TB20 – Serial interface 1SI

Manual

Version 1 / 10/29/2015 for HW 1 & FW V1.04.000 and higher

Manual order no.: 960-400-7BA31/en

Notes

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

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Revision Record

Version	Date	Change
1	10/16/2015	First version 1SI RS232/RS422/485 Renner 10-5-15

Table of contents

1 General Information

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

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

1.3   Note symbols and signal words in the manual

HAZARD

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

WARNING

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

CAUTION

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

ATTENTION

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

NOTE

Gives an indication for better understanding or preventing errors.

1.4   Intended use

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

Communication with a higher-level control system is via a bus system / network and 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-swapping for replacing modules during ongoing operation.

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

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

HAZARD

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

1.5   Improper use

WARNING

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

1.6   Installation

1.6.1   Access restriction

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

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

1.6.2   Electrical installation

Observe the regional safety regulations.

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.

1.6.3   Protection against electrostatic discharges

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

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

1.6.4   Overcurrent protection

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

1.6.5   EMC protection

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

1.6.6 Operation

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

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

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

1.6.7 Liability

The contents of this manual are subject to technical changes resulting from the continuous development of products of Systeme Helmholz GmbH. 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

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

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

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

1.6.9 Warranty

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

The warranty is not valid in case of:

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

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

2   System overview

2.1   General Information

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

It is made up of the following components:

- Bus couplers

- Peripheral modules

- Power and isolation modules

- Power modules

By using these components, you can build a custom automation system that is tailored to your specific needs and that can have up to 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
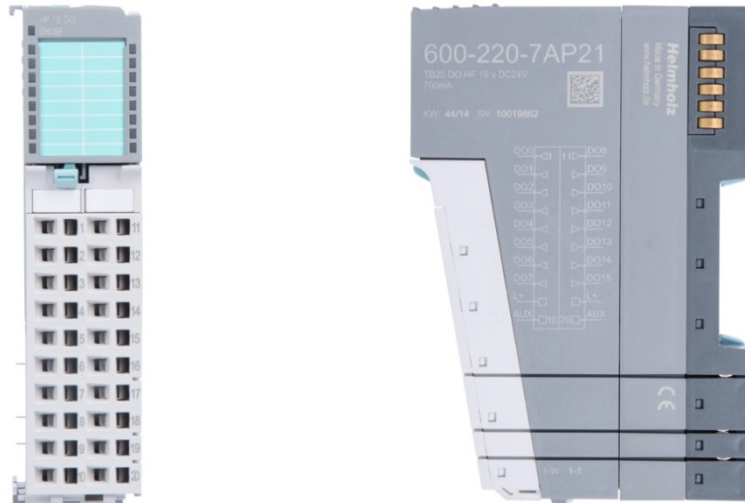
2.2.3   Power and isolation module

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.

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i NOTE

Power modules have a lighter body color.

2.2.5   Final bus cover

The final bus cover protects the contacts on the last base module from accidental contact by covering the outer right-hand side of the base module.
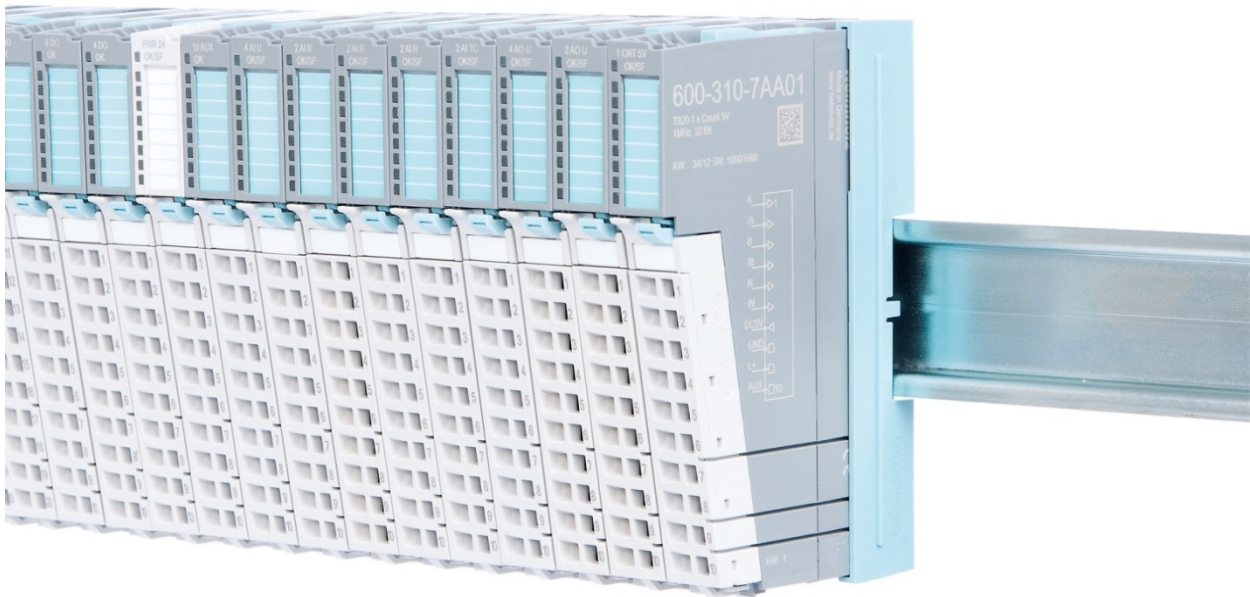
2.2.6   Components in a module

Each module consists of three parts:

- Base module
- Electronic module
- Front connectors

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).
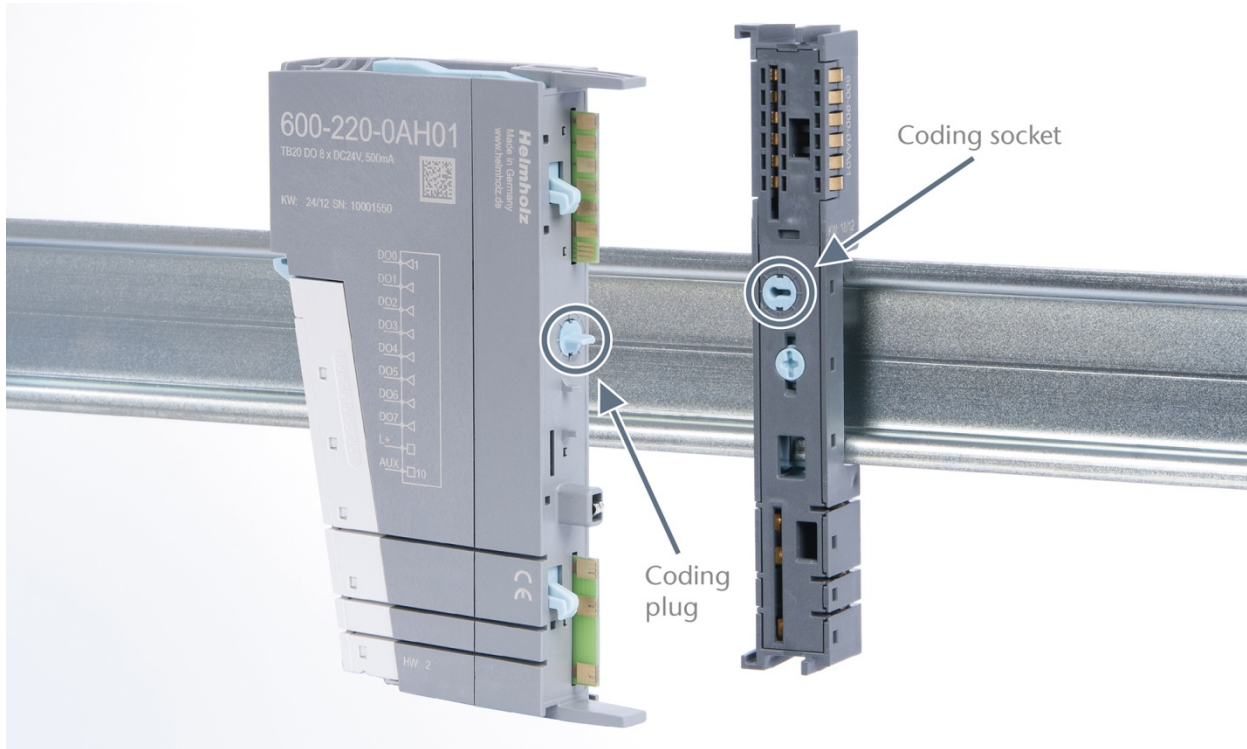
The coding plug and coding socket can each be in one of eight different positions. Each of these eight positions is factory-assigned to a specific type of module (Digital In, Digital Out, Analog In, Analog Out, Power) from the TB20 system. It will only be possible to plug an electronic module into a 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, as well as the cables supplying them with power! During work when the system is live, there is the risk of fatal electrocution!

ATTENTION

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

3.1 Installation position

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

In order to achieve optimum ventilation and be able to use the system at the specified maximum ambient temperature, it 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.
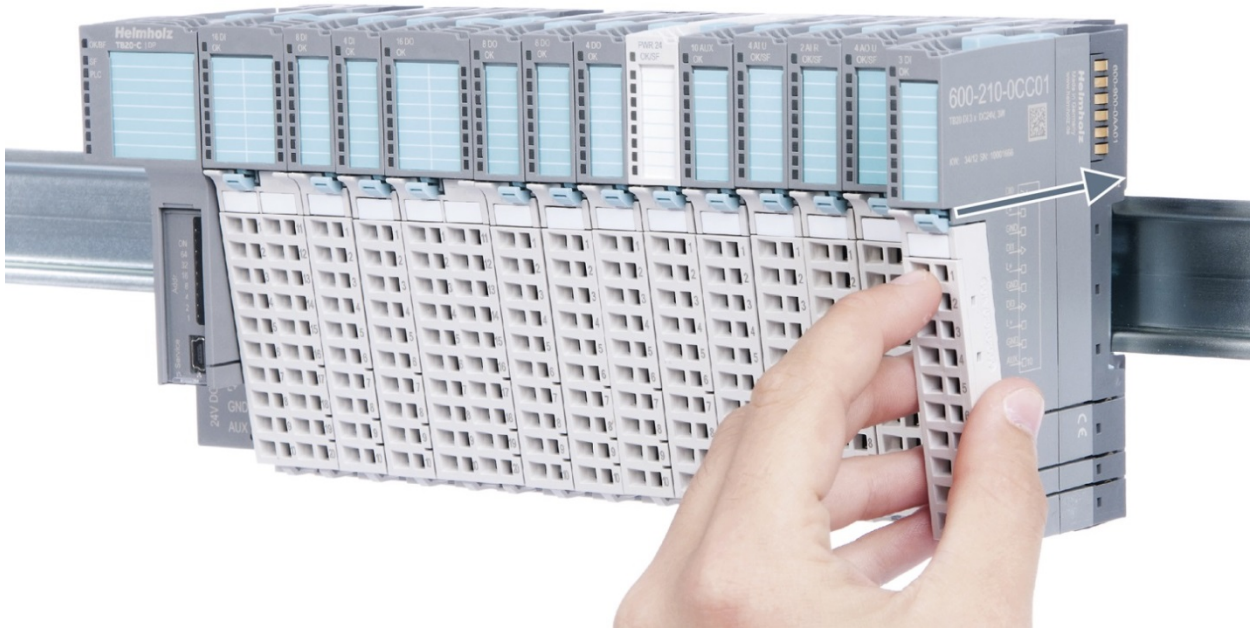
Installing the individual parts of a peripheral module one after the other

