



MRX.neo

Installation and User Manual

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Publisher:

INSYS icom GmbH

Hermann-Köhl-Str. 22

93049 Regensburg

Phone: +49 941 58692 0

Fax: +49 941 58692 45

E-mail: info@insys-icom.com

Internet: <https://www.insys-icom.com>

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1 General

This manual allows for the safe and efficient use of the product. The manual is part of the product and must always be stored accessible for installation, commissioning and operating personnel.

1.1 Defects Liability Terms

A usage not according to the intended purpose, an ignorance of this documentation, the use of insufficiently qualified personnel as well as unauthorised modifications exclude the liability of the manufacturer for damages resulting from this. The liability of the manufacturer ceases to exist.

The regulations of our Delivery and Purchasing Conditions are effective. These can be found on our website (www.insys-icom.com/en/imprint/) under "General Terms and Conditions".

1.2 Applicability

This manual applies to the product with latest hardware and firmware revision at the time of publication.

1.3 Feedback

We are permanently improving our products and the associated technical documentation. Your feedback is very helpful for this. Please tell us what you like in particular on our products and publications and what can be improved from your point of view. We highly appreciate your suggestions and will include them in our work to support you and all our customers. We are looking forward to any of your feedback.

Send an e-mail to support@insys-icom.de.

We'd like to know your applications. Please send us a few headwords that we know the applications you solve using products of INSYS icom.

1.4 Marking of Warnings and Notes

Symbols and Key Words

Danger!



Risk of severe or fatal injury

One of this symbols in conjunction with the key word Danger indicates an imminent danger. It will cause death or severe injuries if not avoided.



Warning!



Risk of severe or fatal injury possible

This symbol in conjunction with the key word Warning indicates a possibly hazardous situation. It might cause death or severe injuries if not avoid.

Caution!



Slight injury and / or material damage

This symbol in conjunction with the key word Caution indicates a possibly hazardous or harmful situation. It might cause slight or minor injuries or a damage of the product or something in its vicinity if not avoided.

Note



Improvement of the application

This symbol in conjunction with the key word Note indicates hints for the user or very useful information. This information helps with installation, set-up and operation of the product to ensure a fault-free operation.

1.5 Meaning of the Symbols and the Formatting in this Manual

This section describes the definition, formatting and symbols used in this manual. The various symbols are meant to help you read and find the information relevant to you. The following text is structured like a typical operating instruction of this manual.

Bold print: The objective. This will tell you what the following steps will result in

After that, there will be a detailed explanation why you could perform the following steps to be able to reach the objective indicated first. You can decide whether the section is relevant for you or not.

→ An arrow will indicate prerequisites which must be fulfilled to be able to process the subsequent steps in a meaningful way. You will also learn which software or which equipment you will need.

1. One individual action step: This tells you what you need to do at this point. The steps are numbered for better orientation.

✓ A result which you will receive after performing a step will be marked with a check mark. At this point, you can check if the previous steps were successful.

ⓘ Additional information which you should consider are marked with a circled "i". At this point, we will indicate possible error sources and tell you how to avoid them.

➤ *Alternative results and steps are marked with an arrow. This will tell you how to reach the same results performing different steps, or what you could do if you didn't reach the expected results at this point.*

2 Safety Instructions

The Safety Instructions section provides an overview about the safety instructions, which must be observed for the operation of the product.

The product is constructed according to the currently valid state-of-the-art technology and reliable in operation. It has been checked and left the factory in flawless condition concerning safety. In order to maintain this condition during the service life, the instructions of the valid publications and certificates must be observed and followed.

It is necessary to adhere to the general safety instructions must when operating the product. The descriptions of processes and operation procedures are provided with precise safety instructions in the respective sections in addition to the general safety instructions.

Moreover, the local accident prevention regulations and general safety regulations for the operating conditions of the device are effective.

An optimum protection of the personnel and the environment from hazards as well as a safe and fault-free operation of the product is only possible if all safety instructions are observed.

2.1 Intended Purpose

The product may be used for the following purposes:

- Usage and installation in an industrial cabinet
- Switching and data transmission functions in machines according to the machine directive 2006/42/EC.
- Usage as data transmission device for a PLC.

The product has no assured properties with regard to functional safety, for example in accordance with the SIL standard. In the event of possible use as a component in a safety function, the system integrator or installer assumes full responsibility for the fulfilment of the safety function.

The product has no assured properties with regard to explosion protection, for example in accordance with the ATEX Directive. In the event of possible use as a component in potentially explosive atmospheres, the system integrator or installer assumes full responsibility for the fulfilment of the scope requirements function.

2.2 Permissible Technical Limits

The product is only intended for the use within the permissible technical limits specified in the data sheets.

The following permissible limits must be observed:

- The ambient temperature limits must not be fallen below or exceeded.
- The supply voltage range must not be fallen below or exceeded.
- The maximum humidity must not be exceeded and condensate formation must be prevented.
- The maximum switching voltage and the maximum switching current load must not be exceeded.
- The maximum input voltage and the maximum input current must not be exceeded.

2.3 SIM Card Requirements

In order to ensure a long function, it is necessary to use so-called M2M SIM cards in industrial quality. Compared to standard SIM cards, industrial SIM cards (also known as M2M or IoT SIM cards) offer not only better mechanical properties but also a significantly longer service life and a much higher number of write cycles, thereby supporting the frequent switching operations that can occur in M2M or IoT applications.

2.1 Responsibilities of the Operator

As a matter of principle, the operator must observe the legal regulations, which are valid in his country, concerning operation, functional test, repair and maintenance of electrical devices.

2.2 Qualification of the Personnel

The installation, commissioning and maintenance of the product must only be performed by trained expert personnel, which has been authorised by the plant operator. The expert personnel must have read and understood this documentation and observe the instructions.

Only a person, who is able to work on electrical installations and identify and avoid possible hazards independently, based on professional training, knowledge and experience as well as knowledge of the relevant standards and regulations is permitted to carry out the electrical connection and commissioning of the product.

2.3 Instructions for Transport and Storage

The following instructions must be observed:

- Do not expose the product to moisture and other potential hazardous environmental conditions (radiation, gases, etc.) during transport and storage. Pack product accordingly.
- Pack product sufficiently to protect it against shocks during transport and storage, e.g. using air-cushioned packing material.

Check product for possible damages, which might have been caused by improper transport and storage, before installation. Transport damages must be noted down to the shipping documents. All claims or damages must be filed immediately and before installation against the carrier or party responsible for the storage.

2.4 Markings on the Product

The identification plate of the product is either a print or a label on a face of the product. Amongst other things, it can contain the following markings, which are explained in detail here.



Observe manual

This symbol indicates that the manual of the product contains essential safety instructions that must be followed implicitly.



Dispose waste electronic equipment environmentally compatible

This symbol indicates that waste electronic equipment must be disposed separately from residual waste via appropriate collecting points. See also Section Disposal in this manual.



CE marking

By applying a CE marking, the manufacturer confirms that the product complies with the European directives that apply product-specific.



UL marking

By applying a UL marking, the manufacturer confirms that the product complies with the obligatory safety requirements.



FCC marking

By applying a FCC marking, the manufacturer confirms that the product complies with the obligatory safety requirements.



Appliance Class II - double insulated

This symbol indicates that the product complies with Appliance Class II



Appliance Class III - protection by extra low voltage

This symbol indicates that the product complies with Appliance Class III

2.5 Protection of the Environment

Dispose the product and the packaging according to the relevant environmental protection regulation. The Waste Disposal section in this manual contains notes about disposing the product. Separate the packaging components of cardboard and paper as well as plastic and deliver them to the respective collection systems for recycling.

2.6 Safety Instructions for Electrical Installation

The electrical connection must only be made by authorised expert personnel according to the wiring diagrams.

The notes to the electrical connection in the manual must be observed. Otherwise, the protection category might be affected.

The safe disconnection of circuits, which are hazardous when touched, is only ensured if the connected devices meet the requirements of VDE 0106 T.101 (Basic requirements for safe disconnection).

The supply lines are to be routed apart from circuits, which are hazardous when touched, or isolated additionally for a safe disconnection.

An easily accessible, fixed installed cut-off device must be installed prior to commissioning to be able to isolate the device from power supply completely (all poles).

2.7 General Safety Instructions

Caution!



Electrostatic discharges may damage the product!

Damage of the product.

Observe the general safety precautions when handling electrostatic-discharge-sensitive parts.

Caution!



Incomplete voltage isolation!

Damage of the product.

To isolate the voltage from the device, disconnect **any** supply circuit with its respective isolation device if a redundant power supply is used.

Caution!



Overcurrent of the device supply!

Fire hazard and damage of the product due to overcurrent.

The product must be secured with a suitable fuse against currents exceeding 3.15 A. It must be ensured that the fuse will only be replaced by a fuse with the same rating in case it needs to be replaced.

Caution!



Moisture and liquids from the environment may seep into the interior of the product!

Fire hazard and damage of the product.

The product must not be used in wet or damp environments, or in the direct vicinity of water. Install the product at a dry location, protected from water spray. Disconnect the power supply before you perform any work on a device which may have been in contact with moisture.

Caution!

Short circuits and damage due to improper repairs and modifications as well as opening of maintenance areas!

Fire hazard and damage of the product.

It is not permitted to open the product for repair or modification exceeding the removal or installation of the designated plug-in cards.

Caution!

Overvoltage and voltage peaks from the mains supply!

Fire hazard and damage of the product due to overvoltage.

Install suitable overvoltage protection.

Caution!

Damage due to chemicals!

Ketones and chlorinated hydrocarbons dissolve the plastic housing and damage the surface of the device.

Never let the device come into contact with ketones (e.g. acetone) or chlorinated hydrocarbons, such as dichloromethane.

Caution!

Distance from antennas to persons!

A too low distance from cellular antennas to persons can affect the health.

Please observe to keep a minimum distance of 30 cm between the cellular antenna and persons during operation.

3 IT Security

Note



Insecure configured routers may compromise security-relevant applications!

Follow the instructions under IT Security Overview to protect your router:

<https://docs.insys-icom.com/docs/en/it-security-en>

For a configuration that meets higher security requirements, a Secure Configuration Guide is also available there (<https://docs.insys-icom.com/docs/en/it-security-secure-configuration-guide-en>).

4 Using Open Source Software

4.1 General

The product contains, amongst others, so-called open-source software that is provided by third parties and has been published for free public use. The open-source software is subject to special open-source software licenses and the copyright of third parties. Basically, each customer can use the open-source software freely in compliance with the licensing terms of the respective producers. The rights of the customer to use the open-source software beyond the purpose of our product are regulated in detail by the respective concerned open-source software licenses. The customer use the open-source software freely, as provided in the respective effective license, beyond the purpose that the open-source software gets in our product. In case there is a contradiction between the licensing terms for our product and the respective open-source software license, the respective relevant open-source software license takes priority over our licensing terms, as far as the respective open-source software is concerned by this.

The use of the used open-source software is possible free of charge. We do not demand usage fees or any comparable fees for the use of the open-source software contained in our product. The use of the open-source software in our product by the customer is not part of the earnings we achieve with the contractual compensation.

All open-source software programs contained in our product can be taken from the available list. The most important open-source software licenses are listed in the Licenses section at the end of this publication.

As far as programs contained in our product are subject to the GNU General Public License (GPL), GNU Lesser General Public License (LGPL), Clarified Artistic License or another open-source software license, which regulates that the source code must be made available, and if this software is not already delivered in source code on a data carrier with our product, we will send you this at any time upon request. If it is required to send this on a data carrier, the sending will be made against payment of a cost compensation of € 10,00. Our offer to send the source code upon request ceases automatically 3 years after delivery of our product to the customer. Requests must be directed to the following address, if possible under specification of the serial number:

INSYS icom GmbH
Hermann-Köhl-Str. 22
93049 Regensburg
Phone +49 941 58692 0
Fax +49 941 58692 45
E-mail: support@insys-icom.de

4.2 Special Liability Regulations

We do not assume any warranty or liability, if the open-source software programs contained in our product are used by the customer in a manner that does not comply any more with the purpose of the contract, which is the basis of the acquisition of our product. This concerns in particular any use of the open-source software programs outside of our product. The warranty and liability regulations that are provided by the respective effective open-source software license for the respective open-source software as listed in the following are effective for the use of the open-source software beyond the purpose of the contract. In particular, we are not liable, if the open-source software in our product or the complete software configuration in our product is changed. The warranty granted with the contract, which is the basis of the acquisition of our product., is only effective for the unchanged open-source software and the unchanged software configuration in our product.

4.3 Used Open-Source Software

You can find a list of the open-source software used in this product by clicking ? > Open-Source Licenses in the title bar of the router's user interface. Alternatively, you can contact our support department (support@insys-icom.de) for a list of the open-source software used in this product.

5 Version History

Version	Modification
1.0	Release

6 Device Variants

This manual describes different variants of the industrial router series MRX.neo of INSYS icom. The flexible industrial routers of the series MRX.neo are available in three housing widths with two, three or five slots and several basic variants. Various plug-in cards (MRcards) are also available to extend the functional scope of the router flexible. Only specific sections of this manual apply depending on housing width, basic variant and inserted plug-in cards.

6.1 Housing Widths

The industrial routers are available in three housing widths, as MRX2.neo with two slots for plug-in cards, MRX3.neo with three slots, and as MRX5.neo with five slots. The left-hand slot is reserved for the basic card with an integrated switch in all versions.

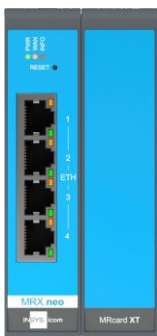


Figure 1: MRX2.neo



Figure 2: MRX3.neo



Figure 3: MRX5.neo

6.2 Basic Variants

The basic variants of the MRX.neo industrial router series are characterised by the fact that the left-hand slot is reserved for a basic card featuring an integrated 4-port switch, two digital inputs/outputs, an RS-485 interface and, optionally, WiFi with integrated power supply. The following basic variants are available:

- MRX5.neo-E with 4x 1 Gbit/s Ethernet, 2 DI/O, RS-485 and 4 free slots
- MRX5.neo-EW with 4x 1 Gbit/s Ethernet, 2 DI/O, RS-485 , WiFi and 4 free slots
- MRX3.neo-E with 4x 1 Gbit/s Ethernet, 2 DI/O, RS-485 and 2 free slots
- MRX3.neo-EW with 4x 1 Gbit/s Ethernet, 2 DI/O, RS-485 , WiFi and 2 free slots
- MRX2.neo-E with 4x 1 Gbit/s Ethernet, 2 DI/O, RS-485 and 1 free slot
- MRX2.neo-EW with 4x 1 Gbit/s Ethernet, 2 DI/O, RS-485 , WiFi and 1 free slot

In addition, the MRX2.neo is available as a pre-configured compact unit in the following versions.

- MRX2.neo-8.LAN (4x 1 Gbit/s and 4x 100 MBit/s Ethernet, 2 DI/O, RS-485, Router)
- MRX2.neo-Fiber (2x SFP, 4x 1 Gbit/s Ethernet, 2 DI/O, 1 DI, RS-485, Router)
- MRX2.neo-5G.WLAN (5G cellular radio, WiFi, 4 DI/O, 1 DI, RS-485, RS-232, Router)

6.3 Plug-in Cards (MRcards)

The MRcards allow a flexible extension of your router to a tailor-made device for your application. The left slot is always reserved for the base card with integrated 4-port switch that is already present in all basic variants. The additional slots are available for flexible expansion of the basic model. The combination of the cards is only limited by the maximum power consumption, refer to page 32. The following MRcards are available at the moment:



Figure 4: MRcard MSI5G

- 5G, 4G/LTE
- RS-232
- 2 digital I/Os
- 1 digital input
- 2 Nano-SIM



Figure 5: MRcard MSI4G

- 4G/LTE
- RS-232
- 2 digital I/Os
- 1 digital input
- 2 Nano-SIM



Figure 6: MRcard PL450D

- 4G/LTE incl. LTE450
- 2 Mini-SIM
- 2 digital inputs



Figure 7: MRcard Fiber

- 2 SFP ports
- 2 digital inputs



Figure 8: MRcard ES

- 4-Port switch (10/100 Mbit/s)



Figure 9: MRcard PD-A/B

- VDSL
- ADSL/2/2+
- 2 digital inputs



Figure 10: MRcard IO

- 3 analogue inputs
- 1 analogue output
- 4 digital inputs
- 4 digital outputs



Figure 11: MRcard SI

- RS-232
- RS-485
- 2 digital inputs
- 2 digital outputs



Figure 12: MRcard PL

- 4G/LTE
- 2 digital inputs
- 1 Mini-SIM

7 Scope of Delivery

The scope of delivery includes all accessories listed below. Please check if all accessories are included in the box. If a part is missing or damaged, please contact your distributor.

- Industrial Routers
- Quick Installation Guide
- Safety Instructions

The scope of delivery does not include optional accessories. Among other things, the following parts are available from your distributor or INSYS icom:

- WiFi and cellular antennas
- Antenna extensions
- Din rail power supply units
- Device App icom Data Suite
- VPN service
icom Connectivity Suite - VPN
- M2M SIM card and management portal
icom Connectivity Suite - M2M SIM
- Central device management for certificates, updates and configurations
icom Router Management

8 Technical Information

8.1 Basic Variants

The following information applies to all variants of the MRX.neo. If these variants differ, the different values will be indicated separately. The specifications of the MRcards can be found subsequently.

For individual units in their respective configurations, as well as the pre-configured compact units of the MRX2.neo, the specifications of the base models and any additional cards installed should be consulted.

8.1.1 Technical Data

8.1.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Operating voltage	12 V ... 24 V DC ($\pm 20\%$), protection against reverse polarity and voltage surges (surge/transient)
Power consumption	MRX2.neo: max. 5 ... 12 W MRX3.neo: max. 5 ... 20 W MRX5.neo: max. 5 ... 30 W See Table 5
Level digital input	Level HIGH = 2 ... 24 V Level LOW = 0 ... 1 V Contact open condition: HIGH
Current consumption input at LOW potential	Typ. 5 mA when connecting to GND
Digital output (open collector), max. load	24 V (DC), 50 mA
Max. voltage drop of the output in ON condition	< 1 V (DC) at 50 mA load
WiFi output power	Max. 100 mW (only MRX.neo2/3/5 W)
Real-time clock (RTC) buffer time	Typ. 25 days

Physical Feature	Value
Weight	MRX2.neo-E: 235 g MRX2.neo-EW: 240 g MRX2.neo-Fiber: 295 g MRX2.neo-8.LAN: 305 g MRX2.neo-5G.WLAN: 310 g MRX3.neo-E: 310 g MRX3.neo-EW: 315 g MRX5.neo-E: 410 g MRX5.neo-EW: 415 g
Dimensions (width x height x depth)/ Width in DIN rail modules	MRX2.neo: 54 x 117 x 88 mm/3TE MRX3.neo: 82 x 117 x 88 mm/5TE MRX5.neo: 136 x 117 x 88 mm/8TE
Temperature	Operation: see Table 2 below Storage: -30 ... 75 °C
Maximum permissible humidity	95% non-condensing
IP rating	Housing IP30, connectors IP30
Environmental conditions	Vibration/Schock as per PLC standard EN 61131-2 und EN 60068-2-6, EN 60068-2-27 Temperature tests as per EN 60068-2- 1, EN 60068-2-2, EN 60068-2-14, EN 60068-2-30
MTBF (established for variant MRX2.neo-E with MRcard MSI.4G, others may vary)	> 645.000 h (25°C), as per standard SN 29500 (according to IEC 61709)

Table 1: MRX2/3/5.neo – physical features

- i** The details for the communication interface can be found for the respective MRcard.
- i** The following requirements apply to the external power supply:
- PS2 classified as per IEC62368-1
 - Short-circuit current < 8 A

Housing variant	Standard	Extended
MRX2.neo-8-LAN	-30 ... 70 °C	-30 ... 75 °C
MRX2.neo-Fiber	-30 ... 70 °C	-30 ... 75 °C
MRX2.neo 5G.WLAN	-30 ... 65 °C	-30 ... 70 °C
MRX2/3/5.neo	-30 ... 70 °C	-30 ... 75 °C
MRX2/3/5.neo-W	-30 ... 70 °C	-30 ... 75 °C

Table 2: MRX2/3/5.neo – physical features– Temperature range - operation



The temperature ranges specified apply to the respective basic devices and are reduced accordingly when additional cards with lower temperature ranges are used.

Depending on the model, the extended temperature range allows a temporary operation under increased or very low temperatures. Please note that temporary functional limitations may occur in this case.

A temporary reduction of the cellular data rate may occur at increased temperatures, for example. This protects the device from excessive heating and occurs in the event of temporarily increased power requirements, such as high cellular data rates or very unfavourable cellular coverage.

For applications with generally increased power requirements, such as continuous data transmission or simultaneous use of more than 2 LAN ports, the extended upper temperature range is not suitable; the upper temperature limit of the standard range shall apply.

8.1.1.2 Technological Features

Technological Feature	Description
4-port Ethernet switch	10/100/1000 Mbit/s full/half duplex auto sense; Auto - MDI/ MDI-X; automatic detection of "crossover" or "patch" wiring.
Isolation voltage	1.5 kV
WiFi	IEEE 802.11 a/b/g/n/ac/ax (Wi-Fi 6), 2.4 and 5 GHz WiFi Station (Client), WiFi AP for up to 16 clients simultaneously, WPA/WPA2/WPA3 (AES, TKIP), 802.1x (EAP, TLS, TTLS, PEAP) (only MRX2/3/5.neo-W and MRX2.neo-5G.WLAN)
RS-485 interface (EIA-485)	Max. baud rate 230,400 bit/s

Table 3: MRX2/3/5.neo – technological features

8.1.2 Connections, operation and display elements

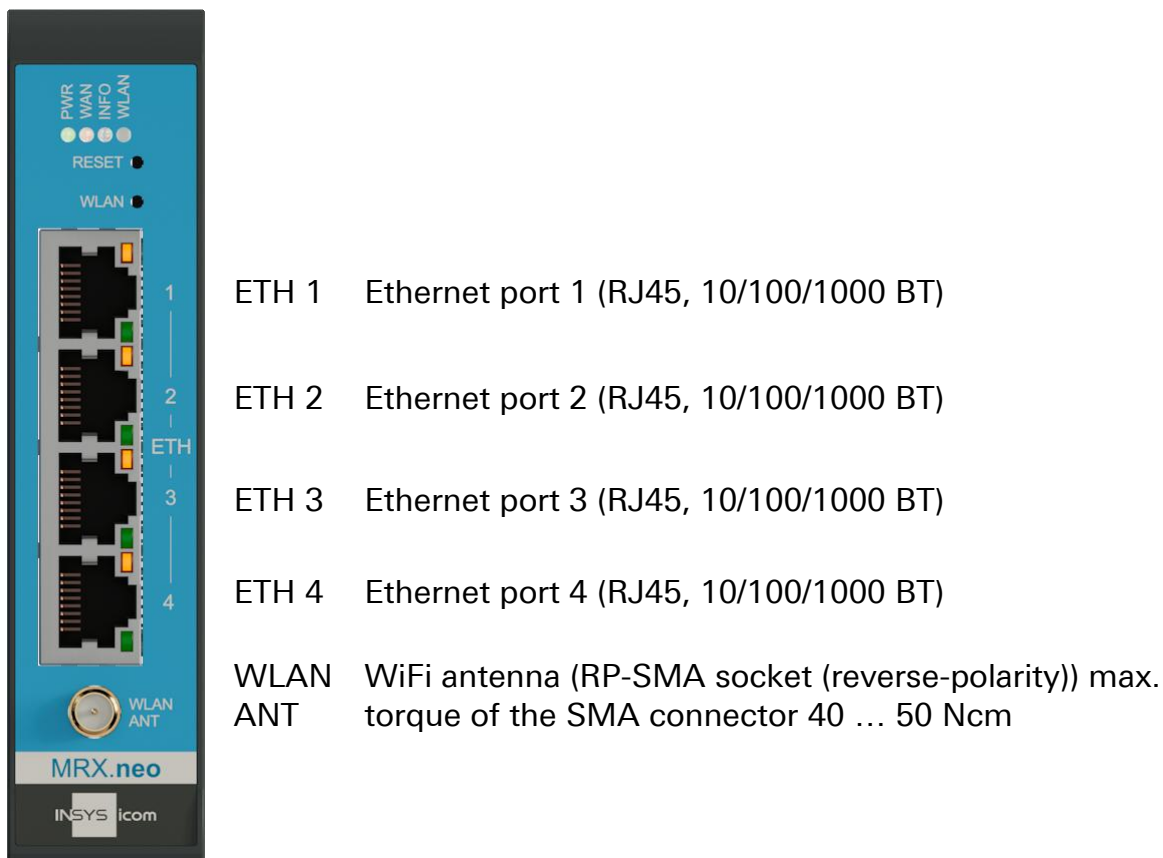


Figure 13: Basic variants – connections, operation and display elements at the front

- ❗ Do not use WiFi antennas with a gain of more than 3.6 dBi (2.4 GHz) or 4.6 dBi (5 GHz)!

