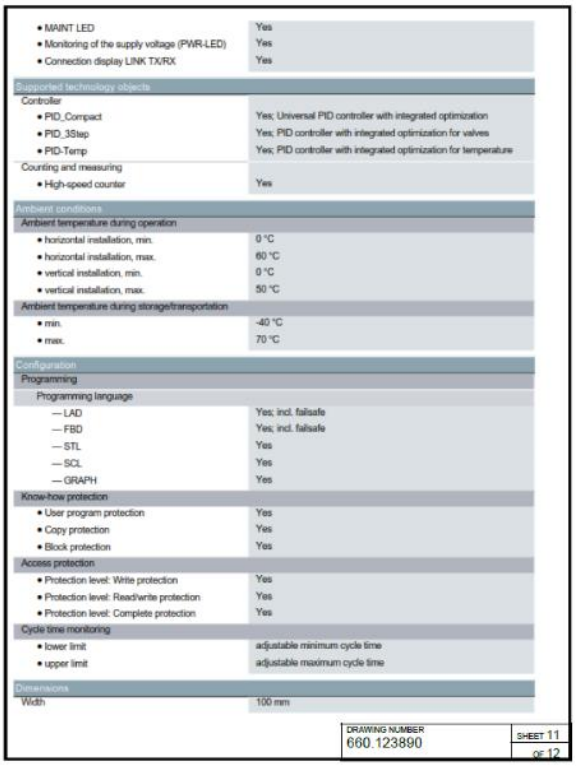

• MAINT LED	Yes
• Monitoring of the supply voltage (PWR-LED)	Yes
• Connection display LINK TX/RX	Yes
Supported technology objects	
Controller	
• PID_Compact	Yes; Universal PID controller with integrated optimization
• PID_3Step	Yes; PID controller with integrated optimization for valves
• PID-Temp	Yes; PID controller with integrated optimization for temperature
Counting and measuring	
• High-speed counter	Yes
Ambient conditions	
Ambient temperature during operation	
• horizontal installation, min.	0 °C
• horizontal installation, max.	60 °C
• vertical installation, min.	0 °C
• vertical installation, max.	50 °C
Ambient temperature during storage/transportation	
• min.	-40 °C
• max.	70 °C
Configuration	
Programming	
Programming language	
— LAD	Yes; incl. failsafe
— FBD	Yes; incl. failsafe
— STL	Yes
— SCL	Yes
— GRAPH	Yes
Know-how protection	
• User program protection	Yes
• Copy protection	Yes
• Block protection	Yes
Access protection	
• Protection level: Write protection	Yes
• Protection level: Read/write protection	Yes
• Protection level: Complete protection	Yes
Cycle time monitoring	
• lower limit	adjustable minimum cycle time
• upper limit	adjustable maximum cycle time
Dimensions	
Width	100 mm

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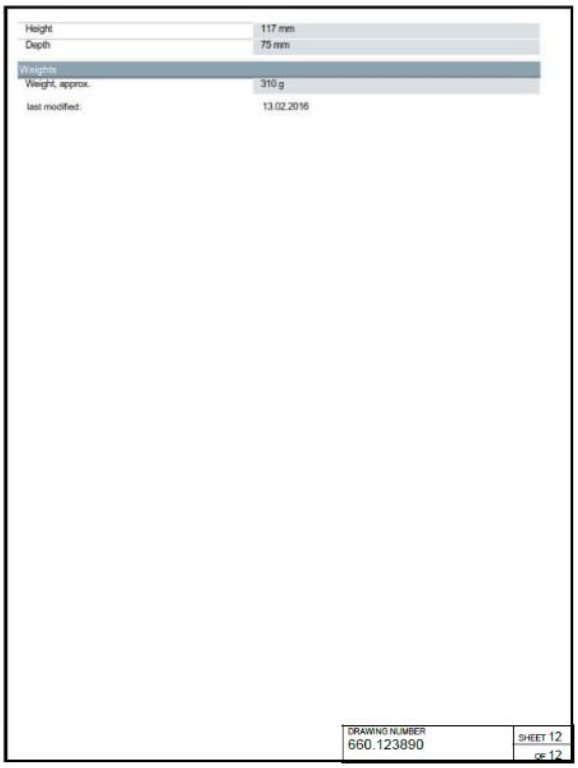

Height	117 mm
Depth	75 mm
Weights	
Weight, approx.	310 g

last modified: 13.02.2016

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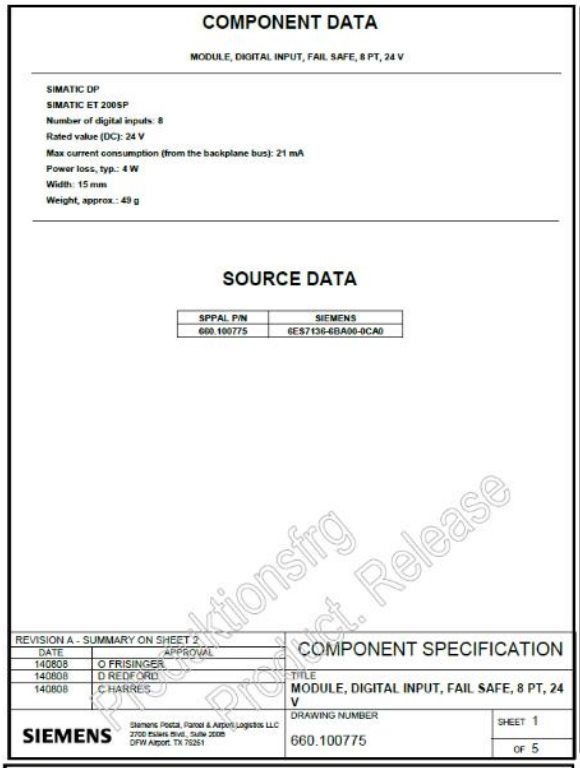
10.2 **Safety I/O Modules**

10.2.1 Safety Input Module



COMPONENT DATA

MODULE, DIGITAL INPUT, FAIL SAFE, 8 PT, 24 V

SIMATIC DP
SIMATIC ET 200SP
Number of digital inputs: 8
Rated value (DC): 24 V
Max current consumption (from the backplane bus): 21 mA
Power loss, typ.: 4 W
Width: 15 mm
Weight, approx.: 49 g

SOURCE DATA

SPPAL P/N	SIEMENS
660.100775	6ES7136-6BA00-0CA0

REVISION A - SUMMARY ON SHEET 2		COMPONENT SPECIFICATION
DATE	APPROVAL	
140808	O FRISINGER	
140808	D REDFORD	TITLE
140808	C HARRIS	MODULE, DIGITAL INPUT, FAIL SAFE, 8 PT, 24 V
SIEMENS	Siemens Postal, Parcel & Airport Logistics LLC 2700 Bailes Blvd., Suite 2005 DFW Airport, TX 76261	DRAWING NUMBER 660.100775 SHEET 1 OF 5