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 16) on the base module in a straight line from above 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 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).
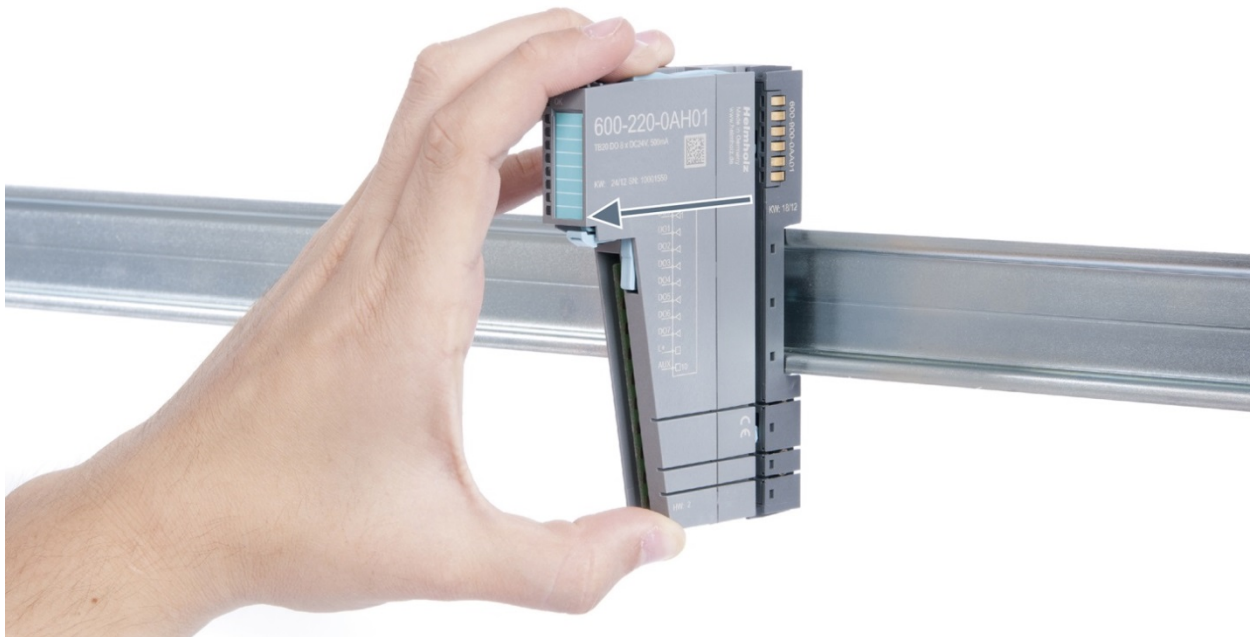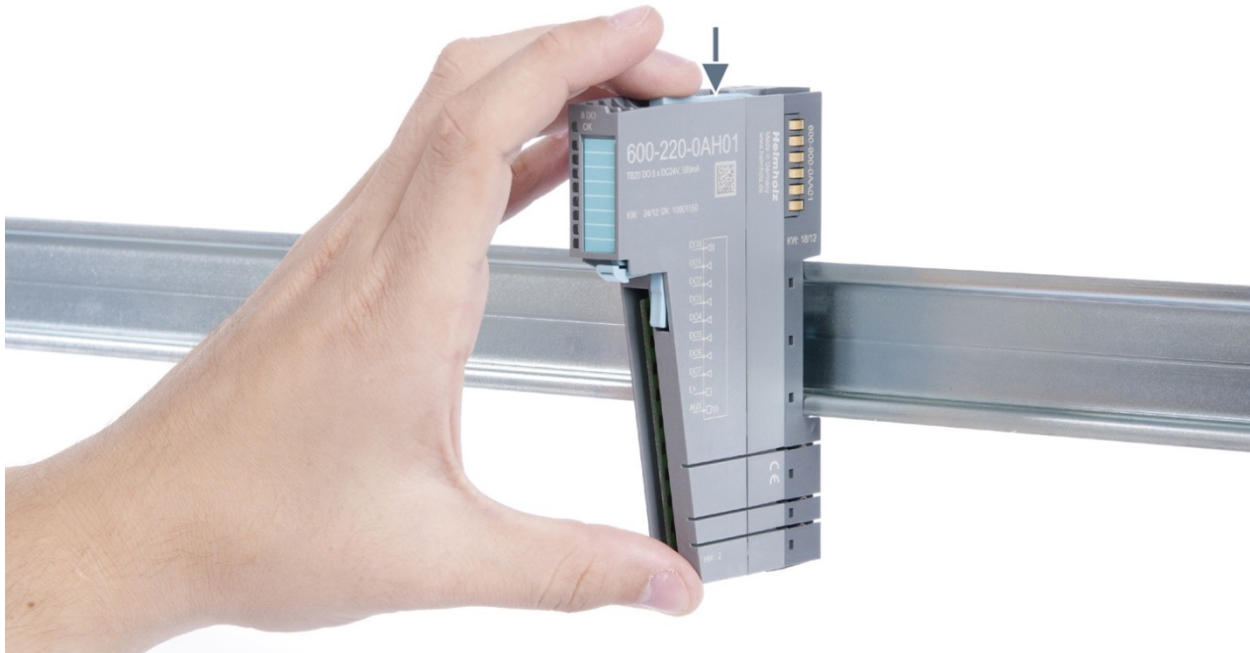
Step 3: Release the base module

Use a screwdriver to release the base module. by turning the locking mechanism 90° counterclockwise.
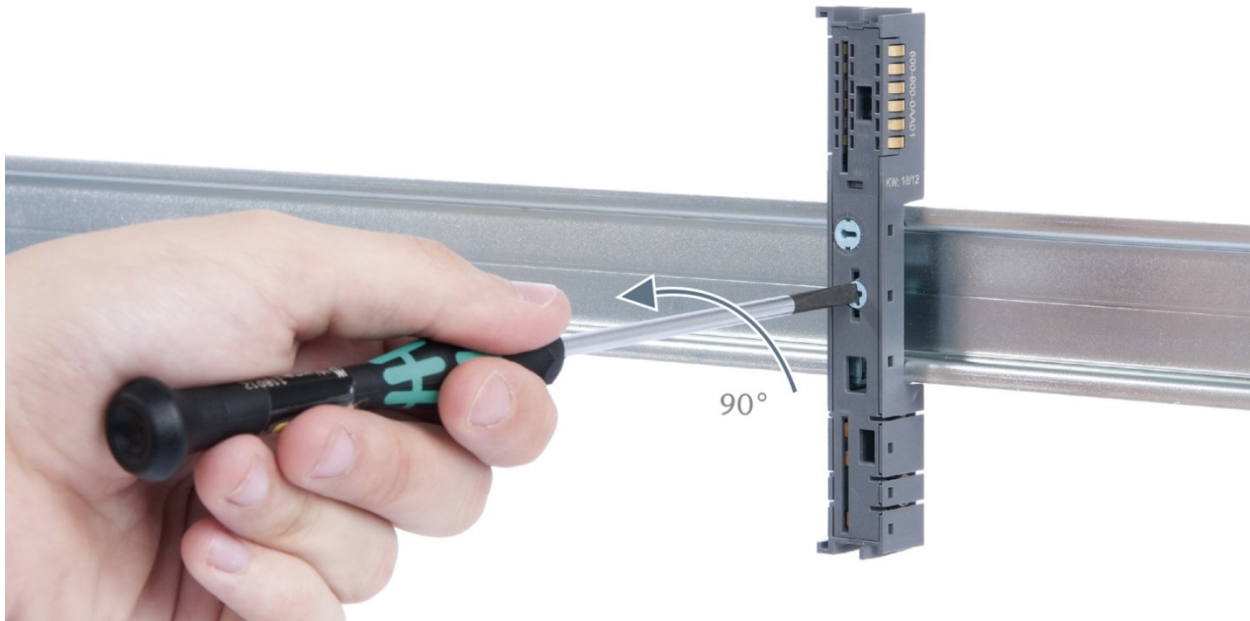
Step 4: Remove the base module

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.

⚠️ **HAZARD**

TB20 modules can carry lethal voltage.

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

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

Step 1: Remove the front connector

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

Step 2: Remove the electronic module

To remove the electronic module, use your middle finger to push on the lever from above and then use your thumb and index finger to pull out the electronic module while holding the lever down (see the picture below).
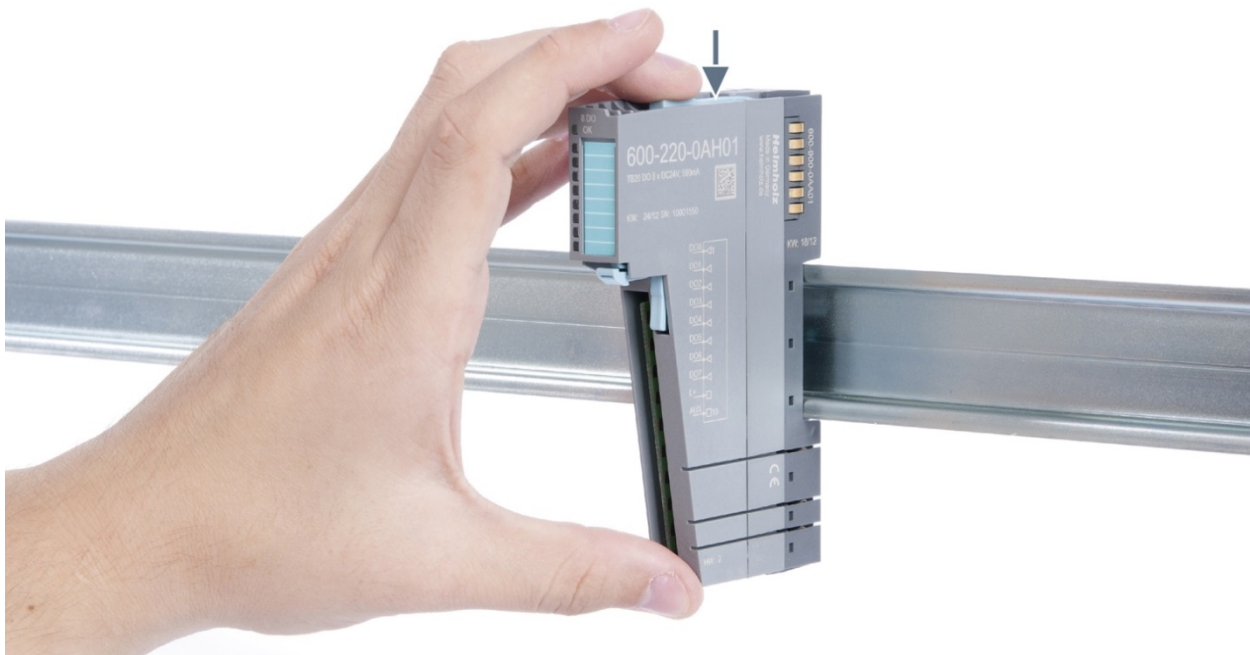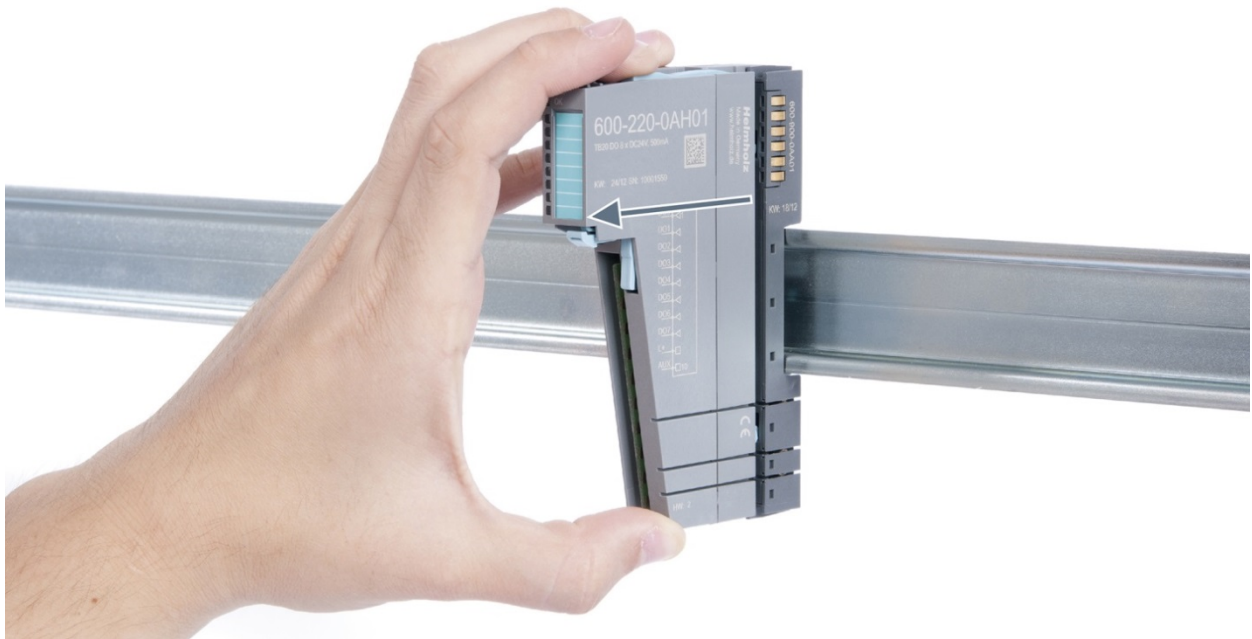
Step 3: Plug in a new electronic module

