

MEC3

The Modular Gateway

General Operating, Maintenance, and Installation Manual



IPCOMM GmbH

Walter-Bouhon-Strasse 4
90427 Nuremberg
Germany

Phone: +49 911 18 07 91-0
Fax: +49 911 18 07 91-10
Internet: <https://www.ipcomm.de>
E-mail: info@ipcomm.de

Edition October 2025
Version 1.1



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1 Introduction

All technical information, descriptions and illustrations contained in this 'Operating, Maintenance, and Installation Manual' remain our property and shall not be used differently than for operating this system, nor shall they be copied, reproduced or passed on to third parties or brought to their notice without our prior written consent.

The information represented in this manual is in keeping with current standards and is subject to subsequent alterations.

This manual contains important instructions referring to safe installation, commissioning, operation, and maintenance.

Read this manual thoroughly, before starting up the gateway, and observe the instructions.

In order to comply with the guidelines for electro-magnetic compatibility, only CE-certified components are used in compliance with project-specific requirements.

Please note that the hardware platform is not protected against lightning and the operator should, if desired, take appropriate protective precautions.

The addition of our RS-232 isolator provides efficient protection of your data and equipment against external influences. We will be pleased to draw up a non-binding offer for you.

Finally we want to draw your attention to the fact that any warranties will be invalid in the event that:

- Operation, servicing, and maintenance are not carried out accurately according to the instructions; repairs are not carried out by our personnel or without our prior written consent.
- Commissioning is not carried out by our personnel or we have not given our approval for the commissioning or the commissioning is carried out by untrained personnel.
- The unit is used inadequately, incorrectly, negligently, or inappropriately or for a purpose other than originally intended.
- The serial number is removed from the product.

For your protection, observe the following safety precautions when setting up your equipment:

- Follow all cautions and instructions marked on the equipment.
- Ensure that the voltage and frequency of your power source match the voltage and frequency inscribed on the equipment's electrical rating label.
- Never push objects of any kind through openings in the equipment. Dangerous voltages may be present. Conductive foreign objects could produce a short circuit that could cause fire, electric shock, or damage to your equipment.

All trade names or trademarks mentioned in this document are used for identification purposes only and are property of their respective owners.

2 The Modular Gateway

2.1 General

This embedded controller has been designed for industrial environments and offers a high degree of flexibility, performance, and reliability.

All components are cooled passively. Factors like quality, availability, and high durability are of particular importance for the selection of our components.

Exhaustive tests of the embedded controller are performed by our company. Each device undergoes an in-depth function test. This function test includes a burn-in test with full communication on all interfaces (min. 48 hours). Communication disruptions, transmission errors, and every important component with regard to function, temperature, voltages etc. are monitored. Hundreds of restarts are executed whereby connections to all interfaces are re-established at each reboot.

Quality assurance is conducted according to the four-eye principle. Each device passes a number of quality inspections.

The mounting bracket can show slight signs of usage due to the aforementioned function tests.

2.2 Special Features at a Glance

- » Redundant power supply
- » Relay contact that is freely configurable in the software
- » Modular: two expansion slots for optional modules
- » No rotating parts
- » “Hardened” *ipLinux* operating system
- » Designed for 24/7 operation
- » IEC 61850-3, EN 61850-3, the special environmental and quality requirements of the standard are met
- » Made in Germany

2.3 System Startup

When the MEC3 starts, a single beep is sounded. This tone signals the start of the boot process.

A hardware reset is triggered automatically if any of the following conditions apply:

- No SD card is inserted
- The system cannot successfully boot from the SD card
- The system does not complete startup within 50 seconds

In this case, a sequence of beeps (three tones: high – low – high) indicates the reset process.

2.4 The Modular System

The modular gateway MEC3 features four slots to flexibly and expansively accommodate individual projects. The various modules are introduced in the main chapter titled “The Individual Modules.”

The module slots are designed in such a way that only the power supply module can be inserted into slot 1, and only a CPU module can be inserted into slot 2.

