

## TB20 – PROFINET Coupler

# Manual

Version 4 - 8/5/2019

for HW 4-4 & FW 1.6x and higher



## Notes

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Hannberger Weg 2, 91091 Großenseebach, Germany

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We welcome all ideas and suggestions.



## Revision Record

Version	Date	Change
1	1/21/2014	First version
2	10/13/2015	UL corrections; Factory reset switch; 340 bytes input/output; Updated introduction section; Section 6.6 "Behavior of outputs" added
3	3/8/2016	PNO certificate added
4	8/5/2019	text corrections and Section TB20-ToolBox added

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# 1. General information

This operating manual applies only to devices, assemblies, software, and services of Helmholz GmbH & Co.KG (“Helmholz”).

## 1.1. Target audience for this manual

This description is only intended for trained personnel qualified in control and automation engineering who are familiar with the applicable national standards. For installation, commissioning, and operation of the components, compliance with the instructions and explanations in this operating manual is essential.



Configuration, execution, and operating errors can interfere with the proper operation of the TB20 devices and result in personal injury as well as material or environmental damage. Only suitably qualified personnel may operate the TB20 devices!

Qualified personnel must ensure that the application and use of the products described meet all the safety requirements, including all relevant laws, regulations, provisions, and standards.

## 1.2. Safety instructions

The safety notes must be observed in order to prevent harm to living creatures, material goods, and the environment. The safety notes indicate possible hazards and provide information about how hazardous situations can be prevented.

### 1.3. Note symbols and signal words in the manual



HAZARD

If the hazard warning is ignored, there is an imminent danger to life and health of people from electrical voltage.



WARNING

If the hazard warning is ignored, there is a probable danger to life and health of people from electrical voltage.



CAUTION

If the hazard warning is ignored, people can be injured or harmed.



ATTENTION

Draws attention to sources of error that can damage equipment or the environment.



NOTE

Gives an indication for better understanding or preventing errors.



## 1.4. Intended use

The TB20 I/O system is an open, modular, and distributed peripheral system designed to be mounted on 35 mm DIN rails.

Communication with a higher-level control system takes place via a bus system / network through a TB20 bus coupler. Up to 63 modules from the TB20 range can be set up on a bus coupler. The bus couplers support hot-swap for replacing modules during ongoing operation.

All components are supplied with a factory hardware and software configuration. The user must carry out the hardware and software configuration for the conditions of use. Modifications to hardware or software configurations which are beyond the documented options are not permitted and nullify the liability of Helmholz.

The TB20 devices should not be used as the only means for preventing hazardous situations on machinery and equipment.

Successful and safe operation of the TB20 devices requires proper transport, storage, installation, assembly, commissioning, operation, and maintenance.

The ambient conditions provided in the technical specifications must be adhered to.

The TB20 systems have a protection rating of IP20 and must have a control box/cabinet fitted to protect against environmental influences in an electrical operating room. To prevent unauthorized access, the doors of control boxes/cabinets must be closed and possibly locked during operation.



HAZARD

TB20 devices can be equipped with modules that can carry dangerously high voltages. The voltages connected to the TB20 devices can result in hazards during work on the TB20 devices.

## 1.5. Improper use



WARNING

The consequences of improper use may include personal injuries of the user or third parties as well as property damage to the control system, the product, or environment. Use TB20 devices only as intended!

## 1.6. Installation

### 1.6.1. Access restriction

The modules are open operating equipment and must only be installed in electrical equipment rooms, cabinets, or housings.

Access to the electrical equipment rooms, cabinets, or housings must only be possible using a tool or key, and access should only be granted to trained or authorized personnel.

### 1.6.2. Electrical installation

Observe the regional safety regulations.



TB20 devices can be equipped with modules that can carry dangerously high voltages. The voltages connected to the TB20 devices can result in hazards during work on the TB20 devices.

### 1.6.3. Protection against electrostatic discharges

To prevent damage through electrostatic discharges, the following safety measures are to be followed during assembly and service work:

- Never place components and modules directly on plastic items (such as polystyrene, PE film) or in their vicinity.
- Before starting work, touch the grounded housing to discharge static electricity.
- Only work with discharged tools.
- Do not touch components and assemblies on contacts.

### 1.6.4. Overcurrent protection

To protect the TB20 and the supply line, a slow-blowing 8 A line protection fuse is required.

### 1.6.5. EMC protection

To ensure electromagnetic compatibility (EMC) in your control cabinets in electrically harsh environments, the known rules of EMC-compliant configuration are to be observed in the design and construction.

### **1.6.6. Operation**

Operate the TB20 only in flawless condition. The permissible operating conditions and performance limits must be adhered to.

Retrofits, changes, or modifications to the device are strictly forbidden.

The TB20 is an operating means intended for use in industrial plants. During operation, the TB20 can carry dangerous voltages. During operation, all covers on the unit and the installation must be closed in order to ensure protection against contact.

### **1.6.7. Liability**

The contents of this manual are subject to technical changes resulting from the continuous development of products of Helmholz. In the event that this manual contains technical or clerical errors, we reserve the right to make changes at any time without notice. No claims for modification of delivered products can be asserted based on the information, illustrations, and descriptions in this documentation. Beyond the instructions contained in the operating manual, the applicable national and international standards and regulations also must be observed in any case.

### **1.6.8. Disclaimer of liability**

Helmholz is not liable for damages if these were caused by use or application of products that was improper or not as intended.

Helmholz assumes no responsibility for any printing errors or other inaccuracies that may appear in the operating manual, unless there are serious errors about which Helmholz was already demonstrably aware.

Beyond the instructions contained in the operating manual, the applicable national and international standards and regulations also must be observed in any case.

Helmholz is not liable for damage caused by software that is running on the user's equipment which compromises, damages, or infects additional equipment or processes through the remote maintenance connection and which triggers or permits unwanted data transfer.

### **1.6.9. Warranty**

Report any defects to the manufacturer immediately after discovery of the defect.

The warranty is not valid in case of:

- Failure to observe these operating instructions
- Use of the device that is not as intended
- Improper work on and with the device
- Operating errors
- Unauthorized modifications to the device

The agreements met upon contract conclusion under "General Terms and Conditions of Helmholz GmbH & Co. KG" apply.

## 2. System overview

### 2.1. General information

The TB20 I/O system is an open, modular, and distributed peripheral system designed to be mounted on 35mm DIN rails.

It is made up of the following components:

- Bus couplers
- Peripheral modules
- Power and isolation modules
- Power modules

By using these components, you can build a custom automation system that is tailored to your specific needs and that can have up to 63 modules connected in series to a bus coupler. All components have a protection rating of IP20.

### 2.2. The components that make up the TB20 I/O system

#### 2.2.1. Bus coupler

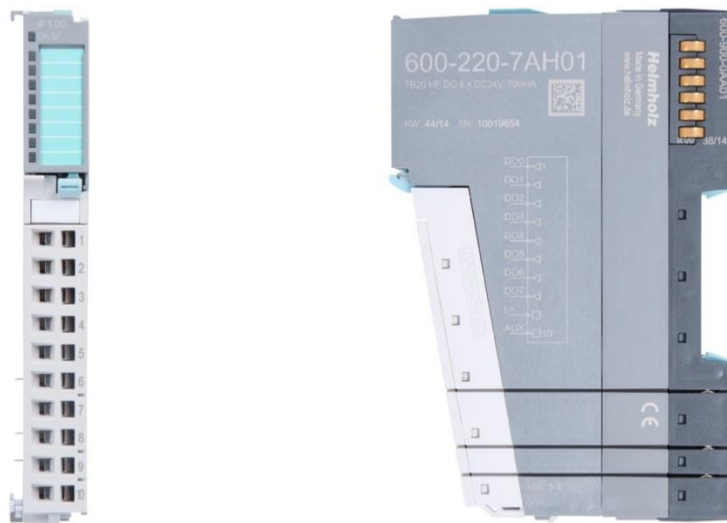
The system's bus coupler includes a bus interface and a power module. The bus interface is responsible for establishing a connection to the higher-level bus system and is used to exchange I/O signals with the automation system's CPU.

The power module is responsible for powering the coupler's electronics and all connected peripheral modules.

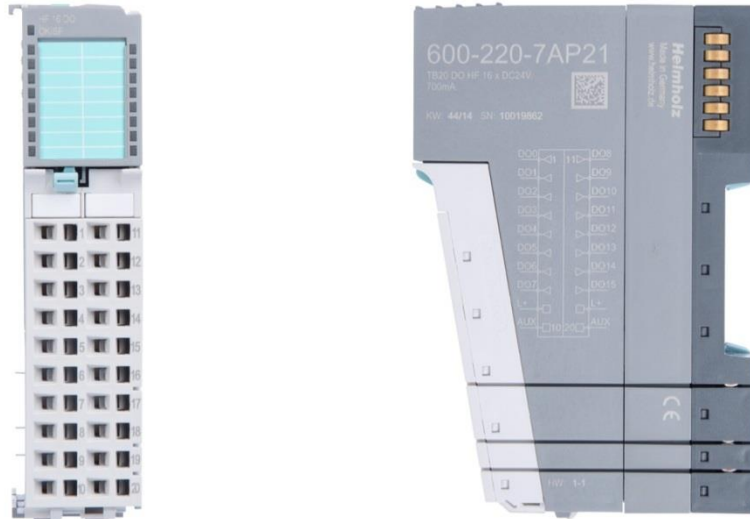
#### 2.2.2. Peripheral modules

The system's peripheral modules are electronic components to which peripheral devices such as sensors and actuators can be connected. A variety of peripheral modules with different tasks and functions are available.

#### Example: Peripheral module with 10-terminal front connector



## Example: Peripheral module with 20-terminal front connector



### 2.2.3. Power and isolation module

The system's bus coupler provides the supply voltage for the communications bus (5 V, top) and for external signals (24 V, bottom). These voltages are passed from module to module through the base modules.

Power and isolation modules make it possible to segment the power supply for external signals into individual power supply sections that are powered separately. Meanwhile, the communication bus signals and supply voltage simply continue to be passed through, in contrast to the way they are handled by power modules (see section 2.2.4).



NOTE

Power and insulation modules have a lighter body color.

## 2.2.4. Power module

The system's bus coupler provides the supply voltage for the communications bus (5 V, top) and for external signals (24 V, bottom). These voltages are passed from module to module through the base modules.

Power modules make it possible to segment the power supply for both external signals and the communication bus into individual power supply sections that are powered separately.

Power modules deliver all necessary power to the peripheral modules connected after them and, if applicable, all the way to the next power module or power and isolation module. A power module is required whenever the power supplied by the coupler alone is not sufficient, e.g., when there are a large number of modules with high power requirements. The "TB20 ToolBox" configuration program can be used to determine whether power modules are needed, as well as how many of them will be needed.

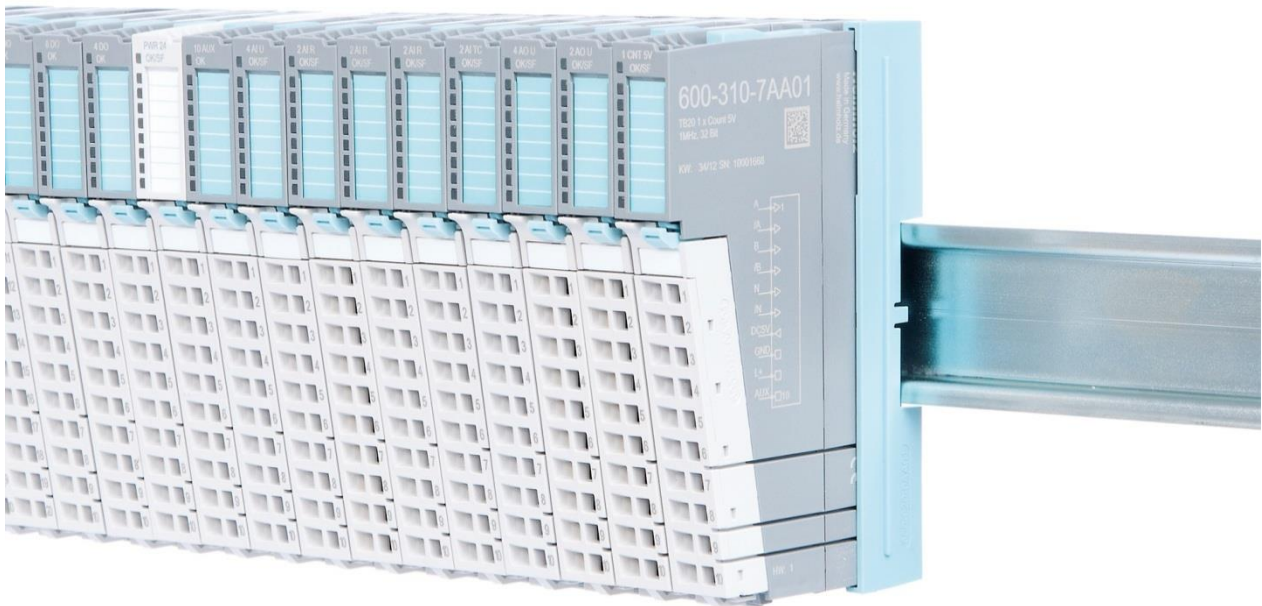


### NOTE

Power modules have a lighter body color.

### 2.2.5. Final cover

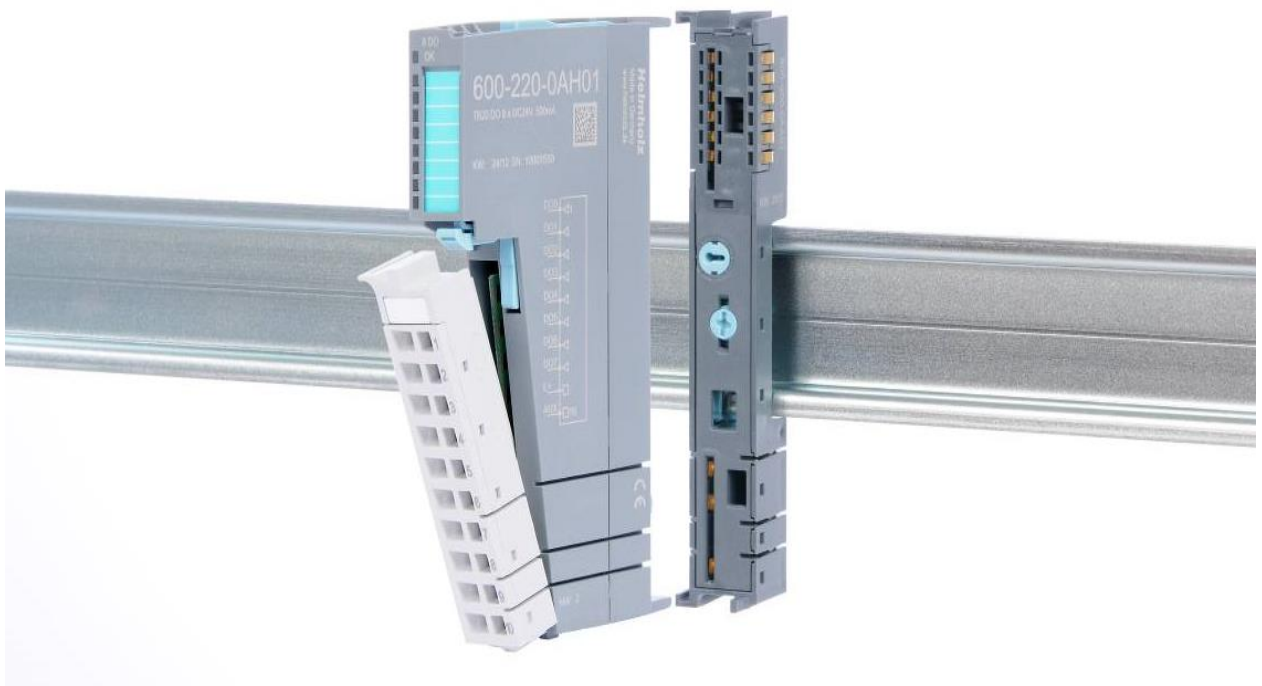
The final cover protects the contacts on the last base module from accidental contact by covering its outer right-hand side.



