CALMS d.o.o.

Operation manual – CAL-PM-X device

Product:	CALMS CAL-PM-X device
Release date:	February 2026

Contents

1. General notes

1.1. Contact

Central Europe	North America	Nordic Europe
CALMS d.o.o.	CALMS AIR INC.	CALMS Nordic AB
Dolenjska cesta 83	6050-C Highway 14 Gray	Linnégatan 30
1000 Ljubljana,	Court, SC 29645, USA	413 04 Göteborg,
Slovenia	E: info.us@calms.com	Sweden
E: info@calms.com	T: +1-864-705-2571	E: info@calms.com

For technical assistance, please, provide the following information when reaching out:

- Serial number (located on the device label, please refer to section 3.2. Nameplate)
- Description of the issue
- Steps already taken to resolve the issue

1.2. Information regarding installation and use of product

Revision history

Revision	Date	Author	Description of change
4.0.0	02.2026	J. Virant	Version 4.0.0. (new HMI design)

The manual must be read attentively before use. It should be stored with the product and kept accessible whenever required. **By installing or using the product, you confirm that you have read, understood, and agreed to follow the instructions provided.**

1.3.   CALMS general conditions and data protection policy

1.3.1.   General conditions

By using the CALMS website or CALMS online services, the user accepts these general conditions and the CALMS policy of data protection. The provider maintains accurate and up-to-date information; however, all content and data are for informational purposes only. Data collected from CALMS devices depend on installation, configuration, and third-party components. The provider is not liable for errors or inaccuracies resulting from such data.

1.3.2.   Limitation of liability

The provider is not responsible for any temporary interruption of service, data inaccuracy, or damages caused by the use or inability to use website information. Linked websites or external data sources are beyond the provider's control; therefore, no responsibility is assumed for their content or data protection practices.

1.3.3.   Personal data protection

Personal data are processed in accordance with the EU **General Data Protection Regulation (GDPR)** and the **Personal Data Protection Act (ZVOP-1)**. Data may be collected when the user registers, subscribes, or interacts with CALMS applications. The provider implements technical and organizational measures to prevent unauthorized access, alteration, loss, or misuse of personal data. Users may withdraw consent or request data access, modification, or deletion at any time by contacting info@calms.com.

1.3.4.   Cookies

The CALMS website uses cookies to ensure proper functionality, analyze usage, and improve user experience. Users can disable cookies in their browser settings, but some website functions may be limited. Third-party cookies may include integration with platforms such as Facebook, Twitter, or Google.

1.3.5.   Policy of Protection of Business Data

The CALMS web application is a cloud-based service for compressed air leak and energy management. All customer data are password-protected and stored in a secure cloud database. Data may be deleted at any time by an authorized customer user; deleted data are permanently removed and cannot be restored. This policy governs the relationship between the provider (CALMS) and its direct customers and does not apply to relationships between partners and their end Users.

1.3.6.   Privacy policy

Personal data are collected only when users subscribe to newsletters, purchase CALMS products, or register for services. Collected data (name, email, company) are used for communication, reporting, and technical support. Provider stores data only for as long as necessary to provide the subscribed service. Users may unsubscribe or withdraw consent at any time.

1.3.7.   Certification

Certificates:

- Low voltage directive 2014/35/EU
    - https://docs.calms.com/uploads/certificates/calms-pm-x-ul-ce-certificate-lv.pdf
- Electromagnetic compatibility directive 2014/30/EU
    - https://docs.calms.com/uploads/certificates/calms-pm-x-ul-ce-certificate-emc.pdf

Product has applied next standards:

- EN 61010-1 ed.2:2011
- EN 61326-1 ed.3:2022

2. Safety

2.1.   Intended use

This manual is intended to provide guidance for the installation, operation, and maintenance of the CALMS CAL-PM-X device. It is provided for informational purposes and is subject to change without notice.

The CALMS CAL-PM-X device (will be referred to as CAL-PM-X) is an intelligent controller designed to optimize and coordinate the entire compressed air system. It provides full control over compressor operation, pressure stability, and energy performance — ensuring safe, reliable, and efficient system management.

The CAL-PM-X is intended to be used as a Compressed Air Energy Management System and central controller for compressor stations. It is designed to:

- Monitor and optimize compressed-air system performance (pressure, flow, power, efficiency KPIs).
- Coordinate and control the operation of up to 2 / 4 / 8 positive-displacement compressors (fixed-speed, VSD, or multi-step), and related peripheral equipment such as dryers and flow controllers.
- Maintain stable system pressure within a user-defined band while improving energy efficiency and system reliability through optional EMCS control functions.
- The CALMS CAL-PM-X system is not only designed for compressor control, but also supports optimization of the compressed air distribution network and end-use consumption. This is achieved through connected CFC units (CALMS Flow Controllers), which enable pressure and flow regulation at critical points in the system, improving efficiency and reducing unnecessary air losses.

There are four versions of the CAL-PM box, each defined by the number of compressors it can manage. The CAL-PM-2 supports connection of up to two compressors, the CAL-PM-4 up to four compressors, the CAL-PM-8 up to eight compressors and CAL-PM-16 up to sixteen compressors. This is reflected in the device name, where X indicates the maximum number of compressors that can be connected.

The CALMS CAL-C-IM compressor interface modules (will be referred to as CAL-C-IM) enable communication with the main CAL-PM-X device and interfaces directly with the compressors.

The **CAL-C-IM module** is a dedicated compressor interface used with both VSD and ON/OFF compressors. It is installed inside each compressor's electrical cabinet and connected to the CAL-PM-X main cabinet via an industrial ethernet cable. The module gathers key compressor status and measurement signals (including power data) and sends control commands back to the compressor, enabling reliable monitoring and coordinated control through the CAL-PM-X system.

User manual is generally written and can be used for all CAL-PM-X types. **Differences are explicitly explained in sections where types differ**.

2.2.   Target group and personnel

This manual is intended for the following target groups:

- **Maintenance personnel** responsible for compressed air systems and associated equipment
- **Service technicians** involved in installation, commissioning, and servicing of the device
- **System integrators** responsible for integrating the device into existing monitoring or control systems
- **Qualified technical personnel** with experience in industrial electrical systems and compressed air installations.

The device shall be installed, commissioned, and serviced **only by qualified and trained personnel by CALMS** who are familiar with the devices and its working.

2.3.   Safety instructions and notices

Please read this manual carefully and completely before installing, operating, or maintaining the device. Follow all safety notes, warnings, and instructions to ensure safe and proper use.The manufacturer cannot be held liable for any damage or injury resulting from failure to comply with the instructions in this manual.

Tampering with the device in any way not described or authorized in this manual will void the warranty and release the manufacturer from any liability.

This product is designed and intended exclusively for the application described in this manual. Use in any other context, or in conditions not specified by the manufacturer, constitutes improper handling and will also void the warranty. The manufacturer shall not be responsible for any consequences arising from improper use.

This manual must be read and understood by all personnel involved in the installation, operation, or maintenance of the device. It should be stored together with the product and made available to users as needed.

When handling, operating, or maintaining this product, authorized personnel must follow safe working practices and comply with all applicable health and safety regulations. If raised platforms are required to provide access to the CAL-PM-X device they must not interfere with normal operation or obstruct access. Platforms and stairs should be of grid or plate construction with safety rails on all open sides. Incorrect operation or maintenance may create dangerous situations and could result in personal injury or equipment damage. The manufacturer cannot foresee every circumstance that may pose a hazard. If users apply procedures, equipment, or methods not specifically recommended by the manufacturer, they are responsible for ensuring that such use does not damage or compromise the product's safety, and that it poses no risk to people or property.

To ensure safe operation and long-term reliability of the device, the following conditions must be met:

- The device should be operating in a dry and electrically safe environment, where the electrical conditions don`t pose a threat to people or equipment present.
- Exposure to moisture, condensation or corosive athmospheres is not permitted.

- The device must **not** be operated or serviced in environments with:
    - Water or high humidity
    - Risk of liquid ingress
    - Electrically conductive or flammable substances
    - Unstable or non-compliant power sources

⚠ **Ignoring the warnings can lead to injury and/or cause serious damage to the people involved!**

|	
🛠	**Installation, maintenance, and repair** of the CAL-PM-X device must be carried out **only by qualified personnel**. Improper handling may cause system malfunction, equipment damage, or personal injury.
⚠	**Disconnect the electrical supply** before installation, maintenance, or repair. Failure to do so may result in **electric shock**.
🎛	The system operates under **high-pressure compressed air**. Always depressurize the system before service. Use appropriate **PPE** and follow local safety regulations.
🛑	Before powering up the device, **verify all electrical connections** are correct and secure to avoid malfunction or damage.
⚠	Operate the device only within the specified **temperature range**. Exceeding limits may cause permanent damage or unreliable operation.

3. Product overview

3.1. Device overview

CAL-PM-X device

Position number	Description
1	Locks on CAL-PM-X device
2	Sticker of the CAL-PM-X device
3	HMI
4	Housing of the CAL-PM-X device

CAL-C-IM modules
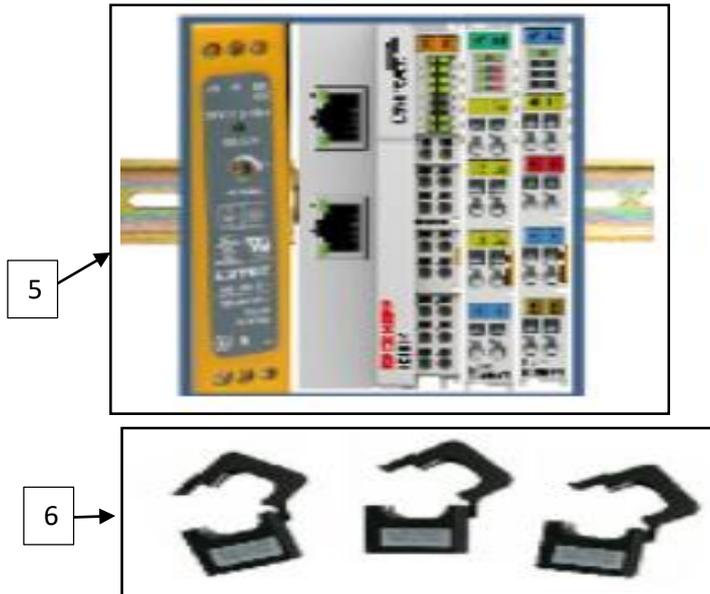
Position number	Description
5	CAL-C-IM modules
6	CT transformers