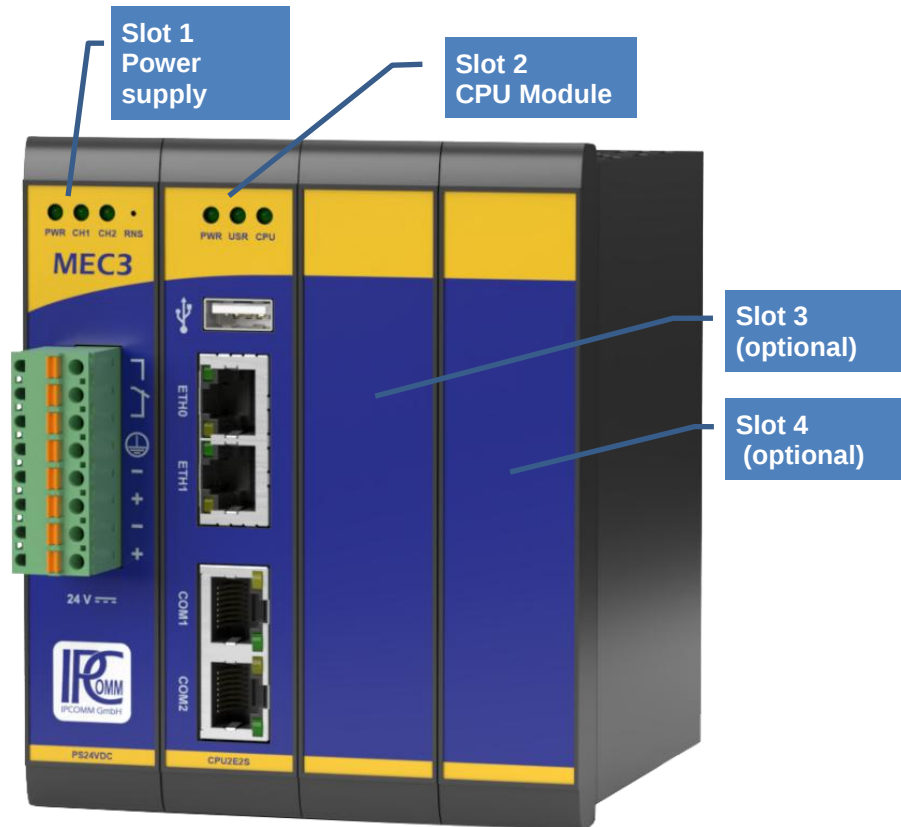


Figure 1: The modular gateway

A power supply module and a CPU module are installed in slots one and two, respectively, as part of the basic configuration.

Available expansion modules can be inserted into slots three and four without any predefined configuration, even retroactively. The additional interfaces of optional modules are addressed via the configuration software.



Figure 2: The optional slots

2.5 Slot Configuration

In the gateway software (*ipConv*), the individual modules are defined within the slot configuration. A deliberate static assignment is used. This static configuration ensures that the addressing remains unchanged — even in the event of a module failure or replacement. This level of consistency could not be guaranteed with an automatic or dynamic configuration.

Within the slot configuration, all modules can be defined, and specific settings can be made depending on the module type. In addition, serial interfaces can be integrated via terminal servers (RFC2217). Their use must be supported by the desired protocol stack.

Extended Network Settings

System-specific Settings

Slot configuration

.slot + 3 elements

1	PS24VDC
2	CPU2E2S
3	COMM2E2S

Serial interface definition

.com_list +

COM22	NVT TCP CLIENT ??? 4001 10 RFC2217 TRUE
-------	---

Figure 3: Slot configuration

All modules must be configured for operation with the gateway software! Operating system–level settings are integrated into the *ipLinux* operating system and will take effect after the next system reboot.

2.6 Interface Addressing

While the addressing of the CPU module interfaces (slot 2) is fixed (Ethernet: ETH0 & ETH1, serial: COM1 & COM2), the addresses of ports for optional modules can be defined by the user. The names of the Ethernet and serial interfaces can be assigned according to specific rules.

.type	COMM2E2S	card type
COM X+0		
.ser1name	COM3	Name of the serial interface
.ser1type	RS232	Serial port 1 interface type
COM X+1		
.ser2name	COM4	Name of the serial interface
.ser2type	RS232	Serial port 2 interface type
ETH X+0		
.eth0name	eth2	Name of the ethernet interface
ETH X+1		
.eth1name	eth3	Name of the ethernet interface

Figure 4: Interface addressing for the COMM2E2S module

The digital and analog expansion modules are registered in the gateway software in the GGIOX protocol stack.

.type	GGIOX	Protocol Stack Type
.name	GGIOX12	module name
General Parameter		
.level	0	logging level
Module List		
.mod +		
	3	8DI8DO

Figure 5: Protocol stack GGIOX

This assignment results in the following normalized address (example for digital inputs and outputs).

.from (digital input)

```
inf-3-0 SI    Prozessinformation Modul '3', point '0'
inf-3-1 SI    Prozessinformation Modul '3', point '1'
inf-3-2 SI    Prozessinformation Modul '3', point '2'
inf-3-3 SI    Prozessinformation Modul '3', point '3'
inf-3-4 SI    Prozessinformation Modul '3', point '4'
inf-3-5 SI    Prozessinformation Modul '3', point '5'
inf-3-6 SI    Prozessinformation Modul '3', point '6'
inf-3-7 SI    Prozessinformation Modul '3', point '7'
```

.to (digital output)

```
inf-3-0 SC    Prozessinformation Modul '3', point '0'
inf-3-1 SC    Prozessinformation Modul '3', point '1'
inf-3-2 SC    Prozessinformation Modul '3', point '2'
inf-3-3 SC    Prozessinformation Modul '3', point '3'
inf-3-4 SC    Prozessinformation Modul '3', point '4'
inf-3-5 SC    Prozessinformation Modul '3', point '5'
inf-3-6 SC    Prozessinformation Modul '3', point '6'
inf-3-7 SC    Prozessinformation Modul '3', point '7'
```

The numbering of the interfaces on the gateway hardware is labeled intuitively for users, starting at 1, whereas in the software, they are technically numbered starting at 0.

Example: Digital inputs numbered 1 to 8 on the hardware correspond to 0 to 7 in the software.

This unique normalized address is used for communication in the data point configuration.

FROM Module -> Node

.from +

inf-3-0
SI info {.[IECApp4] {to {.[inf-3-108] {direct}}}}

TO Module <- Node

.to +

inf-3-7
SC info {.[IECApp4] {from {.[inf-3-202] {direct}}}}

Figure 6: Exemplary communication with an IEC101 protocol stack

3 Installation and Removal

Installation and removal may only be carried out by qualified personnel. Improper handling will void the warranty (and any additional guarantees). The device must be powered off, and all data wires/lines must be disconnected.

The gateway may only be mounted on a 35 mm DIN rail in a horizontal position. When installing multiple gateways side by side, no minimum spacing between the devices is required.