### 2.2.6. Components in a module

Each module consists of three parts:

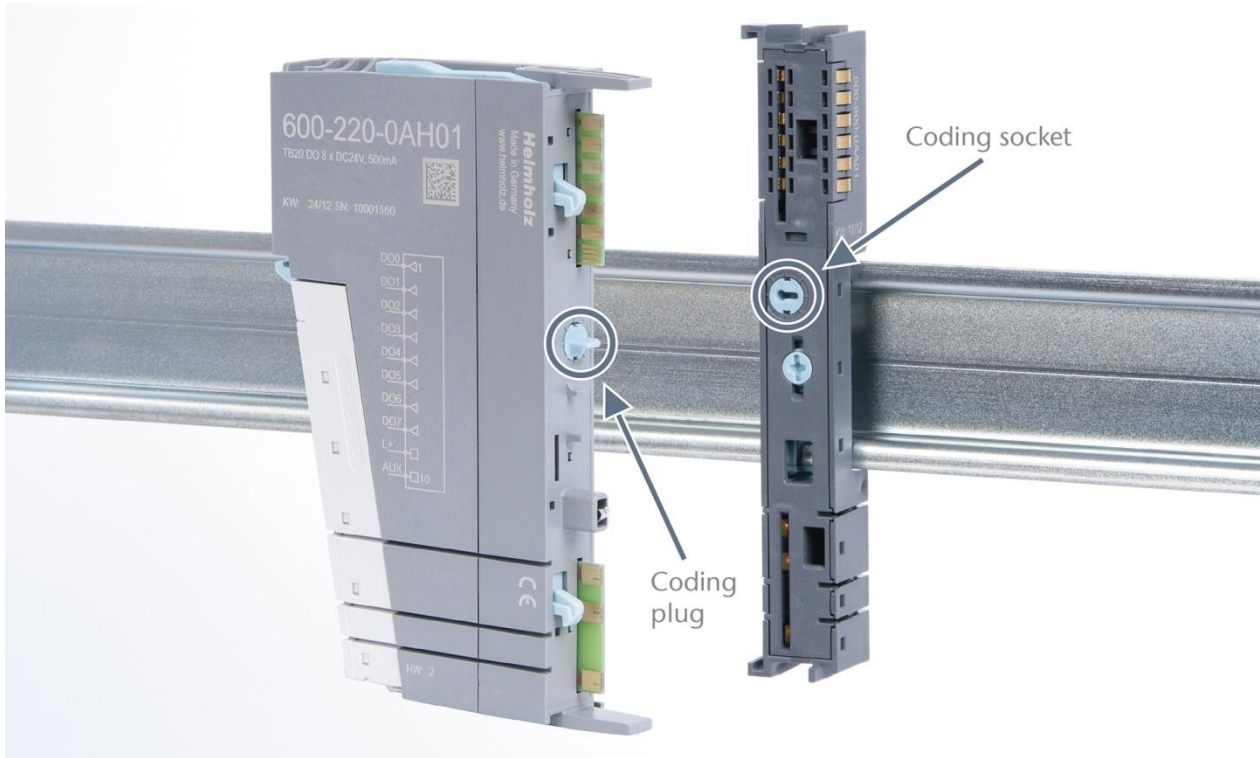
- A base module
- An electronic module
- A front connector



## 2.2.7. Module coding

Electronic modules and base modules feature coding elements meant to prevent the wrong spare electronic modules from being plugged in during maintenance and repairs.

These coding elements consist of a coding plug on the electronic module and a coding socket on the base module (see following figure).



The coding plug and coding socket can each be in one of eight different positions. Each of these eight positions is factory-assigned to a specific type of module (Digital In, Digital Out, Analog In, Analog Out, Power) from the TB20 system. It will only be possible to plug an electronic module into a base module if the position of the coding plug and the position of the coding socket match. If the positions differ, the electronic module is mechanically blocked.



### 3. Installation and removal



TB20 modules can carry lethal voltage.

Before starting any work on TB20 system components, make sure to de-energize all components as well as the cables supplying them with power! During work when the system is live, there is the risk of fatal electrocution!



ATTENTION

Insulation must be carried out according to VDE 0100/IEC 364 and performed in accordance with applicable national standards. The TB20 IO system has protection rating IP20. If a higher protection rating is required, the system must be installed in a housing or control cabinet. In order to ensure safe operation, the ambient temperature must not exceed 60 °C.

#### 3.1. Installation position

The TB20 I/O system can be installed in any position.

In order to achieve optimum ventilation and be able to use the system at the specified maximum ambient temperature, it is necessary to use a horizontal installation layout.

#### 3.2. Minimum clearance

It is recommended to adhere to the minimum clearances specified when installing the coupler and modules. Adhering to these minimum clearances will ensure that:

- The modules can be installed and removed without having to remove any other system components.
- There will be enough space to make connections to all existing terminals and contacts using standard accessories.
- There will be enough space for cable management systems (if needed).

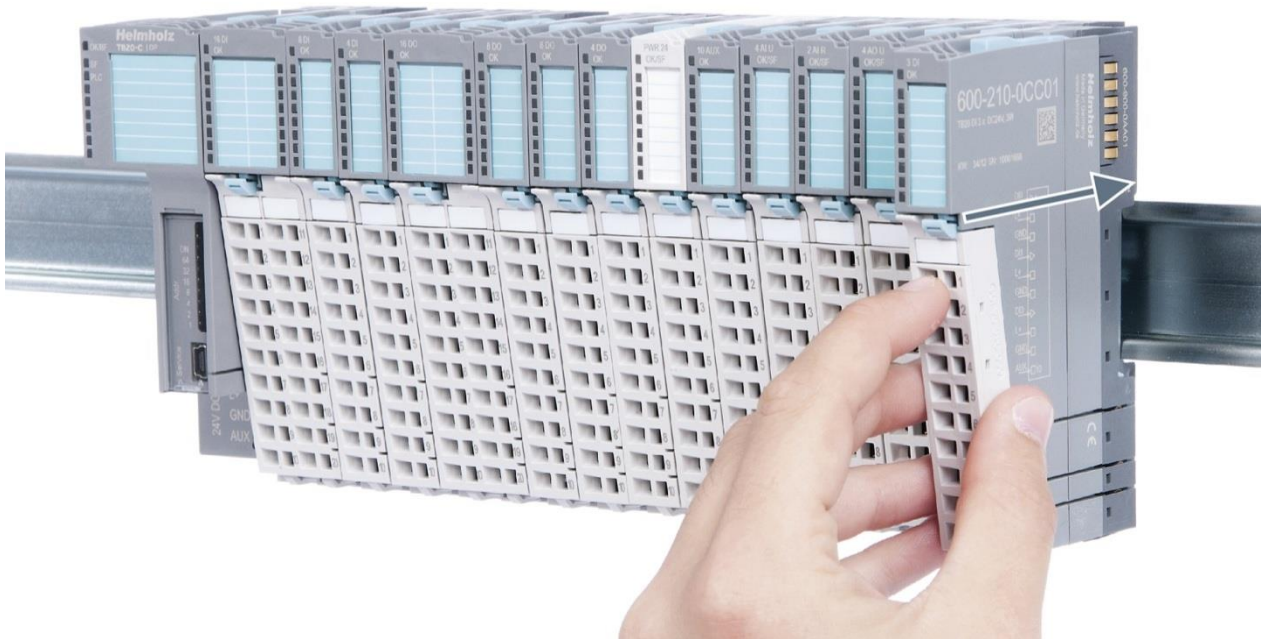
The minimum clearances for mounting TB20 components are: 30 mm on the top and on bottom and 10 mm on each side.

### 3.3. Installing and removing peripheral modules

#### 3.3.1. Installation

##### Installing an assembled peripheral module

Place the assembled module on the DIN rail by moving it straight towards the rail. Make sure that the module engages the upper and lower guide elements of the previous module. Then push the upper part of the module towards the DIN rail until the rail fastener fastens into place on the inside snaps with a soft click.



##### Installing the individual parts of a peripheral module one after the other:

Place the base module on the DIN rail from below in an inclined position. Then push the upper part of the base module towards the rail until the module is parallel to the rail and the rail fastener on the inside snaps into place with a soft click.

Place an electronic module with matching coding (see the “Module coding” section on page 16) on the base module in a straight line and then gently push it onto the base module until both modules are fully resting on top of one another and the module fastener snaps into place with a soft click.

Finally, place the front connector on the electronic module from below in an inclined position and then gently push it onto the electronic module until the front connector fastener snaps into place with a soft click.

### 3.3.2. Removal

To remove a peripheral module, follow the four steps below:

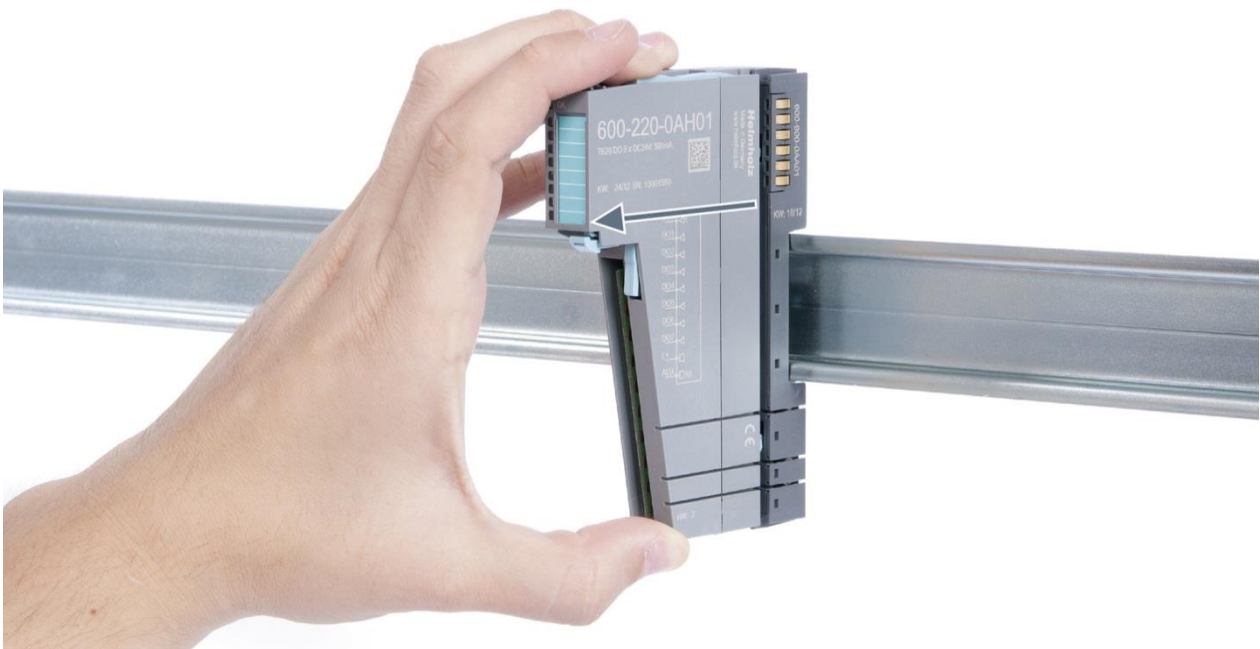
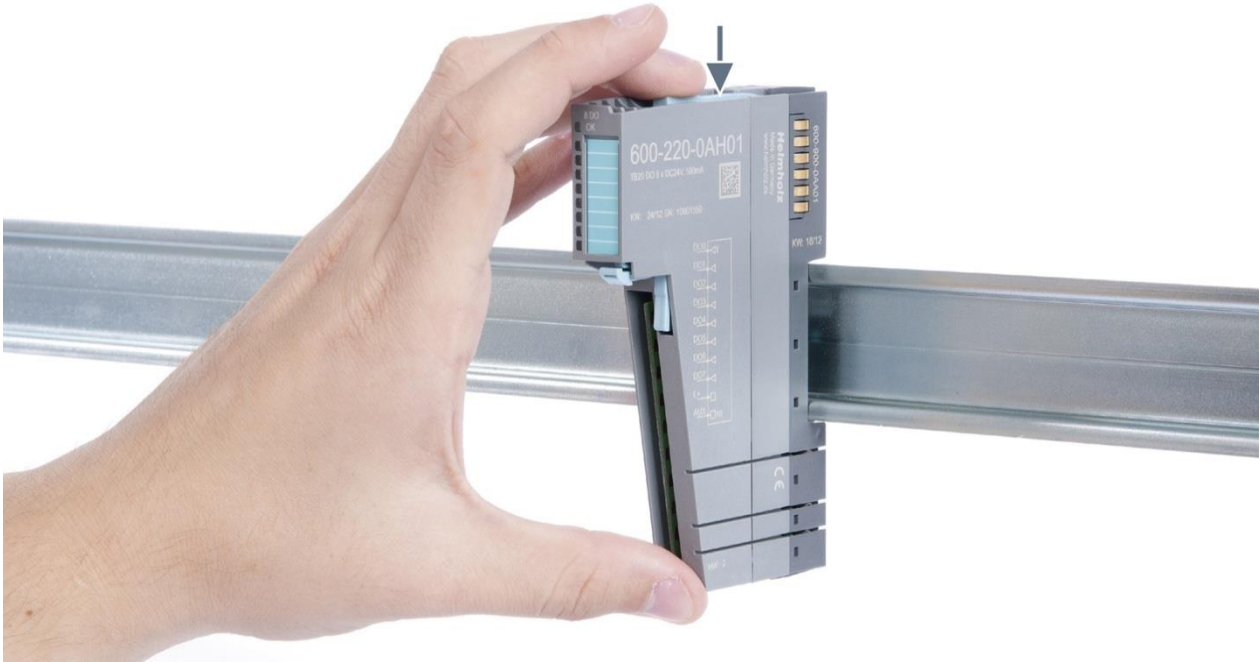
#### Step 1: Remove the front connector

To remove the front connector, push the tab above the front connector upwards (see the picture below). This will push out the front connector, after which you can pull it out.