3.2. Nameplate
Located on the inside of the cabinet of the CAL-PM-X device
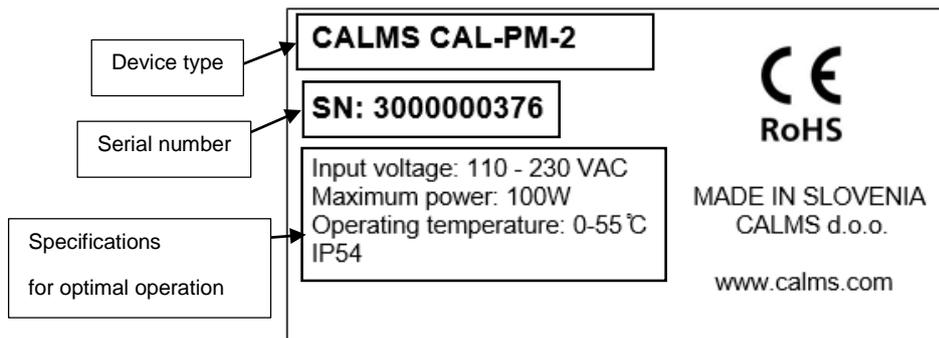
3.3. Scope of supply

Illustration	Number	Description
	1	CAL-PM-X device
	2	CAL-C-IM (with current transformers)
	3	Data sheet
	4	Electrical schematic

4. Technical data

Specification	CAL-PM-2	CAL-PM-4	CAL-PM-8	CAL-PM-16
S-PLC Controller	Processor Arm® Cortex®-A53, 1.2 GHz micro SD 16GB, internal memory 1GB LPDDR4 RAM6	Processor Arm® Cortex®-A53, 1.2 GHz micro SD 16GB, internal memory 1GB LPDDR4 RAM6	Processor Arm® Cortex®-A53, 1.2 GHz micro SD 16GB, internal memory 1GB LPDDR4 RAM6	Processor Arm® Cortex®-A53, 1.2 GHz micro SD 16GB, internal memory 1GB LPDDR4 RAM6
Analog Inputs	4 (4-20mA)	8 (4-20mA)	8 (4-20mA)	8 (4-20mA)
Digital inputs	8 (24VDC)	8 (24VDC)	8 (24VDC)	8 (24VDC)
Digital outputs	4 (relay output terminal, 125VAC/30VDC, 0.5A AC/2A DC)	4 (relay output terminal, 125VAC/30VDC, 0.5A AC/2A DC)	4 (relay output terminal, 125VAC/30VDC, 0.5A AC/2A DC)	4 (relay output terminal, 125VAC/30VDC, 0.5A AC/2A DC)
Analog outputs	-	-	-	-
Communication Protocol	Modbus TCP	Modbus TCP	Modbus TCP	Modbus TCP
Interfaces	3x Ethernet 10/100Mbit/s (2x network adapter)	3x Ethernet 10/100Mbit/s (2x network adapter)	3x Ethernet 10/100Mbit/s (2x network adapter)	3x Ethernet 10/100Mbit/s (2x network adapter)
UPS	1-second UPS (for 1 MB persistent data)	1-second UPS (for 1 MB persistent data)	1-second UPS (for 1 MB persistent data)	1-second UPS (for 1 MB persistent data)
Max. number of compressors	2	4	8	16
WEB Management	Yes	Yes	Yes	Yes
EMCS, CFC	Yes (optional)	Yes (optional)	Yes (optional)	Yes (optional)
Visualization	10" Touch HMI	10" Touch HMI	10" Touch HMI	10" Touch HMI
Logging interval	5sec (configurable)	5sec (configurable)	5sec (configurable)	5sec (configurable)
CALMS upload interval	5min (configurable)	5min (configurable)	5min (configurable)	5min (configurable)
Cloud connection	3G/4G or LAN (optional)	3G/4G or LAN (optional)	3G/4G or LAN (optional)	3G/4G or LAN (optional)
Operating range	0-50°C 32-131F	0-50°C 32-131F	0-50°C 32-131F	0-50°C 32-131F
Power supply	100 - 240VAC 50-60Hz	100 - 240VAC 50-60Hz	100 - 240VAC 50-60Hz	100 - 240VAC 50-60Hz
Size	H210 x W500 x L500 [mm] H8,26 x W19,69 x L19,69 [inches]	H210 x W500 x L500 [mm] H8,26 x W19,69 x L19,69 [inches]	H210 x W500 x L500 [mm] H8,26 x W19,69 x L19,69 [inches]	H210 x W500 x L500 [mm] H8,26 x W19,69 x L19,69 [inches]
Materials	Enclosure: Steel cabinet, Cable Entry ICOTEK	Enclosure: Steel cabinet, Cable Entry ICOTEK	Enclosure: Steel cabinet, Cable Entry ICOTEK	Enclosure: Steel cabinet, Cable Entry ICOTEK
Approvals	CE	CE	CE	CE
Mounting	Mast or wall mounting	Mast or wall mounting	Mast or wall mounting	Mast or wall mounting

5. Transport and storage

The device shall be transported **in its original packaging** or in equivalent protective packaging that provides adequate protection against mechanical shock, vibration, and electrostatic discharge. During transport and storage, the device must be protected from:

- Moisture and condensation
- Dust and dirt
- Direct sunlight
- Corrosive or chemically aggressive environments

The device shall be stored only in **dry, clean, and temperature-controlled indoor environments**.Permissible storage temperature and humidity ranges specified in the technical data must be respected.

6. Mechanical installation

The mechanical installation must be done by authorized personnel trained by CALMS or qualified technical personnel.

The CAL-PM-X device should be mounted in such a location as to allow operational and maintenance access without obstruction or hazard and to allow clear visibility of indicators at all times.

After opening the package the user is able to see the CAL-PM-X device, the CAL-C-IM modules, CT transformers and the appropriate documentation (data sheet, test certificate and electrical schematic). Alongside is the appropriate wall mounting kit for mounting the device.

The CAL-PM-X device is intended to be mounted on a wall and the CAL-C-IM modules are meant to be mounted inside the compressors electrical cabinets.

Below are described the steps how to correctly install the wall mounting brackets on the CAL-PM-X device and how to mount the CAL-C-IM modules inside the compressors. Each CAL-PM-X device is supplied with a wall mounting bracket kit, which is delivered inside the cabinet and the CAL-C-IM modules come already on a DIN rail.

6.1.   Mounting the CAL-PM-X device
1.   **Take the mounting plate out of the cabinet**

First, remove the mounting plate from the cabinet to access the bracket mounting holes. You do this by:

- Using a 13 mm wrench (SW13), loosen and remove the two nuts securing the grounding conductor to the cabinet door and the cabinet (see *Figure 1*).
- Disconnect the wires from HMI1: +, –, PE, and LAN.
- Remove the covers from the wire duct channels
- Remove the 4 nuts securing the mounting plate to the cabinet and lift the mounting plate out of the cabinet.

Figure 1 : Taking the mounting plate out of the cabinet

2. **Install the brackets on the back of the cabinet**

- Pull out the rubber pins that are in the holes intended for the brackets (see *Figure 2*)

Figure 2: Rubber pins on the cabinet

- Place the bracket on the hole and screw it in with the screws provided (SW13,TX30). Make sure they are facing the right way so that the flat surface does not stick out over the edge of the cabinet. (see *Figure 3*)
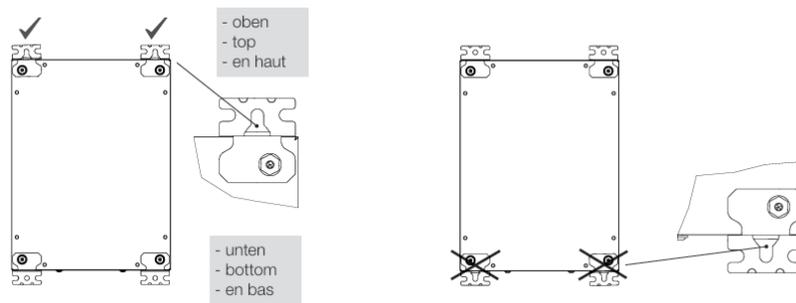

Figure 3: Instructions

- The finished look of the installed brakets is shown on *Figure 4.*

Figure 4: Final look of the mounted brackets

- How the cabinet looks from the inside after the installed brackets is shown on *Figure 5*

Figure 5: Final look of the brackets from inside the cabinet

3. Return the mounting plate to the cabinet
Place the plate back into the cabinet:
- 4 notches on the plate fit onto the screws in the cabinet. Screw it back into the cabinet with the four nuts that were removed earlier.
- Re-ground the cabinet and its door.
- Connect the HMI1 (connect the +, -, PE, and LAN wires).
- Return the covers to the cable duct.

4. Attaching the cabinet to the wall
Depending on the orientation of the brackets, you will need to use 1 or 2 screws (see *Figure 6*).
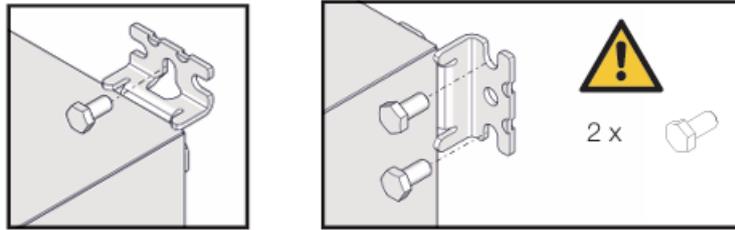
Figure 6: Attaching the cabinet to the wall

Once the cabinet is mounted on the wall, cover the brackets with the plastic covers that came with it.

6.2 CAL-C-IM mechanical installation

First, check whether there is enough space on the mounting plate inside the compressor to install the module. Depending on, if there is or isn`t free space inside the compressor electrical cabinet, there are two different ways on how to mount the CAL-C-IM modules described below.

6.2.1. Mounting the CAL-C-IM with existing DIN rail

If there is insufficient space on the existing DIN rails, the CAL-C-IM can be installed using the DIN rail supplied with the unit and mounted inside the compressor enclosure.

1. Select a suitable installation location, ensuring that the module does not interfere with other operations, such as opening or closing doors or access panels.
2. Remove the end brackets on the modules to expose the mounting holes in the DIN rail.
3. Position the CAL-C-IM in the selected location and secure the DIN rail using two self-tapping screws through the holes at both ends of the rail.
4. After installation, reinstall the end brackets to prevent the module from sliding off the DIN rail.

