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TB20 – PROFIBUS-DP Coupler

Manual

Version 3 - 07/03/2013 for HW 1-1 & FW 1.02 and higher

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Revision Record

Version	Date	Change
2	11/16/2012	First version
3	7/2/2013	connection pictures; Plug/Pull alarm

Table of Contents

1. General Information

This manual explains how to set up and use the TB20 I/O system's PROFIBUS-DP coupler and provides technicians with all the information required to install it.

1.1. Target Group for This Manual

This manual is intended for all project engineers, design engineers, technicians (skilled workers with electrical training), and users who work with the TB20 I/O system.

1.2. Symbols Used Throughout This Manual

The following symbols are used throughout this manual:

Used for tips and general information, e.g., to point out potential sources of error.

 CAUTION!

Risk of property damage or malfunction.

 WARNING!

Risk of bodily injury, e.g., due to electric shock.

1.3. Safety Instructions

For your own safety, and for the safety of others in the vicinity of the equipment, please follow the safety instructions below.

WARNING!

All applicable accident prevention and safety regulations must be complied with when planning the use of, installing, and operating this equipment! The company operating the equipment is responsible for ensuring compliance with these regulations!

WARNING!

Any processes in the equipment that have the potential of resulting in property damage or bodily injury must be safeguarded with the use of additional external devices. These devices must ensure that the equipment will remain in a safe operating state even in the event of a fault or malfunction. These devices include, but are not limited to, electromechanical safety switches, mechanical interlocks, etc. (please refer to EN 954-1, Risk Assessment!).

WARNING!

TB20 modules should only be used for the functions typical of a communications and signaling system. Safety-relevant functions should not be controlled solely with the coupler or with an operating terminal.
Emergency stop devices as per EN 60204/IEC 204 must remain fully functional and effective in all of the equipment's operating modes.
The equipment must not be able to restart in an uncontrolled or undefined manner!
Uncontrolled restarts must be rendered impossible by means of appropriate programming!

2. System Overview

2.1. General Information

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

It is made up of the following components:

1. A bus coupler

2. One or more peripheral modules

3. Optionally, one or more power and isolation modules

4. Optionally, one or more 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 64 modules connected in series to a bus coupler.

All components have a protection rating of IP 20.

2.2. The Components That Make Up the TB20 I/O System

2.2.1. Bus Coupler

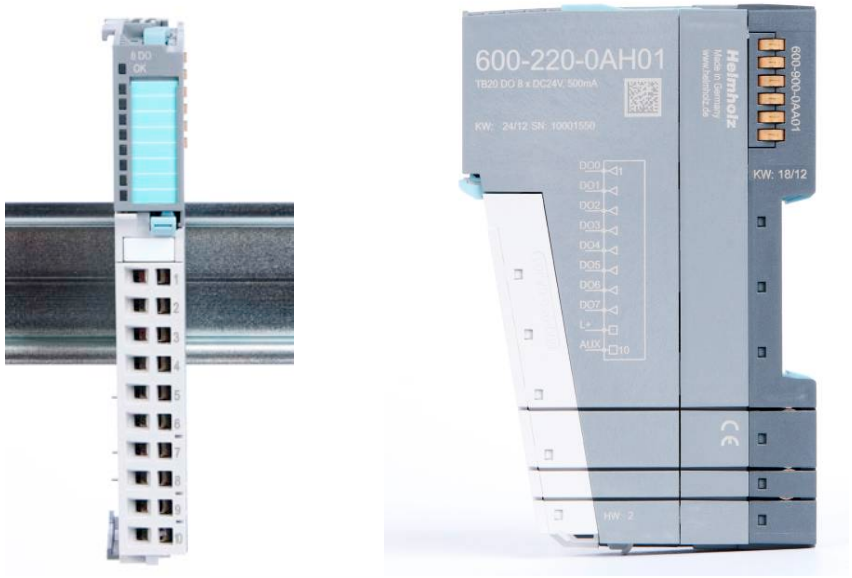
The system's bus coupler includes a bus interface and a power module. The bus interface is responsible for establishing a connection to the higher-level bus system and is used to exchange I/O signals with the automation system's CPU this way.

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

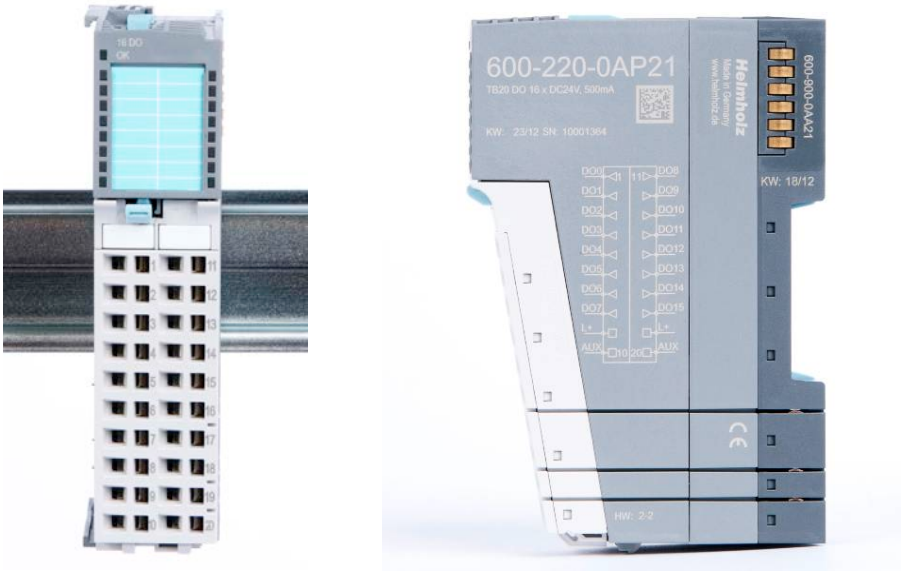
2.2.2. Peripheral Modules

The system's peripheral modules are electronic components to which peripheral devices such as sensors and actuators can be connected. This is why 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 Modules

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 communications bus' signals and supply voltage simply continue to be passed through, in contrast to the way they are handled by power modules (see below).

Power and isolation modules can be recognized by the bright color of their case.

2.2.4. Power Modules

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

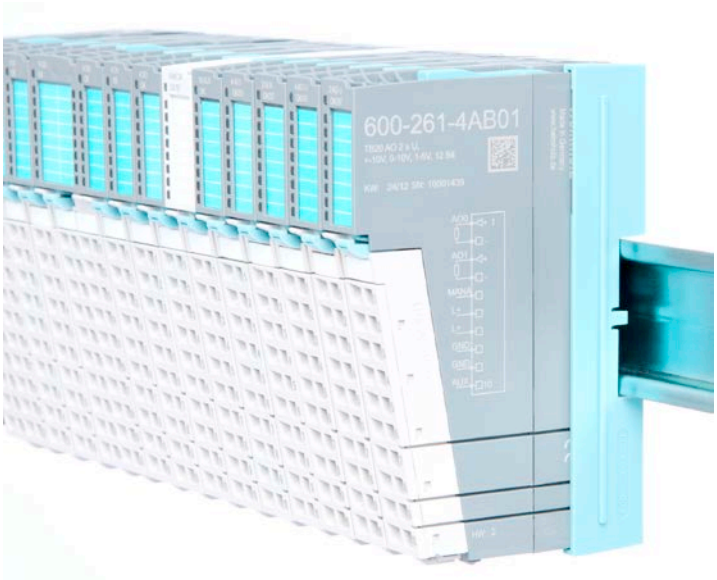
Power modules make it possible to segment the power supply for both external signals and the communication bus into individual power supply sections that are powered separately.

In other words, 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. This is required whenever the power supplied by the coupler alone is not sufficient, e.g., when there are a large number of modules on the bus.
The configuration software "TB20-ToolBox" can be used to determine whether a power module is needed.

Power modules can be recognized by the bright color of their case.

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

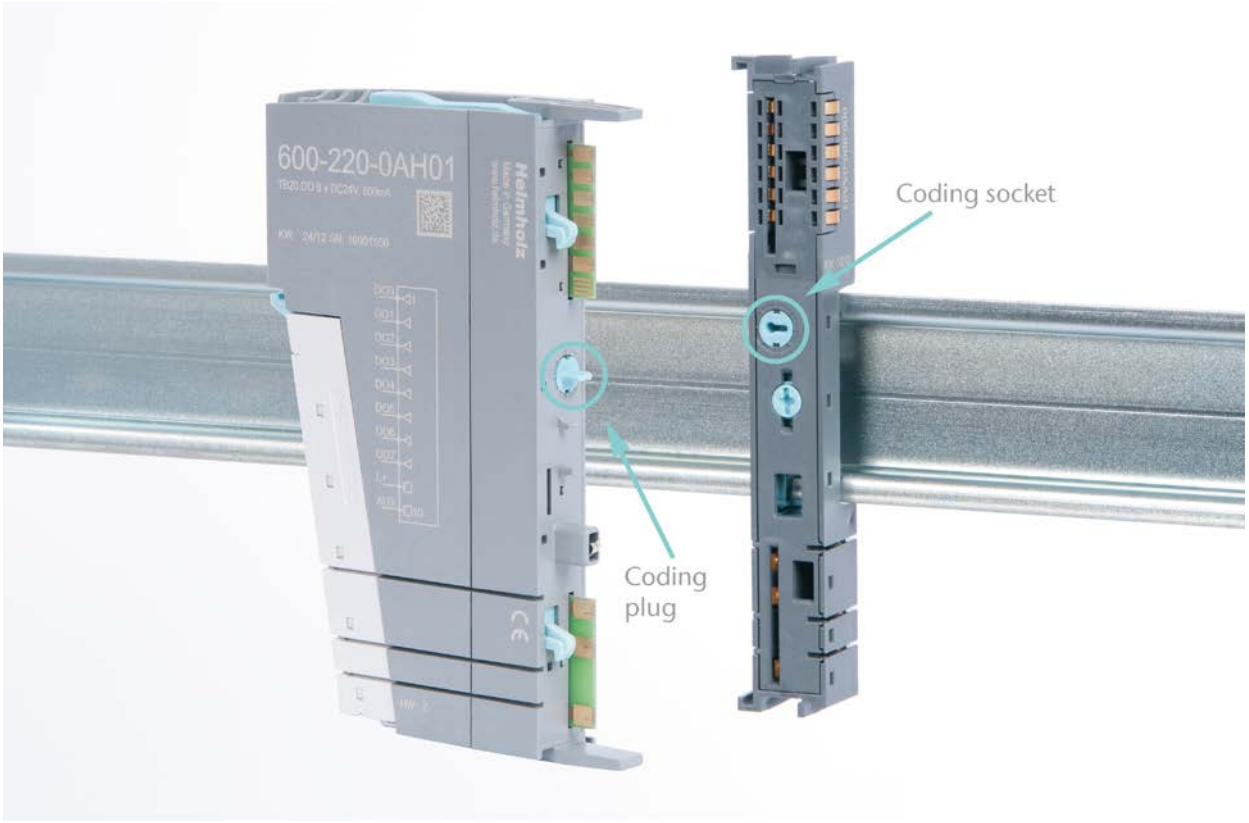
Each module consists of three parts:

- 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 figure below).



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, etc.) from the TB20 I/O 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. Otherwise, the electronic module will be mechanically prevented from being plugged in.

3. Installation and Removal

WARNING!

Before starting any work on TB20 system components, make sure to de-energize all components, as well as the cables supplying them with power! Failure to do so will pose a life-threatening electric shock hazard!

CAUTION!

Installation must be carried out as per VDE 0100/IEC 364. Since the coupler and segments are modules with a protection rating of IP 20, they must be installed inside an enclosure. In order to ensure safe operation, make sure the ambient temperature does 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 will, however, be necessary to use a horizontal installation layout.