8.1.2.1 Switch port LED

Each switch port has a green and an orange LED.

The colour indicates the data rate used on the respective port:

- green + orange – 10 Mbps
- only green – 100 Mbps
- only orange – 1000 Mbps

The status of the LED indicates the function:

- off – no data connection (no cable connected, cable defective or network interface on the connected device is not available)
- blinking – data is being transmitted
- on – data connection established, but no data is being transmitted

8.1.2.2 Power LED

The PWR (Power) LED indicates the device status and the boot process.

- off – device powered down
- blinks green – 1x with soft reset, 3x when resetting to default factory settings

- lights **green** – device is powered on and booted
- lights **orange** – boot process is running
- blinks **red** – reset is being performed
- lights **red** – device has been decommissioned using the 'Secure decommissioning' function and is currently in rescue mode

8.1.2.3 WAN LED

The WAN LED indicates the status of the WAN chain.

- off – WAN chain not active
- blinks **green** – primary WAN chain is being established
- lights **green** – primary WAN chain established up to the final interface
- blinks **orange** – non-primary (alternative) WAN chain is being established
- lights **orange** – non-primary (alternative) WAN chain established up to the final interface

8.1.2.4 INFO LED

The INFO LED can be individually configured and indicates the following in factory settings.

- blinks **orange** – profile active ≠ saved
- lights **red** – boot process is running

8.1.2.5 WLAN LED

The WLAN LED indicates the status of the WiFi interface (if equipped).

- off – WiFi disabled or not active
- lights **green** – connection established in station mode, active, and at least 1 client connected in AP mode
- blinks **orange** – active, but no connection established in station mode; active, but no client connected in AP mode

Designation	Operation	Meaning
RESET	Press 1x for 1-3 seconds and release. Power LED blinks 1x green to confirm	Resets the software and restarts it.
	Press briefly three times in quick succession within 3 seconds, or press and hold for at least 8 seconds. Power LED blinks 3x green to confirm	Deletes all settings and resets the device to the factory defaults.
WLAN	Press 1x: activate WiFi for 120 min. (standard) Press 1x with active WiFi: deactivate WiFi	WiFi on/off

Table 4: Basic variants – function and meaning of the control elements

B	RS-485 interface - data line B
A	RS -485 interface - data line B
DIO 1	Digital input/output 1
DIO 2	Digital input/output 2
GND	Ground (V, IO and RS-232)
V+	Power supply, positive terminal

- ① The device is powered exclusively via this terminal; the power supply terminals on other MRcards must not be used!

Figure 14: Basic variants – connection at the connector

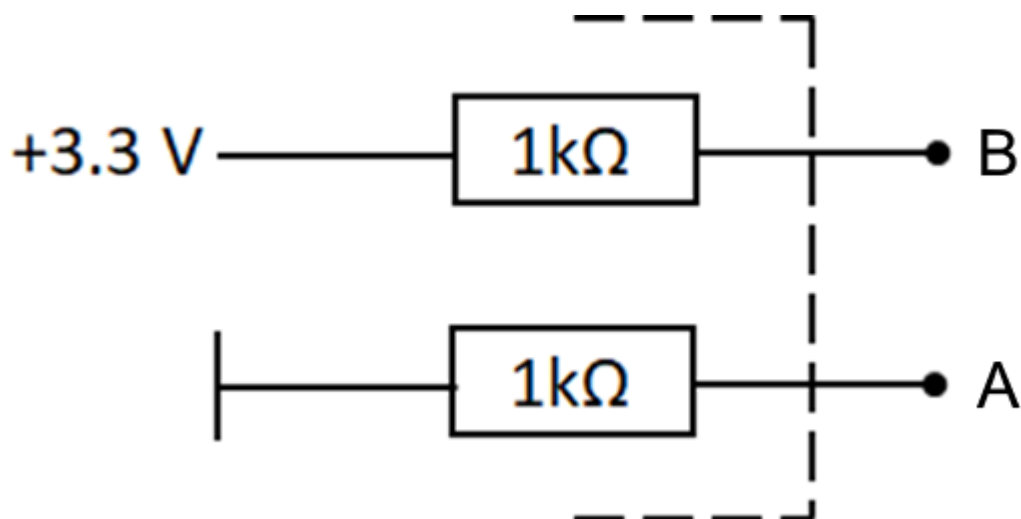


Figure 15: Principle circuit diagram of the RS-485 interface

8.1.2.6 Digital inputs/outputs

The router has two configurable digital inputs/outputs. The digital inputs/outputs are configured as input in default setting.

If the input/output is configured as input, it is low-active, i.e. active, if it is connected to GND.

If the input/output is configured as output, it is designed as open collector output. You'll find more information in Table 1.

The following illustrations show an example of an input connection and two examples of output connections: on the left, an LED; on the right, a relay.

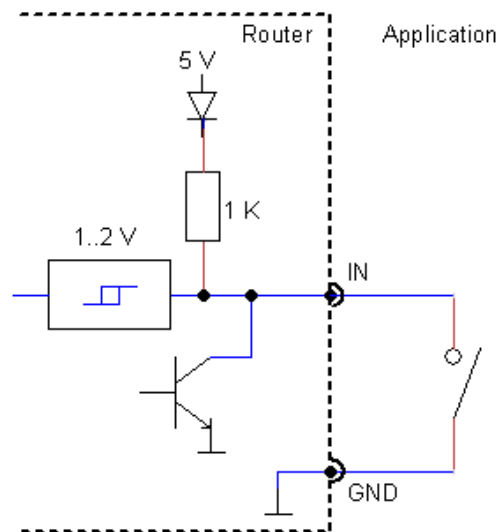


Figure 16: Digital input – connection example

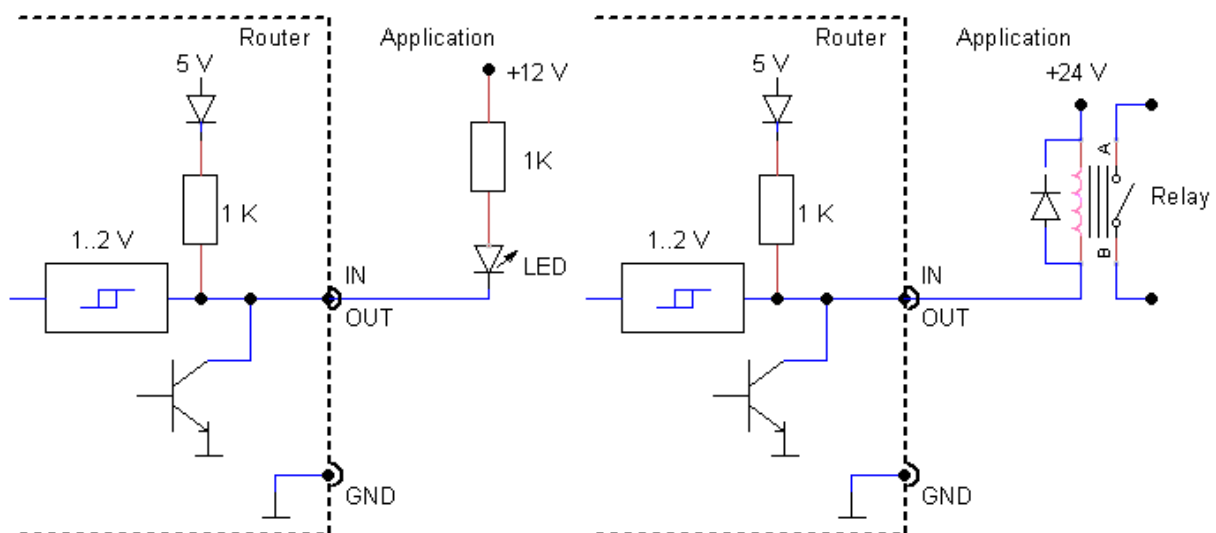


Figure 17: Digital open collector output – connection example

8.1.3 Power consumption estimation

The power consumption of the MRX.neo depends on the inserted MRcards and your special application. The following information serves for estimating the expected power consumption of your solution. All information is based on averaged values and do not consider inrush currents or brief load peaks. Use the maximum values for dimensioning your power supply.

MRcard	Typ.	Max.	Comment
Basic device	2.5 W	5 W	Depending on the number of used ports, data throughput and processor load
MSI.5G	1 W	7 W	Depending on login state, reception and data throughput
MSI.4G	1 W	5 W	Depending on login state, reception and data throughput
PL/PL450/ PL450D	1 W	5 W	Depending on login state, reception and data throughput
PD (DSL)	5 W	5 W	
SI (Serial)	1 W	2.5 W	Depending on the interfaces used and the status of the outputs
ES (Ethernet)	1 W	1.5 W	Depending on the number of used ports and the data throughput
IO (digital and analogue IO)	-	1.5 W	Depending on connections and settings
Fiber	5 W	5 W	4 W plus 0.5 W per inserted SFP module

Table 5: Power consumption estimation

Add the values from above table of the MRcards installed in your MRX.neo to the value of the basic card (incl. 4-port switch). It is not permitted to install more than two MRcards MSI, PL, PL450(D), PD and/or Fiber at the same time.

8.1.4 Connecting the connectors

The connectors supplied vary depending on the MRcard used. The connectors are encoded and cannot be interchanged between different MRcards. The wires are contacted maintenance-free in the connector via a spring clip. Rigid wires (stripped) or stranded wires with end sleeves are only inserted into the connectors to clamp them. Stranded wires (braids) without end sleeve are clamped by pushing in the orange opener (e.g. using a flat-blade screwdriver with max. 3.5 mm width). Unclamping a wire is also done by pushing in the opener.

- ❗ Depending on when the card was manufactured, it may be fitted with a dark grey or white connector from different manufacturers. Even though these connectors are plug-compatible, it is not permitted to use connectors and sockets from different manufacturers together.

The permissible cable cross-sections depend on the nominal cross-section of the connectors and the cable used. They can be found in the following table.

Wire	Cross-section	
	1.5 mm ²	2.5 mm ²
Nominal cross-section	1.5 mm ²	2.5 mm ²
Rigid	0.2 ... 1.5 mm ²	0.2 ... 2.5 mm ²
Flexible	0.2 ... 1.5 mm ²	0.2 ... 2.5 mm ²
Flexible with end sleeve without collar	0.25 ... 1.5 mm ²	0.25 ... 2.5 mm ²
Flexible with end sleeve with collar	0.25 ... 0.75 mm ²	0.25 ... 2.5 mm ²

Table 6: Permissible wire cross-sections for connectors

- ❗ Connectors with a nominal cross-section of 1.5 mm² are located on the base and front of all MRcards; connectors with a nominal cross-section of 2.5 mm² are located on the top of all MRcards.

8.1.5 Maximum line lengths

The maximum line lengths to the connections can be found in the following table.

Wire	Max. length
Antennas, power supply, serial interfaces, inputs and outputs, other signals	30 m

Table 7: Permissible line lengths

8.1.6 Certifications

The router provides the following certifications:

- EMC, Emission: EN 61000-6-3, EN 55032 Class B
- EMC, Immunity: EN 61000-6-2, EN 55035
- Product safety: IEC/EN 62368-1

The compliance of the complete unit depends on the basic variant and the plug-in cards used. The required approval for a particular application will only be granted if the basic variant and all installed plug-in cards meet the approval criteria. The basic variants and individual MRcards provide the following certifications.

MRcard	Certifications
MRX.neo-E	CE, FCC Part 15 Class B, IC (ISED Canada)
MRX.neo-EW	CE
MSI.4G/5G	CE, FCC Part 15 Class B, IC (ISED Canada)
PL (4G/LTE)	MRcard PL 1.1: CE, FCC Part 15 Class B, IC (ISED Canada) MRcard PL 1.0: CE
PD (DSL)	CE
SI (Serial)	CE, FCC Part 15 Class B, IC (ISED Canada)
ES (Ethernet)	CE, FCC Part 15 Class B, IC (ISED Canada)
IO (digital and analogue IO)	CE, FCC Part 15 Class B, IC (ISED Canada)
Fiber	CE, FCC Part 15 Class B, IC (ISED Canada)
PL450(D)	CE, Whitelisting 450connect (provider approval)

Table 8: Certifications

- CE: all EU countries, Albania, Bosnia and Herzegovina, Georgia, Iceland, Liechtenstein, Moldova, Montenegro, North Macedonia, Norway, Switzerland, Serbia, Turkey, Ukraine, the United Kingdom
- FCC Part 15 Class B: USA
- IC (ISED Canada): Canada

You can find the relevant documents in the Knowledge Base on the product information page.

8.2 MRcard MSI.5G

The MRcard MSI.5G is a plug-in card designed to expand the basic variants with a 5G mobile modem featuring two SIM card slots, one digital input, two digital inputs/outputs and a serial RS-232 interface. The technical data of the basic variants are extended by the following data with inserted MRcard MSI.5G.

8.2.1 Technical Data

8.2.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Max. transmission power cellular engine	+25.7 dBm
UMTS	+25.7 dBm
LTE all bands except band 41	+25.7 dBm
LTE band 41	+28.7 dBm
5G bands n41, n77, n78, n79	+25.7 dBm
5G all other bands	
Level digital input DI	Level HIGH = 10 ... 24 V Level LOW = 0 ... 5 V Contact open condition: LOW
Power consumption input DI at HIGH potential	Max. 5 mA at 24 V DC
Level digital input I/O	Level HIGH = 2 ... 24 V Level LOW = 0 ... 1 V Contact open condition: HIGH
Current consumption input I/O at LOW potential	Typ. 5 mA when connecting to GND
Digital output I/O (open collector), max. load	24 V (DC), 50 mA
Max. voltage drop of the output I/O in ON condition	< 1 V (DC) at 50 mA load
Weight	85 g
Dimensions (Width x Height x Depth (w/o protruding connectors))	27 x 117 x 81 mm
Temperature - operation	-30 ... 70 °C extended -30 ... 65 °C standard
Temperature - storage	-30 ... 75 °C

Table 9: MRcard MSI.5G – physical features

- ❶ The specifications for the inputs/outputs and the RS-485 interface can be found in the basic variant section.
- ❶ The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use; the extended temperature range applies under certain conditions (see Table 2 on page 26).

8.2.1.2 Technological Features

Technological Feature	Description
5G-frequency bands	n1 (UL 1920–1989 / DL 2110–2170 MHz) n2 (UL 1850–1910 / DL 1930–1990 MHz) n3 (UL 1710–1785 / DL 1805–1880 MHz) n5 (UL 824–849 / DL 869–894 MHz) n7 (UL 2500–2570 / DL 2620–2690 MHz) n8 (UL 880–915 / DL 925–960 MHz) n12 (UL 699–716 / DL 729–746 MHz) n13 (UL 777–787 / DL 746–756 MHz) n14 (UL 788–798 / DL 758–768 MHz) n18 (UL 815–830 / DL 860–875 MHz) n20 (UL 832–862 / DL 791–821 MHz) n25 (UL 1850–1915 / DL 1930–1995 MHz) n26 (UL 814–849 / DL 859–894 MHz) n28 (UL 703–748 / DL 758–803 MHz) n29 (SDL 717–728 MHz Downlink) n30 (UL 2305–2315 / DL 2350–2360 MHz) n38 (TDD 2570–2620 MHz) n40 (TDD 2300–2400 MHz) n41 (TDD 2469–2690 MHz) n48 (TDD 3550–3700 MHz) n66 (UL 1710–1780 / DL 2110–2200 MHz) n71 (UL 663–698 / DL 617–652 MHz) n75 (SDL 1432–1517 MHz) n76 (SDL 1427–1432 MHz) n77 (TDD 3300–4200 MHz) n78 (TDD 3300–3800 MHz) n79 (TDD 4400–5000 MHz) 5G NSA up to: 3.4 Gbps DL / 0.46 Gbps UL 5G SA up to: 2.5 Gbps DL / 0.90 Gbps UL
LTE frequency bands (4G) Band (MHz)	B1 (UL 1920–1980 / DL 2110–2170 MHz) B2 (UL 1850–1910 / DL 1930–1990 MHz) B3 (UL 1710–1785 / DL 1805–1880 MHz) B4 (UL 1710–1755 / DL 2110–2155 MHz) B5 (UL 824–849 / DL 869–894 MHz) B7 (UL 2500–2570 / DL 2620–2690 MHz) B8 (UL 880–915 / DL 925–960 MHz) B12 (UL 699–716 / DL 729–746 MHz) B13 (UL 777–787 / DL 746–756 MHz)

	B14 (UL 788–798 / DL 758–768 MHz) B17 (UL 704–716 / DL 734–746 MHz) B18 (UL 815–830 / DL 860–875 MHz) B19 (UL 830–845 / DL 875–890 MHz) B20 (UL 832–862 / DL 791–821 MHz) B25 (UL 1850–1915 / DL 1930–1995 MHz) B26 (UL 814–849 / DL 859–894 MHz) B28 (UL 703–748 / DL 758–803 MHz) B29 (SDL DL 717–728 MHz) B30 (UL 2305–2315 / DL 2350–2360 MHz) B32 (SDL DL 1452–1496 MHz) B34 (TDD 2010–2025 MHz) B38 (TDD 2570–2620 MHz) B39 (TDD 1880–1920 MHz) B40 (TDD 2300–2400 MHz) B41 (TDD 2496–2690 MHz) B42 (TDD 3400–3600 MHz) B43 (TDD 3600–3800 MHz) B46 (TDD 5150–5925 MHz) B48 (TDD 3550–3700 MHz) B66 (UL 1710–1780 / DL 2110–2200 MHz) B71 (UL 663–698 / DL 617–652 MHz) B106 (UL 896–901 / DL 935–940 MHz) LTE Cat 19; 4G up to: 1.6 Gbps DL / 211 Mbps UL
UMTS/HSPA frequency bands (3G) Band (MHz)	B1 (UL 1920–1980 / DL 2110–2170 MHz) B2 (UL 1850–1910 / DL 1930–1990 MHz) B4 (UL 1710–1755 / DL 2110–2155 MHz) B5 (UL 824–849 / DL 869–894 MHz) B6 (UL 830–840 / DL 875–885 MHz) B8 (UL 880–915 / DL 925–960 MHz) B19 (UL 830–845 / DL 875–890 MHz) 3G: HSPA+ Rel. 8 (DL/UL 42/11 Mbps)
RS-232 interface	Max. baud rate 230,400 bit/s; software handshake XON/XOFF; various data formats
SIM card reader	Dual SIM Single Standby (DSSS); support of 1.8 V and 3.0 V SIM cards Format: Nano-SIM (4FF)
SMS	Dispatch / receipt
Antenna	5G: 4x4 MIMO 4G: MIMO in downlink direction 3G: Rx Diversity

Table 10: MRcard MSI.5G – technological features

- i** In practice, the maximum data rates of the wireless interface for 4G/5G are usually impossible to achieve. Among other factors, they are limited by the achievable throughput of the respective Ethernet interface (100 or 1000 Mbit/s depending on the Mrcard), the actual reception conditions (network signal strength), the antenna (use of MIMO/Rx diversity (see Antennas), power and positioning, and support from the respective provider (contract terms and network utilization).
- i** The SIM card tray may only be removed when the device is disconnected from the power supply.
- i** The RS-232 interface will only work if the MRCard is inserted into slot #2 of the MRX.neo router.

8.2.2 Connections as well as display and control elements

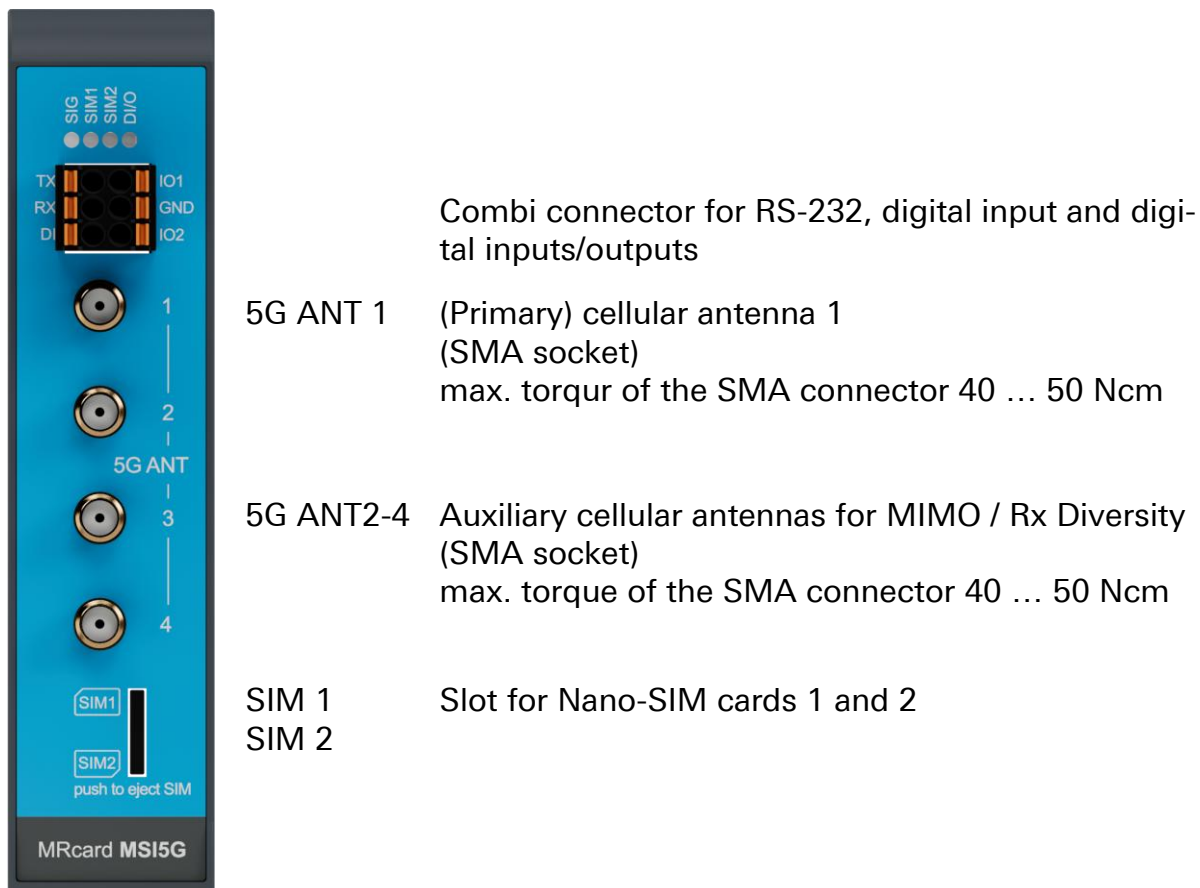


Figure 18: MRcard MSI5G – connections, display and control elements at the front

- i** See 8.2.3 Antennas for antenna connection. The screen of the antenna system must be connected to the protective conductor when using an outside mounted antenna.

8.2.2.1 SIG LED

The SIG (Signal) LED indicates the signal strength of the cellular connection currently in use (SIM1 or SIM2).

- off – SIM1 or SIM2 not registered
- blinks **green** – PDN connection established, for signal strength see Table 11
- blinks **orange** – no PDN connection established, for signal strength see Table 11

8.2.2.2 SIM1 LED

The SIM1 LED indicates the status of the SIM card in slot SIM1.

- off – no SIM card inserted in SIM1 or SIM card not valid
- lights **green** – SIM card in SIM1 is being used

8.2.2.3 SIM2 LED

The SIM2 LED indicates the status of the SIM card in slot SIM2.

- off – no SIM card inserted in SIM2 or SIM card not valid
- lights **green** – SIM card in SIM2 is being used

8.2.2.4 DI/O LED

The DI/O LED indicates a change in the status of a digital input/output.