SIEMENS

Product data sheet 6ES7136-6BA00-0CA0

SIMATIC DP, ELECTRON. MODULE F. ET 200SP, 8 F-DI PROFISAFE, 24V DC, 15 MM WIDTH UP TO PLE (ISO 13849-1)/ SIL3 (IEC 61508)

General information	
Product function	
I&M data	Yes ; I&M0 to I&M3
Engineering with	
STEP 7 TIA Portal configurable/integrated as of version	V15
STEP 7 configurable/integrated as of version	V5.5 SP3 / -
PROFINET as of GSD version/GSD revision	V2.31
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption (rated value)	21 mA ; without load
Current consumption, max.	21 mA ; From the backplane bus
Encoder supply	
Number of outputs	8
Short-circuit protection	Yes ; Electronic ; response threshold 0.7 A to 1.8 A

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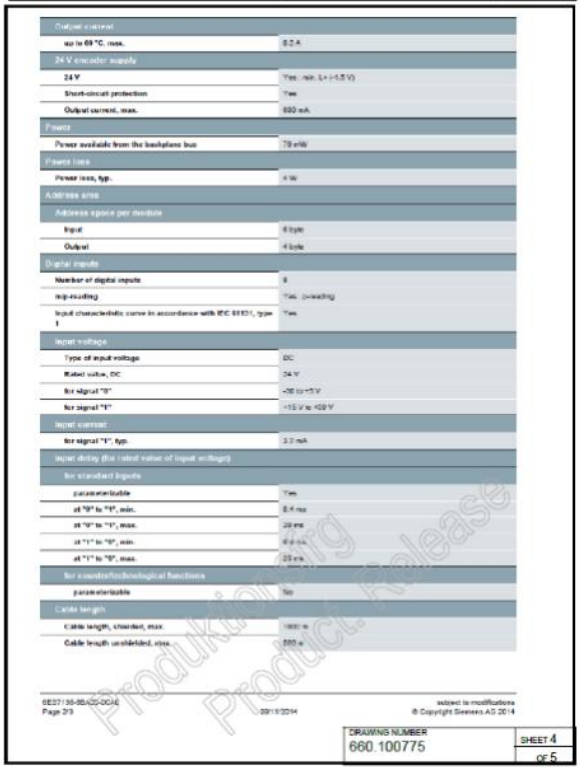
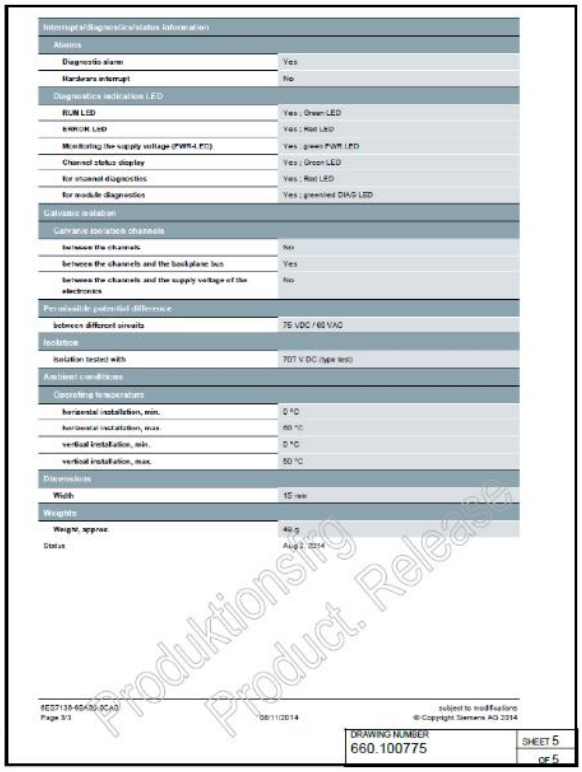
DRAWING NUMBER 660.100775 SHEET 3 OF 5



Output current	
up to 60 °C, max.	0.5 A
24 V encoder supply	
24 V	Yes ; min. L+ (-1.5 V)
Short-circuit protection	Yes
Output current, max.	500 mA
Power	
Power available from the backplane bus	70 mW
Power loss	
Power loss, typ.	4 W
Address area	
Address space per module	
Input	4 byte
Output	4 byte
Digital inputs	
Number of digital inputs	8
Input reading	Yes ; 2-reading
Input characteristic curve in accordance with IEC 61131, type	Yes
1	
Input voltage	
Type of input voltage	DC
Rated value, DC	24 V
for signal "0"	-30 V to +5 V
for signal "1"	+15 V to 400 V
Input current	
for signal "1", typ.	3.7 mA
Input delay (for rated value of input voltage)	
for standard inputs	
parameterizable	Yes
at "0" to "1", min.	0.4 ms
at "0" to "1", max.	20 ms
at "1" to "0", min.	0.4 ms
at "1" to "0", max.	20 ms
for counter/technological functions	
parameterizable	No
Cable length	
Cable length, shielded, max.	1000 m
Cable length unshielded, max.	600 m

6ES7136-6BA00-0CA0 Page 2/3 08/11/2014 subject to modifications © Copyright Siemens AG 2014

DRAWING NUMBER 660.100775 SHEET 4 OF 5



Interrupts/diagnostics/status information	
Alarms	
Diagnostic alarm	Yes
Hardware interrupt	No
Diagnostics indication LED	
RUN LED	Yes ; Green LED
ERROR LED	Yes ; Red LED
Monitoring the supply voltage (PWR-LED)	Yes ; green PWR LED
Channel status display	Yes ; Green LED
for channel diagnostics	Yes ; Red LED
for module diagnostics	Yes ; green/red DIAG LED
Galvanic isolation	
Galvanic isolation channels	
between the channels	No
between the channels and the backplane bus	Yes
between the channels and the supply voltage of the electronics	No
Permissible potential difference	
between different circuits	75 VDC / 60 VAC
Isolation	
Isolation tested with	707 V DC (type test)
Ambient conditions	
Operating temperature	
horizontal installation, min.	0 °C
horizontal installation, max.	60 °C
vertical installation, min.	0 °C
vertical installation, max.	50 °C
Dimensions	
Width	15 mm
Weights	
Weight, approx.	49 g
Status	Aug 1, 2014

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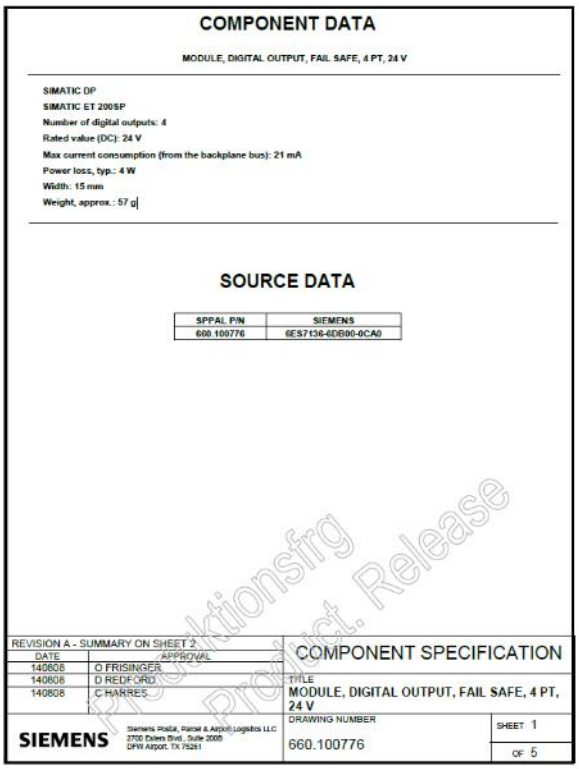
DRAWING NUMBER 660.100775 SHEET 5 OF 5