An example of the completed mounting of the CAL-C-IM modules is shown on *Figure 7.*
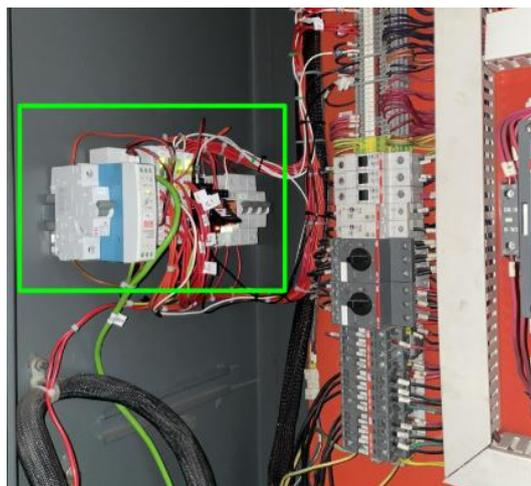
Figure 7: Example of a mounted CAL-C-IM inside a compressor

6.2.2. Mounting CAL-C-IM on existing DIN rail in compressor

Remove the power supply and fuses from the DIN rail by releasing the plastic or metal retaining clips using a screwdriver.

Before removing the I/O modules, release the retaining mechanism of the first module (EK1101) by turning the small orange wheel on its left side like shown on *Figure 8*.
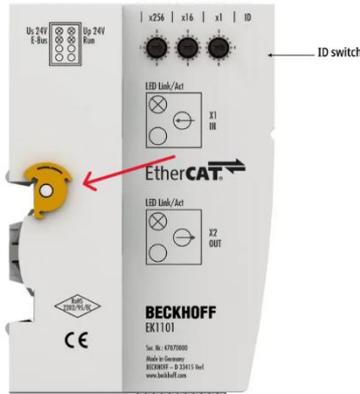
Figure 8: One of the modules on the CAL-C-IM modules (EK1101)

Then remove the I/O modules one by one by lifting the orange release latches on each module, shown on *Figure 9*.

Figure 9: Removing the I/O modules from the DIN rail

After that, all components **must be reinstalled in the same order** on the DIN rail inside the compressor. If there is space around it, an end piece must be added to fix the CAL-C-IM and prevent movement along the DIN rail. An example of this type of mounting of the CAL-C-IM modules is shown on *Figure 10.*
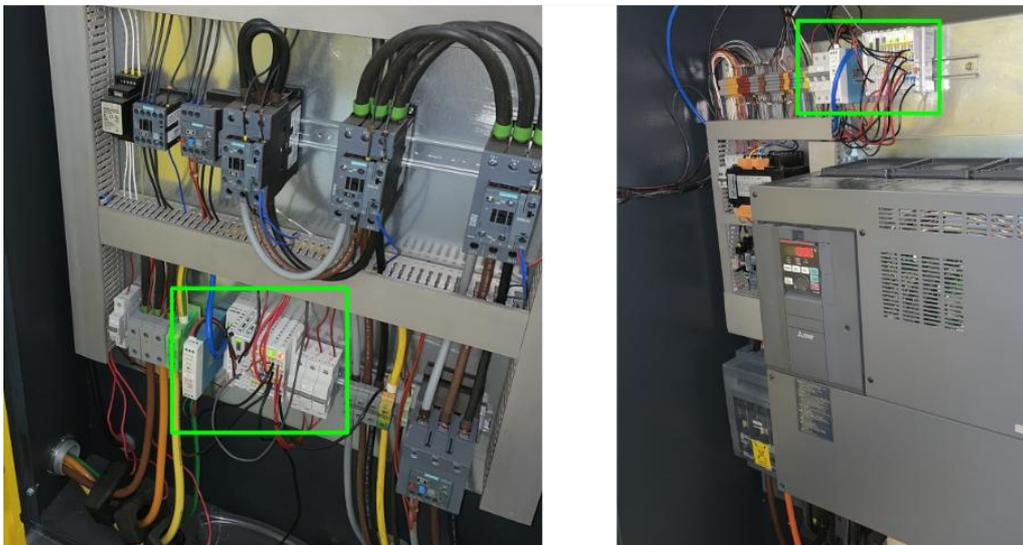
Figure 10: Example of mounting the CAL-C-IM modules on an existing DIN rail inside the compressor

7. Electrical installation

⚠️ **Hazardous voltage (110–230 VAC) is present inside the device. Contact with live components may result in electric shock, serious injury, or death. Disconnect the device from the mains supply before opening the enclosure or performing any installation or maintenance work.**

Electrical installation must be performed only by qualified technical personnel (electricians) or authorized personnel trained by CALMS with understanding of the workings of the CAL-PM-X device.

The device must be operated at the supply voltage and frequency for which it is designed. It is powered 110-230VAC, 50-60 Hz.

For each CAL-PM-X device a customized electrical schematic is made and sent to the customer. The electrical schematic shows clearly and in detail how to electrically install the device inside the compressor station.

7.1. Electrical components inside the CAL-PM-X device
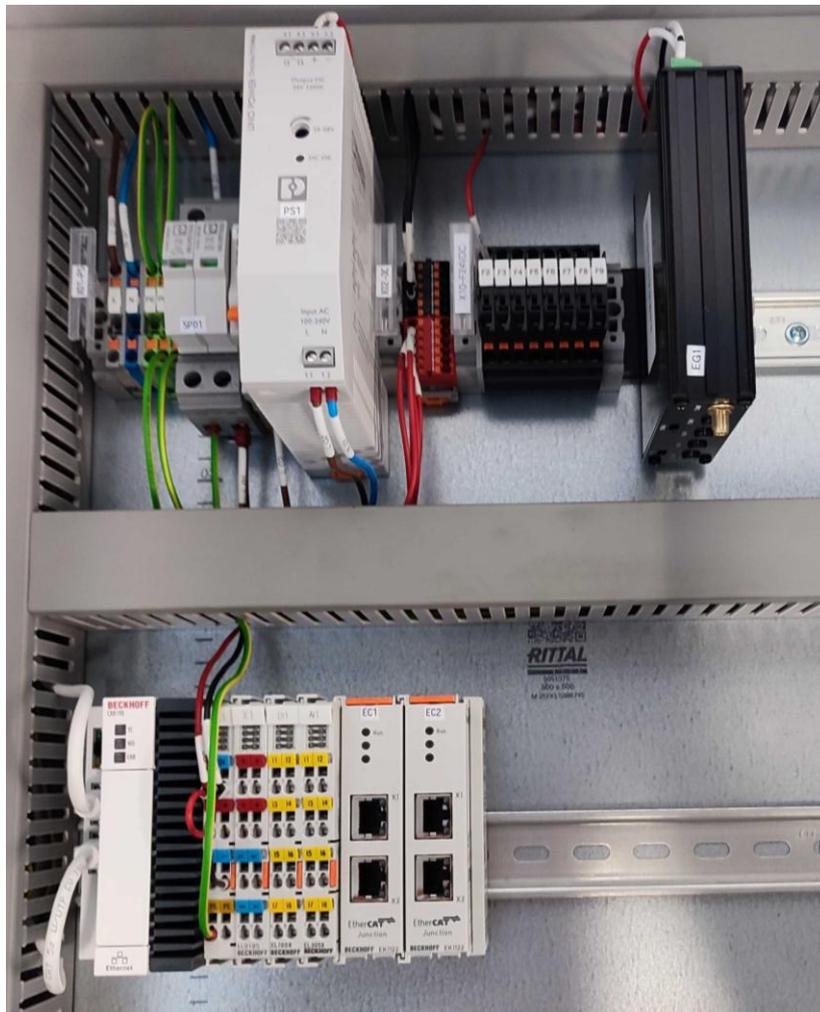
Figure 11: Inside of the CAL-PM-X device

Component label	Description
X01-PS	Power supply terminal block (L,N,PE)
SPD1	Surge protection device
F1	Fuse (C6)
PS1	DC Power supply
X02-DC	24VDC and 0VDC terminal block
X10-F24VDC	F2-F9 fuse terminal block
EG1	CAL-EDGE-0 monitoring device
PLC1	Beckhoff PLC with I/O modules

7.2. Powering on the device – procedure

The CAL-PM-X has all the electrical components already prewired inside the cabinet. It is powered with 110-230VAC. To power on the device a power supply cable, which is to be provided by the customer, has to be run to the cabinet. The **live wire (L) has to be connected to the terminal labeled L on the terminal block X01-PS inside the CAL-PM-X device. The neutral wire (N) has to be connected to the terminal labeled N on the terminal block X01-PS inside the CAL-PM-X device. The protective earth wire (PE) has to be connected to the terminal labeled PE on the terminal block X01-PS inside the CAL-PM-X device.**

After the wires have been correctly connected to the inside of the device, it can be powered on by switching the fuse labeled **F1 inside the CAL-PM-X device.**
After powering on all the main components, the DC power supply (labeled **PS1**), CAL-EDGE-0 device (labeled **EG1**) an the Beckhoff PLC (labeled **PLC1**) inside the CAL-PM-X are powered on and should indicate no errors (red LEDs.)

The electrical schematic on how to properly wire the power supply wires to the device is shown below on *Figure 12.*

Figure 12: Power supply of the CAL-PM-X device

7.3. Powering off the device – procedure

To power off the device, first make sure there are no disconnected live wires inside the CAL-PM-X device. After if the device is controlling any of the compressors in the station remotely, make sure the control mode is switched on

each compressor to **LOCAL.** To do that switch the **LOCAL/REMOTE SWITCH,** that has previously been to REMOTE to **LOCAL.**

Finally, switch off the fuse labeled **F1 inside the CAL-PM-X device, ensuring all the components have been powered off.**

7.4. Restarting the device – procedure

Restarting the device means to perform power cycle. To restart the device make sure the following has been done:

- The device was successfully powered off, as described in the section *7.2. Powering off the device –*

procedure;

- Time of 30-40 seconds has passed before powering on the device again.

The device is then powered back on as described in the section *7.1. Powering on the device – procedure.*

7.5. Powering on the CAL-C-IM modules

After following the instructions from section *6.2.1 Mounting the CAL-C-IM with existing DIN rail* or *6.2.2. Mounting CAL-C-IM on existing DIN rail in compressor* and mechanically installing the modules inside the compressors, follows the electrical installation of the modules.

The CAL-PM-X and CAL-C-IM modules must be connected according to the attached electrical diagram, and the specified cable type must be used (or good alternative).