- blinks **green** – a digital input has changed its state
- blinks **orange** – a digital output has changed its state

Blinking interval LED signal	Signal quality
on	maximum
900 ms on, 100 ms off	very good
200 ms on, 200 ms off	good
100 ms on, 900 ms off	poor
off	no signal or logged out

Table 11: Signal LED blinking cycle

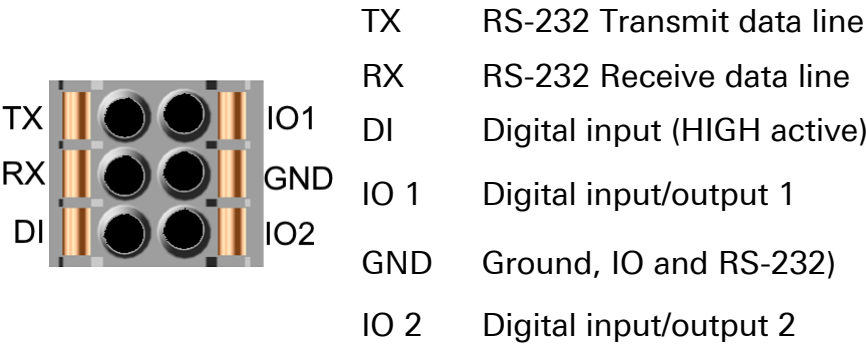


Figure 19: MRcard MSI.5G – connector

8.2.2.5 Inserting SIM cards

Gently press the SIM card tray inwards using your fingernail or a small flat-head screwdriver to release the catch, allowing the tray to slide out of the housing slightly. Then pull the tray out completely.

Then insert the Nano-SIM card into the slot on the relevant side of the tray (labelled SIM1/SIM2), with the contacts facing outwards. Please take care to note the bevelled edge.

Then reinsert the SIM card tray into the router and press it gently until you feel it click into place.

- ❗ The SIM card tray can only be inserted into the device in one orientation. If necessary, turn the tray if it does not slide in easily.

8.2.2.6 Digital inputs/outputs

The card has two configurable digital inputs/outputs and one digital input.

The digital inputs/outputs IO1 and IO2 correspond to the digital input/output of the basic variant, as described under 8.1.2.6 Digital inputs/outputs.

The digital input DI is high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. You'll find more information in Table 1. The illustration below shows an example of how to connect the input.

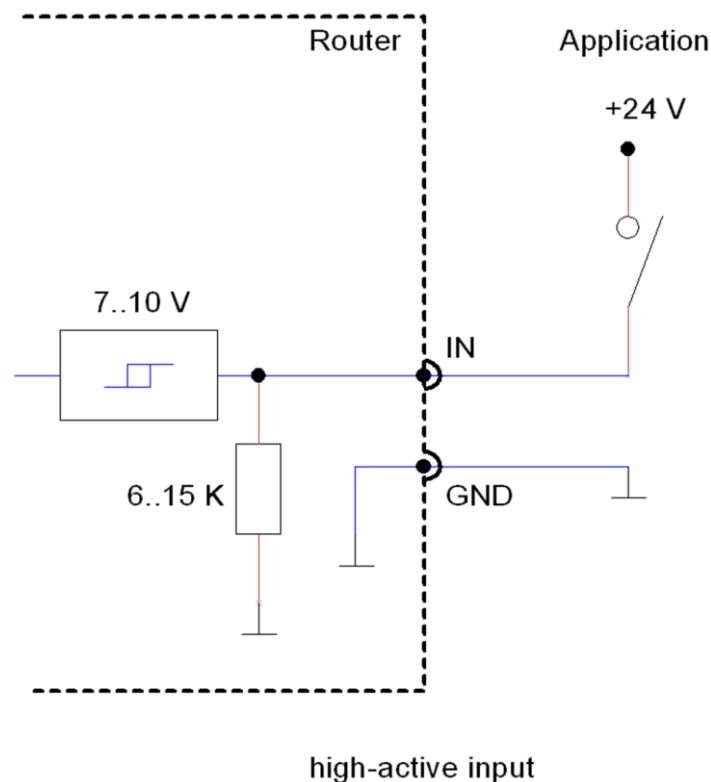


Figure 20: MRcard MSI.5G – digital input – connection example

8.2.3 Antennas

- ① As per EN 2014/53/EU, the operator of a radio equipment must comply with the harmonisation legislation. This includes in particular the selection and utilisation of suitable antenna systems. It must be ensured in particular that devices with radio technology are not operated without a suitable antenna system for an extended period.
- ① A separate antenna must be used for each wireless engine installed (mobile or WiFi). Combined antennas (mobile and WiFi) must not be used. These separate antennas must be at least 20 cm apart.
- ① Use only suitable cellular antennas that support all LTE and 5G frequency bands used at the deployment site. Follow the antenna manufacturer's installation instructions and comply with the regulatory requirements of the country of deployment.

- i** INSYS icom recommends using **four antennas** on the **5G ANT1** to **5G ANT4** connectors for standard 5G and LTE operation. Only with four antennas are all the intended reception and transmission paths available.
At least **two antennas** are required for satisfactory operation. The cellular bands in use must be known so that the appropriate combination of ports can be selected. Use four antennas in the event of unknown bands, automatic band switching or international roaming.
INSYS icom strongly advises against operating with just **one cellular antenna**. No diversity or MIMO functions are available. Reception quality, data rate and connection stability may be significantly reduced. Use this configuration only for a strictly defined LTE-only application or as a special technical operating mode.
- i** The product evaluation was carried out with four cellular antennas connected. Reduced antenna configurations may fall outside the fully tested performance and approval scope.

The **MRcard MSI.5G** in the **MRX.neo** features four cellular antenna connectors, **5G ANT1**, **5G ANT2**, **5G ANT3** and **5G ANT4**.

As the connectors to be used depend on the cellular band, you cannot use just any antenna connectors.

8.2.3.1 Standard installation with four antennas – 4x4 MIMO

For standard 5G and LTE operation, connect a suitable 4x4 MIMO cellular antenna to the 5G ANT1 to 5G ANT4 connectors.

The installation using four antenna connectors is the standard installation recommended by INSYS icom. Only with four antennas are all the intended receive and transmit paths available.

Four antennas do not automatically result in four parallel data streams during upload. Depending on the cellular band and network, the uplink operates using one or two transmit paths.

Additional antennas do not necessarily increase the displayed signal strength. However, they can improve signal quality, connection stability and usable data throughput.

When using the quad antenna supplied by INSYS icom, connect the labelled antenna cables as follows:

Antenna connection on the router	Antenna cable
5G ANT1	3
5G ANT2	4
5G ANT3	1
5G ANT4	2

Table 12: MRcard MSI.5G – connection assignment for quad antenna

8.2.3.2 Reduced installation with two antennas – 2x2 MIMO

An installation with two antennas is intended only for applications where the frequency bands used are known. Use the designated connection combination.

5G ANT1 and 5G ANT3

- 5G and LTE-FDD bands as well as most bands below 3 GHz
- 5G n38, n40 and n41
- LTE B34, B38, B39, B40 and B41

5G ANT1 and 5G ANT4

- 5G and LTE-FDD bands as well as most bands below 3 GHz
- 5G n48, n77, n78 and n79
- LTE B42, B43 and B48

Based on deployment country

The country information is provided for guidance only. The cellular network operator's actual frequency band is the determining factor. If this is not known, use four antennas.

- **Europe:** For 5G, frequencies in the range of approximately 3.3 to 3.8 GHz are particularly relevant.
If this 5G band is used, you should use **5G ANT1** and **5G ANT4**.
- **USA and Kanada:** Both 2.5 GHz bands and frequencies between approximately 3.45 and 3.98 GHz are used. For n41, use **5G ANT1** and **5G ANT3**.

i With two antennas, a maximum of two reception paths are available. On 4x4-capable bands, this limits the maximum possible download speed. Please select the antenna connectors to be used based on the location and your requirements. Using any two antenna connectors does not guarantee proper 2x2 operation.

i With 5G NSA, LTE and 5G frequencies are used simultaneously. The two wireless technologies may require different antenna paths. You should therefore check the installation with the relevant network operator and at the actual location of use.

8.2.3.3 Operation with one antenna – SISO

Operation with just one cellular antenna is technically possible for selected applications. INSYS icom expressly does not recommend this configuration for regular 5G operation.

For a clearly defined LTE-only application, a single antenna can be used on the band-dependent primary connector:

LTE application	Antenna connection at the router
Most LTE-FDD bands as well B34, B38, B39, B40 and B41	5G ANT1
LTE B42, B43 and B48	5G ANT4

Table 13: MRcard MSI.5G – connection assignment for one antenna

Operation with a single antenna is not intended for applications that automatically switch between 5G and LTE. The primary transmit and receive connector may differ between the 5G and LTE bands.

The following primary connectors apply for a special technical 5G mode:

5G band group	Antenna connection at the router
5G-FDD-Bänder and n40	5G ANT1
n38 and n41	5G ANT3
n48, n77, n78 and n79	5G ANT4

Table 14: MRcard MSI.5G – connection assignment for one antenna in 5G special operation

For a 5G single-antenna configuration of this kind, neither the data rate, nor the reception quality, nor the connection stability can be guaranteed.

Based on deployment country

The country information is provided for guidance only. The cellular network operator's actual frequency band is the determining factor.

- **Europe:** For operation in the common 5G band between approximately 3.3 and 3.8 GHz, use **5G ANT4**. For LTE-only and FDD applications, generally use 5G ANT1. For LTE-only and FDD applications, generally use **5G ANT1**.
- **USA:** For 5G in the 2.5 GHz band, use **5G ANT3**. For CBRS and C-band between approximately 3.55 and 3.98 GHz, use **5G ANT4**.
- **Canada:** For 5G in the 3.5 and 3.8 GHz bands, use **5G ANT4**. For LTE-only and FDD applications, generally use **5G ANT1**.

8.3 MRcard MSI.4G

The MRcard MSI.4G is a plug-in card designed to expand the basic variants with a 4G mobile modem featuring two SIM card slots, one digital input, two digital inputs/outputs and a serial RS-232 interface. The technical data of the basic variants are extended by the following data with inserted MRcard MSI.4G.

8.3.1 Technical Data

8.3.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Max. transmission power cellular engine UMTS LTE	+25.7 dBm +25.7 dBm
Level digital input DI	Level HIGH = 10 ... 24 V Level LOW = 0 ... 5 V Contact open condition: LOW
Power consumption input DI at HIGH potential	Max. 5 mA at 24 V DC
Level digital input I/O	Level HIGH = 2 ... 24 V Level LOW = 0 ... 1 V Contact open condition: HIGH
Current consumption input I/O at LOW potential	Typ. 5 mA when connecting to GND
Digital output I/O (open collector), max. load	24 V (DC), 50 mA
Max. voltage drop of the output I/O in ON condition	< 1 V (DC) at 50 mA load
Weight	75 g
Dimensions (Width x Height x Depth (w/o protruding connectors))	27 x 117 x 81 mm
Temperature - operation	-30 ... 70 °C extended -30 ... 65 °C standard
Temperature - storage	-30 ... 75 °C

Table 15: MRcard MSI.4G – physical features



The specifications for the inputs/outputs and the RS-485 interface can be found in the basic variant section.



The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use; the extended temperature range applies under certain conditions (see Table 2 on page 26).

8.3.1.2 Technological Features

Technological Feature	Description
LTE frequency bands (4G) Band (MHz)	B1 (UL 1920–1980 / DL 2110–2170 MHz) B2 (UL 1850–1910 / DL 1930–1990 MHz) B3 (UL 1710–1785 / DL 1805–1880 MHz) B4 (UL 1710–1755 / DL 2110–2155 MHz) B5 (UL 824–849 / DL 869–894 MHz) B7 (UL 2500–2570 / DL 2620–2690 MHz) B8 (UL 880–915 / DL 925–960 MHz) B12 (UL 699–716 / DL 729–746 MHz) B13 (UL 777–787 / DL 746–756 MHz) B14 (UL 788–798 / DL 758–768 MHz) B18 (UL 815–830 / DL 860–875 MHz) B19 (UL 830–845 / DL 875–890 MHz) B20 (UL 832–862 / DL 791–821 MHz) B25 (UL 1850–1915 / DL 1930–1995 MHz) B26 (UL 814–849 / DL 859–894 MHz) B28 (UL 703–748 / DL 758–803 MHz) B38 (TDD 2570–2620 MHz) B39 (TDD 1880–1920 MHz) B40 (TDD 2300–2400 MHz) B41 (TDD 2496–2690 MHz) B66 (UL 1710–1780 / DL 2110–2200 MHz) B71 (UL 663–698 / DL 617–652 MHz) LTE Cat 4 (DL: 150 Mbit/s, UL: 50 Mbit/s)
UMTS/HSPA frequency bands (3G) Band (MHz)	B1 (UL 1920–1980 / DL 2110–2170 MHz) B2 (UL 1850–1910 / DL 1930–1990 MHz) B4 (UL 1710–1755 / DL 2110–2155 MHz) B5 (UL 824–849 / DL 869–894 MHz) B6 (UL 830–840 / DL 875–885 MHz) B8 (UL 880–915 / DL 925–960 MHz) B19 (UL 830–845 / DL 875–890 MHz) Max. 42 Mbps (DL); max. 5.76 Mbps (UL)

RS-232 interface	Max. baud rate 230,400 bit/s; software handshake XON/XOFF; various data formats
SIM card reader	Dual SIM Single Standby (DSSS); support of 1.8 V and 3.0 V SIM cards Format: Nano-SIM (4FF)
SMS	Dispatch / receipt
Antenna	4G: 2x2 MIMO in downlink direction 3G: Rx Diversity

Table 16: MRcard MSI.4G – technological features

- ❶ In practice, the maximum data rates of the wireless interface for LTE Cat 4 are usually impossible to achieve. Among other factors, they are limited by the achievable throughput of the respective Ethernet interface (100 or 1000 Mbit/s depending on the MRcard), the actual reception conditions (network signal strength), the antenna (use of MIMO/Rx diversity (see Antennas), power and positioning, and support from the respective provider (contract terms and network utilization).
- ❷ The SIM card tray may only be removed when the device is disconnected from the power supply.
- ❸ The RS-232 interface will only work if the MRcard is inserted into slot #2 of the MRX.neo router.

8.3.2 Connections as well as display and control elements

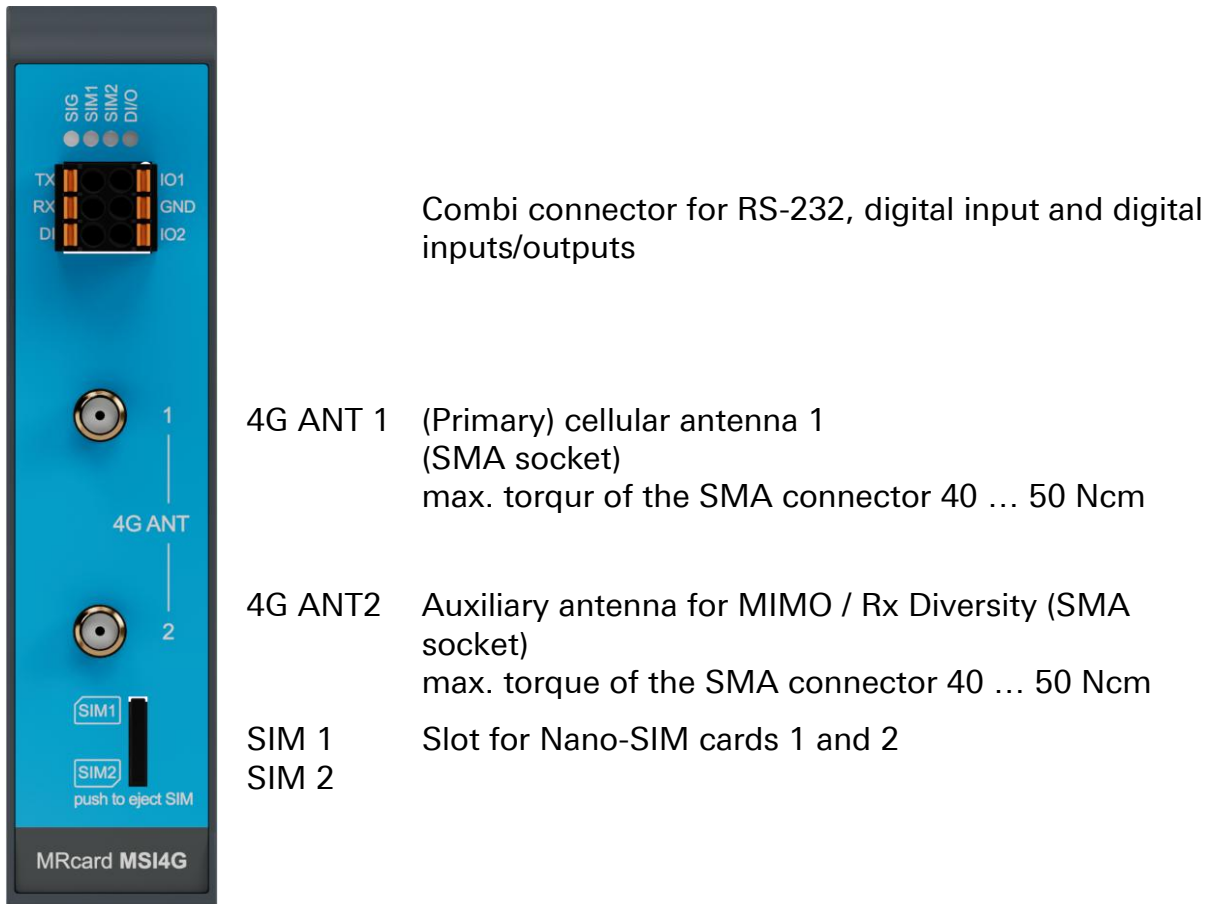


Figure 21: MRcard MSI.4G – connections, display and control elements at the front



See 8.2.3 Antennas for antenna connection. The screen of the antenna system must be connected to the protective conductor when using an outside mounted antenna.

8.3.2.1 SIG LED

The SIG (Signal) LED indicates the signal strength of the cellular connection currently in use (SIM1 or SIM2).

- off – SIM1 or SIM2 not registered
- blinks **green** – PDN connection established, for signal strength see Table 17
- blinks **orange** – no PDN connection established, for signal strength see Table 17

8.3.2.2 SIM1 LED

The SIM1 LED indicates the status of the SIM card in slot SIM1.

- off – no SIM card inserted in SIM1 or SIM card not valid
- lights **green** – SIM card in SIM1 is being used

8.3.2.3 SIM2 LED

The SIM2 LED indicates the status of the SIM card in slot SIM2.

- off – no SIM card inserted in SIM2 or SIM card not valid
- lights **green** – SIM card in SIM2 is being used

8.3.2.4 DI/O LED

The DI/O LED indicates a change in the status of a digital input/output.

- blinks **green** – a digital input has changed its state
- blinks **orange** – a digital output has changed its state

Blinking interval LED signal	Signal quality
on	maximum
900 ms on, 100 ms off	very good
200 ms on, 200 ms off	good
100 ms on, 900 ms off	poor
off	no signal or logged out

Table 17: Signal LED blinking cycle

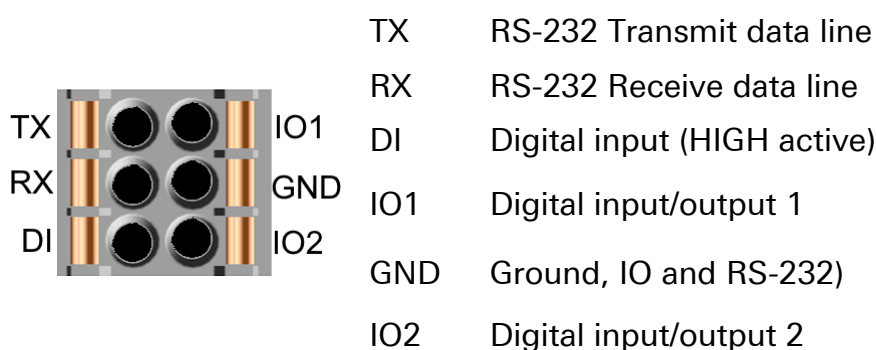


Figure 22: MRcard MSI.4G – connector

8.3.2.5 Inserting SIM cards

Gently press the SIM card tray inwards using your fingernail or a small flat-head screwdriver to release the catch, allowing the tray to slide out of the housing slightly. Then pull the tray out completely.

Then insert the Nano-SIM card into the slot on the relevant side of the tray (labelled SIM1/SIM2), with the contacts facing outwards. Please take care to note the bevelled edge.

Then reinsert the SIM card tray into the router and press it gently until you feel it click into place.



The SIM card tray can only be inserted into the device in one orientation. If necessary, turn the tray if it does not slide in easily.

8.3.2.6 Digital inputs/outputs

The card has two configurable digital inputs/outputs and one digital input.

The digital inputs/outputs IO1 and IO2 correspond to the digital input/output of the basic variant, as described under 8.1.2.6 Digital inputs/outputs.

The digital input DI is high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. You'll find more information in Table 1. The illustration below shows an example of how to connect the input.

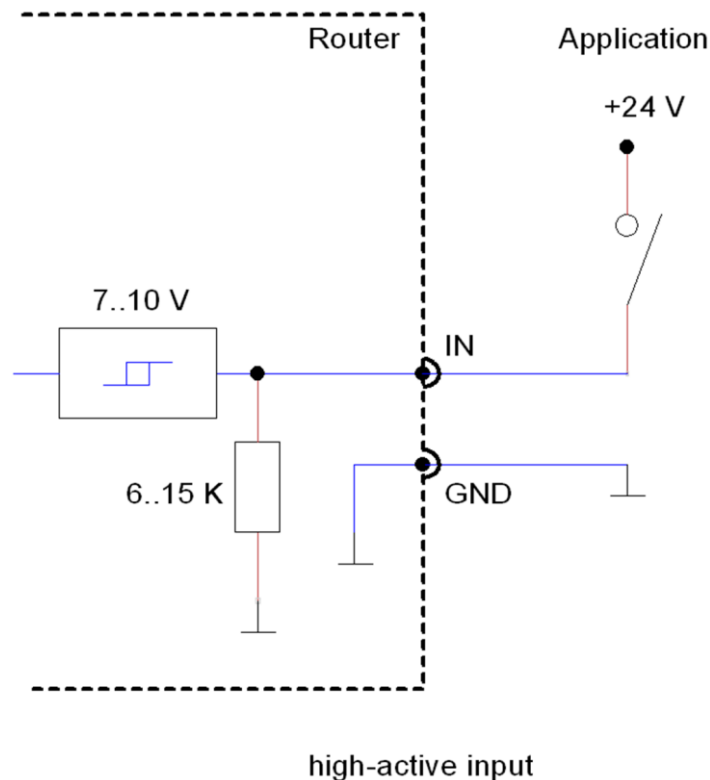


Figure 23: MRcard MSI.4G – digital input – connection example

8.3.3 Antennas

- ① As per EN 2014/53/EU, the operator of a radio equipment must comply with the harmonisation legislation. This includes in particular the selection and utilisation of suitable antenna systems. It must be ensured in particular that devices with radio technology are not operated without a suitable antenna system for an extended period.
- ① A separate antenna must be used for each wireless engine installed (mobile or WiFi). Combined antennas (mobile and WiFi) must not be used. These separate antennas must be at least 20 cm apart.

In order to meet the respective cellular radio specification (and improve reception quality and data rate in downlink), it is necessary to use a second antenna for the operating modes Rx Diversity (UMTS) or MIMO (LTE) or a MIMO/diversity antenna

with two integrated antennas. The following must be observed when using two individual antennas.

8.3.3.1 Main antenna

Since the main antenna is both, first reception antenna and only sending antenna, it should be set-up vertically polarised and omnidirectional to be perfectly aligned with the base station (that is always vertically polarised). It should be possible to compensate the attenuation losses of the antenna lead with an appropriate gain of the antenna.

8.3.3.2 Auxiliary antenna for MIMO / Rx Diversity

When using an auxiliary antenna, it is recommended to use the same type and the same antenna lead as for the main antenna. It would be adverse if the difference in gain of the two antennas is too high. The auxiliary antenna is to be installed at an angle of 90° to receive the horizontally polarised portion of the radio waves that are least "detected" by the main antenna. This allows to compensate negative effects with adverse transmission. Moreover, the possible data rate increases, in particular of the base station broadcasts using two antennas.

8.3.3.3 Antenna arrangement

The distance between the antennas should be as close as possible but not fall below $\frac{1}{4}$ of the maximum wave length (lowest frequency band). Approx. 9 cm would be ideal in case of 800 MHz (LTE, band 20) for example.

Tests have shown that the right arrangement of the antennas is very important. If both antennas are set-up vertically for example, the data rate can be worse than for only one antenna.

8.3.3.4 Outside mounted antenna

When using the outside mounted antennas offered by INSYS, the delivered mounting bracket provides sufficient distance to the wall. If the main antenna is aligned vertically and the auxiliary antenna is mounted at the same point perpendicular, the mounting brackets provide also a minimum distance of the antennas at the feeding point of 10 cm.

8.3.3.5 Magnetic base antenna

The magnetic base antennas offered by INSYS are especially intended for the use on metallic surfaces, e.g. outside a switch cabinet. The metallic, reflecting underground is mandatory for a good antenna effect. Both antennas are to be mounted at an upper corner of the switch cabinet such that the main antenna is on the top of the switch cabinet and the auxiliary antenna on its side wall. The minimum distance at the feeding point must also be observed here.

