Helmholz
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TB20 – DeviceNet™ Coupler

Manual

Version 2 | 2017-05-29

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Notes

To download the latest version of this manual, please visit our website at www.helmholz.de.

We welcome all ideas and suggestions.

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Revision Record

Version	Date	Changes
1	2017-3-1	First Version
2	2017-5-29	Minor corrections

Table of Contents

1 General

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

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.

WARNING

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 instructions 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 a 35 mm DIN rail.

Communication with a higher-level control system takes place via a bus system / network through a TB20 bus coupler. Up to 64 modules from the TB20 range can be set up on a bus coupler. The bus couplers support hot plug 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 extend beyond the documented options are not permitted and nullify the liability of Helmholz GmbH & Co. KG.

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, installation, 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 injury to the user or third parties, as well as property damage to the control system, the product, or the 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 Overvoltage 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 GmbH & Co. K. 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 GmbH & Co. KG is not liable for damages if these were caused by use or application of products that was improper or not as intended.

Helmholz GmbH & Co. KG 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 GmbH & Co. KG 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 GmbH & Co. KG 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 tele service 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

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

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 64 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

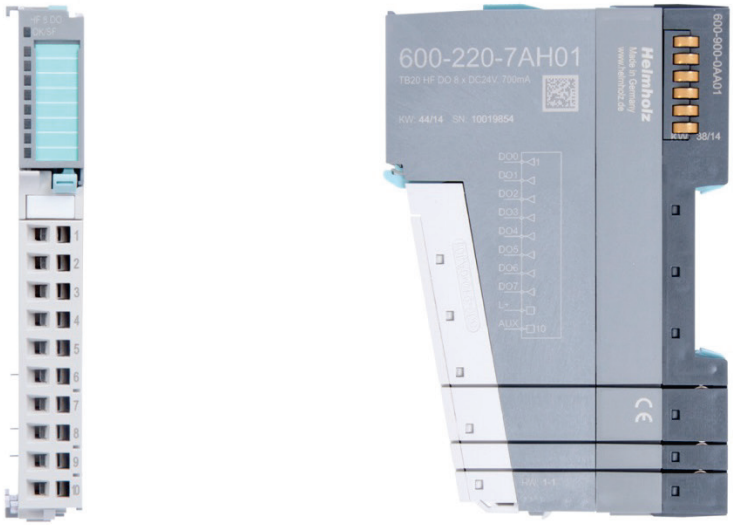
The system's bus coupler includes a bus interface and a power module. The bus interface is responsible for establishing a connection to the higher-level bus system and is used to exchange I/O signals with the automation system's CPU.

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

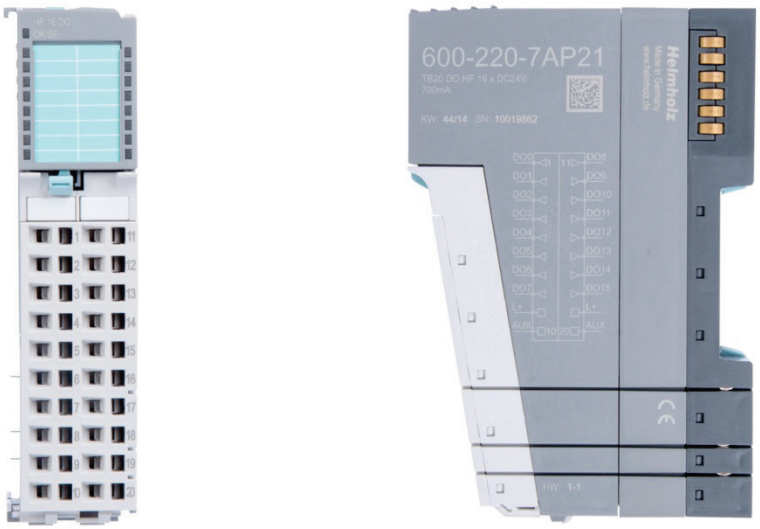
2.2.2 Peripheral modules

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-pin front connector



Example: Peripheral module with 20-pin 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 communications 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.

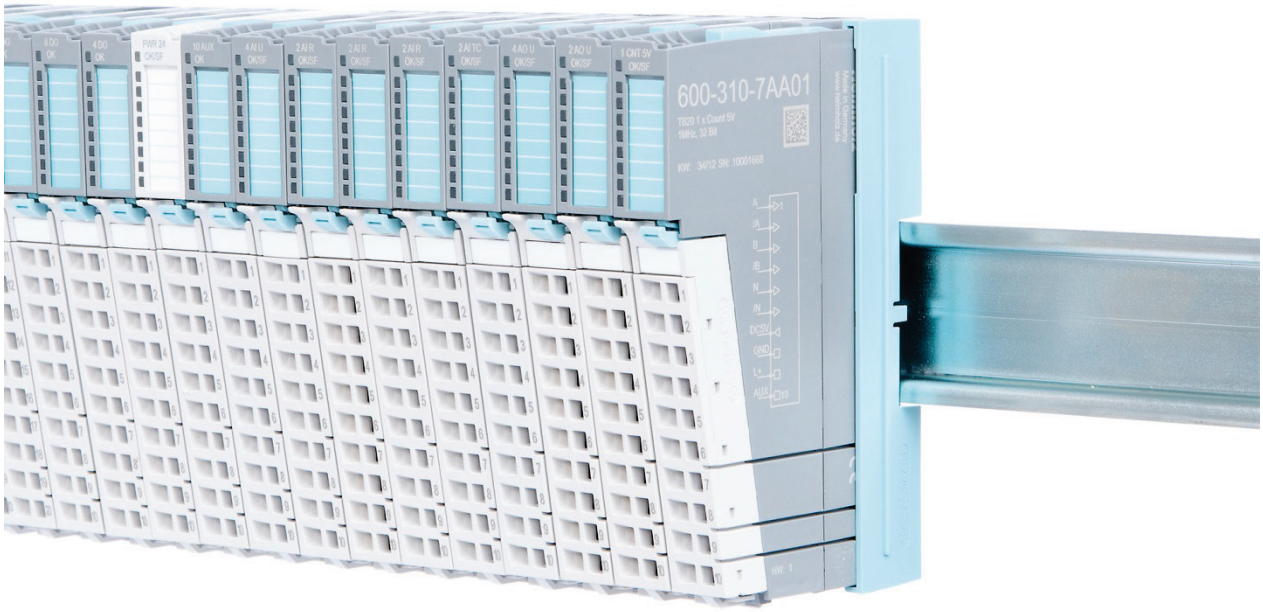
Power modules deliver all necessary power to the peripheral modules connected after them and, if applicable, all the way to the next power module or power and isolation module. A power module is required whenever the power supplied by the coupler alone is not sufficient, e.g., when there are a large 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

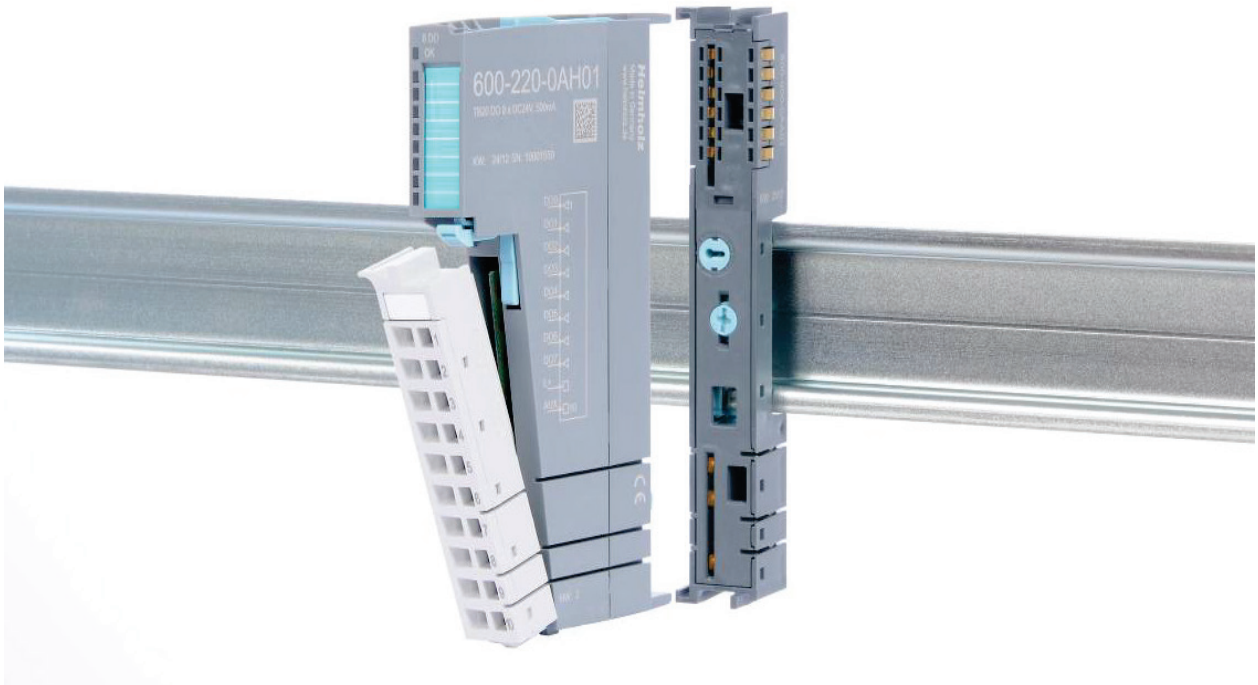
The final cover protects the contacts on the last base module from accidental contact by covering its outer right-hand side.



2.2.6 Components in a module

Each module consists of three parts:

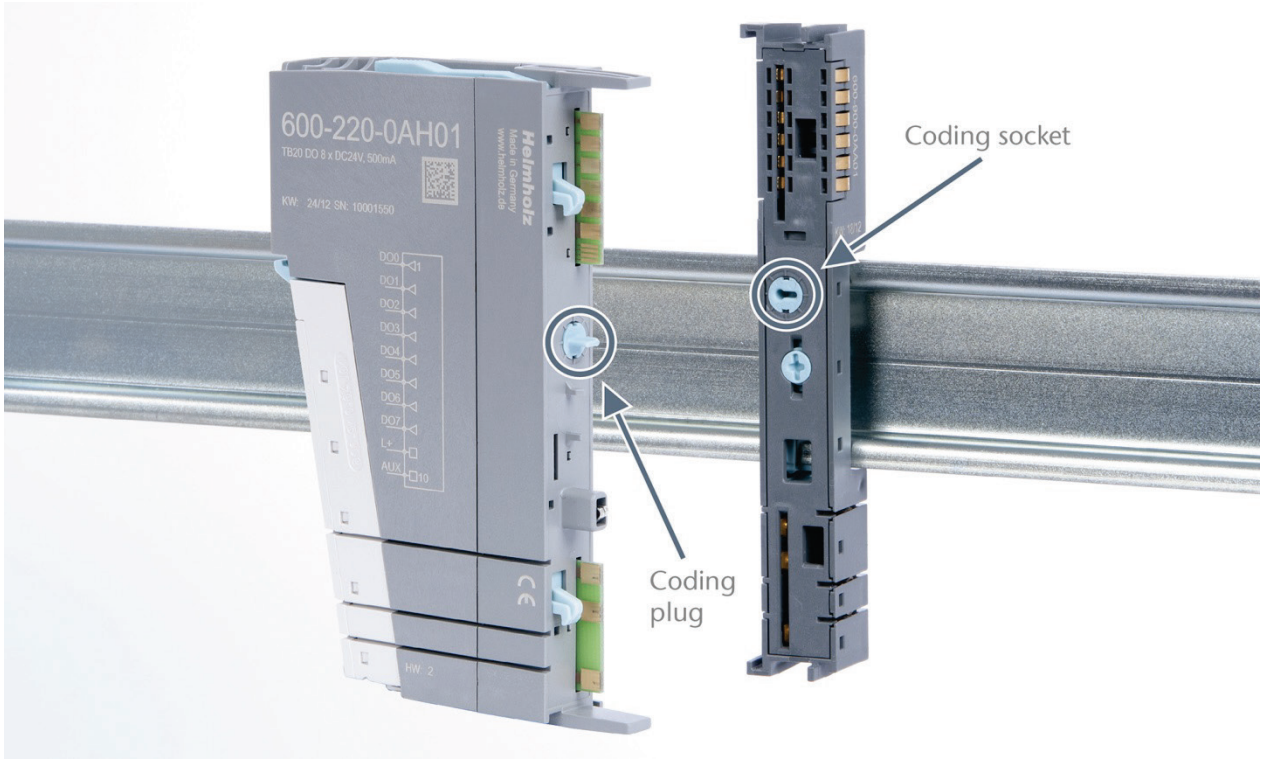
- A base module
- An electronic module
- A front connector



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

HAZARD

TB20 modules can carry lethal voltage.

Before starting any work on TB20 system components, make sure to de-energize all components and 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 will, however, be 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)

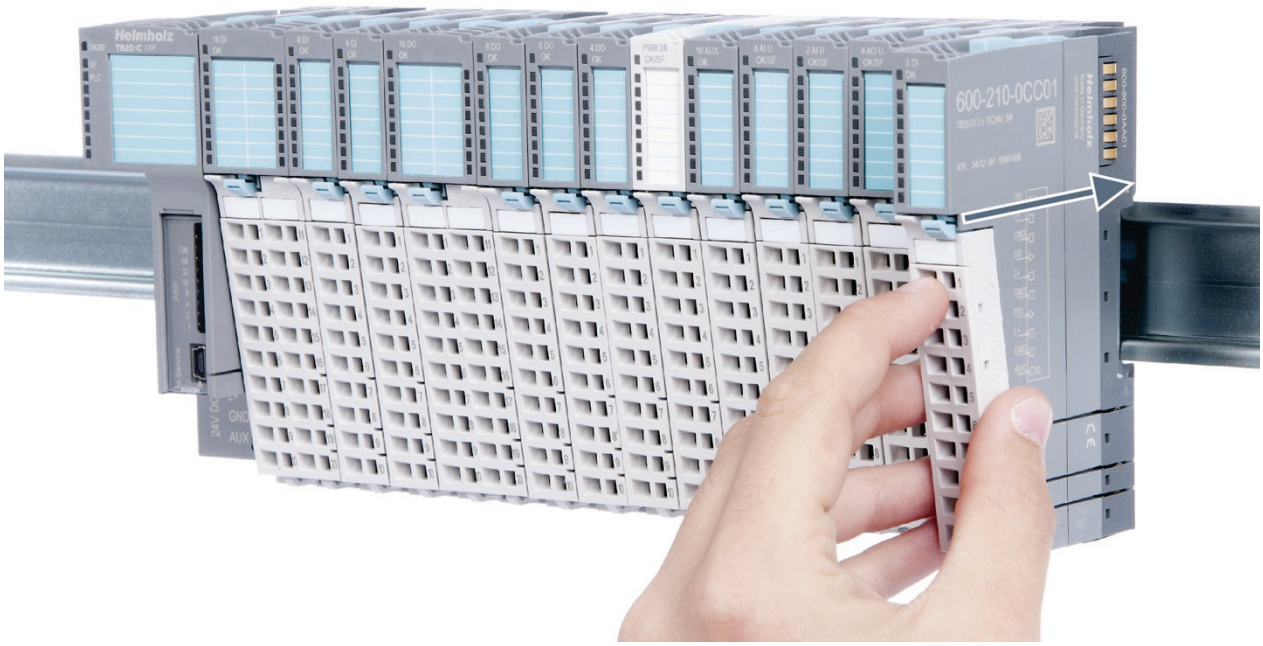
The minimum clearances for mounting TB20 components are: 30 mm on the top and on bottom and 10 mm on each side.

