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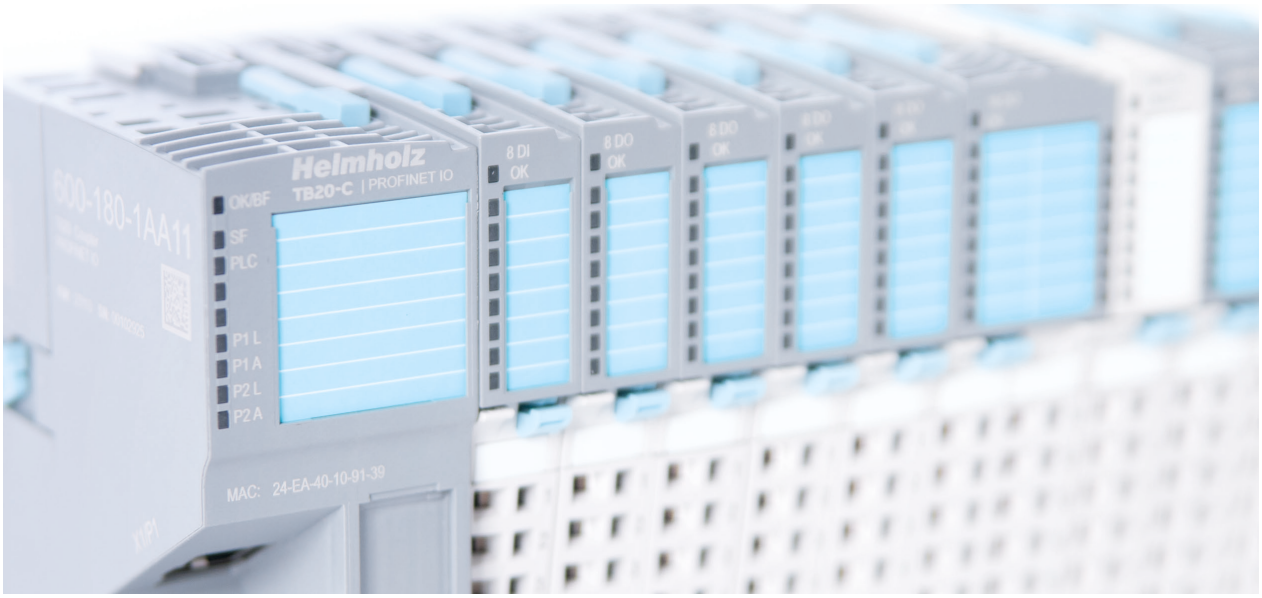

TB20 – 1 x SSI encoder interface

Manual

Version 1 / 19.02.2015 for HW 1-1 & FW 1.00 and higher

Manual Order No.: 960-320-7AA01/en

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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.

The SSI encoder interface was developed and tested with the vital assistance of TR-Electronic and BaumerHübner.

Trademarks

Revision Record

Version	Date	Written/edited by	Change
1	1/29/2015		First version

Table of Contents

1. General Information

This manual explains how to set up and use the TB20 SSI module (order No. 600-320-7AA01) and provides technicians with all the information required to install it.

1.1. Target Audience 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 and Signal Words

The following symbols and signal words are used in this documentation. The combination of a pictogram and signal word classifies each safety warning. The symbol may vary according to the type of hazard.

	Symbol	Signal word	Explanation
Death		**Hazard**	This signal word must be used when death or irreversible health damage can result if the hazard statement is ignored.
Injury and property damage		**Warning**	This signal word indicates personal injury and property damage, including injury, accident, and health risks.
		**Caution**	This signal word indicates a risk of property damage. In addition, there is a slight risk of injury.
Property damage only		**Attention**	This signal word may be used only if no health damage can occur. It warns of damage to property.
No damage		**Note**	This signal word indicates hints for making operation easier and cross references. It excludes all risks of damage or injury.

Warnings used

Symbol	Explanation	Symbol	Explanation
	General warning sign		Electrical voltage warning

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.

Note

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!

Hazard

Risk of death by electric shock

There is residual electrical energy in pipes, equipment, and devices.

Allow work on the electrical supply to be carried out only by qualified electricians.

Hazard

Risk of death, injury, and damage to property

There are hazards if the operating instructions and all safety warnings in the device are not obeyed.

Read the operating instructions carefully before initial use. Fulfill the required security conditions before the initial start-up.

Observe the general safety instructions and the specific safety information included in the other sections.

Hazard

Risk of death and injury in case of defective safety switches

Hazards exist if the safety switches do not work.

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. (refer to EN 954-1, Risk Assessment).

Hazard

Risk of death and injury in case of improper use

Define the responsibilities of the staff.

The TB20 modules should only be used for the functions characteristic 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. 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

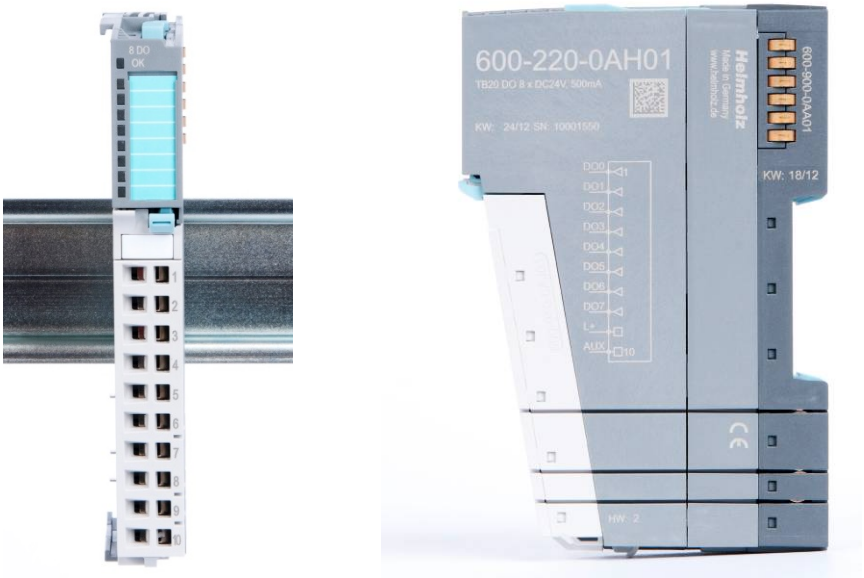
The system's bus coupler includes a bus interface and a power module. The bus interface is responsible for establishing a connection to the higher-level bus system and is used to exchange I/O signals with the automation system's CPU.

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

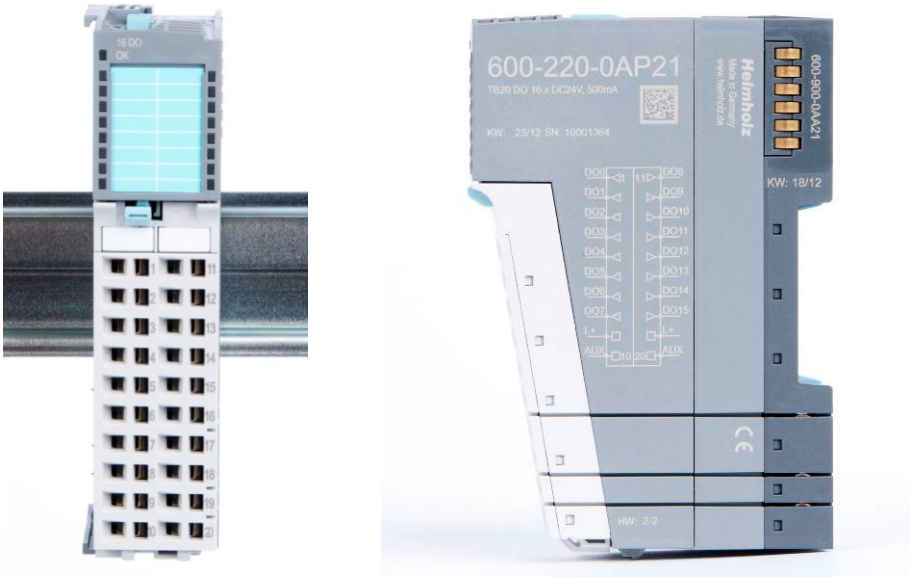
2.2.2. Peripheral Modules

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).

Note

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, bottom) 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.

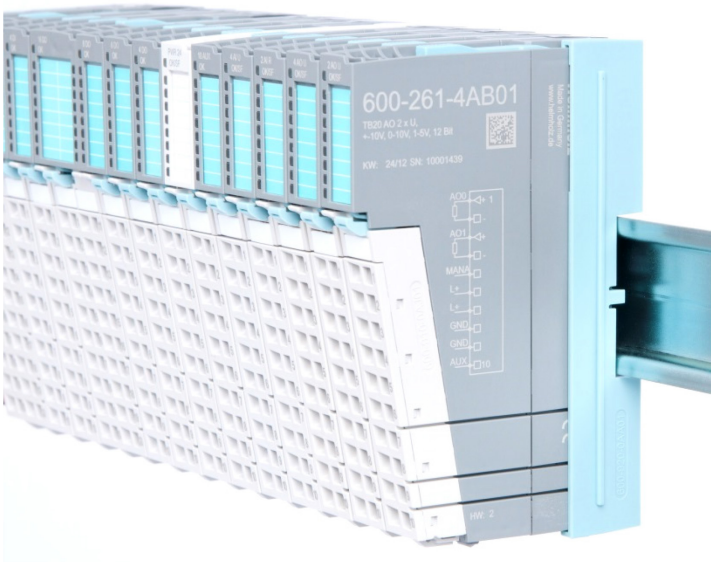
In other words, power modules deliver all the necessary power to the peripheral modules connected after them and, if applicable, all the way to the next power module or power and isolation module. This is required whenever the power supplied by the coupler alone is not sufficient, e.g., when there are a large number of modules on the bus. The "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 can be recognized by the bright color of their case.

2.2.5. Final Bus Cover

The final bus 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

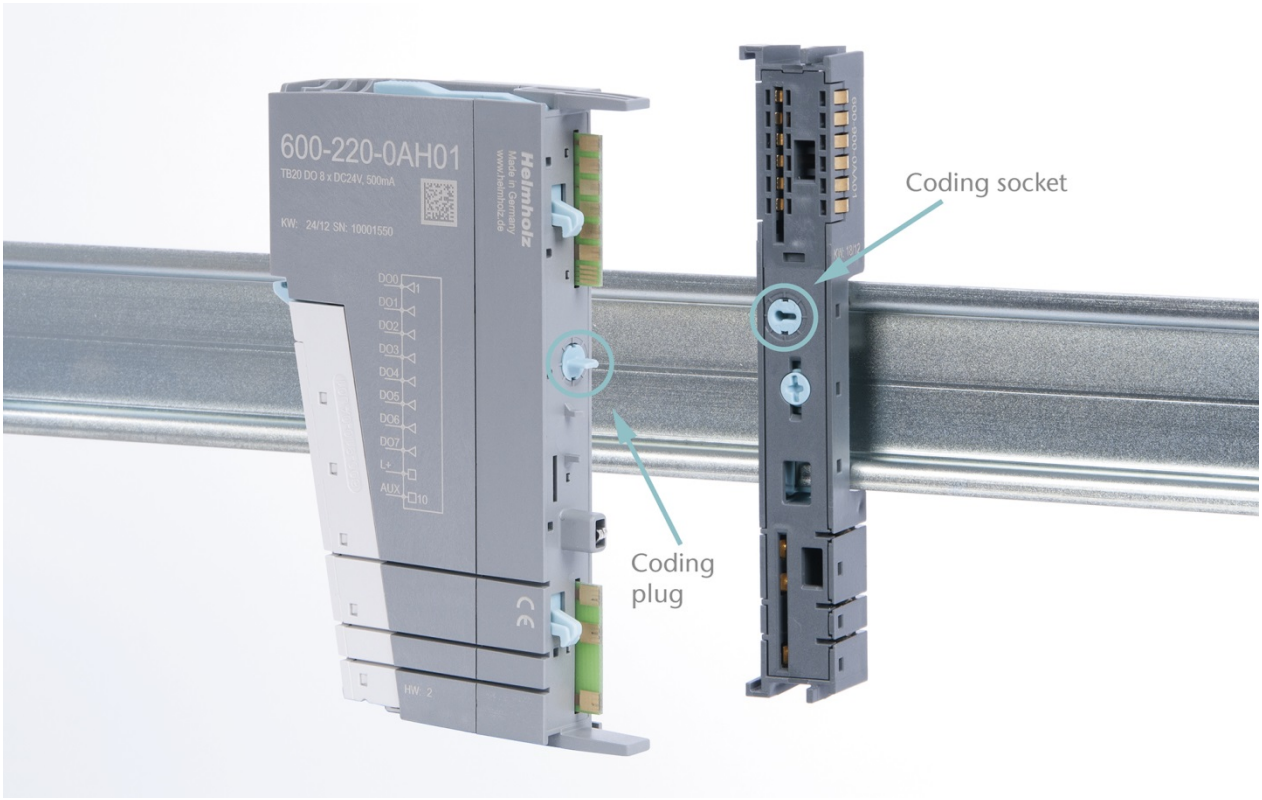
Each module consists of three parts:

- Base module
- Electronic module
- Front connector

2.2.7. Module Coding

Electronic 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 is only possible to plug an electronic module into a base module if the positions of the coding plug and the positions of the coding socket match. Otherwise, the electronic module will be mechanically prevented from being plugged in.