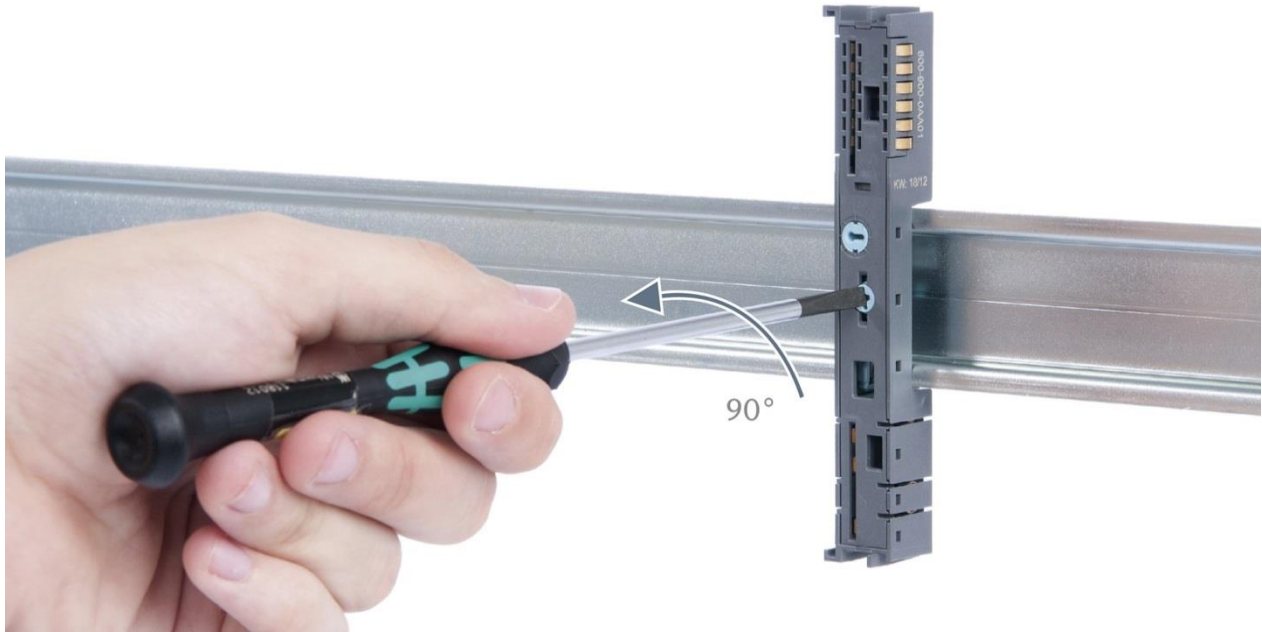
## Step 2: Remove the electronic module

Use your middle finger to push on the lever from above and then use your thumb and index finger to pull out the electronic module while holding the lever down (see the picture below).



### Step 3: Release the base module

Use a screwdriver to release the base module. Turn the screwdriver 90° counterclockwise to release.



### Step 4: Remove the base module

Remove the base module by pulling it towards you.

### 3.4. Replacing an electronic module

The procedure for replacing the electronic module on a peripheral module consists of four steps.

If you need to replace the electronic module while the system is running, make sure to take into account the general technical specifications for the bus coupler being used.



HAZARD

TB20 modules can carry lethal voltage.

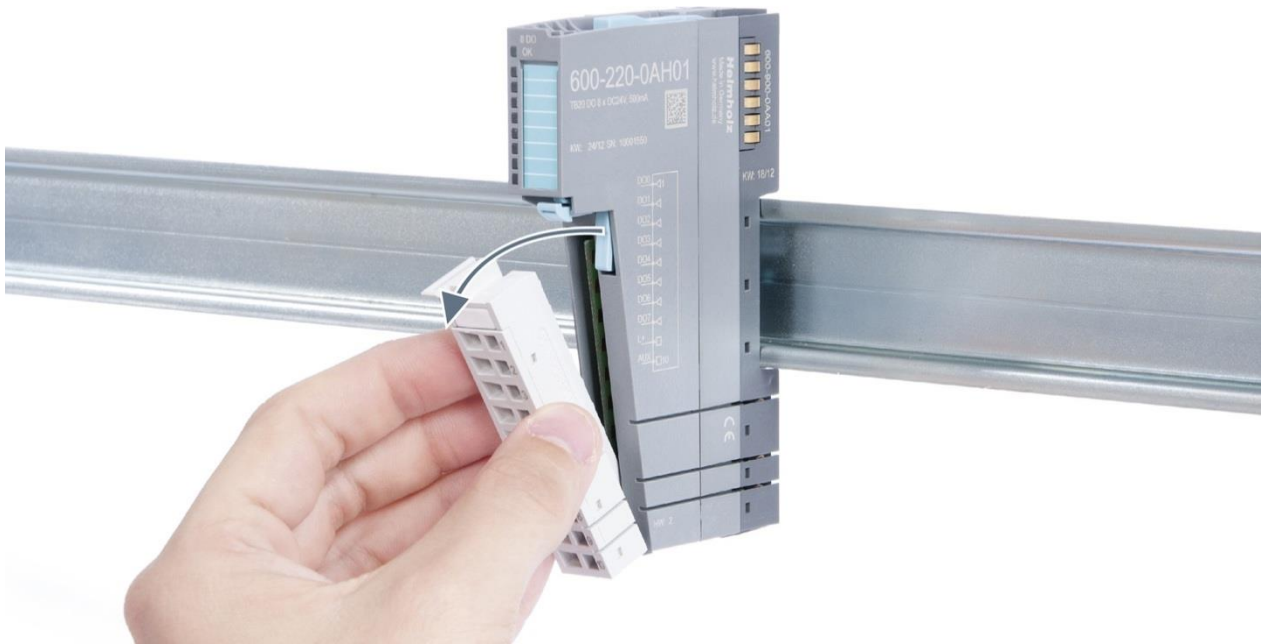
Before starting any work on TB20 system components, make sure to de-energize all components as well as the cables supplying them with power! During work when the system is live, there is the risk of fatal electrocution!

Note the wiring diagram of the system and switch off dangerous voltages before starting work!

#### Step 1: Remove the front connector

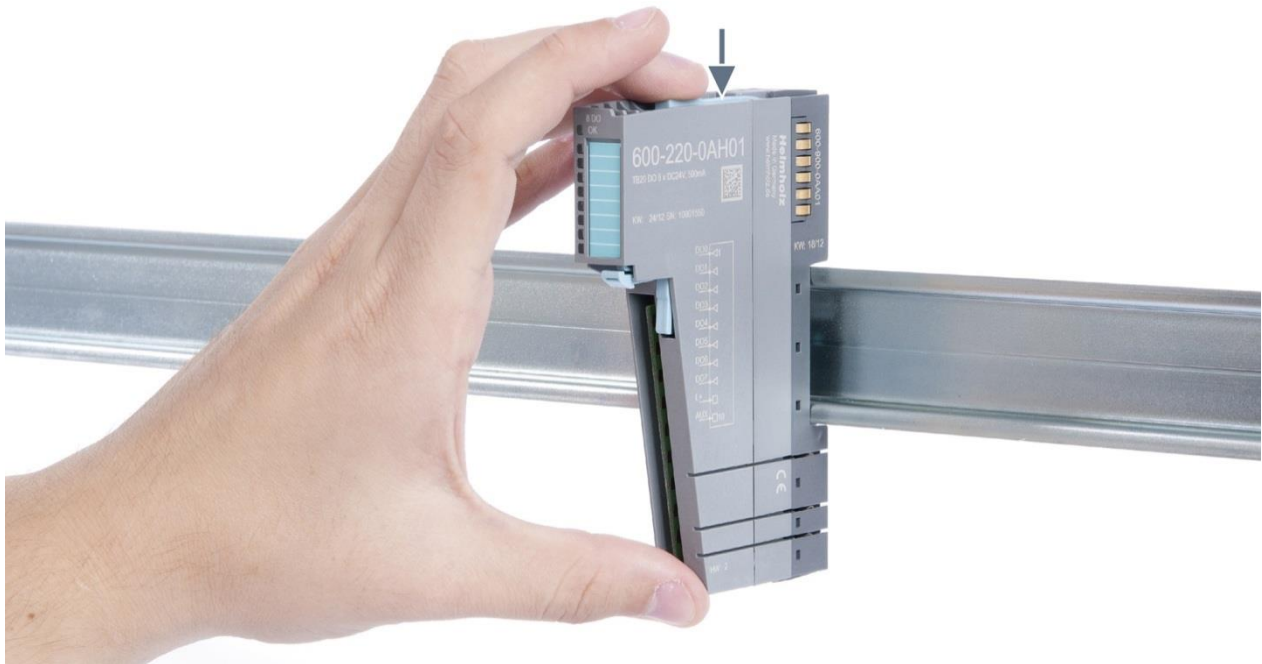
To remove the front connector, push the tab above the front connector upwards (see the picture below). This will push out the front connector, after which you can pull it out.

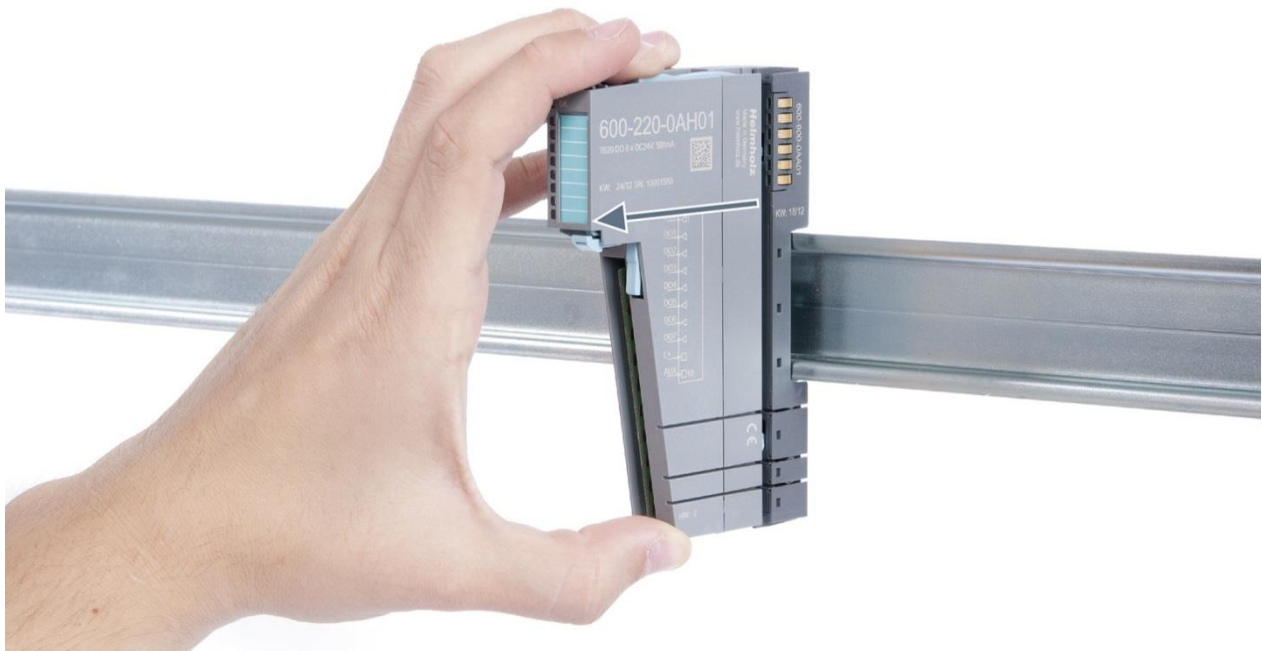




## Step 2: Remove the electronic module

To remove the electronic module, use your middle finger to push on the lever from above and then use your thumb and index finger to pull out the electronic module while holding the lever down (see the picture below).





### Step 3: Plug in a new electronic module



#### ATTENTION

The electronic module must be snapped into place on the base module with a single continuous movement. If the electronic module is not snapped into place firmly and straight on the base module, bus malfunctions may occur.

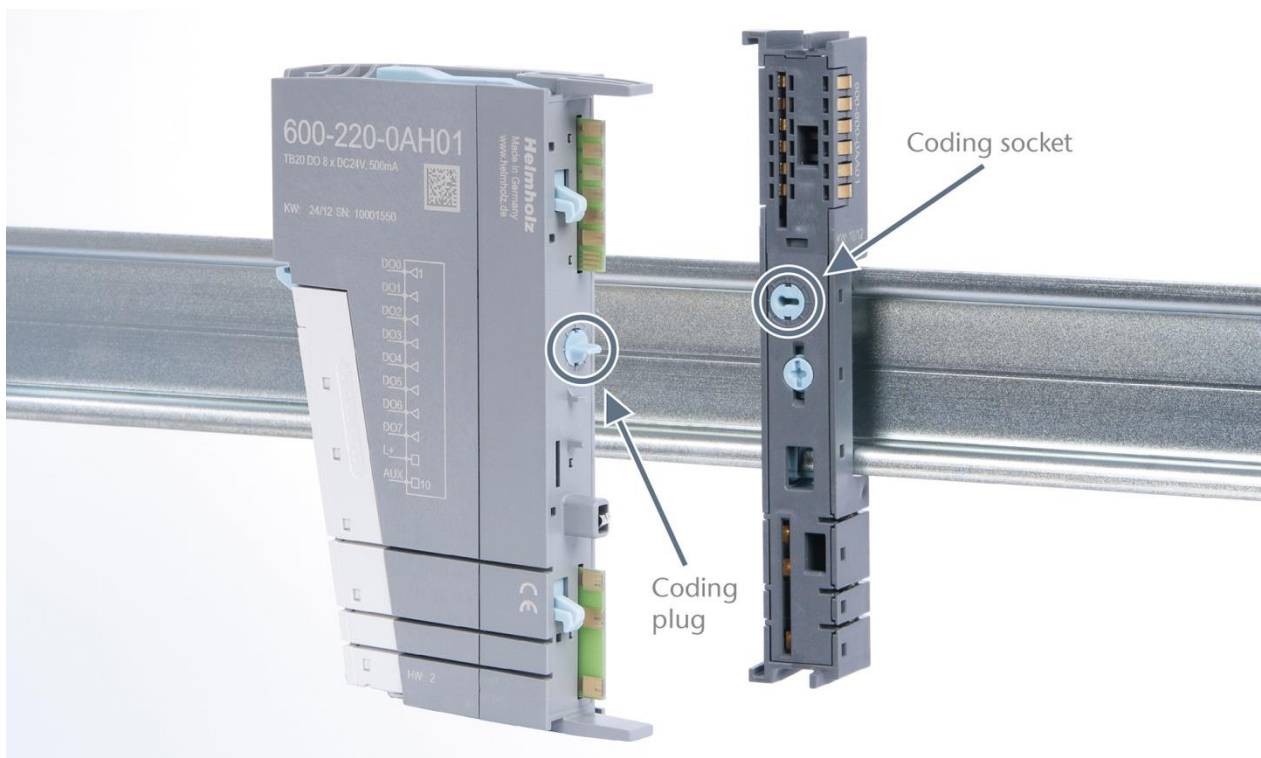




#### ATTENTION

If the electronic module cannot be plugged into the base module, check whether the coding elements on the electronic module and base module (see figure below) match. If the coding elements on the electronic module do not match those on the base module, you may be attempting to plug in the wrong electronic module.

For more information on coding elements, please consult section 2.2.7.