3.2. Minimum Clearance

It is recommended to adhere to the minimum clearances specified below 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)

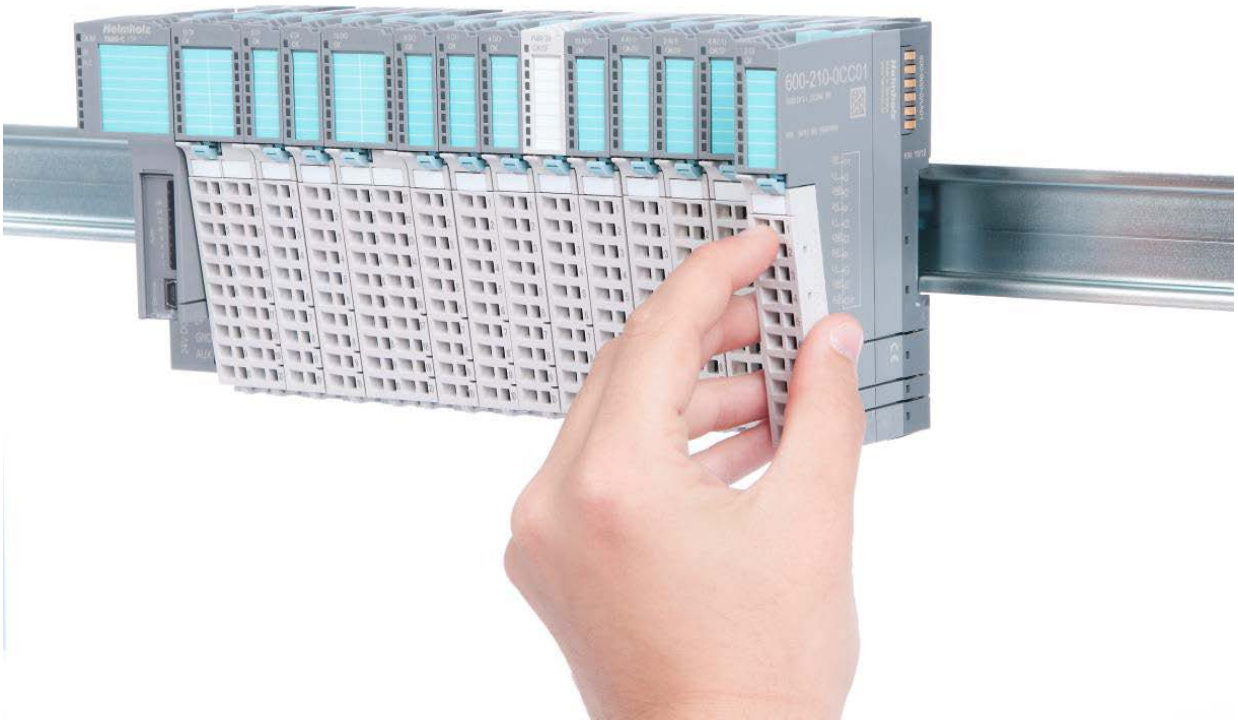
The minimum clearances for TB20 components are: 30 mm on top and on the bottom and 10 mm on each side.

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 on the inside snaps into place 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 7) on the base module in a straight line from the front and then gently push it into the base module until both modules are fully resting against each other and the module fastener snaps into place with a soft click.

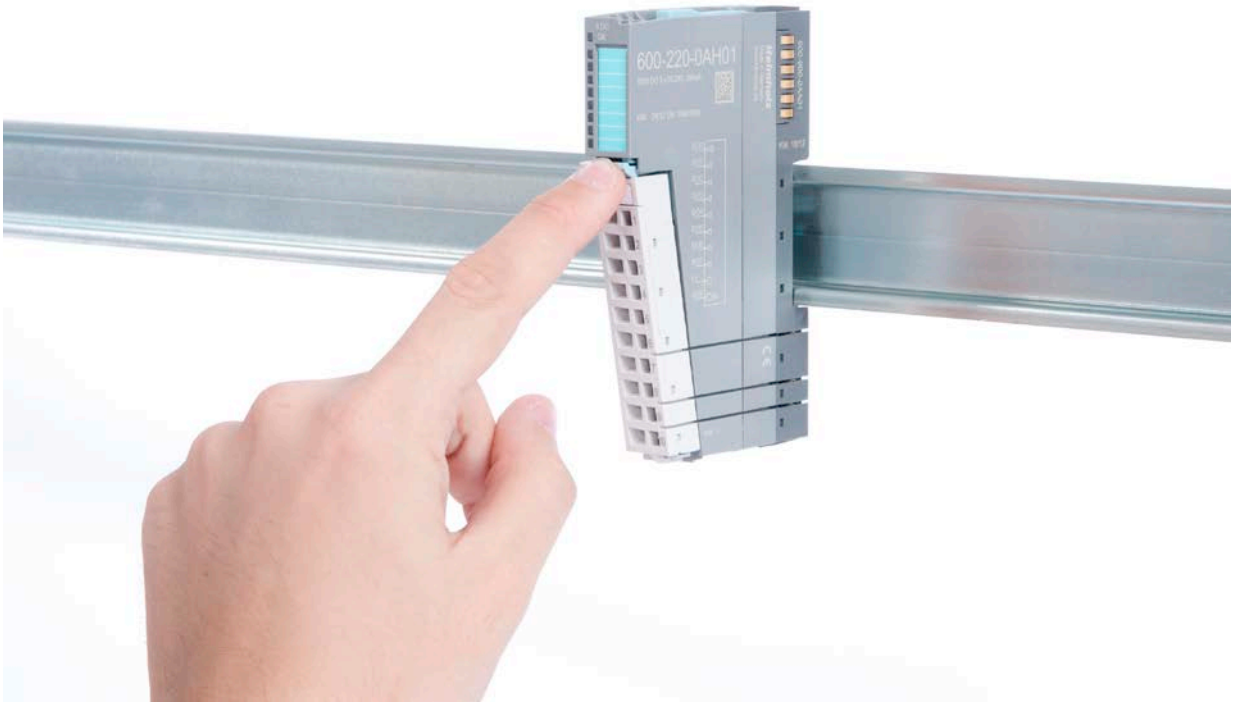
Finally, place the front connector on the electronic module from below in an inclined position and then gently push it onto the electronic module until the front connector fastener snaps into place with a soft click.

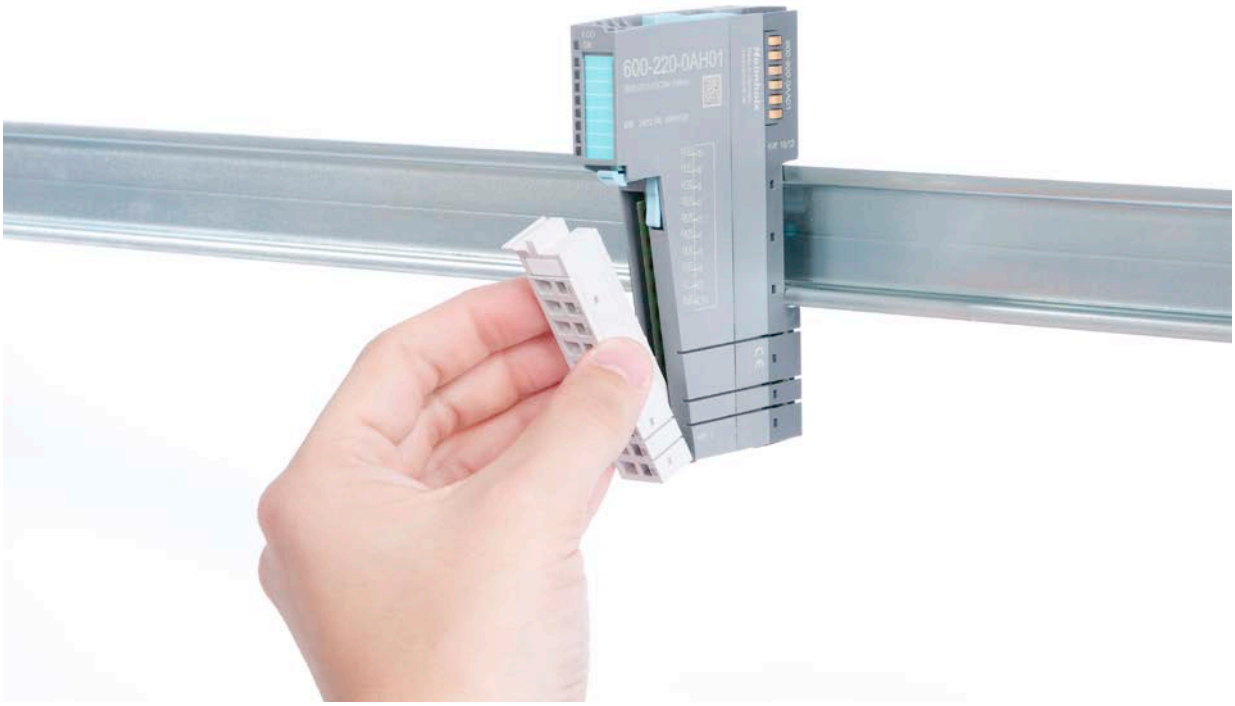
3.3.2. Removal

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

Step 1: Remove the front connector

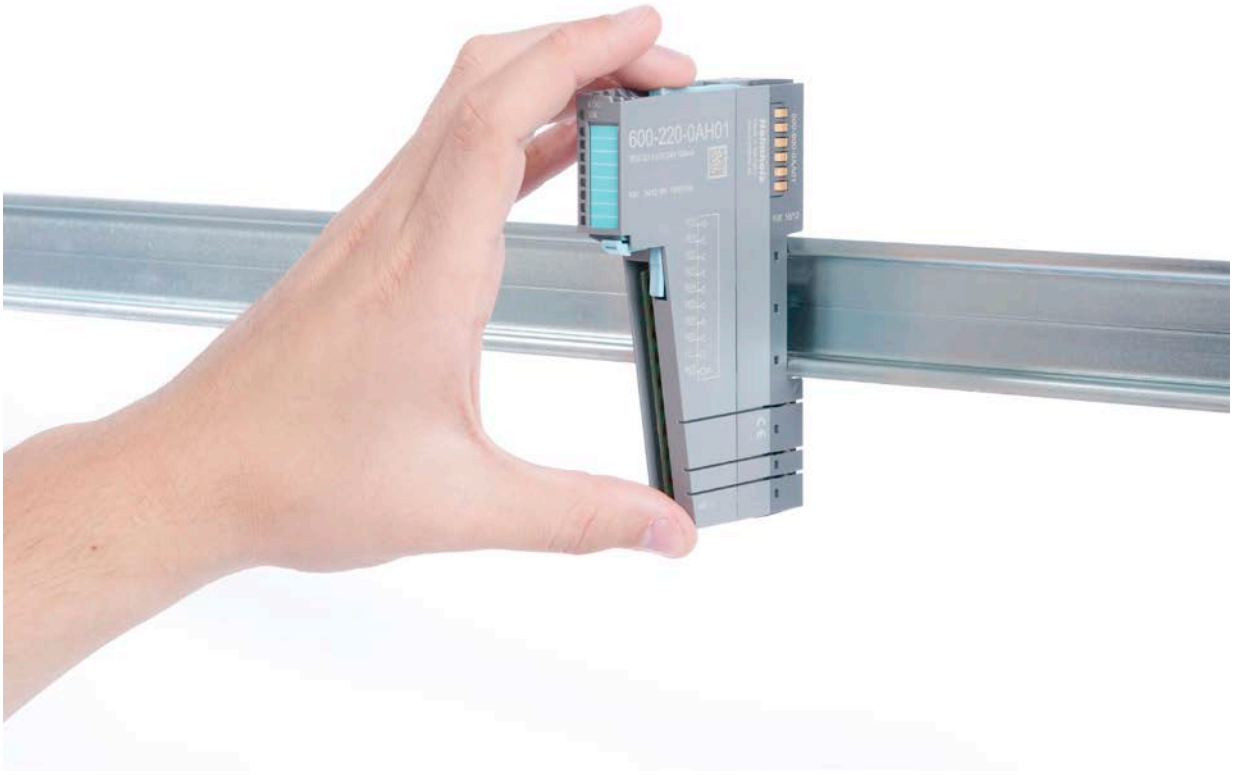
To do so, push the tab above the front connector upwards (see the figure below). This will push out the front connector, after which you can pull it out.





Step 2: Remove the electronic module

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



Step 3: Release the base module

Use a screwdriver to release the base module by turning the locking mechanism 90° counter-clockwise.

Step 4: Remove the base module

Remove the base module by pulling it towards you.