8.4 MRcard PL

The MRcard PL is a plug-in card for extending the basic variants by an LTE cellular modem with two digital inputs. The technical data of the basic variant are extended by the following data with inserted MRcard PL.

8.4.1 Technical Data

8.4.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Max. transmission power cellular engine EGSM 900 GSM 1800 UMTS 900/1800/2100 LTE 800/900/1800/2100/2600	+35 dBm +32 dBm +25.7 dBm +25.7 dBm
Weight	85 g
Dimensions (Width x Height x Depth (w/o protruding connectors))	27 x 117 x 81 mm
Temperature - operation	-30 ... 75 °C extended -30 ... 70 °C standard
Temperature - storage	-30 ... 75 °C

Table 18: MRcard PL – physical features



The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use; the extended temperature range applies under certain conditions (see Table 2 on page 26).

8.4.1.2 Technological Features

Technological Feature	Description
LTE frequency bands (4G) Band (MHz)	1 (2100), 2 (1900), 3 (1800), 4 (2100/1700 AWS), 5 (850), 7 (2600), 8 (900), 12 (700), 13 (700), 18 (850), 19 (850), 20 (800), 26 (850), 28 (700), 38 (2600), 40 (2300), 41 (2500), 66 (2100) LTE Cat 4 (DL: 150 Mbit/s, UL: 50 Mbit/s)
UMTS/HSPA frequency bands (3G) Band (MHz)	1 (2100), 2 (1900), 3 (1800), 4 (2100/1700 AWS), 5 (850), 6 (800), 8 (900), 19 (850) HSDPA, HSUPA (DL Cat 10, UL Cat 6)
GPRS/EDGE frequencies (2G)	850, 900, 1800, 1900 MHz GPRS/EDGE Class 12 (DL/UL: max 237 kBit/s)
SIM card reader	Support for 1.8 V and 3.0 V SIM cards Format: Mini-SIM (2FF)
SMS	Dispatch / receipt
Antenna	LTE: MIMO in downlink direction 3G: Rx Diversity 2G: Main

Table 19: MRcard PL – technological features

- ❗ Please check the availability of the LTE frequencies in the planned operating area. Above specified frequencies are currently used in Europe, Middle East, Africa and, to some extent, in the Asia-Pacific region and South America.
- ❗ When using the MRcard PL in the MRX2 LTE 1.0 device, the following frequency bands are not available (due to PCTRB regulatory requirements): 3G bands 3 and 19, 4G band 41
- ❗ In practice, the maximum data rates of the wireless interface for LTE Cat 3/4 are usually impossible to achieve. Among other factors, they are limited by the achievable throughput of the Ethernet interface (100 Mbit/s), the actual reception conditions (network signal strength), the antenna (use of MIMO/Rx diversity (see Antennas), power and positioning, and support from the respective provider (contract terms and network utilization).
- ❗ The SIM card may only be removed when the device is disconnected from the power supply.

8.4.2 Connections as well as display and control elements

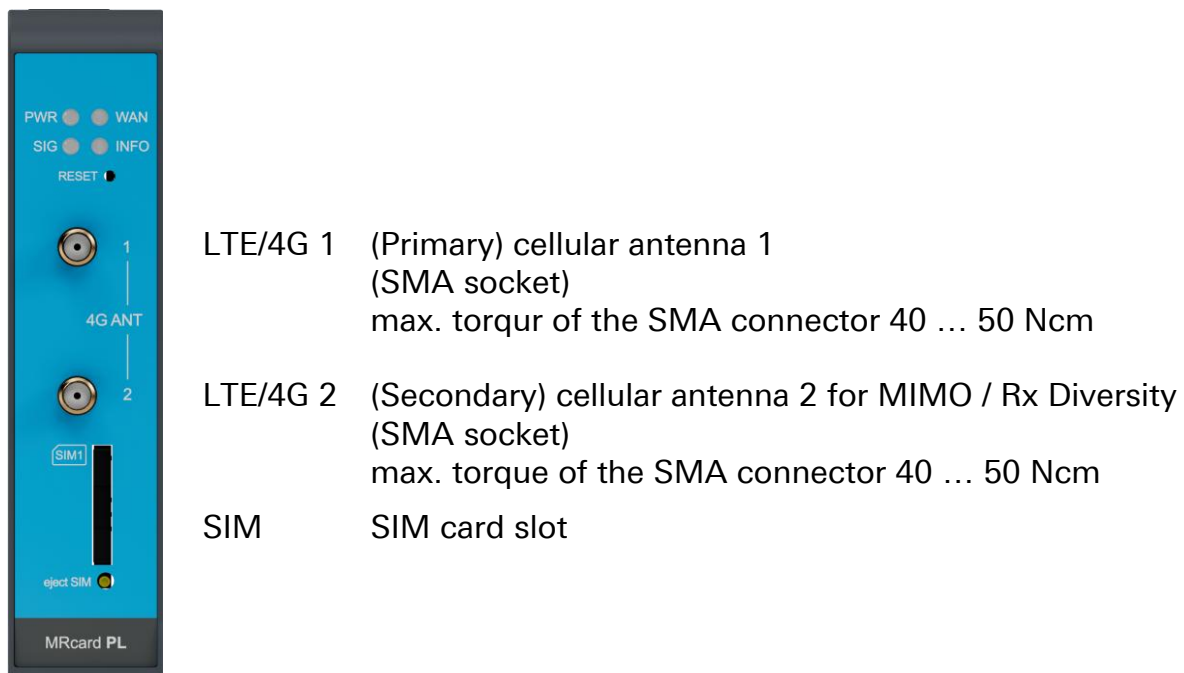


Figure 24: MRcard PL – connections as well as display and control elements at the front

- ❗ The primary antenna connection 1 is the main antenna connection and must be used if only one cellular antenna is used (see page 56). The screen of the antenna system must be connected to the protective conductor when using an outside mounted antenna.
- ❗ The reset key is not functional when the card is used in an MRX.neo, as this is already included on the basic card.
- ❗ The PWR and WAN LEDs are not functional when the card is used in an MRX.neo, as these indicators are already included on the basic card.

8.4.2.1 SIG LED

The SIG (Signal) LED indicates the signal strength of the cellular connection.

- off – SIM card not registered
- blinks green – PDN connection established, for signal strength see Table 20
- blinks orange – no PDN connection established, for signal strength see Table 20

8.4.2.2 INFO LED

The function of the Info LED can be configured via an event and, in the factory settings, indicates a change to the open profile.

- off – opened profile has been activated
- blinks orange – opened profile has been modified and differs from the current profile
- blinks red – the router is being reset
- lights red – the boot process has not been completed

Blinking interval LED signal	Signal quality
on	maximum
900 ms on, 100 ms off	very good
200 ms on, 200 ms off	good
100 ms on, 900 ms off	poor
off	no signal or logged out

Table 20: Blinking code of the signal LED

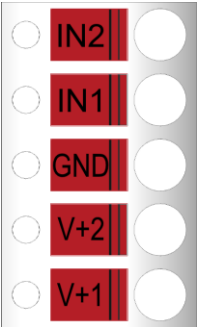
	IN2	Digital input 2 (can also be marked with IN _b)
	IN1	Digital input 1 (can also be marked with IN _a)
	GND	Ground
	V ₊₂	These power supply connections must not be used when the card is installed in the MRX.neo!
	V ₊₁	

Figure 25: MRcard PL – connections at the connector



See also the note on different connectors under 8.1.4 Connecting the connectors on page 33.

8.4.2.3 Digital inputs

The card has two different digital inputs. Input IN1 is low-active, i.e. active, if connected to GND. Input IN2 is high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. You'll find more information in Table 1. The illustration below shows an example of how to connect the different inputs.

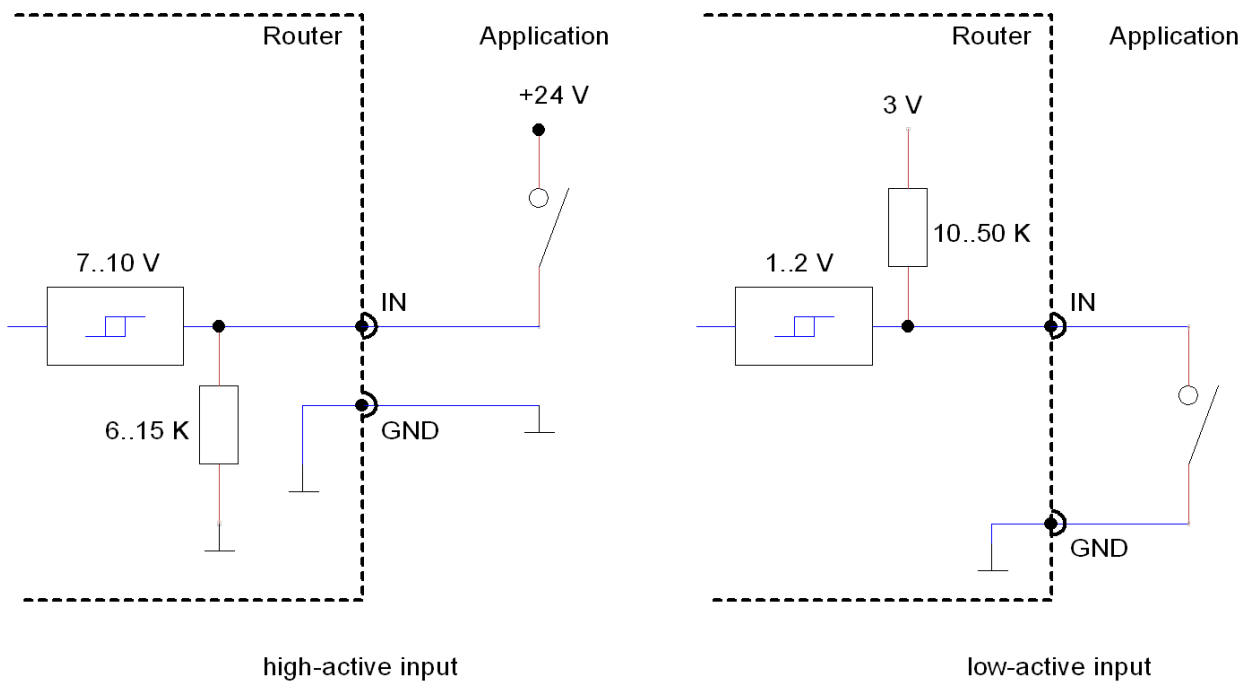


Figure 26: MRcard PL – digital inputs – connection examples

8.4.3 Antennas

- ❗ As per EN 2014/53/EU, the operator of a radio equipment must comply with the harmonisation legislation. This includes in particular the selection and utilisation of suitable antenna systems. It must be ensured in particular that devices with radio technology are not operated without a suitable antenna system for an extended period.
- ❗ A separate antenna must be used for each wireless engine installed (mobile or WiFi). Combined antennas (mobile and WiFi) must not be used. These separate antennas must be at least 20 cm apart.

In order to meet the respective cellular radio specification (and improve reception quality and data rate in downlink), it is necessary to use a second antenna for the operating modes Rx Diversity (UMTS) or MIMO (LTE) or a MIMO/diversity antenna with two integrated antennas. The following must be observed when using two individual antennas.

8.4.3.1 Main antenna

Since the main antenna is both, first reception antenna and only sending antenna, it should be set-up vertically polarised and omnidirectional to be perfectly aligned with the base station (that is always vertically polarised). It should be possible to compensate the attenuation losses of the antenna lead with an appropriate gain of the antenna.

8.4.3.2 Auxiliary antenna for MIMO / Rx Diversity

When using an auxiliary antenna, it is recommended to use the same type and the same antenna lead as for the main antenna. It would be adverse if the difference in gain of the two antennas is too high. The auxiliary antenna is to be installed at an angle of 90° to receive the horizontally polarised portion of the radio waves that are least “detected” by the main antenna. This allows to compensate negative effects with adverse transmission. Moreover, the possible data rate increases, in particular of the base station broadcasts using two antennas.

8.4.3.3 Antenna arrangement

The distance between the antennas should be as close as possible but not fall below $\frac{1}{4}$ of the maximum wave length (lowest frequency band). Approx. 9 cm would be ideal in case of 800 MHz (LTE, band 20) for example.

Tests have shown that the right arrangement of the antennas is very important. If both antennas are set-up vertically for example, the data rate can be worse than for only one antenna.

8.4.3.4 Outside mounted antenna

When using the outside mounted antennas offered by INSYS, the delivered mounting bracket provides sufficient distance to the wall. If the main antenna is aligned vertically and the auxiliary antenna is mounted at the same point perpendicular, the mounting brackets provide also a minimum distance of the antennas at the feeding point of 10 cm.

8.4.3.5 Magnetic base antenna

The magnetic base antennas offered by INSYS are especially intended for the use on metallic surfaces, e.g. outside a switch cabinet. The metallic, reflecting underground is mandatory for a good antenna effect. Both antennas are to be mounted at an upper corner of the switch cabinet such that the main antenna is on the top of the switch cabinet and the auxiliary antenna on its side wall. The minimum distance at the feeding point must also be observed here.

8.5 MRcard PD

The MRcard PD is a plug-in card for extending the basic variants by a VDSL modem with integrated power supply. The technical data of the basic variant are extended by the following data with inserted MRcard PD. The MRcard PD is available in two variants, MRcard PD-A and MRcard PD-B, that only differ in the supported DSL standards.

8.5.1 Technical Data

8.5.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Weight	95 g
Dimensions (width x height x depth)	27 x 117 x 81 mm
Temperature - operation	-30 ... 60 °C extended -30 ... 55 °C standard
Temperature - storage	-30 ... 75 °C

Table 21: MRcard PD – physical features



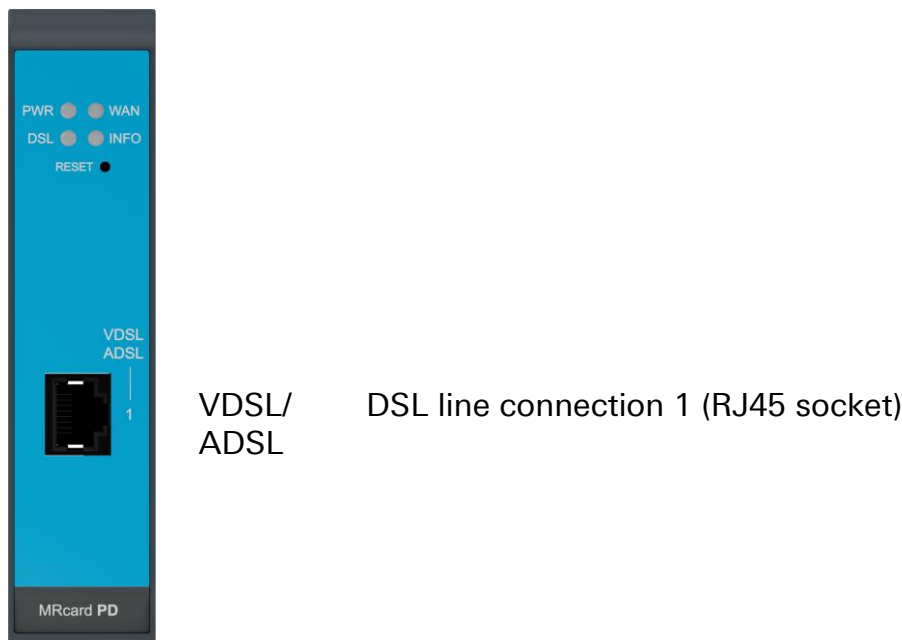
The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use; the extended temperature range applies under certain conditions (see Table 2 on page 26).

8.5.1.2 Technological Features

Technological Feature	Description
Supported standards MRcard PD-A	VDSL2 G.993.2 Profile 8a, 8b, 8c, 8d, 12a, 12b, 17a. 30a VDSL2 Vectoring G.993.5 ADSL G.992.1 Annex A, G.992.3. Annex A/L/M, G.992.5 Annex A and M, T1.413
Supported standards MRcard PD-B	VDSL2 G.993.2 Profile 8a, 8b, 8c, 8d, 12a, 12b, 17a. 30a VDSL2 Vectoring G.993.5 ADSL G.992.1 Annex B, G.992.3. Annex B, G.992.5 Annex B and J

Table 22: MRcard PD – technological features

8.5.2 Connections as well as display and control elements



VDSL/ADSL DSL line connection 1 (RJ45 socket)

Figure 27: MRcard PD – connections as well as display and control elements at the front

- ❗ The reset key is not functional when the card is used in an MRX.neo, as this is already included on the basic card.
- ❗ The PWR and WAN LEDs are not functional when the card is used in an MRX.neo, as these indicators are already included on the basic card.

8.5.2.1 DSL LED

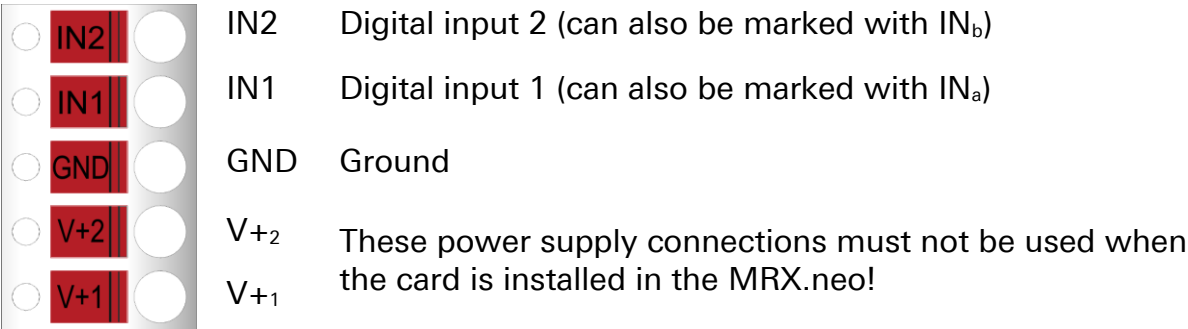
The DSL LED indicates the condition of the DSL Connection.

- off – no DSL connection
- blinks green – DSL connection is being established (handshake/training)
- lights green – DSL connection is established (showtime)
- blinks orange – data is being transmitted
- lights red – the DSL modem is not yet ready

8.5.2.2 INFO LED

The function of the Info LED can be configured via an event and, in the factory settings, indicates a change to the open profile.

- off – opened profile has been activated
- blinks orange – opened profile has been modified and differs from the current profile
- blinks red – the router is being reset
- lights red – the boot process has not been completed



i See also the note on different connectors under 8.1.4 Connecting the connectors on page 33.

Figure 28: MRcard PD – connections at the connector

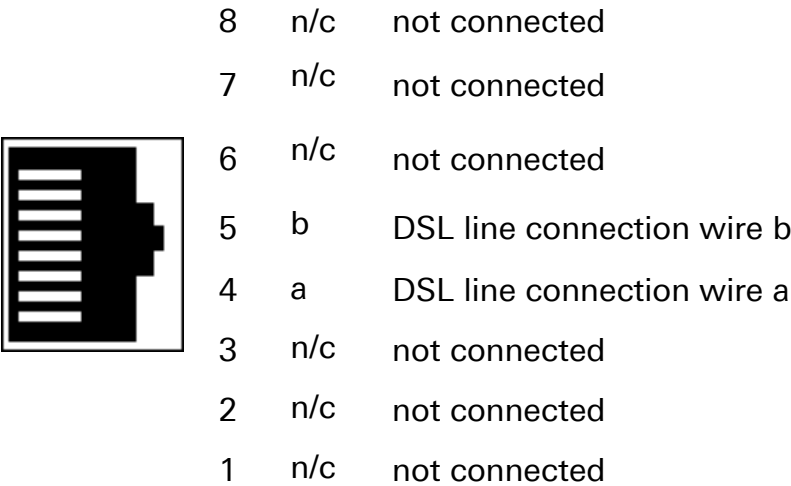


Figure 29: MRcard PD – DSL socket definition

i A splitter must be connected upstream when connecting to DSL lines in telephone networks like Annex A or Annex B.

8.5.2.3 Digital inputs

The card has two different digital inputs. Input IN1 is low-active, i.e. active, if connected to GND. Input IN2 is high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. You'll find more information in Table 1. The illustration below shows an example of how to connect the different inputs.

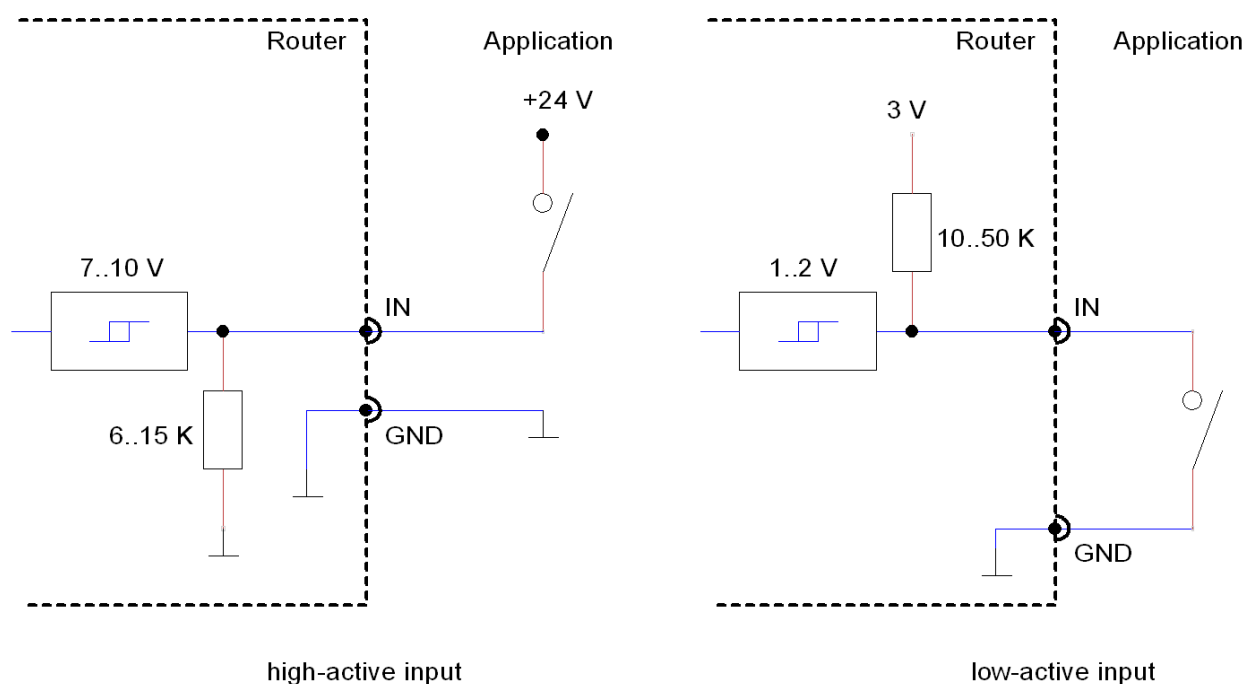


Figure 30: MRcard PD – digital inputs – connection examples

8.6 MRcard SI

The MRcard SI is a plug-in card for extending the basic variants and contains two digital inputs, two digital outputs (changeover relays), a serial RS-232 interface as well as a serial RS-485 interface. The technical data of the basic variants are extended by the following data with inserted MRcard SI.

8.6.1 Technical Data

8.6.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Level inputs IN1 and IN2	HIGH level = 10 ... 24 V LOW level = 0 ... 5 V Contact open condition: LOW
Current consumption input at HIGH potential	Max. 3 mA at 24 V DC
Input sampling rate	1 s
Digital output (changeover relay), max. switch voltage	30 V (DC) / 42 V (AC)
Digital output (changeover relay), max. current load	2 A at 30 V DC / 42 V AC resistive
Weight	90 g
Dimensions (Width x Height x Depth (w/o protruding connectors))	27 x 117 x 81 mm
Temperature - operation and storage	-30 ... 75 °C

Table 23: MRcard SI – physical features



The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use (see Table 2 on page 26).