The ventilation slots on the top and bottom of the housing must not be blocked to ensure proper air circulation.

To mount the gateway on the DIN rail, place the back of the device onto the upper edge of the DIN rail and pivot it downwards until the DIN rail clip on the back of the device locks into place.

To remove the gateway from the DIN rail, pull the DIN rail clip downwards (using a screwdriver if necessary) and pivot the device upwards off the rail.

3.1 Installing and Removing Modules

Installation and removal may only be carried out by qualified personnel. Improper handling will void the warranty (and any additional guarantees).

- The device must be de-energized, and the data lines must be disconnected.
- ESD protection measures, such as the use of an earthing strap, are required.
- The procedure may only be carried out on an earthed and conductive surface.

Example for the installation of a new module in a free optional slot:

1. The gateway must be disconnected from the power supply, and the data lines must be disconnected.
2. The gateway must be removed from the DIN rail.
3. ESD protection measures must be taken into account.
4. Use a module release tool or a screwdriver to carefully unlock the blank panel at the top and bottom of the slot before removing it.
5. The new module can now be inserted into the free slot. Please ensure that the module is properly aligned within the guide rail and that the module locking mechanism clicks securely into place.
Tip: Applying light pressure on the top and bottom of the housing can help it lock in more easily.
6. The embedded controller can be put back into operation once it has been installed correctly.



After installing/removing optional modules, they must be registered or unregistered in the gateway software. See Chapter 2.5 Slot Configuration.

3.2 The Lithium Battery (battery replacement)

The gateway's real-time clock is buffered by a battery when it is powered off. The long-lasting lithium battery generally has a service life of 5 years.

The default settings have been configured to ensure error-free operation even after battery failure. After replacing the battery, the date and time may need to be resynchronized (NTP). If the gateway is time-synchronized, the system will have the current time and date information even without (or with an empty) battery.

A replacement battery can be ordered from IPCOMM GmbH at a reasonable price. It is also possible to commission IPCOMM GmbH to replace the battery.

Installation and removal may only be carried out by qualified personnel. Improper handling will void the warranty (and any additional guarantees).

- The device must be de-energized, and the data lines must be disconnected.
- ESD protection measures, such as the use of an earthing strap, are required.
- The procedure may only be carried out on an earthed and conductive surface.

When changing the battery, charge transfer to the circuit board and components must be avoided.

- There is a risk of explosion if the battery is handled incorrectly!
- Observe the polarity of the battery!
- The battery may only be replaced with a battery of the same type!
- Used batteries must be disposed of in accordance with the manufacturer's instructions!

The real-time clock and the corresponding **lithium battery (type: CR2032 - 3V DC)** are located on the power supply module.

1. Disconnect the gateway from the supply voltage and disconnect the data lines.
2. The gateway must be removed from the DIN rail.
3. Carefully unlock the top and bottom of the power supply module using a module removal tool or a screwdriver. Then the module can then be removed (observe ESD protection measures).
4. Remove the old battery from the battery holder.
5. Ensure correct polarity when inserting the new battery (see polarity markings on the battery base and the battery).
6. The gateway can be put back into operation once it has been installed correctly.

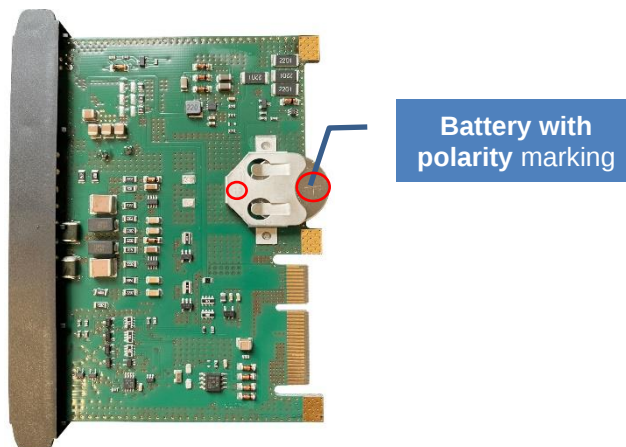


Figure 7: Battery on the power supply module

4 The Individual Modules

MODULE TYPE	LABEL	DESCRIPTION
<u>Power supply module</u>	PS24VDC	Standard power supply
<u>CPU module</u>	CPU2E2S	Standard CPU module with two Ethernet and two serial interfaces
	CPU2E2IE (under development)	Alternative CPU module with two Ethernet and two Industrial Ethernet interfaces (PROFINET, EtherCAT, EtherNet/IP)
<u>Expansion modules</u>	COMM2E2S	Two serial and two Ethernet interfaces.
	8DI8DO	Eight digital inputs and outputs
	PB Sniffer (under development)	Listening to Profibus data without interfering with the communication

4.1 Power Supply Module (PS24VDC)

The power supply module serves as a power supply for all modules. The input voltage can be connected redundantly.

A power supply plug is supplied with each device. The supplied power supply plug must be used.

- The power supply is nominally 24 V DC (see data sheet).
- To ensure the power supply, cables with a cross-section of at least 0.5 mm² must be used.
- The device can also be operated without a redundant power supply (CH1 or CH2).
- An input voltage cannot be used if the polarity is reversed.