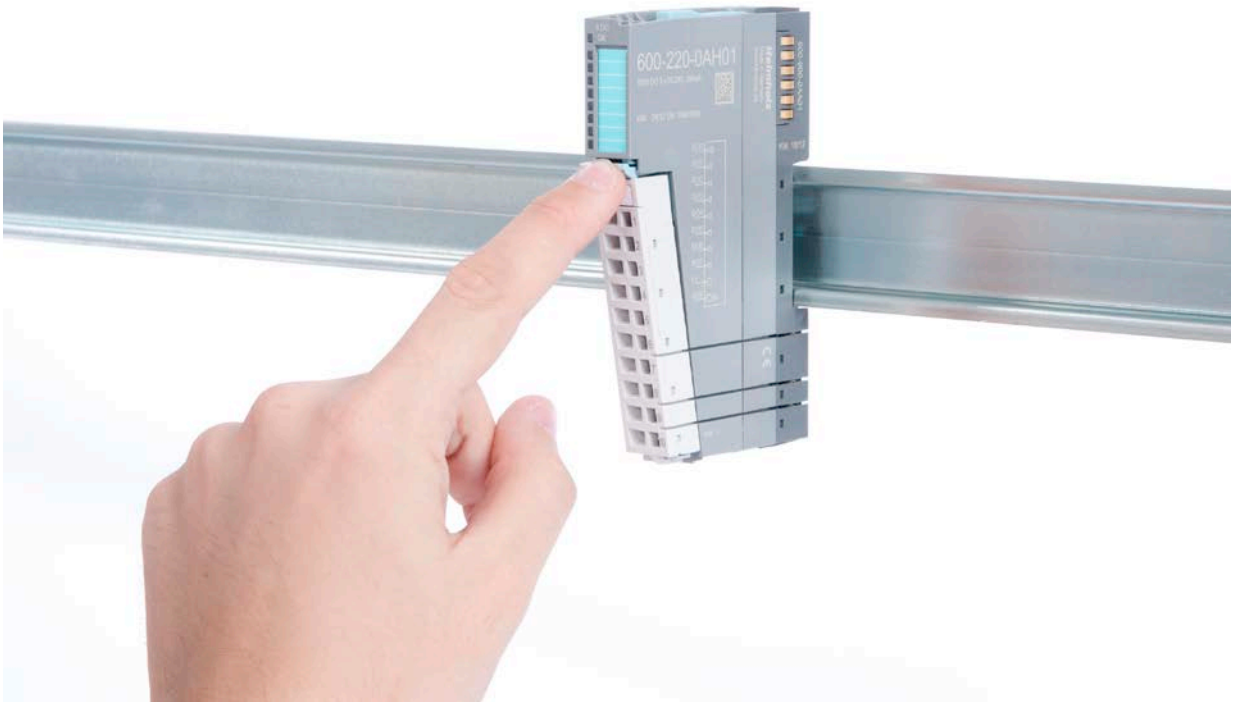
3.4. Replacing an Electronic Module

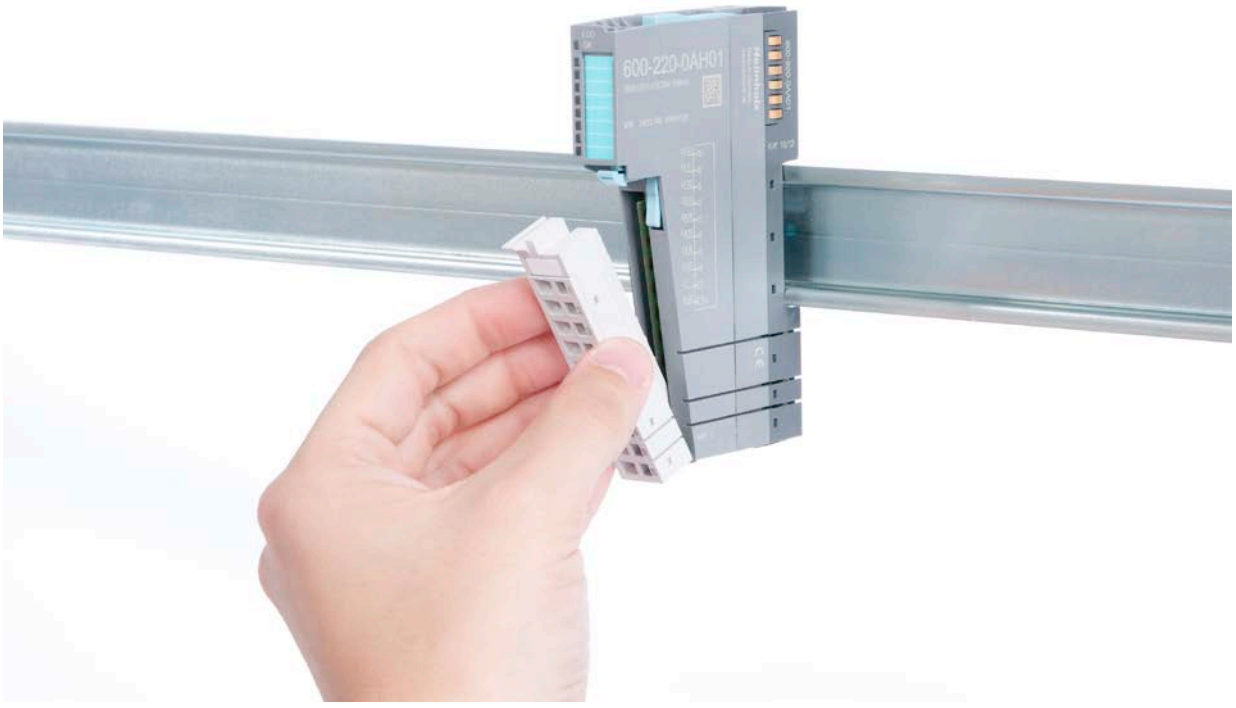
The procedure for replacing the electronic module on a peripheral module consists of four steps.

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.

Step 1: Remove the front connector

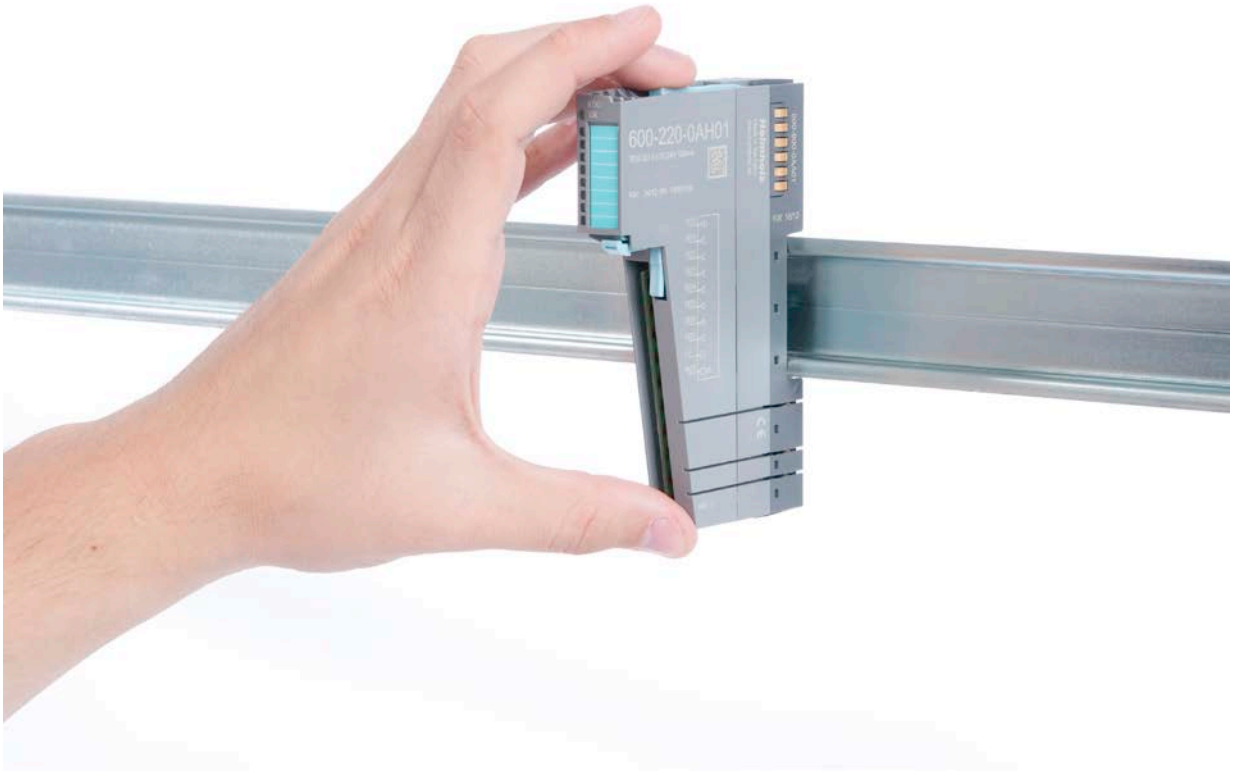
To do so, push the tab above the front connector upwards. The front connector will come loose, after which you can pull it out.





Step 2: Remove the electronic module

To do so, use your middle finger to push on the lever from above and then use your thumb and middle finger to pull out the electronic module while holding the lever down (see figure).



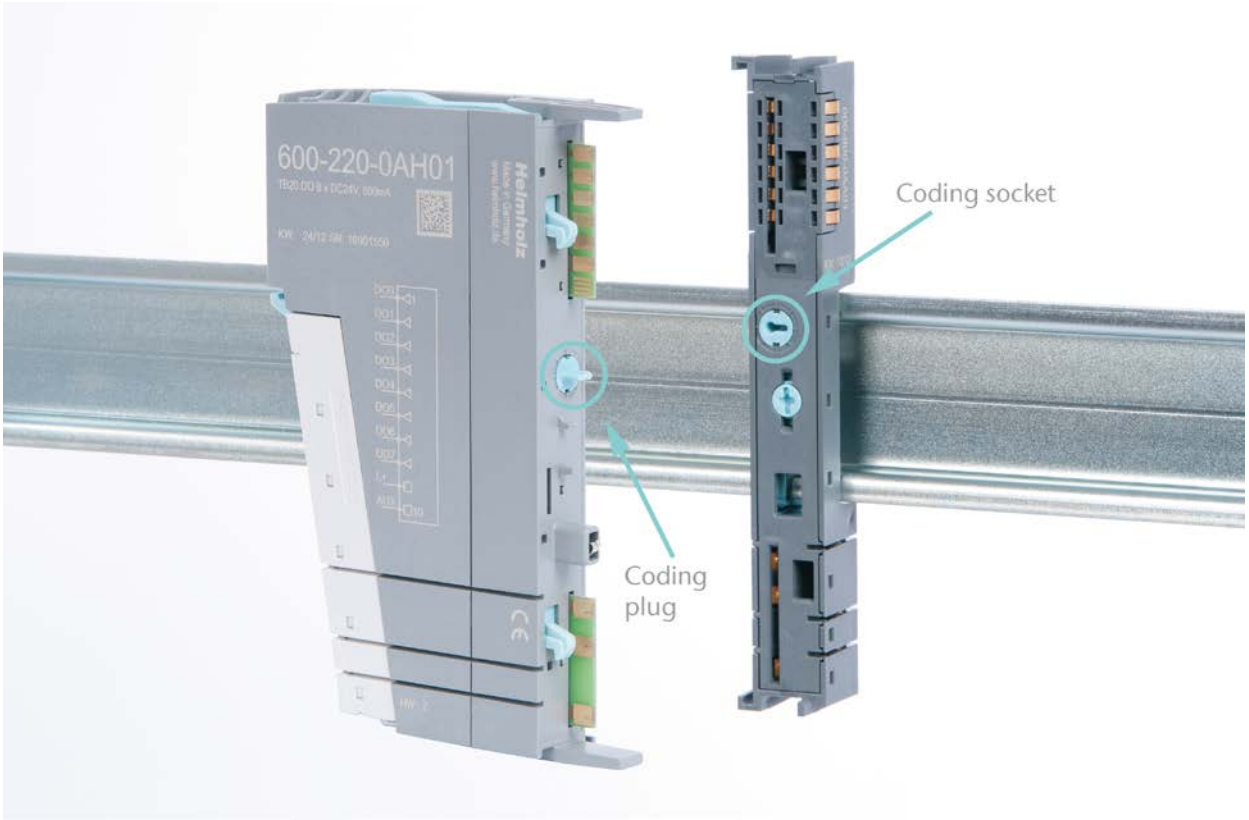
Step 3: Plug in a new electronic module

CAUTION!

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.

CAUTION!

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.