10.2.2 Safety Output Module



COMPONENT DATA

MODULE, DIGITAL OUTPUT, FAIL SAFE, 4 PT, 24 V

SIMATIC DP
SIMATIC ET 200SP
Number of digital outputs: 4
Rated value (DC): 24 V
Max current consumption (from the backplane bus): 21 mA
Power loss, typ.: 4 W
Width: 15 mm
Weight, approx.: 57 g

SOURCE DATA

SPPAL P/N	SIEMENS
600.100776	6ES7136-6DB00-0CA0

REVISION A - SUMMARY ON SHEET 2	
DATE	APPROVAL
140808	O FRISINGER
140808	D REDFORD
140808	C HARRES

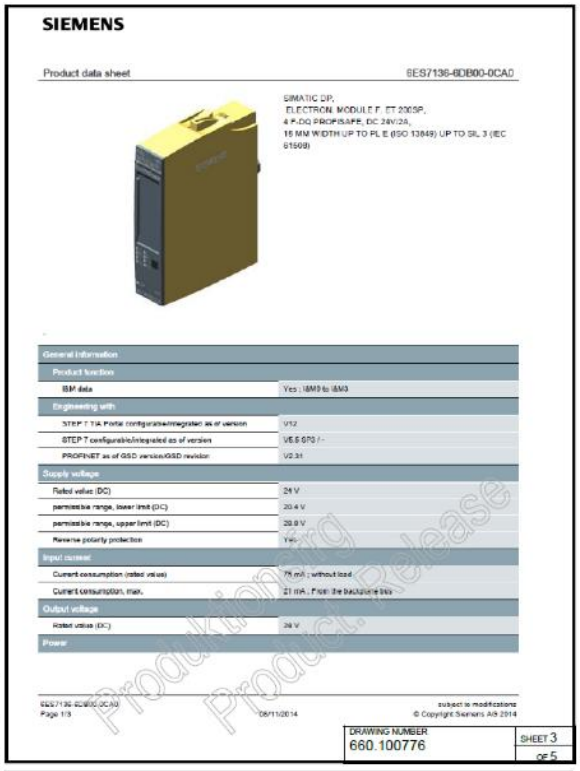
COMPONENT SPECIFICATION

SIEMENS — Siemens Postal, Parcel & Airport Logistics LLC, 2700 Dulles Blvd., Suite 2005, DFW Airport, TX 75261

TITLE: MODULE, DIGITAL OUTPUT, FAIL SAFE, 4 PT, 24 V

DRAWING NUMBER: 660.100776

SHEET 1 OF 5



SIEMENS

Product data sheet — 6ES7136-6DB00-0CA0

SIMATIC DP, ELECTRON. MODULE F. ET 200SP, 4 F-DO PROFISAFE, DC 24V/2A, 15 MM WIDTH UP TO PL E (ISO 13849) UP TO SIL 3 (IEC 61508)

General information	
Product function	
I&M data	Yes ; I&M0 to I&M3
Engineering with	
STEP 7 TIA Portal configurable/integrated as of version	V12
STEP 7 configurable/integrated as of version	V5.5 SP3 / -
PROFINET as of GSD version/GSD revision	V2.31
Supply voltage	
Rated value (DC)	24 V
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Reverse polarity protection	Yes
Input current	
Current consumption (rated value)	75 mA ; without load
Current consumption, max.	21 mA ; From the backplane bus
Output voltage	
Rated value (DC)	24 V
Power	

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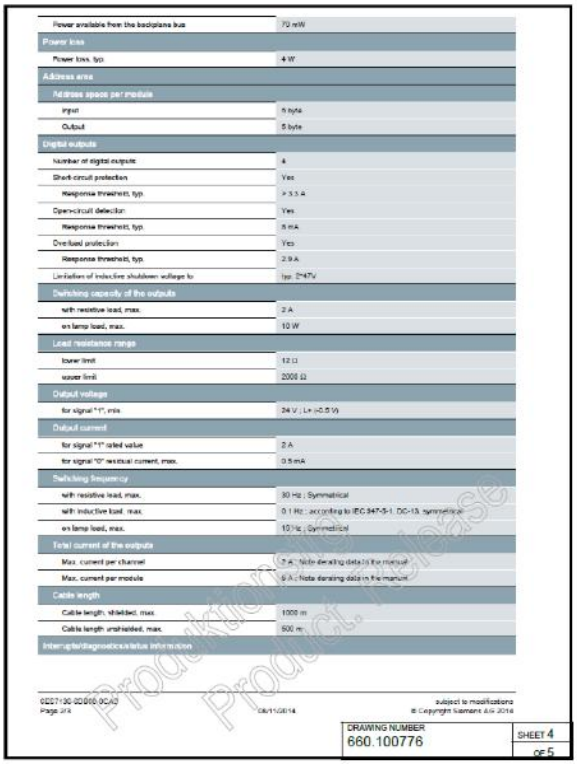
DRAWING NUMBER 660.100776 — SHEET 3 OF 5



Power available from the backplane bus	72 mW
Power loss	
Power loss, typ.	4 W
Address area	
Address space per module	
Input	5 byte
Output	5 byte
Digital outputs	
Number of digital outputs	4
Short-circuit protection	Yes
Response threshold, typ.	> 3.3 A
Open-circuit detection	Yes
Response threshold, typ.	5 mA
Overload protection	Yes
Response threshold, typ.	2.9 A
Limitation of inductive shutdown voltage to	typ. 2*47V
Switching capacity of the outputs	
with resistive load, max.	2 A
on lamp load, max.	10 W
Load resistance range	
lower limit	12 Ω
upper limit	2000 Ω
Output voltage	
for signal "1", min.	24 V ; L+ (-0.5 V)
Output current	
for signal "1" rated value	2 A
for signal "0" residual current, max.	0.5 mA
Switching frequency	
with resistive load, max.	30 Hz ; Symmetrical
with inductive load, max.	0.1 Hz ; according to IEC 947-5-1, DC-13, symmetrical
on lamp load, max.	10 Hz ; Symmetrical
Total current of the outputs	
Max. current per channel	2 A ; Note derating data in the manual
Max. current per module	8 A ; Note derating data in the manual
Cable length	
Cable length, shielded, max.	1000 m
Cable length, unshielded, max.	600 m
Interrupts/diagnostics/status information	

