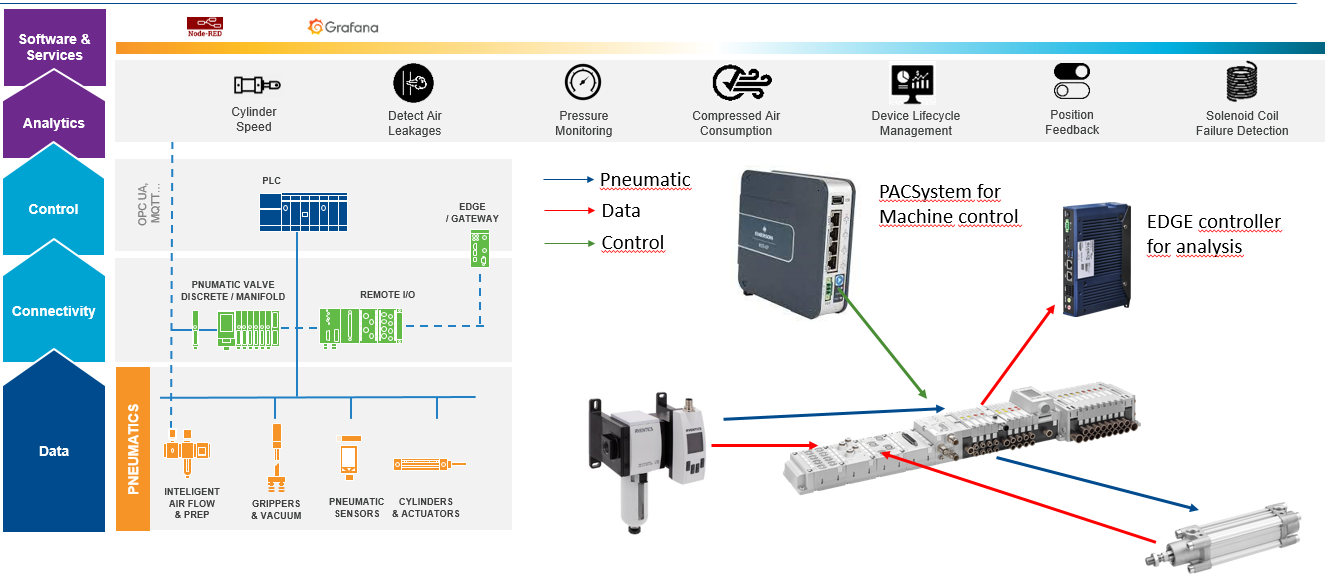
**EXPERIMENTAL STAND RAPORT**



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6. **General description**

This is testing and research equipment made to gather data about pneumatic systems, and especially pneumatic pistons, capabilities, optimal parameters, limits, and the way normal wear affect it’s functionality.

It is meant to collect data, graph it, analyse it and perform predictive maintenance.

1. **Components**

* PACSystem RSTi-EP
* EDGE Contoller
* 3/2 shut off valve
* Filter pressure regulator
* 3/2 directional valve
* Sensor pressure with display
* Expansion module EP-2218
* Profile cylinder (0822122009)
* Profile cylinder (0822123009)
* Profile cylinder (0822121011)
* Profile cylinder (0822123011)
* Compresor PARKSIDE
* Aventics series AES (R412088223)
* Valve system series CD10-PI