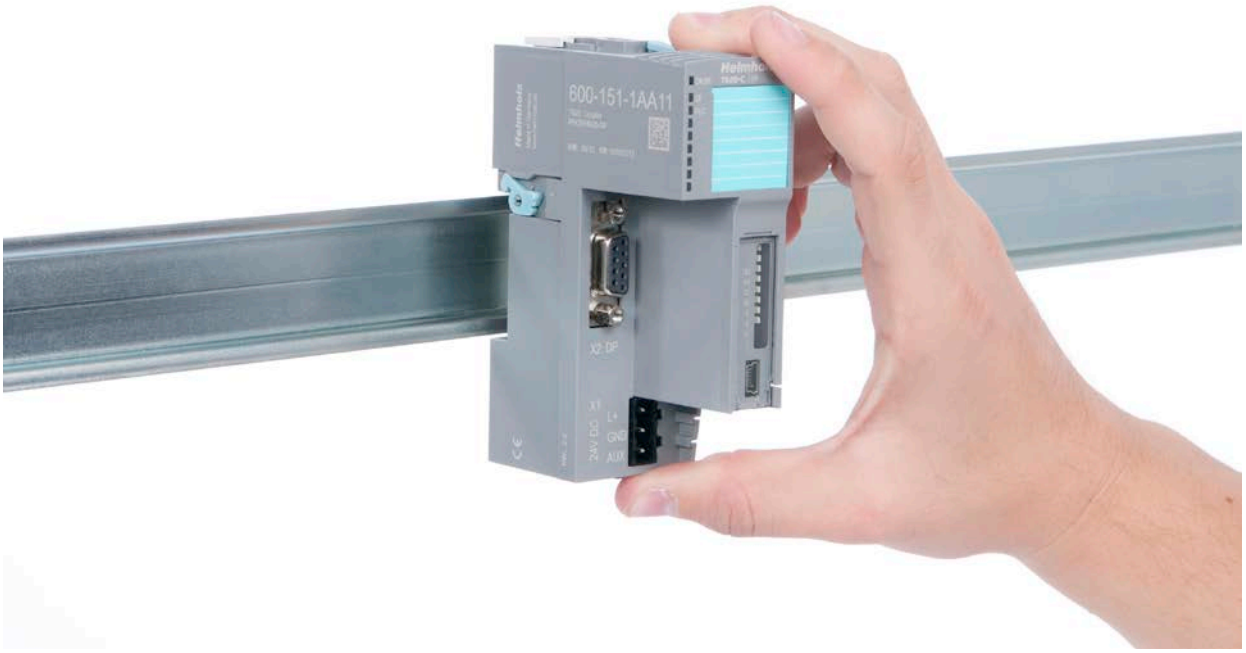
Step 4: Plug in the front connector

3.5. Installing and Removing the Coupler

3.5.1. Installation

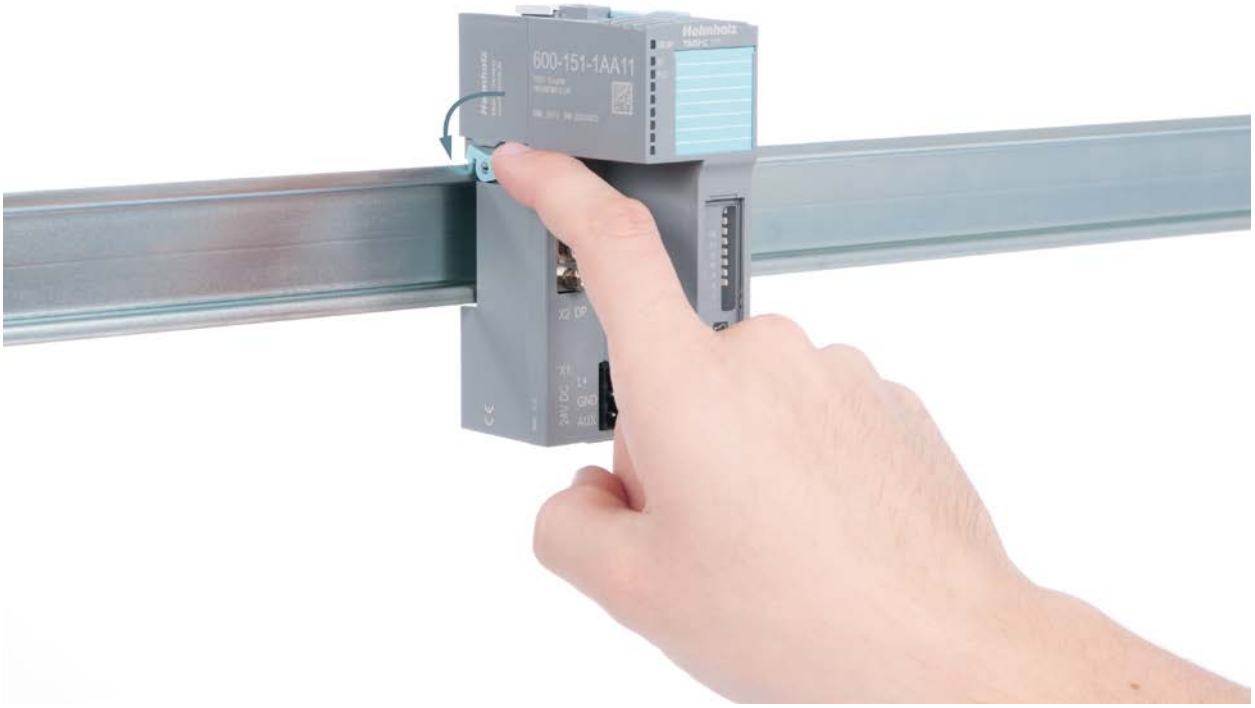
Step 1: Place the coupler on the DIN rail

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

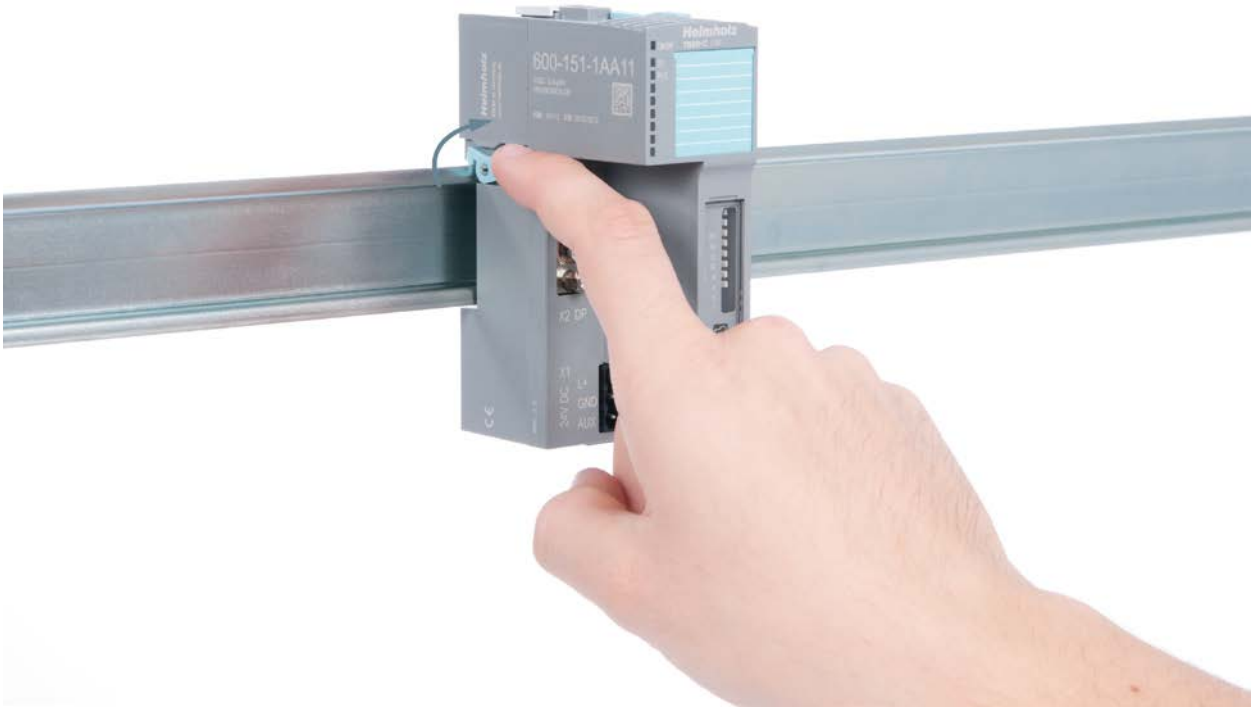
Use the locking lever on the left side to lock the coupler into position on the DIN rail.



3.5.2. Removal

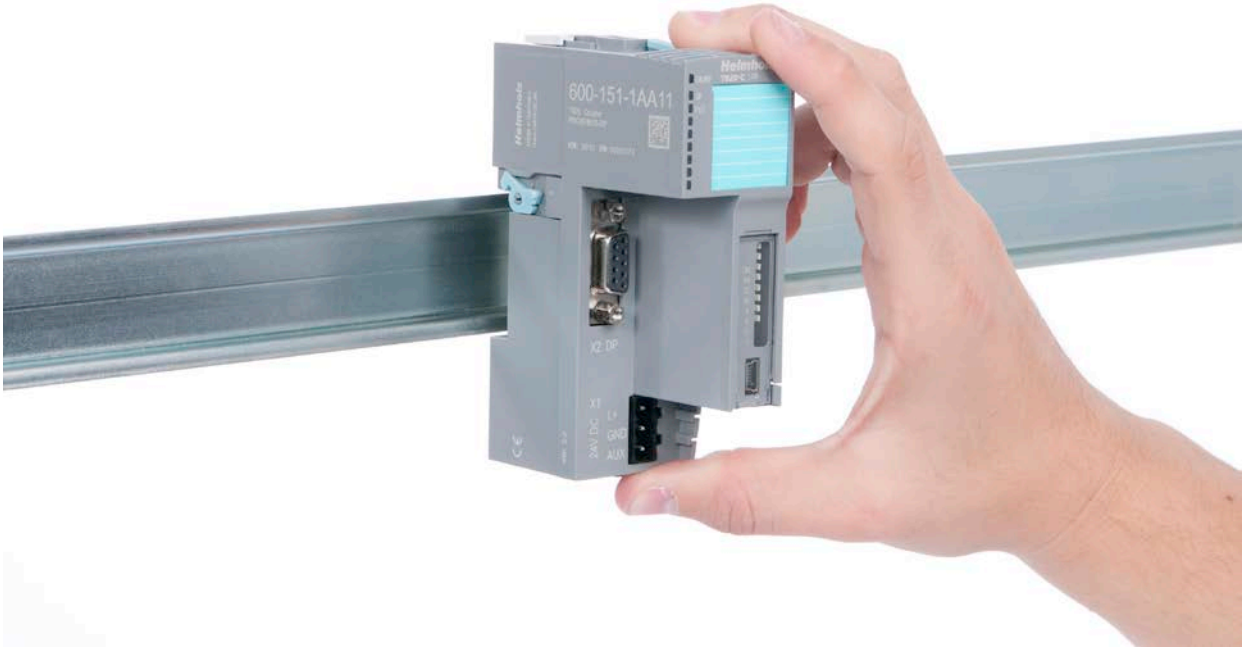
Step 1: Release the locking mechanism

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



Step 2: Remove the coupler

Use your middle finger to push on the release lever from above and then use your thumb and middle 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.

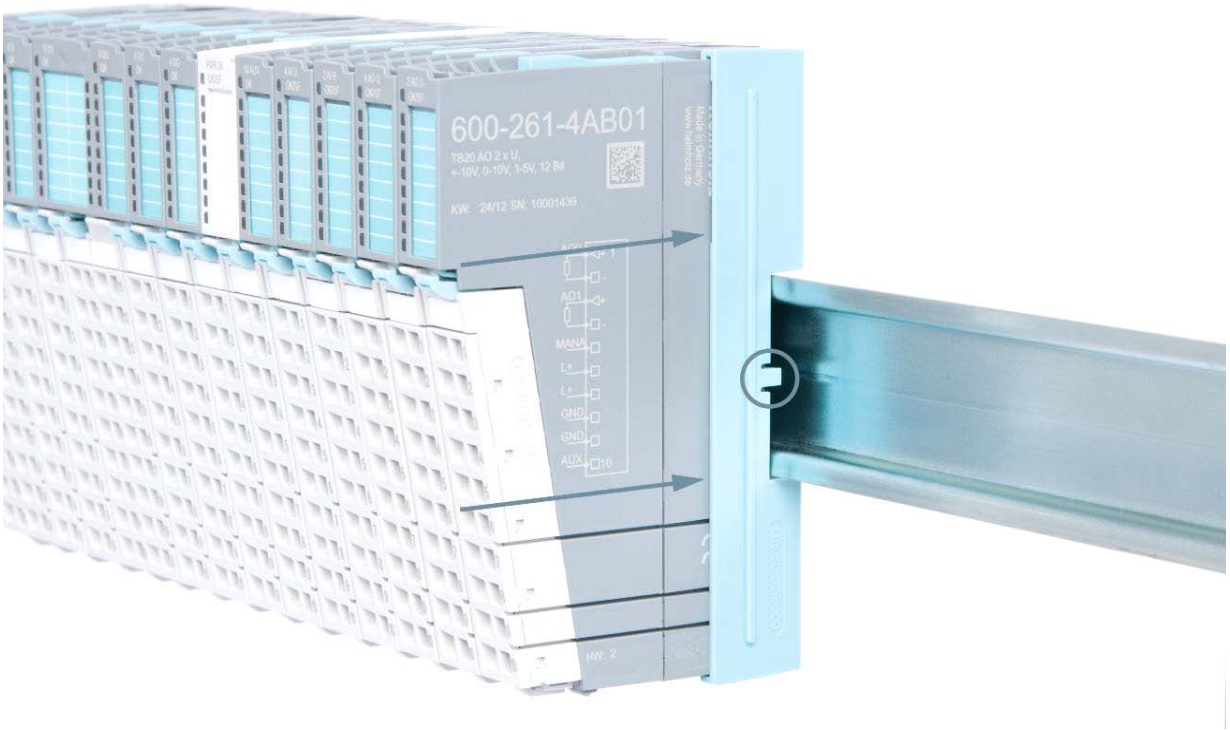
Step 4: Remove the base module

Remove the base module by pulling it towards you.