8.6.1.2 Technological Features

Technological Feature	Description
RS-232 interface	Max. baud rate 230,400 bit/s; hardware handshake RTS/CTS; software handshake XON/XOFF; various data formats
RS-485 interface	Max. baud rate 230,400 bit/s

Table 24: MRcard SI – technological features

8.6.2 Connections and display elements

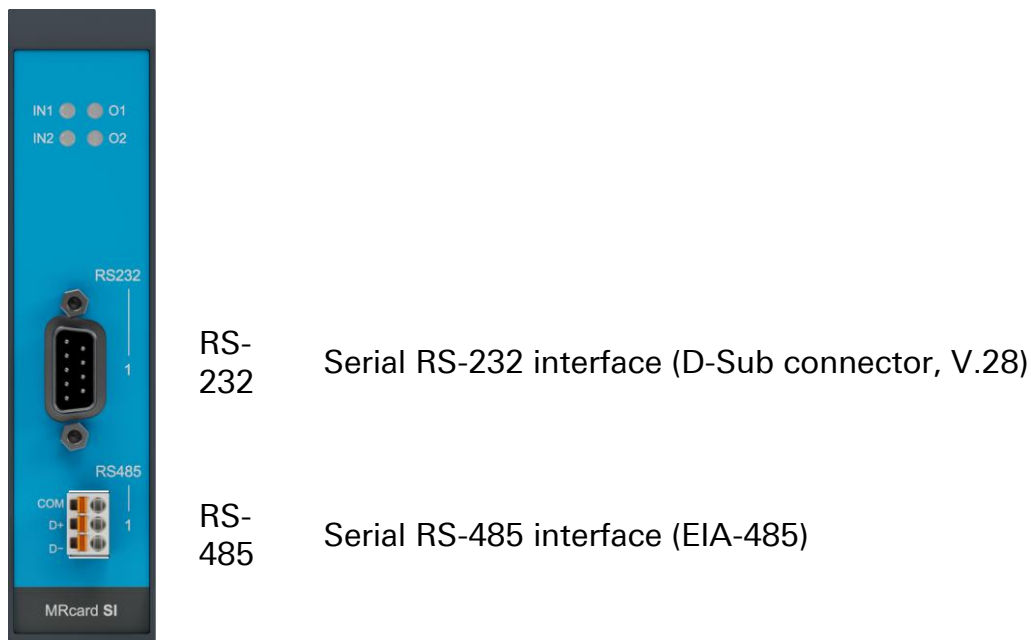


Figure 31: MRcard SI – connections and display elements at the front

8.6.2.1 IN1 LED

The IN1 LED indicates the condition of input 1.

- off – the input is not active (LOW)
- lights **green** – the input is active (HIGH)

8.6.2.2 O1 LED

The O1 LED indicates the condition of output 1.

- off – the output is not active
- lights **green** – the output is active

8.6.2.3 IN2 LED

The IN2 LED indicates the condition of input 2.

- off – the input is not active (LOW)
- lights **green** – the input is active (HIGH)

8.6.2.4 O2 LED

The O2 LED indicates the condition of output 2.

- off – the output is not active
- lights **green** – the output is active

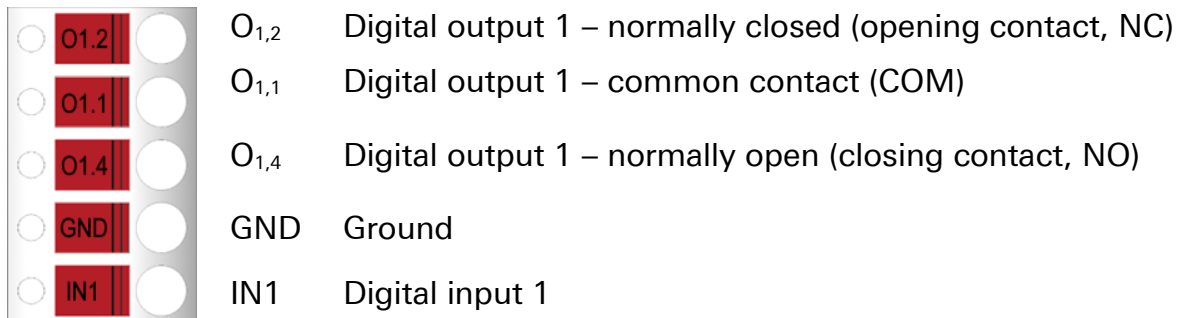
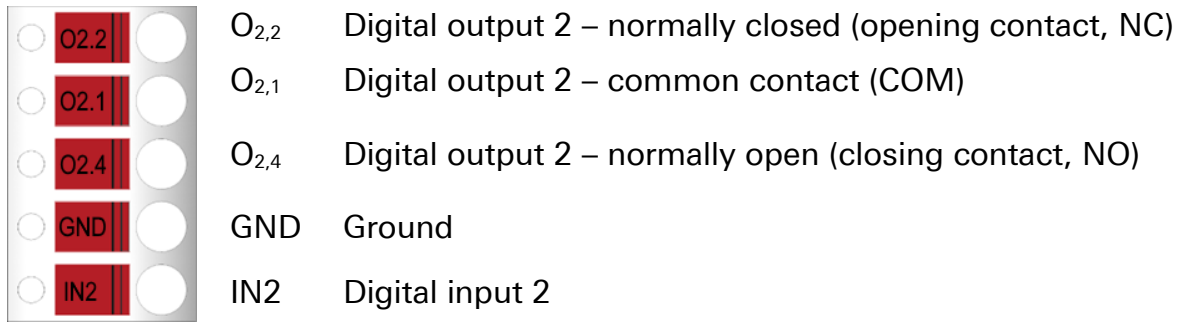


Figure 32: MRcard SI – connections at the connector



See also the note on different connectors under 8.1.4 Connecting the connectors on page 33.

8.6.2.5 Digital inputs

Both inputs are high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. The illustration below shows a connection example.

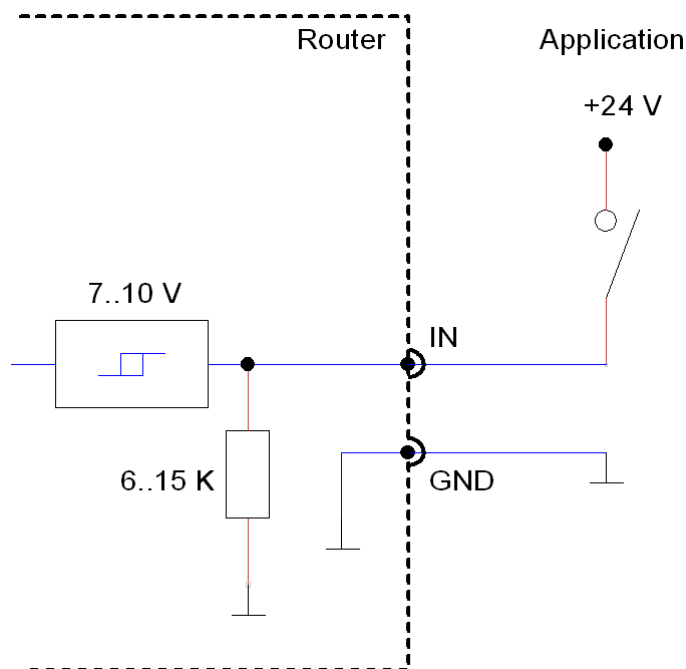


Figure 33: MRcard SI – digital inputs – connection example

8.6.2.6 Digital outputs

Both outputs are designed as changeover relays. The illustration below shows a connection example.

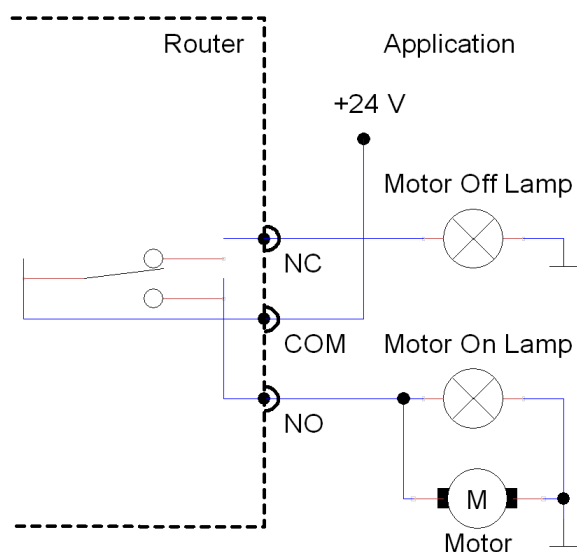


Figure 34: MRcard SI – digital outputs – connection example

8.6.2.7 RS-232 interface

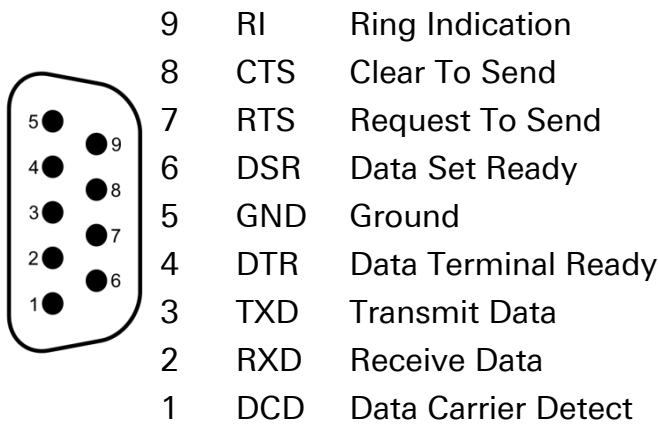


Figure 35: Signal RS-232 interface

i The RS-232 interface conforms to the layout as DTE (Data Terminal Equipment)

8.6.2.8 RS-485 interface

ID	Description
COM	Common (frame GND)
D+	Data line positive
D-	Data line negative

Table 25: Description of the pin allocation of the RS-485 interface

The properties of the RS-485 interface are configured using a 4-pole DIP switch on the circuit board. The respective switch settings are described in the table.

Item	Function	Off (default)	On	Comment
1	Termination	none	active	
2	AC/DC termination	AC termination	DC termination	DC termination: 120 Ohm betw. D+ and D- AC termination: Capacitor (100 nF) in series with 120 Ohm
3	BIAS resistor connection D-	no BIAS resistor	BIAS resistor active	1 kOhm at GND
4	BIAS resistor connection D+	no BIAS resistor	BIAS resistor active	1 kOhm at pos. supply voltage

Table 26: MRcard SI – configuration of the RS-485 interface

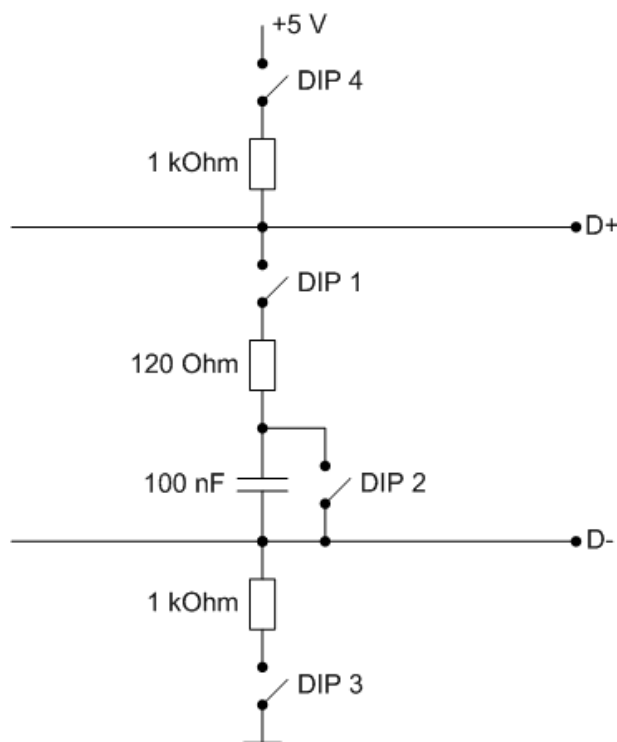


Figure 36: Principle circuit diagram of the RS-485 interface

8.7 MRcard ES

The MRcard ES is a plug-in card for extending the basic variants by a 4-port switch. The technical data of the basic variants are extended by the following data with inserted MRcard ES.

8.7.1 Technical Data

8.7.1.1 Physical Features

Physical Feature	Value
Weight	70 g
Dimensions (width x height x depth)	27 x 117 x 81 mm
Temperature– operation and storage	-30 ... 75 °C

Table 27: MRcard ES – physical features



The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use (see Table 2 on page 26).

8.7.1.2 Technological Features

Technological Feature	Description
4-port Ethernet switch	10/100 Mbit/s full/half duplex auto sense; Auto - MDI/ MDI-X; automatic detection of "crossover" or "patch" wiring.
Isolation voltage	1.5 kV

Table 28: MRcard ES – technological features

8.7.2 Connections and display elements

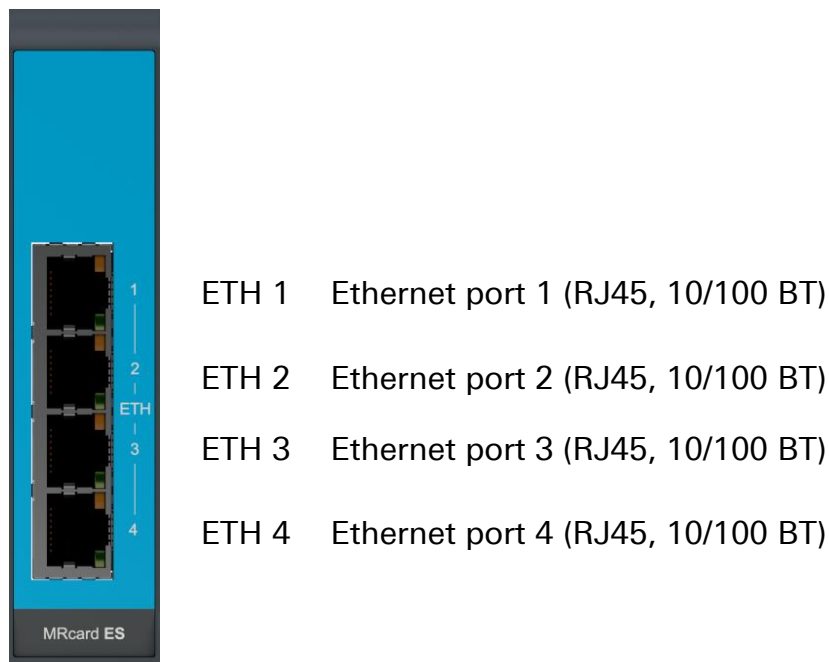


Figure 37: MRcard ES – connections and display elements at the front

8.7.2.1 Switch port LED

Each switch port has a green and an orange LED.

The **orange** LED indicates the data rate used on the respective port:

- off – 10 Mbps
- on – 100 Mbps

The **green** LED indicates the function:

- off – no data connection (no cable connected, cable defective or network interface on the connected device is not available)
- blinking – data is being transmitted
- on – data connection established, but no data is being transmitted

8.8 MRcard IO

The MRcard IO is a plug-in card to extend the basic variants and included four digital inputs, four digital outputs (normally open relay), three analogue inputs as well as an analogue output. The technical data of the basic variants are extended by the following data with inserted MRcard IO.

8.8.1 Technical Data

8.8.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Level inputs	HIGH level = 12 ... 24 V LOW level = 0 ... 5 V Contact open condition: LOW
Current consumption input at HIGH potential	Max. 2 mA at 24 V DC
Input sampling rate	1 s
Digital output (relay), max. switch voltage	30 V (DC) / 42 V (AC)
Digital output (relay), max. current load	3 A at 30 V DC / 42 V AC resistive sum of all outputs max. 5 A
Weight	95 g
Dimensions (Width x Height x Depth (w/o protruding connectors))	27 x 117 x 81 mm
Temperature – operation	-30 ... 70 °C
Temperature – storage	-30 ... 75 °C

Table 29: MRcard IO – physical features



The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use (see Table 2 on page 26).

8.8.1.2 Technological Features

Technological Feature	Description
Analogue inputs	0 ... 20 mA or 0 ... 10 V changeable via SW isolated against each other
Accuracy	$\pm 0,3\%$ plus ± 100 ppm/K tempere drift
Resolution	16 Bit
Input resistance	$> 100 \text{ k}\Omega$
Voltage range	$< 100 \text{ Ohm}$
Loop resistance current range	
Analogue output	0 ... 20 mA oder 0 ... 10 V changeable via SW current output with active current source, RL max. $250 \text{ }\Omega$ voltage output with active voltage source, RL min. $5 \text{ k}\Omega$ isolated from the remaining system short-circuit and open-circuit proof
Resolution	12 Bit
Accuracy	$\pm 0,3\%$ plus ± 100 ppm/K temperature drift
Digital inputs	HIGH active isolated from the remaining system
Input resistance	$16 \text{ k}\Omega$
Digital outputs	Relay (normally open)

Table 30: MRcard IO – technological features

8.8.2 Connections and display elements

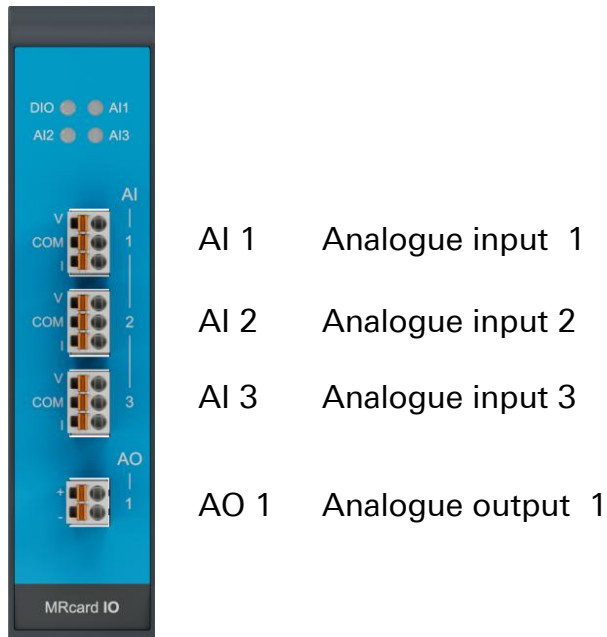


Figure 38: MRcard IO – connections and display elements at the front

8.8.2.1 DIO LED

The DIO LED indicates the state of the digital input/output.

- off – the state of the input/output has not changed
- blinks green – the digital input has changed its state
- blinks orange – the digital output has changed its state

8.8.2.2 AI1 LED

The AI1 LED indicates the state of analogue output 1.

- off – the output is not configured
- lights green – the output is within the normal range
- lights orange – the output is below 100 mV or 4 mA
- lights red – the output has exceeded its range

8.8.2.3 AI2 LED

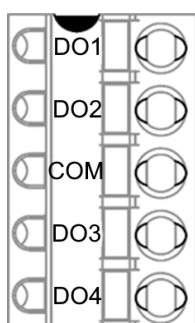
The AI2 LED indicates the state of analogue output 2.

- off – the output is not configured
- lights green – the output is within the normal range
- lights orange – the output is below 100 mV or 4 mA
- lights red – the output has exceeded its range

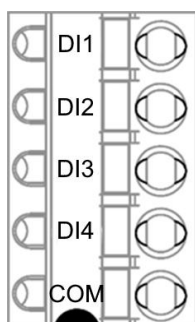
8.8.2.4 AI3 LED

The AI3 LED indicates the state of analogue output 3.

- off – the output is not configured
- lights **green** – the output is within the normal range
- lights **orange** – the output is below 100 mV or 4 mA
- lights **red** – the output has exceeded its range



DO1	Digital output 1 – normally open
DO2	Digital output 2 – normally open (closing contact)
COM	Digital output – common contact
DO3	Digital output 3 – normally open (closing contact)
DO4	Digital output 4 – normally open (closing contact)



DI1	Digital input 1
DI2	Digital input 4
DI3	Digital input 3
DI4	Digital input 4
COM	Digital input – common contact

Figure 39: MRcard IO – connections at the connector



See also the note on different connectors under 8.1.4 Connecting the connectors on page 33.

8.8.2.5 Digital inputs

The digital inputs are galvanically isolated, high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. The illustration below shows a connection example.

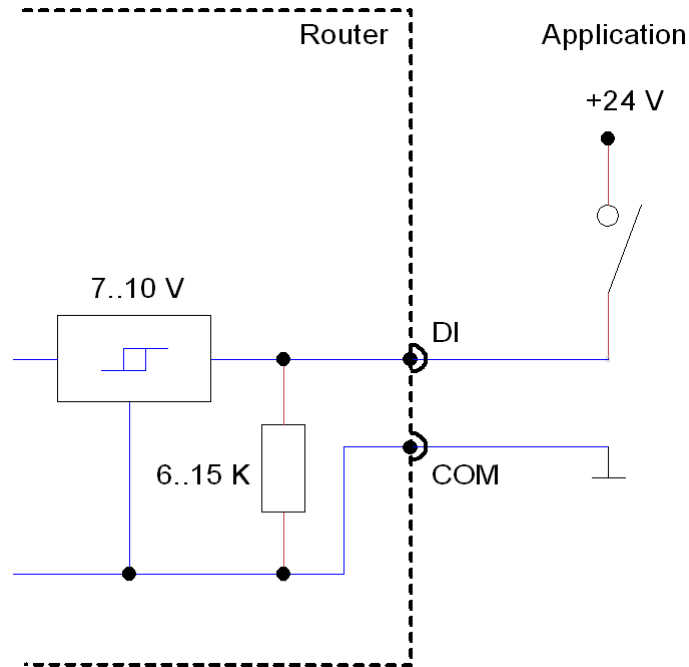


Figure 40: MRcard IO – digital inputs – connection examples

8.8.2.6 Digital outputs

The digital outputs are designed as normally open relays. The illustration below shows a connection example.

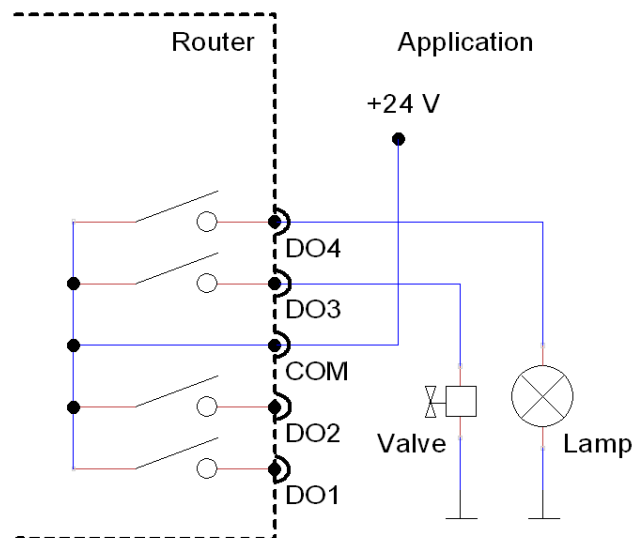


Figure 41: MRcard IO – digital outputs – connection example

8.8.2.7 Analogue inputs

ID	Description
V	Voltage input (0 ... 10 V)
COM	Common – common contact
I	Current input (0 ... 20 mA)

Table 31: MRcard IO – description of the pin allocation of the analogue inputs

-  The analogue inputs must only be connected with V or I depending on their configuration - never both at a time!
If configuration and connection do not match, this will cause wrong values.

8.8.2.8 Analogue outputs

ID	Description
+	Analogue signal – positive contact
-	Analogue signal – negative contact

Table 32: MRcard IO – description of the pin allocation of the analogue outputs

8.9 MRcard Fiber

The MRcard Fiber is a plug-in card to extend the basic variants by a two SFP ports and two digital inputs. The technical data of the basic variants are extended by the following data with inserted MRcard Fiber.

- ❗ Please observe the safety notes and instructions of the manufacturer of the SFP module used (transceiver).

8.9.1 Technical Data

8.9.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Power consumption	Typ. 5 W, max. 5 W
Level input IN1	Level HIGH = 2 ... 24 V Level LOW = 0 ... 1 V Contact open condition: HIGH
Current consumption input IN1 at LOW potential	Typ. 0,1 mA when connecting to GND
Level input IN2	HIGH level = 10 ... 24 V LOW level = 0 ... 5 V Contact open condition: LOW
Current consumption input IN2 at HIGH potential	Typ. 3 mA, max. 6 mA at 24 V DC
Input sampling rate	1 s
Weight	85 g
Dimensions (Width x Height x Depth (w/o protruding connectors))	27 x 117 x 81 mm
Temperature - operation	-30 ... 65 °C
Temperature – storage	-30 ... 75 °C

Table 33: MRcard Fiber – physical features

- ❗ The specification of the power consumption includes the power consumption of 2 SFP transceivers with 0,5 W each.
- ❗ The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use (see Table 2 on page 26).