> ![ATTENTION]
>
> **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.
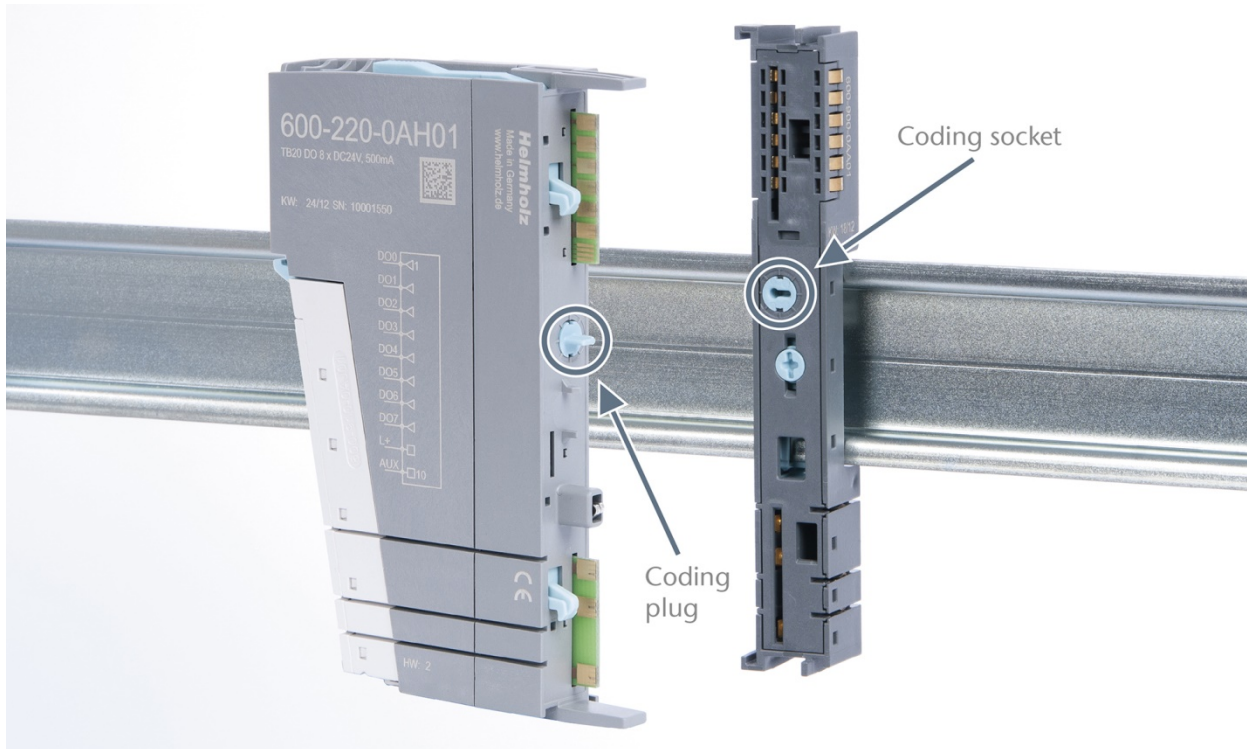
Step 4: Plug in the front connector

3.5   Installing and removing the coupler

3.5.1   Installation

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.
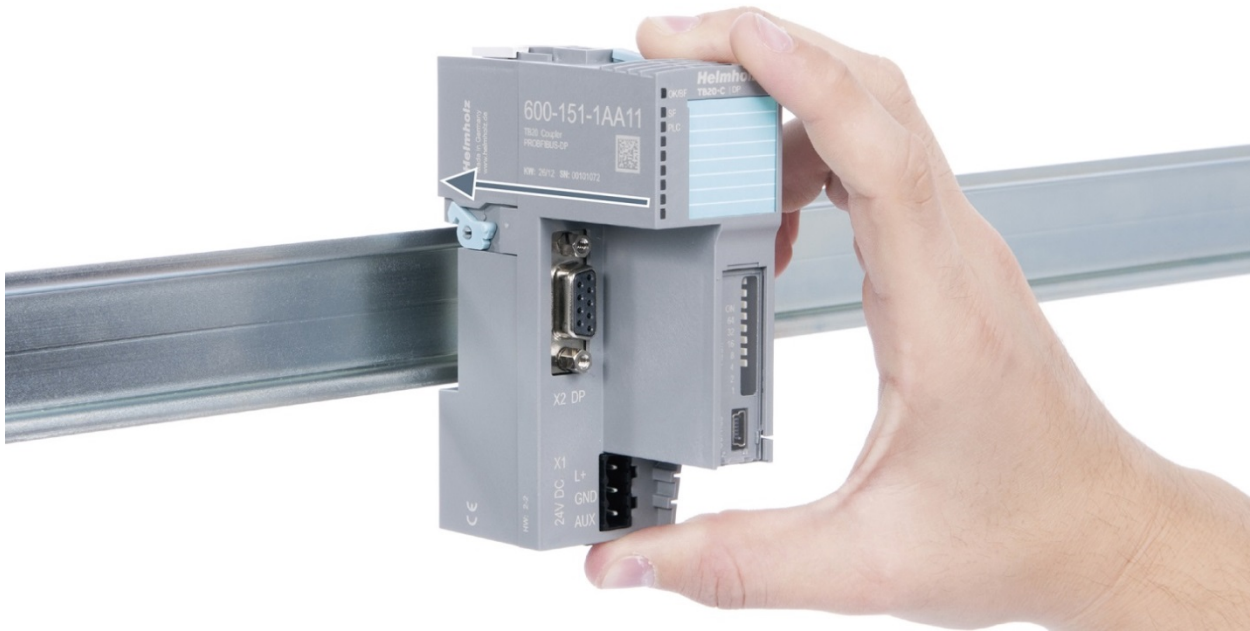
Step 2: Secure the coupler on the DIN rail

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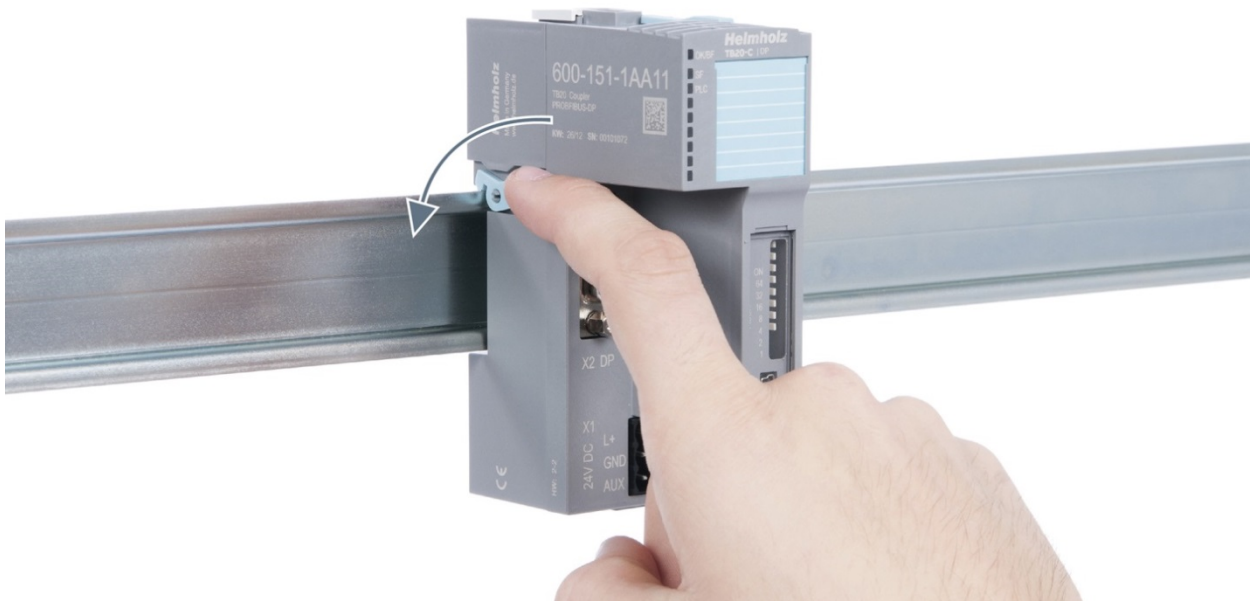
3.5.2   Removal