The cables used to connect the CAL-PM-X device and the modules are ethernet cables and they must not exceed 100 m in length. One end of the ethernet cable is connected to the module **EK1101 of the CAL-C-IM** module and the other to the module in the **CAL-PM-X device labeled ECx.**

The interface module is to be powered from the compressor control transformer. Connect the live conductor to the **F1 (C6) fuse on the module**, and connect **neutral** and **protective earth** directly to the power supply terminals. **Always supply the module via the control transformer** (see *Figure 13*). The control transformer provides a **stable, isolated AC source with a proper return**, protecting the module and ensuring reliable operation.
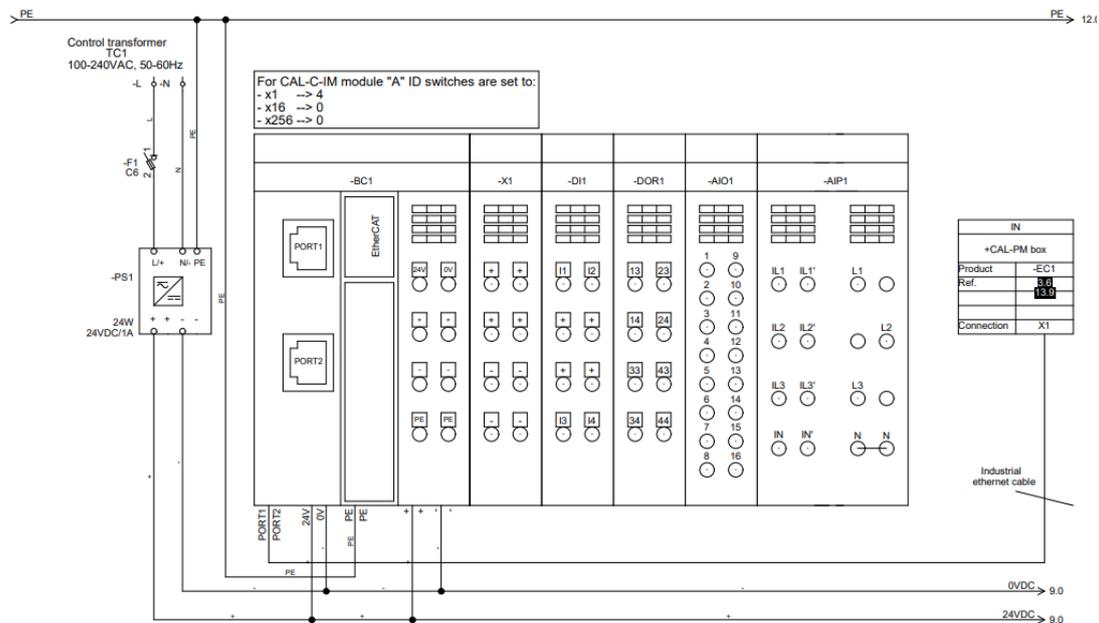
Figure 13: Powering on the CAL-C-IM modules

To then power on the modules, carefully switch the fuse **F1 on the modules.**

18

8. Commissioning

8.1.   Initial commissioning

Mechanical and electrical installation of the device are complete. User must be sure LTE coverage is available at the installation site of the device. User must make sure the device has been installed according to the installation guidelines mentioned in section *6. Mechanical installation* and *7. Electrical installation.*

8.2.   Connecting the device to the Internet

To ensure the data the CAL-PM-X device collects is being sent to the CALMS platform, a descent connection must be provided. The device can connect to the Internet in two ways:

1.   Using a SIM card provided by CALMS:

The SIM card is already in inserted and enabled in the device. To connect the device to the Internet the antenna provided by CALMS must be connected to the SMA connector labeled "**ANT1**" on the CAL-EDGE-0 device inside the CAL-PM-X device. The CALMS devices all have cellular modems inside that provide 3G/4G frequencies it can use.

The use of custom SIM card is possible, but is not recommended. CALMS cannot offer support in case of connectivity issues. Also, installing the SIM card will have to be done by the user of the device. For more information, visit the documentation page for the CALMS devices on this link: *CAL-EDGE-0 documentation*

2.   Using your own LAN:

If a mobile (4G) connection is not available or you prefer not to use it, you can connect the CAL-PM-X to the customer's internal LAN using the **CAL-PM-LAN add-on**.

For more information refer to the section *8.4.3. CAL-PM-LAN.*

8.3.   Standard connection signals to the device

The main component of the CAL-PM-X device is the PLC, which runs all control logic. It is complemented by modular I/O and communication cards, including digital input/output modules, analog input/output modules, and optional communication interfaces such as MODBUS, PROFIBUS, and PROFINET.

8.3.1 Digital signals connection

Signals are connected on the **digital inputs module on the main PLC inside the CAL-PM-X device.** Usually it is used to connect dryer status signal (operating, fault) or any other equipment (condensate drain alarm,…) like shown in the *Figure 14*.
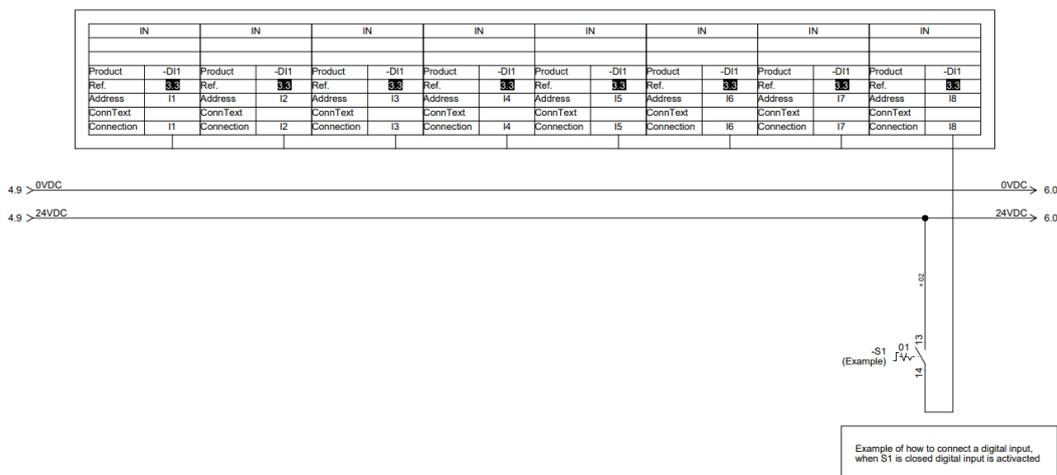
Figure 14: Digital signals connection example

Each input function is assigned and configured through the HMI setup pages.

8.3.2. Analog 4-20 mA signals connection

Analog input terminals allow continuous measurement signals to be connected to the CAL-PM-X device and transmitted to the CALMS Cloud. They support standard **4–20 mA** sensor loops and are typically used for system pressure, flow, dew point, temperature, or other process measurements. Each analog input is assigned, scaled, and configured through the HMI setup pages.
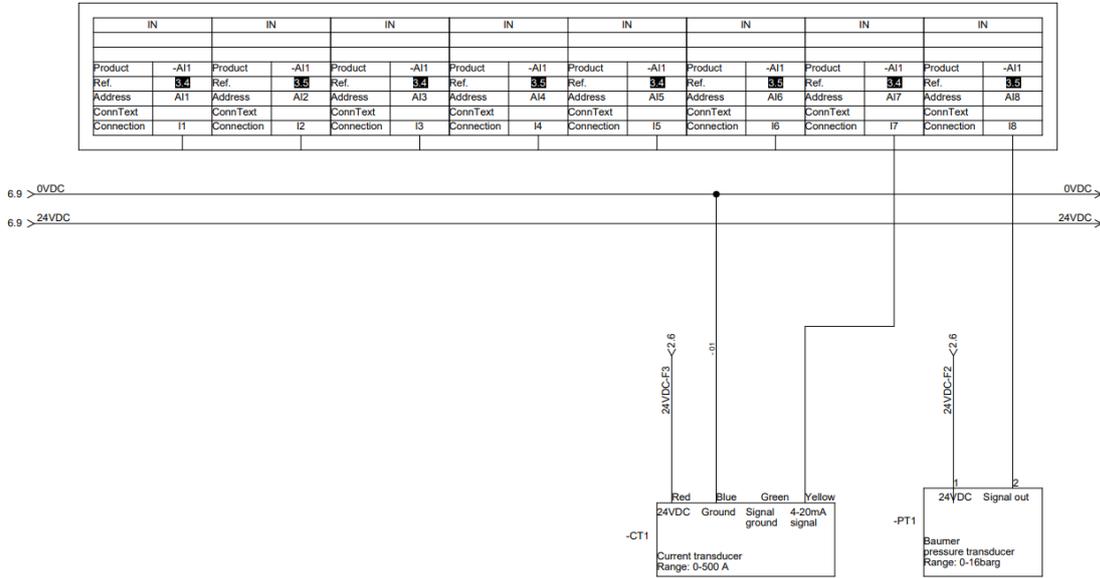

Figure 15: Analog signals connection example

8.3.3. CAL-C-IM connection to the compressors

The digital input terminal (DI1) on the CAL-C-IM is used to connect compressor feedback signals. These inputs are predefined, and each signal must be wired to its dedicated digital input (see *Figure 16*):

- **DI1:I1** → Compressor running
- **DI1:I2** → Compressor loaded
- **DI1:I3** → Compressor in trip
- **DI1:I4** → Compressor in remote mode
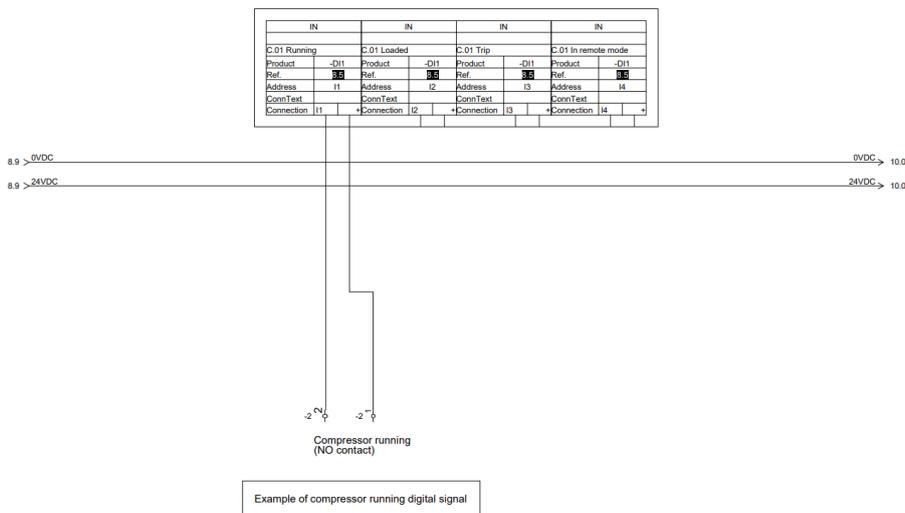
Figure 16: Digital signals of the CAL-C-IM connection example