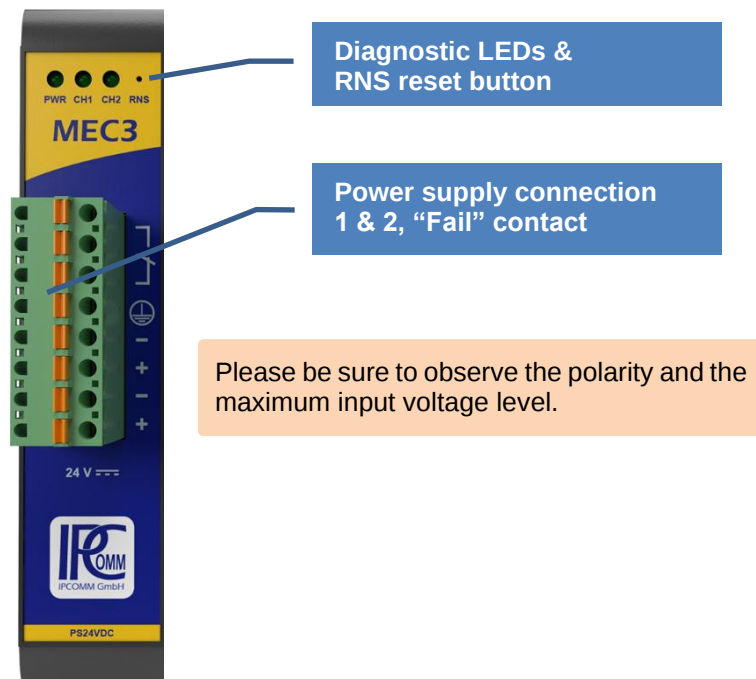


Figure 8: Power supply module (PS24VDC)

Assignment of the power supply:

Pin	1	2	3	4	5	6	7	8
Function	+	-	+	-	PE	Relay: opener		
							Relay: closer	

There are two voltage inputs for redundant feed-in.
 Voltage input CH1 (U_{PWR1}): Pin 1 & 2
 Voltage input CH2 (U_{PWR2}): Pin 3 & 4

The ground (pins 2 & 4) is internally connected directly to the protective conductor contact (pin 5, PE).

Figure 9: Power supply connection

	If CH1 lights up, an input voltage is connected to the CH1 voltage input. If CH2 lights up, an input voltage is connected to the CH2 voltage input. If the PWR LED lights up, the module is supplied with voltage from at least one voltage input and the buffer circuit that protects against brief voltage interruptions is active.
	The reset button RNS (Reset Network Settings) triggers a reset of the network settings when pressed. ¹⁾
	The “FAIL” status relay: The changeover switch can be individually controlled by the gateway software. A command or message can be sent to this fault contact to display particularly important information. The technical data can be found in the data sheet.

Figure 10: LEDs & fail contact

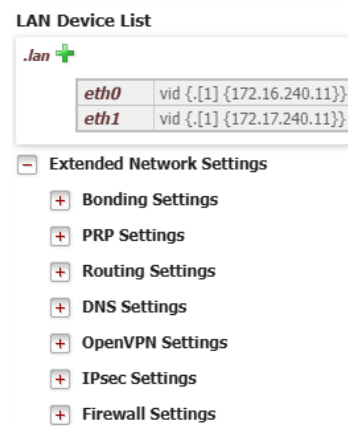
¹⁾ Resetting the network settings (Reset Network Settings) is triggered as follows:

1. Switch off the device
2. Press and hold the RNS reset button
3. Switch on the device and release the reset button
4. The “PWR” LED flashes for several seconds and the gateway restarts
5. After a few seconds, the PWR LED should light up continuously
6. The network settings are reset

The following settings are reset to the “default” settings:

1. Root password of *ipLinux* (operating system)
2. *WebConfig* password (configuration interface)
3. All “LAN connections” (IP addresses of the Ethernet interfaces)
4. Everything under “Extended network settings” (see picture)

The “default” values can be found in the *ipConv* basic description.



Only the “runtime configuration” is changed to enable a local login! For example, if a password or IP address is lost or the firewall locks you out. If the current configuration is reopened, all settings remain unchanged. If a password is lost, for example, it is necessary to change it and run the generation process. If the generation process is executed **without** changes and rebooted, the original status is restored.

4.2 CPU Module (CPU2E2S)

The CPU module (CPU2E2S) is a passively cooled ARM quad-core platform with two integrated Ethernet and two serial interfaces. The addressing of the interfaces of the CPU module is predefined and cannot be changed.