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.
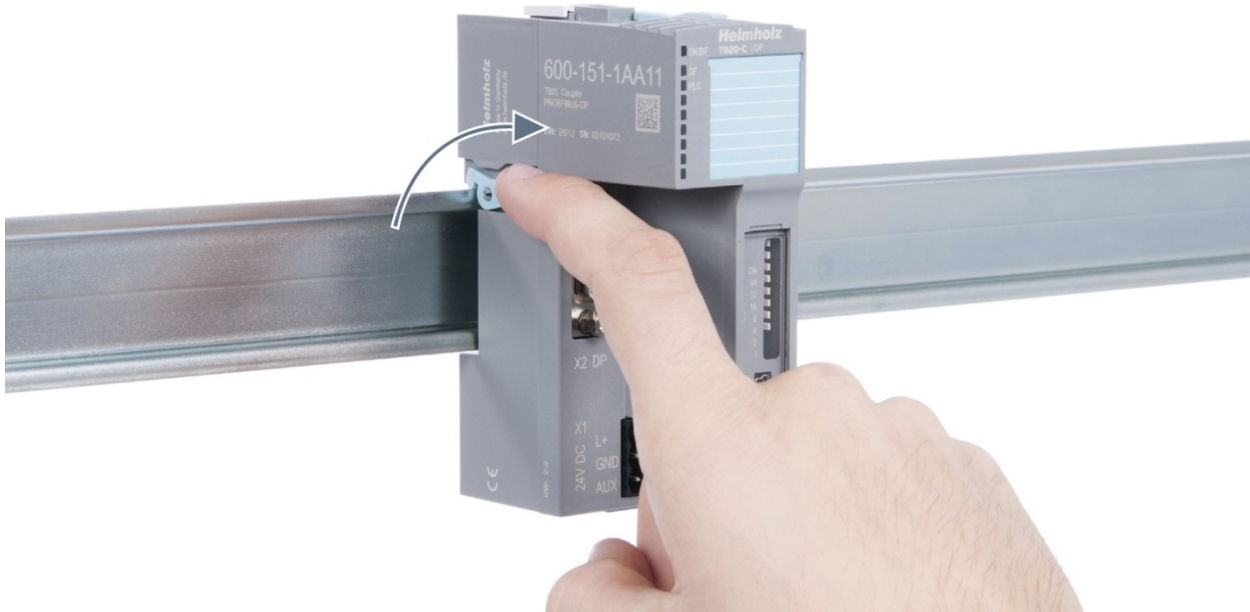
Step 2: Remove the coupler

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.
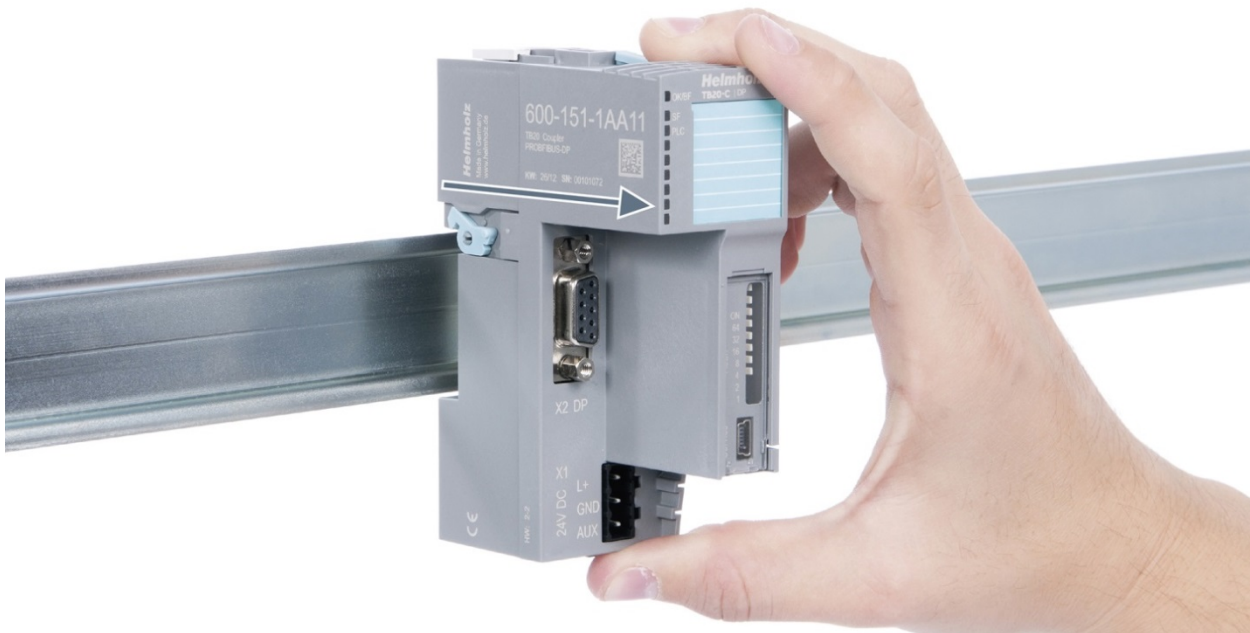
Step 3: Release the base module

Use a screwdriver to release the base module.
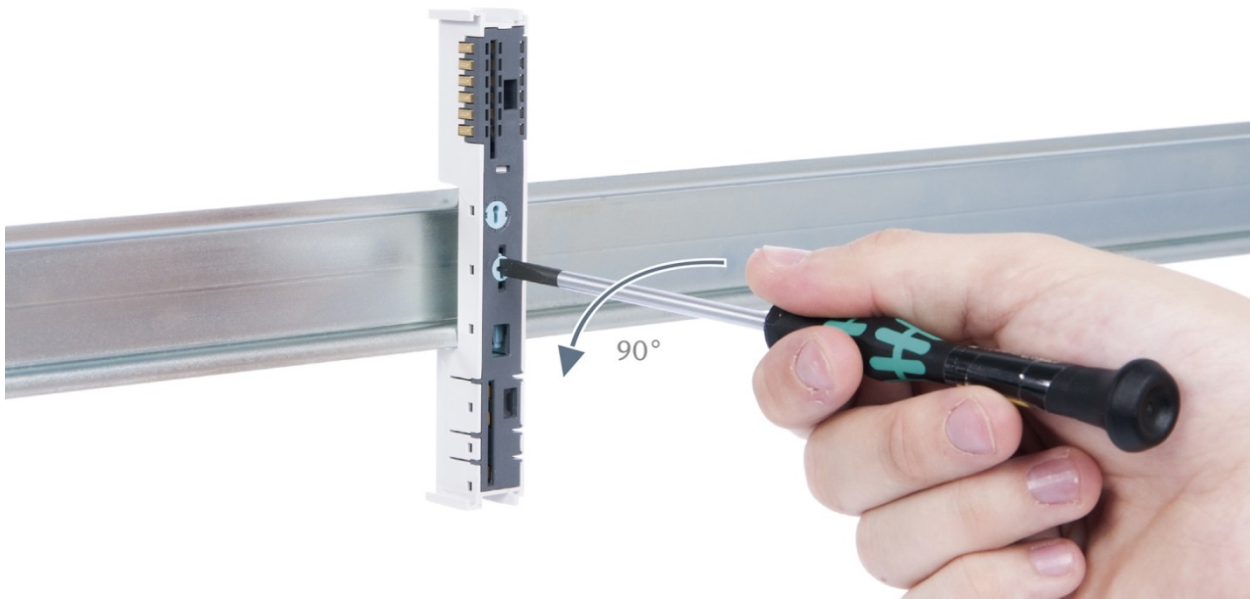
Step 4: Remove the base module

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 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.
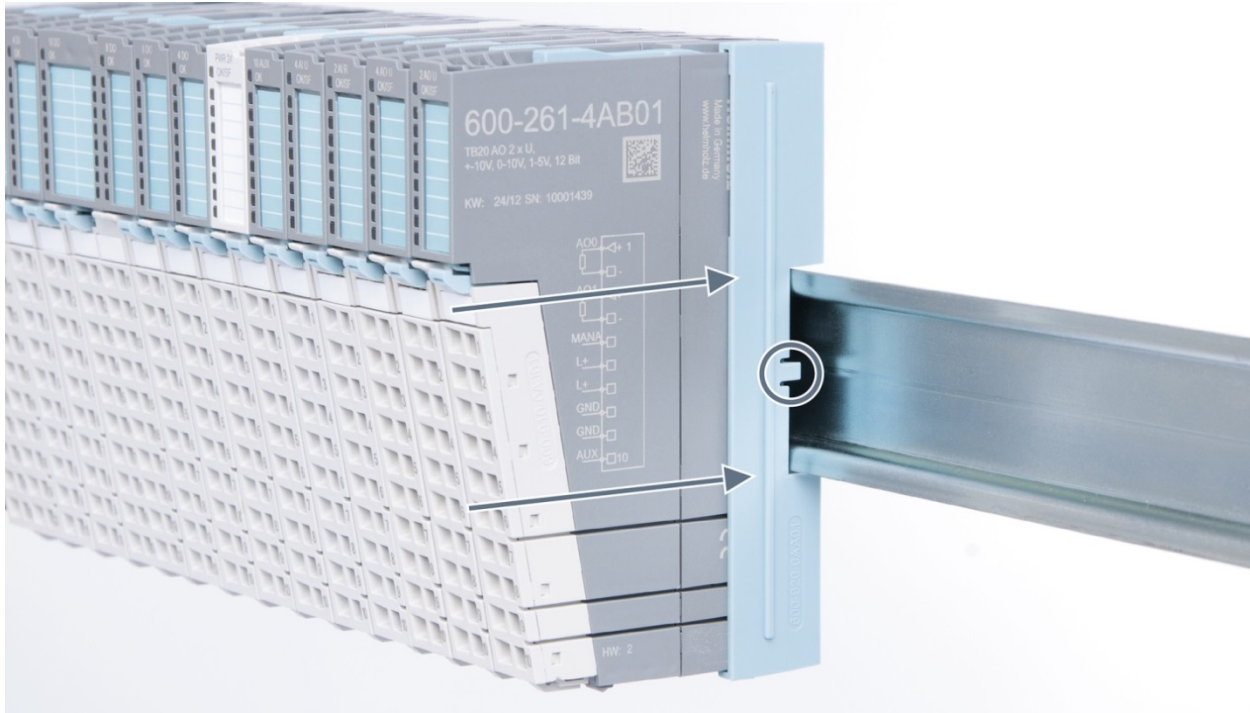
3.6.2   Removal

Pull the final bus cover along the module's case and away from the DIN rail in order to remove it from the module.
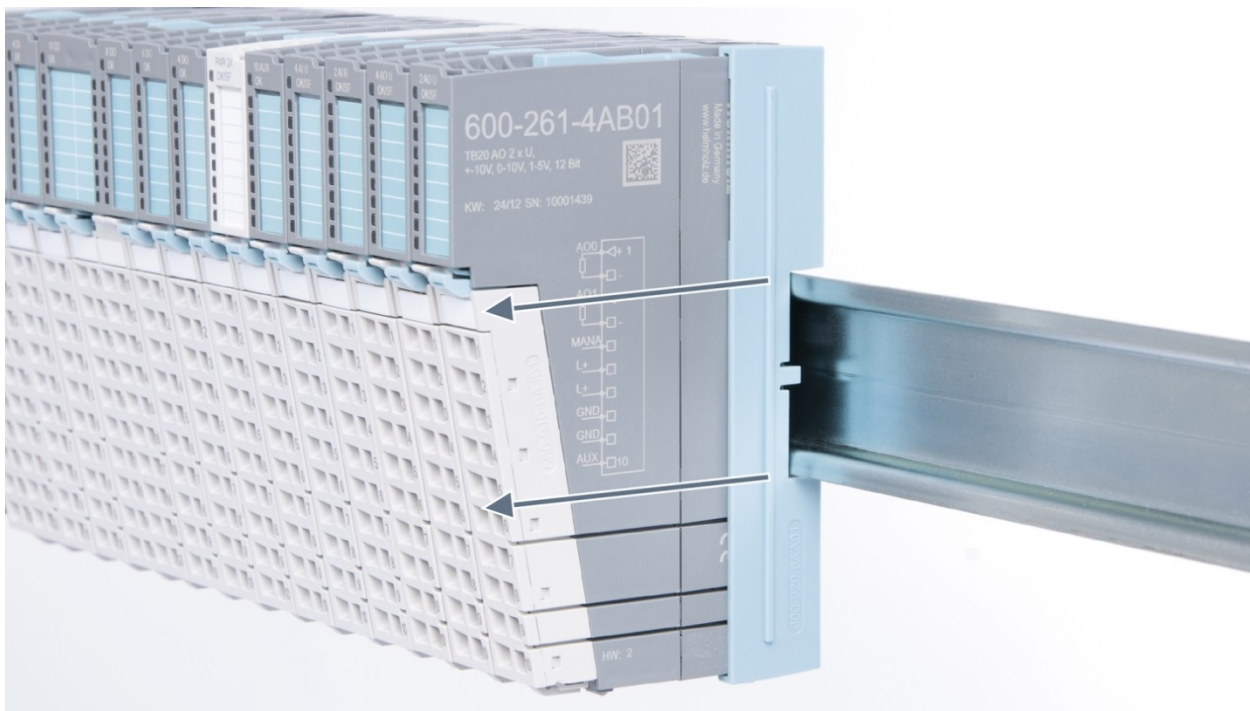
4 Configuration/wiring

4.1 EMC/safety/shielding

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

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

ATTENTION

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

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

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

- All metal parts of the cabinet are to be connected with each other over a large area with good conductivity (no paint on paint). Where necessary, use contact washers or serrated washers.