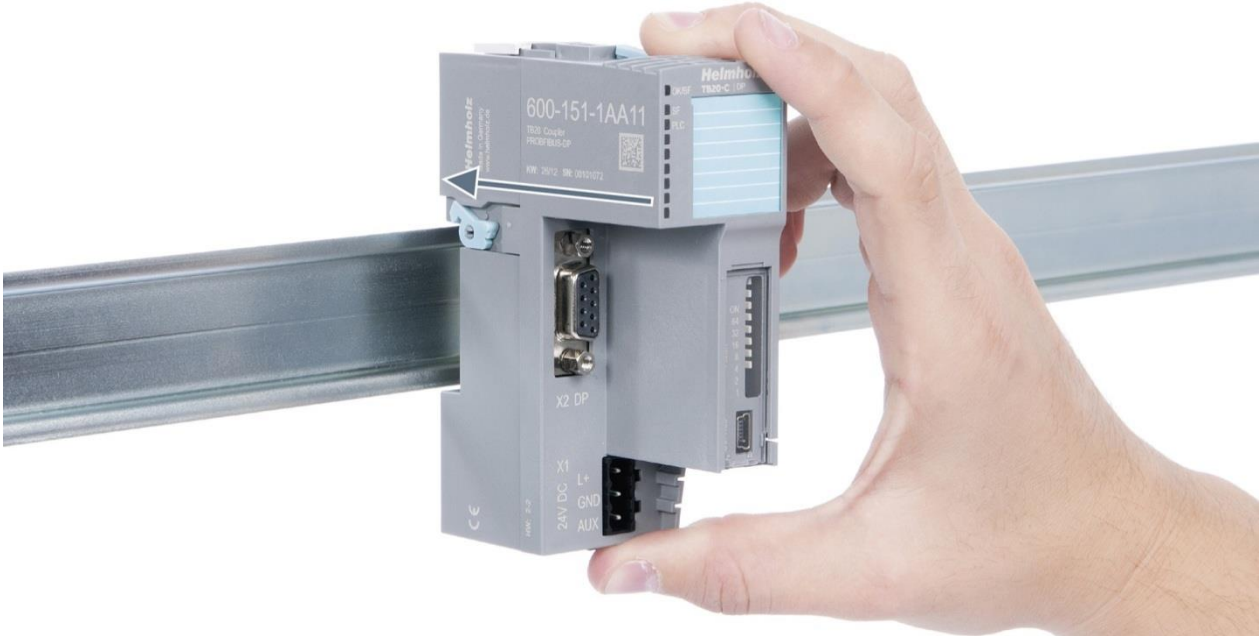


#### Step 4: Plug in the front connector

## 3.5. Installing and removing the coupler

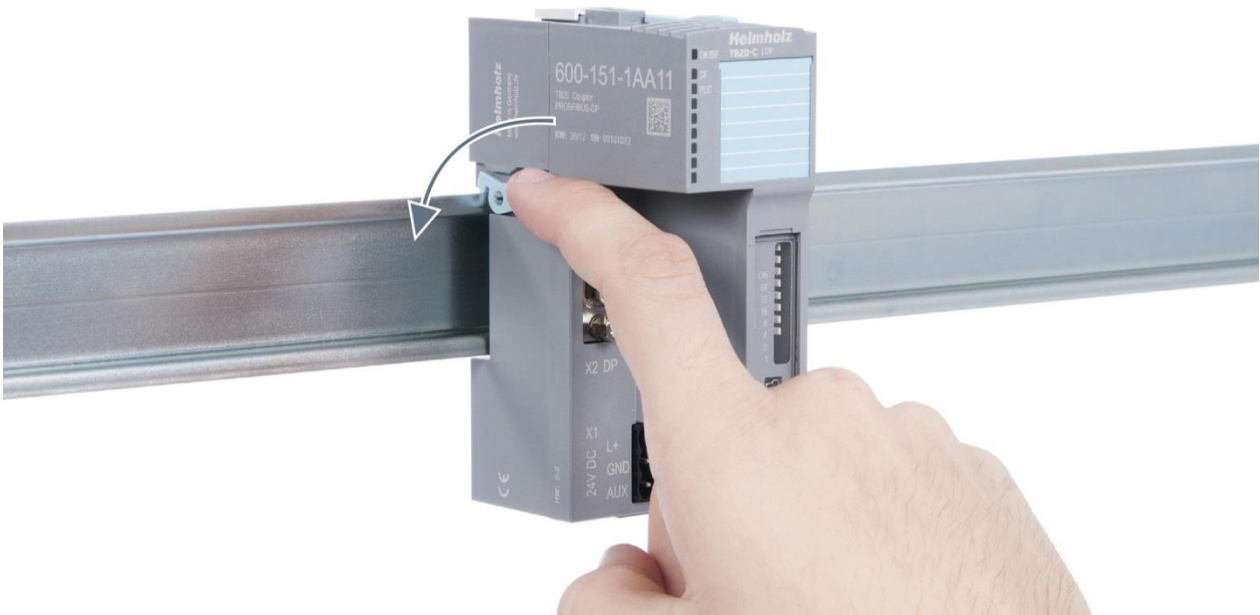
### 3.5.1. Installation

Place the coupler, together with the attached base module, on the DIN rail by moving it straight towards the rail. Then push the coupler towards the rail until the base module's rail fastener snaps into place with a soft click.



#### Step 2: Secure the coupler on the DIN rail

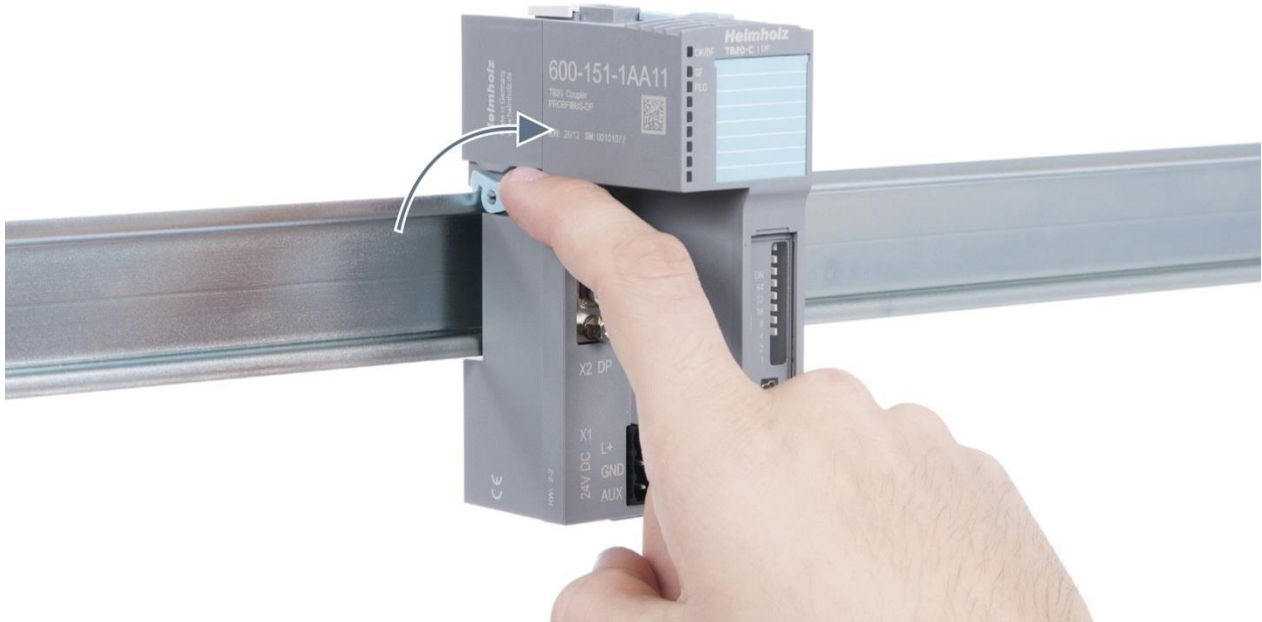
Use the locking lever on the left side of the coupler to lock the coupler into position on the DIN rail.



### 3.5.2. Removal

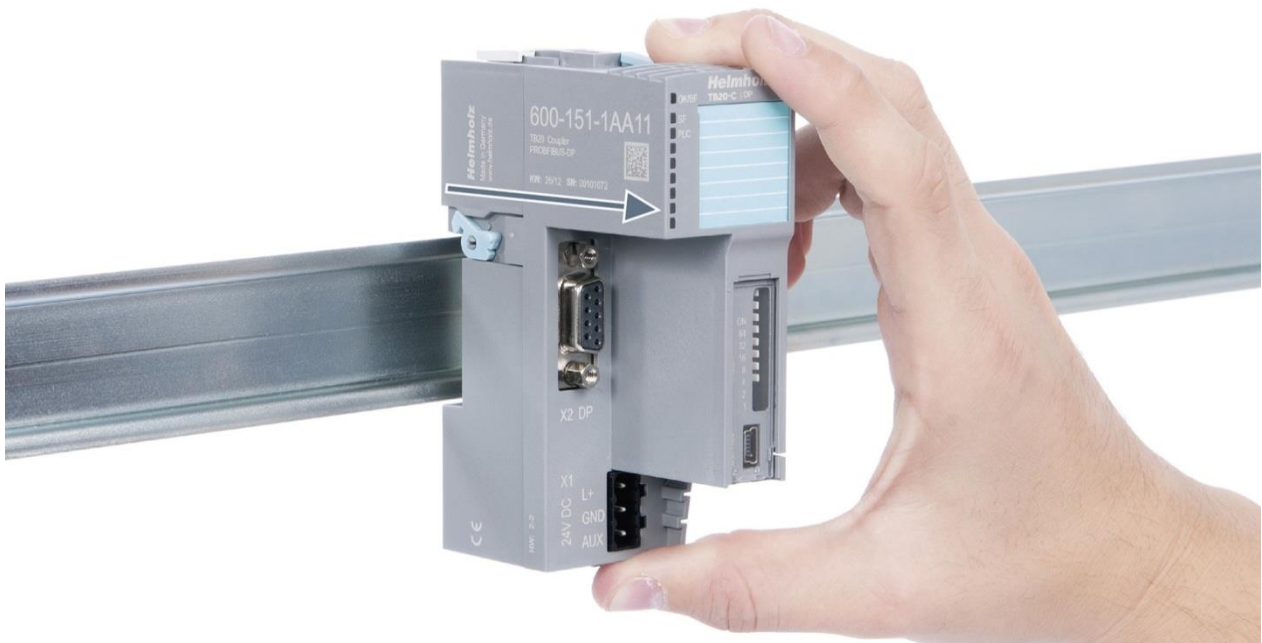
#### Step 1: Release the locking mechanism

Release the locking lever on the left side of the coupler in order to disengage it from the DIN rail.



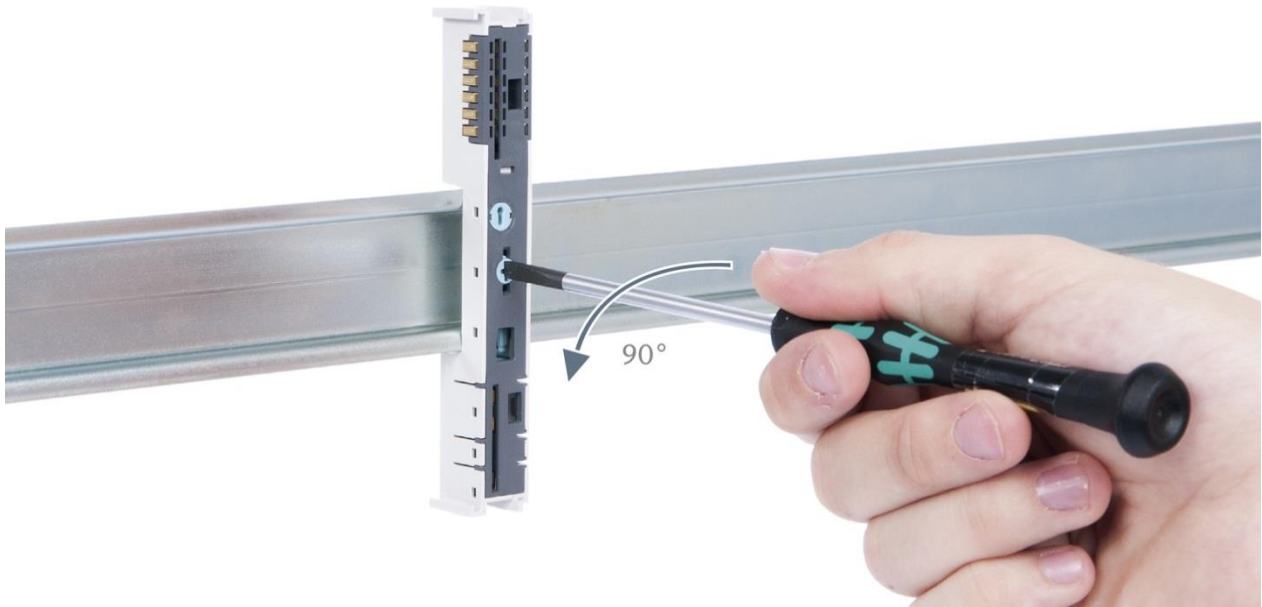
#### Step 2: Remove the coupler

Use your middle finger to push on the lever from above and use your thumb and index finger to pull out the coupler while holding the lever down.



### Step 3: Release the base module

Use a screwdriver to release the base module.



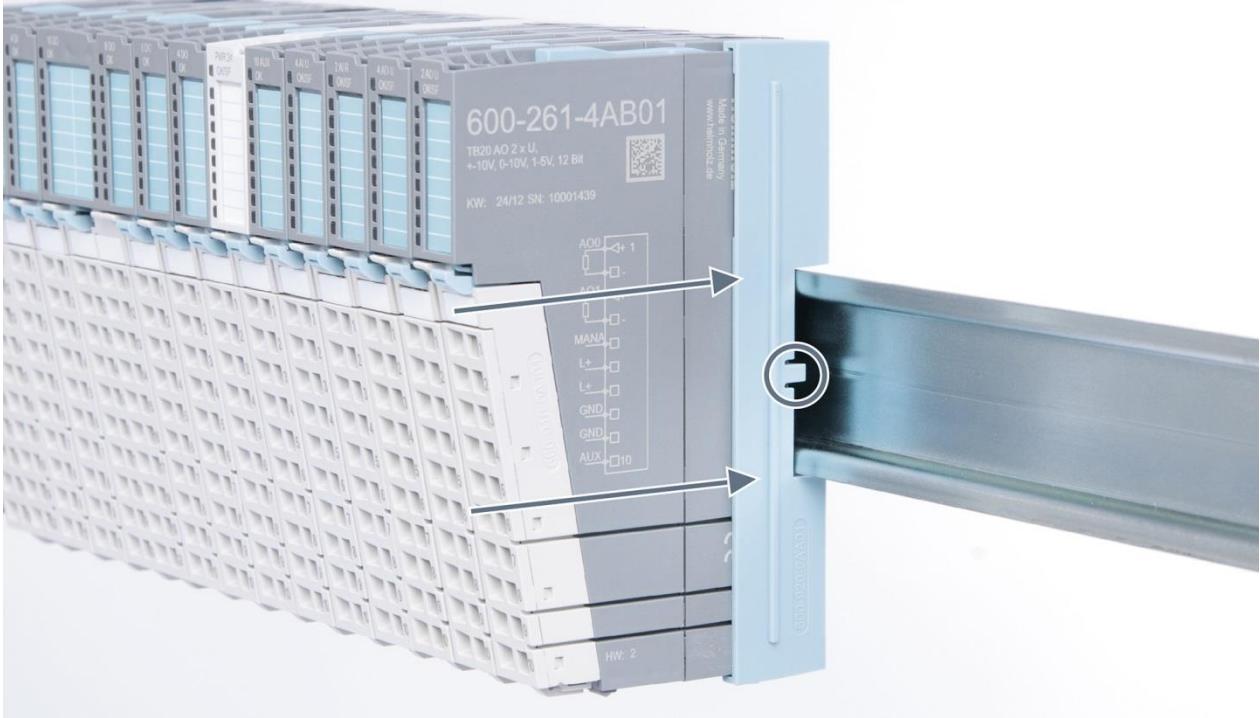
### Step 4: Remove the base module

Remove the base module by pulling it towards you.