The digital output terminal (DOR1) on the CAL-C-IM is used to provide remote control commands to the compressor. The outputs are predefined as follows:
- **DOR1: 33–34** → Remote load / unload command
- **DOR1: 43–44** → Control system ready signal

The **AIO1 terminal** on the CAL-C-IM is a combined analog I/O module used for advanced compressor monitoring and control. It provides **2 × analog inputs (4–20 mA)** for signals such as vibration or other compressor status measurements, and **1 × analog output (4–20 mA)** typically used for **VSD speed / analog remote control** of the compressor. The module uses a **high-density 16-terminal block**, so wiring is more compact and requires extra care; always follow the electrical schematic when connecting sensors and the control signal (see *Figure 17*).
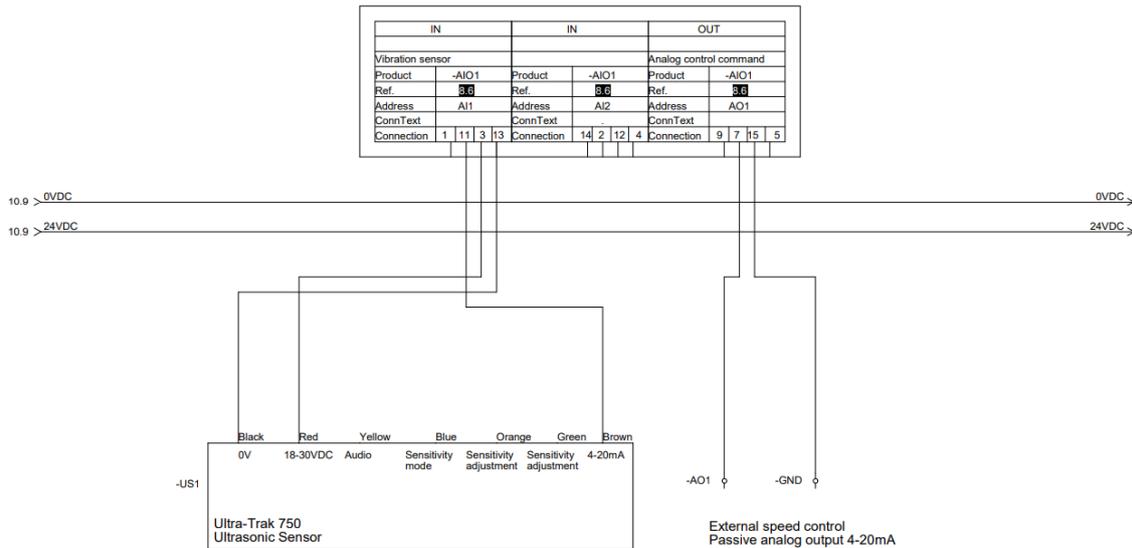
Figure 17: Analog inputs/outputs module connection example

The **AIP1 terminal** is used for **three-phase power measurement** of the compressor. It measures voltage and current on all three phases and calculates key electrical parameters such as **active power, apparent power, reactive power, and power factor**. This data is essential for efficiency calculations, load/unload detection, and advanced energy monitoring within the CALMS platform (see *Figure 18*).

The **current transformers** provide the AIP1 module with the necessary current signals for each phase. They are installed on the compressor's three supply lines and connected to the AIP1 inputs.
- CTs must be installed in the **correct orientation** and on the **appropriate phase conductors**.
- Proper CT wiring is critical for accurate power measurement and correct system behavior.

Note: Phase Sequence and CT Alignment for AIP Power Analyzer
Ensure that the phase sequence (L1–L2–L3)
is correct before powering the AIP power analyzer

Additionally, make sure that the current transformers (CTs) are connected
in the same phase sequence as the corresponding phase voltages

Incorrect phase rotation or CT-phase mismatch can result
in inaccurate power and energy measurements.

IN			IN			IN			IN			IN		
Product		-AIP1	Product		-AIP1	Product		-AIP1	Product		-AIP1			
Ref.		8.7	Ref.		8.7	Ref.		8.7	Ref.		8.7			
Address		AIP-L1	Address		AIP-L2	Address		AIP-L3	Address		AIP1-IN			
ConnText			ConnText			ConnText			ConnText					
Connection	IL1	IL1'	L1	Connection	IL2	IL2'	L2	Connection	IL3	IL3'	L3	Connection	IN	IN'	Connection	N	N

Figure 18: Power analysers on the CAL-C-IM connection example

8.4. Optional add-ons to the device

Add-ons extend the standard capabilities of the CAL-PM-X and can be supplied either **together with the device** or **retrofit later**. When ordered with the CAL-PM-X, add-ons are factory prewired and preconfigured for faster commissioning. If ordered separately, they can be integrated into an existing system by following the dedicated installation guide. Depending on the application, some add-ons may require **additional site-specific information** (e.g., network settings, external system parameters, or signal lists) to ensure correct configuration and operation.

8.4.1. CAL-485-PM for MODBUS communication

This add-on allows easy RS485/MODBUS RTU communication with external devices.

- **MODBUS Master:** Connect MODBUS RTU sensors or meters to CAL-PM-X via **RS485 2-wire half-duplex**. The CAL-PM-X acts as the master and reads data from the sensors.
- **MODBUS Slave:** Connect CAL-PM-X to an external control system (e.g., SCADA, PLC, BMS) via **RS485 2-wire half-duplex**. In this mode, CAL-PM-X acts as a slave and provides data to the external system.

Wiring / terminals

- The add-on is **pre-wired to terminal block X07-MB**.
- **Terminals 1–3:** MODBUS **Master** connection (supports up to **5 devices**, expandable if required).
- **Terminals 4–6:** MODBUS **Slave** connection (contact CALMS support for the available signal/register list).

8.4.2. Digital and analog I/O add-ons

All add-ons increase the available number of respective inputs or outputs on the CAL-PM-X. Each CAL-PM-X can be expanded up to:

- **AI:** 24
- **DI:** 24
- **AO:** 16
- **DO:** 24

Additional functions may be enabled depending on the project.

- **Ordered with the CAL-PM-X:** add-ons are factory **prewired and preconfigured** for quick installation.
- **Ordered later:** add-ons can be retrofitted, but a dedicated integration guide must be followed to install and commission them on an existing device.

8.4.3. CAL-PM-LAN router

If a mobile (4G) connection is not available or you prefer not to use it, you can connect the CAL-PM-X to the customer's internal LAN using the **CAL-PM-LAN add-on**.

Important notes:

- LAN setup requires coordination with the customer's IT team, which **may extend installation/commissioning time**.
- Each site has its own IT/security policies, so network access and approval procedures can vary.

8.4.4. CAL-PROFINET and CAL-PROFIBUS

These add-ons allow the CAL-PM-X to communicate with external systems (such as SCADA, BMS or any other equipment or device) using **PROFIBUS** or **PROFINET**.

- **Ordered together with CAL-PM-X:** the interface is factory **prewired and preconfigured** for fast, plug-and-play installation.
- **Ordered later:** the add-on can be installed on an existing device, but a dedicated integration guide must be followed to retrofit and configure it correctly.

8.4.5. CAL-OPC-UA gateway

This add-on allows the CAL-PM-X to connect to external systems (such as SCADA or BMS) via the **OPC UA** protocol. Depending on the project, additional OPC UA functions can be enabled.

- **Ordered together with CAL-PM-X:** the add-on is factory **prewired and preconfigured** for quick, plug-and-play installation.
- **Ordered later:** it can be retrofitted to an existing device, but a dedicated integration guide must be followed to install and configure it correctly.

www.calms.com

9. Operation

For proper operation of the device, a configuration procedure must be done both on the HMI of the CAL-PM-X device on the web interface – CALMS web application. This manual does not provide detailed instructions for operating the HMI nor the CALMS application itself. It describes only the configuration and use of the CAL-PM-X device within the application. It is assumed that the reader has basic knowledge of the application's operation. For more detailed instructions on the HMI visit the following link: *HMI User manual*

9.1. HMI – Human Machine Interface on the CAL-PM-X device

The HMI (Human–Machine Interface) is the operator's main access point to the CAL-PM-X system. It provides a clear, real-time overview of key process data—such as pressure, flow, power, compressor status, and alarms—and allows authorized users to adjust control parameters, schedules, and operating modes directly on the device (see *Figure 19*). Operator, Manager, and Admin access levels ensure that routine operation is simple, while critical settings remain protected.
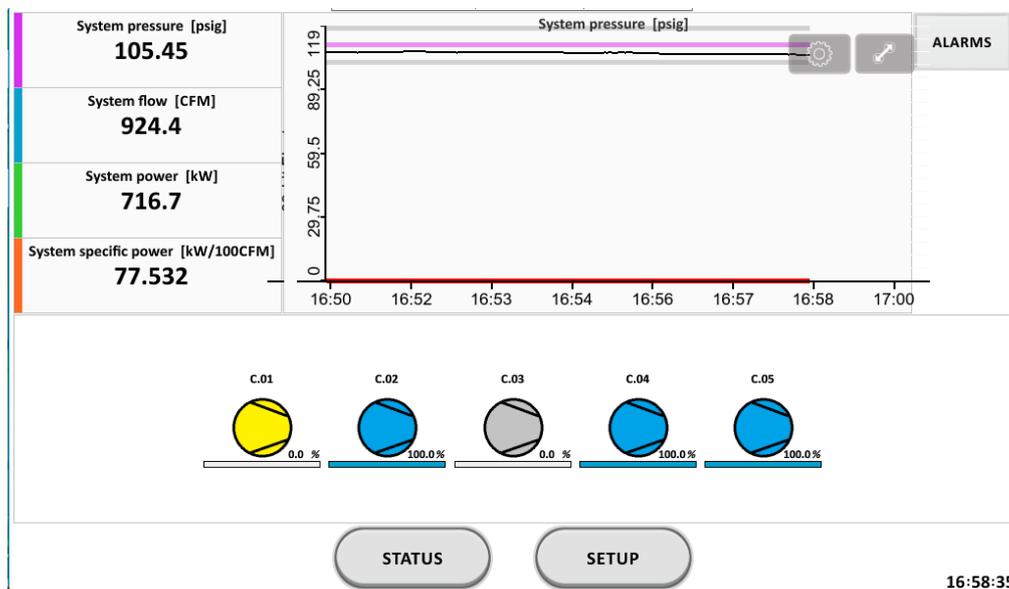
Figure 19: Main overview screen on the HMI

On the main overview screen you can see your system pressure, flow, power and specific power values as well as a graph for all of these values. You can also see compressor statuses.