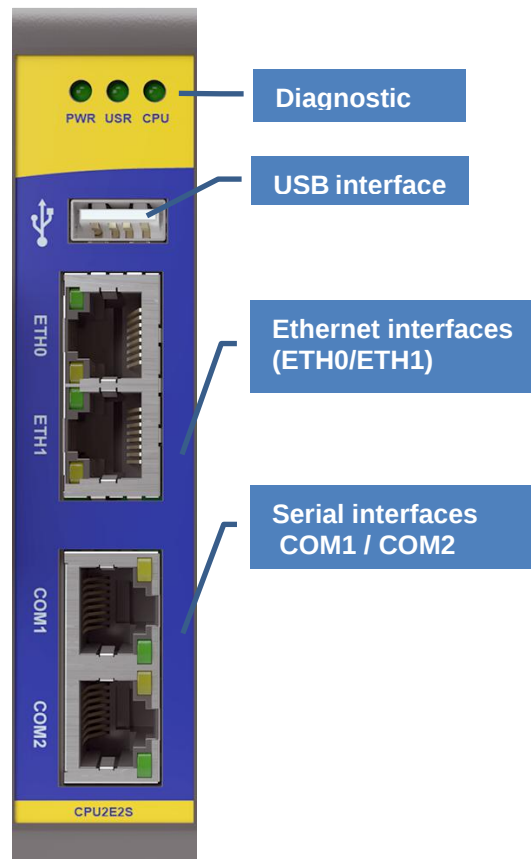
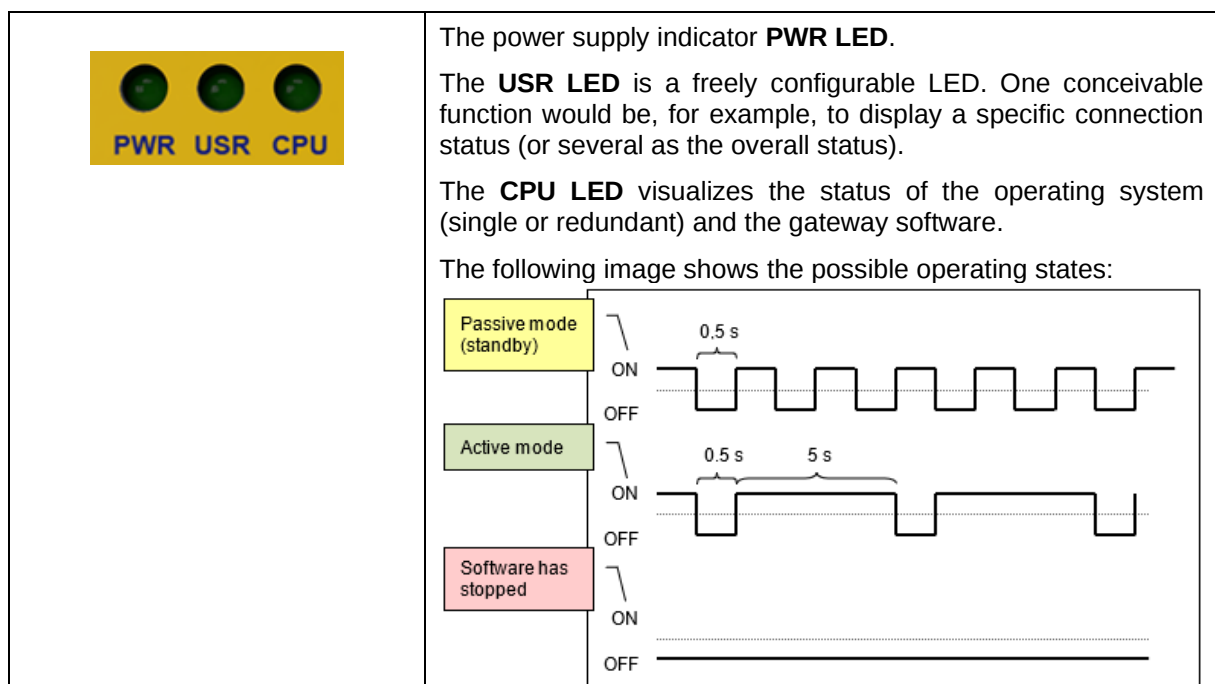


Figure 11: CPU module

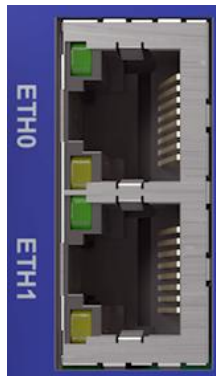


**USB PORT
(FEMALE TYPE A)**



The CPU module offers a standard USB interface.

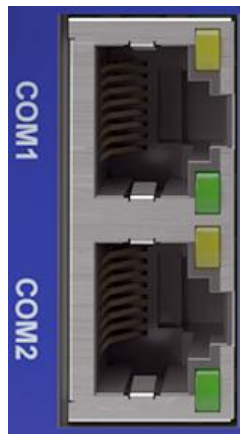
**ETHERNET PORT
(ETH0 / ETH1, RJ45)**



The CPU module has two Ethernet interfaces. The LEDs for the link status (green) and the activity indicator (yellow) of the Ethernet interfaces are located directly on the RJ45 jack.

Pin	Signal
1	TX D1 +
2	TX D1 -
3	RX D2 +
4	BI D3 +
5	BI D3 -
6	RX D2 -
7	BI D4 +
8	BI D4 -

**SERIAL PORT
(COM1 / COM2, RJ45)**



The CPU module has two serial interfaces that can each be configured as RS-232, RS-422, or RS-485 interfaces using the gateway software.

The LEDs for transmitting (TX=green) and receiving (RX=yellow) the COM interfaces are located directly on the RJ45 jack.

Pin	RS-232	RS-422	RS-485
1	DSR	---	---
2	RTS	TXD+	Data+
3	GND	GND	GND
4	TXD	TXD-	Data-
5	RXD	RXD+	---
6	DCD	RXD-	---
7	CTS	---	---
8	DTR	---	---

An "RJ45 - DB9 male" adapter cable is optionally available.

4.3 Serial Ethernet Module (COMM2E2S)

This optional module (COMM2E2S) is an expansion module with two integrated Ethernet and two serial interfaces.