## 3.6. Installing and removing the final cover

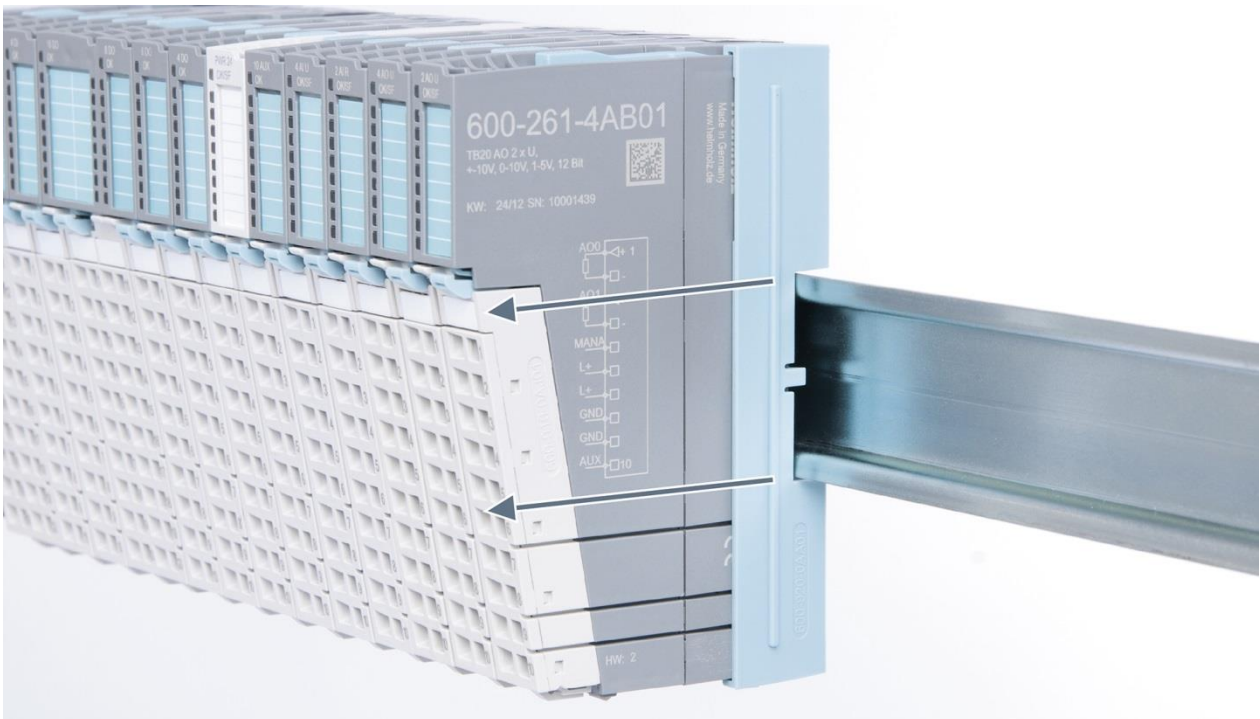
### 3.6.1. Installation

Slide the final cover onto the last module along the case, starting from the end with the front connector and moving towards the DIN rail, until the cover covers the base module's contacts and the tab snaps into place.



### 3.6.2. Removal

Pull the final bus cover upward along and off of the module.



## 4. Setup and wiring

### 4.1. EMC / safety / shielding

The TB20 IO system complies with EU Directive 2004/108/EC (“Electromagnetic Compatibility”).

One effective way to protect against disturbances caused by electromagnetic interference is to shield electric cables, wires, and components.



#### ATTENTION

When putting together the system and routing the required cables, make sure to fully comply with all standards, regulations, and rules regarding shielding (please consult the relevant guidelines and documents published by the PROFIBUS User Organization as well). All work must be done professionally!

Shielding faults can result in serious malfunctions, including the system’s failure.

To ensure electromagnetic compatibility (EMC) in your control cabinets in electrically harsh environments, the following EMC rules are to be observed in the design:

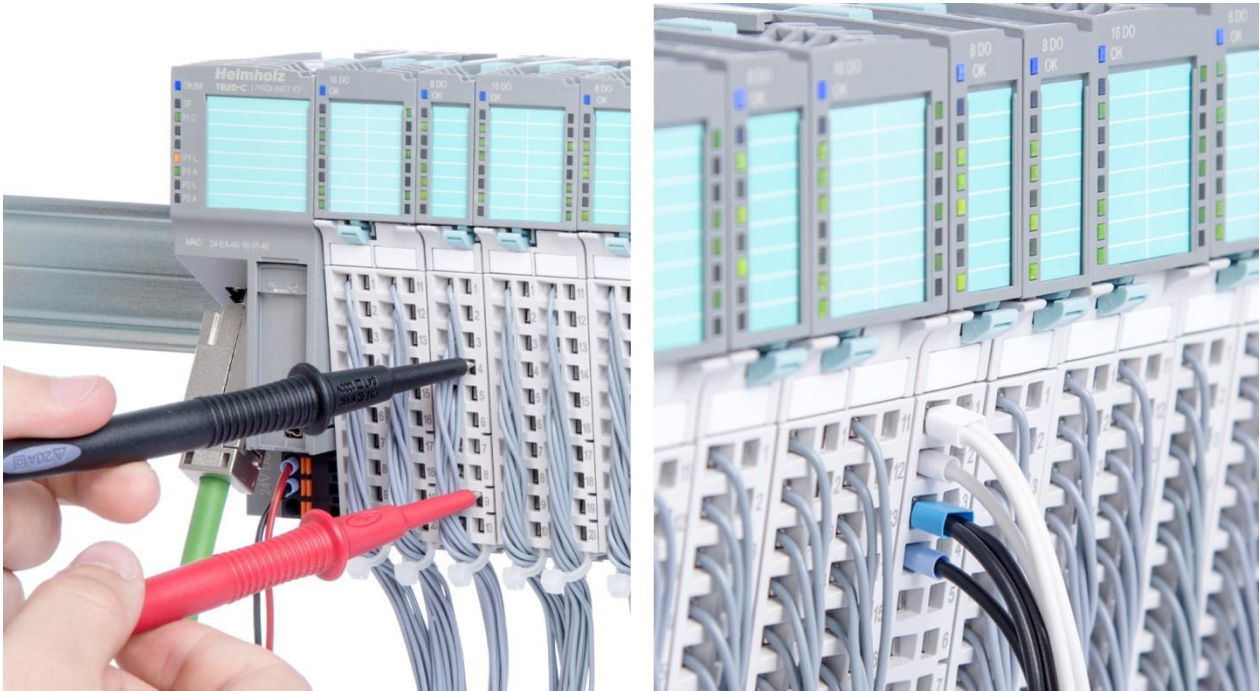
- All metal parts of the cabinet are to be connected with each other over a large area with good conductivity (no paint on paint). Where necessary, use contact washers or serrated washers.
- The cabinet door must be connected to the ground straps (top, middle, bottom) over as short a distance as possible.
- Signal cables and power cables are to be laid separated spatially by a minimum distance of 20 cm from each in order to avoid coupling paths.
- Run signal lines only from one level into the cabinet if possible.
- Unshielded cables in the same circuit (outgoing and incoming conductors) must be twisted if possible.
- Contactors, relays, and solenoid valves in the closet, or in adjacent cabinets if applicable, must be provided with quenching combinations; e.g., with RC elements, varistors, diodes.
- Do not lay wires freely in the closet; instead, run them as closely as possible to the cabinet housing or mounting panels. This also applies to reserve cables. These must be grounded on at least one end, and it is better if they are grounded on both ends (additional shielding effect).
- Unnecessary line lengths should be avoided. Coupling capacitances and inductances are kept low in this way.
- Analog signal lines and data lines must be shielded.

## 4.2. Front connector

The front connector's spring-clamp terminals are designed for a cross-sectional cable area of up to 1.5 mm<sup>2</sup> (16–22 AWG) with or without ferrules.

It is also possible, for example, to connect two 0.75 mm<sup>2</sup> wires to a single spring-type terminal, provided the maximum cross-sectional cable area of 1.5 mm<sup>2</sup> per terminal is not exceeded.

The cables can be attached to the underside of the front connector with a cable tie.



### 4.3. Wiring the coupler

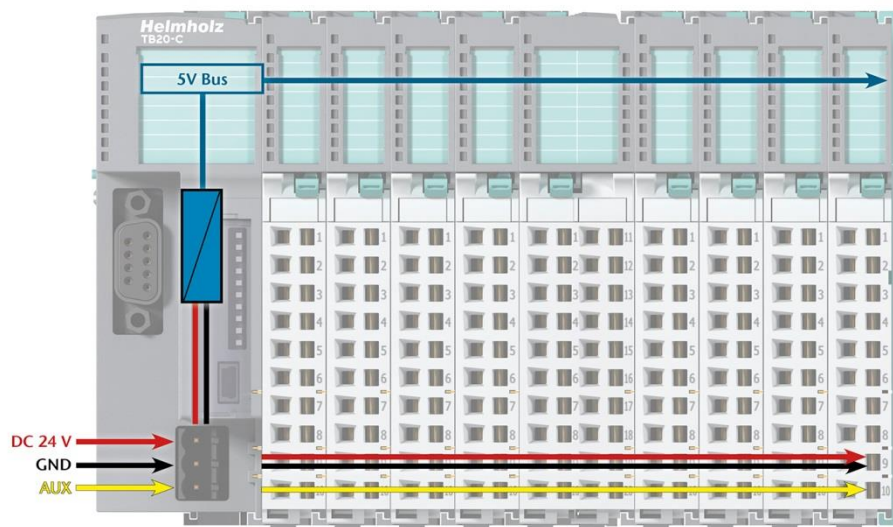
A power supply unit is integrated into the bus coupler. The power supply unit is responsible for powering the peripheral modules connected to the coupler.

In turn, it draws its own power from the three-pin connector on the front (24 VDC, GND, AUX).

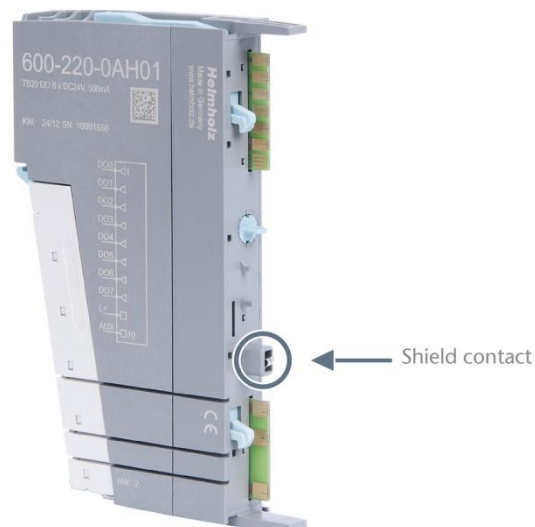
The 24 V connector is used to power two buses:

- The power bus used to power the I/O components (24 VDC, GND, AUX)
- The communications bus used to power the electronics in the peripheral modules

The AUX pin can be used to connect and use an additional voltage potential. Every peripheral module has an AUX terminal on its front connector (the bottommost terminal, i.e., terminals 10 and 20).



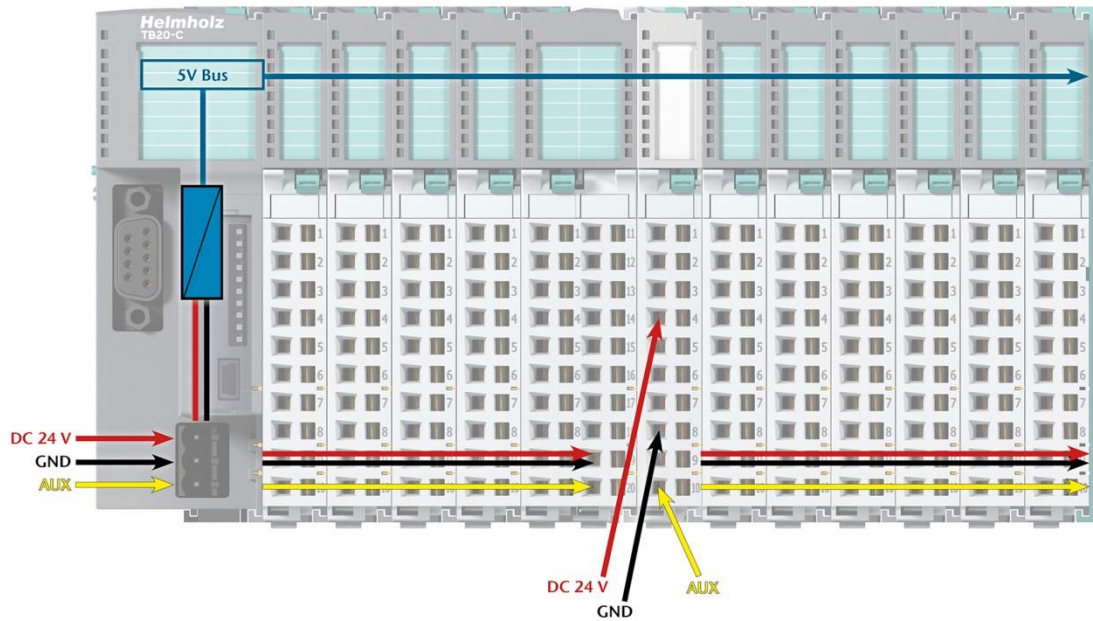
The coupler and the modules are grounded via the shield contact to the DIN rail. The DIN rail must be grounded. The surface of the DIN rail must be clean and conduct electricity well.





#### 4.4. Using power and isolation modules

Power and isolation modules make it possible to segment the power supply for external signals (24 V, GND, AUX) into individual power supply sections that are powered separately.