8.9.1.2 Technological Features

Technological Feature	Description
SFP ports	2 SFP cages for SFP transceiver modules as per SFP-MSA, 1000BASE-X, 100BASE-X

Table 34: MRcard Fiber – technological features

8.9.2 Connections as well as display and control elements

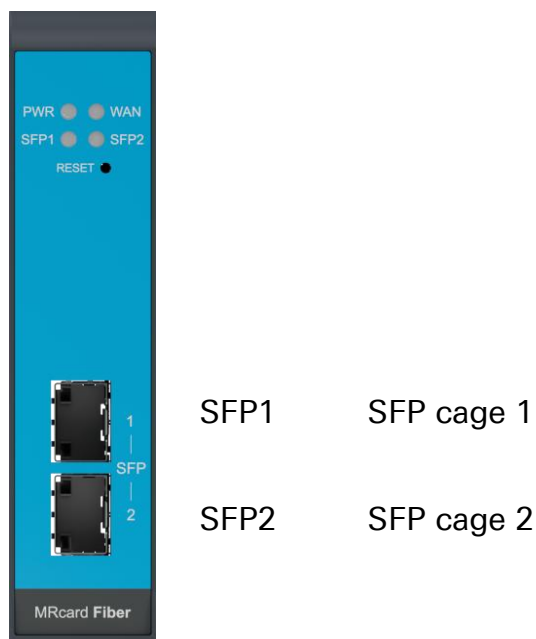


Figure 42: MRcard Fiber – connections, display, control elements at the front

- ❗ The reset key is not functional when the card is used in an MRX.neo, as this is already included on the basic card.
- ❗ The PWR and WAN LEDs are not functional when the card is used in an MRX.neo, as these indicators are already included on the basic card.

8.9.2.1 SFP1 LED

The SFP1 LED indicates the condition of SFP slot 1.

- off – the SFP slot is disabled
- blinks green – data is being transmitted
- lights green – Ethernet link is established
- blinks orange – SFP module detected, no optical signal present
- lights orange – optical signal detected, no Ethernet link
- lights red – TX error in module or missing module

8.9.2.2 SFP2 LED

The SFP2 LED indicates the condition of SFP slot 2.

- off – the SFP slot is disabled

- blinks **green** – data is being transmitted
- lights **green** – Ethernet link is established
- blinks **orange** – SFP module detected, no optical signal present
- lights **orange** – optical signal detected, no Ethernet link
- lights **red** – TX error in module or missing module

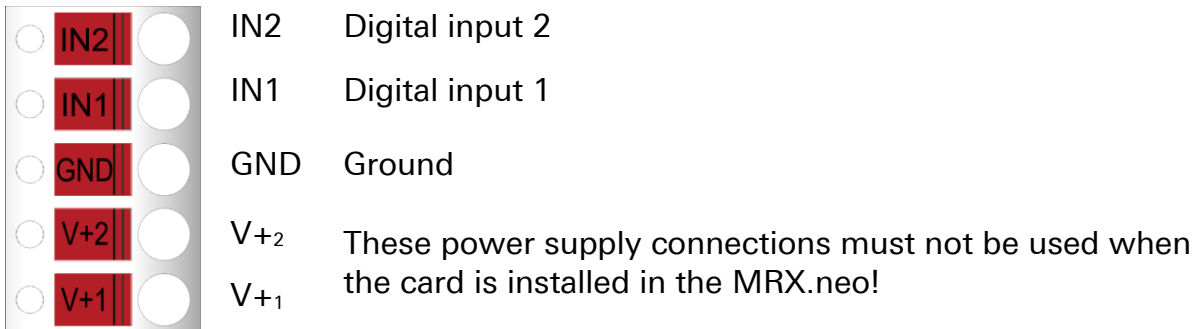


Figure 43: MRcard Fiber – connector



See also the note on different connectors under 8.1.4 Connecting the connectors on page 33.

8.9.2.3 Digital inputs

The card has two different digital inputs. Input IN1 is low-active, i.e. active, if connected to GND. Input IN2 is high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. You'll find more information in Table 1. The illustration below shows an example of how to connect the different inputs.

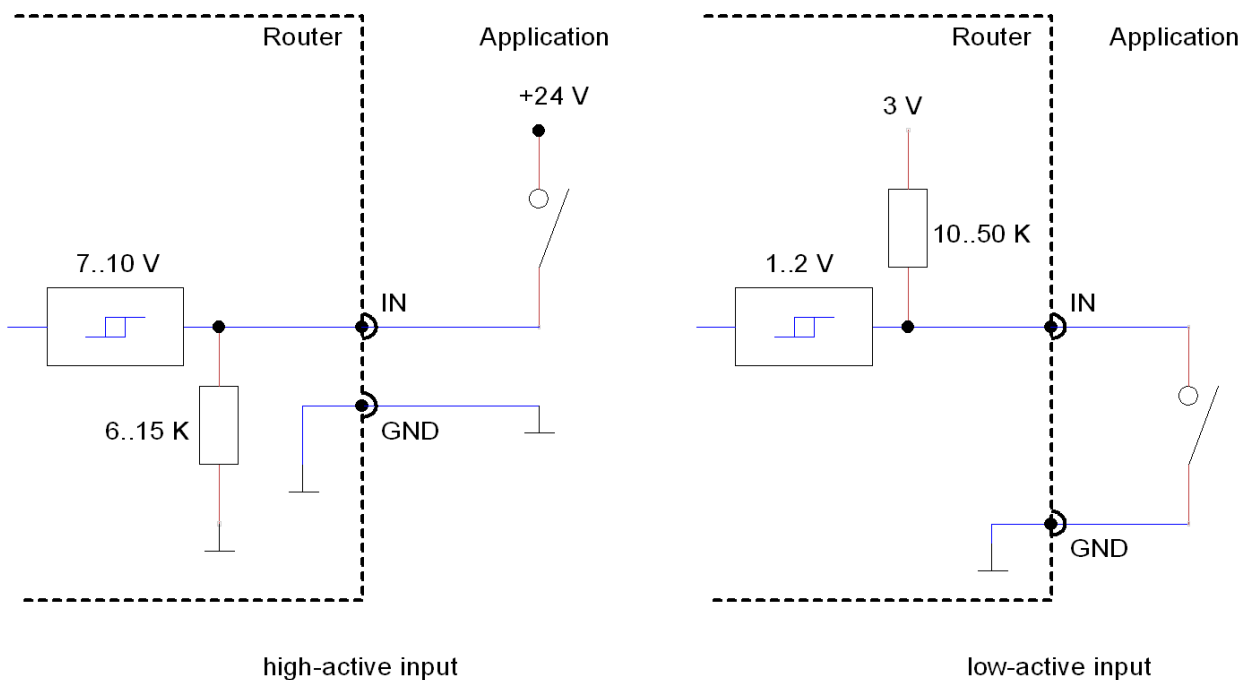


Figure 44: MRcard Fiber – digital inputs – connection examples

8.10 MRcard PL450

The MRcard PL450 is a plug-in card for extending the basic variants by an LTE cellular modem with two digital inputs. In addition to standard LTE bands, the cellular modem also supports LTE450 bands. The technical data of the basic variant are extended by the following data with inserted MRcard PL450.

8.10.1 Technical Data

8.10.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Max. transmission power cellular engine EGSM 900 GSM 1800 LTE 450/700/800/850/900/1800/2100/2600	+35 dBm +32 dBm +25.7 dBm
Weight	85 g
Dimensions (Width x Height x Depth (w/o protruding connectors))	27 x 117 x 81 mm
Temperature - operation	-30 ... 75 °C extended -30 ... 70 °C standard
Temperature – storage	-30 ... 75 °C

Table 35: MRcard PL450 – physical features



The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use; the extended temperature range applies under certain conditions (see Table 2 on page 26).

8.10.1.2 Technological Features

Technological Feature	Description
LTE frequency bands (4G) Band (MHz)	1 (2100), 3 (1800), 5 (850), 7 (2600), 8 (900), 20 (800), 28 (700), 31 (450), 72 (450) LTE Cat 1 (DL: 10 Mbit/s, UL: 5 Mbit/s)
GPRS/EDGE frequencies (2G)	900, 1800 MHz GPRS/EDGE Class 12 (DL/UL: max 237 kBit/s)
SIM card reader	Dual SIM Support for 1.8 V and 3.0 V SIM cards Format: Mini-SIM (2FF) Automatic failover SIM 1: On the front of the card SIM 2: Accessible under the cover on the top of the device
SMS	Dispatch / receipt
Antenna	LTE

Table 36: MRcard PL450 – technological features

- ❗ Please check the availability of the LTE frequencies in the planned operating area.
- ❗ In practice, the maximum data rates of the wireless interface for LTE Cat 1 are usually impossible to achieve. Among other factors, they are limited by the achievable throughput of the respective Ethernet interface (100 Mbit/s), the actual reception conditions (network signal strength), the antenna (see Antenna), power and positioning, and support from the respective provider (contract terms and network utilization).
- ❗ The SIM card may only be removed when the device is disconnected from the power supply.

8.10.2 Connections as well as display and control elements

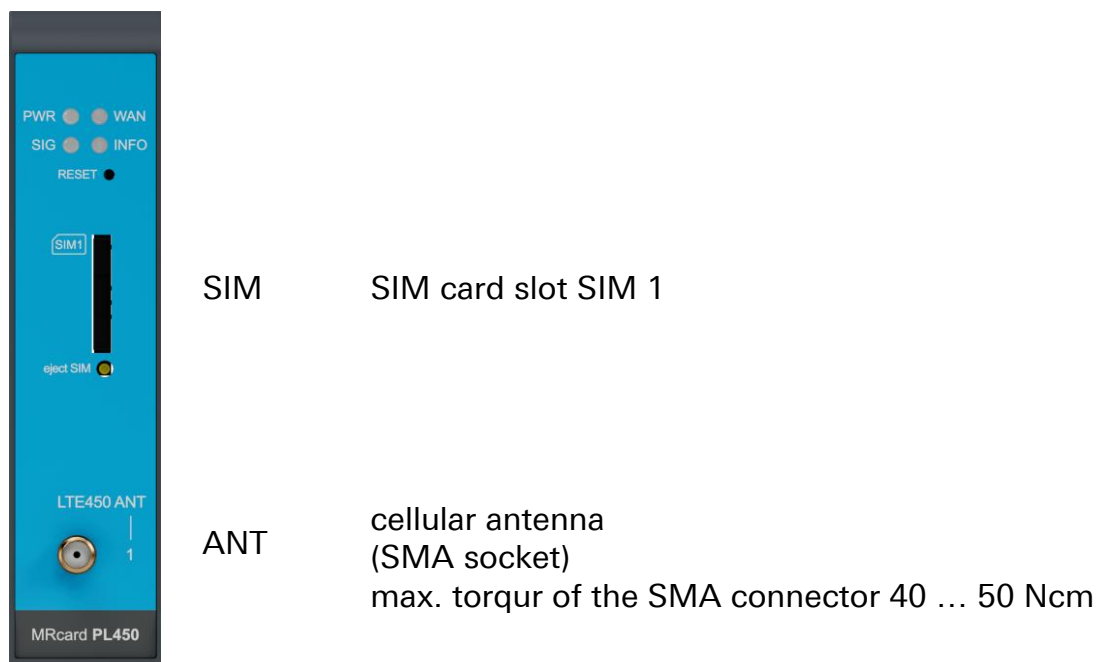


Figure 45: MRcard PL450 – connections, display and control elements at the front

- ❗ The screen of the antenna system must be connected to the protective conductor when using an outside mounted antenna.
- ❗ The reset key is not functional when the card is used in an MRX.neo, as this is already included on the basic card.
- ❗ The PWR and WAN LEDs are not functional when the card is used in an MRX.neo, as these indicators are already included on the basic card.

8.10.2.1 SIG LED

The SIG (Signal) LED indicates the signal strength of the cellular connection.

- off – no signal or SIM card not registered
- blinks green – SIM card is registered, for signal strength see Table 37
- blinks orange – PDP context established, for signal strength see Table 37

8.10.2.2 INFO LED

The function of the Info LED can be configured via an event and, in the factory settings, indicates a change to the open profile.

- off – opened profile has been activated
- blinks orange – opened profile has been modified and differs from the current profile
- blinks red – the router is being reset
- lights red – the boot process has not been completed

Blinking interval LED signal	Signal quality
on	maximum
900 ms on, 100 ms off	very good
200 ms on, 200 ms off	good
100 ms on, 900 ms off	poor
off	no signal or logged out

Table 37: Blinking code of the signal LED

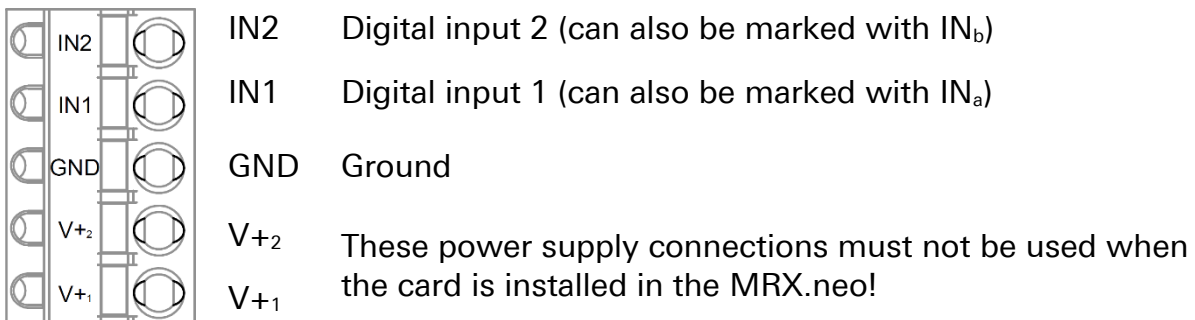


Figure 46: MRcard PL450 – connector



The SIM card slot SIM 2 is under the marked cover on the top of the device. When retrofitting the card, the neutral cover is replaced with the marked cover supplied with the card. To eject a card, simply press it briefly.

8.10.2.3 Digital inputs

The card has two different digital inputs. Input IN1 is low-active, i.e. active, if connected to GND. Input IN2 is high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. You'll find more information in Table 1. The illustration below shows an example of how to connect the different inputs.

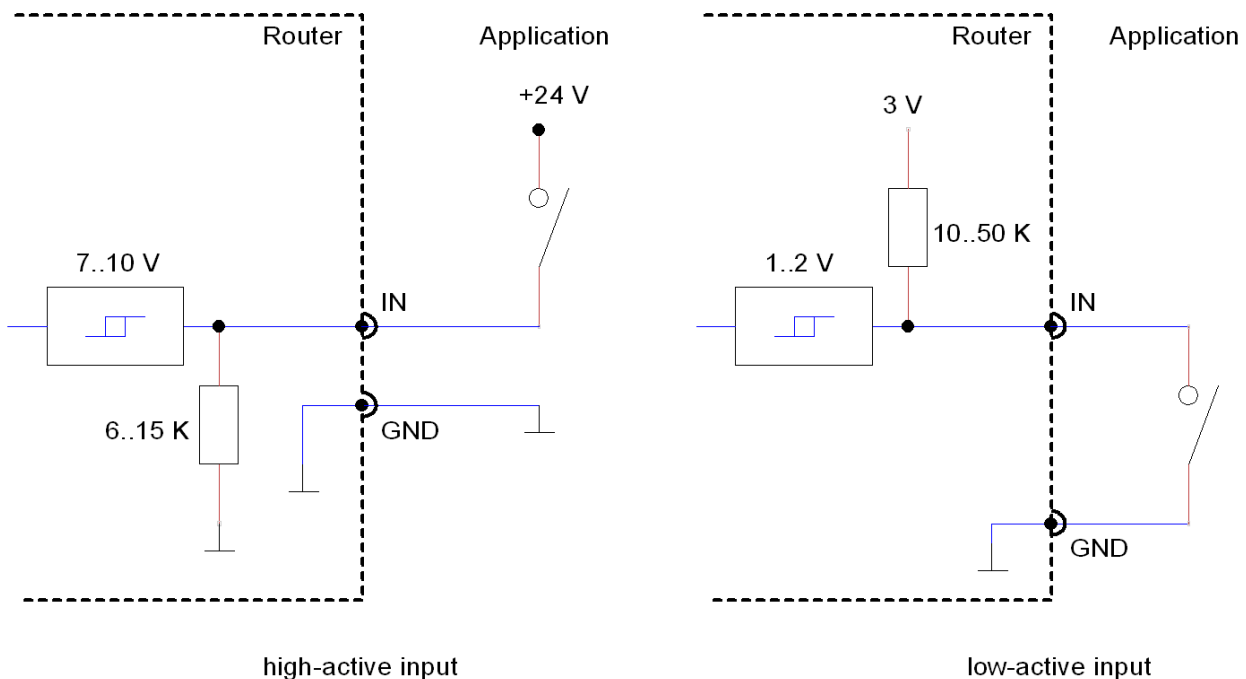


Figure 47: MRcard PL 450 – digital inputs – connection examples

8.10.3 Antenna

- ① As per EN 2014/53/EU, the operator of a radio equipment must comply with the harmonisation legislation. This includes in particular the selection and utilisation of suitable antenna systems. It must be ensured in particular that devices with radio technology are not operated without a suitable antenna system for an extended period.
- ① A separate antenna must be used for each wireless engine installed (mobile or WiFi). Combined antennas (mobile and WiFi) must not be used. These separate antennas must be at least 20 cm apart.

Please ensure that the antenna is suitable for the frequency bands being used. INSYS offers antennas for standard LTE bands and LTE450 bands, as well as combination antennas for both standard LTE bands and LTE450 bands.

8.11 MRcard PL450D

The MRcard PL450D is a plug-in card for extending the basic variants by an LTE cellular modem with two digital inputs. In addition to standard LTE bands, the cellular modem also supports LTE450 bands. The technical data of the basic variant are extended by the following data with inserted MRcard PL450D.

8.11.1 Technical Data

8.11.1.1 Physical Features

All specified data was measured with nominal input voltage, at full load, and an ambient temperature of 25 °C. The limit value tolerances are subject to the usual variations.

Physical Feature	Value
Max. transmission power cellular engine LTE 450/700/800/900/1800/2100/2600 UMTS 850/900/1700/1900/2100	+25.7 dBm +25.7 dBm
Weight	85 g
Dimensions (Width x Height x Depth (w/o protruding connectors))	27 x 117 x 81 mm
Temperature - operation	-30 ... 70 °C extended -30 ... 65 °C standard
Temperature – storage	-30 ... 75 °C

Table 38: MRcard PL450D – physical features



The maximum temperature range of the router may be limited by the narrower temperature ranges of other MRcards in use; the extended temperature range applies under certain conditions (see Table 2 on page 26).

8.11.1.2 Technological Features

Technological Feature	Description
LTE frequency bands (4G) Band (MHz)	1 (2100), 2 (1900), 3 (1800), 4 (2100/1700/AWS), 5 (850), 7 (2600), 8 (900), 20 (800), 28 (700), 31 (450), 38 (2600), 40 (2300), 41 (2500), 66 (2100), 72 (450), 87 (410) LTE Cat 4 (DL: 150 Mbit/s, UL: 50 Mbit/s)
UMTS/HSPA frequency bands (3G) Band (MHz)	1 (2100), 2 (1900), 4 (2100/1700/AWS), 5 (850), 8 (900)
SIM card reader	Dual SIM Support for 1.8 V and 3.0 V SIM cards Format: Mini-SIM (2FF) Automatic failover SIM 1: On the front of the card SIM 2: Accessible under the cover on the top of the device
SMS	Dispatch / receipt
Antenna	LTE: MIMO in downlink direction 3G: Rx Diversity

Table 39: MRcard PL450D – technological features

- ❗ Please check the availability of the LTE frequencies in the planned operating area.
- ❗ In practice, the maximum data rates of the wireless interface for LTE Cat 4 are usually impossible to achieve. Among other factors, they are limited by the achievable throughput of the respective Ethernet interface (100 Mbit/s), the actual reception conditions (network signal strength), the antenna (use of Rx diversity, see Antennas), power and positioning, and support from the respective provider (contract terms and network utilization).
- ❗ The SIM card may only be removed when the device is disconnected from the power supply.

8.11.2 Connections as well as display and control elements

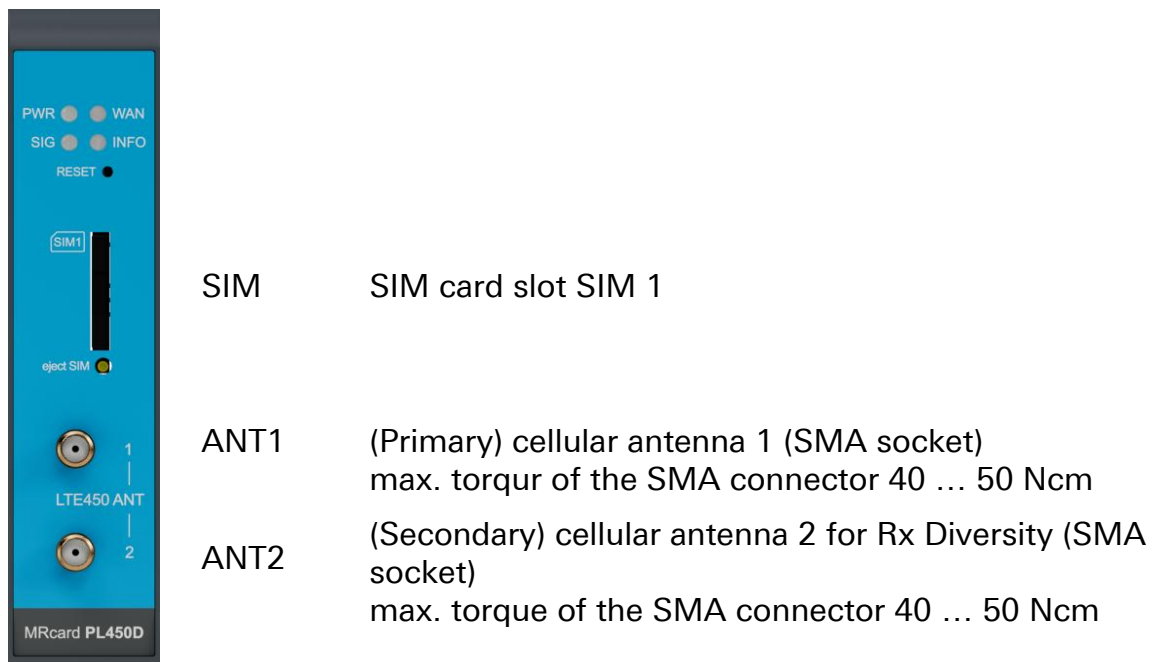


Figure 48: MRcard PL450D – connections, display and control elements at the front

- ❗ The screen of the antenna system must be connected to the protective conductor when using an outside mounted antenna.
- ❗ The reset key is not functional when the card is used in an MRX.neo, as this is already included on the basic card.
- ❗ The PWR and WAN LEDs are not functional when the card is used in an MRX.neo, as these indicators are already included on the basic card.

8.11.2.1 SIG LED

The SIG (Signal) LED indicates the signal strength of the cellular connection.

- off – no signal or SIM card not registered
- blinks green – SIM card is registered, for signal strength see Table 40
- blinks orange – PDP context established, for signal strength see Table 40

8.11.2.2 INFO LED

The function of the Info LED can be configured via an event and, in the factory settings, indicates a change to the open profile.

- off – opened profile has been activated
- blinks orange – opened profile has been modified and differs from the current profile
- blinks red – the router is being reset
- lights red – the boot process has not been completed

Blinking interval LED signal	Signal quality
on	maximum
900 ms on, 100 ms off	very good
200 ms on, 200 ms off	good
100 ms on, 900 ms off	poor
off	no signal or logged out

Table 40: Blinking code of the signal LED

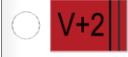
	IN2	Digital input 2 (can also be marked with IN _b)
	IN1	Digital input 1 (can also be marked with IN _a)
	GND	Ground
	V ₊₂	These power supply connections must not be used when the card is installed in the MRX.neo!
	V ₊₁	

Figure 49: MRcard PL450D – connector

- ❗ See also the note on different connectors under 8.1.4 Connecting the connectors on page 33.
- ❗ The SIM card slot SIM 2 is under the marked cover on the top of the device. When retrofitting the card, the neutral cover is replaced with the marked cover supplied with the card. To eject a card, simply press it briefly.

8.11.2.3 Digital inputs

The card has two different digital inputs. Input IN1 is low-active, i.e. active, if connected to GND. Input IN2 is high-active and based on the electrical requirements of the PLC standard DIN EN 61131-2 for digital inputs type 1. You'll find more information in Table 1. The illustration below shows an example of how to connect the different inputs.