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 15) 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

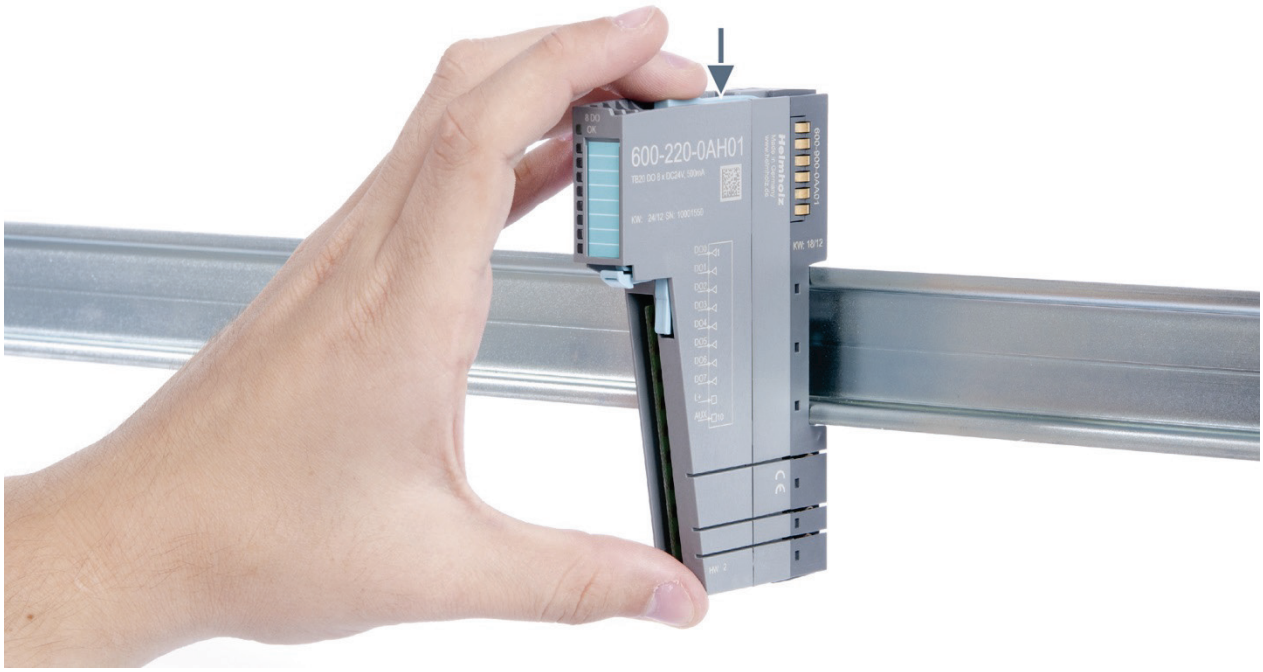
To remove a peripheral module, follow the four steps below:

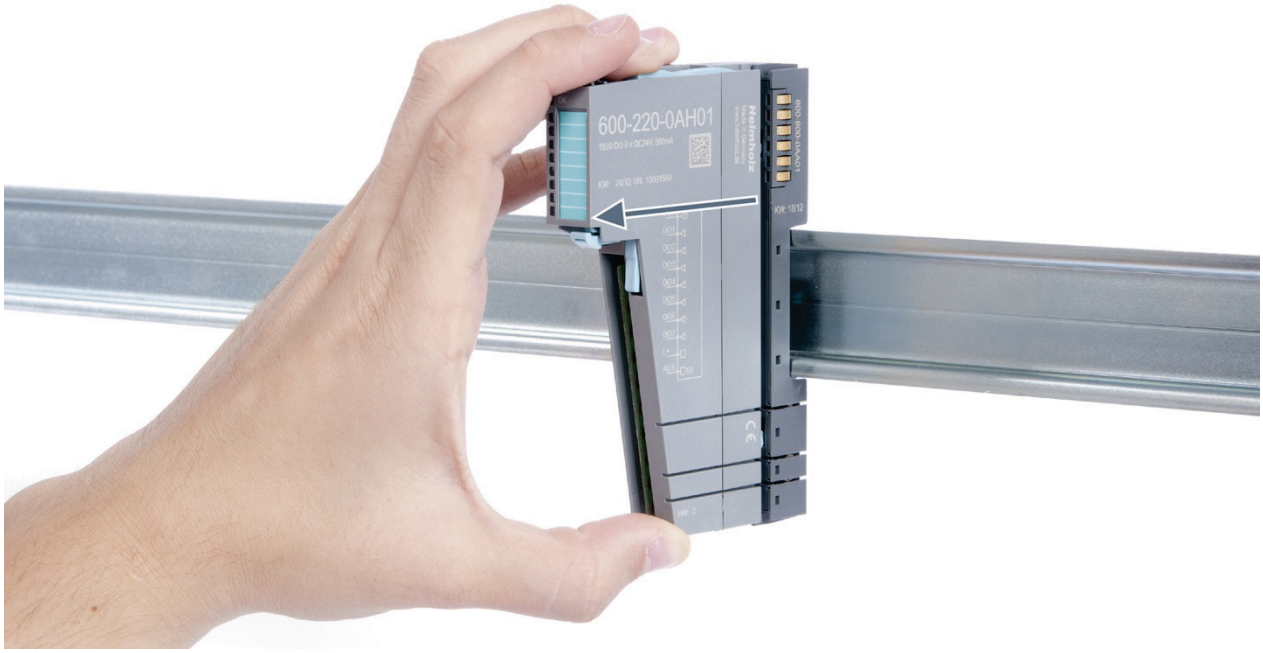
Step 1: Remove the front connector

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

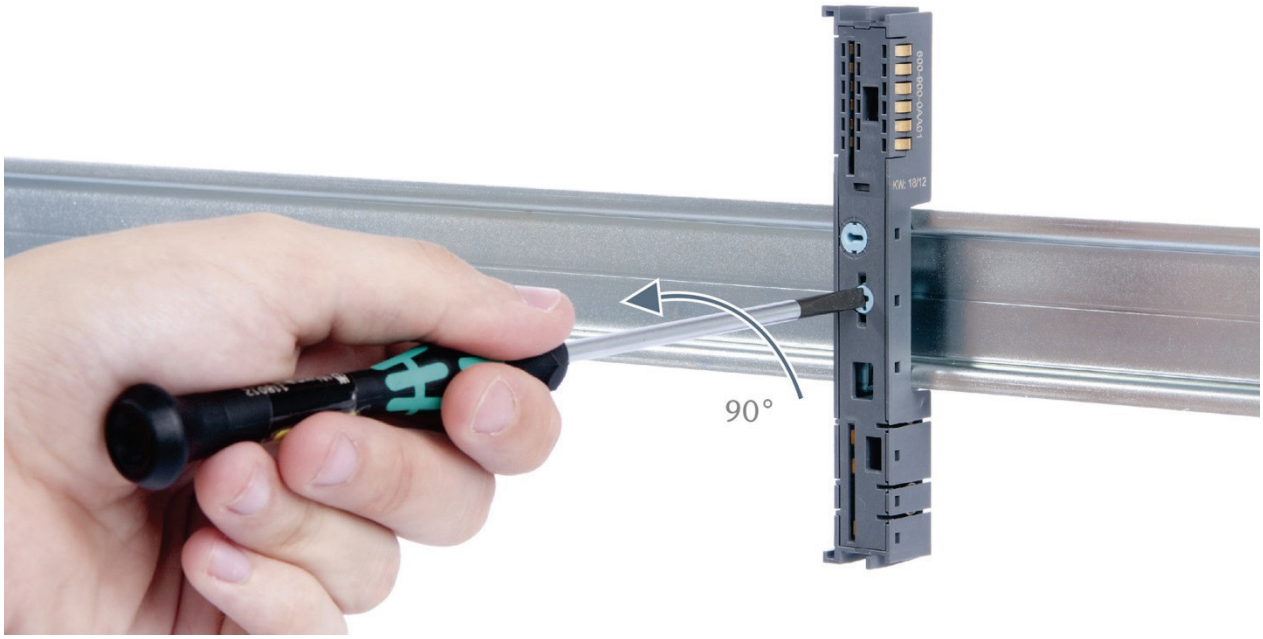
To do so, use your middle finger to push on the lever from above and then use your thumb and index finger to pull out the electronic module while holding the lever down (see the picture below).





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.

TB20 modules can carry lethal voltage.

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

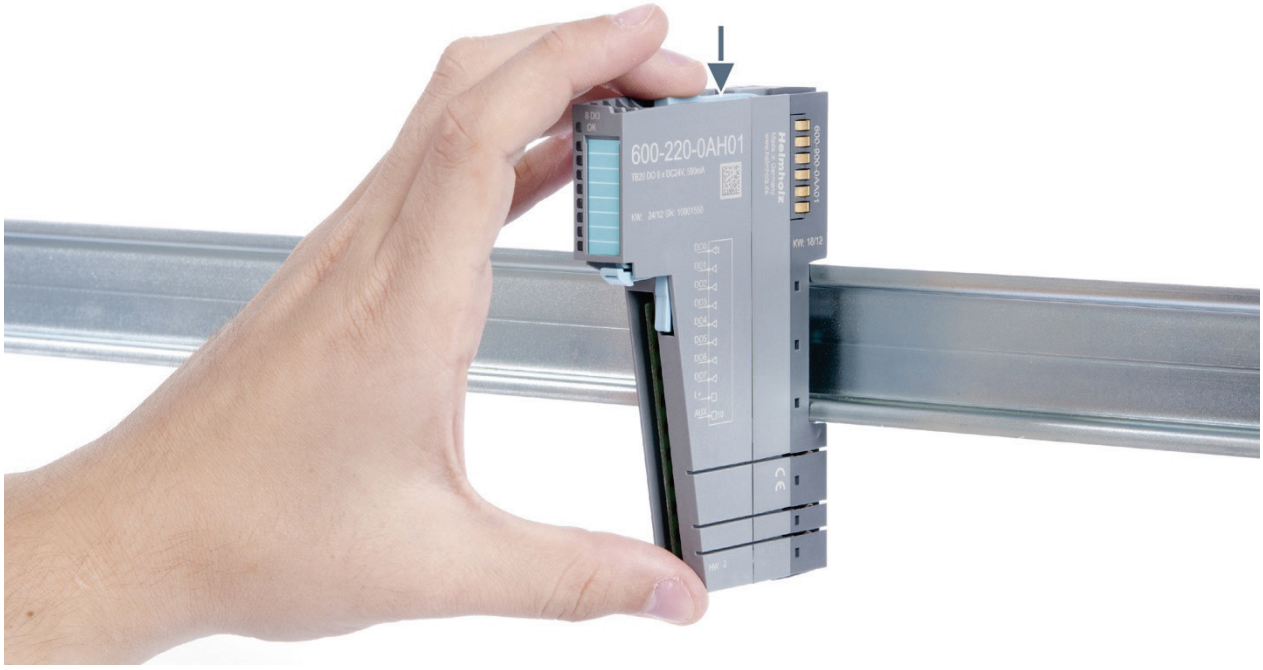
Note the wiring diagram of the system and switch off dangerous voltages before starting work!

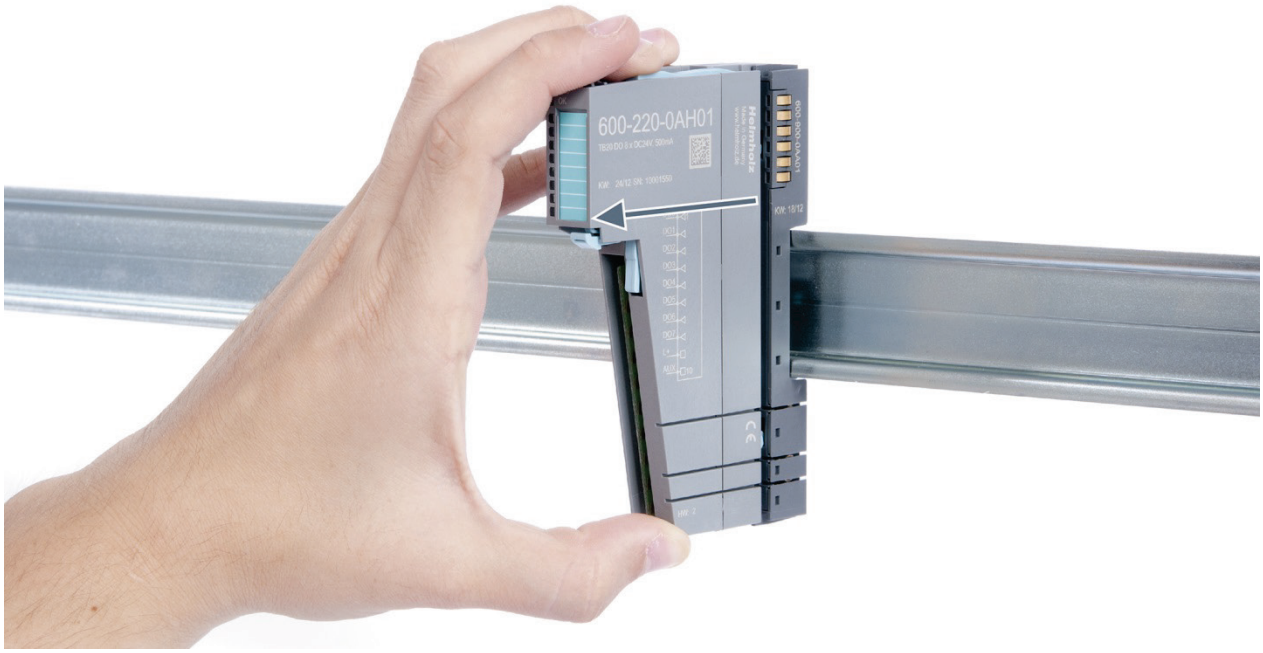
Step 1: Remove the front connector

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

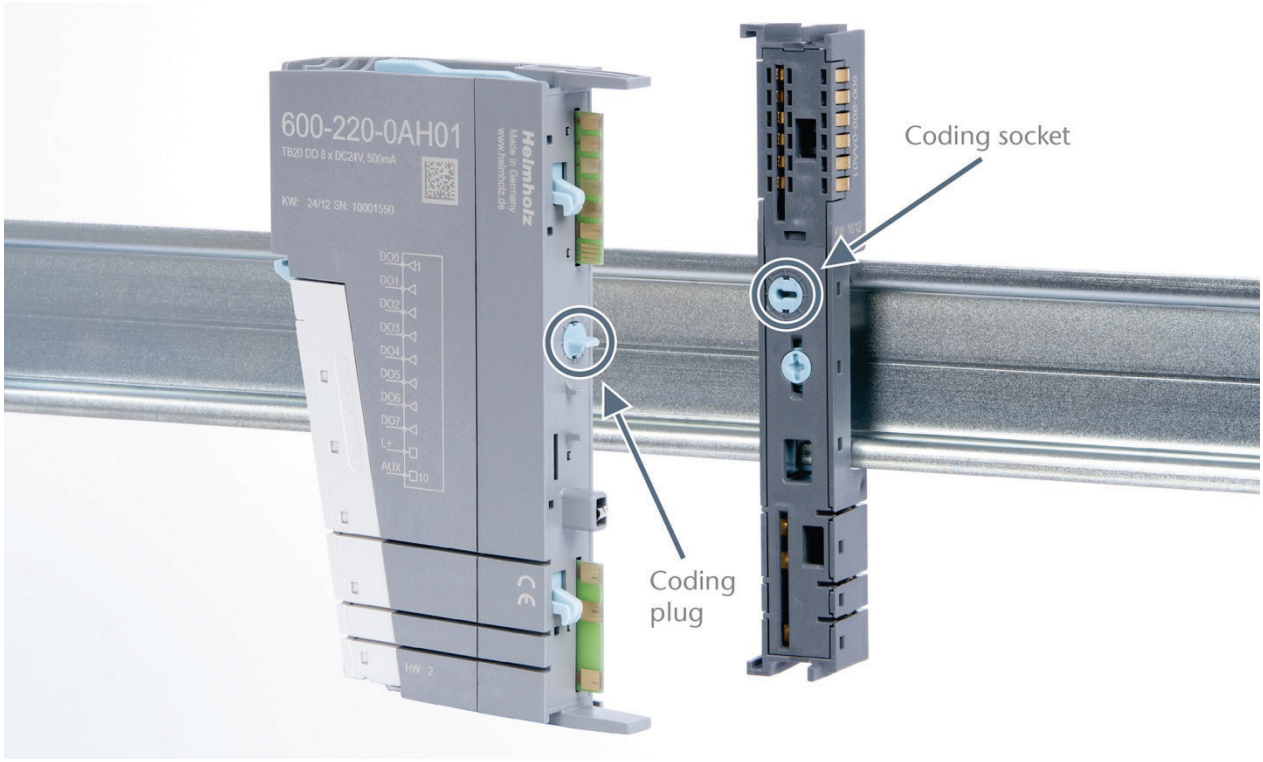
ATTENTION

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.