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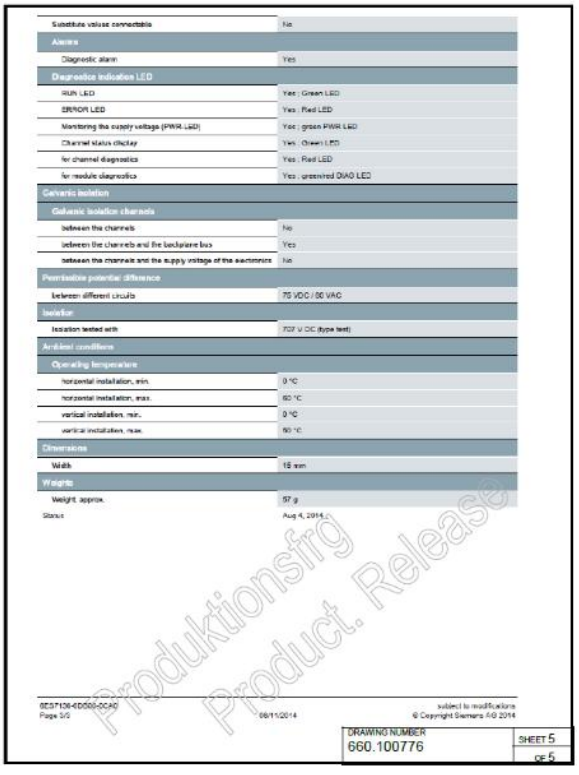
DRAWING NUMBER 660.100776 — SHEET 4 OF 5



Substitute values connectable	No
Alarms	
Diagnostic alarm	Yes
Diagnostics indication LED	
RUN LED	Yes ; Green LED
ERROR LED	Yes ; Red LED
Monitoring the supply voltage (PWR-LED)	Yes ; green PWR LED
Channel status display	Yes ; Green LED
for channel diagnostics	Yes ; Red LED
for module diagnostics	Yes ; green/red DIAG LED
Galvanic isolation	
Galvanic isolation channels	
between the channels	No
between the channels and the backplane bus	Yes
between the channels and the supply voltage of the electronics	No
Permissible potential difference	
between different circuits	75 VDC / 60 VAC
Isolation	
Isolation tested with	707 V DC (type test)
Ambient conditions	
Operating temperature	
horizontal installation, min.	0 °C
horizontal installation, max.	60 °C
vertical installation, min.	0 °C
vertical installation, max.	50 °C
Dimensions	
Width	15 mm
Weights	
Weight, approx.	57 g
Status	Aug 4, 2014

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DRAWING NUMBER 660.100776 — SHEET 5 OF 5

10.3 **Safety Disconnect Switch**

The prescribed disconnect switch provides the following safety features:

- When panel door is open, system power will be completely disconnected and touch-safe.
- Switch can be overridden, but tools are required for that.
- Lockout feature prevents ability to override disconnect switch, even with tools.

660.125015; Rev A

SIEMENS

Data sheet **3LD2144-0TK53**

SENTRON, Switch disconnector 3LD, emergency switching-off switch, 3- pole, Iu: 25 A, operating power / at AC-23 A 400 V: 9.5 kW, floor mounting with door coupling, rotary operating mechanism, Red / yellow, central mounting 22.5 mm of the handle

Model	
Product brand name	SENTRON
Product designation	3LD Switch disconnector
Design of the product	EMERGENCY-STOP switch
Display version / for switch position indicator manual operation	1 ON - 0 OFF
Design of the operating mechanism	Short rotary knob
Design of handle	rotary operating mechanism, red/yellow
Type of the driving mechanism / motor drive	No

General technical data	
Number of poles	3
Type of device	fixed mounting
Type of switch	Floor mounting with door coupling
Size of switch disconnector	2
Operating frequency / maximum	50 1/h

Voltage	
Insulation voltage / rated value	690 V
Surge voltage resistance / rated value	6 kV

1

660.125015; Rev A

Protection class	
Protection class IP	IP65
Protection class IP / on the front	IP65

Dissipation	
Power loss [W] / for rated value of the current / at AC / in hot operating state / per pole	1.1 W

Electricity	
Current / at AC / rated value	25 A
Continuous current / rated value	25 A
Continuous current / of upstream fuse / rated value	25 A
Short-time current resistance (Icw) / at 690 V / limited to 1 s / rated value	640 A

Main circuit	
Operating frequency	
• initial value	50 Hz
• Full-scale value	60 Hz
Operating power	
• at AC-23 A / at 400 V / rated value	9.5 kW
• at AC-23 A / at 690 V / rated value	9.5 kW
• at AC-3 / at 400 V / rated value	7.5 kW
• at AC-3 / at 690 V / rated value	7.5 kW
Operating voltage	
• at AC / at 50/60 Hz / rated value	690 V

Auxiliary circuit	
Number of CO contacts / for auxiliary contacts	0
Number of NC contacts / for auxiliary contacts	0
Number of NO contacts / for auxiliary contacts	0
Operating voltage / of auxiliary contacts / at AC / maximum	500 V
Continuous current / of the auxiliary contact / rated value	10 A
Insulation voltage / of the auxiliary switch / rated value	500 V

Suitability	
Suitability for use	
• Main switch	Yes
• switch disconnector	Yes
• EMERGENCY OFF switch	Yes
• safety switch	Yes
• maintenance/repair switch	Yes

Product details

2

Product feature / interlock	Yes
Number of bracket locks / maximum	3
Hasp thickness / of bracket locks / minimum	4 mm
Hasp thickness / of bracket locks / maximum	8 mm
Product extension / optional	
• motor drive	No
• Voltage trigger	No
Short circuit	
Conditional short-circuit current / with line-side fuse protection	
• at 690 V / by gG fuse / rated value	50 kA
Connections	
Type of connectable conductor cross-sections	
• for copper conductor / solid	1x (1,516mm²)
• for copper conductor / finely stranded / with core end processing	1x (1,510mm²)
• for copper conductor / stranded	1x (1,516mm²)
• for auxiliary contacts / solid	2x (0.75 ... 2.5 mm²), 1x 4 mm²
• for auxiliary contacts / finely stranded / with core end processing	2x (0.75 ... 1.5 mm²), 1x 2.5 mm²
• for auxiliary contacts / stranded	2x (0.75 ... 2.5 mm2), 1x 4 mm2
Type of electrical connection	
• for main current circuit	box terminal
• for auxiliary contacts	connection terminals
Requirements	
Design of the fuse link	
• for short-circuit protection of the main circuit / required	fuse gL/gG: 25 A
• for short-circuit protection of the auxiliary switch / required	fuse gL/gG: 10 A
Mechanical Design	
Height	83 mm
Width	67 mm
Depth	45\ 5 mm
Mounting type	Built-in unit fixed-mounted version
Mounting type	
• front mounting with 4-hole attachment	No
• front mounting with central attachment	Yes
• rail mounting	Yes
Net weight	403 g
Environmental conditions	

Ambient temperature	
• during operation / minimum	-25 °C
• during operation / maximum	55 °C
Certificates	
Reference code	
• acc. to DIN EN 61346-2	S
• acc. to DIN EN 81346-2	SF
Waste electronic equipment must not be disposed as unsorted municipal waste, e.g. household waste. For disposing the waste electronic equipment it is necessary to observe the current local national/international regulations.	