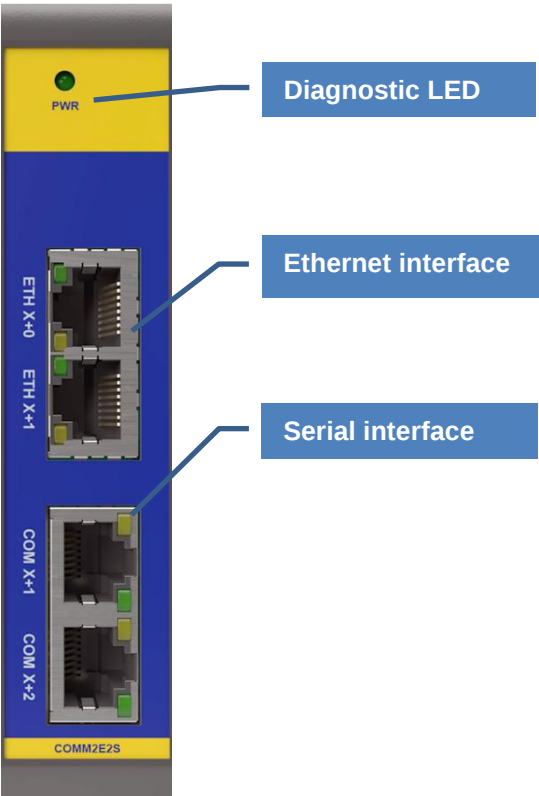
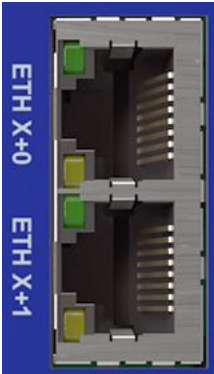
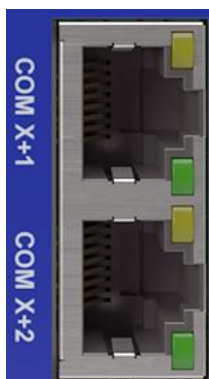


Figure 12: Optional serial Ethernet module

	The power supply indicator PWR LED .																		
ETHERNET PORT (RJ45) 	The module has two Ethernet interfaces. The LEDs for the link status (green) and the activity indicator (yellow) of the Ethernet interfaces are located directly on the RJ45 jack. <table><tr><th>Pin</th><th>Signal</th></tr><tr><td>1</td><td>TX D1 +</td></tr><tr><td>2</td><td>TX D1 -</td></tr><tr><td>3</td><td>RX D2 +</td></tr><tr><td>4</td><td>BI D3 +</td></tr><tr><td>5</td><td>BI D3 -</td></tr><tr><td>6</td><td>RX D2 -</td></tr><tr><td>7</td><td>BI D4 +</td></tr><tr><td>8</td><td>BI D4 -</td></tr></table>	Pin	Signal	1	TX D1 +	2	TX D1 -	3	RX D2 +	4	BI D3 +	5	BI D3 -	6	RX D2 -	7	BI D4 +	8	BI D4 -
Pin	Signal																		
1	TX D1 +																		
2	TX D1 -																		
3	RX D2 +																		
4	BI D3 +																		
5	BI D3 -																		
6	RX D2 -																		
7	BI D4 +																		
8	BI D4 -																		

SERIAL PORT (RJ45)



The COMM2E2S module has two serial interfaces that can each be configured as RS-232, RS-422, or RS-485 interfaces using the gateway software.
The LEDs of the COM interfaces for transmitting and receiving are located directly on the RJ45 jack.

Pin	RS-232	RS-422	RS-485
1	DSR	---	---
2	RTS	TXD+	Data+
3	GND	GND	GND
4	TXD	TXD-	Data-
5	RXD	RXD+	---
6	DCD	RXD-	---
7	CTS	---	---
8	DTR	---	---

An "RJ45 - DB9 male" adapter cable is optionally available.

4.4 Digital I/O Module (8DI8DO)

This optional module (8DI8DO) is an expansion module with eight digital inputs and eight digital outputs.

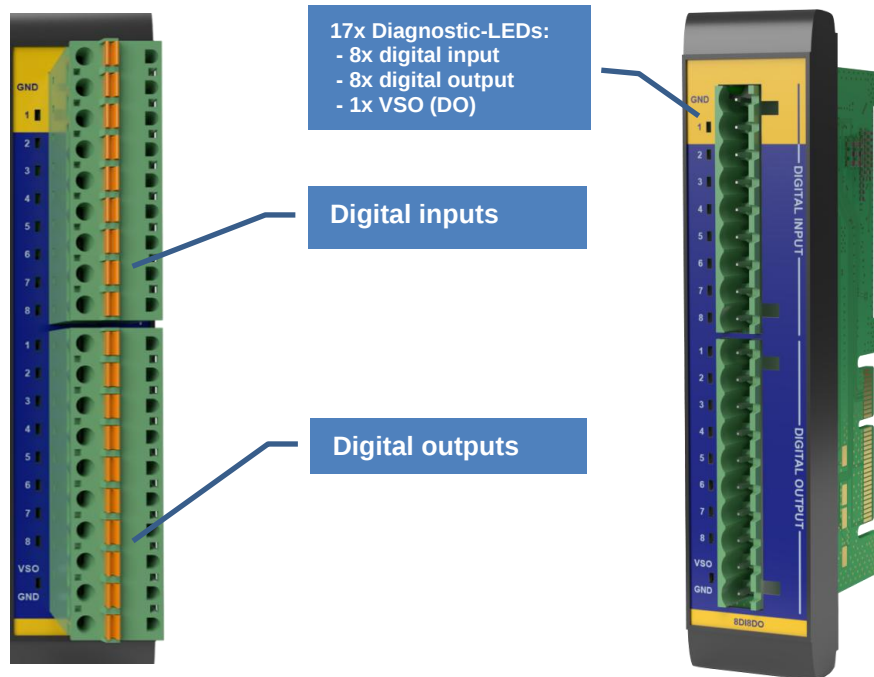
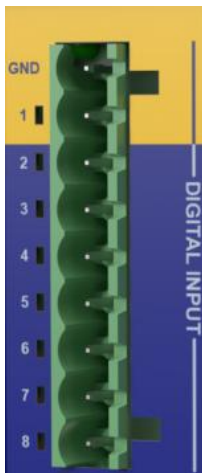