3.6. Installing and Removing the Final Cover

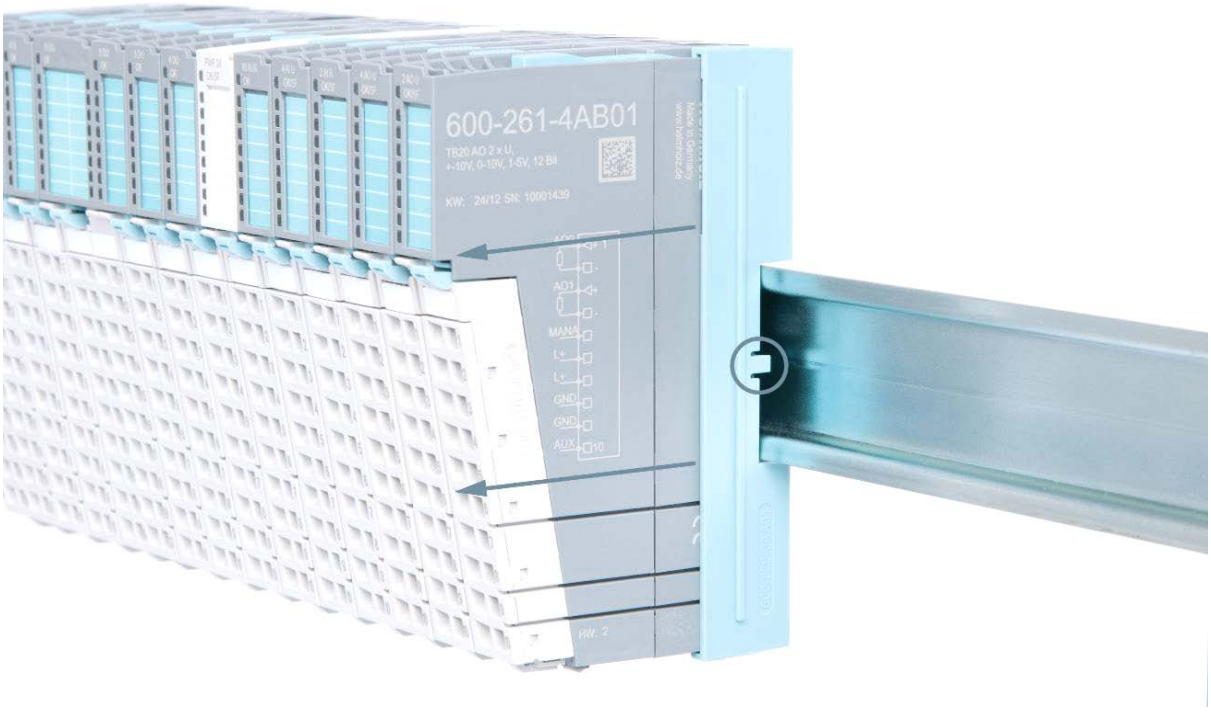
3.6.1. Installation

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 cover along the module's case and away from the DIN rail in order to remove it from the module.



4. Wiring

4.1. EMC / Safety / Shielding

EU Directive 2004/108/EC (“Electromagnetic Compatibility”) defines which electrical devices and equipment must be designed in such a way as to not inevitably affect other neighboring devices and/or equipment with electromagnetic radiation. Within this context, the term “electromagnetic compatibility” refers to all electromagnetic factors that are relevant to the simultaneous operation of various electrical devices and/or equipment in close proximity to each other.

The directive requires, on one hand, for electrical devices and equipment to function flawlessly in an existing environment that exerts an electromagnetic influence within its area, and, on the other, for said devices and equipment to not produce impermissible levels of electromagnetic interference within said environment.

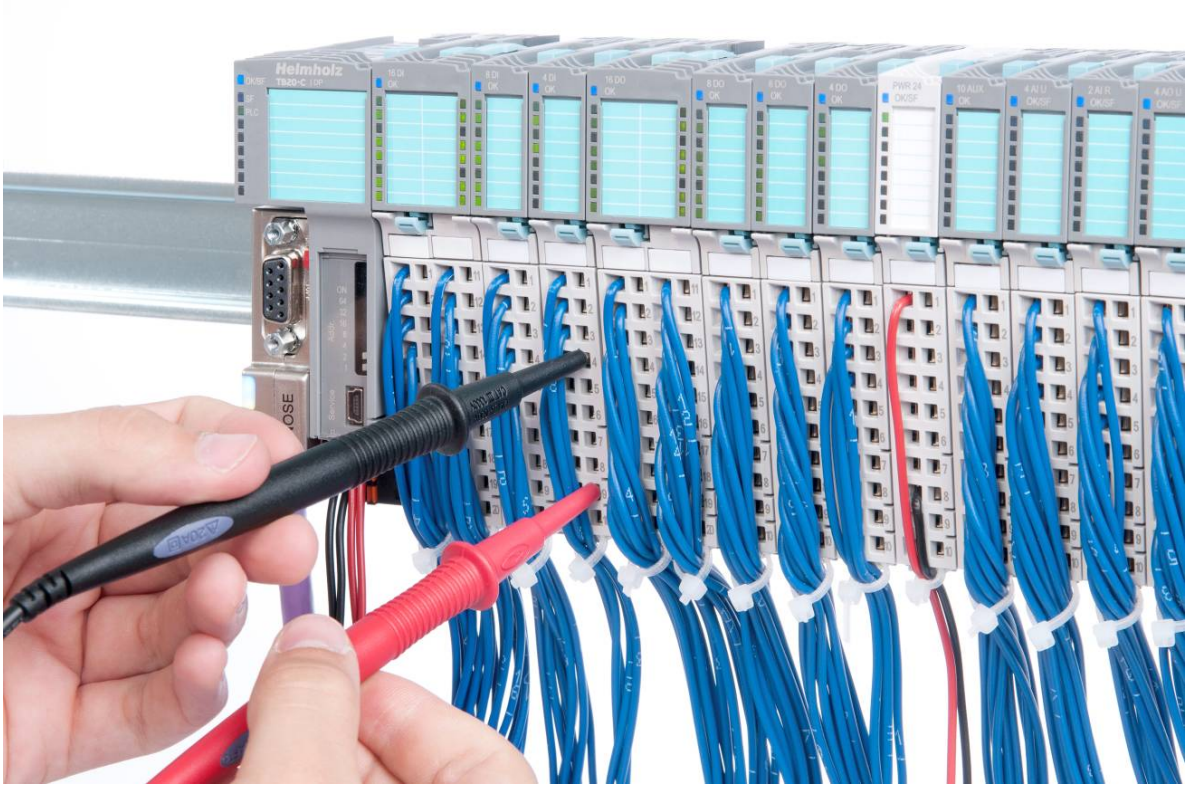
One effective way to protect against disturbances caused by electromagnetic interference is to shield electric cables, wires, and components.

CAUTION!

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.

4.2. Front Connector

The front connector’s spring-clamp terminals are designed for a cross-sectional cable area of up to 1.5 mm² with or without ferrules.



4.3. Wiring the Coupler

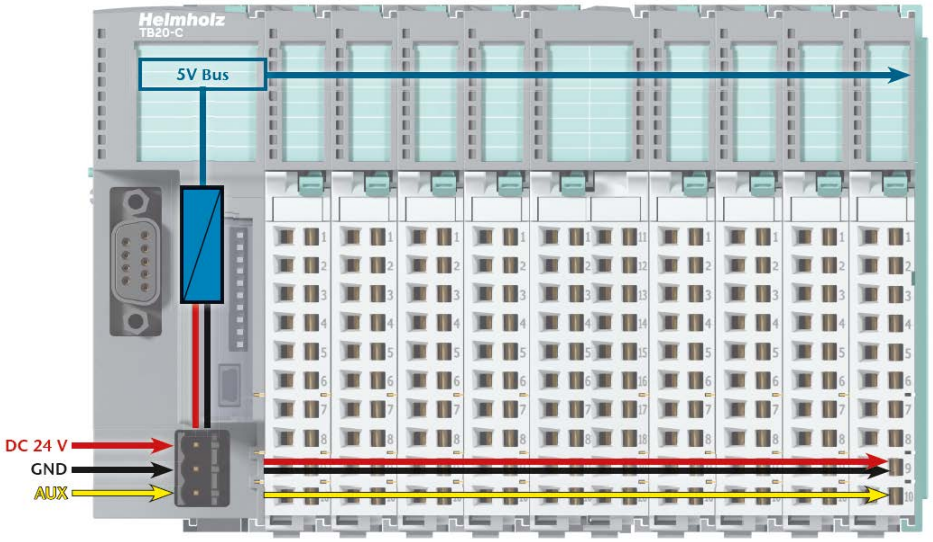
A power supply unit is integrated into the bus coupler. This unit is responsible for powering the peripheral modules connected to the coupler.

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

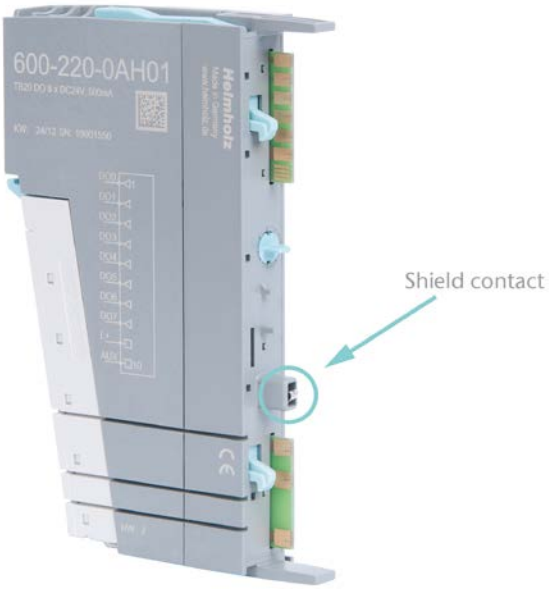
The L+ connector is used to power two buses:

- 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 set up and use an additional wiring channel. Every peripheral module has an AUX terminal on its front connector (the bottommost terminal, i.e., terminals 10 and 20).

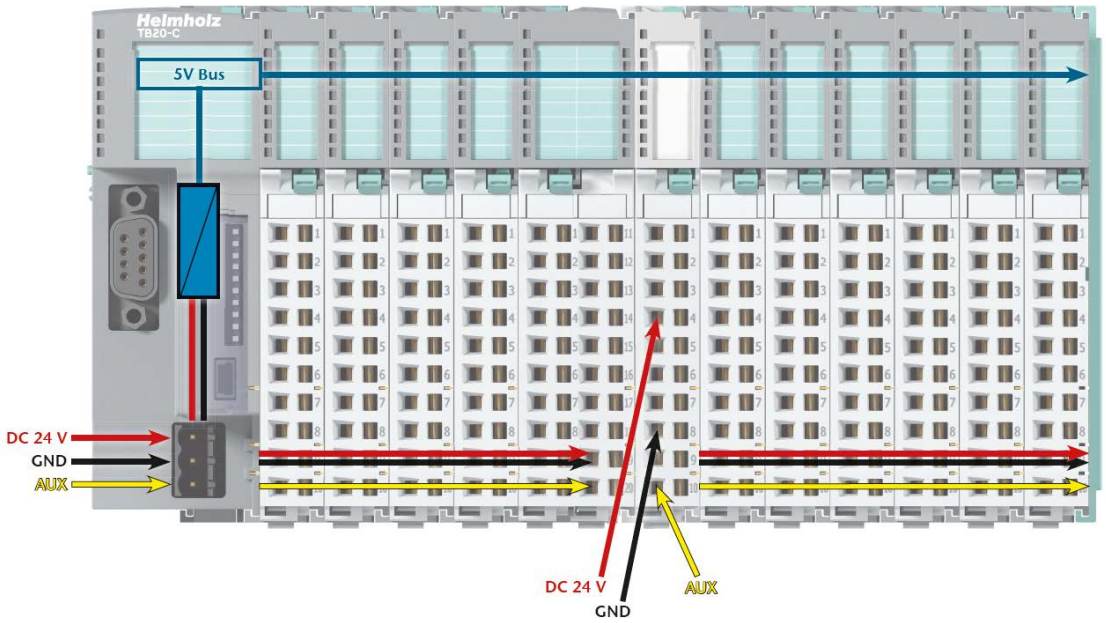


Shielding/grounding is achieved with a corresponding shield contact on the DIN rail:



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.