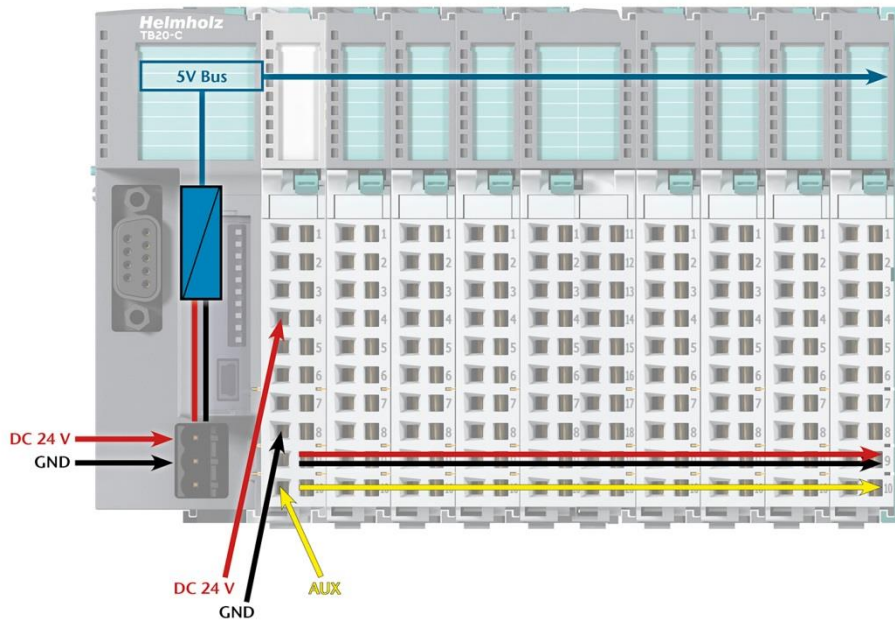
The order no. for the power and isolation module for 24 V signals is 600-710-0AA01.

Its electronic module and base module have the same light gray color as the front connector, ensuring that all power and isolation modules will stand out visually in the system and make it easy to clearly distinguish each individual power supply segment.



#### 4.5. Separate power supply segments for the coupler and the I/O components

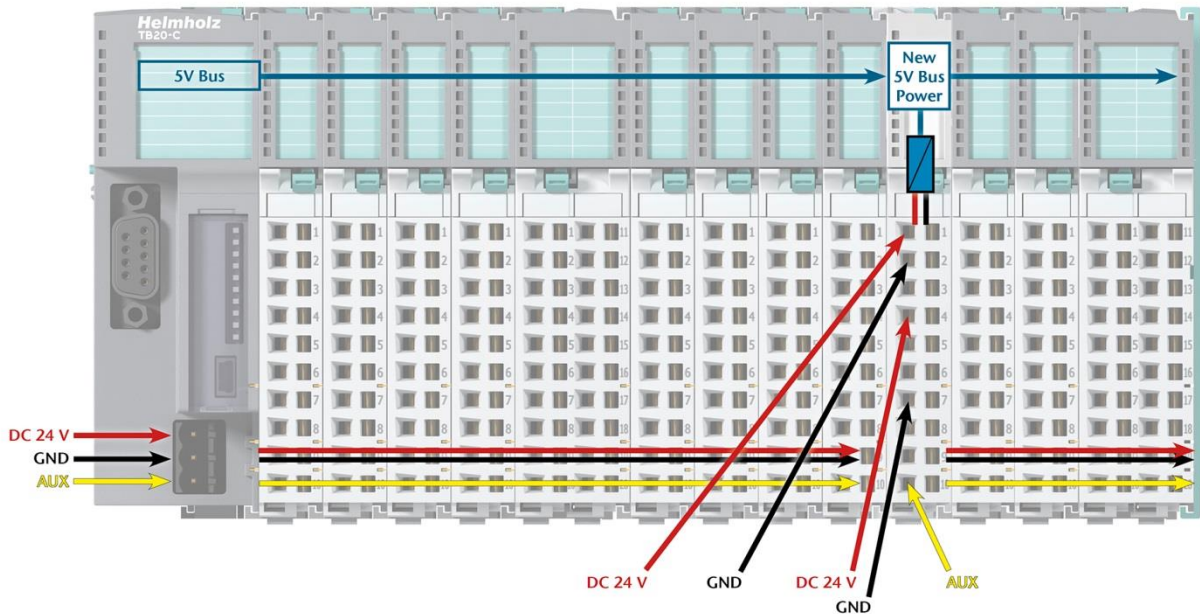
If the power supply for the coupler needs to be separated from the power supply for the I/O level, a power and isolation module can be used right after the coupler.



## 4.6. Using power modules

Power modules deliver all necessary power to the connected peripheral modules and, if applicable, all the way to the next power module or power and isolation module. Power modules must be used whenever the power supplied by the coupler alone is not sufficient, that is, when there are a large number of modules on the bus. The “TB20 ToolBox” parameter configuration and diagnosis program can be used to calculate a system’s total current draw.

24 VDC, GND, and AUX are fed into the terminals on the front, while the connected modules are powered through the base modules’ bus system.



The order no. for the power module is 600-700-0AA01. The electronic module of the power module is light gray like the front connector. The base module of the power module is light gray with a dark top part.



## **4.7. Electronic nameplate**

All of a TB20 module's important information can be found on its electronic nameplate. This information includes, for example, the corresponding module ID, module type, order number, unique serial number, hardware version, firmware version, and internal range of functionalities.

This information can be read in a number of ways, one of which is using the "TB20 ToolBox" configuration and diagnosis program. The modules' electronic nameplates not only make it possible to prevent configuration errors (setup), but also make maintenance (servicing) easier.

## **4.8. Fusing**

The TB20 coupler's and power modules' power supply must be externally fused with a slow-blowing fuse, maximum 8 A, appropriate for the required maximum current.

## 5. PROFINET coupler characteristics

The TB20 PROFINET coupler has the following characteristics:

- PROFINET IO device as per IEC 61158-6-10
- Integrated 2-port switch
- Transmission rate of up to full duplex 100 Mbps
- Up to 340 bytes of input and output data
- A maximum of 63 modules
- Hot swapping of modules
- Media Redundancy Protocol (MRP client)
- Automatic addressing / device hot swapping (LLDP, DCP)
- Topology detection
- I&M data
- Diagnostic alarms, process alarms, pull/plug alarms
- Integration using GSDML file
- 24 VDC power supply
- Integrated power supply unit for powering peripheral modules (2.5 A)
- Supplies the system's I/O voltage (24 VDC)
- 5 LEDs, two of them bi-color
- USB device port for online diagnosis with "TB20 ToolBox"
- Concealed switch for "factory reset" function



## 6. Setup and Use

### 6.1. GSDML file-based configuration

The latest device file (GSDML) for the PROFINET coupler can be downloaded at any time by visiting our website at: [www.helmholz.com](http://www.helmholz.com).



After installing the GSDML file, you will be able to find the PROFINET coupler in the hardware catalog under:

Other Field Devices → PROFINET IO → I/O → TB20-PN → TB20 PROFINET

### 6.2. Startup behavior

When the coupler starts up, the modules are scanned and the corresponding addresses (slot numbers) are assigned to them. Modules are numbered consecutively from left to right, starting with an address of 1. The coupler will first wait to make sure that the entire module configuration is present, i.e., starting with a gap in the module configuration is not possible!

If the entire module configuration is present (no gaps), it will be compared to the configured configuration. Every single TB20 module has a unique ID that is stored in the GSDML file and is therefore specified in the project's hardware configuration.

The module's LED indicator makes it possible to easily find out which modules in the system are configured incorrectly or belong to the wrong model (see Section 6.5.2).

### 6.3. Hot-swap function

Modules can be hot swapped while the PROFINET coupler is running. There are a number of scenarios in which hot swapping can prove to be very useful, one of them being when a module starts malfunctioning due to a defect (e.g., a defective input caused by overvoltage). In a case such as this, the defective modules can be swapped during ongoing operation and the remaining modules will continue to work normally.

If a module is removed, the coupler's "SF" LED will start flashing and a pull alarm will be sent via PROFINET.

If a replacement module of the same model is plugged in, it will be configured automatically and added to the system's cyclic operation. When this occurs, the PLC will receive a plug alarm.

Hot swapping will only be enabled if the configured configuration (module layout) matches the existing module layout and the PROFINET coupler has switched to cyclic operation.



#### ATTENTION

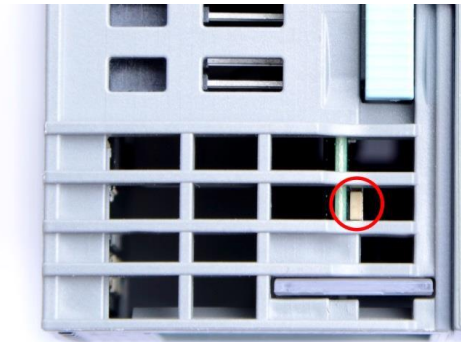
Do not remove more than one module at any one time. Removing a second module will cause the system to stop!

## 6.4. Factory Reset (Restoring the Coupler to Its Factory Settings)

The PROFINET coupler's factory settings can be restored by pressing a concealed button. If you press this button, all coupler parameters will be deleted and the coupler will be restored to its original system state.

The button can be accessed from above through the case's ventilation opening (see the picture on the right) To restore the unit to its factory settings, press the button and hold it down while the device is power is powered up. As soon as the first three LEDs light up, you can let go of the button.

At this point, the coupler will restart with its factory settings.



## 6.5. LED-based diagnosis

### 6.5.1. PROFINET coupler LEDs

The blue “OK” LED is used to indicate the coupler's general status:

*Solid light:* PROFINET running, correct configuration, system running

*Flashing light:* The system is starting up, the module configuration is being read, and a configuration has not yet been received from the PROFINET network.

The red “BF” LED (bus error) is used to indicate PROFINET errors and diagnostic module messages:

*Flashing light:* There is no connection to the PLC (wrong PROFINET address or PROFINET is not connected).  
PROFINET configuration error (wrong or missing modules)

*Solid light:* A module diagnostic message is present or there is a topology error.

The yellow “SF” LED is used to indicate the module bus status:

*Flashing light:* Modules missing (startup) / Module removed (hot swapping)

*Solid light:* Wrong module models plugged in

The green “PLC” LED is used to indicate the master PLC's status:

*Off:* No connection to PLC, coupler parameters not yet configured

*Solid light:* There is a connection to a PLC and all output data is valid

*Flashing light:* There is a connection to a PLC, but some of the output data is invalid. The output modules with invalid data will be switched to STOP so that the corresponding substitute values can be applied instead

*Quickly flashing light:* The coupler has been switched to simulation mode using the TB20 ToolBox. The connection to the PLC was interrupted.



The yellow “P1L” and “P2L” LEDs are used to indicate the link status for ports 1 and 2 respectively.

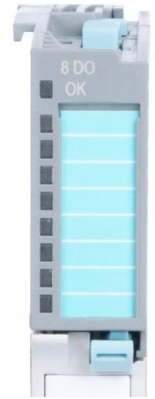
The green “P1A” and “P2A” LEDs are used to indicate the activity status for ports 1 and 2 respectively.

### 6.5.2. Module LEDs

The topmost LED (“OK/SF”) on every module indicates the module’s current system status.

- |                                     |  |
|-------------------------------------|--|
| <i>Solid blue light:</i>            | The module is running (RUN)  |
| <i>Slowly flashing blue light:</i>  | The module is stopped (STOP); substitute values (if any) are being applied |
| <i>Quickly flashing blue light:</i> | The module is idle (IDLE); its parameters have not been configured yet     |
| <i>Solid red light:</i>             | The module is indicating a diagnostic error                                |
| <i>Flashing red light:</i>          | The module is indicating a parameter assignment error                      |

The red “SF” LED lights will only be shown on modules with configurable parameters or diagnostic capabilities.



#### NOTE

IDLE mode (quickly flashing blue LED) indicates modules that have not been added to ongoing system operation by the coupler. One of the reasons that can cause this is an incorrect configuration (wrong module model on the slot).

## 6.6. Behavior of outputs in startup and error situations

During startup of the PROFINET coupler, all modules are in IDLE and the outputs are switched off (high impedance or 0V).

With a PROFINET connection abort or IOPS = Bad, the coupler switches all modules to STOP and the outputs are thus also switched off.

The state of the output can be parameterized (replacement value or keep last value) through use of the function “Switch substitute value” with Analog Out or Digital Out High Feature modules. For this it is necessary that the PROFINET coupler is configured properly and in RUN before an error situation occurs.



## 6.7. Alarm messages sent via PROFINET

PROFINET diagnostic messages are subdivided into two parts. The first part always contains the generic “header information” for the alarm. The second part’s syntax, on the other hand, will depend on the specific type of alarm being sent (additional alarm information).

### 6.7.1. Diagnostic alarm

Byte	Type	Content
0 + 1	WORD	Block type = 0x0002
2 + 3	WORD	Block length (without the first 4 bytes)
4 + 5	WORD	Version (0x0100)
6 + 7	WORD	Alarm type: 1 = Diagnostic alarm (inbound) 2 = Process alarm 3 = Pull Alarm 4 = Plug alarm 12 = Diagnostic alarm (outbound)
8–11	DWORD	API (always 0 for TB20)
12 + 13	WORD	Slot number corresponding to the module triggering the alarm
14 + 15	WORD	Submodule slot (always 1)
16–19	DWORD	Module ID corresponding to the module triggering the alarm (see module manual)
20 -23	DWORD	Submodule identification (always 2 for TB20)
24 + 25	WORD	Alarm specifier: Bits 0–10: Sequence number (0–2047) Bit 11: 1 = Channel diagnosis available Bit 12: 0 = No vendor-specific diagnoses Bit 13: 0 = No errors present anymore 1 = At least one channel diagnosis available Bit 14: 0 (reserved) Bit 15: 1 = At least one configured module is signaling a diagnosis
<b>Additional alarm information:</b>		
26 + 27	WORD	Syntax for additional alarm information: 0x8000 = Channel diagnosis
28 + 29	WORD	Channel number (0–x) or 0x8000 = global module error
30	BYTE	Error type (channel properties): 0x08 = Inbound error 0x10 = Outbound error 0x18 = Outbound error; there are additional errors present
31	BYTE	Reserved
32+33	WORD	Error type / diagnosis ID (refer to section 6.7.2)



#### NOTE

The PROFINET coupler will only send one diagnosis for each diagnostic alarm. If more than one diagnosis is generated at the same time, the diagnoses will be sent one after the other.

## 6.7.2. Diagnostic IDs for channel diagnosis

### PROFIBUS-compliant diagnostic IDs:

- 0 (0x0000) = There is no error anymore; the error has been fixed (outbound diagnosis)
- 1 (0x0001) = Short-circuit (to GND)
- 2 (0x0002) = Undervoltage
- 3 (0x0003) = Overvoltage
- 4 (0x0004) = Overload
- 5 (0x0005) = Excess temperature
- 6 (0x0006) = Line break / wire break
- 7 (0x0007) = Overflow: Value falls above measuring range
- 8 (0x0008) = Underflow: Value falls below measuring range

### Manufacturer-specific diagnostic IDs:

- 16 (0x0010) = Power module: Bus supply voltage drop
- 17 (0x0011) = L+ reference voltage missing
- 18 (0x0012) = Incorrect parameter configuration (*flashing red LED on module*)



#### NOTE

To find out which diagnostic messages can be reported by a module, please refer to the corresponding module manual.