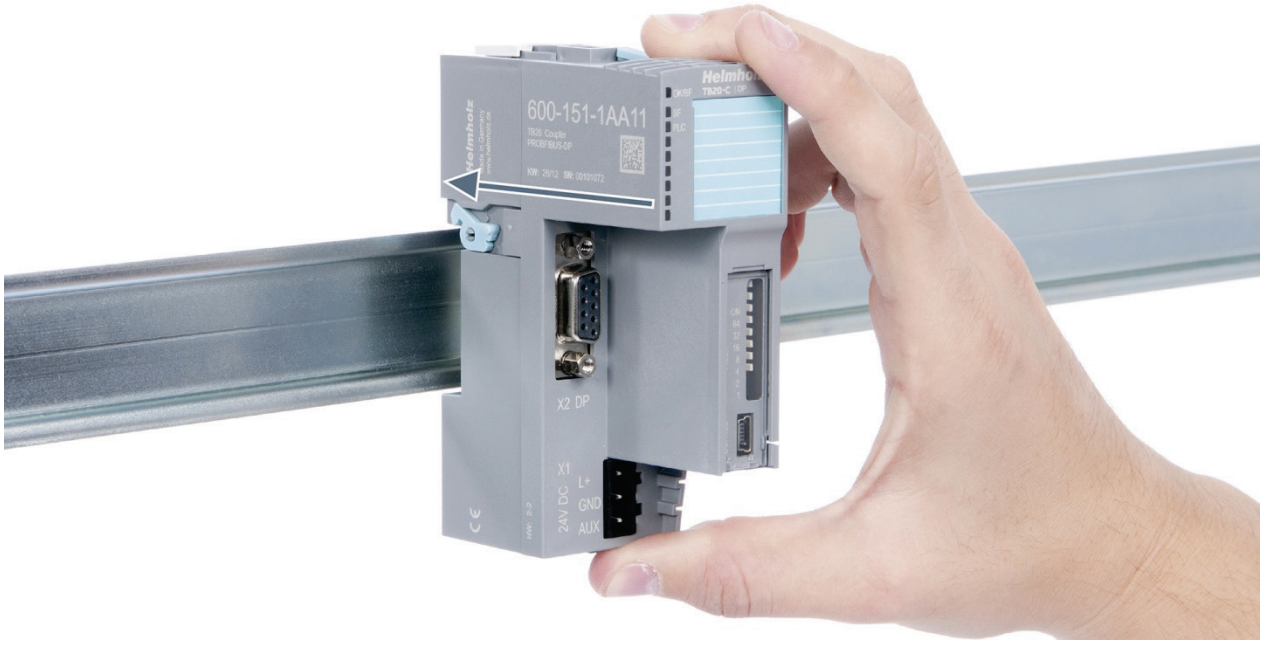


Step 4: Plug in the front connector

3.5 Installing and removing the coupler

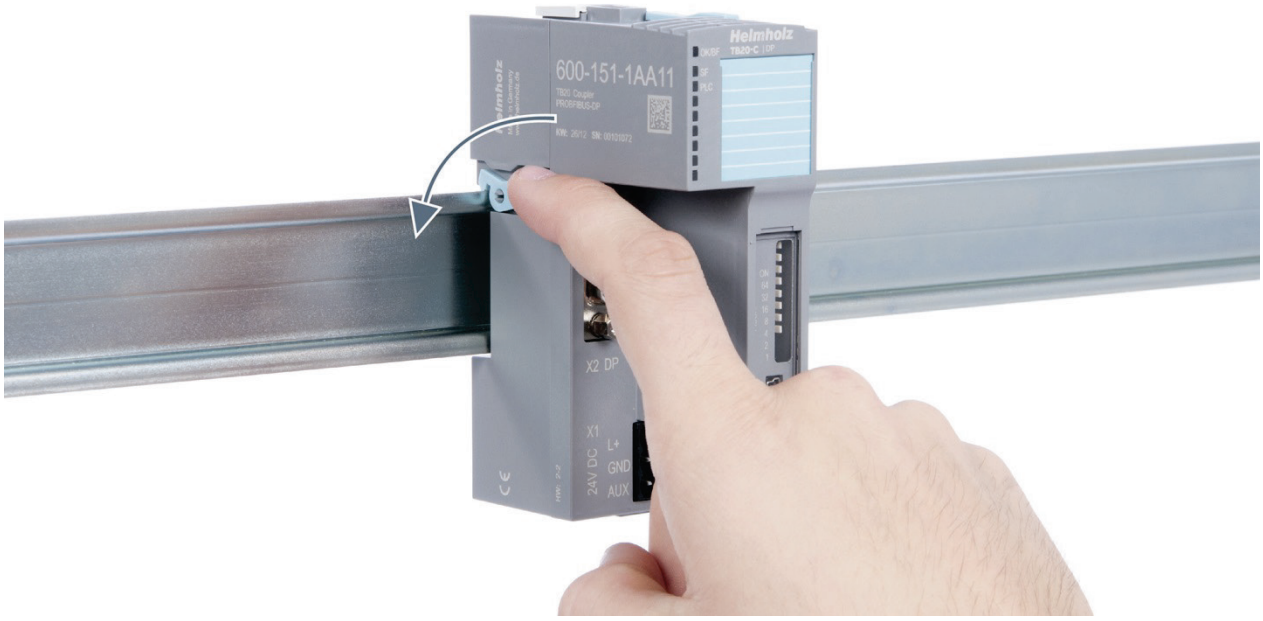
3.5.1 Installation

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

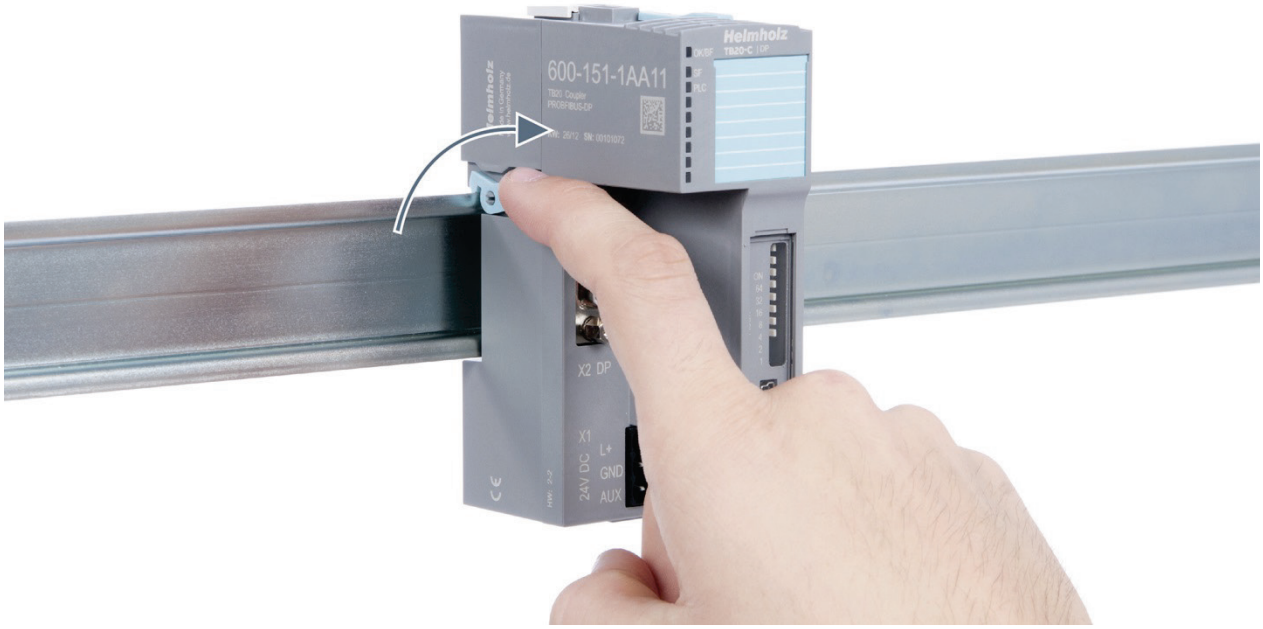
Use the locking lever on the left side of the coupler to lock the coupler into position on the DIN rail.



3.5.2 Removal

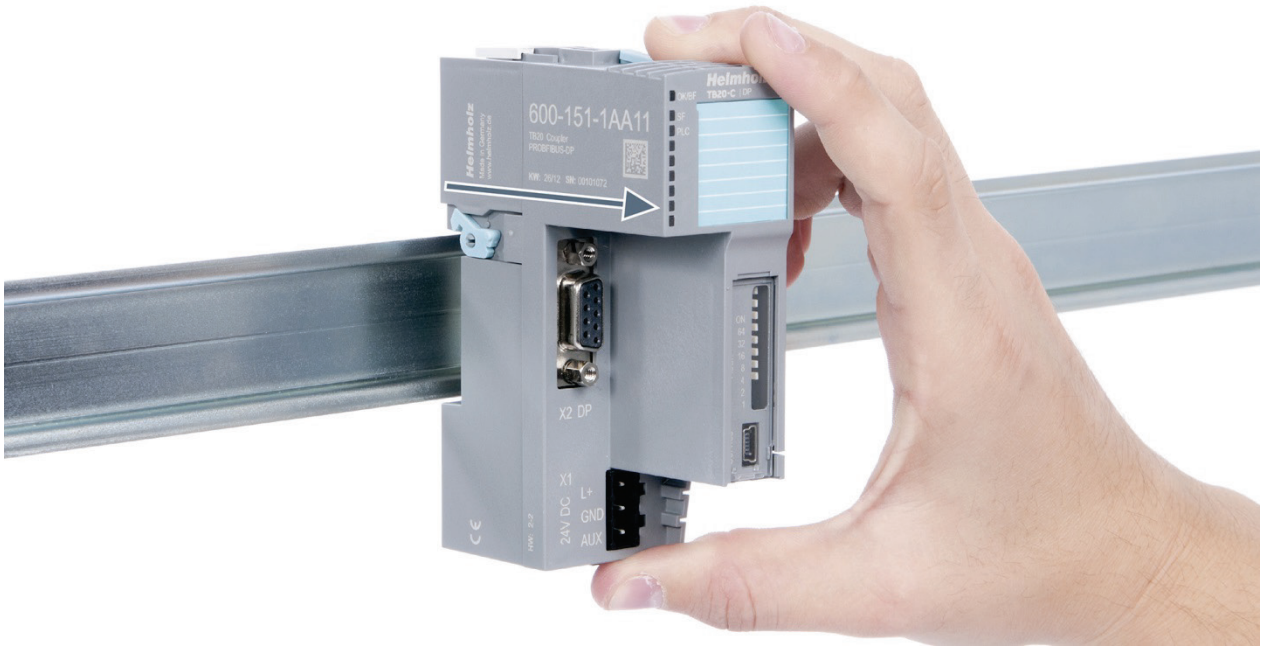
Step 1: Release the locking mechanism

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



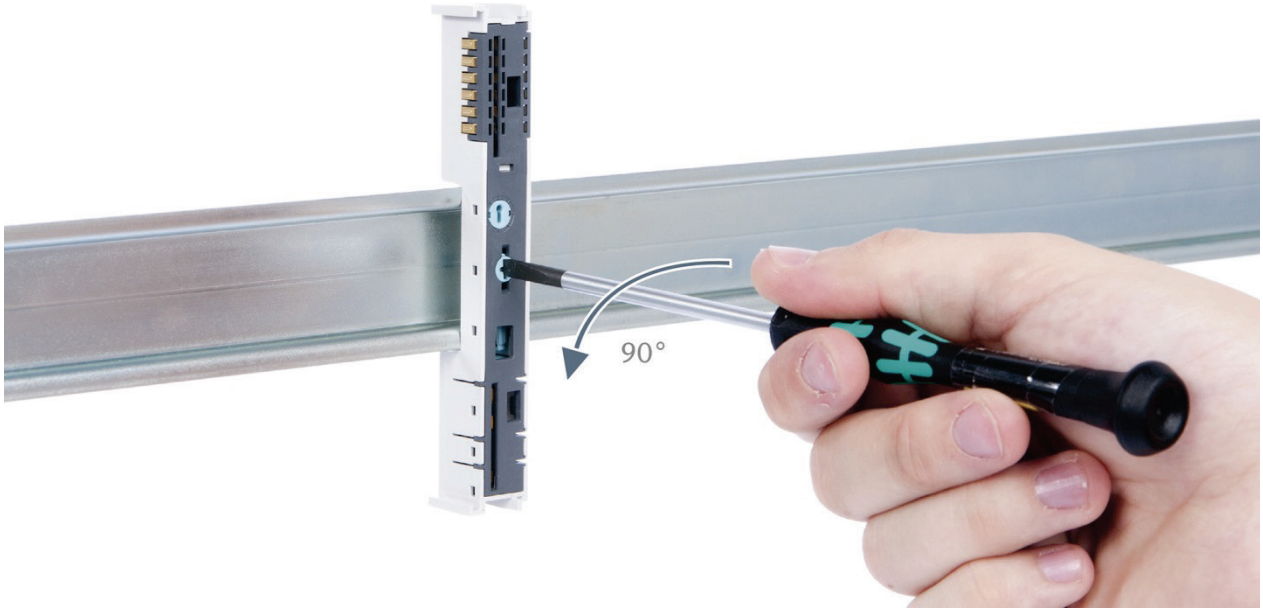
Step 2: Remove the coupler

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.



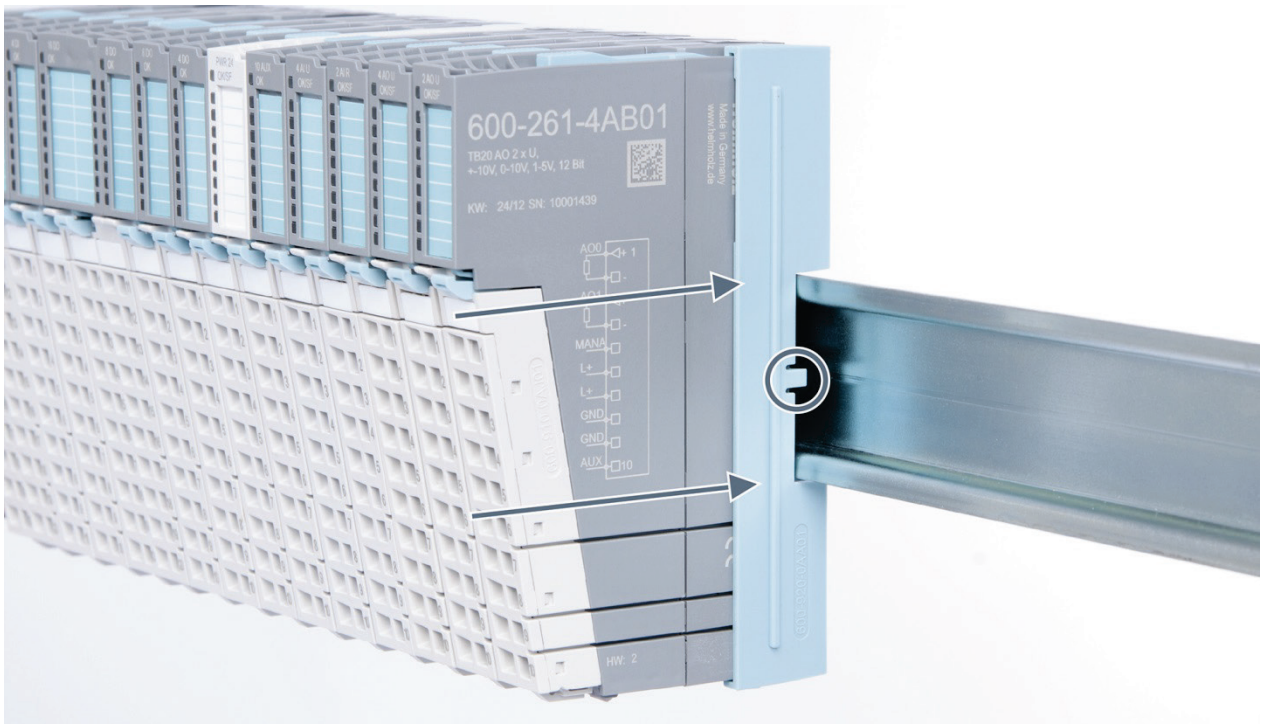
Step 4: Remove the base module

Remove the base module by pulling it towards you.