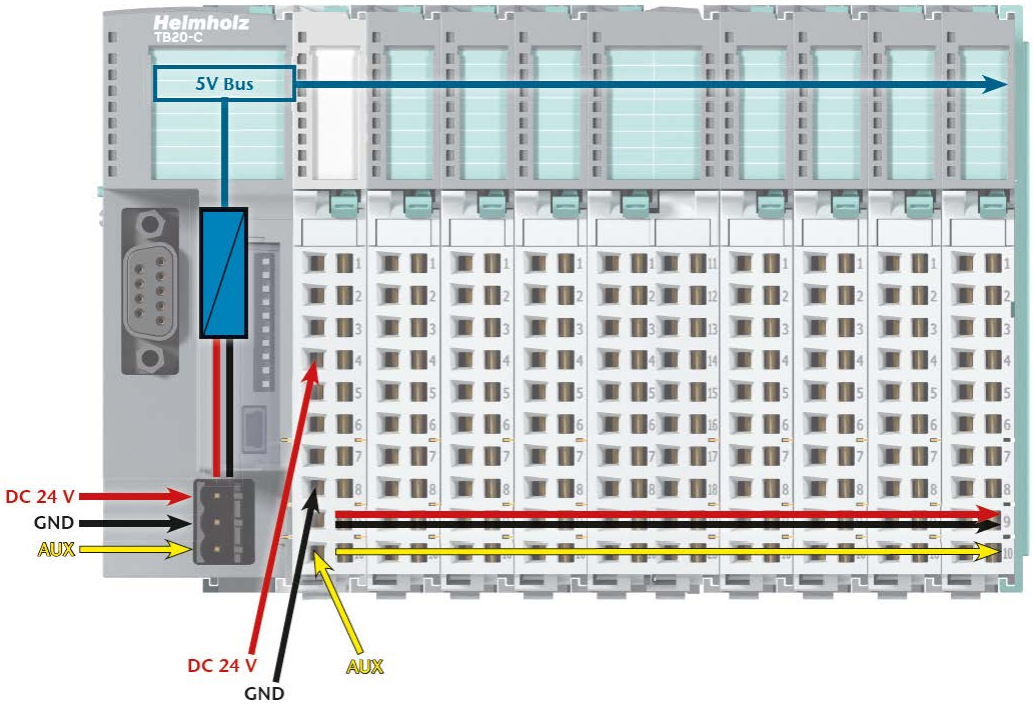


The order No. for the power and isolation module for 24-V signals is 600-710-0AA01.

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

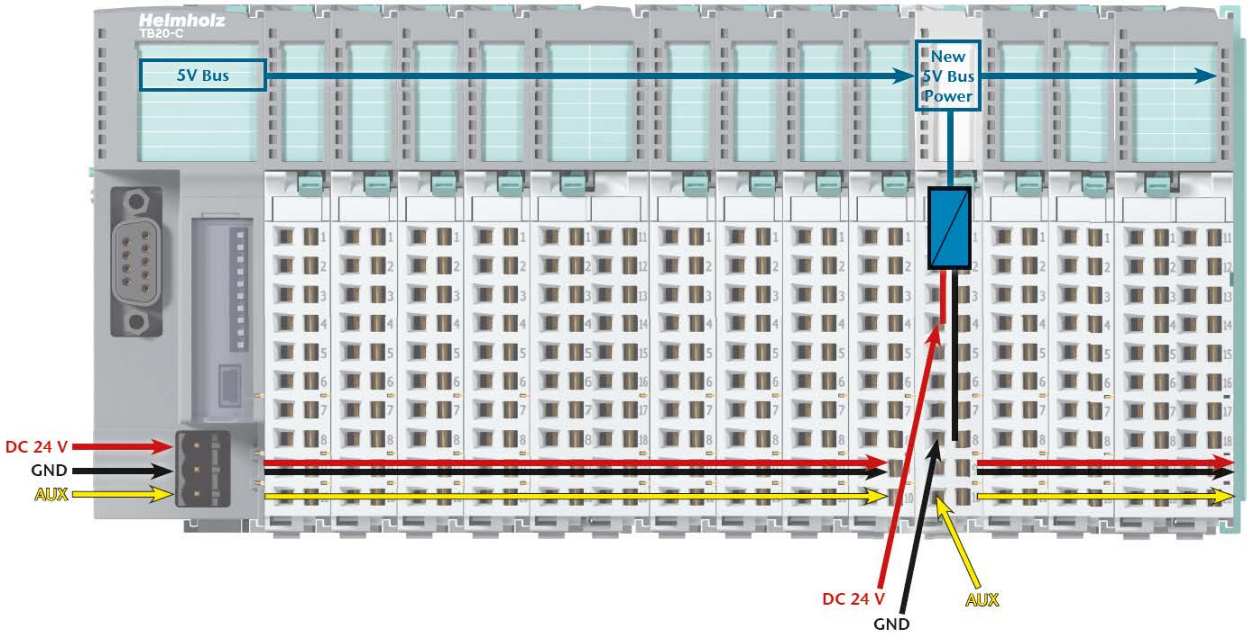
If the power supply for the coupler needs to be separate from the power supply for the I/O modules, a power and isolation module can be used right after the coupler.



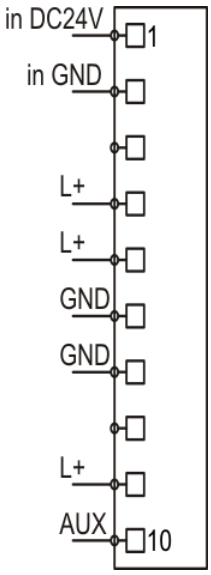
4.6. Using Power Modules

Power modules deliver all necessary power to the peripheral modules connected after them 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, e.g., when there are a large number of modules on the bus. The “TB20-ToolBox” software 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. Its electronic module has the same light gray color as the front connector, while its base module is light gray with a dark core.



4.7. Fusing

The coupler's and power modules' power supply must be externally fused with a fast-blow fuse appropriate for the required maximum current.

4.8. Electronic Nameplate

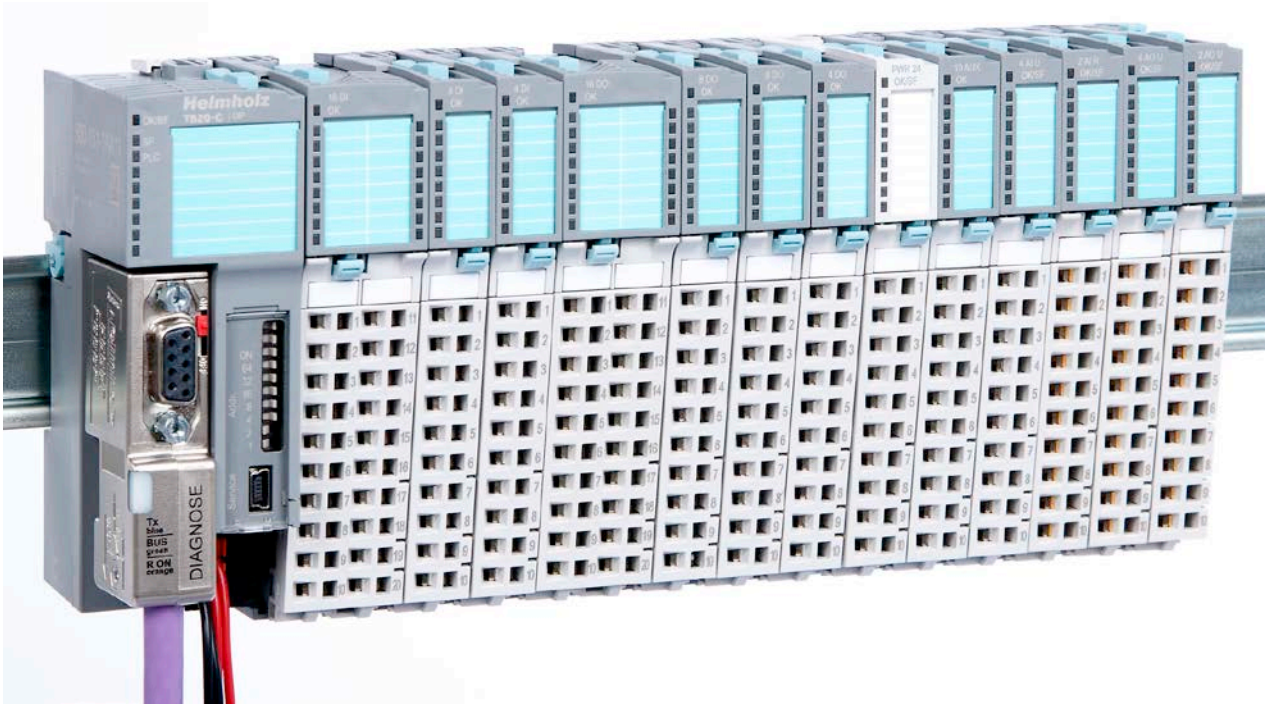
Every TB20 peripheral module features an electronic nameplate containing all of the module's important information. This information includes, for example, the corresponding module ID, module model, order number, unique serial number, hardware version, firmware version, and internal range of functionalities.

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

5. PROFIBUS-DP Coupler Characteristics

The TB20 PROFIBUS-DP coupler has the following characteristics:

- PROFIBUS DP slave as per EN 50170 / IEC 61158
- Supports all PROFIBUS baud rates
- DP-V0 and DP-V1 support
- A maximum of 64 modules
- supports Hot-plug
- Up to 244 bytes of input data and 244 bytes of output data
- One class 1 master connection with 240 bytes of payload data
- Up to three class 2 master connections with 240 bytes of payload data (as a DP-V1 slave)
- 24 VDC power supply
- Integrated power supply unit for powering TB20 peripheral modules (2.5 A)
- Supplies the system's I/O voltage (24 VDC)
- DIP switch for configuring the PROFIBUS address; can be covered
- 3 LEDs, one of them bi-color
- USB device port for online diagnosis with TB20-ToolBox



6. PROFIBUS

6.1. General Information

PROFIBUS is an open fieldbus standard that is specified in EN 50170 / IEC 61158. This standard includes the PROFIBUS DP protocol, which is used to connect distributed peripherals.

Running a PROFIBUS DP system requires at least one active node (master) that will be responsible for communicating with the system's various passive nodes (slaves). This master will normally be the system's PLC.

RS-485 is usually used for the physical layer, but using optical fiber cables as a transmission medium is also possible. PROFIBUS is normally set up in linear bus topologies, with all nodes wired in parallel.

The PROFIBUS DP protocol contemplates transmission rates of 9.6 kbps to 12 Mbps. A maximum of 32 nodes can be operated within each single segment, while a total of 126 nodes can be assigned addresses within a single network. The 32-node limit is a result of the bus' transmission medium, and can be overcome by using PROFIBUS repeaters (see Section 6.2.3) if a greater number of nodes is required within a single network.

The bus cable is specified in standards EN 50170 / IEC 61158, which define the permitted length of a bus segment as a function of the bus' data rate:

Bit rate (kbps)	**9.6**	**19.2**	**93.75**	**187.5**	**500**	**1,500**	**12,000**
Cable length, in m	1200	1200	1200	1000	400	200	100

Branch lines should total a distance of less than 6 m at data rates of up to 1.5 Mbps. At 12 Mbps, no branch lines should be used whatsoever.

Terminating resistors must always be used at the beginning and end of a bus segment. These terminating resistors are normally integrated into PROFIBUS connectors and can be switched on and off (see Section 6.2.2).

When installing the modules and routing the cable, make sure to follow the PROFIBUS DP/FMS technical guidelines published by the PROFIBUS User Organization (www.profibus.de).

DP-V0:

The first PROFIBUS service level DP-V0 provides PROFIBUS DP's basic functions. DP-V0 includes the cyclic exchange of data and makes it possible to use basic diagnostic functions.