**3) Technical specifications on each component**

* **PACSystem RSTi-EP**

**Specifications**

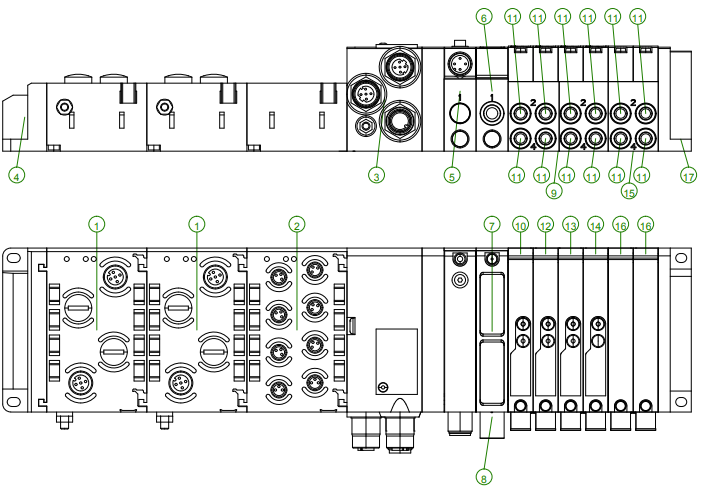
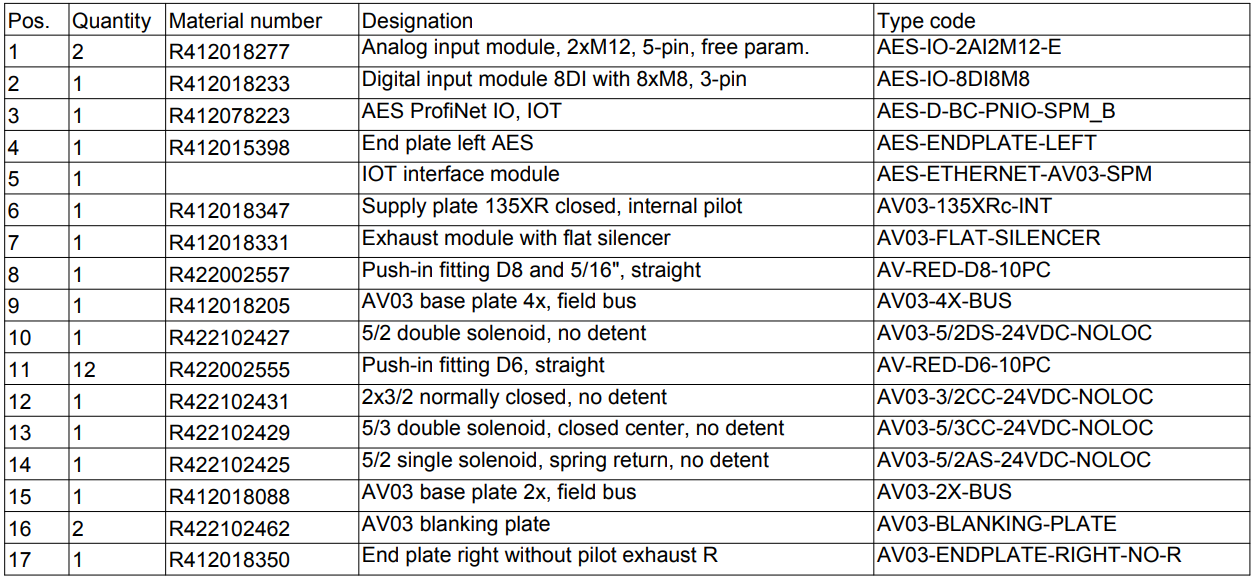
* Part Number: EPSCPE115
* Storage: 1.5MB
* I/O2k Bits Discrete I/O, 32k Words for Analog I/O
* Redundancy SupportMedia Redundancy Protocol (MRP)
* Ethernet Communications: SRTP Client/Server (Max 8 Connections), Modbus TCP/IP (Max 8 Connections), OPC-UA Server (Max 8 Clients), EDG (Max 16 Exchanges), PROFINET (Max 8 IO Devices)
* USB1x USB-A 2.0
* Memory Card Micro SD
* Ethernet Port1x 10/100, 1x 3-port switch 10/100
* Other Interface1x RS-232