3. Installation and Removal

Hazard

Risk of death and injury through electrical energy

Risk of death by electric shock!

Before starting any work on the TB20 system, make sure to de-energize all components as well as the cables supplying them with power.

Attention

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, the ambient temperature must not exceed 60 °C. Also note that the maximum ambient temperature for UL applications is 50 °C.

3.1. Installation Position

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

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

3.2. Minimum Clearance

It is recommended to adhere to the minimum clearances specified 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)

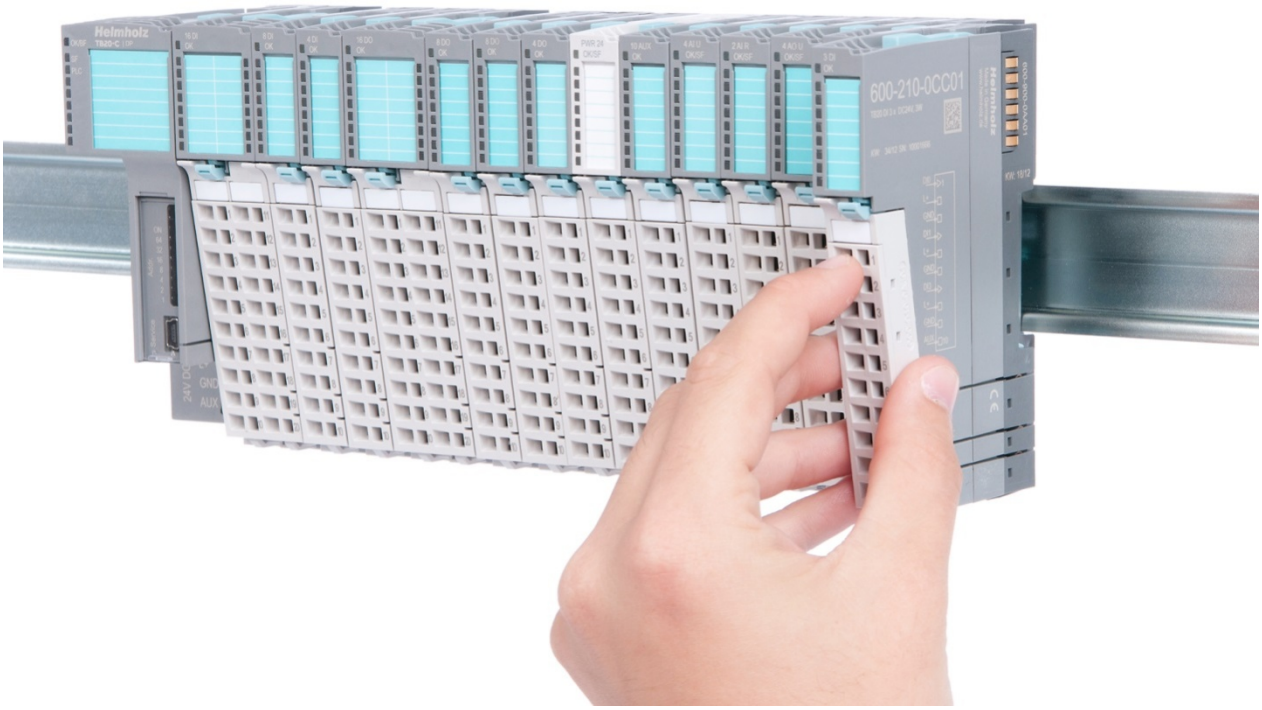
The minimum clearances for TB20 components are: 30 mm on the top and on the bottom and 10 mm on each side.

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 “Modulkodierung” 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.

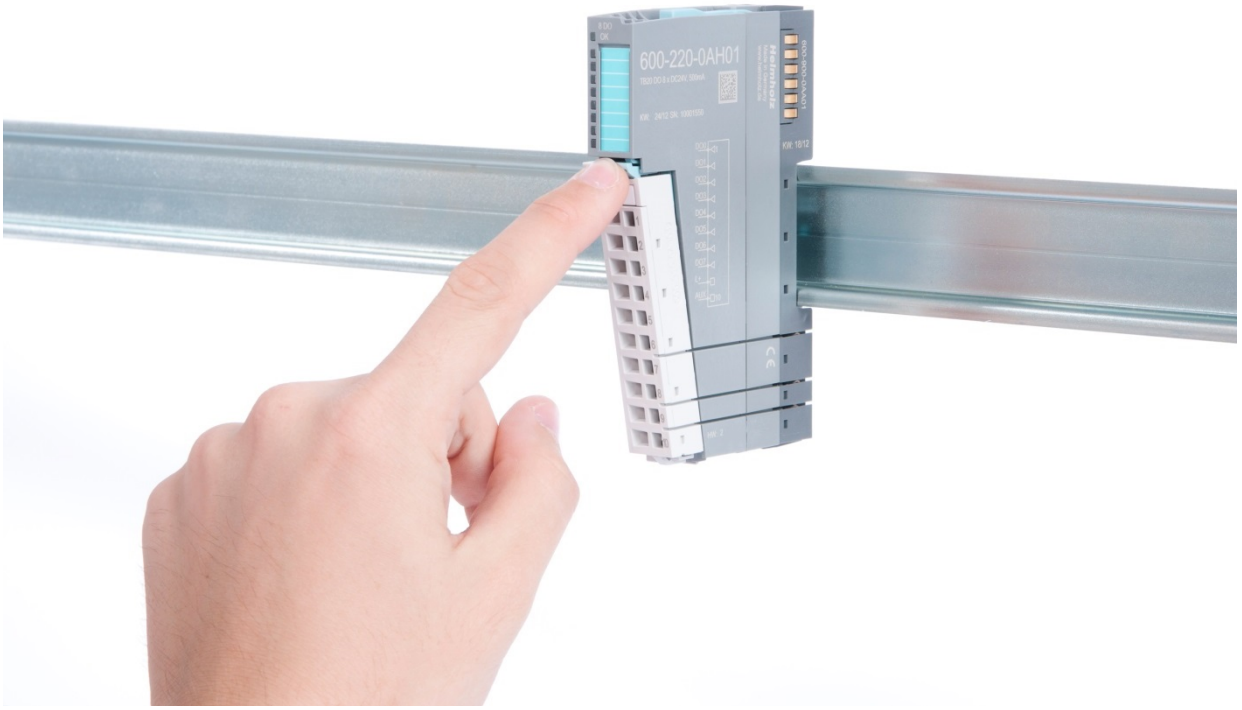
Finally, place the front connector on the electronic module from below in an inclined position and then gently push it onto the electronic module until the front connector fastener snaps into place with a soft click.

3.3.2. Removal

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

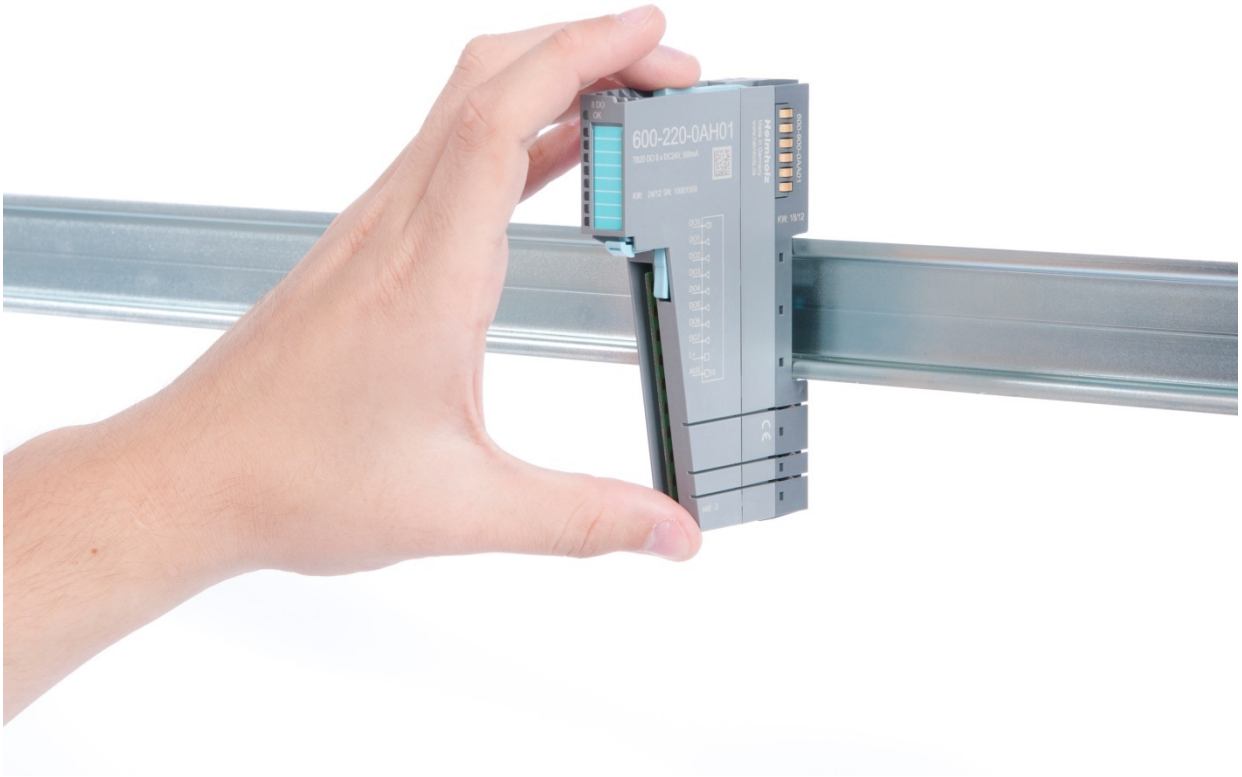
Step 1: Remove the front connector

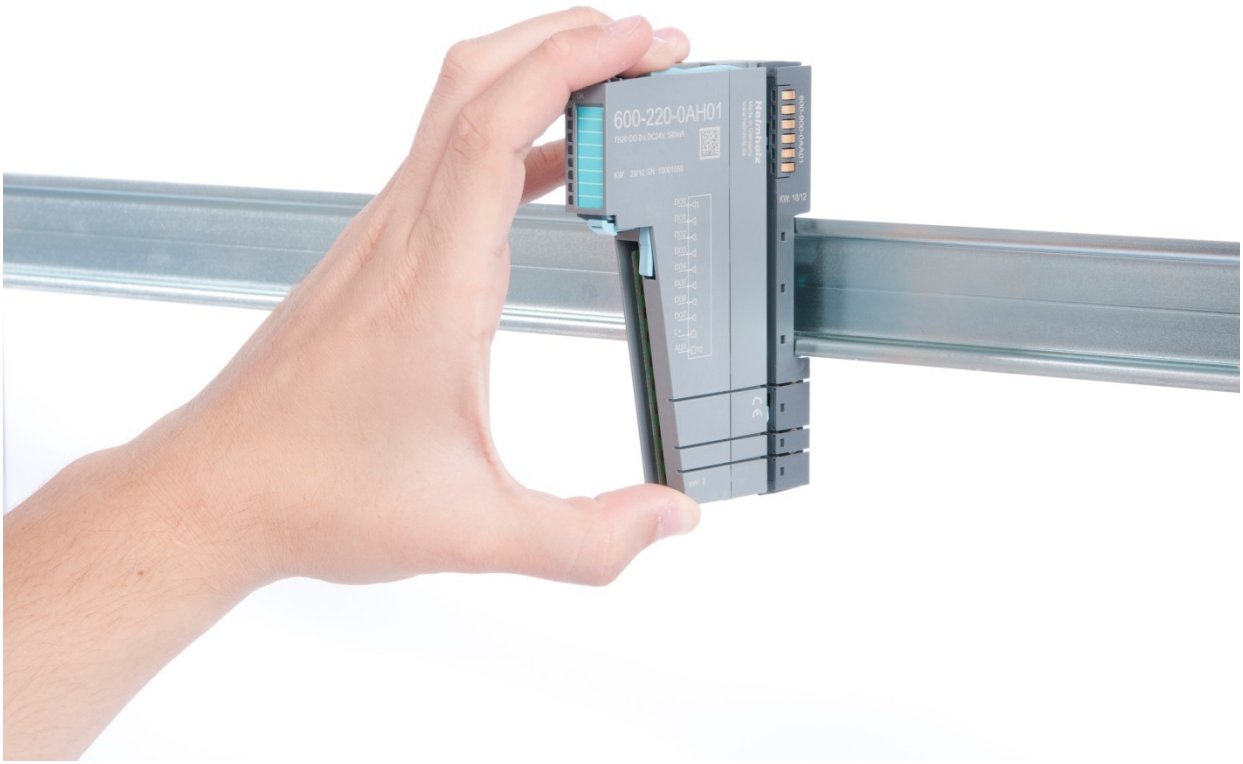
To do so, push the tab above the front connector upwards (see the picture below). This will push out the front connector, after which you can pull it out.