- Compressor stopped – no light –

- Compressor running UNLOADED – yellow light –

- Compressor running LOADED – blue light –

- Compressor is in TRIP – red light –

- Compressor REMOTE CONTROL ENABLED –

- Compressor not communicating with the main CAL-PM-X device -

- Pressing the **ALARMS** button will open up ALARMS MENU, there you can see all alarm massages and information about these alarms and you can also acknowledge all of these alarms.

- Pressing the **SETUP** button will open up the setup menu where you will have to sign in to access the menu.

24
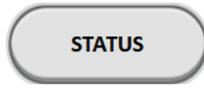
- Pressing the **STATUS** button will open up the status menu. Here you can select and see any parameter from your system such as: compressors, dryers, MODBUS communication etc. You can access them by pressing on the specific button.
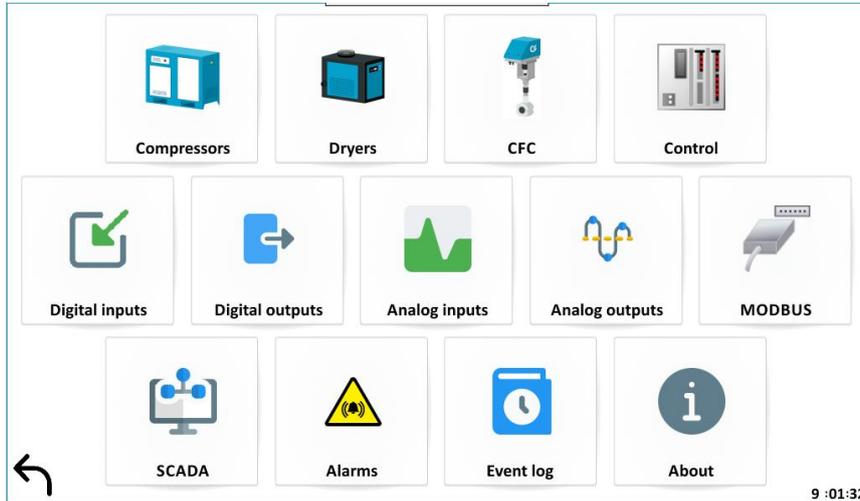
Figure 20: Status menu on the HMI

To change or configure the HMI, the user has to be logged in. For the most basic edits on the HMI the **operator account is used.** The user must log in to this account. To access the **setup menu**, press the **SETUP** on the main Screen. A login window will appear, allowing you to select the desired access level under the username field (see *Figure 21*).

- To log in as **Operator the password is 111.**
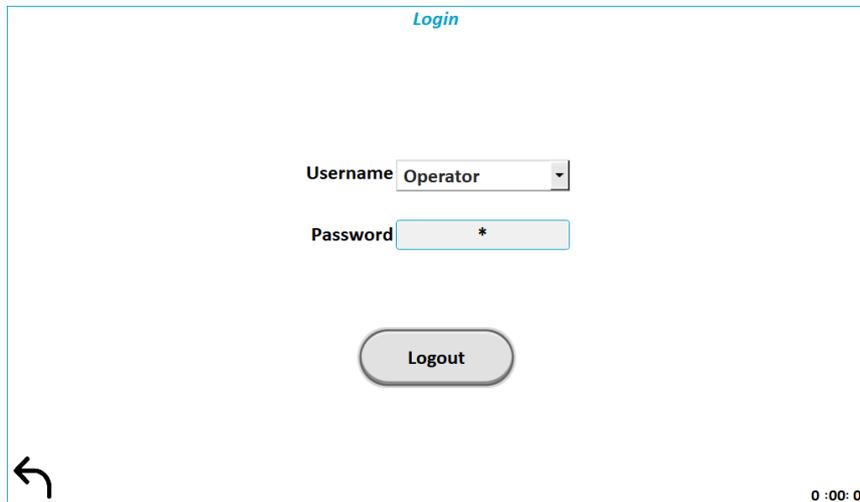
Figure 21: Login as OPERATOR

After logging in, a message that the login has been successful appears like shown in *Figure 22.*
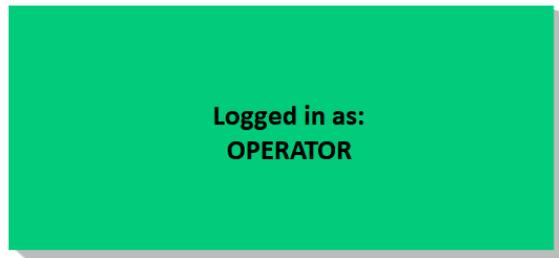
Figure 22: Successful login as OPERATOR

This is operator's setup menu it only has 5 setup sub-menus (see *Figure 23*).

0 :00: 0
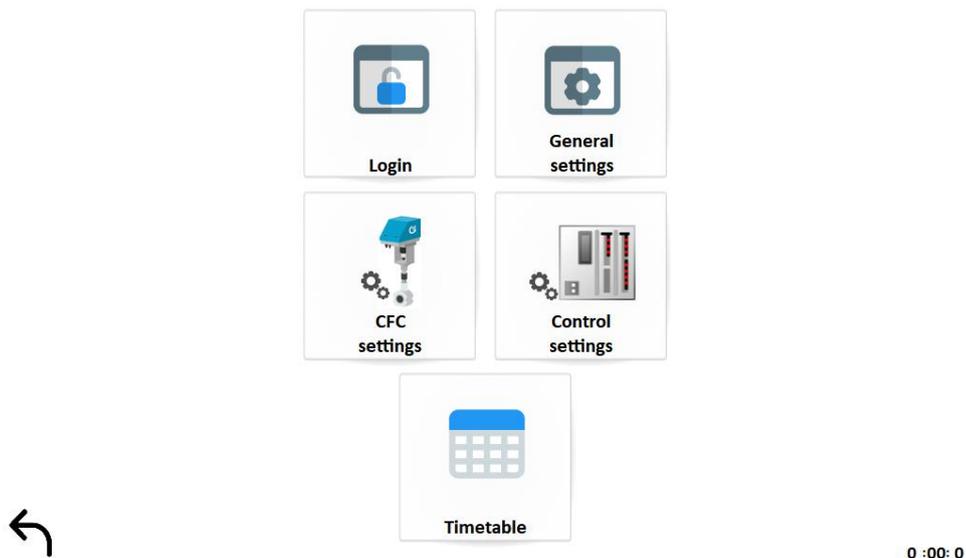
Figure 23: OPERATOR setup page

9.1.1. General settings

Under **General Settings**, you can view and select the measurement units for pressure, flow, temperature, and specific power. You can also change the language, enable or disable the remote connection, and adjust the time and date settings.

Note: HMI system settings should only be changed when specifically advised to do so.
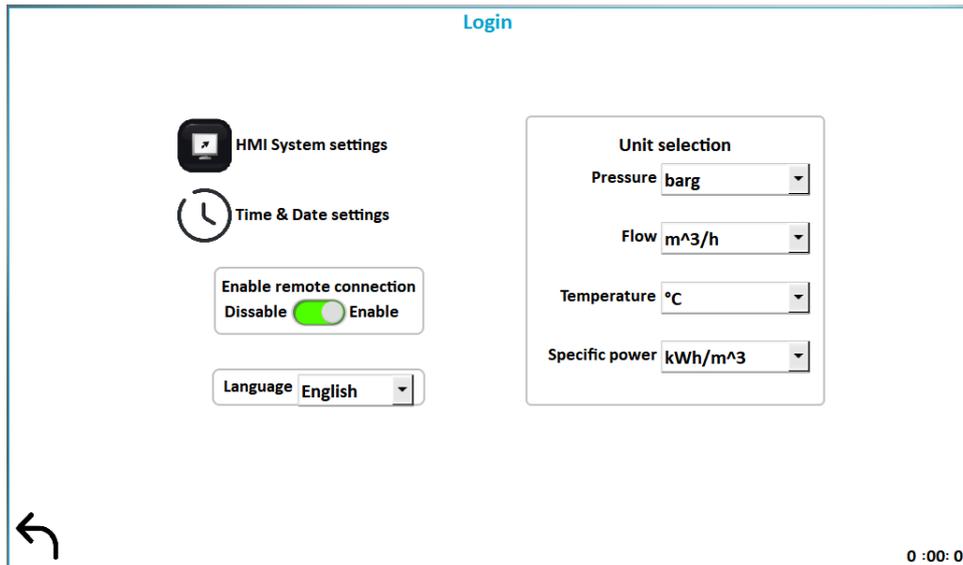
Figure 24 General settings

9.1.2. CFC settings

Under CFC settings you can add or remove CFCs from the system by pressing [Add CFC] or [Remove CFC] .

Selecting a CFC opens a sub-menu where you can adjust all CFC parameters, such as operation mode, fade speed, noise reduction, and other related settings (see *Figure 24*).
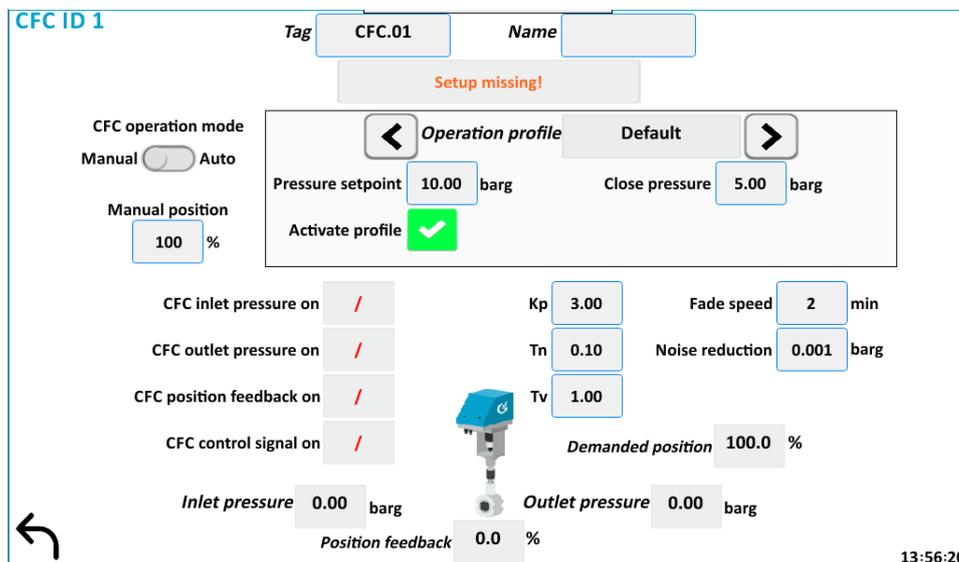
Figure 25: CFC settings on the HMI