- The cabinet door must be connected to the ground straps (top, middle, bottom) over as short a distance as possible.

- Signal cables and power cables are to be laid separated spatially by a minimum distance of 20 cm from each in order to avoid coupling paths.

- Run signal lines only from one level into the cabinet if possible.

- Unshielded cables in the same circuit (outgoing and incoming conductors) must be twisted if possible.

- Contactors, relays, and solenoid valves in the closet, or in adjacent cabinets if applicable, must be provided with quenching combinations; e.g., with RC elements, varistors, diodes.

- Do not lay wires freely in the closet; instead, run them as closely as possible to the cabinet housing or mounting panels. This also applies to reserve cables. These must be grounded on at least one end, and it is better if they are grounded on both ends (additional shielding effect).

- Unnecessary line lengths should be avoided. Coupling capacitances and inductances are kept low in this way.

- Analog signal lines and data lines must be shielded.

4.2   Front 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.
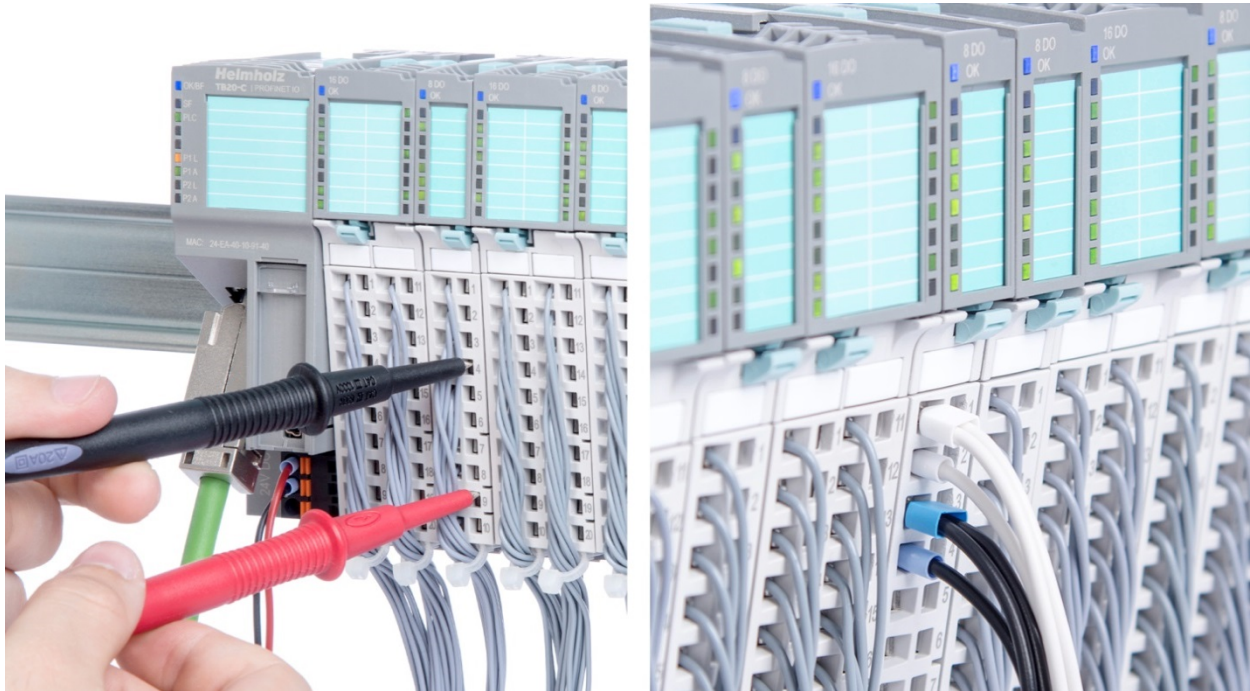
4.3   Wiring the coupler

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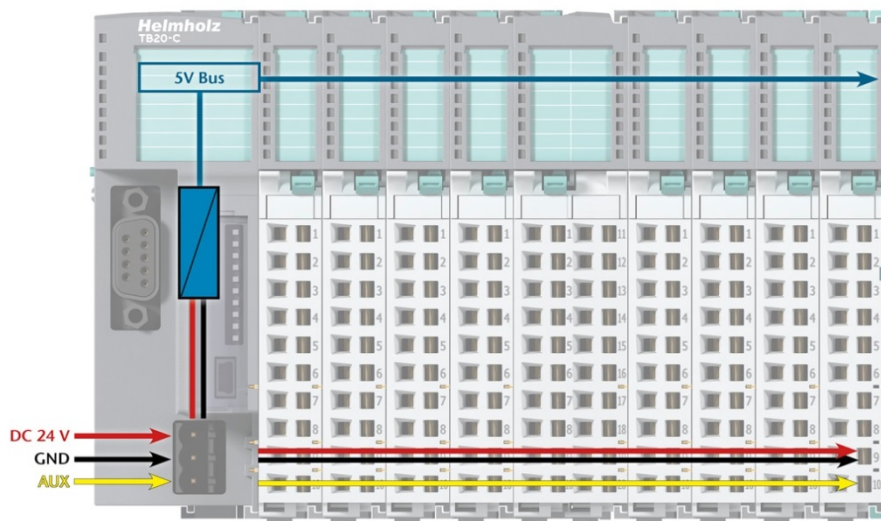
The coupler and the modules are grounded via the shield contact to the DIN rail. The DIN rail must be grounded. The surface of the DIN rail must be clean and conduct electricity well.
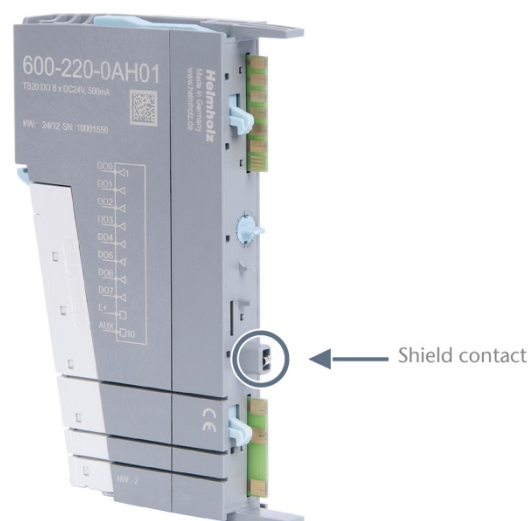
4.4 Using power and isolation modules

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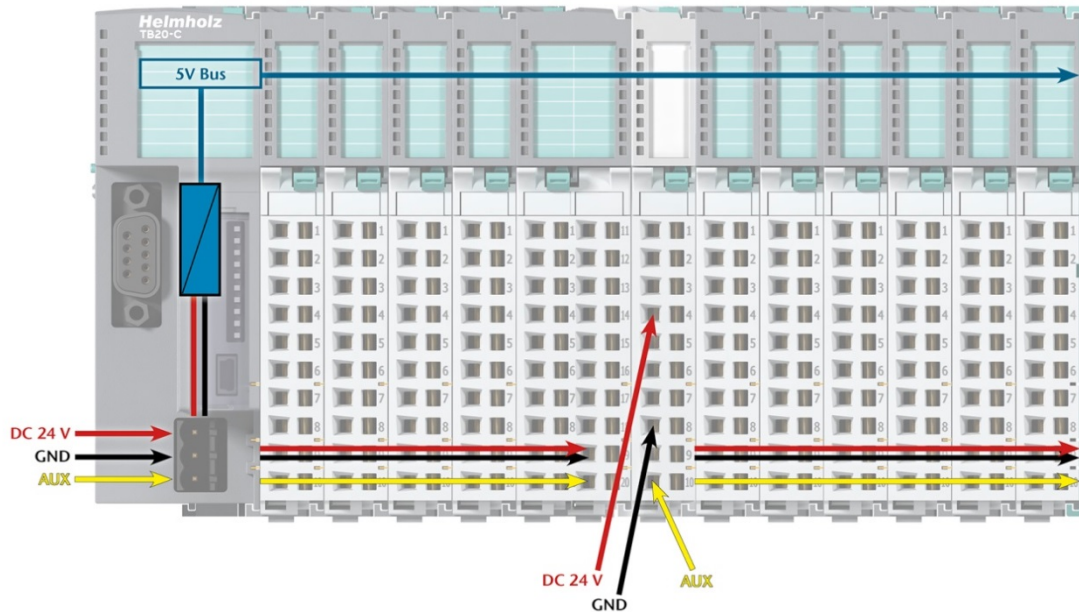
The order no. for the power and isolation module for 24 V signals is 600-710-0AA01.

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.
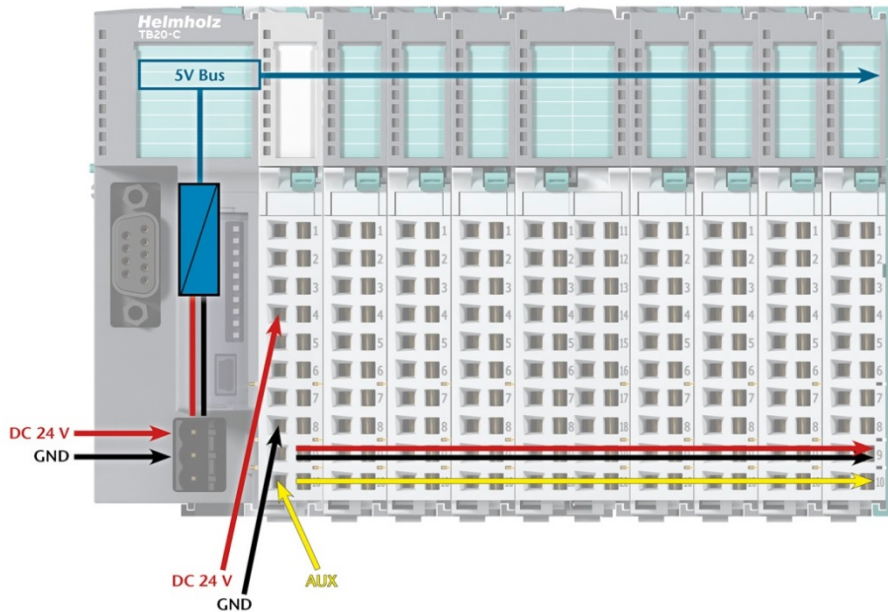
4.6   Using Power Modules