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 by turning the locking mechanism 90 ° counterclockwise.

Step 4: Remove the base module

Remove the base module by pulling it towards you.

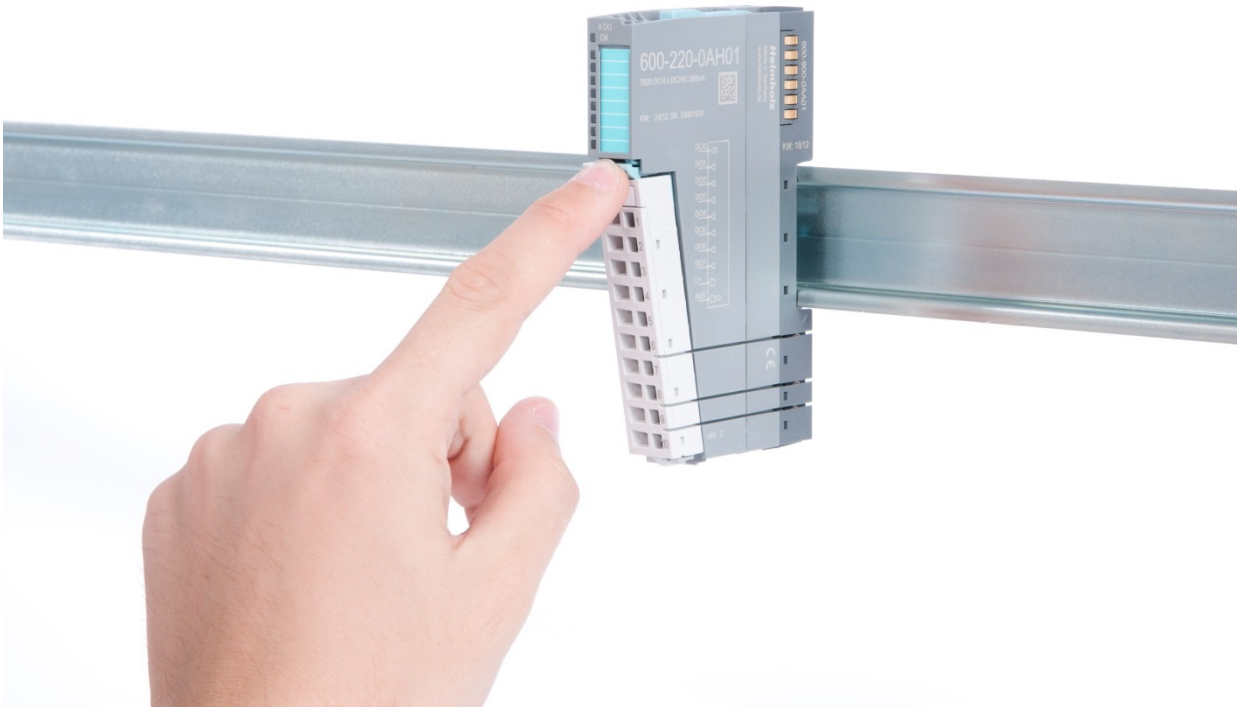
3.4. Replacing an Electronic Module

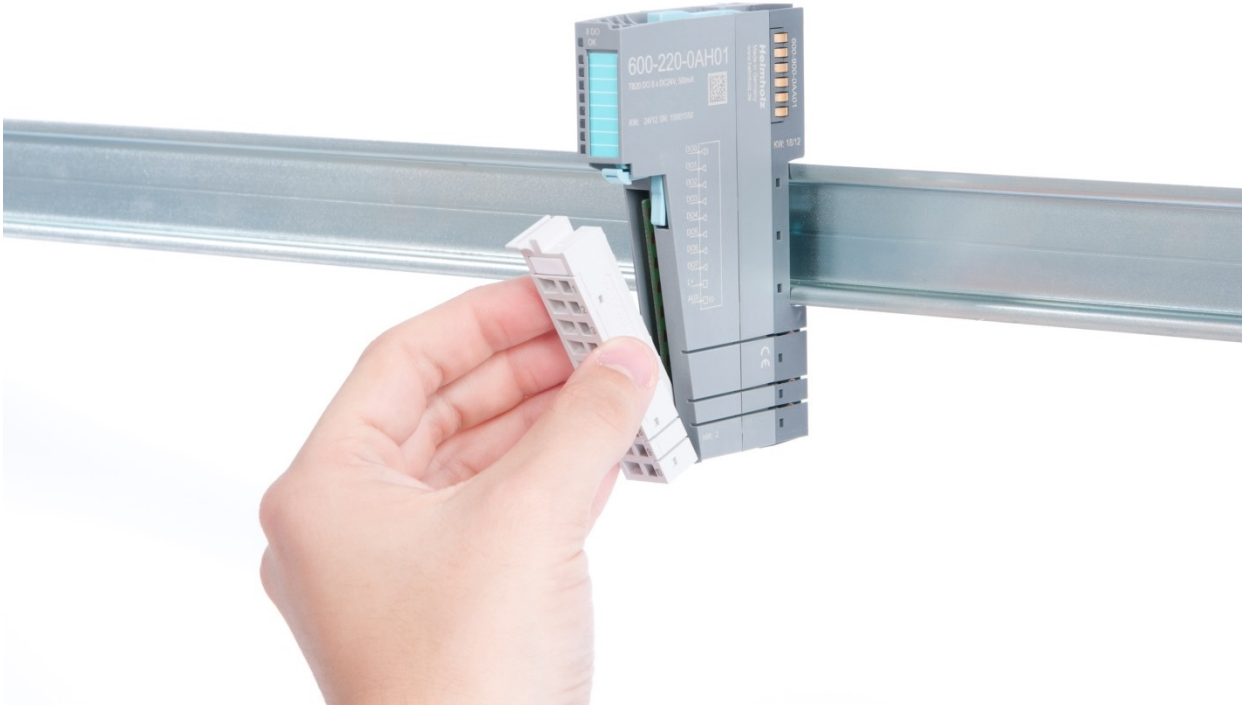
The procedure for replacing the electronic module on a peripheral module consists of four steps.

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

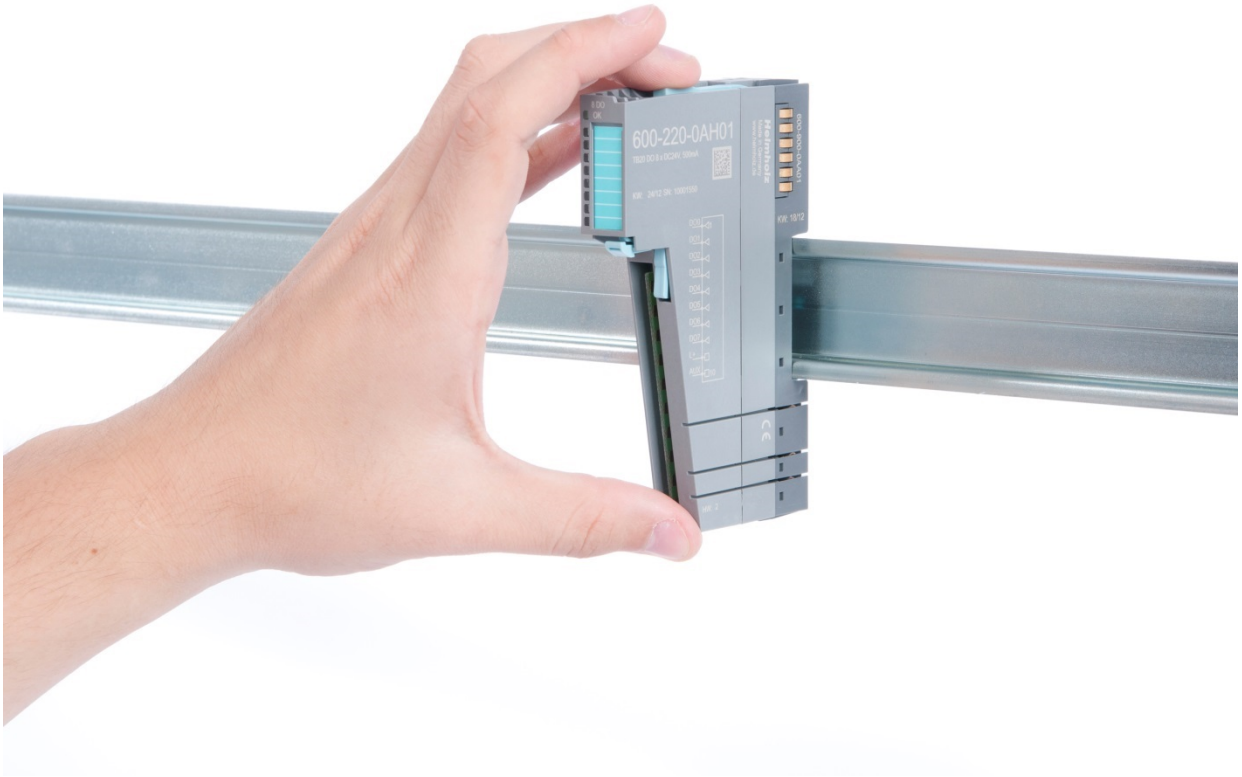
To do so, push the tab above the front connector upwards. The front connector will come loose, after which you can pull it out.

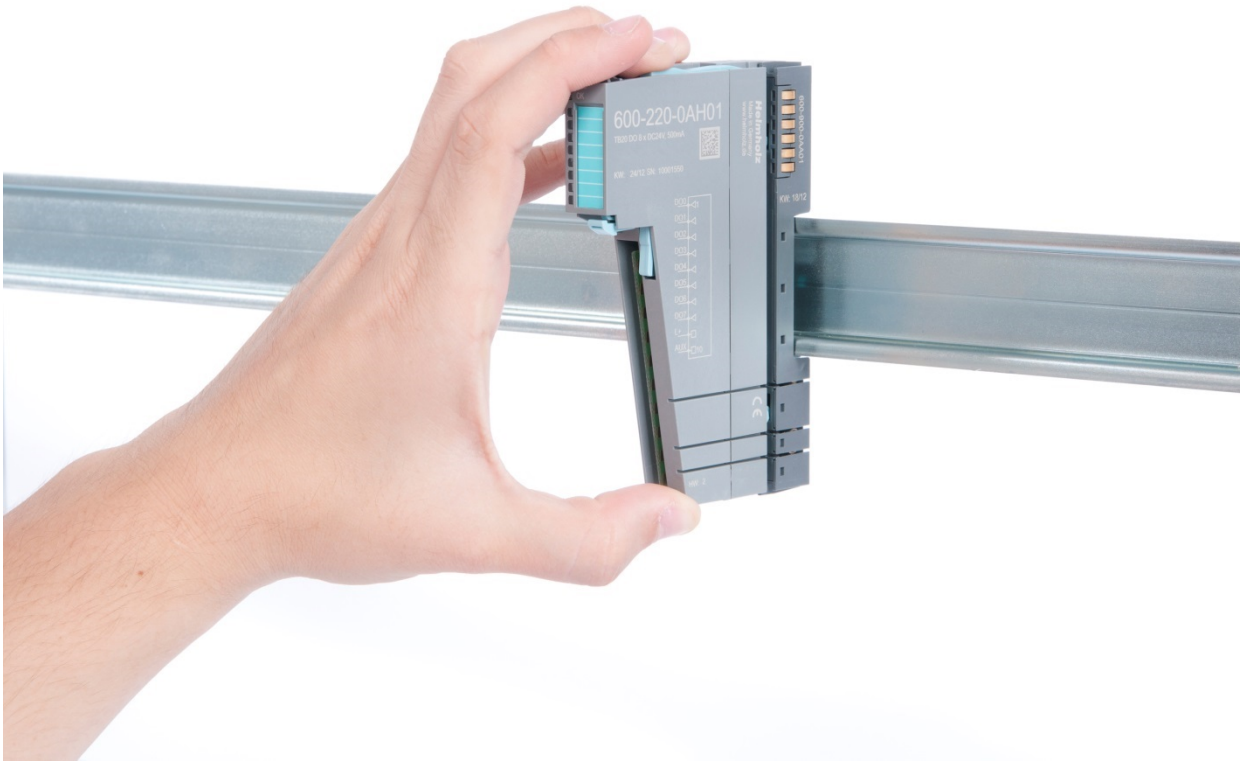




Step 2: Remove the electronic module

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





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.