General Product Approval					Declaration of Conformity
				Miscellaneous	
CCC	CSA	UL	VDE		EG-Konf.

Test Certific-ates	Shipping Approval		other
Special Test Certi-ficate	LRS	PRS	Environmental Con-firmations

Further information

Information- and Downloadcenter (Catalogs, Brochures,...)
http://www.siemens.com/lowvoltage/catalogs

Industry Mall (Online ordering system)
https://mall.industry.siemens.com/mall/en/en/Catalog/product?mlfb=3LD2144-0TK53

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)
https://support.industry.siemens.com/cs/ww/en/pi/3LD2144-0TK53

Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, ...)
http://www.automation.siemens.com/bilddb/cax_en.aspx?mlfb=3LD2144-0TK53

CAx-Online-Generator
http://www.siemens.com/cax

Tender specifications
http://www.siemens.com/specifications

10.4 **E-Stop Push Button**

ax320.937507; Rev -

SIEMENS

Data sheet **3SU1051-1HB20-0AA0**

EMERGENCY STOP mushroom pushbutton, illuminable, 22 mm, round, metal, shiny, red, 40 mm, positive latching, acc. to EN ISO 13850, rotate-to-unlatch

Product brand name	SIRIUS ACT
Product designation	EMERGENCY STOP mushroom pushbuttons
Design of the product	Actuating/signaling element
Product type designation	3SU1
Enclosure	
Number of command points	1
Actuator	
Design of the operating mechanism	positive latching
Manner of function of the actuating element	Latching
Product extension optional Light source	Yes
Color	
• of the actuating element	Red
Material of the actuating element	plastic
Shape of the actuating element	round
Outer diameter of the actuating element	40 mm
Type of unlocking device	rotate-to-unlatch mechanism
Number of switching positions	2
Front ring	

1

Product component front ring	No
General technical data	
Product function	
• positive opening	Yes
• EMERGENCY OFF function	Yes
• EMERGENCY STOP function	Yes
Protection class IP	IP66, IP67, IP69(IP69K)
Degree of protection NEMA rating	NEMA 1, 2, 3, 3R, 4, 4X, 12, 13
Shock resistance	
• acc. to IEC 60068-2-27	Sinusoidal half-wave 50 g / 11 ms
Operating frequency maximum	600 1/h
Mechanical service life (switching cycles)	
• typical	300 000
Reference code acc. to DIN EN 81346-2	S
Reference code acc. to DIN EN 61346-2	S
Safety related data	
B10 value	
• with high demand rate acc. to SN 31920	100 000
Proportion of dangerous failures	
• with low demand rate acc. to SN 31920	20 %
• with high demand rate acc. to SN 31920	20 %
Failure rate [FIT]	
• with low demand rate acc. to SN 31920	100 FIT
T1 value for proof test interval or service life acc. to IEC 61508	20 y
Ambient conditions	
Ambient temperature	
• during operation	-25 ... +70 °C
• during storage	-40 ... +80 °C
Environmental category during operation acc. to IEC 60721	3M6, 3S2, 3B2, 3C3, 3K6 (with relative air humidity of 10 ... 95 %)
Installation/ mounting/ dimensions	
Shape of the installation opening	round
Mounting diameter	22.3 mm
Positive tolerance of installation diameter	0.4 mm
Mounting height	45.3 mm
Installation width	40 mm
Installation depth	26.3 mm
Certificates/approvals	

2

ax320.937507; Rev -

General Product Approval				Declaration of Conformity
				Miscellaneous

Test Certificates	Marine / Shipping
Special Test Certificate	Type Test Certificate/Test Report

Marine / Shipping	other
	Confirmation

Further information

Information- and Downloadcenter (Catalogs, Brochures,...)
http://www.siemens.com/industrial-controls/catalogs

Industry Mall (Online ordering system)
https://mall.industry.siemens.com/mall/en/en/Catalog/product?mlfb=3SU1051-1HB20-0AA0

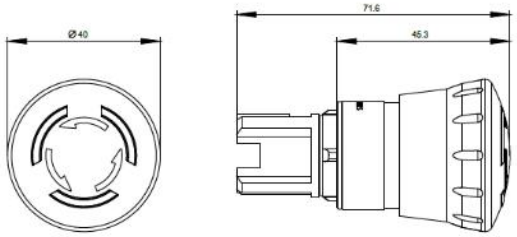
Cax online generator
http://support.automation.siemens.com/WW/CAXorder/default.aspx?lang=en&mlfb=3SU1051-1HB20-0AA0

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)
https://support.industry.siemens.com/cs/ww/en/pv/3SU1051-1HB20-0AA0

Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...)
http://www.automation.siemens.com/bilddb/cax_de.aspx?mlfb=3SU1051-1HB20-0AA0&lang=en

3

ax320.937507; Rev -



last modified: 02/21/2019

4

10.5 **Safety Interlock Switches**

10.5.1 Switch

660.125013; Rev A

SIEMENS

Data sheet 3SE6604-2BA01

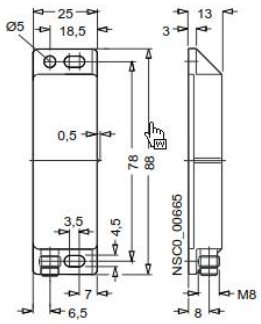
Magnet switch Contact block 25 x 55 mm 2 NC with M8 connector, 4-pole

Product brand name	SIRIUS
Product designation	Magnetically operated switch
Design of the product	Rectangular sensor unit
Product type designation	3SE66
Suitability for use safety-related circuits	Yes
General technical data	
Product function	
• positive opening	No
• cross-circuit/short-circuit recognition	No
Type of voltage of the operating voltage	AC/DC
Protection class IP	IP67
Shock resistance	
• acc. to IEC 60068-2-27	Sinusoidal half-wave 30g / 11 ms
Vibration resistance	
• acc. to IEC 60068-2-6	10 ... 55 Hz: 1 mm
Reference code acc. to DIN 40719 extended according to IEC 204-2 acc. to IEC 750	S
Type of voltage	AC/DC
Height of the sensor	13 mm