Figure 13: Optional digital I/O module

Digital Input Female Connector 9-pole

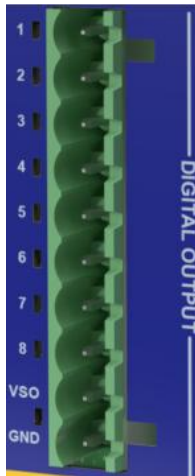


The digital inputs are equipped with overvoltage protection. Diagnostic LEDs for each input are located directly next to the socket strip and indicate a detected "high" signal.

Pin	Signal
1	GND
2	DI 1
3	DI 2
4	DI 3
5	DI 4
6	DI 5
7	DI 6
8	DI 7
9	DI 8

Input voltage: Typically 24 V DC at a sampling rate of max. 20 Hz.
(The hysteresis levels can be configured in the software)

Digital Output Female Connector 10-pole



The digital outputs are also equipped with overvoltage protection and additional overcurrent protection. In the event of a fault the affected digital output switches to a high-impedance state.

The safety shutdown of a digital output can be reset to the “low” state (pin 10 - GND potential) by software control.

Pin	Signal
1	DO 1
2	DO 2
3	DO 3
4	DO 4
5	DO 5
6	DO 6
7	DO 7
8	DO 8
9	VSO
10	GND

Input VSO:

U_{VSO} : 24 V DC, I_{VSO} : max. 4 A

Output DO₁₋₈:

U_{DO} = VSO at a switching frequency of max. 20 Hz, I_{DO} = max. 0.5 A

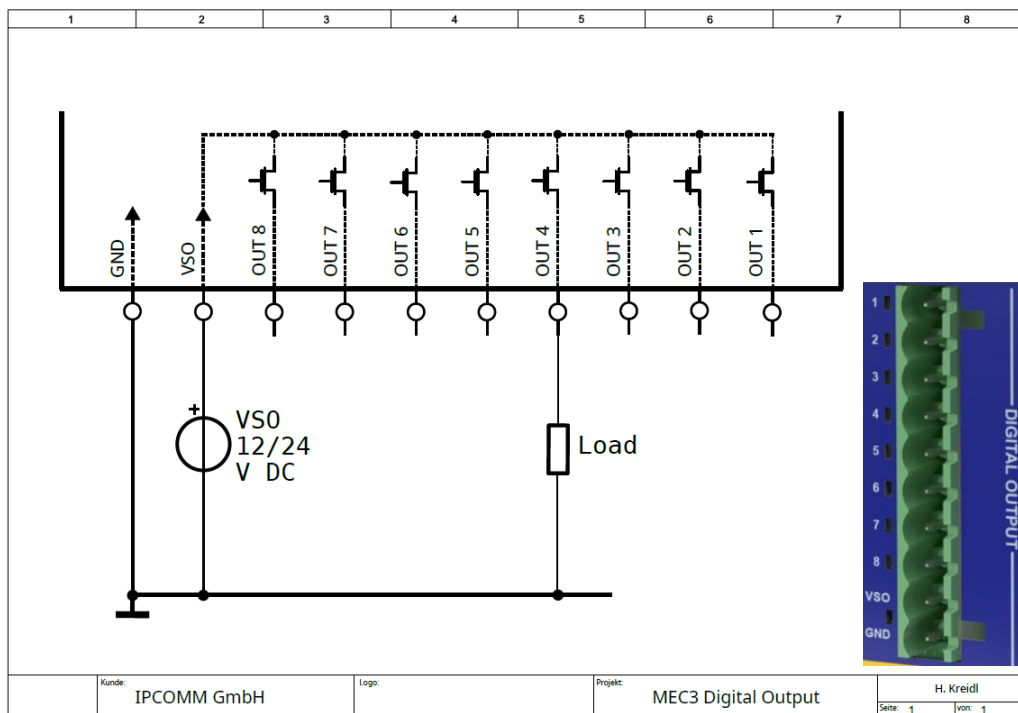


Figure 14: DO circuit

5 Technical Data Sheet

A technical data sheet for the individual hardware models is available separately to this document. In addition to pure technical data, this document also contains information on approval and applied standards (EMC). A current version of it can be found on our website under Hardware / MEC3 / Documentation:

- MEC3 <https://www.ipcomm.de/hardware/MEC3/en/sheet.html>

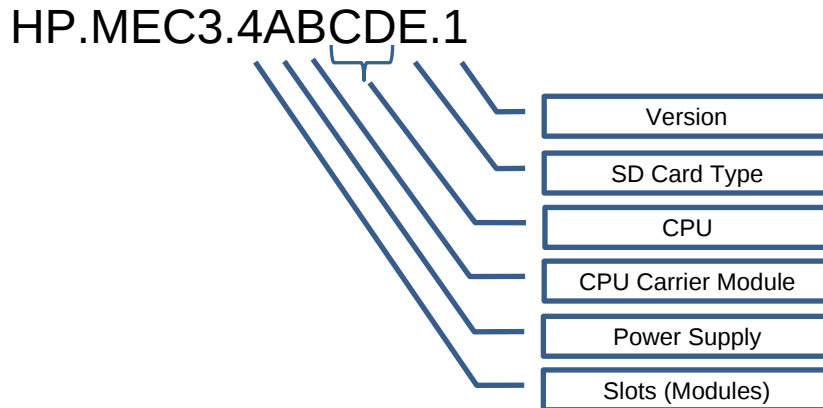
6 EU Declaration of Conformity

An EU Declaration of Conformity for the individual hardware models is available separately to this document. A current version of it can be found on our website under Hardware / MEC3 / Documentation:

- MEC3 <https://www.ipcomm.de/hardware/MEC3/en/sheet.html>

7 Nomenclature of MEC3 Item Code

The MEC3 item code provides information about the gateway configuration.



Slots / Modules

Value	Description
4	slots / modules

Power Supply

Value	Description
B	PS24VDC (24 V DC)

Carrier Module (CPU Basis Module)

Value	Description
A	CPU2E2S (2x Ethernet, 2x serial)
B	CPU2E2IE (2x Ethernet, 2x industrial Ethernet)

CPU

Value	Description
01	Raspberry Pi CM4 (Quad Core Cortex-A72 (ARM v8) 64-bit SoC @ 1.5GHz, 4GB RAM)
02	blank

SD Card

Value	Description
1	2 GB SLC-NAND (industrial version)

7.1 Item Codes of the Modules

Slot 1 Power Supply Modules

Item code:	Description
HK.MEC3.A00.1	PS24VDC (24 V DC)

Slot 2 CPU with Carrier Module

Item code:	Description
HK.MEC3.0A0.1	CPU2E2S (2x Ethernet, 2x serial)
HK.MEC3.0B0.1	CPU2E2IE (2x Ethernet, 2x industrial Ethernet)

Slot 3 & 4 Expansion Modules

Item code:	Description
HK.MEC3.00A.1	COMM2E2S (2x Ethernet, 2x serial)
HK.MEC3.00B.1	8DI8DO (8x digital input, 8x digital output)

8 MEC3 Dimensions

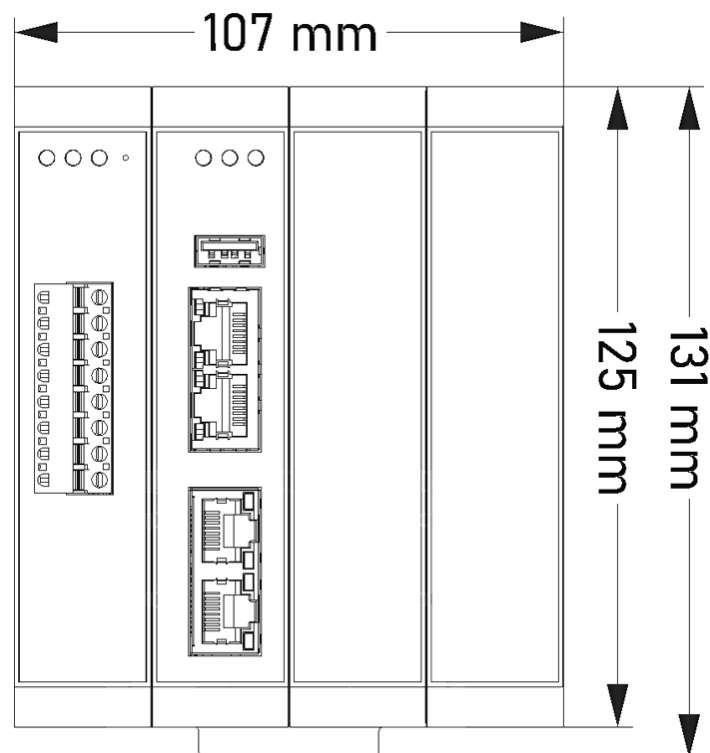


Figure 15: Dimensions – front view MEC3

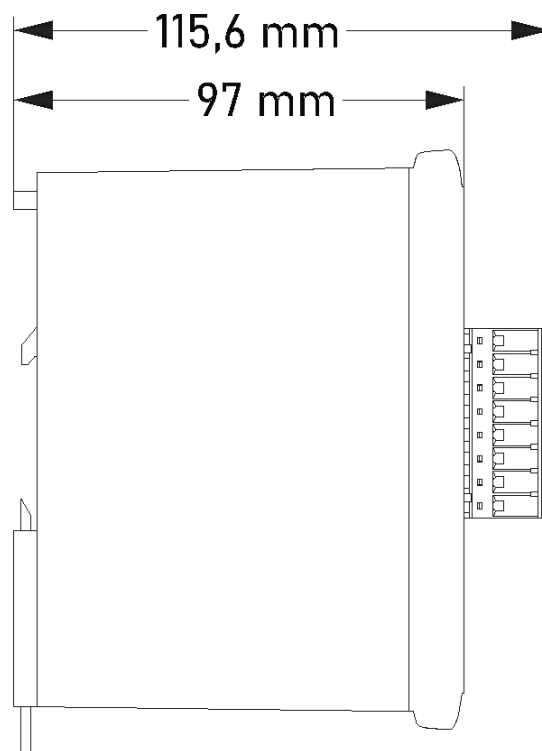


Figure 16: Dimensions – side view MEC3