- **Tag:** Identification label of the CFC unit within the system
- **Name:** Custom name of the CFC unit for easier recognition in the HMI.
- You can select either Manual or Auto operation mode for the CFC.
  - **Manual mode**: The CFC can be manually controlled between 0% and 100% openness. This mode is typically used for testing or maintenance.
  - **Auto mode**: The CFC operates automatically according to the configured parameters.
- **Manual position:** Manually set valve opening in *Manual* mode (0–100%)

27

- **Pressure setpoint:** Target pressure value that the CFC regulates during operation
- **Close pressure:** Inlet pressure threshold at which the CFC closes. This prevents wet air from entering the production line, since dryers cannot effectively dry the air when the pressure is too low(set to 0barg to disable this option)
- **PID parameters:** Used to adjust the CFC control behavior for stable and normal operation
  - **Kp:** Proportional gain of the controller, defining the response to pressure deviation
  - **Tn:** Integral time constant used to stabilize control and reach the setpoint [s]
  - **Tv:** Derivative time constant used to improve response during rapid pressure changes [s]
- **Fade speed:** Defines the stabilization time required for the CFC to reach and settle into its new position [min]
- **Noise reduction:** Defines the deadband range. The CFC position will not change if the outlet pressure is close enough to the pressure setpoint, as determined by the noise reduction parameter

9.1.3. Control settings

The **Control Settings** page is used to define the main operating logic of the compressor control system. From this screen, the user can select the active **operation profile**, adjust pressure targets, and choose the desired control mode (see *Figure 25*).
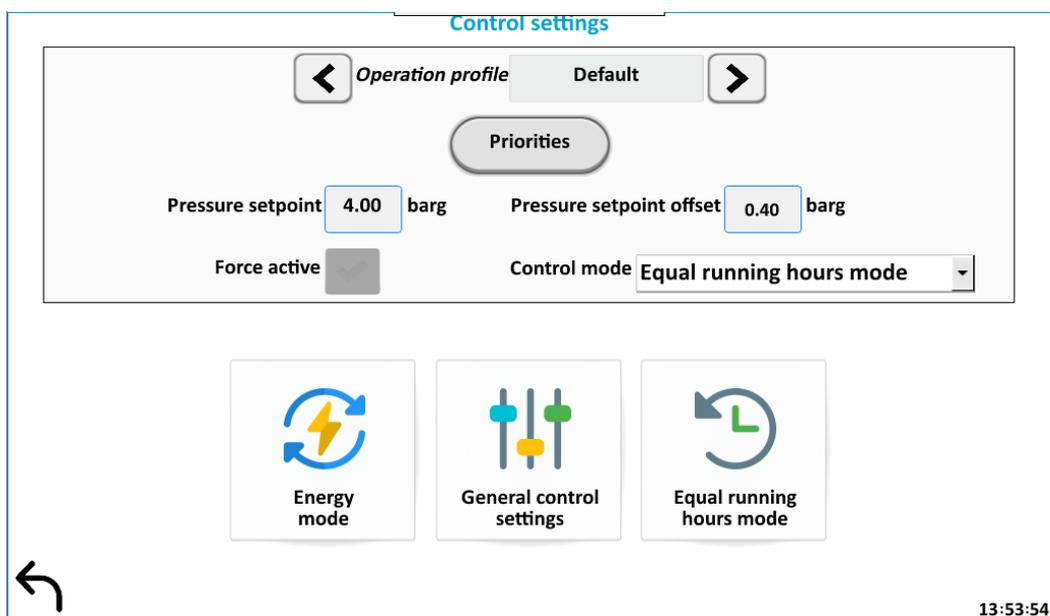
Figure 26: Control settings on the HMI

Configuring the operation profile:
- **Operation profile:** CALMS utilizes two standard system operation profiles (Default and Turned Off) and up to three custom operation profiles tailored to specific customer requirements.
  - The Default operation profile is active when it is selected or when no other profile is enabled.
  - The Turned Off profile is used when there is no demand for compressed air and the compressors are not required to run.
  - Custom profiles (custom labeling) can be configured to match special operating conditions or customer-specific control strategies.
- **Priorities:** Operator can set priority for each compressor.
  - If all compressors have the same priority, they will operate according to the control mode sequence calculation.
  - If each compressor has a unique priority, the control mode sequence is bypassed and compressors operate strictly based on the assigned priorities.
- **Pressure setpoint:** This value defines the main system pressure target that the control system will maintain.
- **Pressure setpoint offset:** The Pressure Setpoint Offset defines the pressure band around the main pressure setpoint that is used for compressor loading and unloading logic.
  - If the system pressure rises above **Pressure Setpoint + Pressure Setpoint Offset**,

the next compressor will be **unloaded**.
- o If the system pressure falls below **Pressure Setpoint − Pressure Setpoint Offset**, the next compressor will be **loaded**.
- o In addition, the system also considers the **pressure slope** (rate of pressure change) as an extra condition to ensure stable and reliable switching behavior.
- **Control mode:** The dropdown menu allows the user to select the main compressor control mode (**Energy mode, Equal running hours mode**) for the certian operation profile. Each control mode has its own detailed parameters, which are configured independently on the dedicated sub-pages accessible through the buttons below.
- **Force active:** When an operation profile is forced, it becomes the active profile and overrides the priority logic. All other operation profiles are automatically disabled until the forced profile is released.

9.1.4. Timetables

The timetable function allows the control system to automatically switch between predefined operation profiles based on configurable time periods throughout the week (see *Figure 26*).
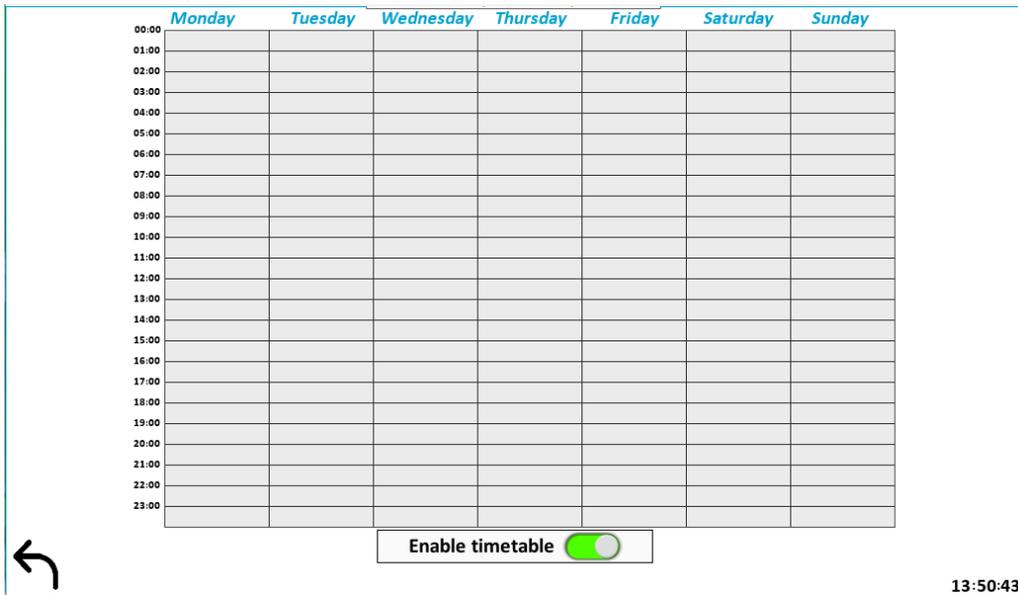
Figure 27: TImetables settings

Using a weekly timetable, the compressed air system can seamlessly transition between different operating profiles (compressor station operation profiles and CFC operation profiles) without operator intervention. This provides increased flexibility and automation, while supporting improved energy efficiency by aligning system behavior with actual demand.

Figure 28: Enabling timetable

The timetable is fully configurable via the HMI and can be enabled or disabled at any time with the "Enable timetable" toggle switch (see *Figure 27*).

Figure 29: Timetable settings

By selecting the day block, a new menu opens that allows editing of the events for the selected day. These events define the operation profiles for the compressor station and the CFCs configured in the system.

Figure 30: Configuration window

With clicking on the green "Add event" button you will add a new event on the selected day. You can add maximum five events each day!

Figure 31: Events

30

Example of usage: Timetable settings

	Sunday	Monday	Monday
From	22 : 00	06 : 00	22 : 00
	Monday	Monday	Tuesday
To	06 : 00	22 : 00	06 : 00
Compressor station operation profile	Turned off	Default	Turned off
CFC.01 operation profile	Default	Default	Default
CFC.02 operation profile	CFC closed	Custom profile 2	CFC closed
CFC.03 operation profile	CFC closed	Custom profile 1	CFC closed
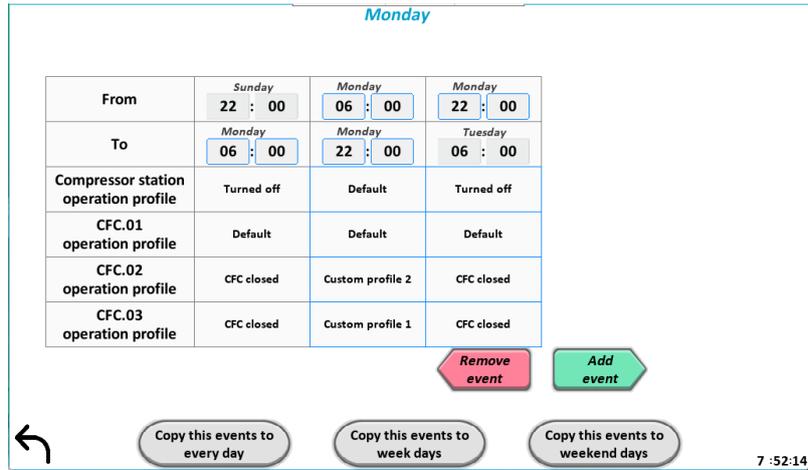
Figure 32: Example of timetable settings

In this example, two events are configured for Monday. The compressor station is started in the Default operation profile, and the corresponding CFC operation profiles are assigned at 06:00. The compressor station is then stopped at 22:00.