DP-V1:

PROFIBUS DP-V1 adds acyclic services for alarm handling and for operating, monitoring, and configuring the parameters of intelligent PROFIBUS field devices. In order to be able to use DP-V1 services, the PROFIBUS master being used must support DP-V1.

6.2. Bus Connection

6.2.1. PROFIBUS Connector Pin Assignment

Pin	PROFIBUS D-sub connector
1	Shield
2	GND (for 24V)
3	Rx/Tx cable B
4	RTS
5	GND (for 5V)
6	+5V
7	+24V
8	Rx/Tx cable A
9	-

The 24-V supply provided through pins 7 and 2 is polarized but has no current limiting or fuse protection.

6.2.2. PROFIBUS Connectors

Systeme Helmholz GmbH has an extensive range of PROFIBUS connectors that can be used with TB20 bus couplers.

6.2.3. PROFIBUS Repeaters

Repeaters are needed in applications that involve large PROFIBUS networks with more than 32 nodes or long cable distances. Systeme Helmholz GmbH has a wide variety of repeaters available. FLEXtra multiRepeaters enable users to also set up star topologies in PROFIBUS.

6.2.4. PROFIBUS via Optical Fiber Cables

The use of repeaters with converters for optical fiber cables (PROFIBUS FO) is recommended for PROFIBUS networks subject to strong EMC interference.

7. Setup and Use

7.1. Address Switches

The lower seven switches are used to define the coupler's PROFIBUS address.

Addresses 1–125 are valid PROFIBUS addresses.

Addresses 0, 126, and 127 will be mapped to address 126. Choosing address 126 means that it will be possible to use the PLC configuration tool to set the TB20 coupler's address (which will be stored in non-volatile memory).

Changes to the address switches' positions will take effect only after the coupler is restarted.

The upper three switches are reserved and should remain in the right-hand position.

7.2. GSD File-Based Configuration

To download the latest GSD (General Station Description) files for DP-V1 and DP-V0, please visit our website at www.helmholz.de.

These GSD files are available in multiple languages and versions:

TB20DPV1.GSG = DP-V1 GSD file in German

TB20DPV1.GSE = DP-V1 GSD file in English

TB20DPV1.GSD = DP-V1 GSD "Default" file in English

TB20DPV0.GSG = DP-V0 GSD file in German

TB20DPV0.GSE = DP-V0 GSD file in English

TB20DPV0.GSD = DP-V0 GSD "Default" file in English

After installing a GSD file, you will be able to find the PROFIBUS coupler in the hardware catalog under:

PROFIBUS-DP → Additional Field Devices → I/O → HELMHOLZ → TB20 IO-System → TB20 PROFIBUS-DP (DPV1)

7.3. Hot Plug Function (DP-V1 Only)

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 “Startup if expected/actual configuration differ” option can be used to configure the coupler’s startup behavior and hot plug function.

If the “Startup if expected/actual configuration differ” option is enabled, the coupler will be able to start if there are at least as many modules in the actual system as there are in the configuration and there are no gaps (missing modules) in the system. If there are too few modules in the system, the coupler will not start (on the other hand, it will still be able to start if there are too many modules). If there are any incorrect modules in the system, only the correct ones will be started.

Hot Plug will only be possible if the “Startup if expected/actual configuration differ” option is enabled.

CAUTION!

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

If the “Startup if expected/actual configuration differ” option is disabled, the coupler will only be able to start up if all the configured modules are found. Hot plug is not permitted with this setting, and removing a module will cause the system to stop immediately.

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 7.4.2).

Hot plug and starting up when the expected configuration is different from the actual configuration are only possible in DP-V1 mode!

7.4. LED-Based Diagnostics

7.4.1. PROFIBUS-DP Coupler LEDs

The blue "**OK**"-LED is used to indicate the coupler's general status:

Solid light: PROFIBUS running, correct parameter configuration, system running

Flashing light: PROFIBUS found, but system did not start

The red "**BF**"-LED (bus error) is used to indicate PROFIBUS errors and PROFIBUS diagnostic messages:

Flashing light: No PLC configuration found. The PROFIBUS address could be wrong. PROFIBUS not connected.

Solid light: There is a diagnostic message.

The yellow "**SF**"-LED is used to indicate system errors and backplane bus errors:

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

Solid light: Incorrect module models plugged in

The green "**PLC**"-LED indicates the master PLC's status:

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

Flashing light: The PLC is stopped (STOP)

Solid light: The PLC is running (RUN)

7.4.2. Modules LEDs

The topmost "**OK/SF**"-LED on every module indicates the module's current system status.

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

IDLE mode (quickly flashing blue LED) is used to indicate modules that are not running, i.e., that the coupler has not added to the system's running operation. One of the potential reasons for this is an incorrect configuration (wrong module model on the slot).

7.5. Configuring Parameters via PROFIBUS

In order to configure the coupler's and modules' parameters in PROFIBUS, a parameter configuration frame is sent to the coupler when the system starts up. The first eight bytes of this parameter configuration frame contain the parameter configuration for the coupler, followed by the parameter bytes for all the configurable modules configured in the peripheral system.

7.5.1. Coupler Parameters

Byte	Bit	Description
0	0–2	0
	3	Watchdog time base (10 ms/1 ms)
	4–5	0
	6	0 = Fail-safe disabled
	7	1 = DP-V1 mode
1	0	"Startup if expected/actual configuration differ" / Enable hot plugging *(with DP-V1 only)*
	1–4	0
	5	1 = Activate diagnostic alarm *(with DP-V1 only)*
	6	1 = Activate process alarm *(with DP-V1 only)*
	7	1 = Activate pull/plug alarm *(with DP-V1 only)*
2	0–7	00h
3	0–7	5 = Length of manufacturer-specific parameters (incl. length byte)
4	0–7	00h *(reserved)*
5	0–7	00h *(reserved)*
6	0–3	0
	4	1 = Enable identifier-related diagnostics
	5	1 = Enable submodule status
	6	1 = Enable channel-related diagnostics
	7	0
7	0–7	00h *(reserved)*

7.5.2. Module Parameters

Please refer to the module manuals for information on the modules' parameter sets.

As per the PROFIBUS standard, the entire parameter frame (i.e., the coupler's parameters and all module parameters) must not exceed a length of 244 bytes!

For certain modules (e.g., analog modules), the GSD file will include both a long parameter set with all configurable functions and a shorter version with reduced functionality. The shorter parameter version makes it possible to set up a system with more configurable modules without reaching the parameter frame limit of 244 bytes.

7.5.3. Module Layout Configuration

In addition to the parameter frame, the master will also send a frame with the TB20 system's configured module layout to the PROFIBUS-DP coupler.

This frame will contain three bytes for each module (each slot). These bytes will tell the coupler what model the module belongs to (PROFIBUS module ID number) and how large its configuration in the I/O data frame is. The configured model will be compared with the electronic nameplate (see Section 4.8) of the module in the actual system and the result will be used to determine the system's status (please see the "Startup if expected/actual configuration differ" option).

The PROFIBUS module ID number is always sent in diagnostic frames as well (see Section 7.6.5) in order to make it easier to identify the relevant module.

PROFIBUS module ID numbers:

Module model	ID number (hex)
2x DI	02
3x, 4x DI	03
6x, 8x DI	04
16x DI	05
2x DO	10
4x DO	18
8x DO	20
16x DO	28
2x / 2x DIO	12
4x / 4x DIO	1B
8x / 8x DIO	24
2x AI U, I, R	42
4x AI U, I, R	43
2x AI TC	52
4x AI TC	5B
2x AO U, I	50
4x AO U, I	58

Module model	ID number (hex)
1x counter 24V, 5V	85
Power module	C8
Power/isolation module	C4
Potential distributor	CC

PROFIBUS module ID numbers cannot be used to identify every existing module separately. Because of this, modules are grouped into model groups in order to make it possible to keep the configuration frame under the limit of 244 bytes as per the PROFIBUS standard.

7.6. Diagnostic Messages via PROFIBUS

Diagnostic messages always start with basic diagnostic data, followed by the diagnostic blocks that can be enabled in the parameter configuration (i.e., the “extended” diagnostic message).

Byte	Length	Content
0 – 5	6 bytes	Basic diagnostic data
6 – 14	9 bytes	One identifier-related diagnosis (configurable)
15 – 34	20 bytes	One submodule status (configurable)
35 – xx	0–64 blocks (3 bytes each)	Zero to 64 channel-related diagnoses (configurable)
xx – xx	12 bytes (diagnostic alarm) / 8 bytes (process alarm)	One device-related diagnosis (diagnostic or process alarm)

7.6.1. Basic Diagnostic Data

Node status, byte 0:

Bit	Description
0	DP slave cannot be accessed by master
1	DP slave is not yet ready for exchanging data
2	0
3	There is a diagnosis active
4	The requested function is not supported by the slave
5	0
6	parameterisation error
7	0

Node status, byte 1:

Bit	Description
0	The DP slave’s parameters need to be reconfigured
1	0
2	1
3	Watchdog enabled
4	The DP slave is in “FREEZE” mode
5	The DP slave is in “SYNC” mode
6	0
7	0

Node status, byte 2:

Bit	Description
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	Diagnostic overflow: There are more diagnostic messages than the master can retrieve.

Basic diagnostic byte 3:

Will contain the master address once the parameters have been configured completely. Before the parameters are configured, byte 3 will hold a value of FF_{hex}.

Basic diagnostic bytes 4 and 5:

Helmholz manufacturer ID: $0D5C_{hex}$

7.6.2. Identifier-Related Diagnostics

Identifier-related diagnostics contain one bit for each module. If this bit has a value of "1," the module has an error condition. Whenever an error is being indicated, the submodule status and the channel-related diagnostics can be checked to obtain more detailed information. Identifier-related diagnostics can be turned on and off with the coupler's parameters (see Section 7.5.1).

Identifier-related diagnostics start on byte 6 and have a length of 9 bytes:

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
6	0	1	0	0	1	0	0	1	Header
	Code		Length of identifier-related diagnostics (9 bytes)						
7	M 8	M 7	M 6	M 5	M 4	M 3	M 2	M 1	Slots (modules) 1–8
8	M 16	M 15	M 14	M 13	M 12	M 11	M 10	M 9	Slots (modules) 9–16
9	M 24	M 23	M 22	M 21	M 20	M 19	M 18	M 17	Slots (modules) 17–24
10	M 32	M 31	M 30	M 29	M 28	M 27	M 26	M 25	Slots (modules) 32–25
11	M 40	M 39	M 38	M 37	M 36	M 35	M 34	M 33	Slots (modules) 33–40
12	M 48	M 47	M 46	M 45	M 44	M 43	M 42	M 41	Slots (modules) 41–48
13	M 56	M 55	M 54	M 53	M 52	M 51	M 50	M 49	Slots (modules) 49–56
14	M 64	M 63	M 62	M 61	M 60	M 59	M 58	M 57	Slots (modules) 57–64

7.6.3. Submodule Status

The submodule status provides a more detailed overview of the configured modules. It indicates whether a module has an error, whether an incorrect module has been plugged in, or whether the module is missing. The submodule status diagnostic function can be turned on and off with the coupler's parameters (see Section 7.5.1).

The submodule status starts after the identifier-related diagnostics and has a length of 20 bytes:

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
15	0	0	0	1	0	1	0	0	Header
	Code		Length of submodule status (20 bytes)						
16	82_{hex}								Submodule status status type
17	0								*Not relevant*
18	0								*Not relevant*
19	Module 4		Module 3		Module 2		Module 1		Slots (modules) 1–4
20	Module 8		Module 7		Module 6		Module 5		Slots (modules) 5–8
21	Module 12		Module 11		Module 10		Module 9		Slots (modules) 9–12
22	Module 16		Module 15		Module 14		Module 13		Slots (modules) 13–16
23	Module 20		Module 19		Module 18		Module 17		Slots (modules) 17–20
24	Module 24		Module 23		Module 22		Module 21		Slots (modules) 21–24
25	Module 28		Module 27		Module 26		Module 25		Slots (modules) 25–28
26	Module 32		Module 31		Module 30		Module 29		Slots (modules) 29–32
27	Module 36		Module 35		Module 34		Module 33		Slots (modules) 33–36
28	Module 40		Module 39		Module 38		Module 37		Slots (modules) 37–40
29	Module 44		Module 43		Module 42		Module 41		Slots (modules) 41–44
30	Module 48		Module 47		Module 46		Module 45		Slots (modules) 45–48
31	Module 52		Module 51		Module 50		Module 49		Slots (modules) 49–52
32	Module 56		Module 55		Module 54		Module 53		Slots (modules) 53–56
33	Module 60		Module 59		Module 58		Module 57		Slots (modules) 57–60
34	Module 64		Module 63		Module 62		Module 61		Slots (modules) 61–64

Submodule status states:

0 0 = Module OK; valid payload data

0 1 = Module error (check diagnosis)

1 0 = Wrong module (non-matching module ID)

1 1 = missing module (possibly Hot-Plug); module dropped out

7.6.4. Channel-Related Diagnostics

Channel-related diagnostics provide detailed information regarding a module's channel errors and make it possible to report several channel errors for several modules simultaneously. These channel-related diagnostics start after the submodule status. Channel-related diagnostics can be turned on and off with the coupler's parameters (see Section 7.5.1).