3.6 Installing and Removing the Final Bus Cover

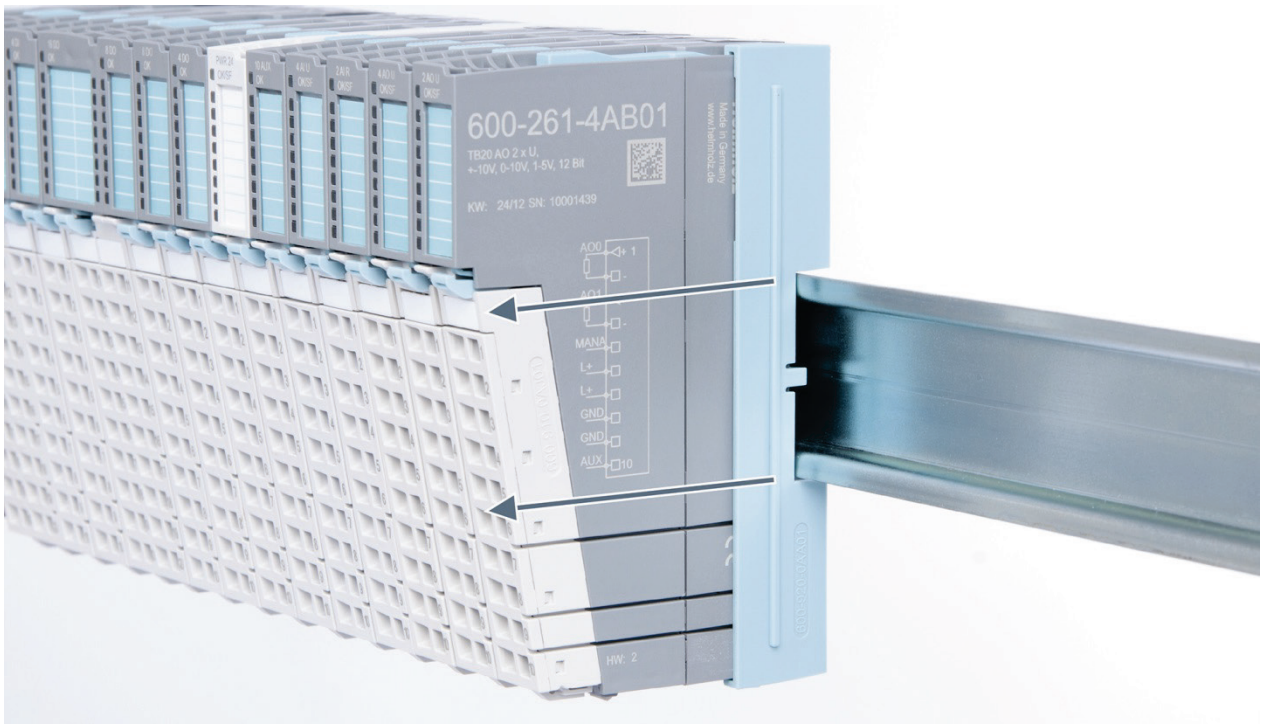
3.6.1 Installation

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 setting up the system and laying the necessary cables, make sure to fully comply with all standards, regulations, and rules regarding shielding (please also consult the relevant guidelines and documents published by the PROFIBUS User Organization). 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:

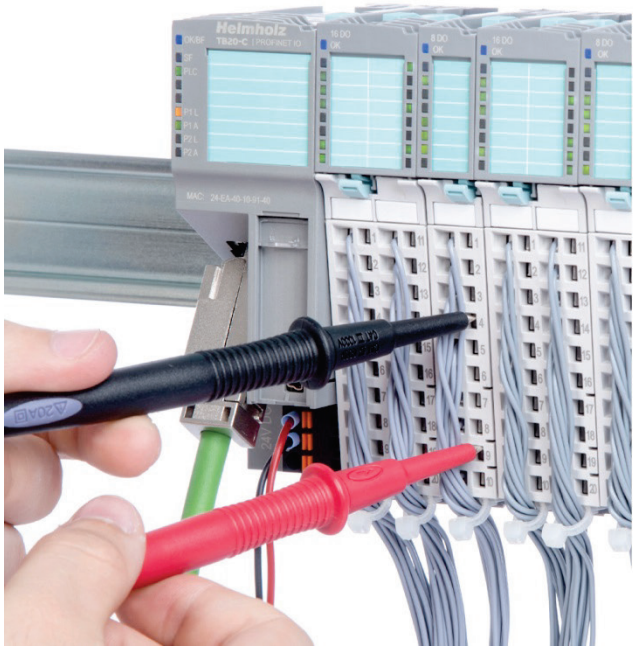
- All metal parts of the cabinet are to be connected with each other over a large area with good conductivity (no paint on paint). Where necessary, use contact washers or serrated washers.
- The cabinet door must be connected to the ground straps (top, middle, bottom) over as short a distance as possible.
- 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 at 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.

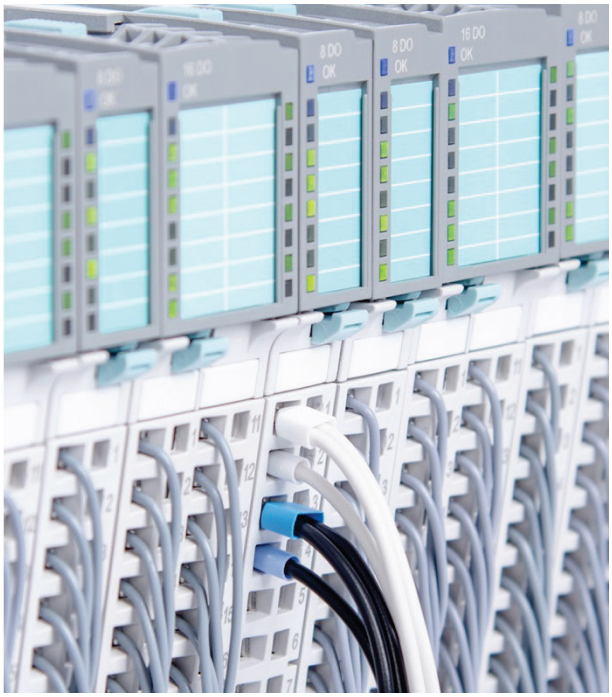
4.2 Front connectors

The front connector's spring-clamp terminals are designed for a cross-sectional cable area of up to 1.5 mm² (16–22 AWG) with or without ferrules.

It is also possible, for example, to connect two 0.75 mm² wires to a single spring-type terminal, provided the maximum cross-sectional cable area of 1.5 mm² 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

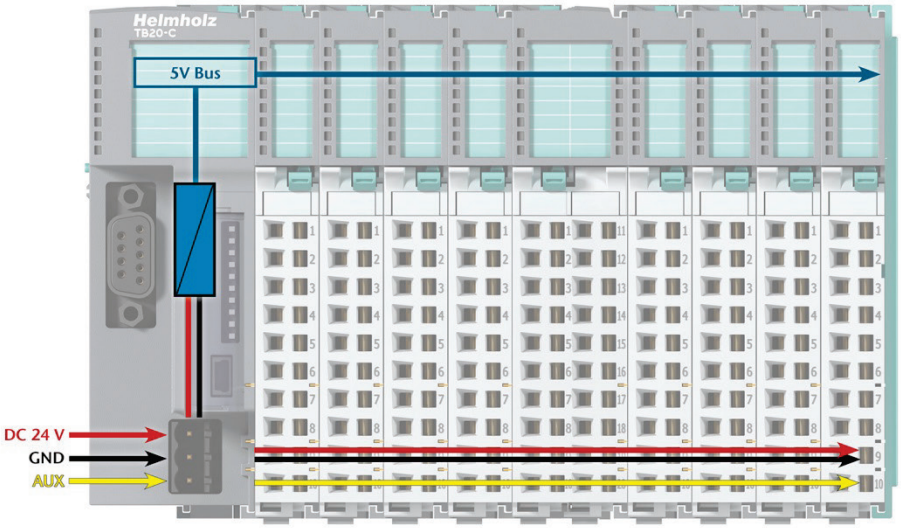
A power supply unit is integrated into the bus coupler. The power supply unit is responsible for powering the peripheral modules connected to the coupler.

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

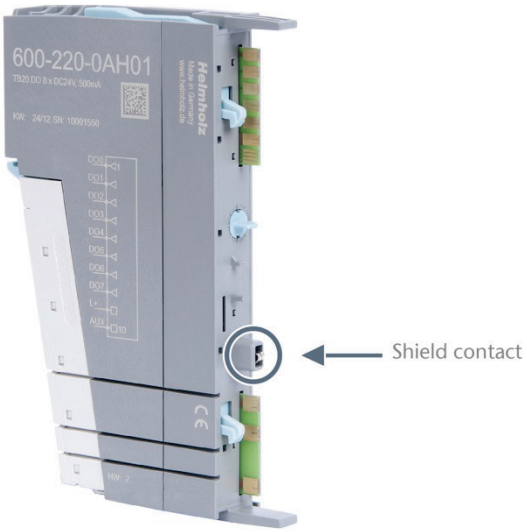
The 24 V connector is used to power two buses:

- 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).

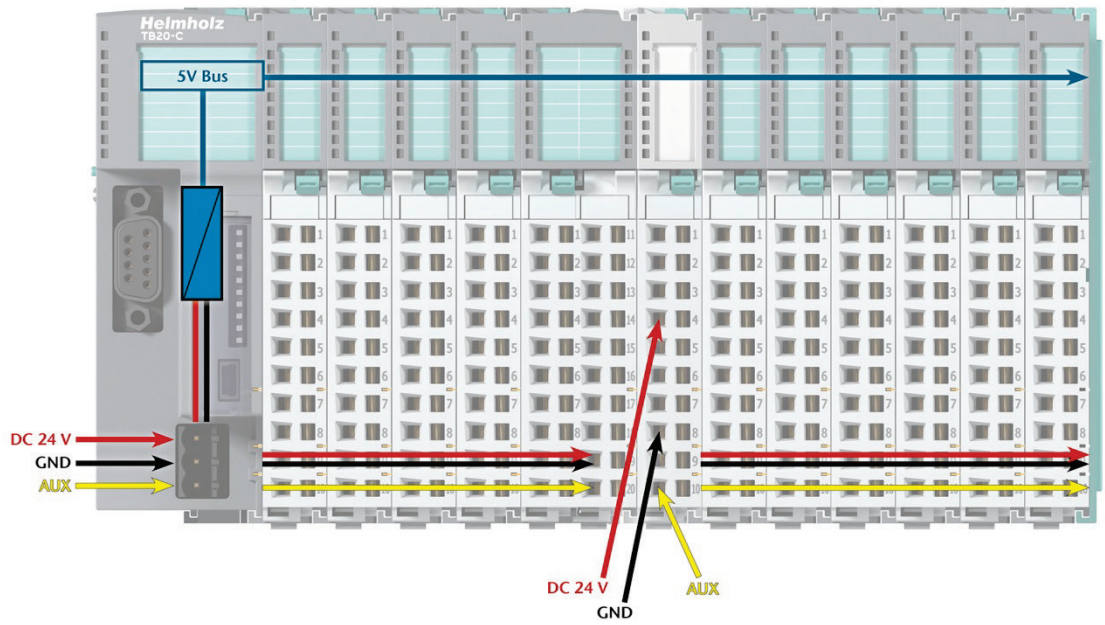


The coupler and the modules are grounded via the shield contact to the DIN rail. The DIN rail must be grounded. The surface of the DIN rail must be clean and conduct electricity well.



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.

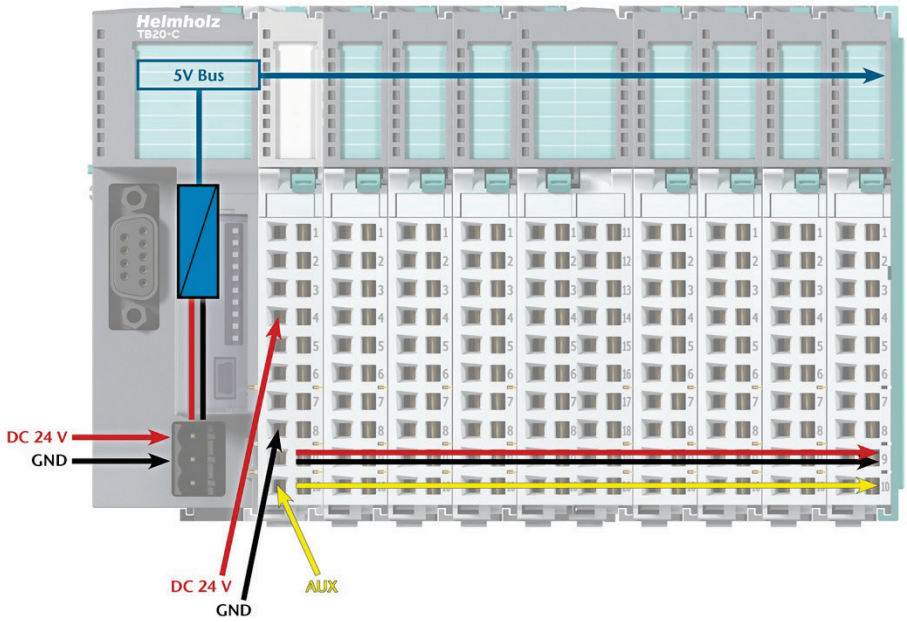


The order no. for the power and isolation module for 24 V signals is 600-710-0AA01.

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

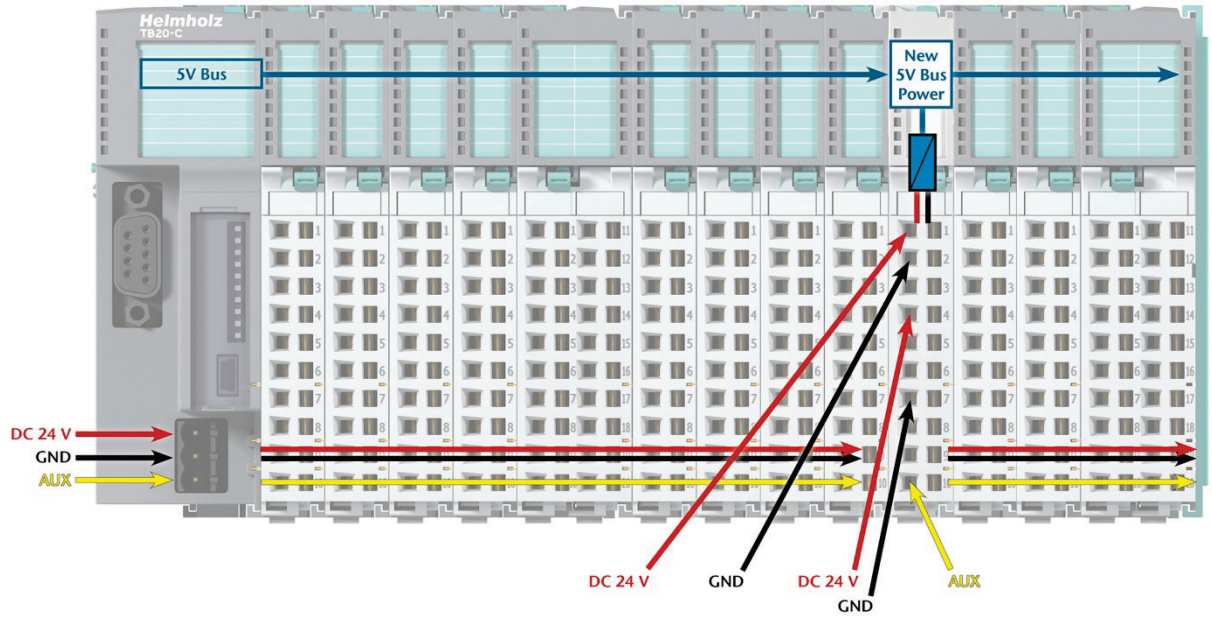
If the power supply for the coupler needs to be separate from the power supply for the I/O modules, a power and isolation module can be used right after the coupler.



4.6 Using power modules

Power modules deliver all necessary power to the 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.

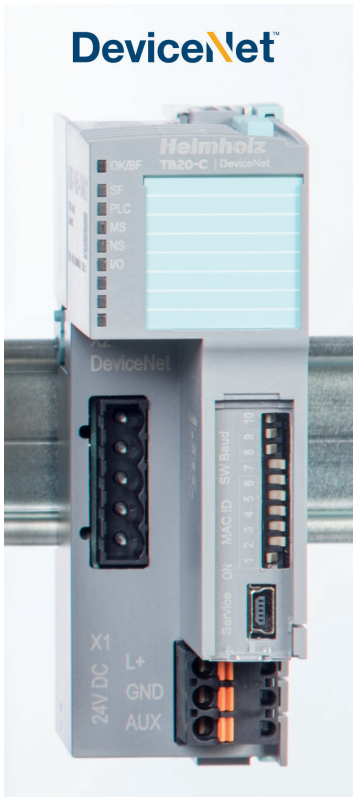
This information can be read in a number of ways, one of which is using the "TB20 ToolBox" configuration and diagnosis software. The modules' electronic nameplates not only make it possible to prevent configuration errors (setup), but also make maintenance (servicing) easier.