* **EDGE Controller**

**Specifications**

* Part Number: R2L0N1A2AD
* Software: PACEdge
* Operating System: Ubuntu Linux
* Processor: AMD G-Series SOC 2nd Generation GX-210HL Processor, 7W 2c 1.0GHz 1MB cache
* Memory: 4GB DDR3L
* Storage: 32GB SSD
* Ethernet2x 1-gigabit Ethernet channels - RJ-45 standard
* USB2x USB 3.0 external
* Serial Interfaces1x RS232, 1x RS422/485 RTC
* Certifications: UL, CE, FCC, RoHS, ATEX, IECEx
* Marine: ABS, BV, DNV GL, LR
* UL Listed US/CAN HazLocClass 1 Division 2, Class 2 Division 2, Class 3 Division 1
* Expansion Slots0 Slot
* Operating Temperature – 30 °C to 65 °C



**• 3/2 shut off valve**

A picture containing camera

Description automatically generated**Specifications**

* Standards ISO 5599-2, ISO 1
* Working pressure min./max. -1/10 bar
* Ambient temperature min./max. -10/50 °C
* Medium temperature min./max. 0/50 °C
* Medium Compressed air
* Nominal flow Qn 1400 l/min
* Operational voltage electronics 24 V DC
* Number of valve positions max. 12
* Protection class with connection IP65
* DC operating voltage 24 V
* Voltage tolerance DC -10% / +10%

**• Filter pressure regulator**

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* A picture containing electronics, different, several, adapter

  Description automatically generated**3/2 directional valve**

**Specifications**

* Standards ISO 5599-2, ISO 1
* Working pressure min./max. -1/10 bar
* Ambient temperature min./max. -10/50 °C
* Medium temperature min./max. 0/50 °C
* Medium Compressed air
* Nominal flow Qn 1400 l/min
* Operational voltage electronics 24 V DC
* Number of valve positions max. 12
* Protection class with connection IP65
* DC operating voltage 24 V
* Voltage tolerance DC -10% / +10%
* **Sensor pressure with display**

**Specifications**

* + - Frame size AS2
    - Switching principle Flow measuring principle: calorimetric
    - Nominal flow Qn min., Standard5 l/min
    - Nominal flow Qn max., Standard1060 l/min
    - Nominal flow Qn min., extended1060 l/min
    - Nominal flow Qn max., extended1590 l/min
    - Compressed air connection G 3/8
    - Certificates CE declaration of conformity, RoHS
    - Working pressure min.0 bar
    - Working pressure max16 bar
    - Min. ambient temperature-20 °C
    - Max. ambient temperature60 °C
    - Min. medium temperature-20 °C
    - Max. medium temperature60 °C
    - Medium Carbon dioxide, Helium, Argon, Compressed air, Nitrogen
    - filter porosity 5 µm
    - Display OLED
    - Flow display unit ft³/s, m³/min, l/sec, m³/h, l/min
    - Pressure display unit psi, bar
    - Temperature display unit °C, °F
    - Electrical connection 5-pin
* A close-up of an object

  Description automatically generated with low confidence**Profile cylinder (0822122009)**

**Specifications**

* StandardsISO 15552
* Piston Ø50 mm
* Hub 320 mm
* Principle double-acting
* Damping pneumatically adjustable damping
* Magnetic pistons Piston with magnet
* Environmental Requirements Industry standard, ATEX optional
* Certificates ATEX optional
* Rod unilateral
* Wiper Standard Industrial Wiper
* Pressure for determining piston forces6.3 bar
* Piston force retracting1035 N
* Piston force extending1235 N
* Ambient temperature min.-20 °C
* Ambient temperature max.80 °C
* Operating pressure min.1.5 bar
* Operating pressure max.10 bar
* Connections G 1/4
* Piston rod threadM16x1.5
* Damping length17 mm
* Attenuation energy15 years
* Weight 0 mm stroke1.06 kg
* Weight +10 mm stroke0.047 kg
* Hub max.2100 mm
* Medium Compressed air
* A close-up of an object