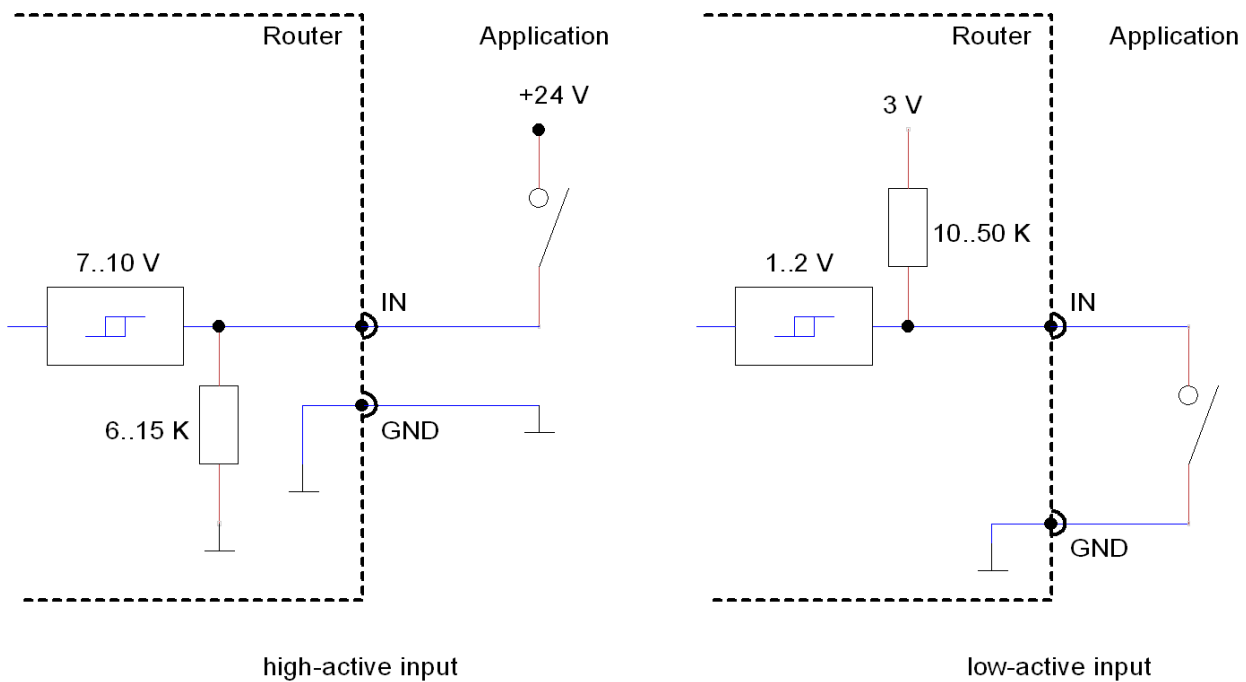


Figure 50: MRcard PL450D – digital inputs – connection examples

8.11.3 Antennas

- ❗ As per EN 2014/53/EU, the operator of a radio equipment must comply with the harmonisation legislation. This includes in particular the selection and utilisation of suitable antenna systems. It must be ensured in particular that devices with radio technology are not operated without a suitable antenna system for an extended period.
- ❗ A separate antenna must be used for each wireless engine installed (mobile or WiFi). Combined antennas (mobile and WiFi) must not be used. These separate antennas must be at least 20 cm apart.

Please ensure that the antenna is suitable for the frequency bands being used. INSYS offers antennas for standard LTE bands and LTE450 bands, as well as combination antennas for both standard LTE bands and LTE450 bands.

For information regarding antennas for Rx Diversity, refer to the MRcard PL section on page 56.

9 MRcard Installation

The industrial router MRX.neo is available in different basic variants and allows a flexible extension of these basic variants with the additionally available MRcards. Proceed as follows to remove or install an MRcard.

Caution!



The MRX.neo and the MRcards contain electrostatic-discharge-sensitive parts. Electrostatic discharges may damage these parts!

Damage of the parts.

Observe the general safety precautions when handling electrostatic-discharge-sensitive parts.

- Only install the cards with isolated power supply. Wait at least 30 seconds upon isolating the power supply.
- Only work on an ESD-compliant desktop that is connected to ground potential.
- Wear ESD-compliant shoes and clothing.
- Wear a ground strap at the wrist that is connected to ground potential.
- Take the MRcards directly out of the ESD protection packing and place removed MRcards directly back to the ESD protection packing.

Caution!



Objects penetrating the housing may damage the product!

Damage of the product.

When using tools like screwdrivers or ball-pens to remove the MRcards, pay attention not to penetrate the inside of the housing to avoid a damage of the product.

Cover the housing after removing an MRcard with a blind front cover and, if necessary, a terminal cover.

9.1 Positions and Combinations of MRcards

The slots in the MRX.neo are enumerated from the left with #1...#2 (MRX2.neo), #1...#3 (MRX3.neo) or #1...#5 (MRX5.neo). This enumeration is also visible at the base PCB if individual MRcards or front covers are removed.

9.1.1 Slot for basic card

The left slot (#1), as viewed from the front, is always reserved for a basic card featuring an integrated 4-port switch, an RS-485 interface, 2 DI/Os and optional WiFi, regardless of whether the system is the MRX2.neo (with two slots), the MRX3.neo (with three slots) or the MRX5.neo (with five slots). This plug-in card is necessary for the operation of the MRX.neo and can only be inserted in this slot; it is also not possible to insert a different MRcard in this slot. Therefore, do not remove this plug-in card.



Figure 51: Slot for basic card

9.1.2 Slots for extensions

For the MRX.neo, any combination of MRcards may be inserted into the free slots from #2 onwards.

However, no more than two cards with high power requirements, such as the MRcard MSI.4G/5G, MRcard PL, MRcard PL450(D), MRcard PD or MRcard Fiber, may be installed. See also section 8.1.3 Power consumption estimation for this. The serial interface on the MRcard MSI.4G/5G can only be used if this card is inserted into slot #2.



Figure 52: Slots for extensions

9.2 Removal of an MRcard

How to remove an MRcard or a front cover:

- You will need an ordinary ball-pen.
- The connectors are disconnected.
- The MRX.neo is not connected to the power supply.

1. ***Insert the ball-pen as shown in the following figure vertically from above in the snap-in recess (red arrow) and press it down slightly to release the MRcard or front cover. Repeat the procedure at the bottom.***

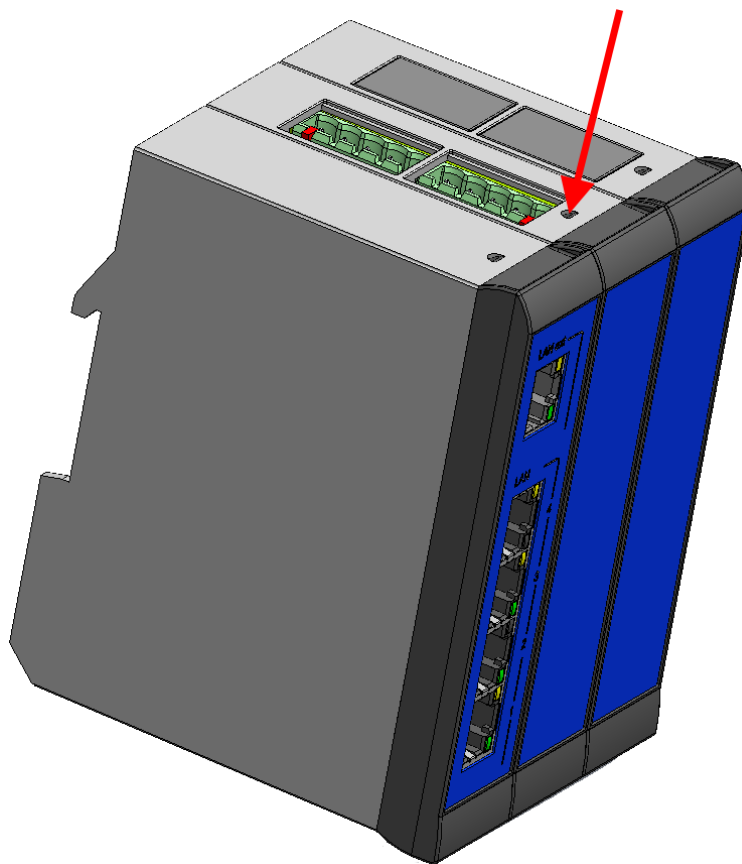


Figure 53: MRcard – Removal

2. ***Remove the MRcard or front cover to the front and keep it.***

✓ The MRcard or front cover is removed with this.

9.3 Installation of an MRcard

How to install an MRcard or a front cover:

- The connectors are disconnected.
 - The MRX.neo is not connected to the power supply.
- 1. Place the MRX.neo with its back onto the desktop.**
 - 2. Insert the card with the board in the guides or the front cover from above into the slot from above.**
 - 3. Press on both sides slightly down (red arrows) until the tabs snap into place appreciably. Slightly pressing on both sides (green arrows) facilitate snapping.**

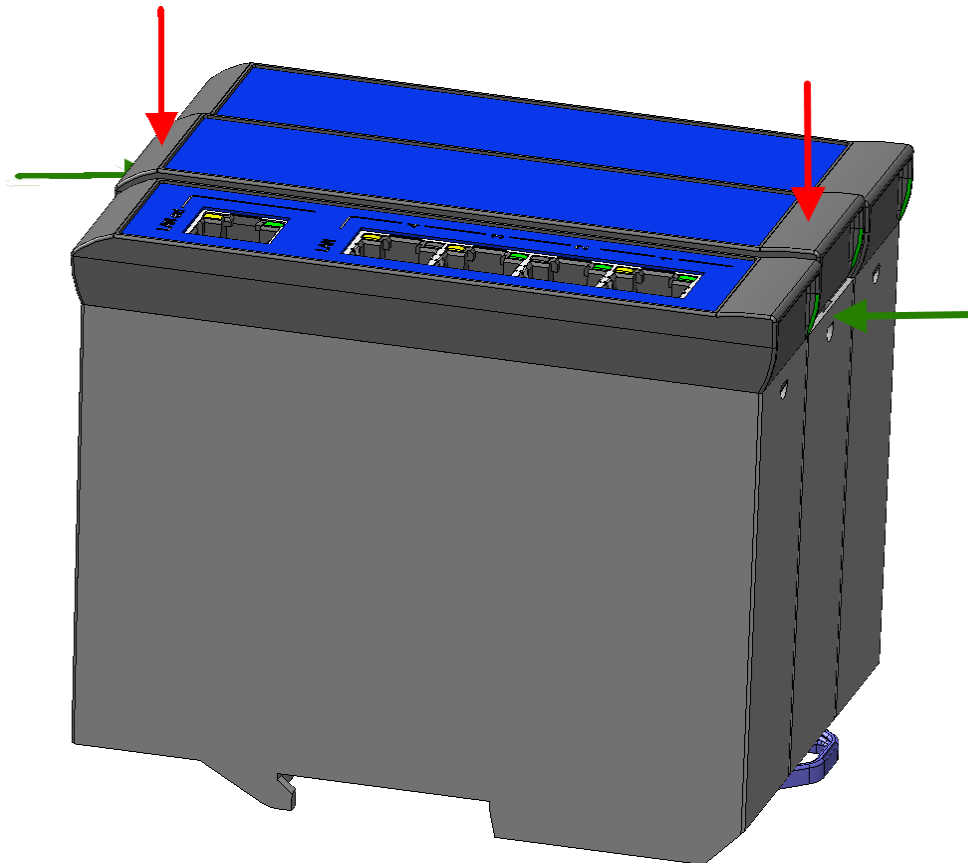


Figure 54: MRcard – Installation



The MRcard or front cover is installed with this.

9.4 Removing a terminal/SIM slot cover

Depending on the MRcard to be installed, it might be necessary to remove one or two terminal covers at the top of the MRX.neo to provide an opening for the terminal connectors to the Mrcard or insert a SIM card.

How to remove a terminal or SIM card slot cover:

- You will need a flat-blade screwdriver (max. 3.5 mm width).
- The connectors are disconnected.
- The MRX.neo is not connected to the power supply.

1. ***Insert the screwdriver as shown in the following figure from above between the center bar and the respective cover (red arrow) and move it to the front or back by approx. 45° (green arrow) under slight pressure to pry open the respective terminal/SIM card slot cover.***

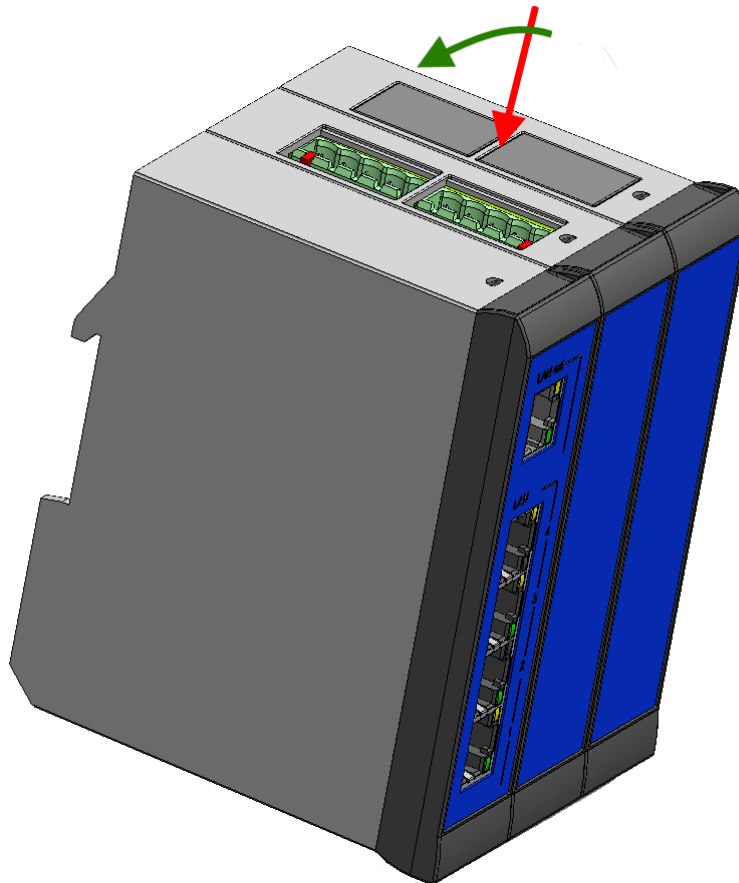


Figure 55: Terminal cover – Removal

2. ***Remove the terminal/SIM card slot cover and keep it.***

✓ The terminal/SIM card slot cover is removed with this.

9.5 Fitting a terminal/SIM card slot cover

When you have removed an MRcard with terminal connector, replaced it by one without terminal connector or inserted/removed a SIM card, you need to insert the terminal or SIM card slot cover(s) at the top of the MRX.neo again to re-establish the integrity of the housing.

How to fit a terminal or SIM card slot cover:

- The connectors are disconnected.
- The MRX.neo is not connected to the power supply.

- 1. Place the terminal or SIM card slot cover on the opening to be closed and press it slightly downwards (green arrow) until it snaps into place appreciably.**



Different bars at the bottom avoid that a cover that is placed the wrong way round can snap into place.

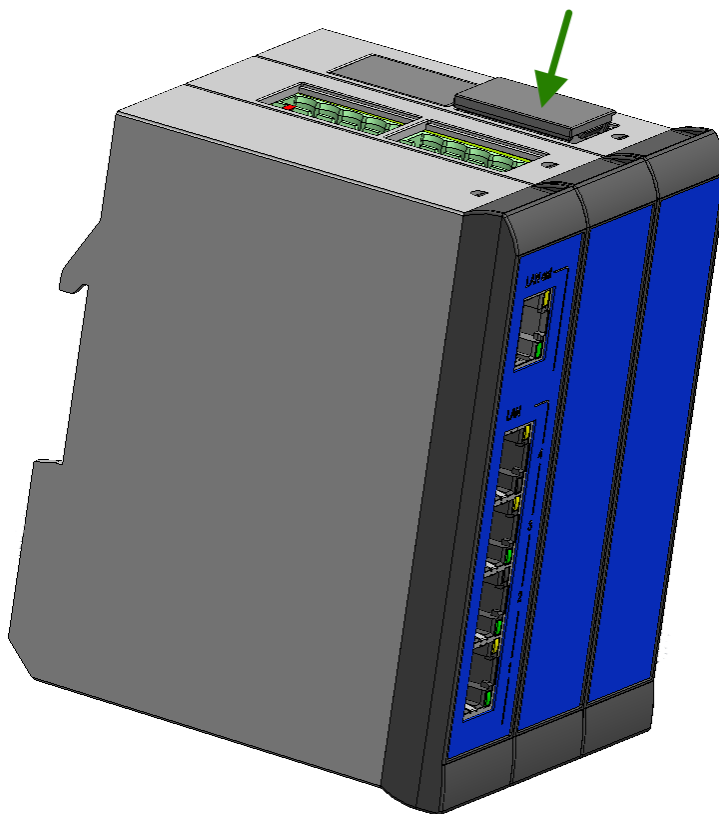


Figure 56: Terminal cover – Installation



The terminal or SIM card cover is installed with this.

9.6 Device Label

The devices of the industrial router series MRX.neo in their basic variants have a device label attached to one side face that contains various information, which specify the device at hand exactly and also meet legal requirements. If a basic variant will be extended by one or more MRcards, this device label must also be modified accordingly. A field is provided for each free slot at the label for this, onto which the label delivered with the MRcard (see Figure 58) can be stuck.



Figure 57: Example for MRX.neo device label

Moreover, it might be necessary after installing an MRcard to modify the fields for CE marking and FCC approval. Just follow the instructions on the label supplement delivered with the MRcard.

Supplement label MRcard XX

Use this label for completion of the MRX type plate with the data of your specific MRcard. Apply it to the area (1) corresponding to the figure below, by taking notice of the used MRcard Slot.

MRcard XX 1.0 10000000 001
 S/N 14010101
 MAC 00 05 PB 11 11 11
 IMEI 352661039841549
 Contains FCCID QPPhSS-P
 IC: 7833A-PHESP

This specific MRcard modifies the CE labeling of your MRX. Apply this label to the area (2) corresponding to the figure below.

When using this specific MRcard in a MRX, the FCC labeling of the MRX type plate has to be voided. Apply this empty label to the area (3) corresponding to the figure below.

INSYS icom
 INSYS MICROELECTRONICS GmbH
 Internet: www.insys-icom.de
 Sales: info@insys-icom.de
 Support: support@insys-icom.de

MRX type plate

Figure 58: Example for label supplement of an MRcard

10 Mounting

This section describes how to mount MRX.neo to a DIN rail, connect the power supply and uninstall it again. Observe the instructions in the "Safety" section of this manual, in particular the "Safety Instructions for Electrical Installation" for that purpose unconditionally.

Caution!



Moisture and liquids from the environment may seep into the interior of the device!

Fire hazard and damage of the product.

The device must not be used in wet or damp environments, or in the direct vicinity of water. Install the device at a dry location, protected from water spray. Disconnect the power supply before you perform any work on a device which may have been in contact with moisture.

Caution!



The device could be destroyed if the wrong power supply is used!

If the device is operated with a power supply that supplies a voltage exceeding the permissible operating voltage, it will be destroyed.

Make sure that you use the suitable power supply. Refer to the Technical Data section for the proper voltage range.

Caution!



Risk due to mounting failure!

Injury or malfunction due to falling device.

Make sure you install the device so that the potential drop height is less than two (2) metres. When mounting the product at the end of a DIN rail, ensure that the device cannot move axially by accident (e.g., by using end stops or an equivalent mechanical stop).



Figure 59: MRX.neo – dimensions

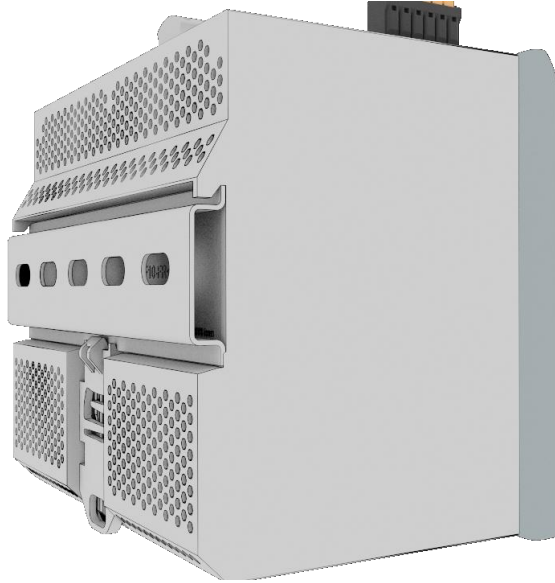
Mounting the device to the DIN rail

How to mount the router to a DIN rail:

1. **Position the device at the DIN rail as seen in the following diagram. There are two snap-in hooks at the upper DIN rail groove. Hook them into place behind the upper edge of the DIN rail when connecting the device.**



2. ***Fold down the device perpendicular to the DIN rail until the lower, flexible snap-in hook engages in the DIN rail.***



✓ The router is now readily mounted.

Connecting the power supply

- The device has already been mounted to the DIN rail.
- The power supply is connected and switched off.

❗ Power can only be supplied via the basic card on the far left; power supply inputs on MRcards must not be used!

2. ***Remove the plug-in terminal connector from the basic card on the far left.***
3. ***Connect the ground lead of the power supply to the terminal "GND" of the terminal connector.***
4. ***Connect the positive lead of the power supply to the terminal "V+" of the terminal connector.***
5. ***Connect the terminal connector to the terminal strip at the basic card on the far left.***

✓ The router is now connected to the power supply.

Disconnecting the power supply

- The device is mounted to the DIN rail.
- The power supply is connected and switched off.

1. Remove the plug-in terminal connector from the basic card on the far left.

- ✓ The router is disconnected from the power supply.

Removing the device from the DIN rail

How to uninstall the router from a DIN rail in a switch cabinet:

- You will need a flat-blade screwdriver (max. 3.5 mm width).
- The power supply of the switch cabinet is switched off and secured against being switched on accidentally.
- All connectors at the device are disconnected.

1. Insert the flat-blade screwdriver into the recess in the bottom of the DIN rail clip as shown in the following figure.



2. ***Turn the flat-blade screwdriver into the direction of the device as shown in the following figure.***



- ✓ The plastic spring of the snap-in hook is stretched.
3. ***While you hold the plastic spring apart with the lower snap-in hook, pull the device away from the DIN rail.***
 4. ***Un-hook the device and take it off perpendicularly to the DIN rail.***
- ✓ The router is now removed.

11 Commissioning

This chapter describes how to commission the router, i.e. how to connect it via Ethernet to a PC, and how to prepare it for the configuration.

Inserting the SIM card (only MRX.neo with MRcard MSI.4G/5G).

How to insert the SIM card (when only using one SIM card).

- The power supply is disabled.
- You will need a functionable Nano-SIM card of your mobile provider.
- You will also need the associated PIN.

1. Gently press the SIM card tray inwards using your fingernail or a small flat-head screwdriver.

✓ The SIM card holder will be ejected a little bit out of the housing.

2. Remove the SIM card holder.

3. Insert your SIM card into the tray in the slot labelled SIM 1.

❗ The SIM card will only fit into the SIM card tray in one position. Note the bevelled edge and make sure that the SIM card does not extend over the card holder.



4. Insert the SIM card holder together with the SIM card again. The contacts of the SIM card must face to the the outside.

5. Using a finger, carefully push the SIM card tray with the inserted SIM card into the housing, until the card holder snaps into place.

6. Enable the power supply again.

Inserting the SIM card (only MRX.neo with MRcard PL or PL450 with SIM card slot at the front, for second SIM card slot of the MRcard PL450(D) see next section).

How to insert the SIM card.

- The power supply is disabled.
- You will need a functionable Mini-SIM card of your mobile provider.
- You will also need the associated PIN.
- You will need a pointed object to operate the SIM card eject button, e.g. a screwdriver with a blade of max. 1.5 mm.

1. Gently press the SIM card tray inwards using your fingernail or a small flat-head screwdriver.

- ✓ The SIM card holder will be ejected a little bit out of the housing.

2. Remove the SIM card holder.

3. Insert your SIM card into the tray in the slot labelled SIM 1.

- ① The SIM card will only fit into the SIM card tray in one position. Make sure that the SIM card does not extend over the card holder.

4. Insert the SIM card holder together with the SIM card again. The contacts of the SIM card must face to the the outside.

5. Using a finger, carefully push the SIM card holder with the inserted SIM card into the housing, until the card holder snaps into place.

6. Enable the power supply again.

Inserting the SIM card (only MRX.neo with second SIM card slot of the MRcard PL450(D) at the top).

How to insert the SIM card.

- The power supply is disabled.
- You will need a functionable Mini-SIM card of your mobile provider.
- You will also need the associated PIN.
- You will need a flat-blade screwdriver (max. 3.5 mm width).

1. Remove the SIM slot cover as described in the section on Removing a terminal/SIM slot cover.

2. Insert your SIM card into the SIM card slot.

- ① The SIM card will only fit into the SIM card slot in one position. Make sure that the SIM card contacts are faced outwards and the chamfer is at the bottom.

3. Press the SIM card gently into the SIM card slot using a finger until it snaps in.

- ① In order to remove the SIM card, briefly press on the card. The card will then be ejected a little bit and can be removed.