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 DeviceNet™ Coupler Characteristics

The TB20 DeviceNet™ coupler has the following characteristics:



- Group 2 Server
- UCMM capable
- Polled, Bit-Strobe, COS/Cyclic connections
- Supports Offline Connection Set, Device Heartbeat and Device Shutdown message
- Software and hardware (DIP switch) settable MAC ID and Baud Rate
- Supports 125, 250 and 500 kbaud
- Up to 64 TB20 modules
- 1024 bytes of input data / 1024 bytes of output data
- 120 bytes of parameter data per module
- With the help of "TB20 ToolBox", modules can be freely configured
- Configuration with Rockwell RSNetWorx© using explicit messaging service possible
- The coupler's state can be read using explicit messaging service
- Supports module diagnostics
- Supports hot-plugging
- 24 VDC power supply
- Features an Open Style Connector
- Integrated power supply unit for powering peripheral modules (2.5 A)
- Supplies the system’s I/O voltage (24 VDC)
- Six LEDs, four of them bi-color (three DeviceNet LEDs and one TB20 specific)
- USB device port for online diagnostics, configuring parameters, setup, and firmware updates with "TB20-ToolBox"
- Reset to factory settings using hidden switch (Factory Reset)

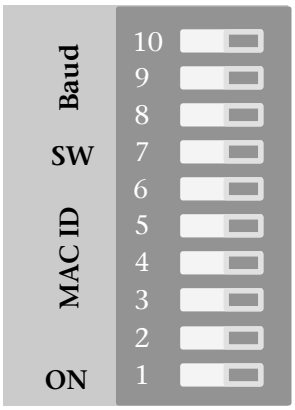
6 Configuration and Use

6.1 Using DIP switches

Coupler's MAC ID and Baud rate can be configured using the DIP switches. Thereafter a restart of the coupler is necessary

The MAC ID is configured by using seven DIP switches – the order of the switches is bottom up. Six of the switches (labeled "MAC ID") are used for setting the numerical value of the MAC ID and seventh switch (labeled "SW") is used for enabling the software setting of the MAC ID. This "SW" switch simulates the invalid MAC ID value of 64, which then enables setting the MAC ID from the configuration tool.

Highest possible MAC ID value is 63.



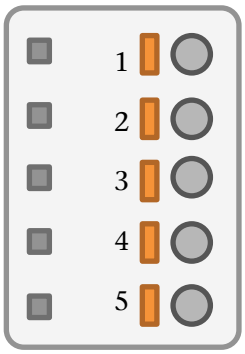
Setting the Baud rate is done by using the DIP switches eight and nine (labeled "Baud").

Switch setting		Baudrate
Switch 9	**Switch 8**	
OFF	OFF	125 Kbaud
OFF	ON	250 Kbaud
ON	OFF	500 Kbaud
ON	ON	Baudrate is software settable

6.2 Bus Connector

The DeviceNet™ coupler uses an "Open Style" connector to connect to the DeviceNet™ network.

Since the coupler uses its internal 24 VDC for network power, connecting 24 VDC to pin 1 (V+) is used only for network power detection failure.



Pin	Function
1	V+
2	CAN_H
3	Shield
4	CAN_L
5	V-

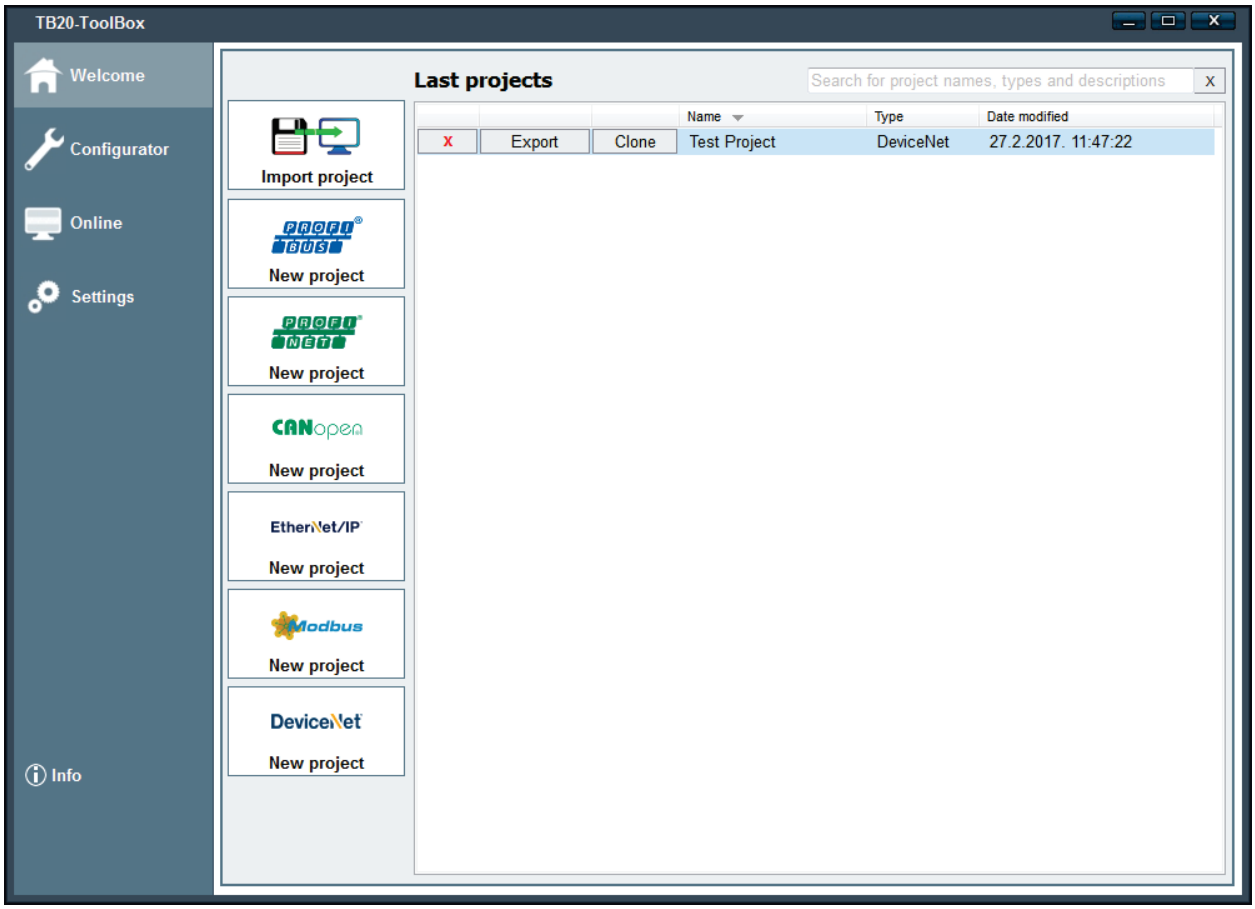
6.3 Using TB20-ToolBox

Helmholz GmbH & Co. KG has designed its TB20-ToolBox program, which is available for free, specifically for setting up, configuring parameters and diagnosing TB20 I/O systems.

The software's latest version is available for download at www.helmholz.de. TB20-ToolBox can be installed on any computer with a Windows operating system (Windows 7 with SP1 or higher, 32-bit/64-bit and Windows 8/8.1/10). Moreover, the installation routine asks for input from the user installing the program, making it possible to set up TB20-ToolBox as necessary for your specific environment. Please note that the program requires at least one enabled USB port.

In order to conveniently configure and update the couplers and monitors, as well as monitor them in real time, you will need a standard USB 2.0 cable (Type A plug to Mini-B plug) with a maximum length of 5 m (not included).

Once you are done installing TB20-ToolBox, you can simply use the corresponding program icon to start the program. When you do so, the project management tool start screen will appear:

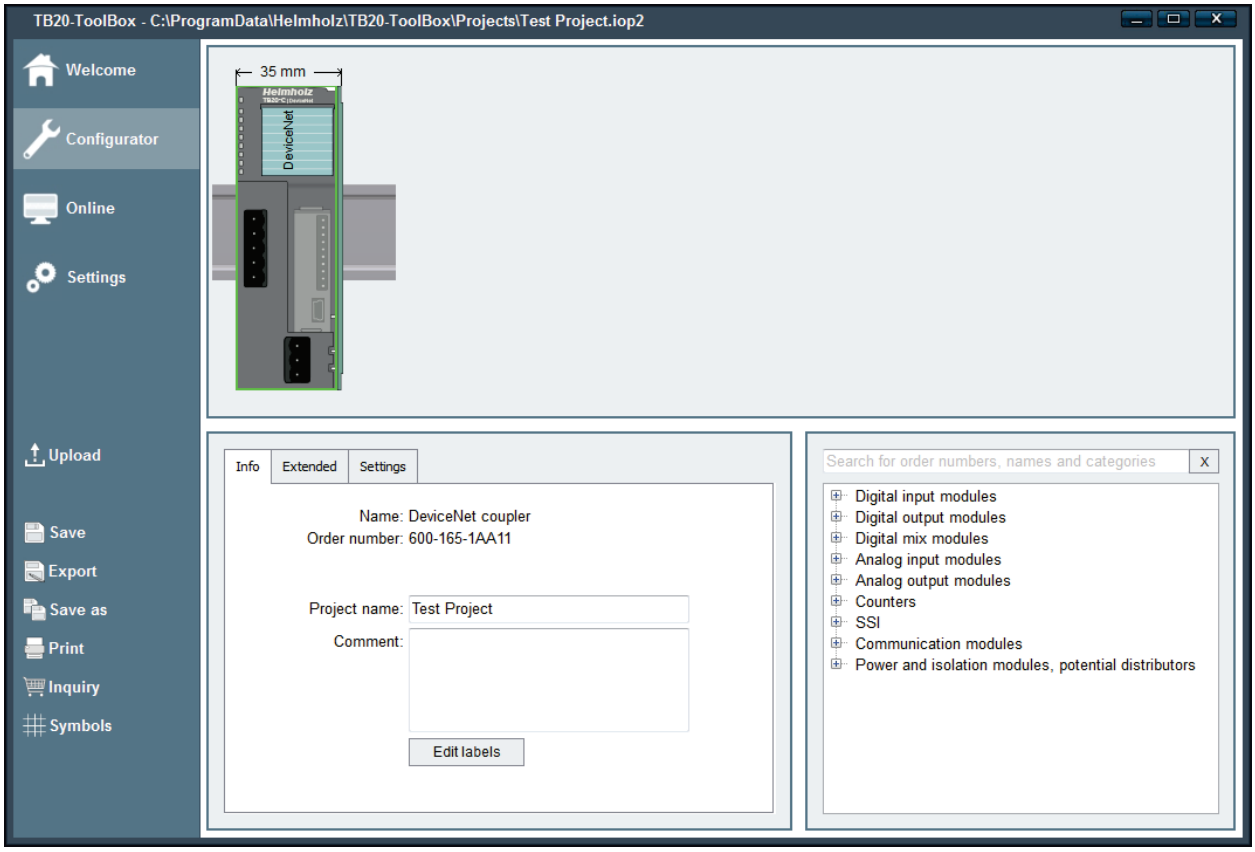


The buttons on this screen can be used to create new projects for the TB20 coupler you want or import an existing project from file.

Each project will be identified with a unique name assigned by the user and can be opened by double-clicking on it in the project selection pane.

6.3.1 Configuration

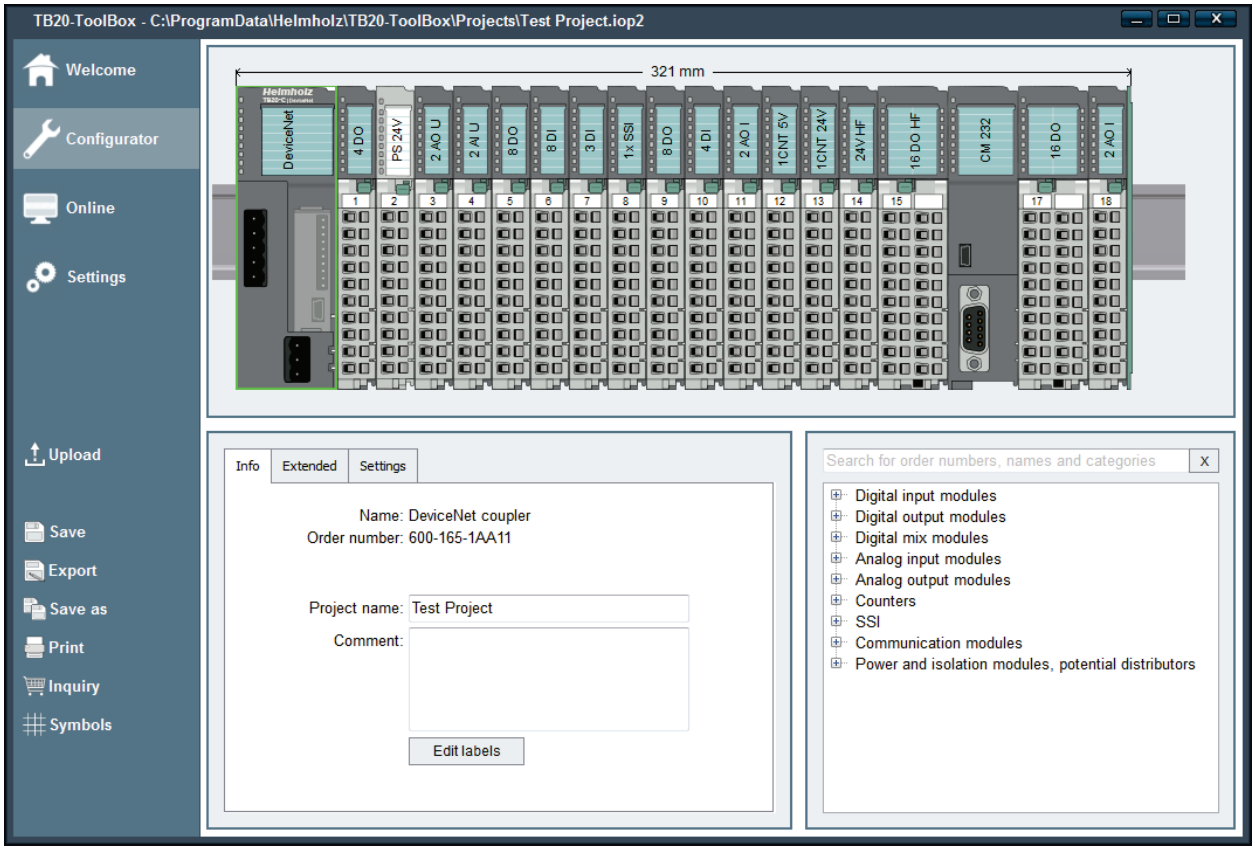
Once you open or create a project, the program will open the configuration screen, which will always start by showing the coupler type you selected previously in the layout pane. In addition, the screen will show an information pane containing a variety of status information on module-specific parameters in the lower left pane. This pane can be used for a variety of purposes, such as clicking on the "Edit labels" button under the "Info" tab in order to access the editing field used to add and edit labels.



Meanwhile, the module catalog pane on the lower right can be used to select the modules that you want to configure and add them to the coupler module by double-clicking on them or dragging and dropping them. Finally, the layout pane can be used to click on any of the modules found in it. Once you click on one of these modules, the information pane will show all the relevant information for that module. Moreover, clicking on the modules will allow you to configure them as necessary.

NOTE

When changing the baud rate using Rockwell RSNetWorx (or any other configuration tool for configuring the coupler over DeviceNet™ bus), the change is immediately shown in the TB20 Toolbox, even though the value are not used until the coupler is restarted.



Once you have configured all the relevant settings for all the modules (e.g., coupler MAC ID, other communication parameters, general and channel-specific module parameters) you can click on "Upload." This will transfer the configuration to the coupler, where it will be stored in non-volatile memory. You can also save the projects' data on the computer or click on "Export" to transfer it to other storage media.

Meanwhile, clicking on "Print" will open a selection field that will enable you to print either the labels you created or documentation concerning the project.

Finally, clicking on "Inquiry" will provide you with a list of all the project components in the form of a CSV file that you can save, print out as a fax form, or send directly to Helmholz sales team by e-mail.

Because of the specific handling of the DeviceNet™ object instance during initialization, there is a situation where the behavior concerning uploading parameters from the Toolbox might not seem intuitive.