### 6.7.3. Process alarm

Byte	Type	Content
0 + 1	WORD	Block type = 0x0001
2 + 3	WORD	Block length (without the first 4 bytes)
4 + 5	WORD	Version (0x0100)
6 + 7	WORD	Alarm type: 2 = Process alarm
8–11	DWORD	API (always 0 for TB20)
12 + 13	WORD	Slot number corresponding to the module triggering the alarm
14 + 15	WORD	Submodule slot (always 1)
16–19	DWORD	Module ID corresponding to the module triggering the alarm (see module manual)
20 -23	DWORD	Submodule identification (always 2 for TB20)
24 + 25	WORD	Alarm specifier: Bits 0–10: Sequence number (0–2047) Bit 11: 0 = Channel diagnosis available Bit 12: 0 = No vendor-specific diagnoses Bit 13: 0 = No errors present anymore 1 = At least one channel diagnosis available Bit 14: 0 (reserved) Bit 15: 1 = At least one configured module is signaling a diagnosis
<b>Additional alarm information:</b>		
26 + 27	WORD	Syntax for additional alarm information (USI): 0x0000 = Vendor-specific alarm
28–31	DWORD	Process alarm information

#### 6.7.4. Pull/plug alarm

Byte	Type	Content
0 + 1	WORD	Block type = 0x0002
2 + 3	WORD	Block length (without the first 4 bytes)
4 + 5	WORD	Version (0x0100)
6 + 7	WORD	Alarm type: 3 = Pull alarm 4 = Plug alarm
8–11	DWORD	API (always 0 for TB20)
12 + 13	WORD	Slot number corresponding to the module triggering the alarm
14 + 15	WORD	Submodule slot (always 1)
16–19	DWORD	Module ID corresponding to the module triggering the alarm (see module manual)
20 -23	DWORD	Submodule identification (always 2 for TB20)
24 + 25	WORD	Alarm specifier: Bits 0–10: Sequence number (0–2047) Bit 11: 0 = No channel diagnosis available Bit 12: 0 = No vendor-specific diagnoses Bit 13: 0 = No additional diagnoses available Bit 14: 0 (reserved) Bit 15: 0
<b>Additional alarm information:</b>		
26 + 27	WORD	Syntax for additional alarm information (USI): 0x0000 = Vendor-specific alarm

## 6.8. PROFINET I&M data

Identification and maintenance (I&M) data consists of information that is stored inside the coupler. This data includes both coupler ID information that is programmed at the factory and fields that users can use in order to store their own information in the module. I&M data is stored in the coupler's non-volatile memory.

### 6.8.1. Identification data 0 [AFF0]

Identification data	Size	Access	Content	Description
MANUFACTURER_ID	2 bytes	read	021B	Manufacturer ID Helmholtz
ORDER_ID	20 bytes	read	'600-180-1AA11'	The coupler's order No.
SERIAL_NUMBER	16 bytes	read	'123456'	The coupler's serial number
HARDWARE_REVISION	2 bytes	read	00 01	Hardware version 1
SOFTWARE_REVISION	4 bytes	read	56 01 00 00	V1.00.000
REVISION_COUNTER	2 bytes	read	xx xx	Is incremented every time the I&M data is written to
PROFILE_ID	2 bytes	read	00 00	Generic device
PROFILE_SPECIFIC_TYPE	2 bytes	read	00 05	Interface module
IM_VERSION	2 bytes	read	01 00	
IM_SUPPORTED	2 bytes	read	00 1E	I&M indexes 1–4 are supported

### 6.8.2. Identification data 1 [AFF1]

Identification data	Size	Access	Content	Description
TAG_FUNCTION	32 bytes	r/w	-	Unique system-wide module ID
TAG_LOCATION	22 bytes	r/w	-	Installation location

### 6.8.3. Identification data 2 [AFF2]

Identification data	Size	Access	Content	Description
INSTALLATION_DATE	16 bytes	r/w	-	Date of installation

### 6.8.4. Identification data 3 [AFF3]

Identification data	Size	Access	Content	Description
DESCRIPTOR	54 bytes	r/w	-	Comment regarding the module

## 7. Configuration with the TB20 ToolBox

The TB20 ToolBox V2 is free software for the configuration, testing and diagnostics of the TB20 system. The TB20 ToolBox is not absolutely necessary in order to configure and operate the PROFINET coupler, but it can be used for the setup and for functional testing.

A USB cable is required for communication with the TB20 PROFINET coupler.

### 7.1. Installation of the TB20 ToolBox

The software can be downloaded at no charge at the website [www.helmholz.de](http://www.helmholz.de) in the download area of the TB20 system. The software currently runs with Windows 7 and 10.



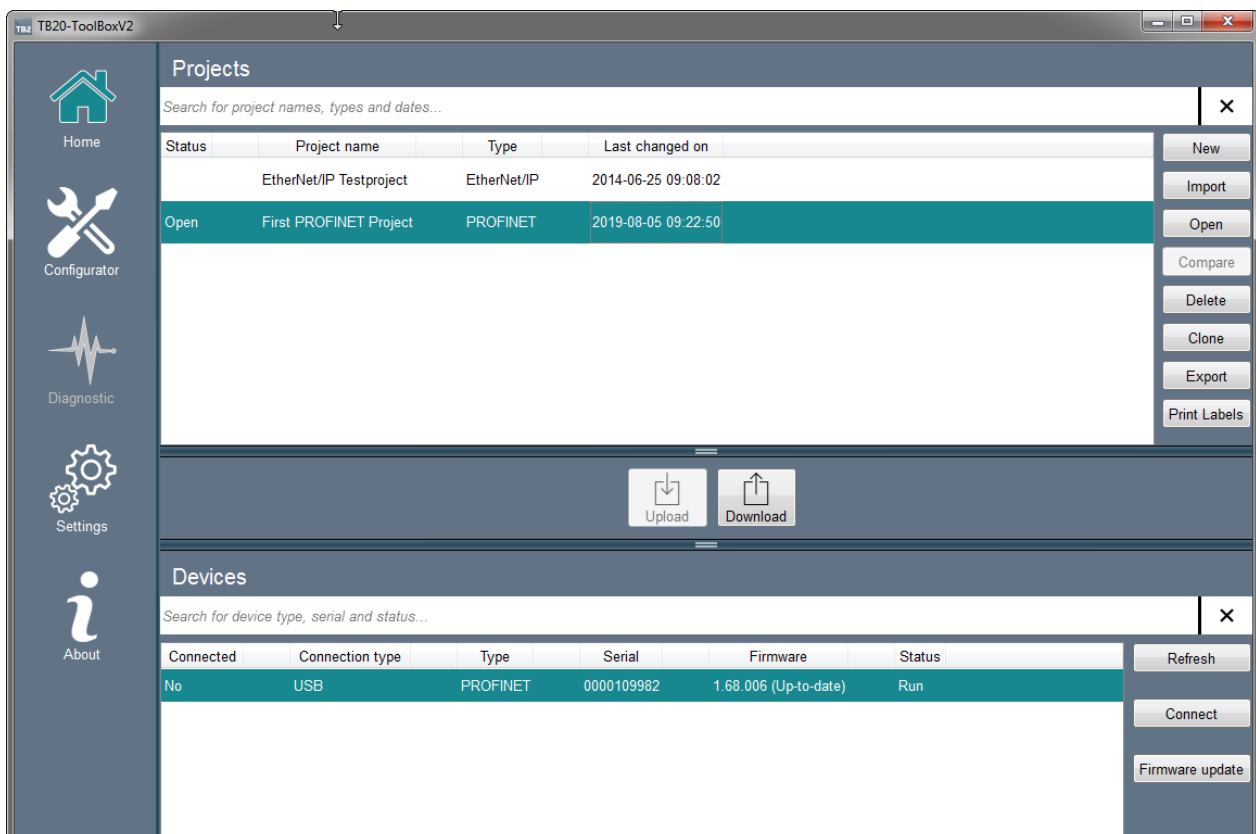
Carry out the setup and follow the instructions of the program.

The USB driver is copied onto the hard drive together with the TB20 ToolBox and is available for installation. You can find the USB driver in the TB20 ToolBox under "Settings".

### 7.2. Start and create a new project ("Welcome")

In the TB20-ToolBox view "Welcome" you can create a new project, import a project, open an existing project or read out a project from a connected coupler. Furthermore you can see in the lower section under "Devices" the USB-connected couplers.

To create a new project, select the "New" button in the menu on the right.



The screenshot displays the TB20-ToolBox V2 interface. On the left is a navigation sidebar with icons for Home, Configurator, Diagnostic, Settings, and About. The main area is divided into two sections: 'Projects' and 'Devices'.

**Projects Section:**

Status	Project name	Type	Last changed on
	EtherNet/IP Testproject	EtherNet/IP	2014-06-25 09:08:02
Open	First PROFINET Project	PROFINET	2019-08-05 09:22:50

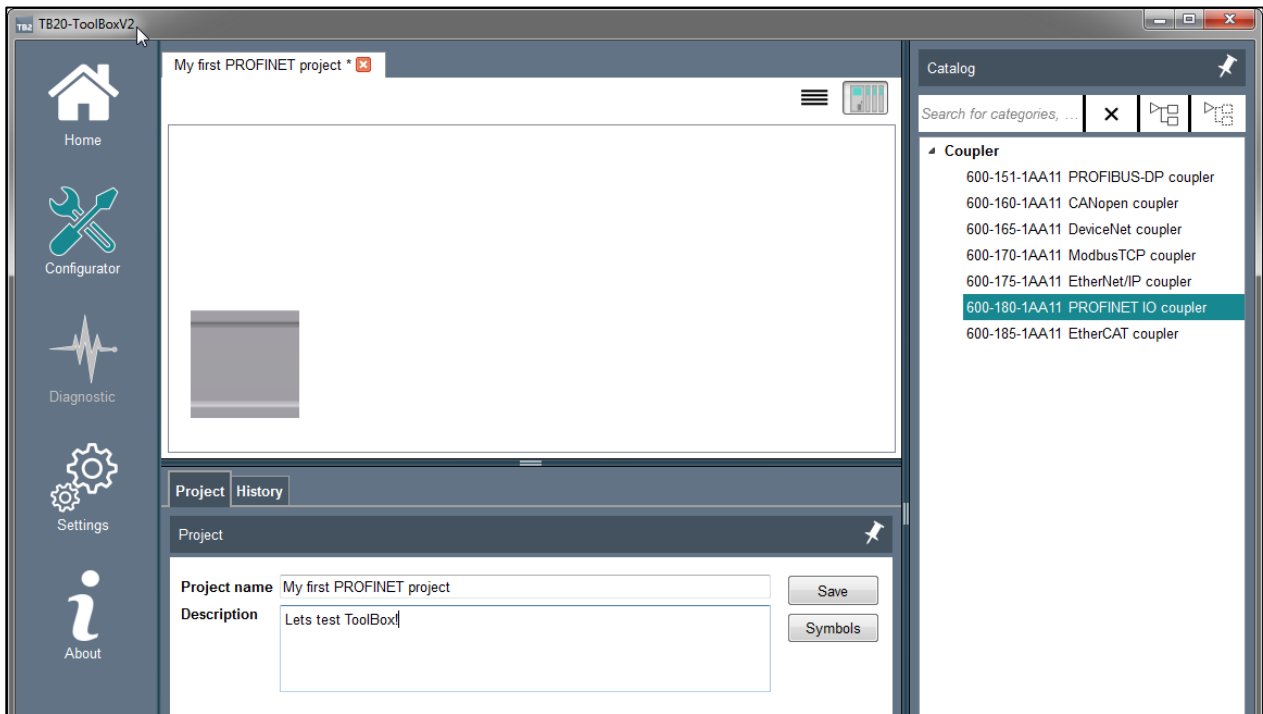
**Devices Section:**

Connected	Connection type	Type	Serial	Firmware	Status
No	USB	PROFINET	0000109982	1.68.006 (Up-to-date)	Run

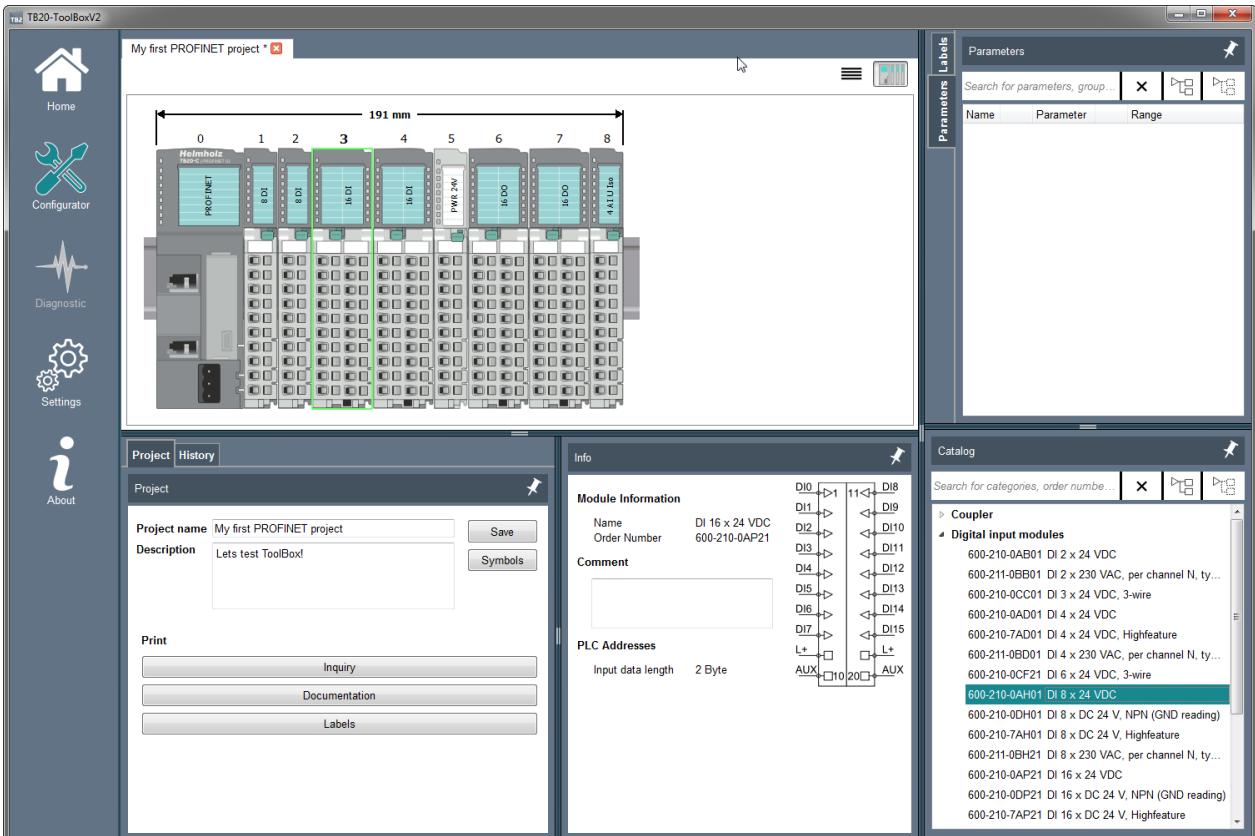
Buttons for 'New', 'Import', 'Open', 'Compare', 'Delete', 'Clone', 'Export', and 'Print Labels' are visible on the right side of the Projects table. Buttons for 'Upload', 'Download', 'Refresh', 'Connect', and 'Firmware update' are visible on the right side of the Devices table.

### 7.3. Configurator

After entering a project name and selecting the desired coupler, the "Configurator" view is opened.



In this view, you can add new modules to the TB20 system, define the symbols, edit the labels, and print the label strips.