  Description automatically generated with low confidence**Profile cylinder**

**Specifications**

* Standards ISO 15552
* Piston Ø63 mm
* Hub 500 mm
* Principle double-acting
* Damping pneumatically adjustable damping
* Magnetic pistons Piston with magnet
* Environmental Requirements Industry standard, ATEX optional
* Certificates ATEX optional
* Rod unilateral
* Wiper Standard Industrial Wiper
* Pressure for determining piston forces 6.3 bar
* Piston force retracting1765 N
* Piston force extending1960 N
* Ambient temperature min.-20 °C
* Ambient temperature max.80 °C
* Operating pressure min.1.5 bar
* Operating pressure max.10 bar
* ConnectionsG 3/8
* Piston rod thread M16x1.5
* Damping length16.5 mm
* Attenuation energy 27 years
* Weight 0 mm stroke1.42 kg
* Weight +10 mm stroke0.054 kg
* Hub max. 2500 mm
* Medium Compressed air
* A close-up of an object

  Description automatically generated with low confidence**Profile cylinder (0822121011)**

**Specifications**

* Standards ISO 15552
* Piston Ø40 mm
* Hub 500 mm
* Principle double-acting
* Damping pneumatically adjustable damping
* Magnetic pistons Piston with magnet
* Environmental Requirements Industry standard, ATEX optional
* Certificates ATEX optional
* Rod unilateral
* Wiper Standard Industrial Wiper
* Pressure for determining piston forces6.3 bar
* Piston force retracting660 N
* Piston force extending790 N
* Ambient temperature min.-20 °C
* Ambient temperature max.80 °C
* Operating pressure min.1.5 bar
* Operating pressure max.10 bar
* Connections G 1/4
* Piston rod thread M12x1.25
* Damping length19 mm
* Attenuation energy9 J
* Weight 0 mm stroke0.65 kg
* Weight +10 mm stroke0.032 kg
* Hub max.1900 mm
* Medium Compressed air
* **Profile cylinder (0822123011)**

**Specifications**

* StandardsISO 15552
* Piston Ø40 mm
* Hub500 mm
* Principledouble-acting
* Dampingpneumatically adjustable damping
* Magnetic pistonsPiston with magnet
* Environmental RequirementsIndustry standard, ATEX optional
* CertificatesATEX optional
* Rodunilateral
* WiperStandard Industrial Wiper
* Pressure for determining piston forces6.3 bar
* Piston force retracting660 N
* Piston force extending790 N
* Ambient temperature min.-20 °C
* Ambient temperature max.80 °C
* Operating pressure min.1.5 bar
* Operating pressure max.10 bar
* ConnectionsG 1/4
* Piston rod threadM12x1.25
* Damping length19 mm
* Attenuation energy9 J
* Weight 0 mm stroke0.65 kg
* Weight +10 mm stroke0.032 kg
* Hub max.1900 mm
* Medium Compressed air
* A picture containing tool

  Description automatically generated**Compresor PARKSIDE**

**Specifications**

* Mains connection 230 V ~ 50 Hz
* Motor rating W 1800
* Operating mode S1
* Compressor speed min-12850
* Pressure vessel capacity (in liters) 24
* Operating pressure approx. 8 ba
* Theoretical intake capaci-ty (l/min)approx. 270
* Sound power level LWA97 dB(A)
* Uncertainty KWA4 dB
* Protection type IP20
* Weight of the unit in kg 26
* Oil (15W 40) l 0,3
* Max. altitude (above mean sea level) 1000 m
* A picture containing camera

  Description automatically generated**Aventics series AES (R412088223)**

**Specifications**

* Version Bus coupler
* Fieldbus protocol PROFINET IO
* Electrical connection type Plug (male)
* Electrical connection size M12
* Electrical connection number of poles 4-pin
* Electrical connection coding A-coded
* Fieldbus design D-design
* Type Generation 2
* Note Fieldbus connection with I/O functionality
* Min. ambient temperature -10 °C
* Max. ambient temperature 60 °C
* Number of solenoid coils max. 128
* Max. number of valve positions 64
* Operational voltage electronics 24 V DC
* Electronics voltage tolerance -25% / +25%
* Power consumption electronics 0.1 A
* Operating voltage, actuators 24 V DC
* Total current for actuators 4 A
* Protection class IP65
* Cycle time at 256 bits< 1 ms
* Logic/actuator voltage Galvanically isolated
* Diagnosis Short circuit, Undervoltage
* I/O module extension max.10
* Generic emission standard in accordance with normEN 61000-6-4
* Generic immunity standard in accordance with normEN 61000-6-2
* **Valve system series CD10-PI**