Example:

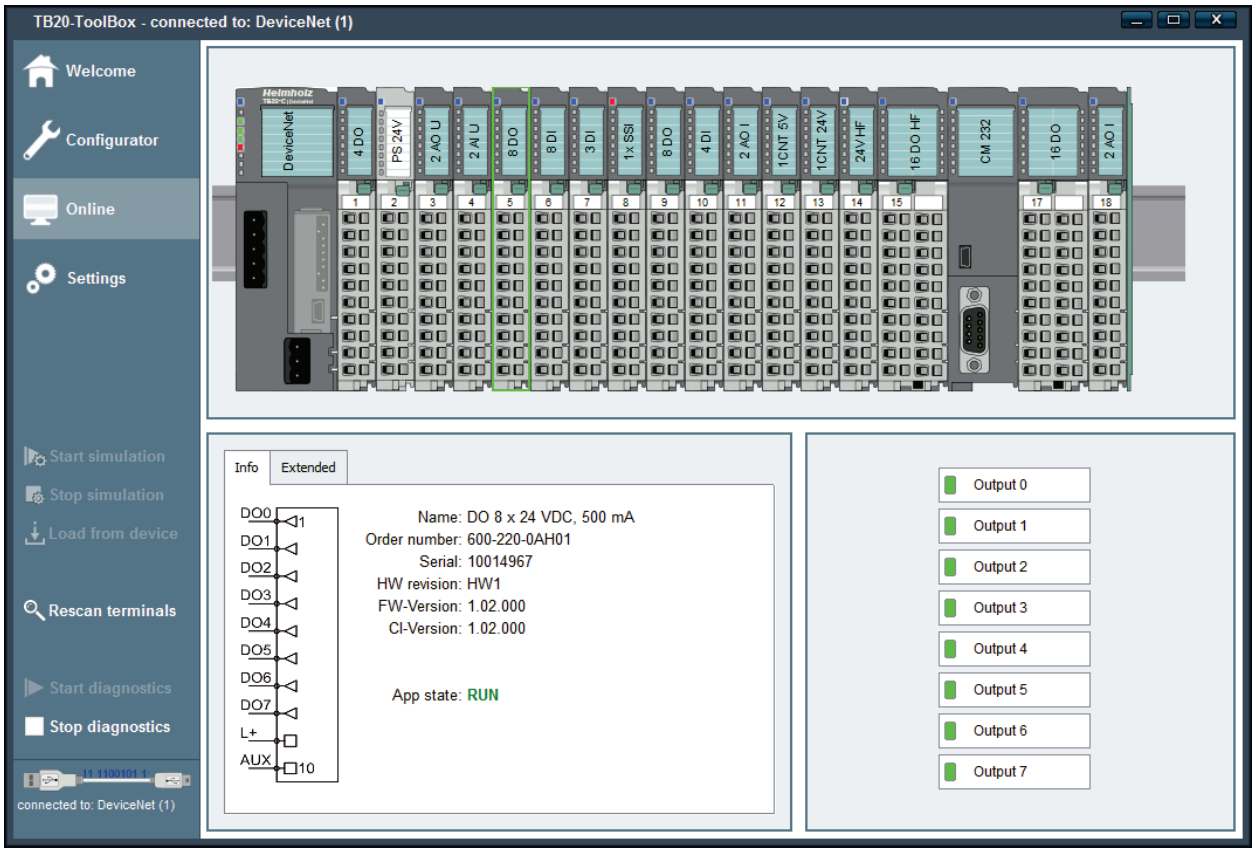
1. A configuration was loaded with the Toolbox, including 500 Kbaud for a network running with 500 Kbaud.
2. The coupler is started with baud rate switches set to 0x01 (250 Kbaud.)
3. The coupler is now restarted again with baud rate switches set to 0x3 (set by SW), but still has 250 Kbaud.

This is because, during DeviceNet™ object instance initialization, if the baud rate switch has a valid value it is immediately stored on the coupler's EEPROM and used next time the coupler starts up. This behavior is defined in the DeviceNet™ specification (Volume 3, 5-4.2.1 & 5-4.2.2).

6.3.2 Real-Time Diagnosis (Online Mode)

The real-time diagnosis function, which can be accessed by clicking on "Online," will become available as soon as the appropriate TB20 hardware is connected to the PC using a USB cable. This function not only provides simulation mode (please refer to 6.3.3) and firmware update (please refer to 6.3.4) options, but can also be used to import the project stored in the module by clicking on "Load from device." If you use this option, you will be asked to give the project a new name and the project will be saved on your computer.

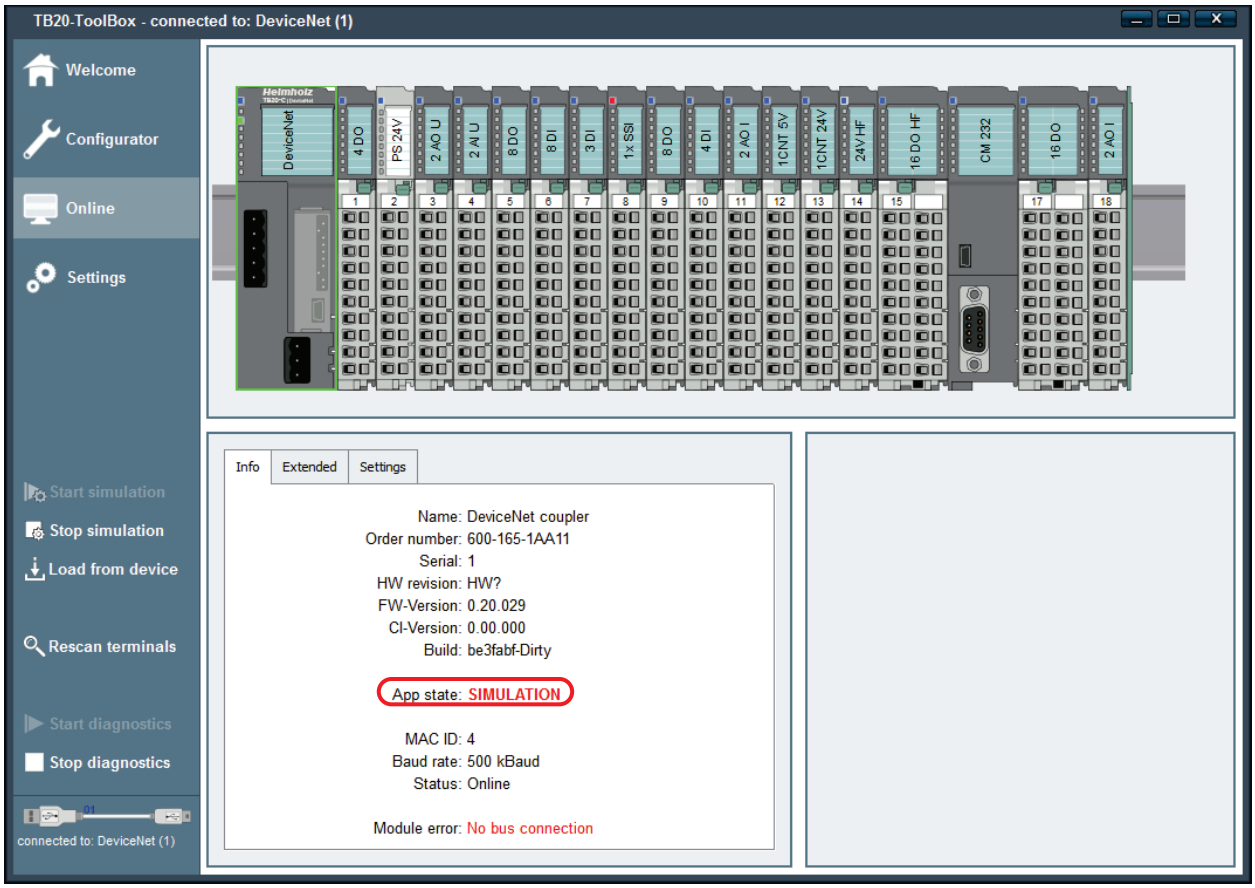
The actual diagnosis can be started and stopped manually. All relevant LED states will be shown visually on the layout view the same way they would appear on the physical devices, i.e., the LEDs will light up and turn off the same way. Once you select a module, the Info pane will display the App status and you will be able to use the I/O diagnostic pane on the bottom right to monitor, for example, individual input/output values or analog states.



6.3.3 Simulation Mode

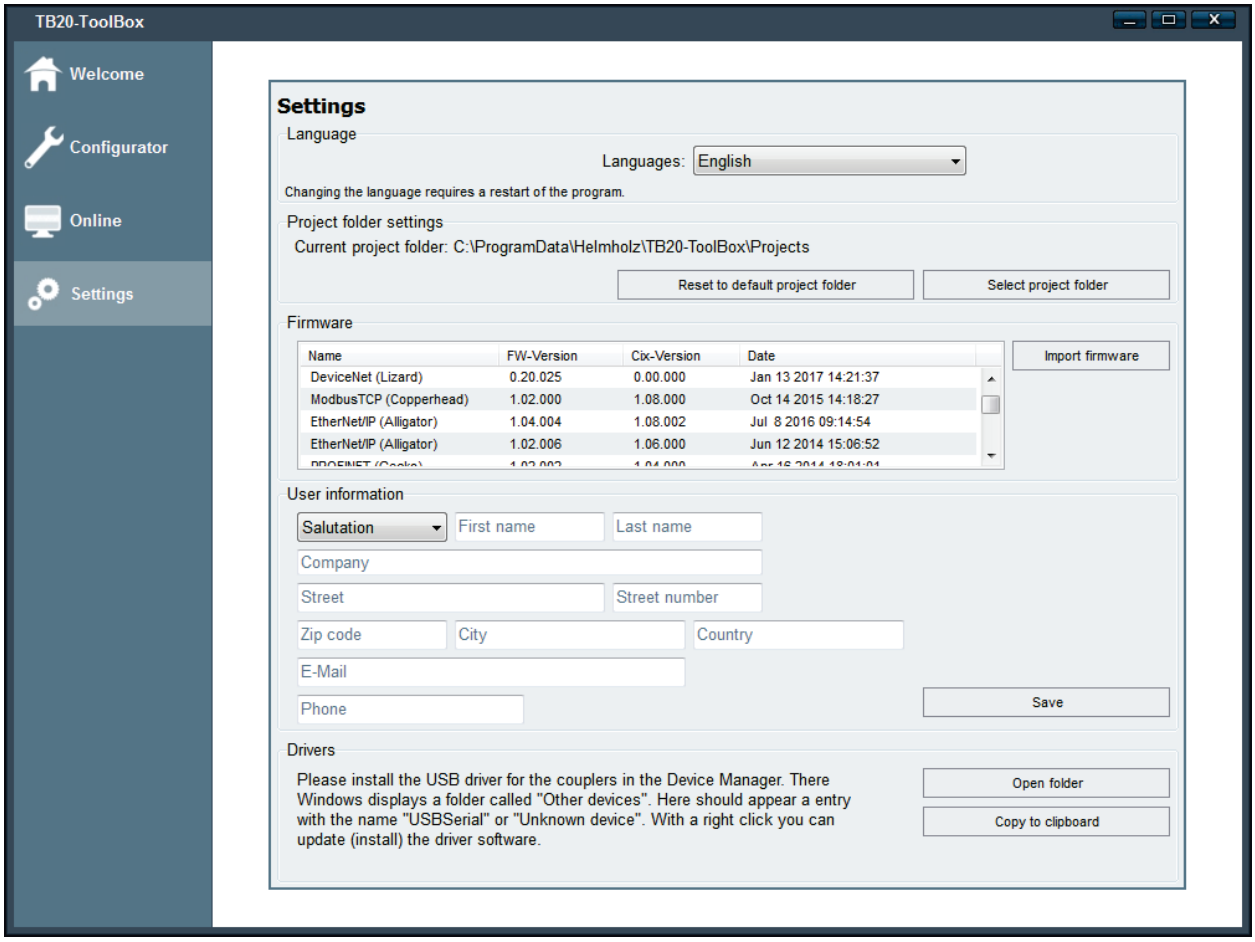
In order to be able to run a simulation, you must be in online mode, the hardware must be connected, and you must explicitly select the coupler by clicking on it. Simulating individual output addresses can come in handy when setting up a system or attempting to troubleshoot an issue. It is also possible to change the module parameters on the fly while in simulation mode, but when exiting the simulation mode the parameters are reverted back to previously uploaded values. To ensure that this does not lead to accidents or malfunctions in the physical system and the higher-level controllers, the TB20 terminal will remove itself from the bus system and TB20-ToolBox will show a message to this effect once the simulation starts.

The status shown in the Info pane will change from "Run" to "Simulation," after which you will be able to test each individual module.