Byte	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0	Description
35	1 0		Module slot (slots 0–63)						1st channel-rel. diagnosis
36	0 1 = Input 1 0 = Output 1 1 = Input/Output		Number of channel (0–63)						
37	Channel resolution: 0 0 1 = Bit 1 0 0 = Byte 1 0 1 = Word 1 1 0 = 2 words		Diagnosis ID (see Section 7.6.6)						
38	1 0		Module slot (slots 0–63)						2nd channel-rel. diagnosis
…	…								…

7.6.5. Device-Related Diagnostics

Device-related diagnostics refer either to a diagnostic alarm or to a process alarm. Only one alarm is sent in each diagnostic frame.

Diagnostic alarms

Byte 0: Header byte:
Bits 7, 6 = 0 0: Alarm status (DP-V1) / 1 0: Submodule status (DP-V0)
Bits 0-5 = Length of device-specific diagnosis (max. 12 bytes)

Byte 1: Alarm type 1 = Diagnostic alarm

Byte 2: Module slot (slots 1–n)

Byte 3: Alarm status:
Bit 0 = 1: Error occurred / There is a fault
Bit 1 = 1: Error gone / Fault gone

Byte 4: 0x0D = Coming diagnosis
0x00 = Going diagnosis

Byte 5: PROFIBUS ID number for module (see Section 7.5.3)

Byte 6: Number of diagnostic bytes (equals the number of channels + 1)

Byte 7: Diagnostic ID of module-wide error (see Section 0)

Byte 8ff.: Diagnostic ID for each channel 0–n (see Section 0)

Process alarms (DP-V1 only)

Byte 0: Header byte:
Bits 7,6 = 0 0: Alarm status
Bits 0-5 = Length of device-specific diagnosis (8 bytes)

Byte 1: Alarm type 2 = Process alarm

Byte 2: Module slot (slots 1–n)

Byte 3: Bits 3–7: Sequence number

Bytes 4–7: Module-specific alarm bits (see module manual for details)

Pull-alarm (nur DP-V1)

Byte 0: Headerbyte:
Bit 7,6 = 0 0: Alarm status
Bits 0-5 = Length of device-specific diagnosis (8 bytes)

Byte 1: Alarm type 3 = Pull alarm

Byte 2: Module slot (slots 1–n)

Byte 3: Bits 3–7: Sequence number

Plug alarm (nur DP-V1)

Byte 0: Headerbyte:
Bit 7,6 = 0 0: Alarm status
Bits 0-5 = Length of device-specific diagnosis (8 bytes)

Byte 1: Alarm type 4 = Plug alarm

Byte 2: Module slot (slots 1–n)

Byte 3: Bits 3–7: Sequence number

7.6.6. Diagnostic IDs

PROFIBUS-compliant diagnostic IDs:

0 = There is no error / The error has been fixed

1 = Short circuit (to GND)

2 = Undervoltage

3 = Overvoltage

4 = Overload

5 = Excess temperature

6 = Line break / Wire break

7 = Overflow: Value is above measuring range

8 = Underflow: Value is below measuring range

Manufacturer-specific diagnostic IDs:

16 = Power module: Bus supply voltage drop

17 = L+ reference voltage missing

18 = Incorrect parameter configuration *(flashing red LED on module)*

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

7.7. PROFIBUS DP-V1 I&M Data

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

I&M data structures follow the specifications in the "Profile Guidelines Part 1: Identification & Maintenance Functions / Guideline / Version 1.2 / October 2009 / Order No: 3.502" document published by PNO.

7.7.1. Identification Data 0 / Index 1

Identification data	Size	Access	Content	Description
MANUFACTURER_ID	2 bytes	read	0D 5C	Helmholz manufacturer ID
ORDER_ID	20 bytes	read	'600-151-1AA11'	The coupler's order No.
SERIAL_NUMBER	16 bytes	read	'100001'	The coupler's serial number
HARDWARE_REVISION	2 bytes	read	00 01	Hardware version 1
SOFTWARE_REVISION	4 bytes	read	56 01 02 00	V1.02.000
REVISION_COUNTER	2 bytes	read	xx xx	Is incremented every time the I&M data is written to
PROFILE_ID	2 bytes	read	F6 00	Generic device
PROFILE_SPECIFIC_TYPE	2 bytes	read	00 05	Interface module
IM_VERSION	2 bytes	read	01 02	
IM_SUPPORTED	2 bytes	read	00 0F	I&M indexes 1–4 are supported

7.7.2. Identification Data 1 / Index 2

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

7.7.3. Identification Data 2 / Index 3

Identification data	Size	Access	Content	Description
INSTALLATION_DATE	16 bytes	r/w	-	Date of installation
RESERVED	38 bytes	r/w	-	Reserved

7.7.4. Identification Data 3 / Index 4

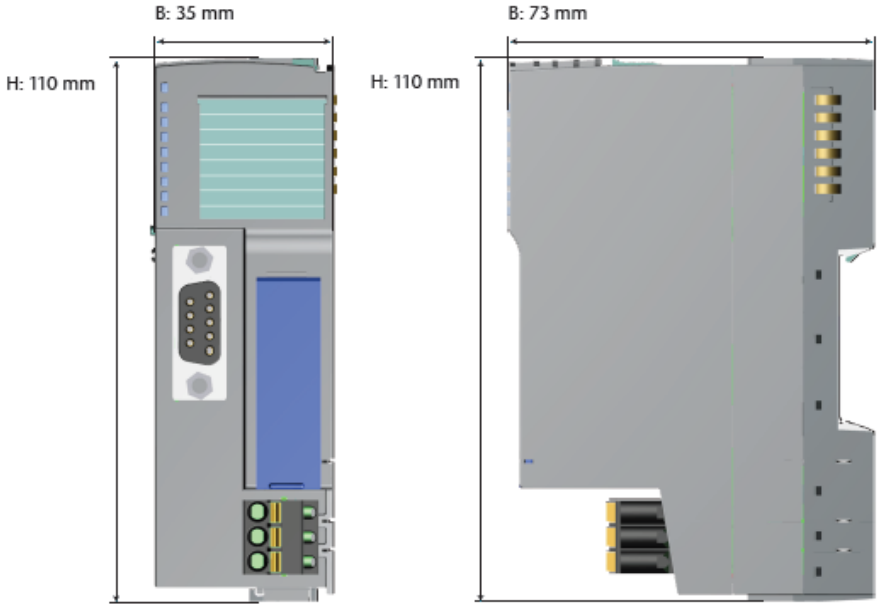
Identification data	Size	Access	Content	Description
DESCRIPTOR	54 bytes	r/w	-	Comment regarding the module

8. Technical Specifications

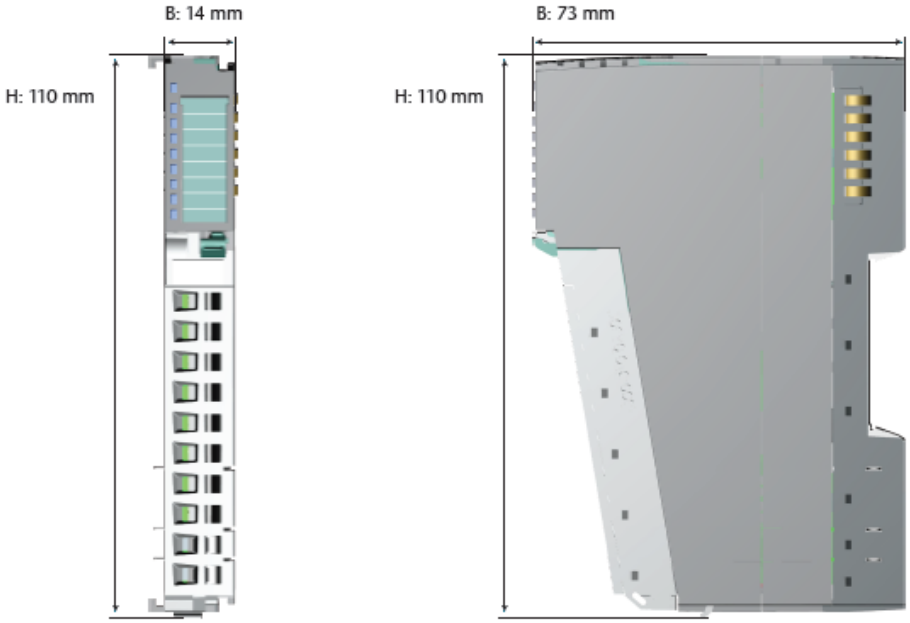
Order No.	**600-151-1AA11**
Module name	PROFIBUS-DP coupler
PROFIBUS interface	
Protocol	PROFIBUS DP-V0 & DP-V1 as per EN 50170
Baud rate	9.6 kbaud to 12 Mbaud, automatic detection
I/O image table size	244 input bytes / 244 output bytes
Parameter configuration length	244 bytes
Interface	RS-485
Connector	9-pin D-sub female connector
USB port	
Protocol	Full-speed USB 2.0 Device
Connector	Mini-USB
Isolation voltage	1.5 kV
Electrically isolation	Yes
Voltage supply	24 VDC, 18–28 VDC
Current draw without modules (internal)	75 mA
Power dissipation	Max. 8 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 pending*
Noise immunity	DIN EN 61000-6-2 “EMC Immunity”
Interference emission	DIN EN 61000-6-4 “EMC Emission”
Vibration and shock resistance	DIN EN 60068-2-8:2008 “Vibration” DIN EN 60068-27:2010 “Shock”
Protection rating	IP 20
Relative humidity	95% without condensation
Installation position	Any
Permissible ambient temperature	0 °C to 60 °C
Transport and storage temperature	-20 °C to 80 °C

9. Dimensions

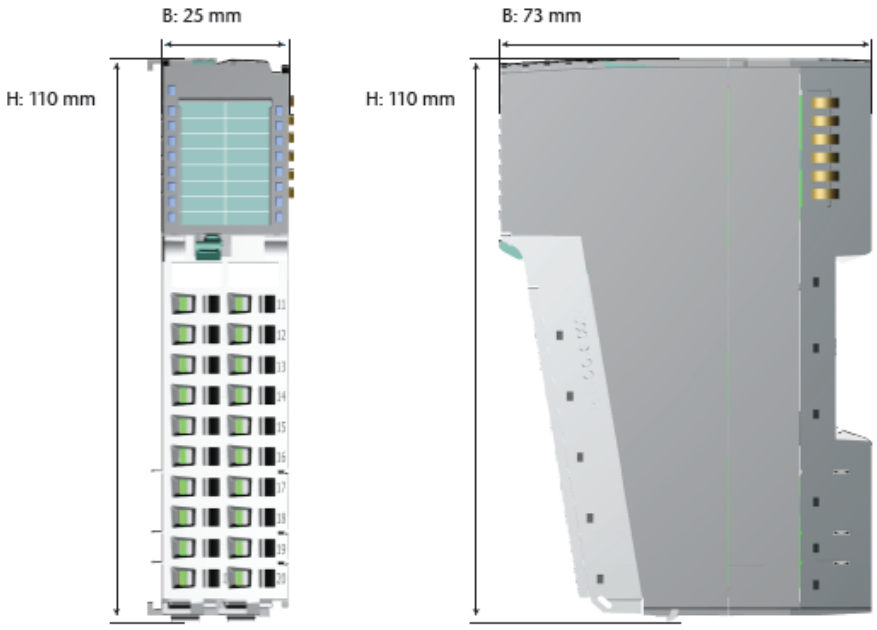
9.1. PROFIBUS-DP coupler



9.2. 14-mm Module



9.3. 25-mm Module



10. Spare Parts

10.1. Base Modules

10.1.1. 14 mm-Width Standard Base Module

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

10.1.2. 25 mm-Width Base Module

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

10.1.3. Power and Isolation Base Module

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

10.1.4. 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.

10.2. Front Connectors

10.2.1. 10-Terminal Front Connector

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

10.2.2. 20-Terminal Front Connector

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

10.3. Electronic Modules

To order spare electronic modules, simply use the order No. for the original product. Electronic modules are always sent as a complete assembly, including the corresponding base module and front connector.

10.4. Final Cover

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