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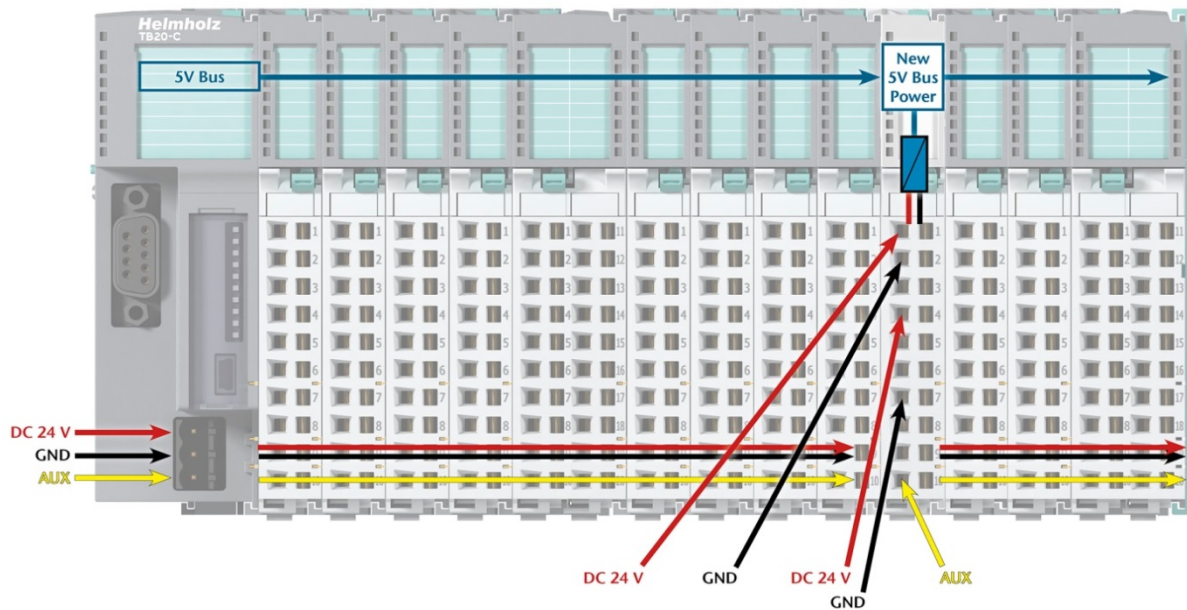
The order no. for the power module is 600-700-0AA01. The electronic module of the power module is light gray like the front connector. The base module of the power module is light gray with a dark top part.

4.7   Function of the OK-LED

The topmost LED (OK-LED) on every module indicates the module's current system status.

Solid blue light: The module is running (RUN)

Slowly flashing blue light: The module is stopped (STOP); substitute values (if any) are being applied

Quickly flashing blue light: The module is idle (IDLE); its parameters have not been configured yet

Solid red light: The module is indicating a diagnostic error

Flashing red light: The module is indicating a parameter assignment error
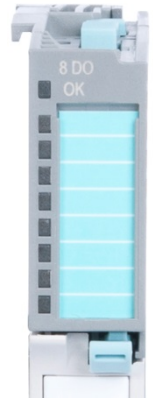
The red LED lights will only be shown on modules with configurable parameters or diagnosis capabilities.

4.8   Electronic nameplate

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

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

4.9   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.

4.10 Dimensions

Module with standard width

W: 14 mm

H: 110 mm

D: 73 mm

H: 110 mm
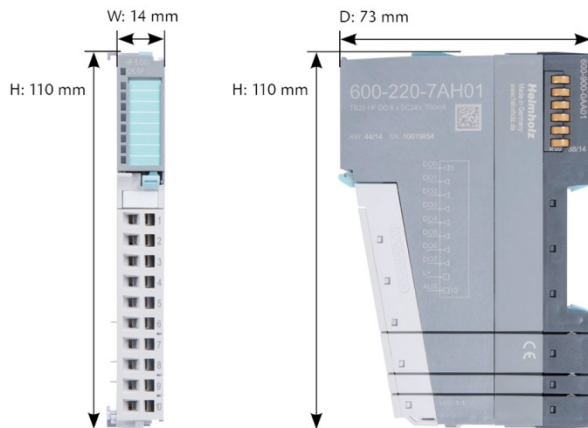
Module with double width

W: 25 mm

H: 110 mm

D: 73 mm

H: 110 mm

Communication Module

W: 25 mm

H: 110 mm

D: 73 mm

H: 110 mm

Bus Coupler

W: 35 mm

H: 110 mm

D: 73 mm

H: 110 mm

W: 35 mm

H: 110 mm

D: 73 mm

H: 110 mm
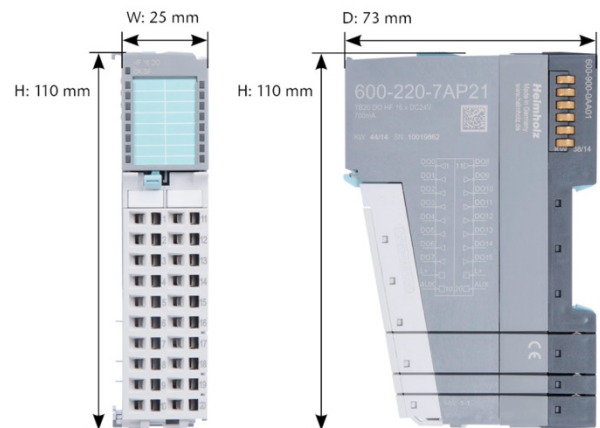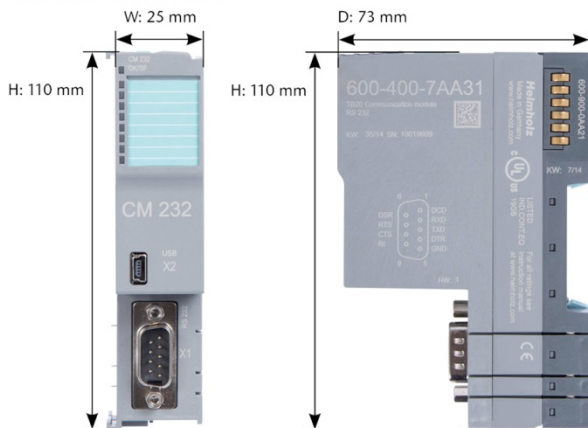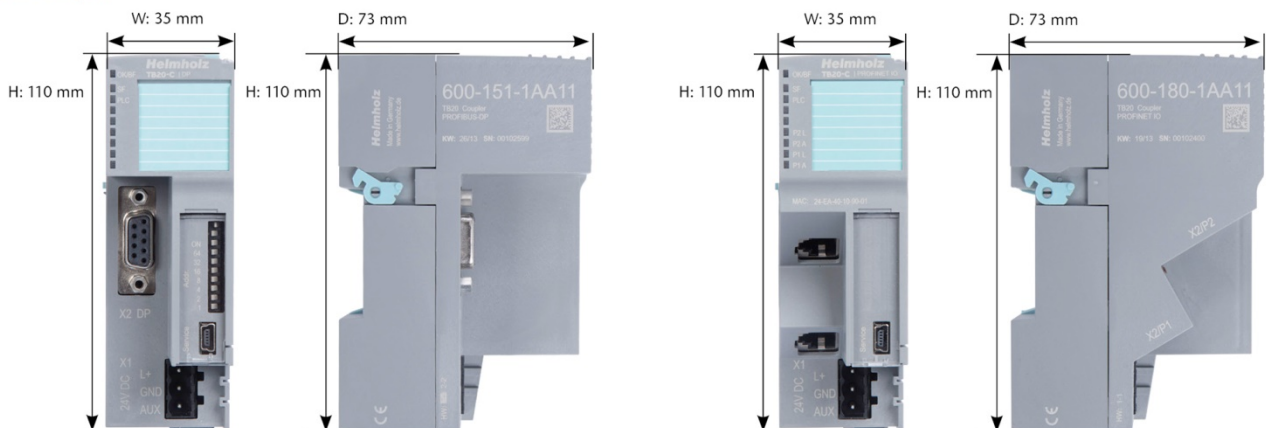
5 TB20 – Serial interface 1SI

5.1 Properties RS232

The 1SI serial interface is a module for the Helmholz fieldbus I/O system TB20. Communication with a Helmholz fieldbus coupler is via the backplane bus of the TB20 system.

The 1SI serial interface is a voltage interface for serial data transmission in accordance with the RS232C standard.

Through the TB20 bus, parameter data and control commands are transmitted from the TB20 fieldbus coupler to the 1SI serial interface. The 1SI serial interface sends feedback data to the TB20 fieldbus coupler.

The 1SI serial interface allows for a point-to-point connection with various modules with serial interface.

Serial communication

The 1SI serial interface handles the data transmission with the communication partner automatically. The ASCII and the 3964(R) protocols are available for bidirectional data transfer. The modes half duplex and full duplex are possible.

Half-duplex

The data is transmitted alternately between the communication partners. A communication partner cannot transmit and receive simultaneously. Control characters for flow control are transmitted regardless of the transmit/receive operation.

Full-duplex

The data is transmitted simultaneously in both directions between the communication partners. The communication partners must be equipped for simultaneous transmit/receive operation.

The 1SI serial interface can be configured via the TB20-ToolBox software and GSD, and GSDML.

5.2   Properties RS422/RS485

The 1SI serial interface is a module for the Helmholz fieldbus I/O system TB20. Communication with a Helmholz fieldbus coupler is via the backplane bus of the TB20 system.

The 1SI serial interface is a voltage difference interface for serial data transmission in accordance with the RS422/485 standard.

Through the TB20 bus, parameter data and control commands are transmitted from the TB20 fieldbus coupler to the 1SI serial interface. The 1SI serial interface sends feedback data to the TB20 fieldbus coupler.

The 1SI serial interface allows for a point-to-point connection with various modules with serial interface. The ASCII and the 3964(R) protocols are supported (3964(R) not for RS485) for communication with connected serial devices.

Serial communication

The 1SI serial interface handles the data transmission with the communication partner automatically. The ASCII and the 3964(R) protocols are available (3964(R) not for RS485) for bidirectional data transfer. The modes half duplex and full duplex (except 3964(R)) are possible.

Half-duplex RS422/RS485

The data is transmitted alternately between the communication partners. A communication partner cannot transmit and receive simultaneously. Control characters for flow control are transmitted regardless of the transmit/receive operation.

Full-duplex RS422

The data is transmitted simultaneously in both directions between the communication partners. The communication partners must be equipped for simultaneous transmit/receive operation.

The 1SI serial interface can be configured via the TB20-ToolBox software and GSD, and GSDML.