4. Enable the power supply again.

5. Replace the SIM card cover as described in the section on Fitting a terminal/SIM card slot cover.

Connecting a cellular antenna (only MRX.neo with MRcard PL)

How to connect the router to a cellular antenna.

- The power supply is disabled.
- You will need a suitable cellular antenna (available from INSYS icom).

- ① When selecting and mounting the antenna, make sure to comply with CE conformity. See also the Antenna sections in the chapters of the respective MRcard.

1. Connect the cellular antenna to antenna connector #1.

- ✓ The cellular antenna is connected with this.

- ① Using a second antenna allows higher data rate if supported by the provider.

Connecting a PC

How to connect the router to a PC via a network cable.

- The power supply is disabled.
- You will need a network patch cable (Cat 5e or higher).
- You will need a network card in the PC.

1. Locate the RJ-45 socket of the network card at the PC.

2. Plug one end of the network cable into the RJ45 socket of the PC, and the other end into the ETH 1 socket in the left slot of the router.

- ✓ The router is connected to the PC with this.

Configuring the router

- The device is connected to the PC.
- The power supply of the device is enabled and the device is ready for operation (Info LED doesn't light red any more).
- You have the required access rights to change the IP address of the network card at the PC to which the router is connected in case DHCP cannot be used.

1. Make sure that the DHCP client is enabled for the PC (Obtain an IP address automatically).

- ❗ The integrated DHCP server of the router will then allocate an address from the according address range to your network card.

- *Alternatively, you can change the IP address of the network card to which the device is connected to an address that starts with 192.168.1. Do not use the address 192.168.1.1 here. This is the factory default IP address of the device. For example, use 192.168.1.2 as IP address for the network card in your PC.*

2. Open a web browser and enter the host name <https://insys.icom> (or the URL <https://192.168.1.1>) into the address bar.

- ✓ The browser loads the start page of the router.

- *If the browser reports a potential security risk, you can ignore this warning for the initial setup and allow the connection to the router. See also Access via HTTPS Protocol on page 111.*

- *If you see the message in your browser window that the page with this address cannot be found, follow the following steps: Check, whether the device is supplied with power. If yes, most probably a wrong IP address is configured in the device. Press the reset key at least for 8 seconds and repeat this instruction from step 2.*
- ✓ You should now see the start page of the user interface.
- ✓ The router is installed successfully and ready for configuration.

12 Operating Principle

This chapter describes how to operate and configure the router via Ethernet connection.

There are different options for configuration and operation:

- Via a web-based user interface (UI). This is displayed and operated using a web browser. Operation via the UI and access via HTTPS protocol are described in the following.
When you open it for the first time, a landing page appears that leads to the new UI, which replaces the classic web interface and significantly improves the user experience. You can return to the classic view at any time by clicking the button ↶ (to the classic view) in the title bar. The Inline Help in the classic web interface explains the importance of possible settings. It is displayed using the ? button (Display help text) in the title bar besides language selection. An Online Help is available for further explanations that can be opened using links in the Inline Help or the Help -> Documentation menu.
- Via a command line interface (CLI). Configuration and operation via command line are described in detail in the online help in the classic web interface of the router.
- Via a configuration file (binary or ASCII). Configuration and operation via a configuration file are described in detail in the online help in the classic web interface of the router.
- Via the REST interface. Configuration and operation via the REST interface are described in detail in the online help in the classic web interface of the router.

Profiles are used for all types of configuration. The basic handling of these profiles are described at the end of this section.

Note



Insecure configured routers may compromise security-relevant applications!

Follow the instructions in our IT Security Overview to protect your router:

<https://docs.insys-icom.com/docs/en/it-security-hardening-the-router-en>

For a secure initial setup, the router **must** be connected to the computer via a cable since a non-compromisable connection cannot be ensured otherwise.

12.1 Operation via the user interface

The user interface allows easy configuration using a web browser. All functions can be configured via the user interface. The operation is mostly self-explanatory.

- ❗ We recommend using the Startup wizard for the basic configuration of the router.

Access to the user interface

How to access the user interface basically.

- The device is ready for operation and you have access to it (refer to Commissioning section).
- The device is in delivery condition and default settings.

1. ***Start the web browser and enter the host name "https://insys.icom" into the address bar.***

- ❗ The factory default IP address is **192.168.1.1**.
Access is only possible via **HTTPS** protocol in default settings.
If the browser reports a potential security risk, you can ignore this warning for the initial setup and allow the connection to the router.
See also Access via HTTPS Protocol on page 111.

- ✓ The start page of the user interface is displayed.

2. ***Perform the Startup wizard.***

3. ***Make the desired settings and complete the Startup wizard.***

Language selection in the user interface

How to change the language in the user interface.

- The device is ready for operation and you have access to the user interface.

1. ***Click in the title bar on the button and then select the language in the drop-down list .***

- ✓ The user interface is displayed in the selected language then.

Logging out from the user interface

How to log out from the user interface in case an authentication has already been configured and you're logged in to the user interface. This prevents unauthorised access after completing the configuration.

- The device is ready for operation and you have access to the user interface.

1. Click in the title bar on the button and then select the button (Log out).

✓ You will be logged out from the user interface and returned to the login screen.

① A session will also be terminated after 15 minutes of inactivity (default setting) due to security reasons.

12.2 Access via HTTPS Protocol

The user interface permits a secure configuration only using the HTTPS protocol in default settings. The HTTPS protocol allows an authentication of the server (i.e. the router) as well as an encryption of the data transmission. It is not recommended to activate the HTTP protocol.

12.2.1 Authentication via the device-individual certificate/key combination

Note



Increased security requirements for critical applications!

Use an Authentication via an own certificate structure for applications with particularly high requirements to security, such as critical infrastructures. Coordinate the proceeding for securing the router with the IT security department of your company.

The following describes an approach that meets common industrial safety levels at all times, taking into account known hazards.

The installation of the CA certificate of INSYS may conflict with the IT security policies of your company.

For a configuration that meets higher security requirements, a Secure Configuration Guide is also available there (<https://docs.insys-icom.com/docs/en/it-security-secure-configuration-guide-en>).

The router is authenticated using a self-signed, device-individual certificate/key combination by default. In case of a first access via the HTTPS protocol, the browser indicates that the router uses an invalid security certificate. The certificate is not trusted, because the CA (certification authority) certificate is unknown. Since the connection to the router is made via a non-compromisable cable connection, you can ignore this warning message and (depending on the browser and operating system) add an exception for this server or establish the secure connection to this server anyway.

12.2.2 Authentication via an own certificate structure

A more secure alternative is to use your own certificate structure and load a self-generated certificate/key combination onto the router and then use this for access via an HTTPS connection.

Proceed as follows in coordination with the IT security department of your company to ensure a secure availability of the router:

1. Ask the DNS administrator of your company to create a DNS entry, which resolves the name of the router (e.g. router01.internal.company-domain.com) to the planned IP address of the router.
2. Ask the PKI administrator of your company responsible for the certificate structure issue and sign a certificate on the name of the router (e.g. router01.internal.company-domain.com).
3. Install this certificate and the associated key on the router as part of a secure initial setup (the router must only be connected to the configuration computer via an Ethernet cable with this). Upload these to the router in the Administration -> Certificates menu.

Select this certificate/key combination in the Administration -> Configuration access -> Web/REST interface menu for the configuration of the Web/REST interface: access via HTTPS.

12.3 Profiles and Profile Handling

The configuration of the router is called profile. Several profiles can be stored on one device so that the configuration of a device can be changed quickly.

12.3.1 Term definitions

The following terms or conditions are to be distinguished for profiles:

- **running:** the current configuration of the router which is used for operation at the moment
- **opened:** the profile that is currently displayed in the user interface (or CLI or REST interface) for editing
- **last activated, changed:** the last activated profile that differs from the running profile by subsequent changes
- **stored:** one of several possible profiles that are stored on the router by the user

Simple applications do not require the use of more than one profile. However, the router allows many applications by using several profiles. From risk-free testing of modified configurations up to time- or event-triggered switching of different profiles, there are almost no limits for your application.

If the running profile differs from the opened profile, this will be indicated by the appearance of a blinking gear symbol  with the "Activate profile" button.

Following an intentional or unintentional restart of the router (e.g. power supply interruption), the previously running profile will continue to run and the last activated profile will be opened again. If they differ, the button with the gear symbol  blinks again.

12.3.2 Working with one profile

If only one profile is used, the current (opened) profile can be configured in the user interface. Settings made in the opened profile are stored in this profile with a click on the button "Submit" or "OK". They will not become effective in the running profile with this.

If the current profile has been modified, the blinking gear symbol  appears in the title bar. A click on the button with the blinking gear symbol  activates the opened profile, i.e. it becomes the running profile and the modifications of the router configuration become effective. The gear symbol will disappear.



Figure 60: Profile handling – activating c

12.3.3 Using several profiles

The versatile possible applications of the router suggest the use of several profiles. The following sections describe the profile handling.

12.3.3.1 Storing a profile

When settings made in the open profile are stored, they will not become effective in the running profile just yet. They become only effective if the opened profile is activated, i.e. made the running profile.

A profile can be stored:

- In the new UI by clicking on the “Submit” button
- In the classic web interface by clicking on the “OK” button

12.3.3.2 Activating a profile

A click on the button with the blinking gear symbol  in the title bar activates the opened profile, i.e. it becomes the running profile.

A stored profile can be activated and opened:

- In the new UI in the “Administration” menu on the “Profiles” page by clicking the  (Edit) button of the respective profile, then on  (activate and open) and “Submit”
- In the classic web interface in the "Administration" menu on the "Profiles" page by clicking on the button with the gear symbol  behind the respective profile.

 If the router is still in default settings, a changed profile cannot be activated until an authentication has been configured.

12.3.3.3 Opening a profile for editing

A stored profile can be opened:

- In the new UI in the “Administration” menu on the “Profiles” page by clicking the  (Edit) button of the respective profile, then on  (open for editing) and “Submit”
- In the classic web interface in the "Administration" menu on the "Profiles" page by clicking on the button with the gear symbol  behind the respective profile.

12.3.3.4 Creating a profile

A new profile can be created from:

- the running profile
- stored profiles
- the default settings

A new profile can be created:

- In the new UI in the “Administration” menu on the “Profiles” page by clicking the  (Add) button and selecting “Create new profile”
- In the classic web interface in the "Administration" menu on the "Profiles" page by making the correspondent selection behind “Create profile from”

The new profile will be created and appears in the list of profiles. The profile can then be given a descriptive name. It must first be opened to edit it.

12.3.3.5 Exporting a profile

Profiles stored on the router can be exported to the computer, i.e. downloaded.

A stored profile can be exported:

- In the new UI in the "Administration" menu on the "Profiles" page by clicking the  (Edit) button of the respective profile
- In the classic web interface in the "Administration" menu on the "Profiles" page behind the respective profile

A click on the button for the binary file download  downloads the profile as a binary file. This is recommended to archive the profile or transmit it to another router, e.g. a backup device.

A click on the button for the ASCII file download  downloads the profile as a ASCII configuration file. This is recommended if the profile is to be edited manually on the computer.

12.3.3.6 Importing a profile or an ASCII configuration file

Profiles (in binary format) or ASCII configuration files can be uploaded to the router.

A profile or an ASCII configuration file can be imported:

- In the new UI in the "Administration" menu on the "Profiles" page by clicking the  (Add) button in the "Profile" section and selecting "Upload profile" or by clicking the  (Upload) button in the "ASCII configuration" section
- In the classic web interface in the "Administration" menu on the "Profiles" page under "Import profile or ASCII configuration file"

The profile or ASCII configuration file will be uploaded and appear in the respective list.

12.3.3.7 Deleting a profile

A stored profile can also be deleted again.

A stored profile can be deleted:

- In the new UI in the "Administration" menu on the "Profiles" page by clicking the  (Edit) button of the respective profile and a click on  (Delete)
- In the classic web interface in the "Administration" menu on the "Profiles" page by clicking on the button with the bin symbol  behind the respective profile

12.3.3.8 Comparing two profiles

To show the differences between two profiles, it is possible to compare the default settings, the running profile and the stored profiles to each other.

For this, you need to select the two profiles to be compared in the "Administration" menu on the "Profiles" page under "Compare profiles". The different settings of both profiles are displayed side by side when clicking the button "OK". This function is currently only available in the classic web interface.

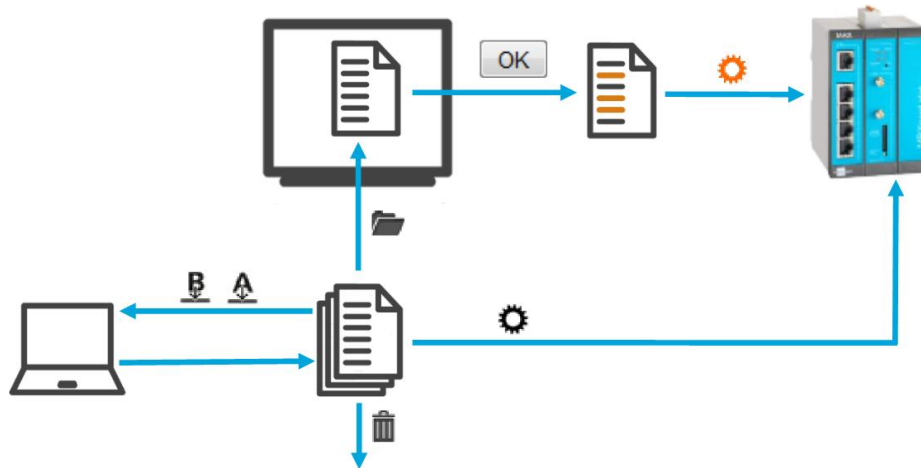


Figure 61: Profile handling – scheme

12.3.4 ASCII Configuration

ASCII configurations are a sequence of commands as they could also be entered in the CLI. Each line contains a command that modifies the opened profile.

Syntax and parameters can be taken from a downloaded profile in ASCII format for example. Refer to the CLI description for further information about the syntax.

Commands that affect plug-in cards that are not installed will be taken over to the profile, but will have no effect.

12.3.5 Profile Mode

The router provides two profile modes: permanent and volatile. The configuration of this function is currently only available in the classic web interface.

The router is in permanent profile mode in normal operation. All modifications are permanently saved and remain intact after a restart.

In certain safety-critical applications, it is required that a router always starts up in a defined basic state after a restart and receives its specific configuration via an update server or router management. A volatile profile mode is available for such purposes. In this mode, all changes to the configuration (including profiles and ASCII configuration files) are lost when the router is restarted and the router restarts in the state it was in when it was changed to volatile mode.

13 Maintenance, Troubleshooting and Repair

13.1 Maintenance

The product is maintenance-free and does not require special regular maintenance.

13.2 Troubleshooting

If a failure occurs during the operation of the product, you will find troubleshooting tips on our support page (<https://www.insys-icom.com/en/support/>). If you need further support, please contact your sales partner or INSYS icom support. You can contact our support department via e-mail under support@insys-icom.de.

13.3 Repair

Information for proceeding in case of repair or complaints are available on our support page (<https://www.insys-icom.com/en/support/>).

Before dispatching the device:

- Remove any inserted SIM cards.
- Backup the configuration on the device and any other stored data if required.
- Backup any applications running on the device.

Caution!



Short circuits and damage due to improper repairs and modifications of products.

Fire hazard and damage of the product.

It is not permitted to open the product for repair or modification exceeding the exchange of plug-in cards.

14 Disposal

14.1 Repurchasing of legacy systems

According to the new WEEE guidelines, the repurchasing and recycling of INSYS legacy devices for our clients is regulated as follows:

Please contact your sales representative by e-mail or phone to initiate a return shipment to INSYS icom.

E-mail: info@insys-icom.de

Phone: +49 941 58692-0



Please consider possible stored passwords or security certificates before disposing the device. It is recommended to block possible existing access rights for the device (e.g. on your VPN server) and reset the device to default settings (if possible), before passing it on or disposing it.

15 Declaration of Conformity

15.1 Devices with radio technology

Hereby, INSYS icom GmbH declares that the device type MRX.neo is in compliance with Directives 2014/53/EU and 2011/65/EU. The full text of the EC Declaration of Conformity is available under the following Internet address:
www.insys-icom.com/manual

To ensure that radio equipment complies with CE requirements, exposure of persons to electromagnetic fields must be limited and therefore checked in relation to the antennas used. Compliance with these requirements can only be guaranteed if the antennas supplied by INSYS as accessory products are used.

If this radio equipment product is incorporated into a non-radio equipment product in accordance with the installation instructions in this manual, a re-assessment of the conformity of the complete product in accordance with the Radio Equipment Directive 2014/53/EU is not required, provided that the product into which this radio equipment product is incorporated is subject to assessment criteria comparable to those of this radio equipment product.

Provided that the combined product does not require a further conformity assessment under Directive 2014/53/EU in accordance with the above requirements, the declaration of conformity for the radio equipment may be used for its declaration of conformity, provided that

- the overall product is subject to equivalent assessment criteria, and
- no changes are made to the radio equipment product.

The above information is a summary of the relevant points of the ETSI EG 203 367 application guideline for the harmonised standards relating to Articles 3.1b and 3.2 of the Radio Equipment Directive 2014/53/EU (RED) for multi-purpose radio equipment and combined radio and non-radio equipment; the content of the guideline takes precedence.

In addition, IT security requirements also apply to system integrators and operators of radio equipment in accordance with the RED. The system integrator or operator must, among other things, ensure that radio equipment is protected against unauthorised access and does not have any known vulnerabilities to cyber attacks, for example by securing communication interfaces. The system integrator or operator is required to ensure that the firmware is updated regularly (see <https://icom-os.releasenotes.io/>), to keep themselves informed about potential security vulnerabilities (see <https://www.insys-icom.com/en/support/security-advisories/>) and to configure the devices (including any container applications that may be installed) in a manner that ensures appropriate IT security (see <https://docs.insys-icom.com/docs/en/it-security-en>).

15.2 Devices without radio technology

Hereby, INSYS icom GmbH declares that the device type MRX.neo is in compliance with Directives 2014/30/EU and 2011/65/EU. The full text of the EC Declaration of Conformity is available under the following Internet address:
www.insys-icom.com/manual

16 FCC Statement

Note: Certain variants of this device comply with part 15 of the FCC Rules (this is indicated by the FCC symbol on the label). Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment under FCC rules.

17 Export Restriction

The chip sets for analogue modems and cellular radio adapters used by INSYS icom GmbH are subject to export restrictions as per US ECCN classification (5A991).

Therefore, it is not allowed to export these communication devices into the following countries (at the time when this publication has been issued): Cuba, Iran, North Korea, Sudan, Syria

The currently effective country list can be found in section „Country Group E“ in the document "Supplement No. 1 to Part 740" of the Export Administration Regulations (EAR) (<https://www.bis.doc.gov>). Please contact the US authorities directly for a special permit.

We want to make you aware that the US legislation may have an effect in Germany. Amongst others, it may happen that US companies may be precluded from supplying foreign violators of the EAR on the basis of US legislation.

Note



Export restriction!

Possible violation of export regulations.

This device uses encryption technology and is therefore subject to export control as per German (AL classification 5A002) and European law (EG-DUAL-USE VO 428/2009). The export from Germany requires a permission of the Bundesamt für Wirtschaft und Ausfuhrkontrolle (Federal Office of Economics and Export Control).

This device may contain components with US origin. Possible export conditions as per US law (ECCN classification) will be mentioned explicitly on receipts, if possible, or can always be requested.

18 Glossary

This describes the most important terms and abbreviations of this manual.

- APN:** Access Point Name, computer name that provides cellular subscribers of the GPRS network with Internet access.
- AT command:** Commands to devices such as modems to set up this device.
- Broadcast:** Data packet that is sent to all participants of a network.
- Caller ID:** Phone number transmitted by the caller that can be evaluated by the called device.
- Client:** Device that requests services from another device (server).
- DHCP:** Dynamic Host Configuration Protocol; DHCP servers can dynamically design an IP address and other parameters to DHCP clients on request.
- DNS:** Domain Name System; service used for the translation of domain names into IP addresses.
- Domain name:** The domain is the name of an Internet site (e.g. insys-icom). It consists of the name and an extension (Top Level Domain, e.g. .com), (e.g. insys-icom.com).
- DSSS:** Dual SIM Single Standby refers to a dual-SIM system in which two SIM cards are inserted into a single device, but only one SIM can be connected to the network at a time. To ensure redundancy in the event of a provider change, you can switch between the cards.
- EDGE:** Enhanced Data Rates for GSM Evolution designates a technology for increasing the data rate in GSM cellular networks by introducing an additional modulation process. EDGE enhances GPRS to E-GPRS (Enhanced GPRS) and HSCSD to ECSD.
- Firewall:** Network rules that block in particular data packets to certain sources or destinations.
- Gateway:** This is a machine that works like a router. In contrast to the router, a gateway can also route data packets from different hardware networks.
- GPRS:** General Packet Radio Service; advancement of the -> GSM cellular network to achieve higher data transmission rates.
- GSM:** Global System for Mobile communications; cellular network for voice and data transmission.
- ICMP:** Internet Control Message Protocol; protocol that is often used to control a network. The program "ping" uses ICMP for example.
- Interface:** A network device that can transport IP connections.

- IP address:** Internet Protocol address; The IP address of a device in a network under which it can be accessed. It consists of four bytes and is indicated decimal, (e.g. 192.168.1.1)
- IP net:** An Ethernet-based interface that can become a LAN or a WAN interface.
- LAN:** Local Area Network; a network of computers which are located relatively close to each other.
- LAN interface:** An interface that is assigned to a local network (plant network, machine network, local network); it is connected to a WAN via the router.
- MAC address:** Media Access Control Address. A MAC is a part of an Ethernet interface. Each Ethernet interface has a unique global number, the MAC address.
- Netmask:** Defines a logical group of IP addresses in net address and device addresses.
- Net address:** Consists of the overlap of IP address and netmask. It always ends with "0". The netmask (e.g. 255.255.255.0) is applied in binary form to an IP address (e.g. 192.168.1.1); the still "visible" part of this overlapping (masking) is the net address (here: 192.168.1.0).
- Network rules:** You decide how the different data packets are handled in a network device. You can block or redirect data packets to or from certain network participants for example.
- Port:** (1) Socket at the switch for connecting Ethernet devices.
(2) Part of a socket for data connections
- Port-Forwarding:** Network rules that redirect data packets from certain senders to special recipients of a network.
- PPP:** Point to Point Protocol; a protocol, which connects two machines via a serial line to enable the exchange of TCP/IP packets between those two machines.
- PPPoE:** Point to Point Protocol over Ethernet; a protocol, which connects two devices via an Ethernet line to enable the exchange of TCP/IP packets between those two machines.
- Router:** This is a machine in a network, which is responsible for the incoming data of a protocol to be forwarded to the planned destination or sub network.
- SCN:** Service Center Number, phone number of the computer that accepts short messages (->SMS) via the GSM network and forwards them to the recipients.
- Server:** Device that provides services, e.g. web server, to other devices (client).

SMS:	Short Message Service; short messages can be sent via the GSM cellular network.
Socket:	Data connections that are established using ->TCP or ->UDP use sockets for addressing. A socket consists of an IP address and a port (cf. address: street name and number)
Switch:	A device that can connect several machines with the Ethernet. In contrast to a hub, a switch will "think" by itself, i.e. it can remember the MAC addresses connected to a port and directs the traffic more efficiently to the individual ports.
TCP:	Transmission Control Protocol; a transport protocol to enable data exchange between network devices. It operates "connection-based", i.t. the data transmission is protected.
UDP:	User Datagram Protocol; a transport protocol to enable data exchange between network devices. It operates "without connection", i.t. the data transmission is not protected.
UMTS:	Universal Mobile Telecommunications System stands for the third generation cellular standard (3G) that allows significantly higher data transmission rates (384 kbit/s to 7.2 Mbit/s) than the second generation cellular standard (2G), the GSM standard (9.6 kbit/s to 220 kbit/s).
URL:	Uniform Resource Locator; this is the address used by a service to be found in the web browser. In this manual, an URL is mostly entered as the IP address of the device.
VPN:	Virtual Private Network; logical connections (so-called tunnels) are established via existing unsafe connections. The end points of these connections (tunnel ends) and the devices behind can be considered as an independent logical network. A very high degree of tap- and tamper-resistance can be achieved with the encryption of the data transmission via the tunnels and the previous two-way authentication of the participants at this logical network.
WAN:	Wide Area Network; a network consisting of computers, which are located far away from each other.
WAN group:	Defines a collection of WAN interfaces that can be started or stopped in parallel.
WAN interface:	An interface that serves to connect the local network (or one of the local networks) with a superordinate network.
WAN chain:	Defines a WAN by arranging WAN interfaces or WAN groups in a sequence.

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