## 7.4. Diagnostic ("Online")

In the TB20 ToolBox "Diagnostic" view you can monitor the current status of the TB20 PROFINET coupler and all modules.

To activate the diagnosis of a connected coupler, click on the desired coupler and "Connect" in the "Welcome" window.

Connected	Connection type	Type	Serial	Firmware	Status
No	USB	PROFINET	0000109982	1.68.006 (Up-to-date)	Run

PROFINET coupler: 109982 @ USB

105 mm

0 1 2 3 4 5

PROFINET

400

410

2x1U

2x0U

1x1U

1x1U

Home

Configurator

Diagnostic

Settings

About

Project name: PROFINET 109982

Download

Start Simulation

Save Diagnostic

Print

Inquiry

Documentation

Reset

Restart

Factory default

Info

Module Information

Name: AI 4 x U, ±10 V, 0-10 V

Order Number: 600-252-7BD01

Status

App State: Run

Diagnostic: None

Hardware

Serial: 10018380

HW revision: HW2

Software

FW-Version: 1.1.2

CI-Version: 1.14.0

PLC Addresses

Input data length: 8 Byte

Parameters

Search for parameters, groups and values...

Name

Active Parameter

Range

General

Diagnostic alarm

Diagnostic overflow/underflow

Format of values: Simatic S7

Channel 0

Measurement range: 0..10 V

Interf. frequency suppression: 50 Hz

Wire break detection

Limit value alarm

Upper limit: 0

Lower limit: 0

Channel 1

Inputs/Outputs

Search for I/O names and values...

Name

Simulation Value

Inputs

Channel 0: 0 (0.0 V)

Channel 1: 0 (0.0 V)

Channel 2: 1 (0.4 mV)

Channel 3: 0 (0.0 V)

In addition to the "Restart" functions and resetting to "Factory default", the diagnostics status can also be saved in a text file on your computer ("Save Diagnostic"). The diagnostic state contains important information for the support.



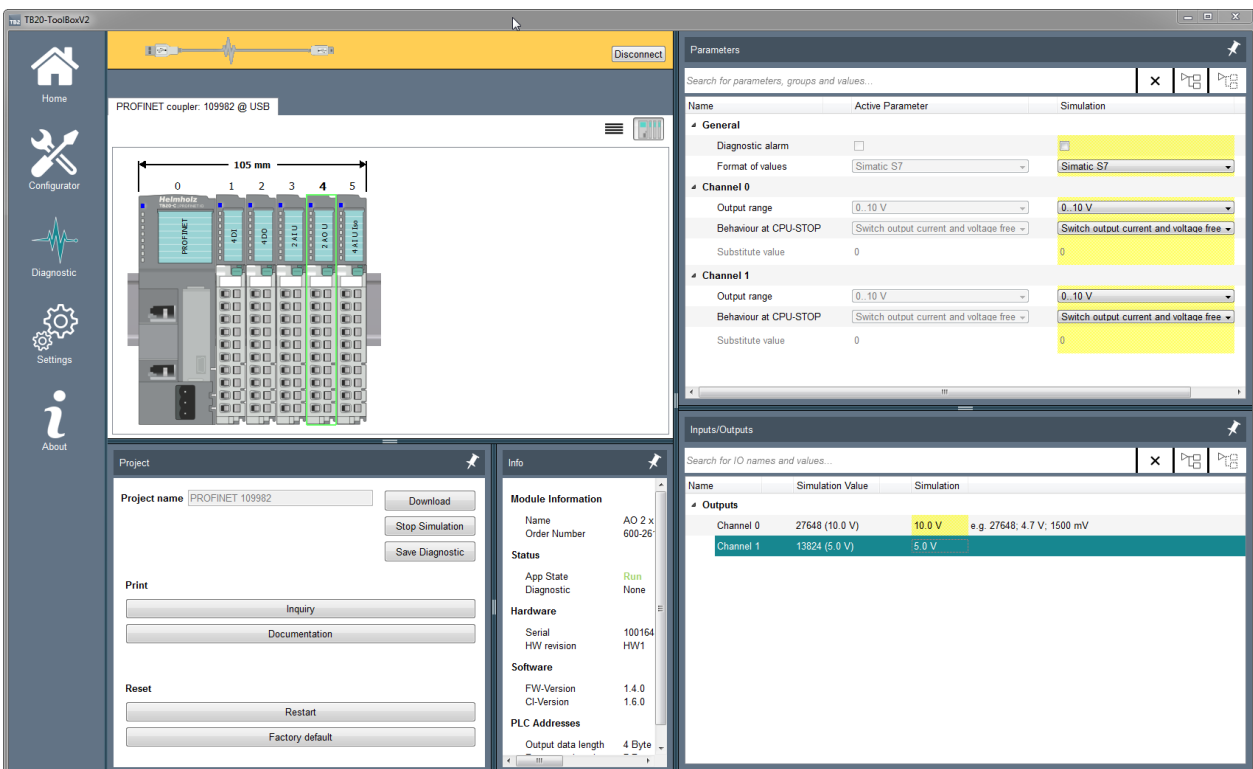
### 7.4.1. Load project from the coupler (“Load from device”)

If you have not created a project from an existing TB20 system, or if the project file has been lost, you can load the current status of the coupler with all modules and module parameters into the TB20 ToolBox.

Use the “Load from device” function in the “Diagnostic” view when you are connected with a coupler via USB. The function loads all relevant information from the coupler and creates a new project file.

### 7.4.2. Simulation

In the “Diagnostic” view you can switch the PROFINET coupler to a simulation mode (“Start Simulation”). You take control over the behavior of the PROFINET coupler in the current status. You can display the current input data, activate the outputs, and change the parameters of modules.



The coupler displays the simulation mode with a quickly flashing, green “PLC” LED.



#### ATTENTION

The PROFINET coupler is completely separated from the PROFINET controller in the simulation mode. Hot plug is activated as a standard in simulation mode.

When the simulation mode ends, the PROFINET coupler restarts and logs back onto the PROFINET controller. When leaving simulation operation, all of the changes carried out in simulation mode are discarded.

## 8. Technical specifications

<b>Order no.</b>	<b>600-180-1AA11</b>
Module designation	PROFINET coupler
PROFINET interface	
Protocol	PROFINET IO as defined in IEC 61158-6-10
Transmission rate	100 Mbps, full-duplex
I/O image table size	340 bytes
Connector	Two RJ45, integrated switch
Features	Media Redundancy Protocol (MRP), automatic addressing / topology detection (LLDP, DCP), PTCIP, statistics counter
Alarm functions	Diagnostic alarms Process alarms Pull/plug alarms
Minimum cycle time	250 µsec.
IRT bridge delay	< 3 µsec.
USB interface	
Protocol	Full-speed USB 2.0 device
Connector	Mini-USB
Isolation voltage	1.5 kV
Electrical isolation	Yes
Number of modules that can be connected in series	63, all products
Voltage supply	DC 24 V , 18–28 V DC
Current draw without modules (internal)	150 mA
Power dissipation	Max. 8.5 W
Power supply for modules	5 VDC, max. 2.5 A
Dimensions (H x W x D)	110 mm x 35 mm x 73 mm
Weight	115 g
Certifications	CE, UL 508
Noise immunity	DIN EN 61000-6-2 "EMC Immunity"
Interference emission	DIN EN 61000-6-2 "EMC Emission"
Vibration and shock resistance	DIN EN 60068-2-6:2008 "Vibration" DIN EN 60068-2-27:2010 "Shock"
Protection rating	IP 20
Relative humidity	95% without condensation
Installation position	Any
Permissible ambient temperature	0 °C to 60 °C For UL applications: 0 °C to 50 °C
Transport and storage temperature	-20 °C to 80 °C
Pollution degree	2

## 9. PNO Certificate



### Certificate

PROFIBUS Nutzerorganisation e.V. grants to

**Systeme Helmholz GmbH**  
**Hannberger Weg 2, 91091 Großenseebach, Germany**

the Certificate No: **Z11339** for the PROFINET IO Device:

**Model Name: TB20 PROFINET-Koppler**  
**Revision: SW/FW: V1.5.27; HW: 1**  
**Identnumber: 0x021B; 0x0007**  
**GSD: GSDML-V2.31-Helmholz-TB20-PN-20151003.xml**  
**DAP: DAP 1: TB20 PROFINET, 0x00000001**

This certificate confirms that the product has successfully passed the certification tests with the following scope:

<input checked="" type="checkbox"/> PNIO_Version	V2.2
<input checked="" type="checkbox"/> Conformance Class	C Optional features: FSU, IRT
<input checked="" type="checkbox"/> PNIO_Tester_Version	V2.2.4
<input checked="" type="checkbox"/> Tester	SIEMENS AG, Fürth, Germany PN396-1, IRT094-1

This certificate is granted according to the document:  
"Framework for testing and certification of PROFIBUS and PROFINET products".

For all products that are placed in circulation by February 25, 2019 the certificate is valid for life.

(Official in Charge)

Board of PROFIBUS Nutzerorganisation e. V.

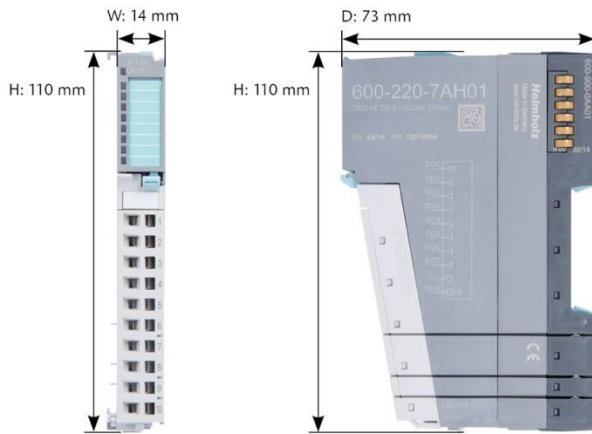
(Karsten Schneider)



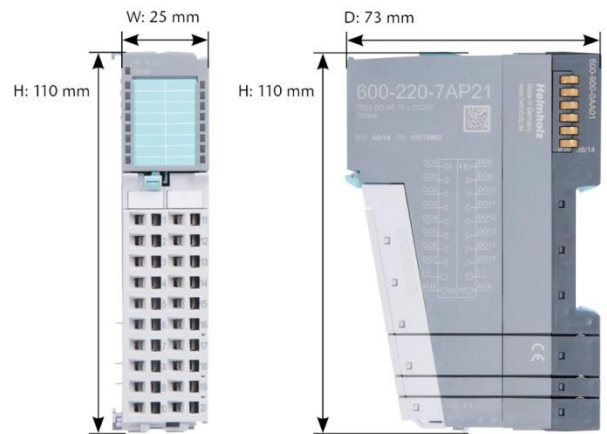
(K.-P. Lindner)

# 10. Dimensions

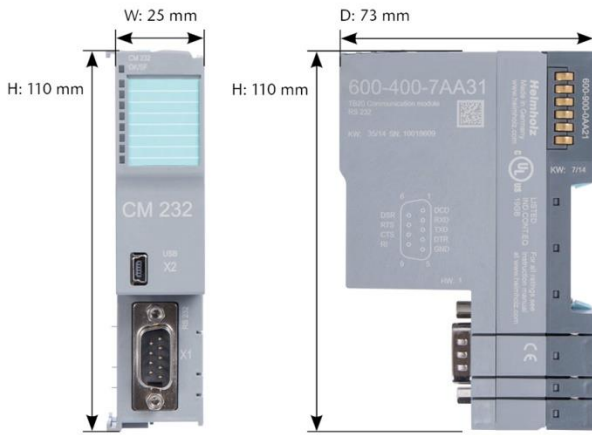
Module with standard width



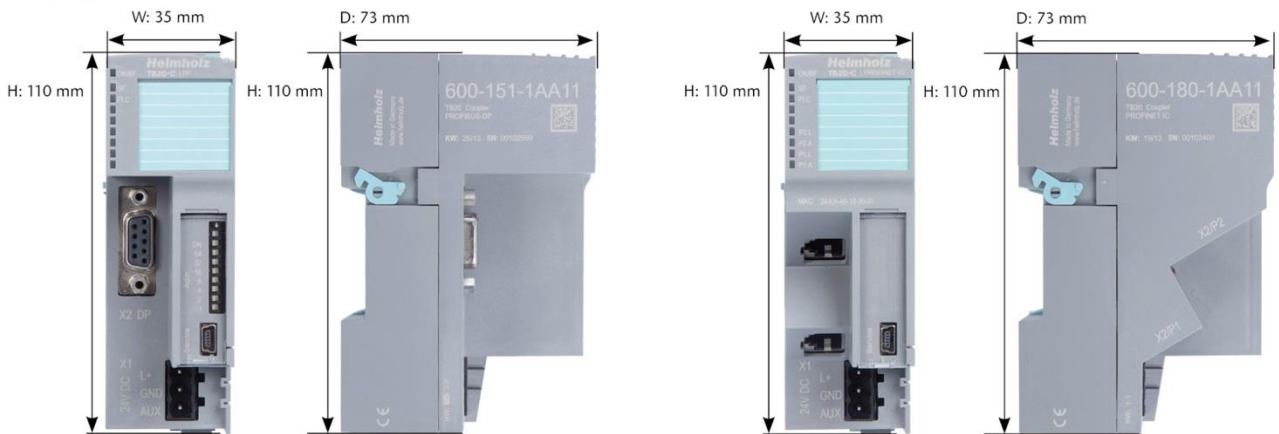
Module with double width



Communication Module



Bus Coupler



## 11. Spare parts

### 11.1. Base modules

#### 11.1.1. 14 mm width standard base module

The 14 mm standard base module width is available in sets of five with order no. 600-900-9AA01.



#### 11.1.2. 25 mm width base module

The 25 mm standard base module width is available in sets of five with order no. 600-900-9AA21.



#### 11.1.3. Power and isolation base module

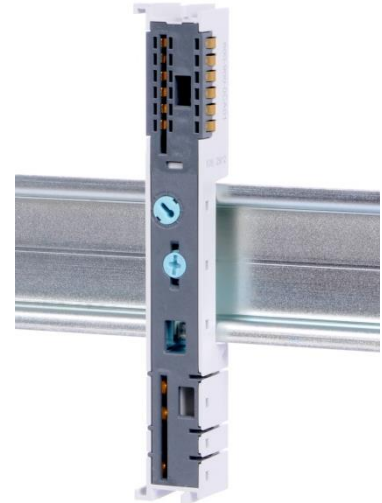
The power and isolation base module is available in sets of five with order no. 600-900-9BA01.



#### 11.1.4. Power base module

The power base module is available in sets of five with order no. 600-900-9CA01.

It can be used with the power module (600-700-0AA01) and with all bus couplers.



### 11.2. Front connector

#### 11.2.1. 10-terminal front connector

The 10-terminal front connector is available in sets of five with order no. 600-910-9AJ01.



#### 11.2.2. 20-terminal front connector

The 20-terminal front connector is available in sets of five with order no. 600-910-9AT21.



### 11.3. Electronic modules

Electronic modules can be ordered as spare parts with the order number of the original product. Electronic modules are always sent as a complete assembly, including the corresponding base module and front connector.

### 11.4. Final cover

The final cover is available in sets of five with order no. 600-920-9AA01.