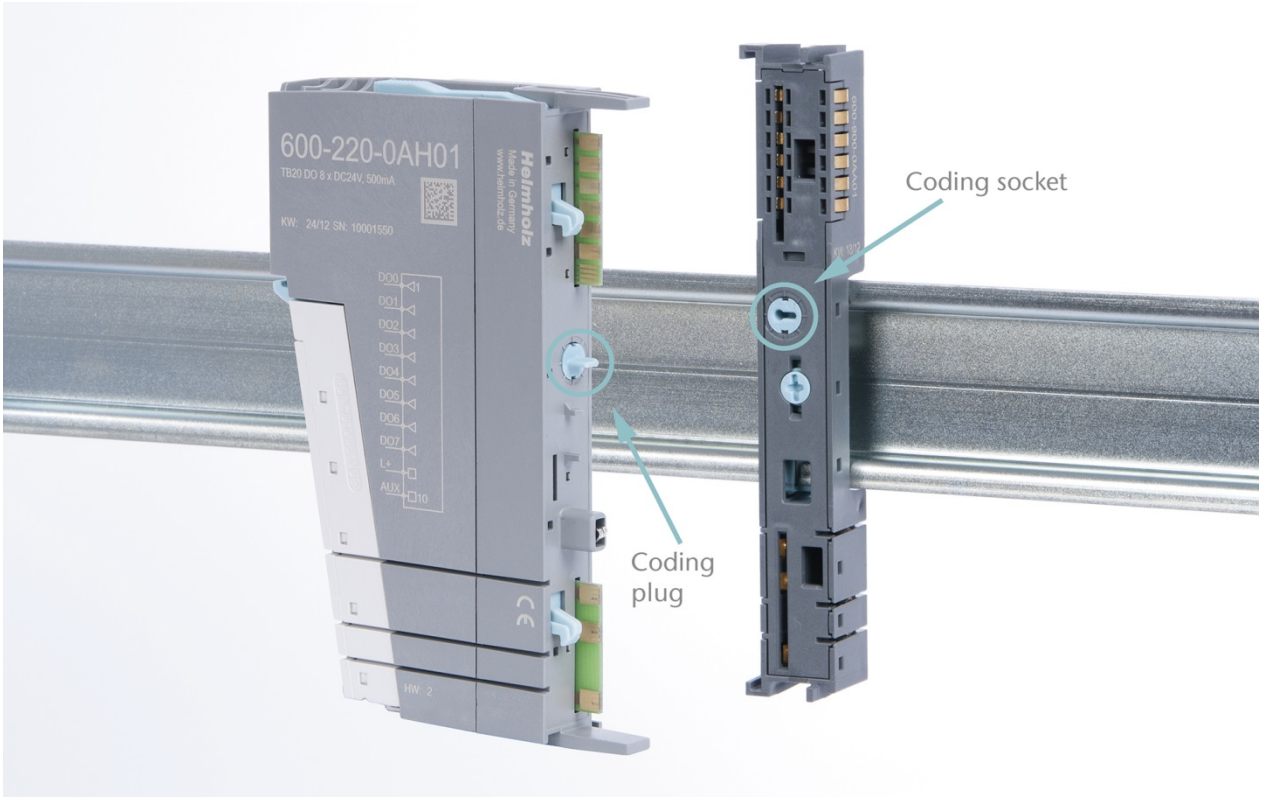
If the electronic module is not snapped into place firmly and straight on the base module, bus malfunctions may occur.

Note

If the electronic module cannot be plugged into the base module, check whether the coding elements on the electronic module and base module (see picture 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*.



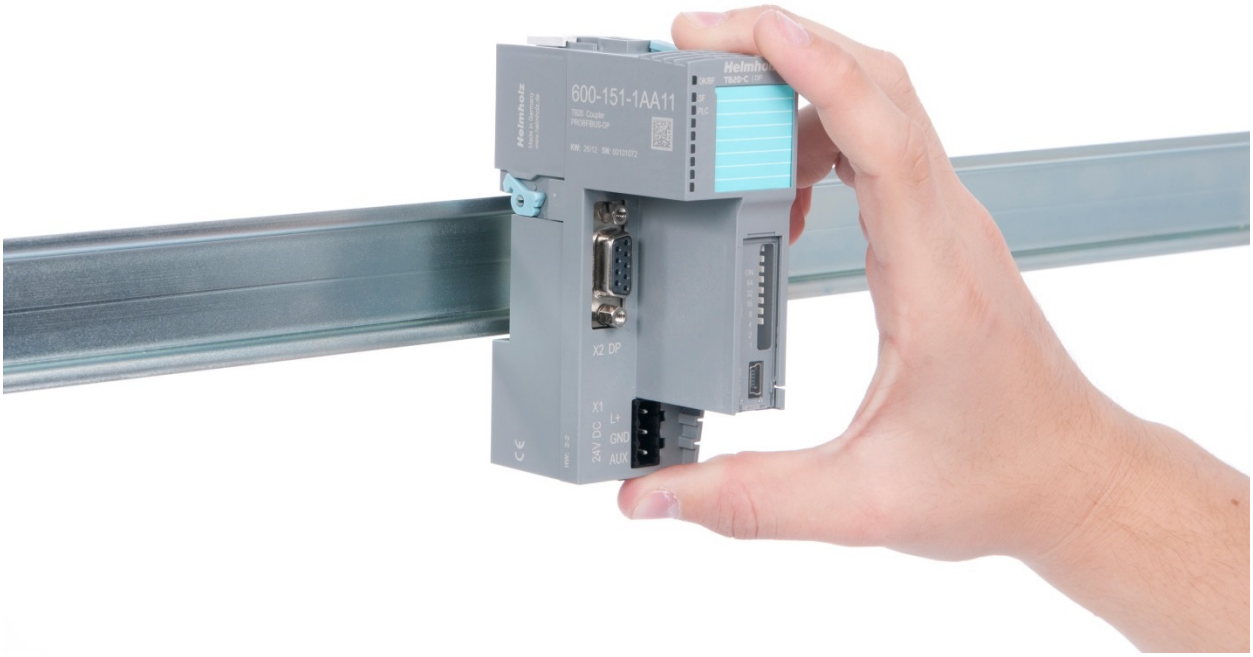
Step 4: Plug in the front connector

3.5. Installing and Removing the Coupler

3.5.1. Installation

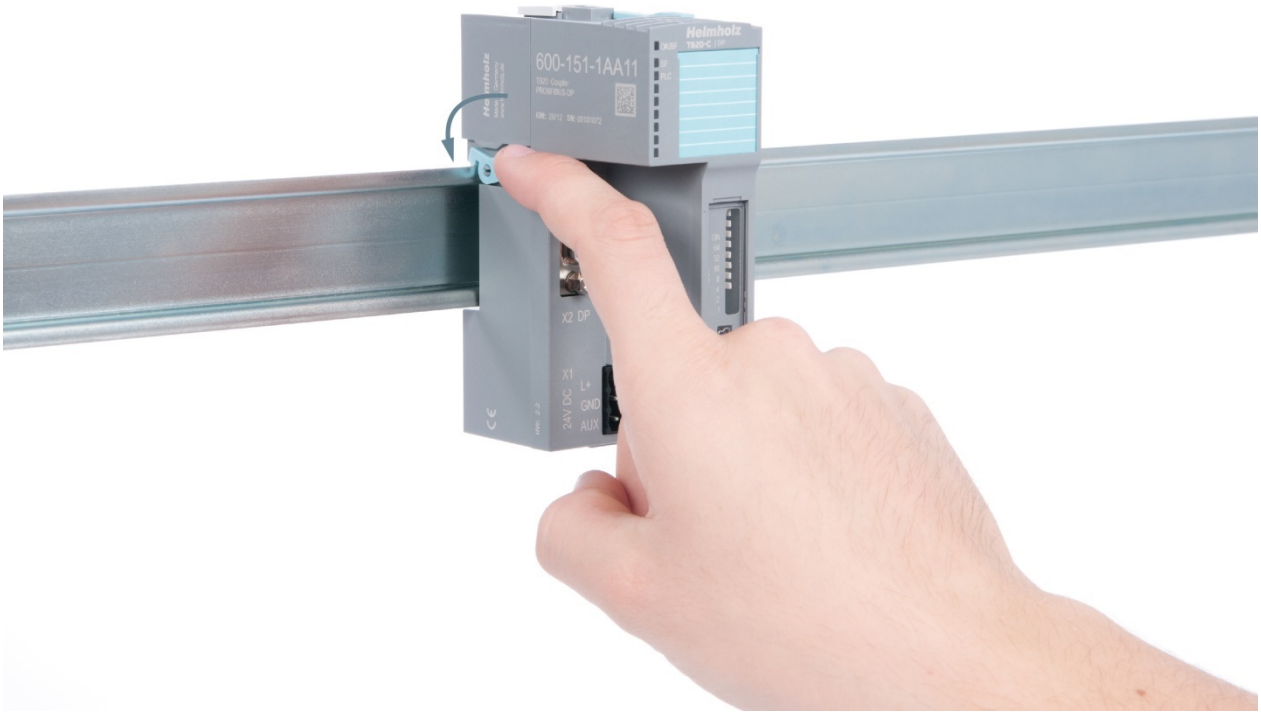
Step 1: Place the coupler on the DIN rail

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

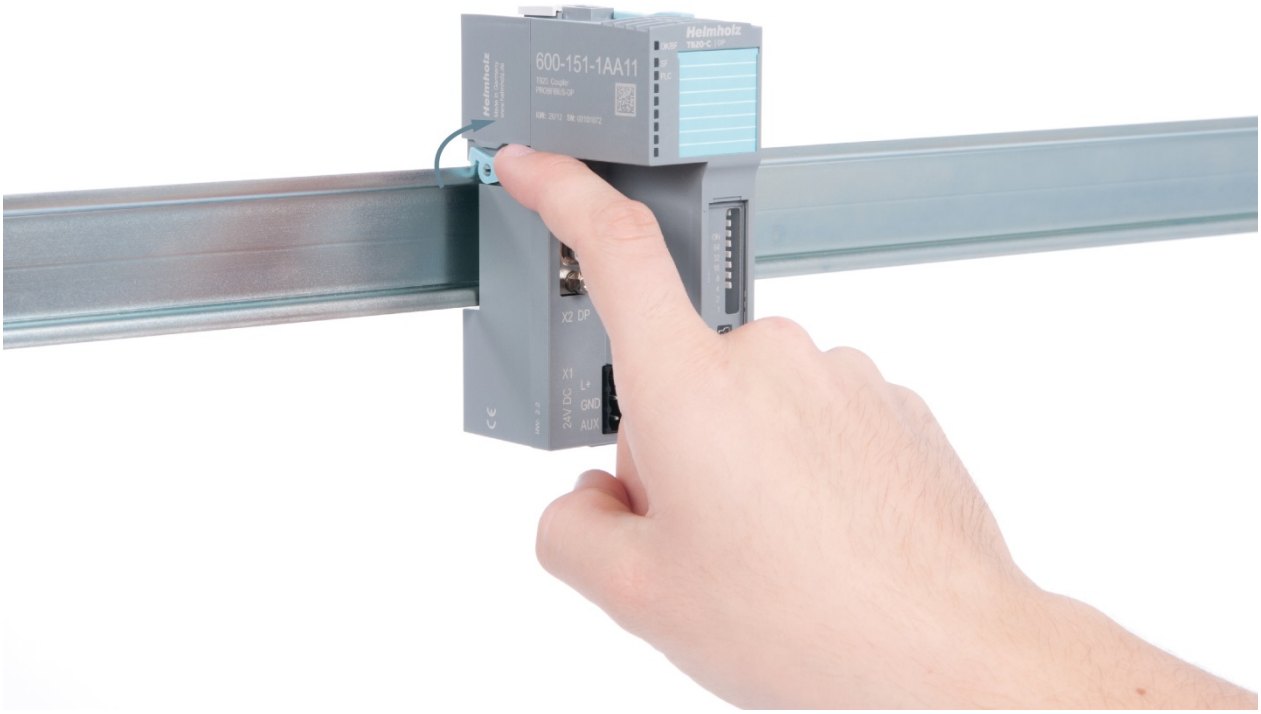
Use the locking lever on the left side to lock the coupler into position on the DIN rail.