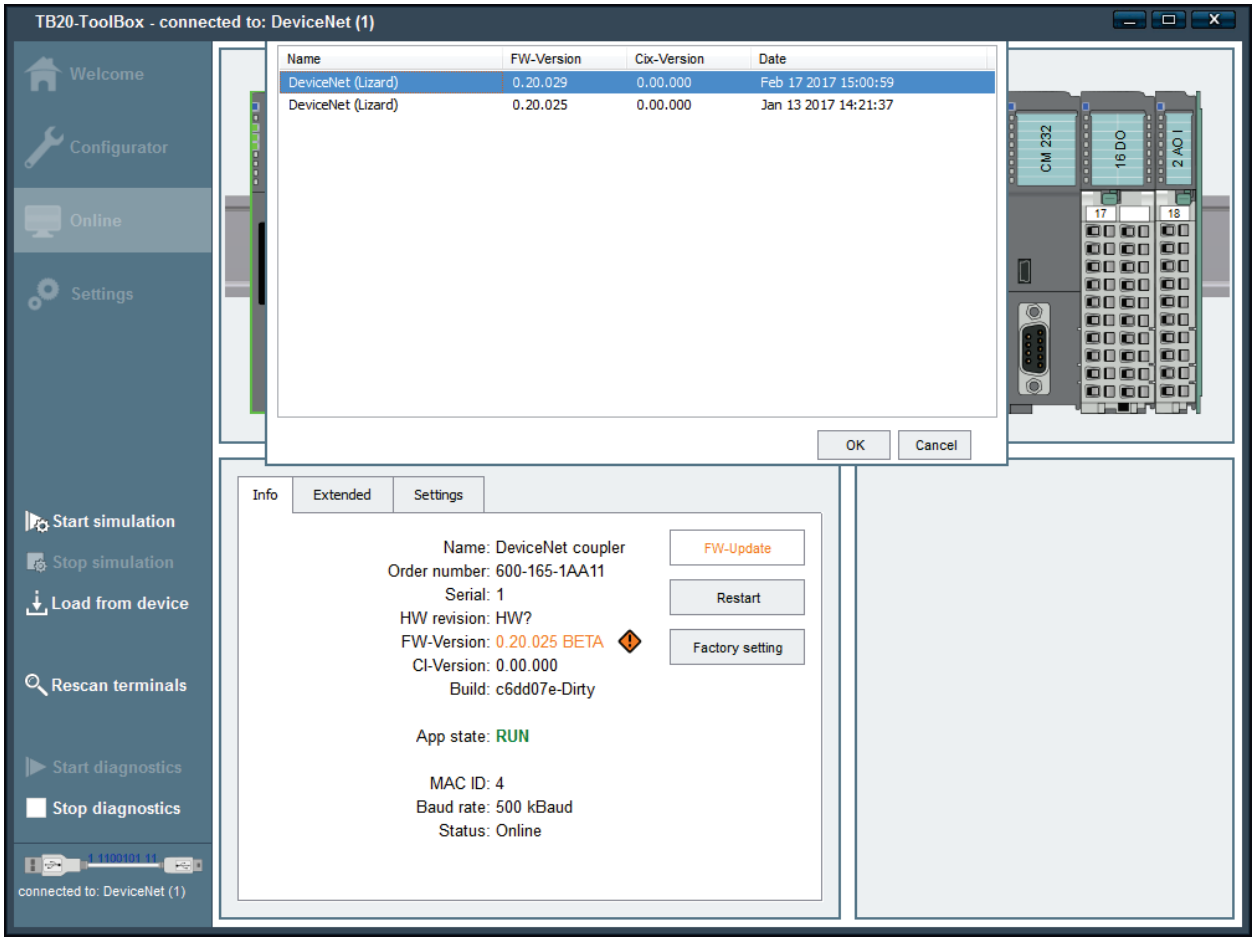


6.3.4 Firmware Updates

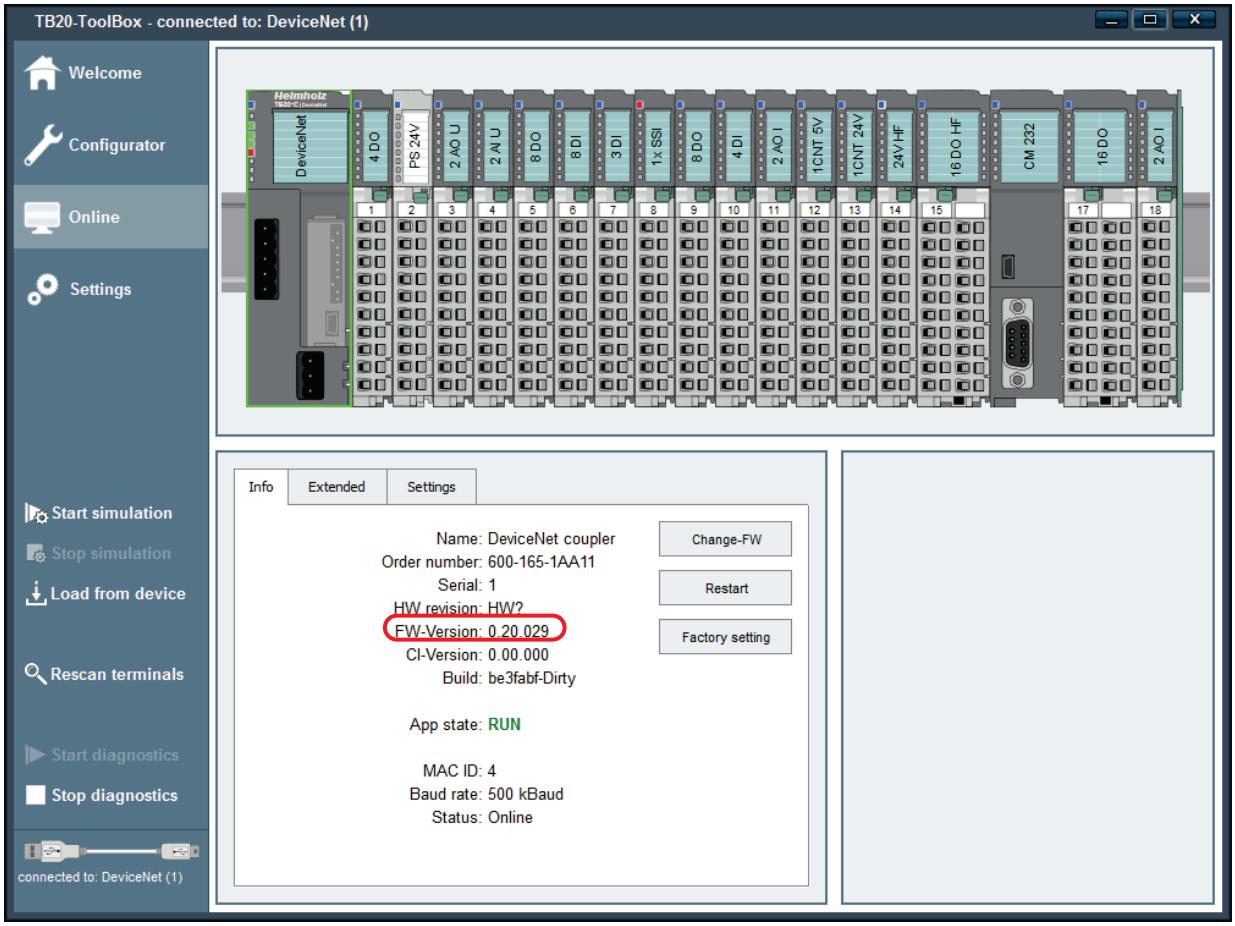
The latest firmware files will be automatically installed after setting up TB20-ToolBox and will be available so that the TB20 coupler's operating system can be updated through a USB connection. The TB20-ToolBox program can be downloaded at any time from the Downloads area at www.helmholz.de. To get an overview of the firmware files currently available, click on the "Settings" menu option.



Firmware can only be uploaded in online mode (please refer to 6.3.2). Clicking on the "FW Update" button will open a selection list like the one shown in the screenshot below. Once you get to this list, simply select the firmware version you want and click on "OK."



A progress bar will indicate the transfer's progress. Once the update is successfully completed, the active firmware version will be shown in the Info pane in online mode.



6.4 Startup Flow

The three following events will all trigger a DeviceNet™ coupler (re)start:

1. Power on
2. "Reset" command from the DeviceNet™ bus (on the Identity object instance 1) or TB20-ToolBox
3. A physical change to the module setup

There are two different possible startup flows for the DeviceNet™ coupler:

Startup flow 1: A project is already stored in the coupler's non-volatile memory.

1. The coupler carries out a basic initialization routine
2. The coupler scans the modules
3. The coupler compares the results from the bus scan with the modules stored in its configuration.

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 (even with hot plugging enabled) is not permitted.

As soon as the coupler determines that there are no gaps in the module configuration and the modules match the ones in the stored list, the coupler proceeds to RUN mode.

Startup flow 2: If there is no project stored in the coupler´s non-volatile memory it will obtain the module list from the backplane bus and will use this information to go online.

1. The coupler carries out a basic initialization routine and assigns all required addresses
2. The coupler scans the modules
3. If the coupler detects a gap in the configuration, all modules remain IDLE.

If there are no gaps, the modules will be switched to STOP and then start running (RUN) with their standard configuration.

Once this is done, the coupler will carry out its mapping routine based on the modules that are plugged in.

6.5 Hot Plugging

Modules can be hot-swapped while the DeviceNet™ 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 such cases, 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.

If a replacement module of the same model is plugged in, it will be configured automatically and added to the system's cyclic operation.

Hot-plug will only be enabled if the configured configuration (module layout) matches the existing module layout and the DeviceNet™ coupler has switched to cyclic operation.

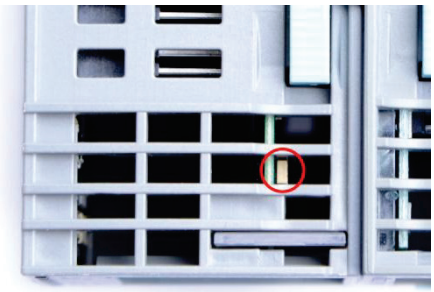
ATTENTION

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

6.6 Factory Reset (Restoring the Coupler to Its Factory Settings)

The DeviceNet™ coupler's factory settings can be restored by pressing a purposefully hard-to-find button. If you press this button, all coupler parameters, as well as the project, 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 coupler is booting 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.

6.7 LED-based diagnosis

6.7.1 DeviceNet™ Coupler LEDs

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

On	Correct configuration, system running
Flashing	The coupler is starting up or is unable to switch to cyclic operation due to its module configuration (gaps, wrong modules)

The **red "BF" LED** (bus error) is used for diagnostic module messages:

On	There is a diagnostic module message.
Flashing	Internal coupler error.

The **yellow "SF" LED** is used to indicate the module bus' status:

On	The wrong module is plugged in.
Flashing	Modules missing (startup) / Module removed (hot swap).

The **green "PLC" LED** is used to indicate the DeviceNet™ connection's state:

Off	A DeviceNet™ master has not been connected or has been disconnected.
On	There is at least one DeviceNet™ connection and the system is running (RUN).
Flashing	There is at least one DeviceNet™ connection and the system is stopped (STOP).
Quickly flashing	The coupler has been switched to simulation mode by TB20-ToolBox. All DeviceNet™ connections have been terminated.

The bi-color green/red "**MS**", "**NS**" and "**IO**" LEDs are used to indicate the DeviceNet™ status.

The **red/green "MS" indicator** displays the module status. It shows the overall status of the coupler:

Off	If the device has no power, the indicator is off.
green	When the device is fully ready for operation, the indicator lights up steady green.
Flashing green	If the device has not been configured, the indicator flashes green.
red	If the device has detected a non-recoverable major error,the indicator lights up steady red.
Flashing red	If the device has detected a recoverable minor error, the LED flashes red. An incorrect or inconsistent configuration is considered a minor fault.
Flashing red/green	During the self-test after powering up, the indicator flashes red/green.

The **red/green "NS" indicator** displays the network status. It shows the status of the network interface of the coupler:

Off	Device is not on–line: • The device has not completed the Dup_MAC_ID test yet. • The device may not be powered, look at Module Status LED. • No network power present.
green	If at least one CIP connection is established and no exclusive owner connection has a timeout, the indicator lights up steady green.
Flashing green	Device is on–line but has no connections in the established state. The device has passed the Dup_MAC_ID test, is on–line, but has no established connections to other nodes.
red	Failed communication device. The device has detected an error that has rendered it incapable of communicating on the network (Duplicate MAC ID, or Bus–off).
Flashing red	When an exclusive owner connection whose target is the device has a timeout, the indicator flashes red. The display does not change back to steady green until all exclusive owner connections have been re-established.
Flashing red/green	A specific Communication Faulted device. The device has detected a Network Access error and is in the Communication Faulted state. The device has subsequently received and accepted an Identify Communication Faulted Request - Long Protocol message.

The **red/green "I/O" indicator** displays I/O status information, simple diagnostics:

Off	All outputs are inactive. All inputs are inactive.
green	One or more outputs are active and under control, and no outputs are "faulted". One or more inputs are active and producing data, and no inputs are "faulted".
red	One or more outputs are forced off. One or more inputs has an unrecoverable fault - Parameterization fault behavior.
Flashing red	One or more outputs are in the fault state. One or more inputs are in the fault state. A short-circuit, or other diagnostic event occurred.

6.7.2 Module LEDs

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

blue light	The module is running (RUN).
Slowly flashing blue	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.
red light	The module is indicating a diagnostic error.
Flashing red light	The module is indicating a parameter assignment error.

The red "**SF**" LED light 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).

7 DeviceNet™ Introduction

DeviceNet™ is a network system which provides connections between control devices and process peripherals (I/O devices – sensor and actuators).

The DeviceNet™ protocol uses CAN (Controller Area Network) for its data link layer and CIP™.

(Common Industrial Protocol) for the upper layers of the network, and shares all the common aspects of CIP with adaptations to fit the message frame size of DeviceNet™. It is an open standard managed by ODVA.

The network supports up to 64 nodes and works on 125, 250 or 500 Kbaud. The table below shows the relation between Data Rate and maximum Trunk Distance.

Data Rate	Trunk Distance
125 Kbaud	500 meters (1640 ft.)
250 Kbaud	250 meters (820 ft.)
500 Kbaud	100 meters (328 ft.)

7.1 Communications Management

Communication on the DeviceNet™ network is connection based. A connection is established by the UCMM or a Group 2 Unconnected Port.

Messages are divided into 2 types: I/O and explicit messages. Explicit messages are used to move information from one node to another or to establish additional I/O connections.

I/O messages are used to transfer data to and from devices on the network. The protocol for transferring I/O messages is contained within the 11-bit CAN identifier and the rest is data.

Messages which are more than 8 bytes in length are fragmented and transferred using DeviceNet™ fragmentation protocol.

7.1.1 I/O connection types

The coupler supports 3 types of DeviceNet™ I/O connection types:

- Polled
- Bit-Strobe
- COS/Cyclic connections

Polled I/O connection is used to move any amount of I/O data (fragmented or not) between a Master (PLC) and the coupler. The Master is sending Poll commands to which the coupler responds with Poll responses.

When the Bit-Strobe connection is enabled and upon detecting a Bit-Strobe command from the Master, the coupler responds with the Status Word (described in chapter 8.7). Currently, setting the output bit for the Bit-Strobe command doesn’t have any effect on the coupler

COS/Cyclic connection is used to move any amount of I/O data between a Master and the coupler. Data production can be either acknowledged or unacknowledged. With COS (Change Of State) connection the coupler produces data for the Master whenever it changes and with Cyclic connection configured, the data is produced after the expiration of a preset time interval.

Since the coupler's timer resolution is 8 ms, setting the EPR (Expected Packet Rate) to a value not divisible by 8 causes the coupler to round up the specified value to the next serviceable value. For example: Setting the EPR value to 75 causes the coupler to load the value of 80 into the EPR attribute of the Connection Object.

7.2 Bus-Off Interrupt behavior

There are two possible parameterization settings when encountering a bus-off event:

1. Hold the CAN chip in bus-off (reset) state upon detection of a bus-off indication
2. If possible, fully reset the CAN chip and continue communicating upon detection of a bus-off indication

These parameters can be set by uploading the configuration via the TB20 Toolbox, or by using the explicit messaging service on DeviceNet™ object Instance 1, attribute 3. Parameter settings and behavior are given in the following table:

00	Hold the CAN chip in Bus-off (reset) state upon detection of a bus-off indication
01	If possible, fully reset the CAN chip and continue communicating upon detection of a Bus-off indication

7.3 Offline Connection Set

The coupler supports the Offline Connection set.

The Group 4 Offline Connection Set messages are used by network tools (e.g. Rockwell RSNetWorx©) to recover nodes in the Communication Faulted state. Using the Offline Connection Set messages a client (tool) can:

- visually identify the coupler in fault state to which it is communicating with by flashing an LED
- send fault recovery messages to the faulted coupler
- when possible, recover the faulted coupler without having to unplug it from the subnet

7.4 Device Heartbeat message

Device Heartbeat message is triggered by the Identity Object and it broadcasts the current state of the coupler. It is used to let the scanner aware that the coupler is still functional.

Byte 5 of the Heartbeat message contains the DF (Device fault, bit 0) and UF (User fault, bit 1) flags which are set by the coupler in case of faults.

DF flag is set when there is a backplane bus error, and UF flag is set in case the user has uploaded faulty parameters to the coupler.

7.5 Device Shutdown message

The Device Shutdown message is produced by the coupler when it transitions to the offline state. The message is triggered with following events:

- coupler restart via Toolbox or via CIP-Service "Reset"
- entering simulation mode
- reset to factory default settings or via CIP-Service "Reset"
- firmware upgrade

The message code transmitted has the value 0x2 – meaning “Operator reset”. In case of the CIP-Service "Reset" the code transmitted has the value 0x4 - meaning "Remote reset".

7.6 Reset Service

The coupler can be reset from the network by issuing a Reset service (0x05) request to the Identity object instance 1.

The reset can be performed in two ways:

1. Reset with current configuration, done by making a Reset request with no data or sending a “0” as service data
2. Reset with “out-of-box” configuration, done by making a Reset request with “1” as service data

7.7 The EDS file

DeviceNet™ uses EDS (Electronic Data Sheet) files as device description files. In addition to basic information such as the manufacturer and version of the device, it can include information about the supported CIP™ objects (attributes and methods). The EDS file for the DeviceNet™ TB20 coupler is available for download at www.helmholz.de. It is used for projecting tools such as RSLogix / Studio 5000 (Rockwell Automation, Inc.).

8 DeviceNet™ Classes

In this chapter the supported classes, attributes and services are presented, according to the official DeviceNet™ specification.

8.1 Identity class 0x01

Class attributes:

Attrib. ID	Access	Name	Data Type	Description
1	GET	Revision	UINT	Rev. number of the Identity object class
2	GET	Max. number of instances	UINT	Max. number of instances of this class for the device

Class Services:

- Get_Attribute_Single (0x0E)

Instance Attributes:

Attrib. ID	Access	Name	Data Type	Description
1	GET	Vendor ID	UINT	Helmholz Co. & KG Vendor ID
2	GET	Device Type	UINT	Used to identify Device Profile – Communications adapter
3	GET	Product Code	UINT	Product code for a particular device type
4	GET	Revision	STRUCT of:	Revision of the coupler – increments with changes to the device functionality
		Major Revision	USINT	
		Minor Revision	USINT	
5	GET	Status	WORD	Current status of the device
6	GET	Serial Number	UDINT	Unique serial number
7	GET	Product Name	SHORT_STRING	Coupler name
8	GET	State	USINT	Current state of the device
10	GET/SET	Heartbeat Interval	USINT	Interval between the production of HB messages

Instance Services:

- Get_Attribute_Single (0x0E)
- Set_Attribute_Single (0x10)
- Reset (0x05)

Reset Service supports values 0 (Power Cycle) and 1 (Factory Reset & Power Cycle), see chapter 7.6.

8.2 DeviceNet Class 0x03

Attrib. ID	Access	Name	Data Type	Description
1	GET	Revision	UINT	Rev. number of the DeviceNet™ object class

Class Services:

- Get_Attribute_Single (0x0E)

Instance Attributes:

Attrib. ID	Access	Name	Data Type	Description	
1	GET/SET	MAC ID	USINT	Node Address	
2	GET/SET	Baud Rate	USINT	Baud Rate setting	
				Value	Baud rate
				00	125 kbps
				01	250 kbps
				02	500 kbps
3	GET/SET	BOI	BOOL	Bus Off Interrupt setting: The BOI attribute consists of one bit that defines how a CAN device processes the bus–off interrupt:	
				Value	Behavior
				00	Hold the CAN chip in Bus-off (reset) state upon detection of a bus-off indication
				01	If possible, fully reset the CAN chip and continue communicating upon detection of a Bus-off indication
4	GET/SET	Bus-Off-Counter	USINT	Number of times Bus-off event occurred	
5	GET	Allocation Information	STRUCT of:		
		Allocation choice byte	BYTE	Which of the Predefined Master/Slave connections are in Configuring or Established state	
		Master's MAC ID	USINT	Master's MAC ID (from Allocate)	
6	GET	MAC ID Switch Changed	BOOL	Indicates switch change since last power cycle / reset	
7	GET	Baud Rate Switch Changed	BOOL	Indicates switch change since last power cycle / reset	
8	GET	MAC ID Switch Value	USINT	MAC ID Switch Value	
9	GET	Baud Rate Switch Value	USINT	Baud Rate Switch Value	

Instance Services:

- Get Attribute Single (0x0E)
- Set Attribute Single (0x10)
- Allocate Master/Slave Connection Set (0x4B)

- Release Group 2 Identifier Set (0x4C)

8.3 Connection Class 0x05

Attrib. ID	Access	Name	Data Type	Description
1	GET	Revision	UINT	Rev. number of the Connection object class

Class Services:

- Get_Attribute_Single (0x0E)
- Create (0x08)

Attrib. ID	Access	Name	Data Type	Description
1		State	USINT	State of the object
2		Instance type	USINT	Type of connection (I/O or Messaging)
3		TransportClass_trigger	BYTE	Behavior of the connection
4		DeviceNet_produced_ connection_id	UINT	Transmitting connection CAN ID
5		DeviceNet_consumed_ connection_id	UINT	Receiving connection CAN ID
6		DeviceNet_initial_comm_ characteristics	BYTE	Message group across which productions and consumptions occur on DeviceNet™ subnet
7		Produced_connection_size	UINT	Max. number of bytes transmitted on this connection
8		Consumed_connection_siz e	UINT	Max. number of bytes received on this connection
9		Expected_packet_rate	UINT	Defines timing on this connection
12		Watchdog_timeout_action	USINT	Handling of inactivity or Watchdog timeouts
13		Produced_connection_path _length	UINT	Number of bytes in the produced_connection_path attribute
14		Produced_connection_path	Packed EPATH	Application object whose data will be produced by this connection object
15		Consumed_connection_pa th_length	UINT	Number of bytes in the consumed_connection_path attribute
16		Consumed_connection_pa th	Packed EPATH	Application object that receives data consumed by this connection object
17		Production_inhibit_time	UINT	Defines minimum time between new data production. This attribute is required for all I/O Client connections, except those with a production trigger of Cyclic
18		Connection_timeout_multi plier	USINT	Specifies the multiplier applied to the expected_packet_rate value to derive the value for the Inactivity/Watchdog Timer

Instance Services:

- Get_Attribute_Single (0x0E)
- Set_Attribute_Single (0x10)

- Delete (0x09)
- Reset (0x05)
- Apply_Attributes (0x0D)

The Reset Service (0x05) is used to reset all resettable Connection Objects.