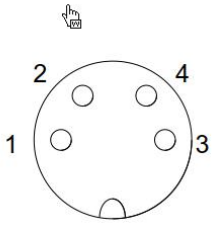
660.125013; Rev A

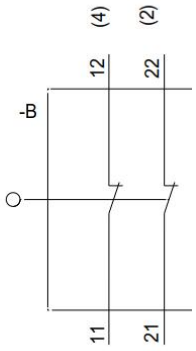
Length of the sensor	55 mm
Width of the sensor	25 mm
Material of the active sensor area	plastic
Mechanical installation condition for sensor	no flush installation possible
Operating voltage rated value	60 V
Operating current rated value	400 mA
Operating power rated value	10 W
Number of NC contacts	
• for auxiliary contacts	2
Number of NO contacts	
• for auxiliary contacts	0
Number of CO contacts for auxiliary contacts	0
Enclosure	
Design of the housing	block
Material of the enclosure	plastic
Actuator	
Design of the operating mechanism	magnet
Contact	
Circuit principle	reed switches
Switching frequency	5 Hz
Safe operating distance OFF	15 mm
Safe operating distance ON	5 mm
Design of the switching function	NC contact
Connections/Terminals	
Type of electrical connection	M8 connector, 4-pole
Safety related data	
Safety Integrity Level (SIL) acc. to IEC 61508	3
Performance level (PL) acc. to EN ISO 13849-1	e
Category acc. to EN 954-1	4
Ambient conditions	
Ambient temperature	
• during operation	-25 ... +70 °C
• during storage and transport	-25 ... +70 °C
Inputs/ Outputs	
Type of switching output	Reed contacts
Display	
Evaluation version required	yes
Installation/ mounting/ dimensions	
• (mounting type)	screw fixing

660.125013; Rev A



660.125013; Rev A





last modified: 04/29/2019

10.5.2 Interlock Magnet

660.125014; Rev A

SIEMENS

Data sheet 3SE6704-2BA

Solenoid rectangular large

Product brand name	SIRIUS
Product designation	Magnetically operated switch
Design of the product	Coded magnet, rectangular
Product type designation	3SE67
Suitability for use safety-related circuits	Yes
General technical data	
Product function	
• positive opening	No
• cross-circuit/short-circuit recognition	No
Protection class IP	IP67
Reference code acc. to DIN 40719 extended according to IEC 204-2 acc. to IEC 750	S
Height of the sensor	13 mm
Length of the sensor	55 mm
Width of the sensor	25 mm
Mechanical installation condition for sensor	no flush installation possible
Number of NC contacts	
• for auxiliary contacts	0
Number of NO contacts	
• for auxiliary contacts	0
Number of CO contacts for auxiliary contacts	0
Enclosure	
Design of the housing	block
Material of the enclosure	plastic
Contact	
Switching frequency	5 Hz
Safety related data	
Safety Integrity Level (SIL) acc. to IEC 61508	3
Performance level (PL) acc. to EN ISO 13849-1	e
Category acc. to EN 954-1	4
Ambient conditions	
Ambient temperature	
• during operation	-25 ... +70 °C
Inputs/ Outputs	
Type of switching output	Reed contacts
Display	
Evaluation version required	yes
Installation/ mounting/ dimensions	
• (mounting type)	screw fixing
Certificates/approvals	
General Product Approval	other

Confirmation

Further information

Information- and Downloadcenter (Catalogs, Brochures,...)
http://www.siemens.com/industrial-controls/catalogs

Industry Mall (Online ordering system)
https://mall.industry.siemens.com/mall/en/en/Catalog/product?mlfb=3SE6704-2BA

Cax online generator
http://support.automation.siemens.com/WW/CAXorder/default.aspx?lang=en&mlfb=3SE6704-2BA

Service&Support (Manuals, Certificates, Characteristics, FAQs,...)
https://support.industry.siemens.com/cs/ww/en/ps/3SE6704-2BA

Image database (product images, 2D dimension drawings, 3D models, device circuit diagrams, EPLAN macros, ...)
http://www.automation.siemens.com/bilddb/cax_de.aspx?mlfb=3SE6704-2BA&lang=en

last modified: 04/29/2019

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660.125014; Rev A

Produktionsfreigabe Product Release

2

10.6 **Safety Light Curtains**

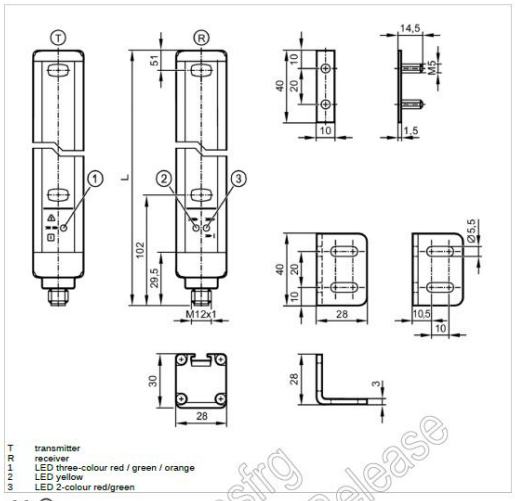
10.6.1 Tote Entry Light Curtain

660.125133: Rev A

OY116S

Safety light grids

OYA0910-04-4-12-P-1



Application	
Protective function	Access prevention body protection

660.125133: Rev A

OY116S

Safety light grids

OYA0910-04-4-12-P-1

Electrical data		
Operating voltage tolerance	[%]	20
Operating voltage	[V]	24 DC
Protection class		III
Reverse polarity protection		yes
Power-on delay time	[s]	< 2
Type of light		Infrared light
Wave length	[nm]	950
Receiver		
Current consumption	[mA]	83
Transmitter		
Current consumption	[mA]	42
Outputs		
Electrical design		PNP
Number of OSSD outputs		2
Max. current load per OSSD output	[mA]	400; (24 V)
Short-circuit protection		yes
Monitoring range		
Protected area height	[mm]	910
Number of beams		4
Protection area width (low light intensity)	[m]	0...4
Protection area width (high light intensity)	[m]	3...12
Reaction times		
Response time	[ms]	3
Operating conditions		
Applications		Class C to EN 60654-1 weatherproof application
Ambient temperature	[°C]	-10...55
Storage temperature	[°C]	-20...70
Max. relative air humidity	[%]	95
Protection		IP 65; IP 67
Tests / approvals		
EMC		IEC 61496-1
Shock resistance		IEC 61496-1
Vibration resistance		IEC 61496-1
Safety classification		
ISO 13849-1		Category 2, PL e
IEC 61508		SIL 3
IEC 62061		SILCL 3
Mission time TM	[h]	175200
Safety-related reliability PFHD	[1/h]	8.2E-09