3.5.2. Removal

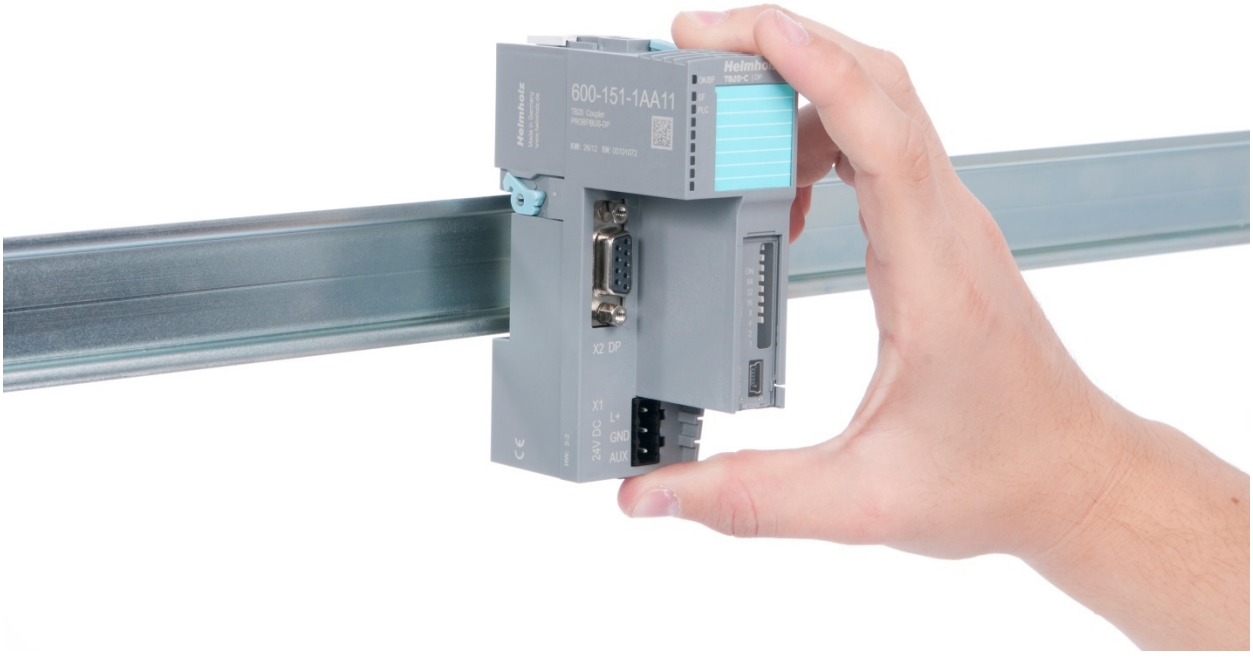
Step 1: Release the locking mechanism

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 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.

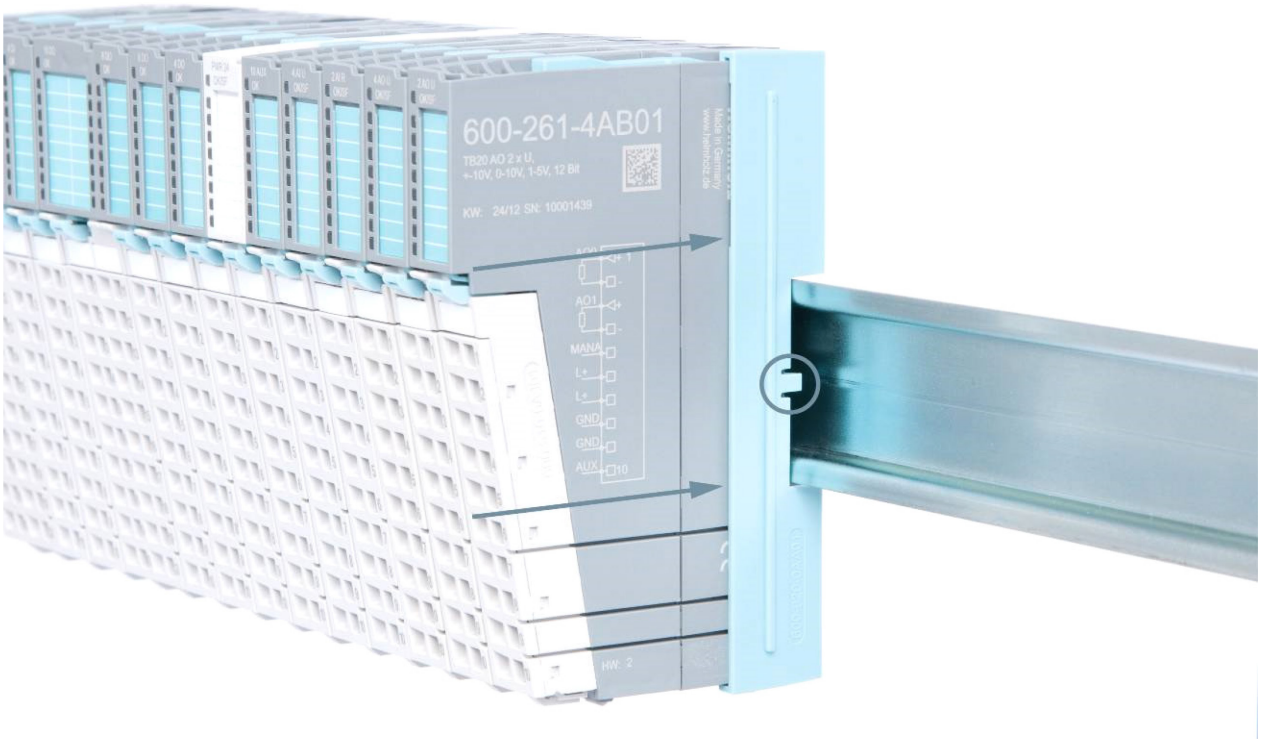
Step 4: Remove the base module

Remove the base module by pulling it towards you.

3.6. Installing and Removing the Final Bus Cover

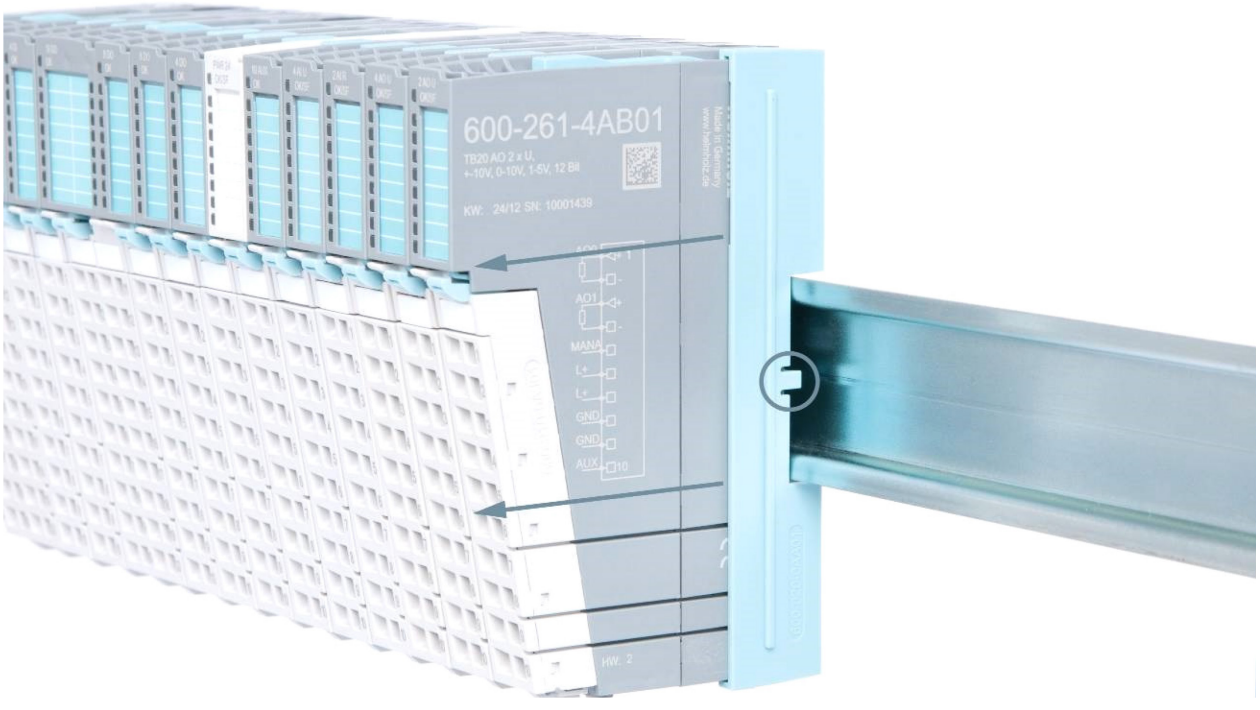
3.6.1. Installation

Slide the final bus 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 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 not to 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.

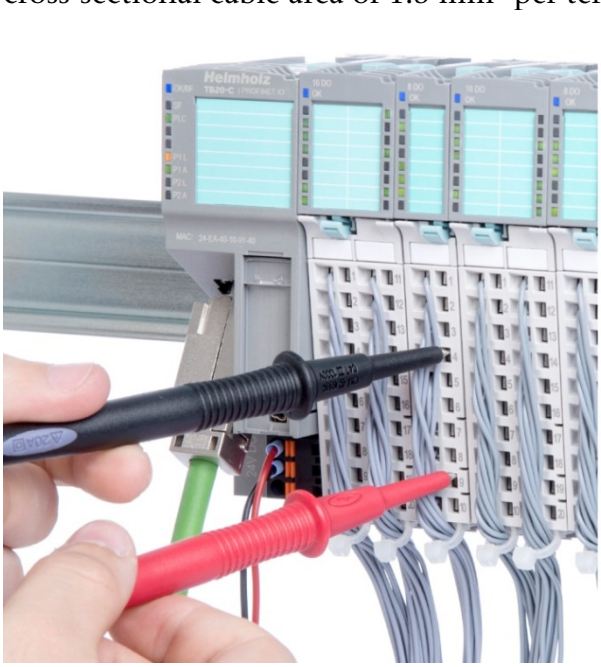
Warning

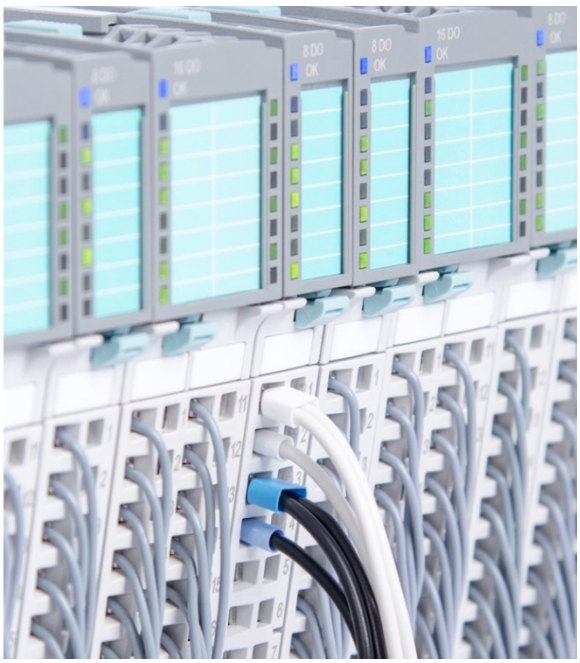
When putting together the system and routing the required cables, make sure to fully comply with all standards, regulations, and rules regarding shielding (please consult the relevant guidelines and documents published by the PROFIBUS User Organization as well). All work must be done professionally!

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 (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.





4.3. Wiring the Coupler

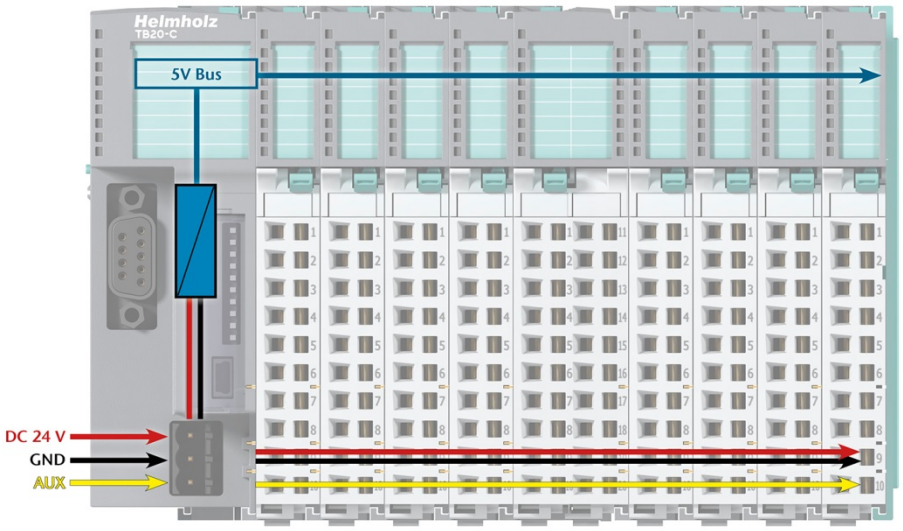
A power supply unit is integrated into the bus coupler. This unit is responsible for powering the peripheral modules connected to the coupler.

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

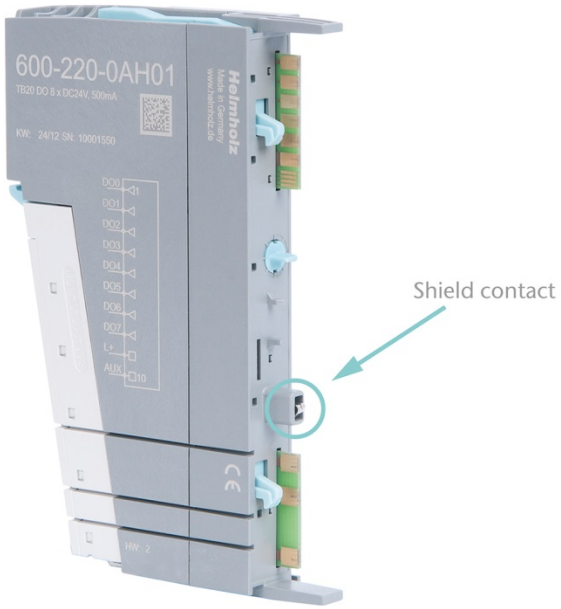
The L+ connector is used to power two buses:

- 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).