There are 9 instances of this class supported in the coupler, which can be referenced from the network when they are in the “Established” state.

The order of the instances is the following:

1. Explicit connection
2. Poll
3. Bit Strobe
4. COS/Cyclic
5. – 9. Dynamic explicit (UCMM)

Dynamic I/O connections are currently not supported.

8.4 Assembly Class 0x04

Attrib. ID	Access	Name	Data Type	Description
1	GET	Revision	UINT	Rev. number of the DeviceNet™ object class
2	GET	Max. number of instances	UINT	Max. number of instances of this class for the device

Class Services:

- Get_Attribute_Single (0x0E)
- Create (0x08)

Attrib. ID	Access	Name	Data Type	Description
3	GET/SET	Data	ARRAY of BYTE	Application data
4	GET	Size	UINT	Number of bytes in Data array

Instance Services:

- Get_Attribute_Single (0x0E)
- Set_Attribute_Single (0x10)

The coupler supports only static assemblies. There are two assembly instances: the input assembly (instance 101) and the output assembly (instance 102).

More information about coupler’s assemblies can be found in chapter 9 Input/Output Data.

8.5 Acknowledge Handler Class 0x2B

Attrib. ID	Access	Name	Data Type	Description
1	GET	Revision	UINT	Rev. number of the DeviceNet™ object class
2	GET	Max. number of instances	UINT	Max. number of instances of this class for the device

Class Services:

- Get_Attribute_Single (0x0E)

Attrib. ID	Access	Name	Data Type	Description
1	GET/SET	Acknowledge Timer	UINT	Time to wait for acknowledge before resending
2	GET/SET	Retry Limit	USINT	Number of AckTimeout events, before application is informed
3	GET/SET	COS Producing Connection Instance	UINT	Instance Number of the COS Connection Instance
4	GET	Ack List Size	BYTE	Number of members in Ack List
5	GET	Ack List	BYTE Array of UINT	List of active Connection instances which are receiving Acks
6	GET	Data with Ack Path List Size	BYTE	Maximum number of members in Data with Ack Path List
7	GET	Data with Ack Path List	BYTE Array of UINT USINT Padded EPATH	Path to (one) Object which is to receive the data attached to the Acknowledge message.

Instance Services:

- Delete (0x09)
- Set_Attribute_Single (0x10)
- Get_Attribute_Single (0x0E)

8.6 DeviceNet™ Vendor specific Classes

TB20 System is described using two Vendor Specific classes – class 100 is assigned to the coupler and class 101 to modules.

8.6.1 Coupler Information/Configuration Class 0x64

Attrib. ID	Access	NV	Name	Data Type	Default Value	Description
Instance 0x00						
1	GET	-	Revision	UINT	1	Object revision
2	GET	-	Max Number of Instances	UINT	1	Maximum number of instances of this object
Instance 0x01						
100 (0x64)	GET	NV	Order Number	SHORT_ STRING	-	Coupler Order Number
101 (0x65)	GET	NV	Serial Number	UDINT	-	Coupler serial number
102 (0x66)	GET	NV	Firmware version	ARRAY OF BYTE	-	Firmware version
103 (0x67)	GET	NV	Hardware revision	SHORT_ STRING	-	Hardware revision
104 (0x68)	GET	NV	App State	BYTE	-	Coupler Application State:
105 (0x69)	GET	NV	MAC ID	UINT	-	Coupler MAC ID (0 – 63)
106 (0x6A)	GET	NV	Baud Rate	UINT	-	Coupler Baud Rate (0: 125 kbaud, 1: 250 kbaud, 2: 500 kbaud)
107 (0x6B)	GET	NV	Status Word	UINT	-	Coupler status word containing basic info (app state, diags active)
108 (0x6C)	GET	NV	I/O Alignment	UINT	-	I/O data Alignment (0: module order, 1: word-aligned, 2: size aligned)
109 (0x6D)	GET	NV	Poll conn. Produced size	UINT	-	Poll connection Produced size
110 (0x6E)	GET	NV	Poll conn. Consumed size	UINT	-	Poll connection Consumed size
111 (0x6F)	GET	NV	COS/Cyclic conn. Produced size	UINT	-	COS/Cyclic connection Produced size
112 (0x70)	GET	NV	COS/Cyclic conn. Consumed size	UINT	-	COS/Cyclic connection Consumed size
113 (0x71)	GET	NV	Bit Strobe conn. Produced size	UINT	-	Bit Strobe connection Produced size
114 (0x72)	GET	NV	Bit Strobe conn. Consumed size	UINT	-	Bit Strobe connection Consumed size

8.6.2 TB20 Module Class 0x65

Each module is represented by an Object instance of Class 101 (0x65).

Using explicit messaging service it is possible to access the module information.

It is also possible to configure the module using the attribute 111 (0x6F) – Parameters (see the note below for more info).

Module diagnostics can be read by using the attribute 112 (0x70) – Diagnostic Data.

Attrib. ID	Access Rule	NV	Name	Data Type	Default Value	Description
Instance 0						
1	GET	-	Revision	UINT	1	Object revision
2	GET	-	Max Number of Instances	UINT	64	Maximum number of instances of this object
Instance 1 – 64 (0x01 - 0x40)						
100 (0x64)	GET	-	Order Number	SHORT_ STRING	-	Module order number
101 (0x65)	GET	-	Serial Number	UDINT	-	Module serial number
102 (0x66)	GET	-	FW version	UINT	-	Module Firmware version
103 (0x67)	GET	-	HW revision	SHORT_ STRING	-	Module Hardware revision
104 (0x68)	GET	-	App State	BYTE	-	Module Application State
105 (0x69)	GET	-	Input data size	BYTE	-	Size of process input data
106 (0x6A)	GET	-	Output data size	BYTE	-	Size of process output data
107 (0x6B)	GET	-	Parameter size	BYTE	-	Size of module parameters
108 (0x6C)	GET	-	Diagnostic data size	BYTE	-	Size of module diagnostics
109 (0x6D)	GET	-	Input data	ARRAY OF BYTE	-	Process Input data
110 (0x6E)	GET /SET	-	Output data	ARRAY OF BYTE	-	Process Output data
111 (0x6F)	GET /SET	-	Parameters	ARRAY OF BYTE	-	Module Parameters
112 (0x70)	GET	-	Diagnostic data	ARRAY OF BYTE	-	Module active diagnostics

NOTE

Module parameters can be set via attribute 111 (0x6F) when the coupler is in either STOP RUN mode. However, these parameters are volatile and are lost upon coupler restart.

8.7 Status Word

The Status Word of the coupler contains information about the status of the backplane bus and DeviceNet™ specific diagnosis.

It can be fetched by using the explicit messaging service on the coupler class 0x64, instance 1, attribute 0x6B, or seen in the networking tool (e.g. in the Rockwell RSNetWorx©, by right clicking on the coupler image and clicking the “Parameters Tab”.

Status Word:

15	14	13	12	11	10	9	Bit 8
reserved	reserved	reserved	reserved	reserved	reserved	I/O connection status: 0 = time out, 1 = idle, 2 = deleted, 3 = established	

Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
reserved	reserved	reserved	reserved	reserved	Module Configuration invalid	Backplane bus error	TB20 module diagnostic

9 Input and Output Data

The DeviceNet™ coupler has an address space of 1,024 bytes for inputs and 1,024 bytes for outputs.

These inputs and outputs are automatically assigned to the address space (what is referred to as assemblies) when the coupler starts and the corresponding assignments cannot be manually changed or otherwise configured. The DeviceNet™ assembly class numerical designator is 0x04.

There are 2 assemblies addressable from the network:

- input data assembly (instance 0x65)
- output data assembly (instance 0x66)

You can read the mapping assignments by using the TB20-ToolBox program. You can find the mapping information for each module under the “Extended” tab either in the “Configurator” or in “Online Diagnostic Mode”.

For a description of the input and output space that a module will take up, please consult the manual for that module.

Note: Outputs can only be written to when the coupler is running (RUN).

9.1 IO mapping rule (data mapping)

There are currently 2 different modes of data alignment:

- Module Order (no alignment)
- Data type size

Module order (no alignment) is the basic and default I/O data alignment. In this mode I/O data is mapped in reference to the module order, not taking into account the size of particular modules’ I/O data.

Data type size mode maps the I/O data in a way that the largest sets of data are mapped first, e.g. first is mapped I/O data sized 4 bytes, then 2 bytes and lastly I/O data sized 1 byte (also containing bits).

With careful planning of the module order and by choosing the convenient I/O alignment option, the user can minimize the I/O data size thus reducing stress on the network.

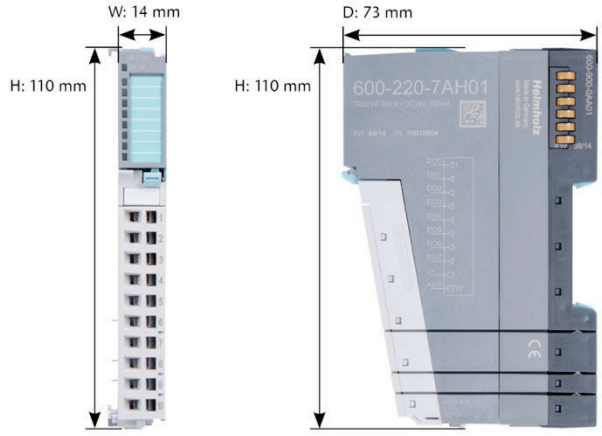
The position and size of the I/O data (in the I/O assembly) of a certain module, is shown in the "Extended" tab of the selected module and the total size of the whole configuration is shown in the coupler’s "Extended" tab in the TB20 Toolbox.

10 Technical data

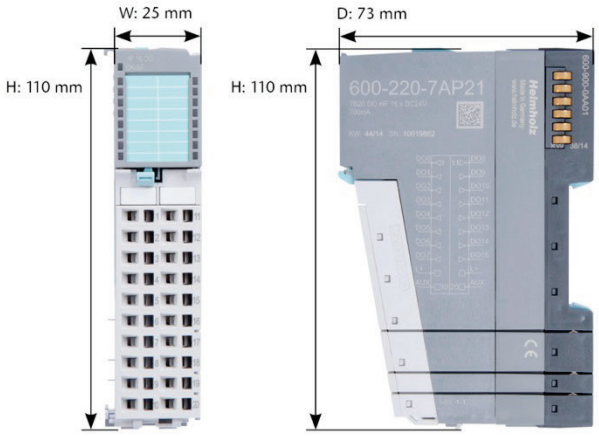
Order no.	**600-165-1AA11**
Module type	DeviceNet™ coupler
DeviceNet™ port	
Protocol	DeviceNet™
Transmission rate	125, 250 and 500 kbaud
I/O image size	1024 / 1024 bytes
Parameters per module	120 bytes
Connector	DeviceNet™ Open Connector
USB port	
Protocol	Full-speed USB 2.0 device
Connection	Mini-USB
Isolation voltage	1.5 kV
Number of TB20 modules that can be connected in series	64, all products
Voltage supply	24 V DC, 18–28 V DC
Current draw without modules (internal)	75 mA
Power dissipation	Max. 8 W
Power supply for modules	5 V DC, max. 2.5 A
Electrically isolated from backplane bus	No
Electrically isolated from USB	Yes
Dimensions (H x W x D)	110 mm x 35 mm x 73 mm
Weight	115 g
Certifications	CE
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
Pollution degree	2

11 TB20 System Dimensions

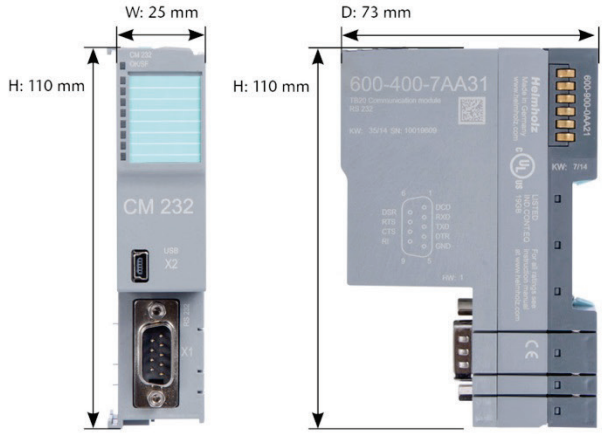
Module with standard width



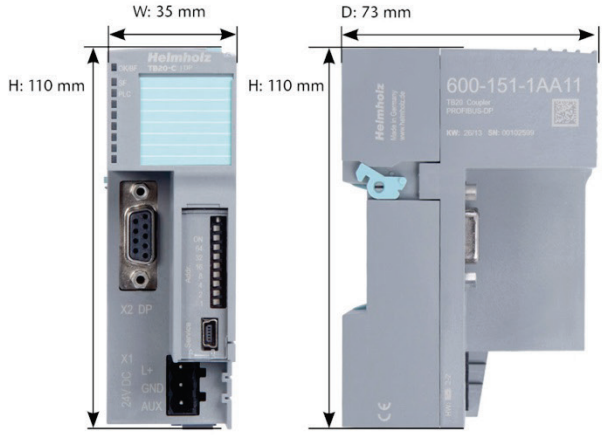
Module with double width

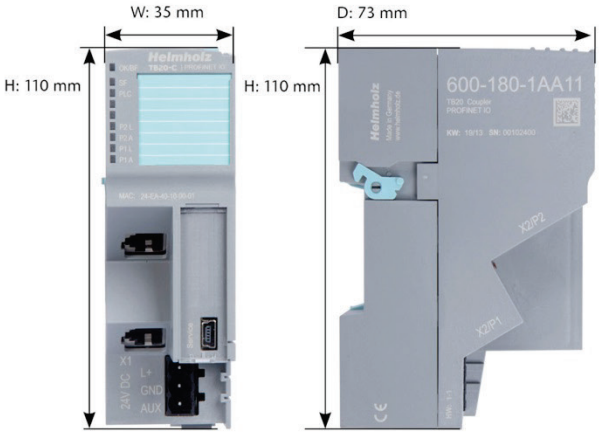


Communication Module



Bus Coupler





12 Spare parts

12.1 Base modules

12.1.1 14 mm width standard base module

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

12.1.2 25 mm width base module

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

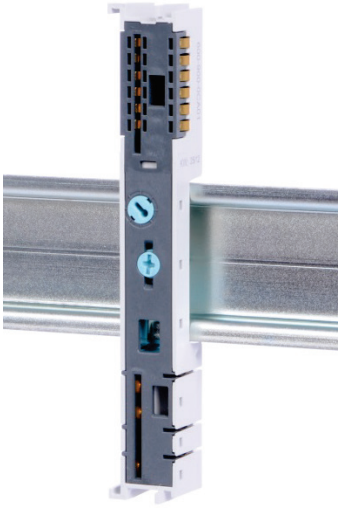
12.1.3 Power and isolation base module

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

12.1.4 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.



12.2 Front connectors

12.2.1 10-terminal front connector

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

12.2.2 20-terminal front connector

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

12.3 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.

12.4 Final cover

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