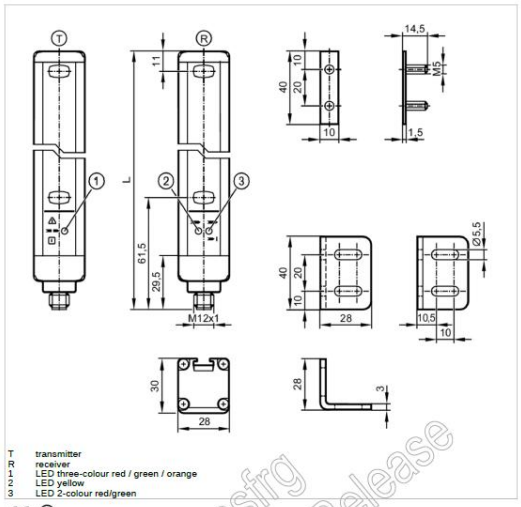
10.6.2 Tote Exit Light Curtain

660.125134: Rev A

OY042S

Safety light curtain

OYA0310-30-4-12-P-1



Application	
Protective function	Access prevention hand protection

660.125134: Rev A

OY042S

Safety light curtain

OYA0310-30-4-12-P-1

Electrical data		
Operating voltage tolerance	[%]	20
Operating voltage	[V]	24 DC
Protection class		III
Reverse polarity protection		yes
Power-on delay time	[s]	< 2
Type of light		Infrared light
Wave length	[nm]	950
Receiver		
Current consumption	[mA]	83
Transmitter		
Current consumption	[mA]	42
Outputs		
Electrical design		PNP
Number of OSSD outputs		2
Max. current load per OSSD output	[mA]	400; (24 V)
Short-circuit protection		yes
Monitoring range		
Protected area height	[mm]	310
Resolution (detection capacity d)	[mm]	30
Protection area width (low light intensity)	[m]	0...4
Protection area width (high light intensity)	[m]	3...12
Reaction times		
Response time	[ms]	5.5
Operating conditions		
Applications		Class C to EN 60654-1 weatherproof application
Ambient temperature	[°C]	-10...55
Storage temperature	[°C]	-20...70
Max. relative air humidity	[%]	95
Protection		IP 65; IP 67
Tests / approvals		
EMC		IEC 61496-1
Shock resistance		IEC 61496-1
Vibration resistance		IEC 61496-1
Safety classification		
ISO 13849-1		Category 4, PL e
IEC 61508		SIL 3
IEC 62061		SILCL 3
Mission time TM	[h]	175200
Safety-related reliability PFHD	[1/h]	8.2E-09

10.7 **Lift Motor**

10.7.1 Motor Controller

660.125007; Rev A

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Data sheet for SINAMICS S210

MLFB-Ordering data 6SL3210-5HB10-8UF0

Client order no. :
Order no. :
Offer no. :
Remarks :

Item no. :
Consignment no. :
Project :

Rated data

Input

Number of phases	1 AC
Line voltage	200 ... 240 V ±10 %
Line frequency	45 ... 66 Hz
Rated current	9.3 A
Inrush current	8.0 A

Output

Number of phases	3 AC
Rated power	0.75 kW (1.02 hp)
Rated current I_n	4.4 A
Max. output current	16.0 A
Pulse frequency	8 kHz
Output frequency for servo control	0 ... 550 Hz

Electronics power supply

Voltage	24 V -15 % ... +20 %
Current demand, max.	1.6 A

Communication

Communication	PROFINET

Ambient conditions

Installation altitude	1000 m (3280.84 ft)
Cooling	convection cooling
Ambient temperature during	
Operation	0 ... 50 °C (32 ... 122 °F) Better than class 3K3, in acc. with EN 60721-3-3, without derating
Transport	-40 ... 70 °C (-40 ... 158 °F) Class 2K4, in acc. with EN 60721-3-2, in transport packaging
Storage	-25 ... 55 °C (-13 ... 131 °F) Class 1K4, in acc. with EN 60721-3-1, in product packaging
Relative humidity during	
Max. operation	95 % RH, condensation not permitted
Transport, max.	95 % at 40 °C (104 °F)
Storing, max.	95 %

660.125007; Rev A

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Data sheet for SINAMICS S210

MLFB-Ordering data 6SL3210-5HB10-8UF0

Inputs / outputs

Standard digital inputs

Number	5 of which 2 for F-DI

Fail-safe digital inputs

Number	1 Can only be used for STO/SS1

Mechanical data

Dimensions

Width	75.0 mm (2.95 in)
Height	170.0 mm (6.69 in)
Depth	197.4 mm (7.68 in)
Mounting position	vertical wall mounting
Degree of protection	IP20 / UL open type
Size	FSC
Net weight	1.70 kg (3.75 lb)

Connections

Line side

Version	push-in spring-type terminals
Conductor cross-section	0.2 ... 2.5 mm² / 24 ... 14 AWG

Motor end

Version	push-in spring-type terminals
Conductor cross-section	0.2 ... 2.5 mm² / 24 ... 14 AWG

DC link (for braking resistor)

Version	push-in spring-type terminals
Conductor cross-section	0.2 ... 2.5 mm² / 24 ... 14 AWG
Cable length	3 m (9.84 ft)

PE connection

Version	M4 screw studs

Max. motor cable length

Shielded	50 m (164.04 ft)

Standards

Compliance with standards	CE, cULus, RCM, KC, EAC
CE marking	Low-voltage directive 2006/95/EC
Verification of suitability for fail-safety	SIL 2 in acc. with IEC 61508 parts 1-3 (2010) and IEC 61800-5-2 (2016), PL d in acc. with ISO 13849 part 1 (2015), Category 3 in acc. with IEC 60204 (2007)

10.7.2 Servo Motor

660.125010; Rev A

SIEMENS

Data sheet for SIMOTICS S-1FK2

MLFB-Ordering data 1FK2104-5AK10-0MA0

Figure similar

Client order no. :
Order no. :
Offer no. :
Remarks :

Item no. :
Consignment no. :
Project :

Basic motor data

Motor type	Permanent-magnet synchronous motor, Natural cooling, IP64
Motor type	High Dynamic
Static torque	2.40 Nm
Static current	4.4 A
Maximum torque	7.60 Nm
Maximum current	16.0 A
Maximum speed	7100 rpm
Rotor moment of inertia	0.650 kgcm²
Weight	3.7 kg

Rated data for operation with a SINAMICS S210 and 230 V 1 AC

Rated speed	3000 rpm
Rated torque	2.40 Nm
Rated current	4.4 A
Rated power	0.75 kW

Encoder system

Encoder system	Encoder AM22DQC: Absolute encoder 22 bit + 12 bit multiturn

Motor connection

Connection type	OCC
Connector size	M17

Mechanical data

Design acc. to Code I	IM B5 (IM V1, IM V3)
Vibration severity grade	Grade A
Shaft height	40
Flange size (AB)	80 mm
Centering ring (N)	70 mm
Hole circle (M)	90 mm
Screw-on hole (S)	6.5 mm
Overall length (LB)	170 mm
Diameter of shaft (D)	19 mm
Length of shaft (E)	40 mm
Length of flange diagonal (P)	105 mm
Shaft extension	Plain shaft

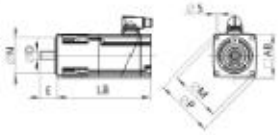

Figure similar

Holding brake

Holding brake version	Spring type brake
Holding torque	3.30 Nm
Opening time	50 ms
Closing time	15 ms
Maximum speed, emergency stop	7500 rpm
Maximum single switching energy	270.0 J
Service life, operating energy	120000 J

Technical data are subject to change! There may be discrepancies between calculated and rating plate values.