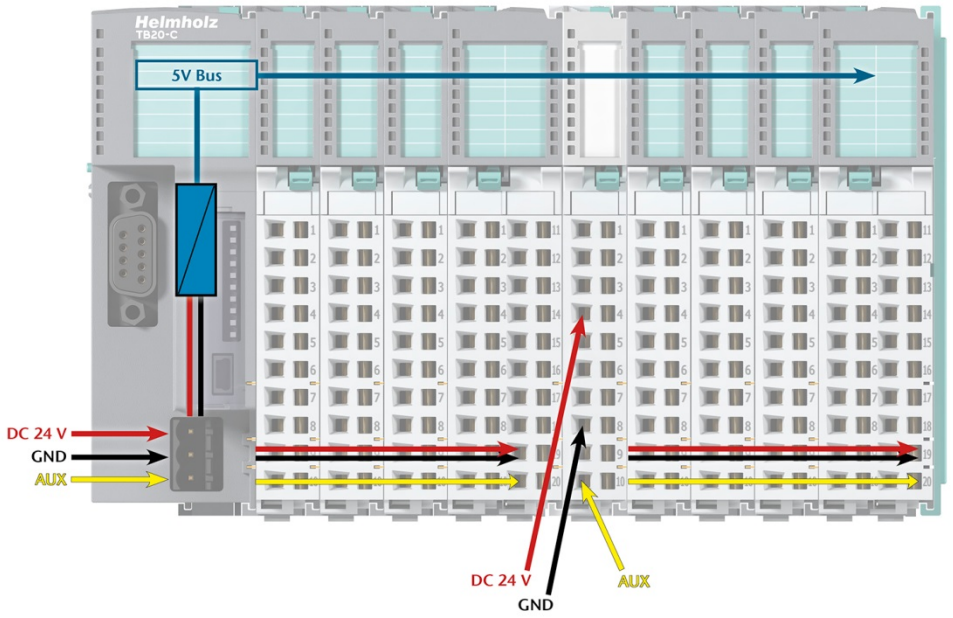


Shielding/grounding is achieved with a corresponding shield contact on the DIN rail:



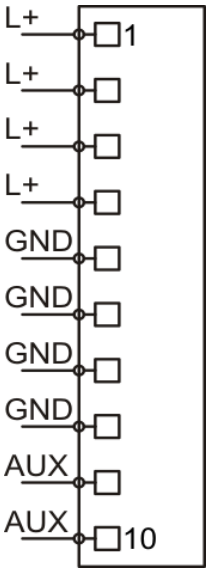
4.4. Using Power and Isolation Modules

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.



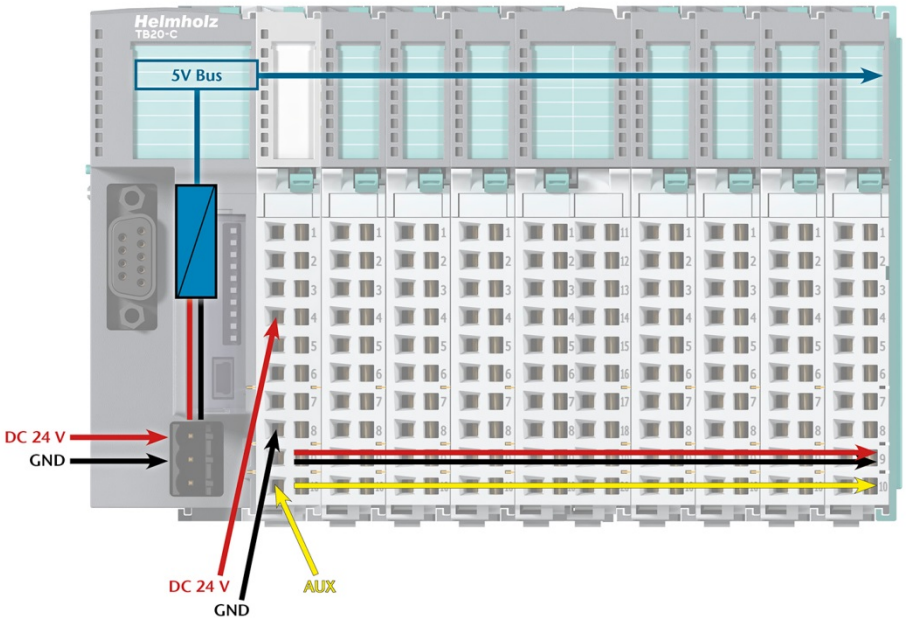
The order No. for the power and isolation module for 24-V signals is 600-710-0AA01.

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

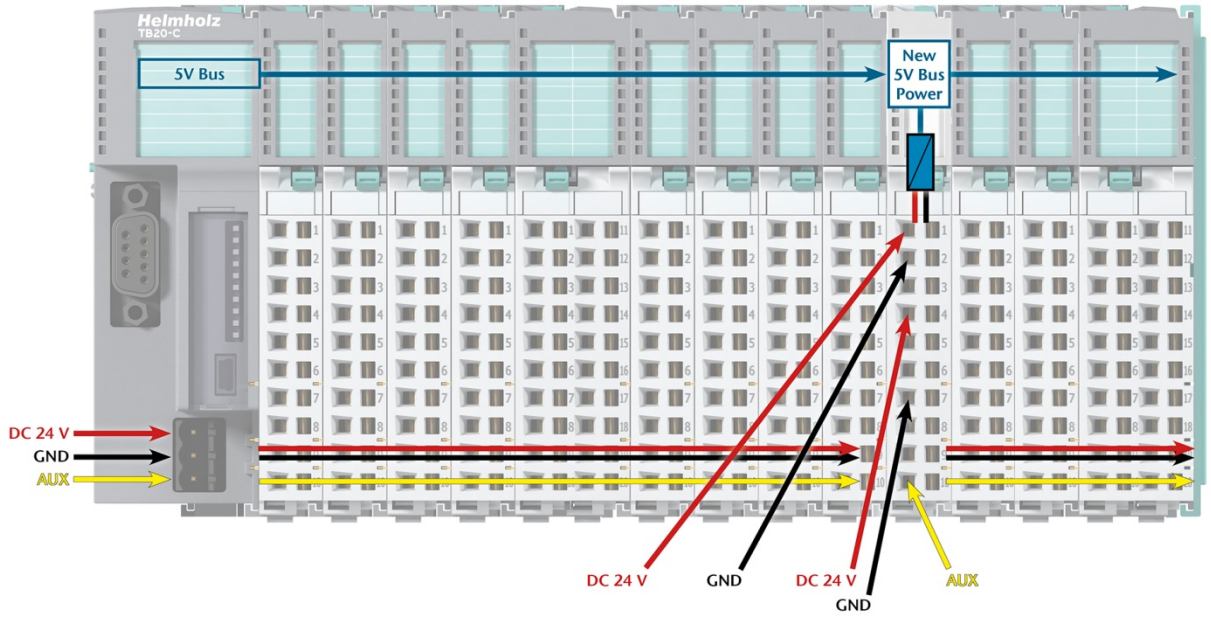
If the power supply for the coupler needs to be separate from the power supply for the I/O modules, a power and isolation module can be used right after the coupler.



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” 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. 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.

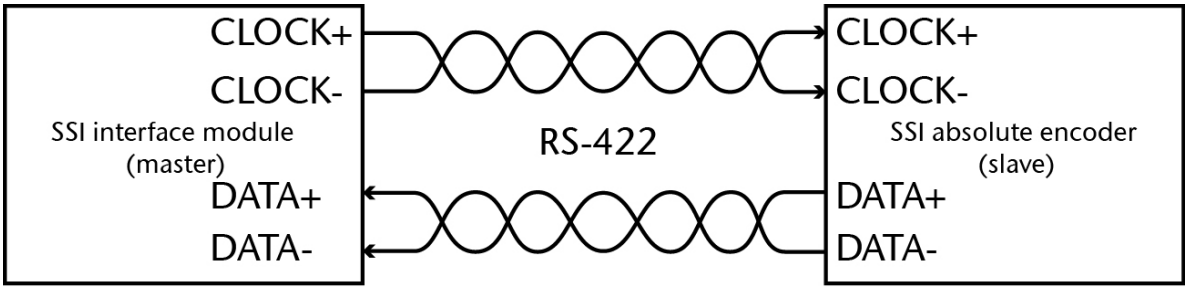
This information can be read in a number of ways, one of which is by using the "TB20 ToolBox" program. The modules' electronic nameplates not only make it possible to prevent configuration errors (setup), but also make maintenance (servicing) easier.

5. Synchronous Serial Interface (SSI)

5.1. General Description

Synchronous Serial Interface is a serial interface used for absolute position sensors, including absolute linear and angular encoders. It makes it possible to obtain absolute position data using serial communication.

In terms of hardware, SSI is implemented as a point-to-point connection in accordance with the RS-422 standard. Moreover, in order to avoid ground loops, opto-isolators are used to achieve full electrical isolation. Finally, excellent noise immunity is ensured by the fact that clock and data signals are sent through twisted pair cables using synchronous and symmetric communication, resulting in high reliability and robustness levels ideal for industrial environments.



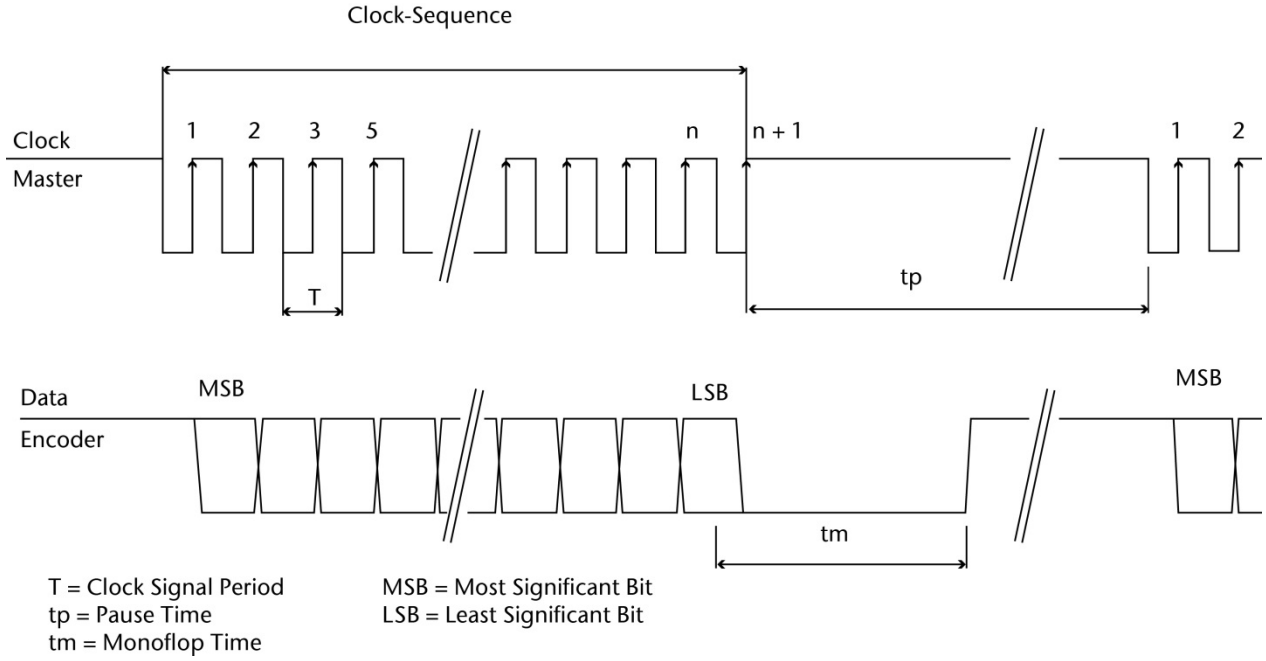
SSI Block Diagram

SSI provides several crucial advantages when compared to other interfaces for position measuring systems:
For starters, only two twisted pair cables are required in order to transmit data – one for the clock signal and one for the actual data. This means that wiring SSI systems is relatively simple and cost-effective and that the interface hardware is completely independent from the resolution of the sensor being used.