A picture containing electronics, different, several, adapter

Description automatically generated**Specifications**

* Standards ISO 5599-2, ISO 1
* Working pressure min./max. -1 ... 10 bar
* Ambient temperature min./max. -10 ... 50 °C
* Medium temperature min./max. 0 ... 50 °C
* Medium Compressed air
* Nominal flow Qn 1400 l/min
* Operational voltage electronics 24 V DC
* Number of valve positions max. 12
* Protection class with connection IP65
* DC operating voltage 24 V
* Voltage tolerance DC -10% / +10%

1. **Principle of functioning**

The *RSTi-EP PACSystem* controls the behaviour of the system and can be programmed using *Proficy Machine Edition(PME).*

The *EDGE controller* is used to gather data, process it, graph it and making it easily accessible.

The *BUS coupler* is used to connect the *PACSystem* to the outputs and inputs of the system as well as transmitting the data to the *EDGE controller*.

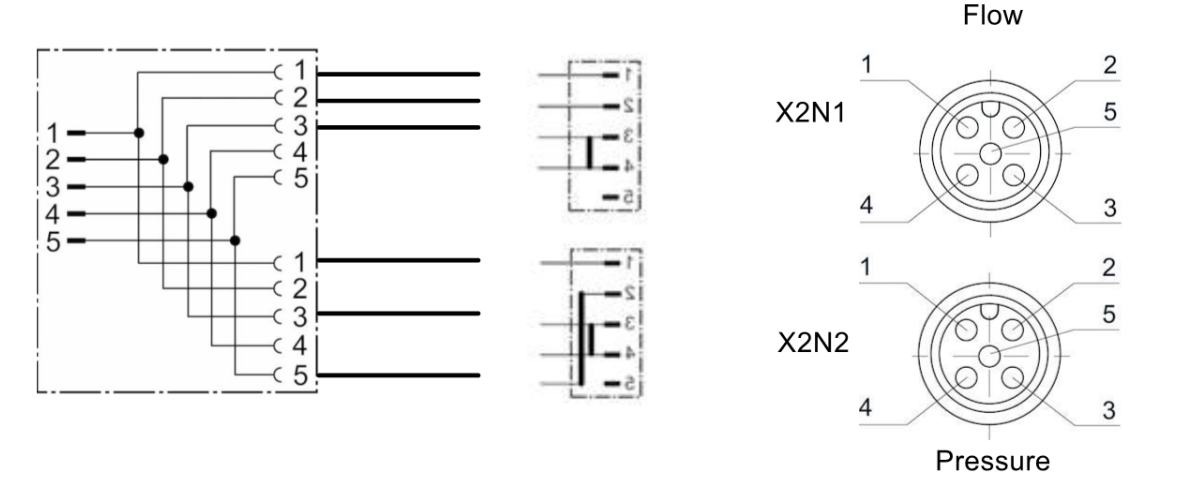
The *valves* controll the flow of air, moving the *pistons*.

The *input*s are *sensors* connected to the extremities of the *pistons* for detection of the *rod's* position.

The *AF2  IO-Link* measures the pressure and flow , transmitting it to the *BUS coupler* and prepares the air by filtering it.

Connection between *PACSystem* and the *BUS coupler* is done via a M12-D to ethernet adaptor cable, from a LAN2 inteface of the pac to the X7E1 port of the BUS and it makes connection between the programed logic and the inputs/outputs (sensors/valves).

Connection between AF2 is done via a M12-A spliter cable connected to the 2AI2M12-E I/O module for flow and pressure measurements.