The "Copy these events to every day" function is used to apply the same event configuration to all days of the week.
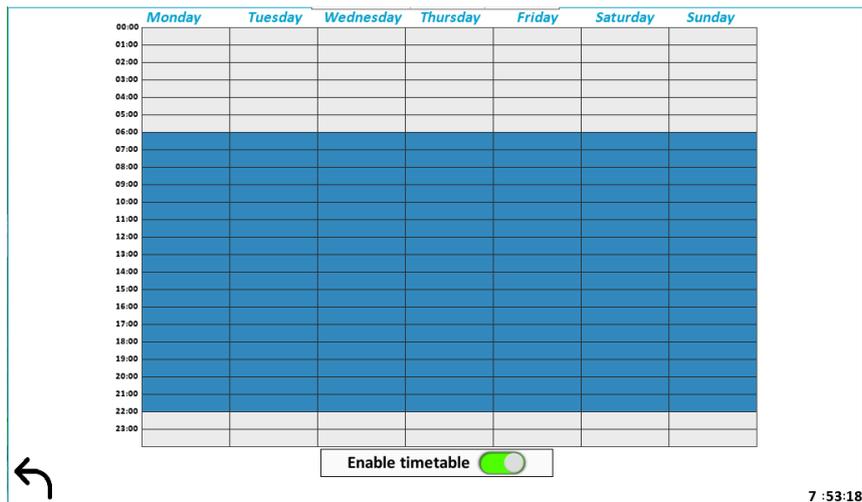
The main timetable page also provides a visual representation of operation profile changes. The displayed colors indicate the active operating state for each time period.

Important notes:

- If the compressor station is switched off, the visualization is always shown in grey, regardless of the

<u>selected CFCs operation profiles.</u>
- <u>An event must have a minimum duration of 30 minutes to be displayed in the timetable visualization.</u>

For example, if the compressor station is not required to operate during the weekend, all events for Saturday and Sunday can be deleted. In this case, the last active event of the week remains the Friday 22:00 event, which sets the compressor station operation profile to "Turned off".

The compressor station will then be started again on Monday at 06:00, according to the next scheduled event.

Another example is the use of different compressor station and CFC operation profiles during the weekend, while weekday operation remains unchanged.

Weekend operation configuration:
- From 07:00 to 11:00:
  - Compressor station operates in "Custom 3" operation profile
  - CFC.01 operates in "Custom profile 1"
  - CFC.02 operates in "Custom profile 1"
  - CFC.03 is closed
- From 11:00 to 15:00:
  - Compressor station operates in "Custom 3" operation profile
  - CFC.01 operates in "Custom profile 2"
  - CFC.02 is closed
  - CFC.03 is closed
- From 15:00 to 19:00:
  - Compressor station operates in "Custom 3" operation profile
  - CFC.01 is closed
  - CFC.02 is closed
  - CFC.03 is closed
- From 19:00 onwards:
  - The compressor station is set to the "Turned off" operation profile.

9.2.   CALMS web application

Every CAL-PM-X device has its own unique serial number, located on the inside of the cabinet, refer to the *3.2. Nameplate* section. Once logged in the web application CALMS and creating a system, the CAL-PM-X device has to be added in your system. First, you open your system and navigate to the **Setup** page. There you click on »**Add device**« and choose your device like shown in the *Figure 9* below.
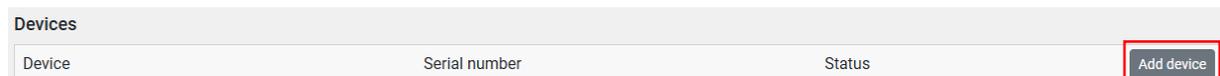

Figure 33 : Adding device in CALMS system

On the **Equipment page** add a sensor on your scheme. To »connect« the sensor to your device you have to again choose your device (serial number) and configure the sensors on the CALMS application. The customer is able to:

- Configure digital sensors (signals) based on what **input they are connected to.**
- Configure analog sensors (4-20 mA) based on **what they measure (quantity), their unit of measurement, to which analog input they are connected to and the range of the sensor.**
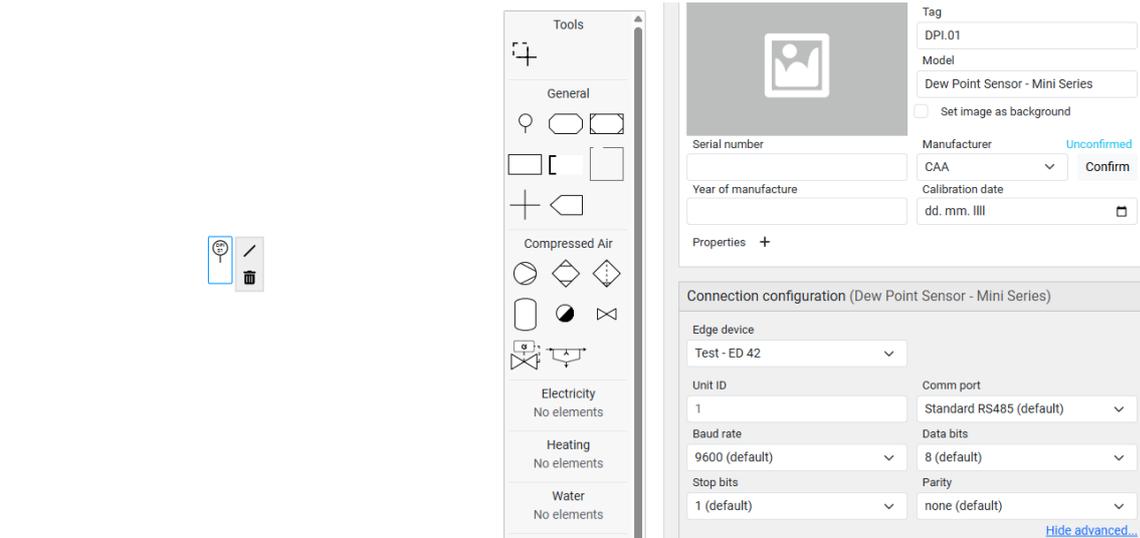- Configure MODBUS sensor (RTU and TCP)

Figure 34 : Sensor configuration on CALMS

The data collected from the sensor for periods of time can be checked on the **Monitoring page.** There the customer has the option to choose which channels (inputs) to monitor, view them in a graph, choose the inspect period and aggregation (see *Figure 34*).

Figure 35 : Monitoring page

10. Maintenance

The proper maintenance procedure for the safe operation and long-term reliability of the device is stated below.

10.1. Visual inspection:

Check the cabinet for any mechanical damage, dents, or scratches that could affect sealing or structural integrity.
Inspect the Icotek inserts:
- Ensure that all openings without cables are properly sealed with plugs to prevent dust ingress.
- Check for any signs of damage, deformation, or wear on the seals.

Verify that door hinges and locks operate correctly and that the cabinet closes fully to maintain dust protection
Inspect all modules, DIN rails, and components for mechanical integrity:
- Ensure that all modules are securely attached and that there are no loose parts.
- Check that cables are properly sealed in Icotek inserts and that no dust or debris has entered the cabinet.

Look for signs of condensation, especially at the bottom of the cabinet or on metallic surfaces, which could indicate environmental issues.
Visually inspect surge protection devices, fuses, LEDs on the PLC, I/O modules, and power supply:
- Ensure all indicators are in normal operation (RUN/ERR lights, power supply status).
- Check for any signs of overheating, discoloration, or damage.

Confirm that all components remain properly secured after inspection.

10.2. Cleaning

Wipe Down Surfaces
Use a dry microfiber cloth to clean metal surfaces, rails, enclosure walls, and doors.
For tight spaces around PLC, I/O modules, and cable glands, use an antistatic brush to dislodge dust. Check icotek cable glands and door seals for dust buildup or damage.
Inspect and Final Check
Look for loose or disconnected wires, damaged insulation, or signs of overheating. Verify all screws, DIN rails, and modules remain properly secured. Ensure door seals are intact and the cabinet closes properly to maintain dust protection. Confirm no tools or debris remain inside the cabinet before re-energizing.

Failure to comply with these instructions may result in device malfunction, damage, or safety hazards.

11. Adjustments

For device adjustments please refer to the section *8.4. Optional add-ons to the device*.

12. Spare parts

To obtain information on the spare parts available for this device, contact the CALMS support team.

The CALMS team requires the following information for ordering spare parts:

- CALMS device name
- Serial number (see nameplate)
- Required quantity

The contact of the CALMS support team is listed in the section *1.2. Contact.*

13. Decommissioning

The device must be decommissioned during longer periods of inoperation, for example:

- Maintenance of the product
- System inactivity
- Not in use

To decommission the device, turn OFF the main circuit breaker (F1) in the CAL-PM-X cabinet and main circuit breaker (F1) on each individual interface module.

14. Disassembly

14.1. Warning notices

For disassembly work to be carried out, the following protective equipment must always be worn.

Electric voltage hazard

There is a danger of **death or serious injuries** following contact with components which are in contact with electric voltage
Before starting work:
Set up a safe working area around the device. Make sure the area is not cramped; there are no conductive objects that could contact live parts
Make sure that the environment around the device is dry, there are no damp floors.

Insufficient qualification

If personnel carrying out the work on the device are not properly qualified, this could result in accidents and damages to property.
All work on the device must be carried out by skilled technical personnel specializing in electrical device service.

14.2. Disassembly work

After reading and applying the warning notices you can start the disassembly process.

14.2.1. CAL-PM-X device (cabinet)

- Make sure that the circuit breaker for the incoming supply voltage is turned OFF ➔ power supply cable for CAL-PM-X device is voltage-free!
- Switch OFF the main circuit breaker inside the device (F1)
- Disconnect the power supply cable from the terminal X01-PS (L, N, PE wires). Remove the cable through the bottom cable entry system
- Disconnect any external wires that are either connected to the fuses on X10-24VDC terminal or any of the PLC I/O cards (DI1, AI1). Remove the wires through the bottom cable entry system
- Disconnect external ethernet cables from the Ecx PLC cards and remove them through the bottom cable entry system
- Carefully disconnect the antenna from edge device (EG1) and put it inside the cabinet
- Unmount the cabinet and lock the door.

14.2.2. Compressor interface modules – CAL-C-IM

Each compressor is equipped with CALMS compressor interface module. On this interface module multiple wires are connected.
Be careful, some wires have voltage present including **230 VAC**!

- Make sure the compressor is powered down
- Turn OFF the main circuit breaker (F1) and then secondary circuit breaker (F2) on the interface module
- Disconnect and remove all wires from the interface module and on the compressor side otherwise, when the compressor is powered back on there could be lethal voltages present
- Disconnect and remove the ethernet cable
- Remove interface module from the DIN rail (or with the DIN rail if possible)

- Remove the current transformers from the compressor power supply cables

15. Disposal

After disassembly, the device can be disposed of.

Component	Material	EU waste code
Metal cabinet	Iron and steel	17 04 05
PLC	Electronic components with their plastic parts	16 02 16
Edge device		
Power supply		
Other electronic components		
Cables and wires	PVC / copper	17 04 11
Other plastic parts	Plastic	15 01 02

16. Troubleshooting

For information on troubleshooting steps, please visit the link below:

CALMS Training platform

For more information scan the QR code!