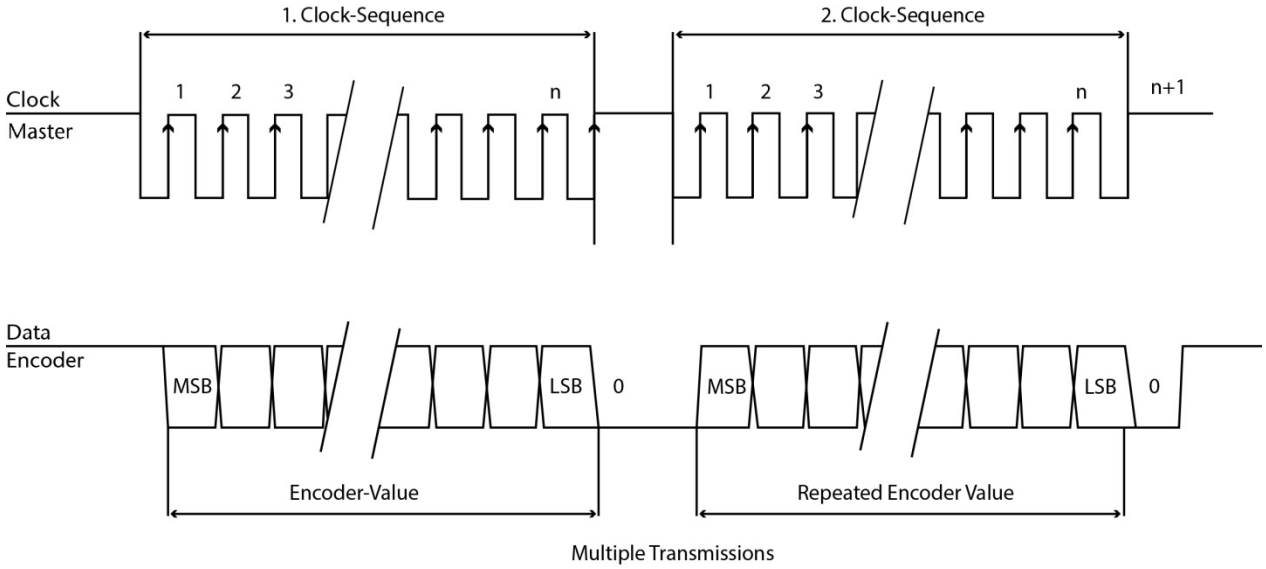
Another advantage is that the clock frequency can be adjusted, making it possible to vary the maximum cable length as necessary. And, since the number of data bits is also adjustable, SSI also provides flexibility in regard to the resolutions that can be used. Moreover, data values can be in either Gray code or natural binary code and a parity bit can be optionally transmitted for data integrity checking purposes. Also, special bits can be transmitted, enabling certain sensors that use this feature to send additional information to the master.

5.2. Transmission Modes

When dealing with SSI, it is necessary to distinguish between two types of transmission modes for position values: single transmission and multiple transmission. To have the sensor start transmitting its position value, n+1 clock pulses are sent to the sensor's clock input, followed by at least one idle cycle.



Position values can also be transmitted multiple times, enabling the SSI module to detect transmission errors. To do this, the train of clock pulses is sent to the sensor multiple times. When doing this, it is absolutely necessary to make sure that at least one additional clock pulse (idle cycle) is inserted between the clock pulse sequences. This additional clock cycle sets the data output signal to LOW after a data sequence is transmitted, separating the individual position value transmissions from each other.



6. TB20 SSI Module Characteristics

The TB20 SSI module has the following characteristics:

- Accommodates a single-turn/multi-turn absolute encoder with a resolution of 8 to 31 bits in accordance with the RS-422 interface standard
- Digital 24 V "latch function" input for freezing the current encoder value
- Encoder value normalization, i.e., the encoder value will only contain position-relevant bits
- Configurable multiple transmission for encoder values
- Comparator function with two loadable reference values
- Counting direction LED indicator
- Configurable counting direction reversal
- Configurable internal Gray-natural binary conversion
- Configurable encoder value parity check
- Supports transmission rates of up to 2 MHz
- Wire break detection
- 24 V encoder supply
- Standard 14-mm I/O module case

7. Setup and Use

7.1. Quick Start Setup Guide for SSI Encoder Interface

- Please refer to Section 3.3.1 for installation instructions
- Please refer to Section 4 for instructions on how to wire the TB20 system
- Wire the SSI encoder as instructed in the corresponding operating manual. Please refer to Section 7.2 for the pin assignment
- Configure the TB20 SSI module

→ Please refer to Section 7.3 for information on the module's LED indicators

7.2. Pin Assignment

Terminal	I/O	Function
1	C0+	SSI CLOCK+ (clock line) to SSI encoder
2	C0-	SSI CLOCK- (clock line) to SSI encoder
3	D0+	DATA+ from SSI encoder
4	D0-	DATA- from SSI encoder
5	DI0	Digital latch function
6	GND	GND from coupler, power module, or power and isolation module
7	GND	GND from coupler, power module, or power and isolation module
8	L+, 24 VDC Sensor supply	24 VDC encoder supply Max. 100 mA*
9	L+, 24 VDC Sensor supply	24 VDC encoder supply Max. 100 mA*
10	AUX	AUX potential from coupler, power module, or power and isolation module

* The encoder supply is powered from L+ and output at terminals 8 & 9.
The total current must not exceed 100 mA and is fused with a 250-mA fast-blow fuse.

7.3. Diagnosis Using the Status LEDs

The upper **OK/SF** LED (1) indicates the module's current system status.

Solid blue light:	The module is running (RUN)
Slowly flashing blue light:	The module is stopped (STOP)
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

LED green (2):	Status indicator used to show that SSI communications are OK
LED green (3):	Status indicator used to show that there is an encoder value change in the forward direction
LED green (4):	Status indicator used to show that there is an encoder value change in the reverse direction
LED yellow (5):	Status indicator showing comparator result 1
LED yellow (6):	Status indicator showing comparator result 2
LED green (7):	Status indicator for digital input (latch function)

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 in the slot).

8. Functionality

8.1. Available Settings

8.1.1. Gray-Natural Binary Converter

Depending on the type of absolute encoder set up, the TB20 SSI module will convert the received SSI frame:

- When configured with the "Gray converter" setting, the absolute encoder will deliver its value in Gray code. The TB20 SSI module will convert this value to natural binary before sending it to the TB20 master.
- When configured with the "Binary code converter" setting, the value read from the absolute encoder will remain unchanged when transmitted to the TB20 master.

Note

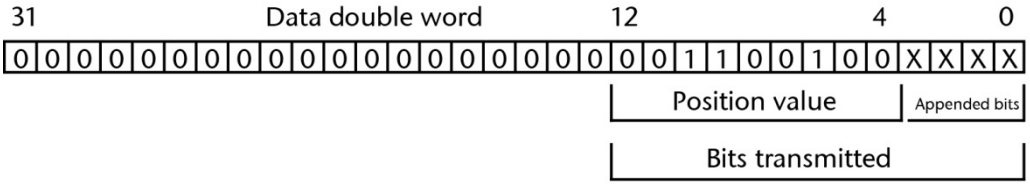
Using the "Gray converter" setting will not result in the entire encoder value being converted. More specifically, any special bits that follow the actual position value (appended bits) will not be converted, ensuring that they will retain their original value when transmitted.

8.1.2. Encoder Value and Normalization

This function depends on the structure of the absolute encoder data word sent to the TB20 master.

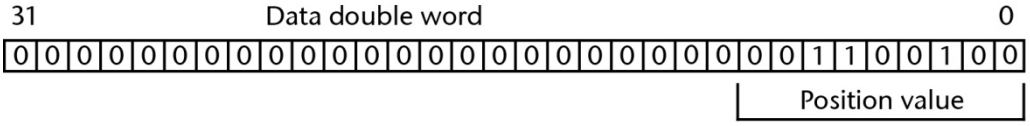
The normalization function per se will produce a normalized data word based on the frame. This means that only the bits relevant to the position will be sent – more specifically, that they will be moved in such a way that the least significant bit of the position value will be bit 0 and that the bits not relevant to the position will all be set to 0. This will apply even if the encoder sends the data word in multi-turn or Tannenbaum format.

Without normalization: Cyclically read encoder position 100

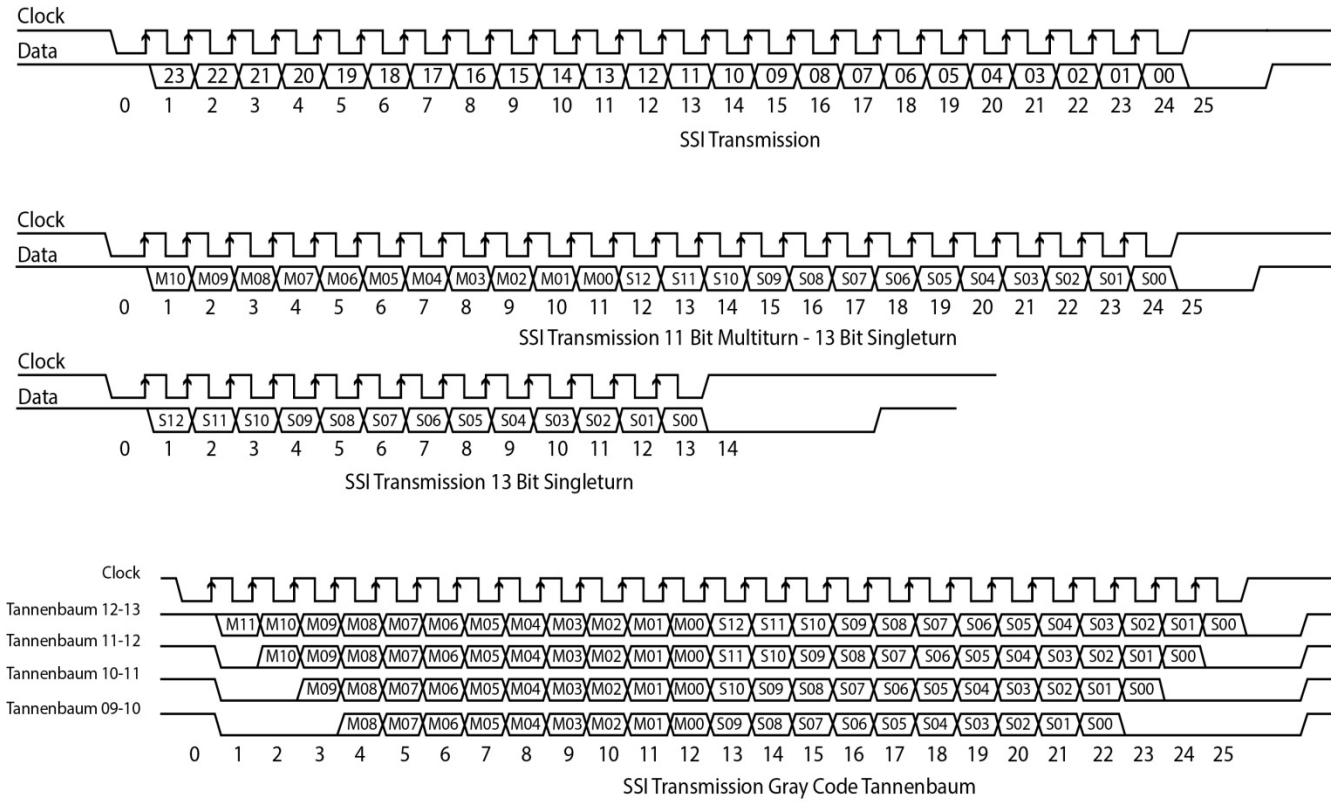


From the bits transmitted, bits 4 to 12 are needed in order to evaluate the encoder position.

After normalization: Encoder position 100



Bits 0 to 3 (marked with "X" above) have been removed.



8.1.3. Direction Detection

The TB20 SSI module uses the encoder position values it reads to determine what the current counting direction is. It then shows this counting direction using its LED indicators (please refer to Section 7.3) and sends it to the TB20 master using feedback data (please refer to 8.2.1).

8.1.4. Direction Reversal

When the counting direction is reversed, the counting direction will be changed in line with the encoder's direction of movement.

8.1.5. Latch Function

The TB20 SSI module features an edge-triggered digital input that can be used to read the absolute encoder value (latch function). If the function is configured (please refer to 8.3), the TB20 SSI module will evaluate this input. When the appropriate edge is detected, the encoder value will be accordingly read and stored until the latch memory is reset with a control command bit (please refer to 8.2.2).

8.1.6. Comparator Function

The TB20 SSI module comes with the option of comparing the current position value with up to two configurable absolute values. The comparison results will be output both in the feedback data and on the status LEDs.

After loading a comparison value the comparator function is a activated as soon as the corresponding "comparison value " bit (output byte 4, bit 0 or 1) is reset to 0 and the input byte 5 bit 0 "loading function running " changes from value 1 to value 0.