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10.8 **Touch Pad OCP**

660.125011; Rev A

660.125011; Rev A

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Data sheet **6AV3688-3AF37-0AX0**

SIMATIC HMI KPBF PN, Key Panel, 8 short-stroke switches with multi-colored LEDs, PROFINET interfaces with PROFIsafe; 8 DI/DO and 2 safety DI pins, 24 V DC can be looped through parameterizable as of STEP 7 V5.5

General information	
Product type designation	KPBF PN
Control elements	
With parameterizable keys	Yes
Keyboard fonts	
• Membrane keyboard	
— user-definable label membrane keys	Yes
• Function keys	
— Number of function keys	8
• Short-stroke keys	
— Number of short-stroke keys	8
Expansions for operator control of the process	
• DP direct LEDs (LEDs as S7 output I/O)	8; Adjustable brightness
• Number of color modes for LED	5; Red, green, blue, yellow, white
• Direct keys (keys as S7 input I/O)	8
Installation type/mounting	
Mounting type	Mounting clip
Mounting position	vertical

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Rack mounting	No
Front mounting	Yes; Compatible with Extension Units dimensions
Rail mounting	No
Wall mounting/direct mounting	No
Mounting in portrait format possible	Yes
Mounting in landscape format possible	Yes
maximum permissible angle of inclination without external ventilation	30°; To the front/rear
Number of slots for command devices and signaling units	0
Supply voltage	
Type of supply voltage	DC
Rated value (DC)	24 V; 24 V can be looped through connector, interrupted when pulled
permissible range, lower limit (DC)	20.4 V
permissible range, upper limit (DC)	28.8 V
Input current	
Current consumption (rated value)	0.3 A
Type of output	
LED colors	
• red	Yes
• yellow	Yes
• green	Yes
• white	Yes
• blue	Yes
Digital inputs	
Number of digital inputs	8; Total inputs and outputs max. 8 and 1x SIL 2 or 2x SIL 3
Input voltage	
• Rated value (DC)	24 V
Digital outputs	
Number of digital outputs	8; Max. 8 inputs and outputs (total)
Short-circuit protection	Yes
Switching capacity of the outputs	
• with resistive load, max.	100 mA
Output voltage	
• Rated value (DC)	24 V; Non-isolated
Total current of the outputs	
• Current per channel, max.	100 mA
• Current per group, max.	800 mA
Interfaces	
Number of industrial Ethernet interfaces	2; For the construction of lines and rings without external switch

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660.125011; Rev A

660.125011; Rev A

• Limit class B, for use in residential areas	No
Degree and class of protection	
IP (at the front)	IP65
Enclosure Type 4 at the front	No
Enclosure Type 4x at the front	Yes; Incl. NEMA12
IP (rear)	IP20
Standards, approvals, certificates	
CE mark	Yes
cULus	Yes
RCM (formerly C-TICK)	Yes
KC approval	Yes
CCC	No; not necessary
Suitable for safety functions	Yes
Use in hazardous areas	
• ATEX Zone 2	Yes
• ATEX Zone 22	Yes
• cULus Class I Zone 1	No
• cULus Class I Zone 2, Division 2	Yes
• FM Class I Division 2	Yes
Marine approval	
• Germanischer Lloyd (GL)	No
• American Bureau of Shipping (ABS)	No
• Bureau Veritas (BV)	No
• Det Norske Veritas (DNV)	No
• Lloyds Register of Shipping (LRS)	No
• Nippon Kaiji Kyokai (Class NK)	No
• Polski Rejestr Statkow (PRS)	No
Ambient conditions	
Ambient temperature during operation	
• min.	0 °C
• max.	55 °C
• Operation (vertical installation)	
— For vertical installation, min.	0 °C
— For vertical installation, max.	55 °C
• Operation (max. tilt angle)	
— At maximum tilt angle, min.	0 °C
— At maximum tilt angle, min.	45 °C
• Operation (vertical installation, portrait format)	
— For vertical installation, min.	0 °C
— For vertical installation, max.	55 °C
• Operation (max. tilt angle, portrait format)	

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— At maximum tilt angle, min.	0 °C
— At maximum tilt angle, min.	45 °C
Ambient temperature during storage/transportation	
• min.	-20 °C
• max.	60 °C
Relative humidity	
• Operation, max.	95 %; no condensation
Configuration	
Configuration software	
• STEP 7 Basic (TIA Portal)	Yes
• STEP 7 Professional (TIA Portal)	Yes
Functionality under WinCC (TIA Portal)	
Process coupling	
• S7-1200	Yes; with ET 200pro CPU and ET 200S CPU
• S7-1500	Yes
• S7-200	No
• S7-300/400	Yes; with F-CPU: STEP 7 V11 SP1 (or higher) and Safety V11 (or higher) or SIMATIC STEP 7 Basic V11 (or higher)
• LOGO!	No
• WinAC	Yes
• SINUMERIK	No
• SIMOTION	No
• Allen Bradley (EtherNet/IP)	No
• Allen Bradley (DF1)	No
• Mitsubishi (MC TCP/IP)	No
• Mitsubishi (FX)	No
• OMRON (FINS TCP)	No
• OMRON (LINK/Multilink)	No
• Modicon (Modbus TCP/IP)	No
• Modicon (Modbus)	No
Mechanics/material	
Enclosure material (front)	
• Plastic	Yes
• Aluminum	No
• Stainless steel	No
Service life	
• Short-stroke keys (in switching cycles)	1 500 000
• LEDs (ON period)	100 %
Dimensions	
Width of the housing front	98 mm

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10.9 **Phase Monitor – PN 660.005953**

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Product data sheet **3UG4614-1BR20**

DIGITAL MONITORING RELAY UNBALANCE 0-20% REVERSIBLE PHASE SEQUENCE PHASE FAILURE 3X 160 TO 690V AC 50 TO 60 HZ UNDERVOLTAGE 160-690V HYSTERESIS 1-20V ON AND OFF DELAY 0-20S 2 CHANGEOVER CONTACTS SCREW TERMINAL REPLACEMENT PRODUCT FOR 3UG3012-1A..

General technical details:	
Measurable voltage / for AC	
• initial value	160 V
• final value	690 V
Type of voltage / for operating	AC
• at 50 Hz / at AC / rated value	
• minimum	160 V
• maximum	690 V
• at 60 Hz / at AC / rated value	
• minimum	160 V
• maximum	690 V
Impulse voltage resistance / rated value	6 kV
Adjustable backslide delay time	
• initial value	0.1 s
• final value	20 s
Adjustable operating delay time	
• initial value	0.1 s
• final value	20 s
number of NC contacts / for auxiliary contact	0

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11. Appendix C – Acronyms

Acronym	Definition
SOW	Statement of Work
DFMA	Design for Manufacture and Assembly
DTC	Design to Cost
BOM	Bill of Materials
TDP	Technical Data Package
R&D	Research and Development
VFD	Variable Frequency Drive
SCM	Supply Chain Management
SCD	Source Control Documents
HMI	Human Machine Interface
GDU	Graphic Display Unit
MCP	Main Control Panel
PE	Photoeye
PLC	Programmable Logic Controller
STO	Safe Torque Off
LH	Left Hand
RH	Right Hand
CW	Clock Wise
CCW	Counter Clock Wise