5.2.1 Functions in the RS232 operating mode

Communications module 1SI serial interface	600-400-7BA31
Protocols	ASCII 3964(R)
Physical layer	RS232
Connection	Sub-D 9-pin
Transmission rates Procedure ASCII driver and 3964(R) driver	110, 300, 600, 1,200, 4,800, 9,600, 14,400, 19,200, 38,400, 57,600, 76,800, 115,200 baud
Signals	TXD, RXD, RTS, CTS, DTR, DSR, DCD, GND
Cable length	Max. 15 m LIYCY 7x0.14
Data bits	7 data bits / 8 data bits
Stop bits	1 stop bit / 2 stop bits
Parity	None / Even / Odd / Custom
ASCII frame end detection	Terminator, number of characters, inter-character delay (1–65535 ms)
Frame length	1–224 characters
Using RS232C escort signals	yes
Controlling/reading RS232C escort signals with FBs	For communication with Siemens PLC
Flow control with RTS/CTS	yes
Flow control with XON/XOFF	yes

5.2.2 Functions in the RS422 operating mode

Communications module 1SI serial interface	600-400-7BA31
Protocols	ASCII 3964(R)
Physical layer	RS422
Connection	Sub-D 9-pin
Transmission rates Procedure ASCII driver and 3964(R) driver	110, 300, 600, 1,200, 4,800, 9,600, 14,400, 19,200, 38,400, 57,600, 76,800, 115,200 baud
Signals	TX-, RX-, TX+, RX+, GND
Cable length	Max. 1,200 m LIYCY 3x2x0.14, drilled paired
Data bits	7 data bits / 8 data bits
Stop bits	1 stop bit / 2 stop bits
Parity	None / Even / Odd / Custom
ASCII frame end detection	Terminator, number of characters, inter-character delay (1–65535 ms)
Frame length	1–224 characters
Using RS232C escort signals	no
Controlling/reading RS232C escort signals with FBs	no
Flow control with RTS/CTS	no
Flow control with XON/XOFF	yes

5.2.3 Functions in the RS485 operating mode

Communications module 1SI serial interface	600-400-7BA31
Protocols	ASCII
Physical layer	RS485
Connection	Sub-D 9-pin
Transmission rates Procedure ASCII driver and 3964(R) driver	110, 300, 600, 1,200, 4,800, 9,600, 14,400, 19,200, 38,400, 57,600, 76,800, 115,200 baud
Signals	D-, D+, GND
Cable length	Max. 1,200 m LIYCY 3x2x0.14, drilled paired
Data bits	7 data bits / 8 data bits
Stop bits	1 stop bit / 2 stop bits
Parity	None / Even / Odd / Custom
ASCII frame end detection	Terminator, number of characters, inter-character delay (1–65535 ms)
Frame length	1–224 characters
Using RS232C escort signals	no
Controlling/reading RS232C escort signals with FBs	no
Flow control with RTS/CTS	no
Flow control with XON/XOFF	no

5.2.4 Pin assignment RS232

The pin assignment applies for the 1SI serial interface with configured RS232 protocol.
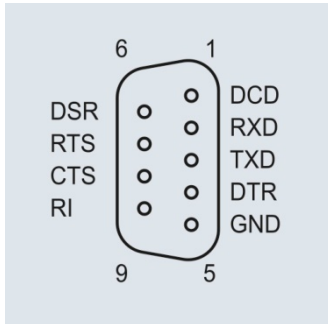
Pin	Name	Function	Direction	Description
1	DCD	Data Carrier Detect	Input	Carrier signal (modem)
2	RxD	Receive Data	Input	Receive Data Receiving line is held at logic "1" by the communication partner
3	TxD	Transmit Data	Output	Transmit Data The 1SI serial interface keeps the transmission line in the idle state logic "1"
4	DTR	Data Terminal Ready	Output	ON = 1SI serial interface is ready for operation
5	GND	Signal Ground		Reference potential
6	DSR	Data Set Ready	Input	Communication partner ready for operation?
7	RTS	Request to send	Output	ON = 1SI serial interface ready to transmit OFF = does not transmit
8	CTS	Clear to send	Input	Communication partner ready to receive? The 1SI serial interface responds on RTS=ON.
9	RI	Ring indicator	Input	Ring indicator (modem)

5.2.5 Cable assignment of point-to-point connection RS232

For the point-to-point connection to a RS-232 communication partner with 9-pin SUB-D terminal, a cable with the pin assignment in accordance with the following image is required.

TB20, 1SI serial interface

Communication partner
with 9-pin SUB-D connector

2	RXD	←	TXD	3
3	TXD	→	RXD	2
7	RTS	→	CTS	8
8	CTS	←	RTS	7
6	DSR	←	DTR	4
4	DTR	→	DSR	6
5	PE	(ground)	PE	5

Shield
connection

Enclosure shield
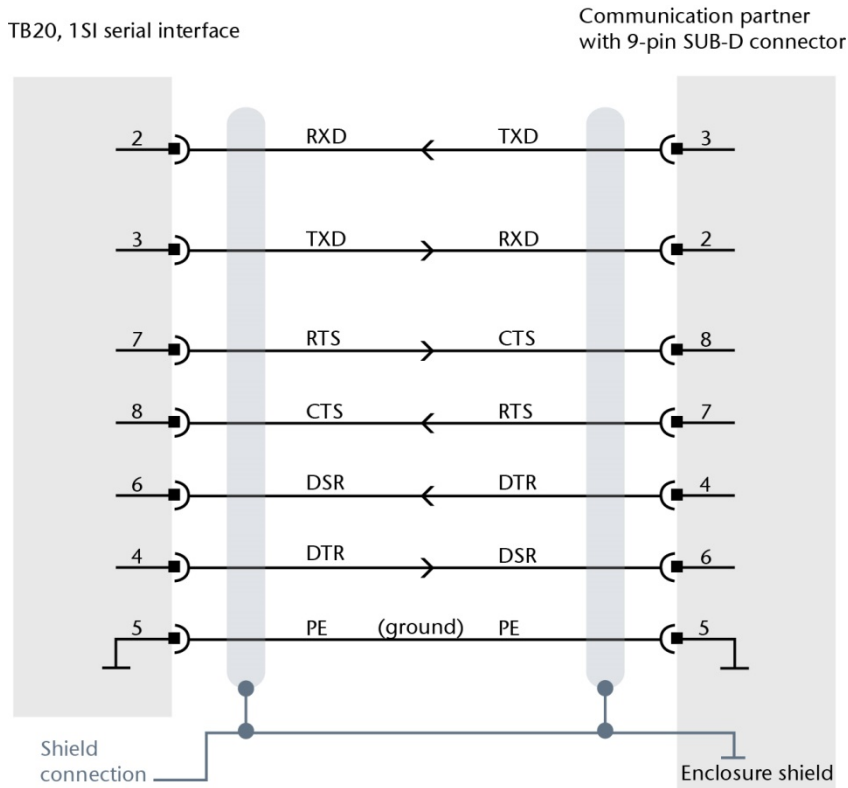
5.2.6 Pin assignment RS422

The pin assignment applies for the 1SI serial interface with configured RS422 protocol.
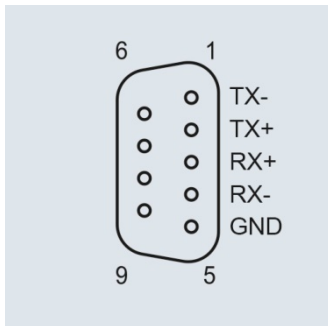
Pin	Name	Function	Direction	Description
1	TX-	Transmit Data (A)-	Output	Transmit data
2	TX+	Transmit Data (A)+	Output	Transmit data
3	RX+	Receive Data (B)+	Input	Receive data
4	RX-	Receive Data (B)-	Input	Receive data
5	GND	Ground		
6				
7				
8				
9	GND			

NOTE

By way of the configuration of the module, a termination with an internal 120Ω terminating resistor can be activated at the terminals Rx- und Rx+.

5.2.7 Cable assignment of point-to-point connection RS422

For the point-to-point connection to a RS422 communication partner with 9-pin SUB-D terminal, a cable with the pin assignment in accordance with the following image is required.
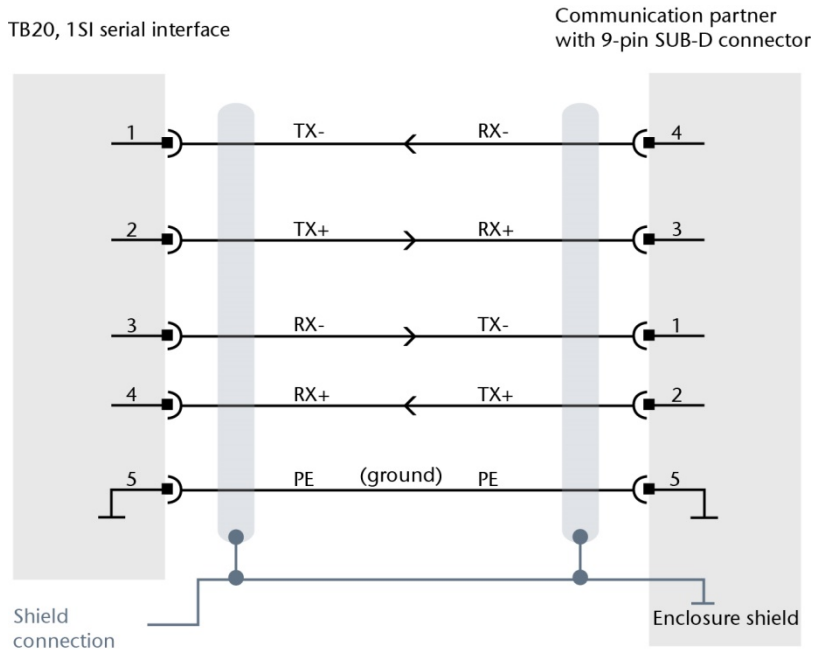
5.2.8   Pin assignment RS485

The pin assignment applies for the 1SI serial interface with configured RS485 protocol.
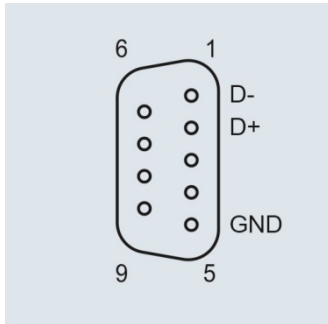
Pin	Name	Function	Direction	Description
1	D-	Receive Transmit Data (R/T)+		Receive data/ Transmit data
2	D+	Receive Transmit Data (R/T)-		Receive data/ Transmit data
3				
4				
5	GND	Ground		
6				
7				
8				
9				

Recommended cable type: LIYCY 3x2x0.14, drilled paired (Belden8102 or equivalent)

Possible line lengths when using the recommended cable

Cable length	Transmission rate
1200 m	19,200 baud
500 m	38,400 baud
250 m	76,800 baud

NOTE

By way of the configuration of the module, a termination with an internal 120Ω terminating resistor can be activated at the terminals D- and D+.

5.2.9 Cable assignment of point-to-point connection RS485

For the point-to-point connection to a RS485 communication partner with 9-pin SUB-D terminal, a cable with the pin assignment in accordance with the following image is required.
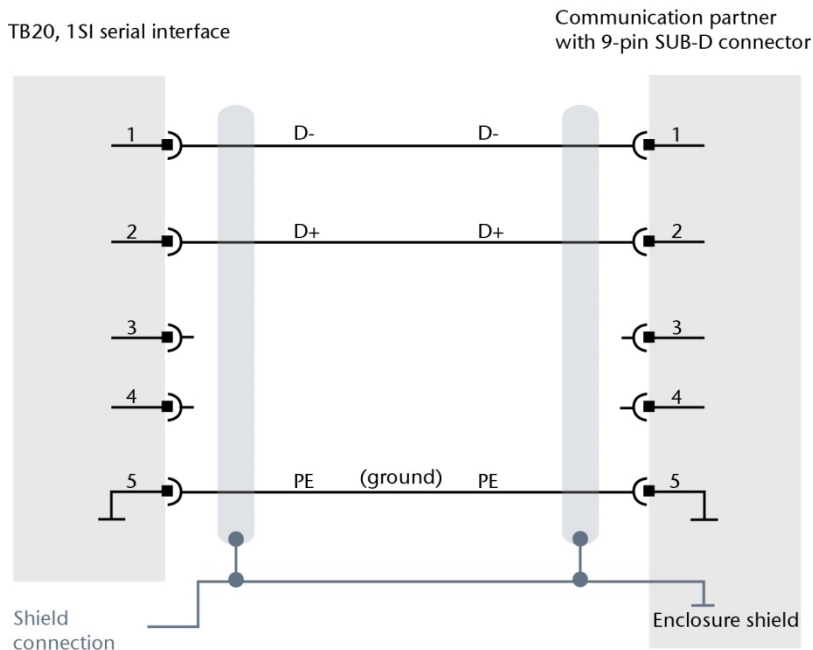
Recommended cable type: LIYCY 3x2x0.14, drilled paired (Belden8102 or equivalent)

Possible line lengths when using the recommended cable

Cable length	Transmission rate
1200 m	19,200 baud
500 m	38,400 baud
250 m	76,800 baud
200 m	115,200 baud

> ℹ️ **NOTE**
>
> By way of the configuration of the module, a termination with an internal 120Ω terminating resistor can be activated at the terminals D- and D+.