The type of comparison can be configured as follows using the parameter data:

Setting	Comparison result
0 – Disabled	The module will not perform any comparisons. The feedback bit will be set to 0.
1 – Forward direction	The current encoder value will be compared using the positive counting direction. • Encoder value >= Comparison value ⇨ Feedback bit = 1 • Encoder value < Comparison value ⇨ Feedback bit = 0 If the counting direction is negative or the encoder is stopped, the feedback bit will remain unchanged.
2 – Reverse direction	The current encoder value will be compared using the negative counting direction. • Encoder value <= Comparison value ⇨ Feedback bit = 1 • Encoder value > Comparison value ⇨ Feedback bit = 0 If the counting direction is positive or the encoder is stopped, the feedback bit will remain unchanged.
3 – Both directions	The current encoder value will be compared using both counting directions. If the counting direction is positive: • Encoder value >= Comparison value ⇨ Feedback bit = 1 • Encoder value < Comparison value ⇨ Feedback bit = 0 If the counting direction is negative: • Encoder value <= Comparison value ⇨ Feedback bit = 1 • Encoder value > Comparison value ⇨ Feedback bit = 0 If the encoder is stopped, the feedback bit will remain unchanged.

8.2. Input and Output Bit Assignments in Counter Mode

8.2.1. Feedback (Inputs)

Input space length: 6 bytes

	7	6	5	4	3	2	1	0
Bytes 0–3	Bits 0–30 = Encoder value; bit 31 = Latch active							
Byte 4	Reserved	Ready for operation	Reserved	Encoder value fault	24-V encoder supply fault	DI state	DN state	UP state
Byte 5	Reserved	Reserved	Reserved	Reserved	Comparator 1 state	Comparator 2 state	Loading function error	Loading function running

Encoder value

Bytes 0 to 3 contain the current encoder value and a bit indicating whether the latch function is active. More specifically, bits 0 to 30 contain the current encoder value and bit 31 indicates that the encoder value is a stored value / that the latch function is active.

Ready for operation

Byte 4, bit 6 is used to signal that the TB20 SSI module is ready for operation, i.e., that communications between the module and the connected encoder are OK.

Absolute encoder fault

Byte 4, bit 4 is used to signal faults such as wire breaks and parity errors detected when communicating with the absolute encoder. The corresponding fault needs to be reset before the module can be used.

24-V encoder supply fault

Byte 4, bit 3 is used to signal faults in the 24-V encoder supply.

The corresponding fault needs to be reset before the module can be used.

DI state

Byte 4, bit 2 is used to signal the state of the latch function's digital input.

DN state

Byte 4, bit 1 is used to signal a negative direction of movement.

UP state

Byte 4, bit 0 is used to signal a positive direction of movement.

Comparator 1 state

Byte 5, bit 3 is used to signal the state of comparator 1 (please refer to 8.1.6).

Comparator 2 state Byte 5, bit 2 is used to signal the state of comparator 2 (please refer to 8.1.6).

Loading function error Byte 5, bit 1 is used to indicate that an error occurred when attempting to execute the loading function. To eliminate the error bits "load reference value 2" and "load reference value 1" (output byte 4, bits 0 and 1) are to be set to 0.

Loading function running Byte 5, bit 0 is used to signal that the loading function is active.

8.2.2. Control Interface (Outputs)

Output space length: 6 bytes

	7	6	5	4	3	2	1	0
Bytes 0–3	Preset count for reference value 1 or 2							
Byte 4	Reset fault	Reset latch function	Reserved	Reserved	Reserved	Reserved	Load reference value 2	Load reference value 1
Byte 5	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved	Reserved

Preset count for reference value Used to specify the count that will be used as a reference value by the comparator.

Reset fault This bit is used to reset the aforementioned faults/errors.

Reset latch function This bit is used to reset the latch function.

Load reference value 2 This bit is used to start transmitting the preset count (from bytes 0 to 3) to comparator 2.

Load reference value 1 This bit is used to start transmitting the preset count (from bytes 0 to 3) to comparator 1.

8.3. Parameters

All configurable modules come with a default parameter configuration. Depending on the bus system being used, the bus coupler will automatically load the desired operating parameter configuration into the modules when starting up or the user will have to transfer the configuration from the PLC by using the relevant methods. When using bus couplers with project storage capabilities (e.g., CANopen couplers), the parameters can be configured in advance with the “TB20 ToolBox” program. Modules can also be reconfigured at any time—even during operation. The methods that have to be used for this purpose will vary depending on the bus system and PLC being used.

8.3.1. Parameter Set Structure

Parameter set length: 10 bytes

Byte	7	6	5	4	3	2	1	0
0	Operating mode							
1	Encoder value coding	Encoder value bit width						
2–5	Total number of encoder steps							
6	Multiple transmission		Parity		Number of appended bits			
7	Baud rate				Monostable multivibrator time period			
8	Comparator 2 mode				Comparator 1 mode			
9	Diagnosis alarm	Reserved	Reserved	Reserved	Normalization	Direction reversal	Latch	

Operating mode 1 = Operating mode 1

Encoder value coding 0 = Gray code; 1 = Natural binary code

Encoder value bit width 0 = No encoder
8 = 8 bits / 9 = 9 bits /…/15 = 15 bits/ … / 31 = 31 bits (with no parity bit)

Total number of encoder steps (16 – 2^31); (16,…, 32768,…, 2147483648)

Multiple transmission 0 = No multiple transmission
1–3 = Multiple transmission with 1–3 idle cycles

Parity bit 0 = None; 1 = Odd; 2 = Even

Number of appended bits 0 bits–15 bits

Baud rate/Clock frequency 0 = 125 kHz; 1 = 250 kHz; 2 = 500 kHz; 3 = 1 MHz;
4 = 1.5 MHz; 5 = 2 MHz

Monostable multivibrator time period 0 = 16 µs; 1 = 32 µs; 2 = 48 µs; 3 = 64 µs

Comparator 1/2 mode 0 = Disabled; 1 = Forward direction; 2 = Reverse direction; 3 = Both directions

Diagnosis alarm 0 = Disabled; 1 = Enabled

Normalization 0 = Disabled; 1 = Enabled

Direction reversal 0 = Disabled; 1 = Enabled

Latch 0 = Disabled; 1 = Rising edge at DI;
2 = Falling edge at DI; 3 = Both edges at DI

Note

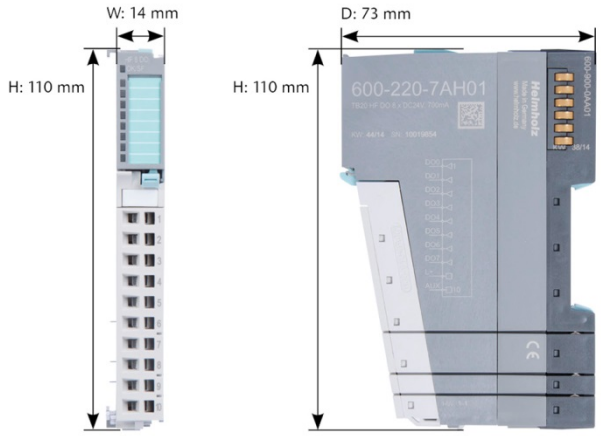
The corresponding default settings are underlined.

9. Technical Specifications

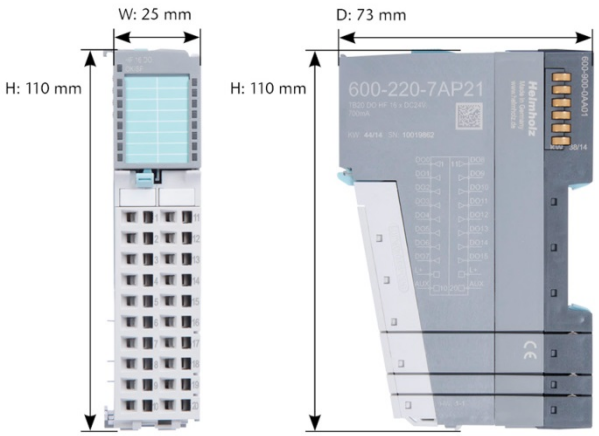
Order No.	**600-320-7AA01**
Module designation	TB20 SSI module
Module ID / Module model	12100/0401
Number of SSI decoders	1
Internal Gray-natural binary conversion	Configurable
Direction detection	Yes
Direction reversal	Configurable
Encoder value normalization	Configurable
Encoder value latch function	Can be triggered with a 24 V digital input
Power supplied to encoder by module	24 VDC
Electrically isolated from backplane bus	Yes
Current draw	
External	Max. 20 mA + max. 24-V encoder supply load of 100 mA
Internal	Max. 130 mA
Power dissipation	Max. 1.0 W
Input characteristic curve	Type 2, EN 61131-2
Hot-pluggable	Yes
Parameter configuration length	10 bytes
Dimensions (H x W x D)	110 mm x 14 mm x 73 mm
Weight	70 g
Certifications	CE, UL 508 (pending)
Noise immunity	DIN EN 61000-6-2 "EMC Immunity"
Interference emission	DIN EN 61000-6-2 "EMC Emission"
Vibration and shock resistance	DIN EN 60068-2-8:2008 “Vibration” DIN 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

10. TB20 System Dimensions

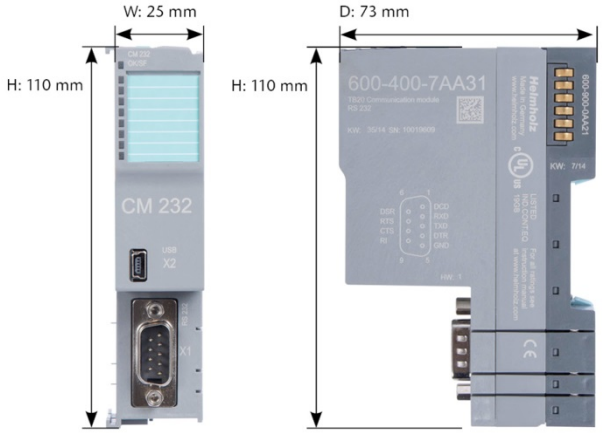
Module with standart width



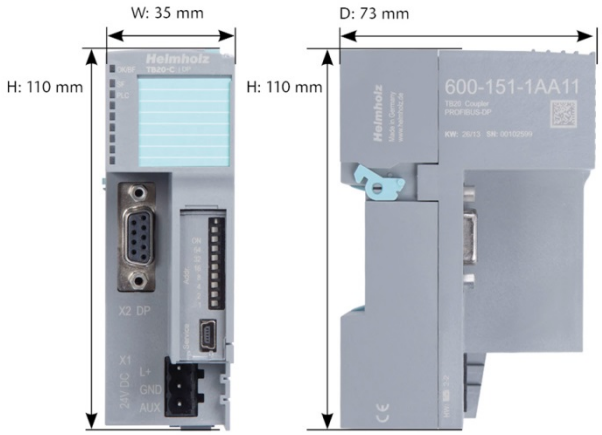
Module with double width

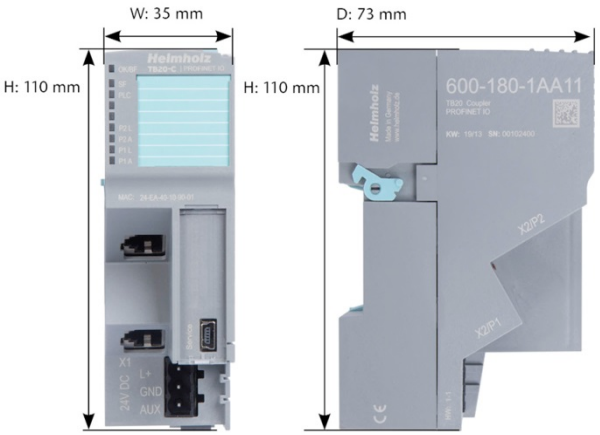


Communication Module



Bus Coupler





11. Spare Parts

11.1. Base Modules

11.1.1. 14 mm-Width Standard Base Module

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

11.1.2. 25 mm-Width Base Module

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

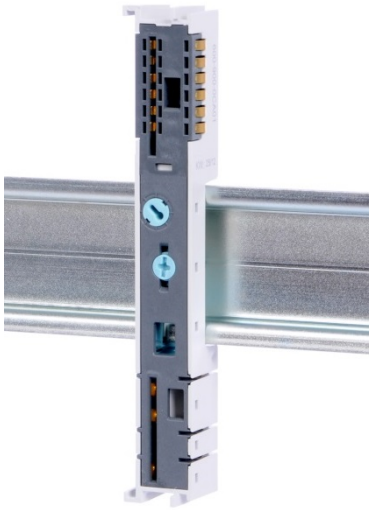
11.1.3. Power and Isolation Base Module

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

11.1.4. Power Base Module

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

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



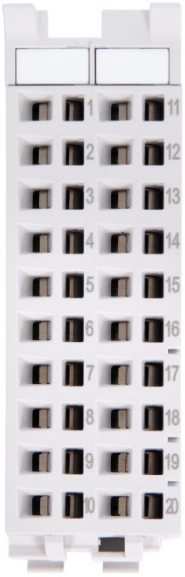
11.2. Front Connectors

11.2.1. 10-Terminal Front Connector

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

11.2.2. 20-Terminal Front Connector

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



11.3. Electronic Modules

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.

11.4. Final Bus Cover

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