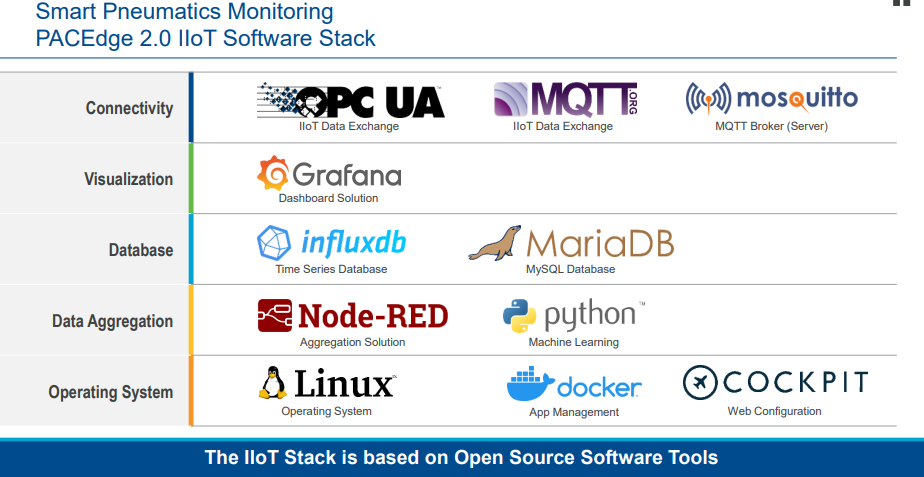


Connection between the BUS coupler and the EDGE controller for analysis is done via a M12-A to USB cable.

The pneumatic cylinders are connected pneumatically via air tubes from the valves connected to the BUS coupler and electrically via magnetic proximity sensors mounted on the cylinders extremities that are connected to the 8DI8M8 digital inputs module.

Connection between a computer and the PACSystem is done by ETHERNET. After connection and adition of present IO-devices the project is ready for upload/download of any programed logic.

PME configuration:

1. Configure the PROFINET Controller
   1. Set IP Address in the Inspector, this is recommended to be on a different subnet to the main network interface (eg controller LAN1 192.168.0.100, PROFINET LAN 192.168.1.100)
   2. Set speed to 100Mbps (some devices don’t work at 1Gbps)
   3. Configure IP Auto-Assign range (eg 192.168.1.101 to 192.168.1.199)
2. Configure the PROFINET IO Device under the PROFINET Controller
   1. Right-click on the PROFINET Controller and select Add IO Device
   2. Choose the correct device form the list of devices or import your own GSDML file
   3. Assign a unique device number (1 to 255)
   4. Give the device a unique device name (all lower case) (or make a note of the default if just using one device)
   5. Note the IP address (auto-assigned from step 1.c above or assign your own IP address in the correct range)
   6. Right-click on the IO device and select Change Module List then add modules as required
   7. Double-click on the device and each of its modules and configure as required
3. Download the configuration to the controller
4. Configure the PROFINET IO device itself using PAC Machine Edition (some IO devices like RSTi-EP can also use their built-in web page to do this but PROFINET allows for the controller to send the configuration to the IO device when it powers up)
   1. Connect the programming computer to the PROFINET Network (ie change Ethernet connections)
   2. Change the programming computer’s IP address and subnet mask to match the PROFINET network
   3. Start PAC Machine Edition in Administrator mode (right-click, run as administrator)
   4. Open the project, then right-click on the PROFINET controller in the target and select “Launch Discovery Tool” to open the PROFINET DCP tool
   5. Choose the correct network in the Connection pull-down (laptops often have more than one network connection) then Refresh Device List
   6. Double-click on a device to display its properties, then enter the correct device name and IP address configuration (click the identify device button to make its LEDs flash so you know you are configuring the correct device)
5. Once the application is downloaded and the PROFINET device is configured then you should be able to monitor inputs and control outputs (you will need to connect the programmer to the controller and change the IP address back to the correct IP address)
6. **IIoT stand integration**

IIoT integration is done using the EDGE controller, having remote acces capabilities it can make the collected data accesibile to other devices, including a remote server used for data storage.