5.2.10 USB interface

Function	Firmware update
· Protocol	USB 1.01 Device, Full Speed
· Terminal	Mini-USB

5.2.11 LEDs of the serial interface
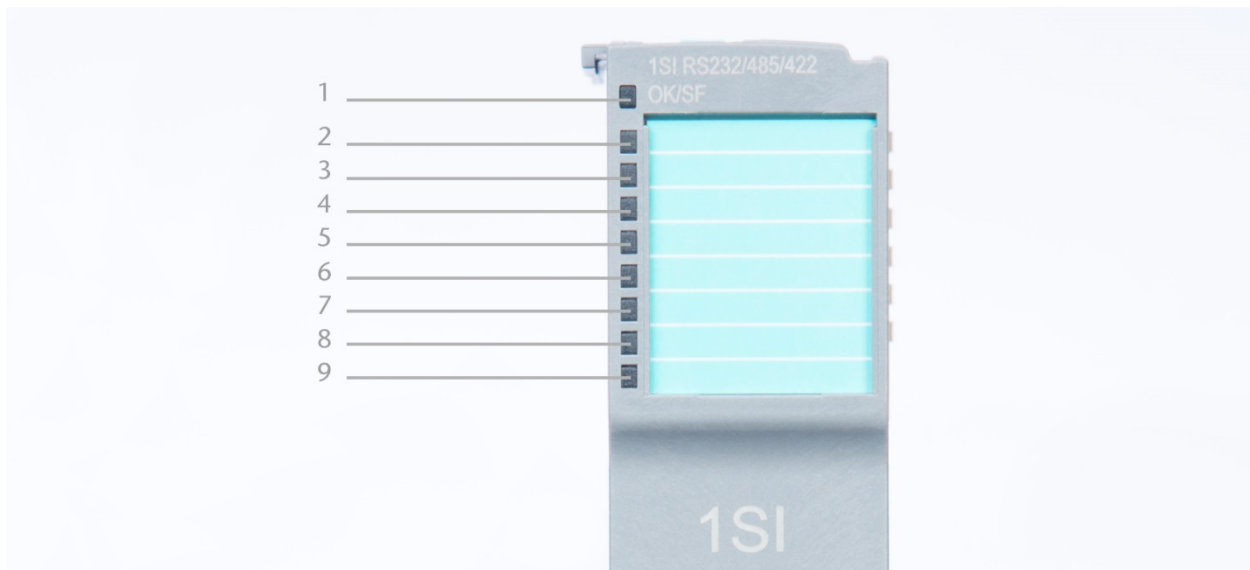
LED	Name	Display	Description
1	OK/SF LED	Solid blue light	The module is running (RUN)
		Slowly flashing blue light	The module is stopped (STOP)
		Quickly flashing blue light	The module is idle (IDLE); module's parameters have not been configured yet
		Solid red light	The module is indicating a diagnostic error
		Flashing red	The module is indicating a parameter assignment error
2	PLC	Quickly flashing green	Communication with PLC is taking place
3	TxD	Solid green light	Characters are being transmitted
4	RxD	Solid green light	Characters are being received
5	CTS	Solid green light	If CTS signal is high
6	RTS	Solid green light	If RTS signal is high
7	RS232		
8	RS485		
9	RS422		

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).

6 Commissioning

6.1 TB20-ToolBox

In the TB20-ToolBox, positioning and configuration of the parameters of the components for the planning of a system is possible. Using the USB interface of the bus coupler, parameters can be configured for the 1SI serial interface.

6.2 Firmware update

A firmware update can be requested from the support department of Helmholz if required (e-mail: support@helmholz.de).

6.3 Integrating the 1SI serial interface with the GSD file

The serial interface 1SI can be incorporated into the project and parameterized with a GSD file (PROFIBUS) or GSDML file (PROFINET). The GSD and GSDML files can be downloaded in the download area under www.helmholz.de.

If the serial interface 1SI is used with a Simatic S7 PLC, the standard handling components FB2 and FB3 can be used. The data exchange with the serial interface is described in chapter 8.

6.4 Using the serial 1SI serial interface with other PLCs

Depending upon the coupler type, the serial interface 1SI can be parameterized with the TB20 ToolBox or with coupler-specific methods. The data exchange with the serial interface 1SI is described in chapter 8.

7 Parameterization

7.1 ASCII protocol

7.1.1 Features

Using the ASCII protocol, data can be transferred to and from connected communication partners. The ASCII protocol includes only a bit transmission layer and no data link layer.

With the ASCII protocol, the complete transmission frame is passed from the TB20 master to the 1SI serial interface. The supplied data is not supplemented with control characters by the 1SI serial interface.

In the receive direction, the end criterion of a frame is defined by the parameterization of the module. The structure of the transmission frames may differ from that of the receive frames.

The ASCII protocol allows data with any structure to be sent and received.

All ASCII characters from 00 to FFh (for transmission with 8 data bits) or from 00 to 7Fh (for transmission with 7 data bits) can be transferred.

7.1.2 Transmitting data

During transmission, the number of payload data bytes to be transmitted and the payload data are transferred by the TB20 master. In the payload data, any required start and end characters may need to be included.

If the end criterion "Expiration of character delay time" needs to be configured with parameters, the 1SI serial interface keeps a pause between two frames during transmission.

Data may be transferred at any time to the 1SI serial interface. The 1SI serial interface begins with output only if a time greater than the parameterized character delay time has passed since the last frame was sent.

7.1.3 Receiving data

For receipt of data with the ASCII protocol, three different end criteria are supported. The end criterion specifies when a frame was received completely and is defined by parameterization. Supported end criteria are:

- Reception of the end character(s)
  At the end of the frame, there are one or two defined end characters.

- Reception of a fixed number of characters
  The length of the receive frames is always identical.

- Expiration of character delay time
  The frame has neither a fixed length nor defined end characters. The end of a frame is defined by a pause on the line (expiration of character delay time). The minimum values of the character delay time are dependent on the configured baud rate.

7.1.4 Minimum character delay time

The minimum delay time is dependent on the baud rate; see table:

Baud rate	Minimum character delay time
110	364 ms
300	130 ms
600	65 ms
1 200	32 ms
4 800	8 ms
9 600	4 ms
14 400	3 ms
19 200	2 ms
38 400	1 ms
57 600	1 ms
76 800	1 ms
115 200	1 ms

7.1.5 Receive buffer

The receive buffer of the RS232 serial interface is 4,096 bytes. Parameterization of the 1SI serial interface defines whether the receive buffer is deleted at start-up (changing the operating state from STOP to RUN) and whether overwriting of data is to be prevented in the receive buffer. Whether the buffering of received frames is enabled or disabled is also defined.

The receive buffer of the 1SI serial interface is designed as a ring buffer:

- If several frames are stored in the receive buffer of the 1SI serial interface, the oldest frame is always transferred to the TB20 master.

- If only the most recent message frame is to be transferred to the master, the buffer overwrite protection must be canceled in the parameterization, and the parameter "Dynamic frames" must be disabled.

7.1.6 Reception error

If a reception error (parity error) is detected by the 1SI serial interface upon receipt of a frame, the entire frame is discarded upon expiration of the character delay time or the receipt of the end character and the corresponding error is reported to the TB20 master.

If the end criterion "Receipt of a fixed number of characters" is set, expiration of the character delay time before reaching the parameterized number of characters generates a reception error, which is reported to the TB20 master.

7.1.7   RS232 escort lines

The 1SI serial interface supports the following escort lines:

- DCD   (Input) Data carrier detect; data carrier recognized

- DTR   (Output) Data terminal ready; 1SI serial interface is ready for operation

- DSR   (Input) Data set ready; communication partner ready for operation

- RTS   (Output) Request to send; 1SI serial interface is ready to transmit

- CTS   (Input) Clear to send; communication partner can receive data from the 1SI serial interface (response to RTS = ON)

After the 1SI serial interface is switched on, the output signals are in the OFF state (inactive).

7.1.8   Control of the RS232 escort lines

The control of the control signals DTR/DSR and RTS/CTS is defined by the parameterization in the ToolBox or can be controlled by the user program of the bus master.

The following modes are supported:

- Automatic control of all escort lines

- Data flow control via RS232 escort lines (RTS/CTS)

- No control

7.1.9   Automatic control of the RS232 escort lines

For automatic control of escort signals, only half-duplex operation is possible!

Automatic operation of the RS232 escort signals has the following functions:

- Once the 1SI serial interface is put into an operating mode with automatic use of the RS-232 escort signals through parameterization, it sets the RTS lines to OFF and the DTR line to ON.
  Transmitting and receiving of frames is only possible after the DTR line is set to ON. As long as DTR remains set to OFF, no data is received on the RS232 interface. A transmit job is aborted with the corresponding error.

- When a transmit job is pending, RTS is set to ON, and with CTS = ON, the data is transmitted on the RS232 interface.

- If during transmission within the data output time the CTS line is not set to ON, or if CTS changes to OFF during the transmission process, the transmit job is aborted and an appropriate error is sent to the TB20 master.

- After the data is transmitted, the RTS line is set to OFF after expiration of the parameterized RTS removal time. The 1SI serial interface does not wait for CTS to change to OFF.

- Data can be received via the RS232 interface as soon as the DSR line is set to ON. If the receive buffer of the 1SI serial interface threatens to overflow, there is no reaction of the 1SI serial interface.

- If DSR changes from ON to OFF, both a running transmit job and the reception of data will be aborted and a corresponding error will be sent to the TB20 master.

7.1.10 Data flow control via RS232 escort lines (RTS/CTS)

The handshake procedure via RS232 escort lines controls the data flow between the 1SI serial interface and the communication partner. The handshake procedure makes it possible to prevent having data lost during transmission when the speed of data processing of the communication partner differs.

The data flow control via RS232 escort lines (RTS/CTS) is implemented in the RS232 serial interface as follows:

- If the 1SI serial interface is parameterized in the operating mode "Data flow control via RS232 escort lines," the 1SI serial interface sets the RTS line to ON.

- If the receive buffer overflows with more than 4,096 bytes or 250 frames, the 1SI serial interface sets the RTS line to OFF. If the communication partner nonetheless continues to transmit, a corresponding error is sent to the TB20 master and the received data of the last frame is discarded.

- If a frame is read by the bus master and the receive buffer is ready to receive, the 1SI serial interface sets the RTS line to ON.

- If the control signal CTS is set to OFF, the 1SI serial interface interrupts the transmission. If CTS is not set to ON after the configured time, the transmission is aborted and an error message is generated.

- If CTS is set back to ON within the waiting time for CTS ON, the remaining bytes of the previously aborted frame are sent.
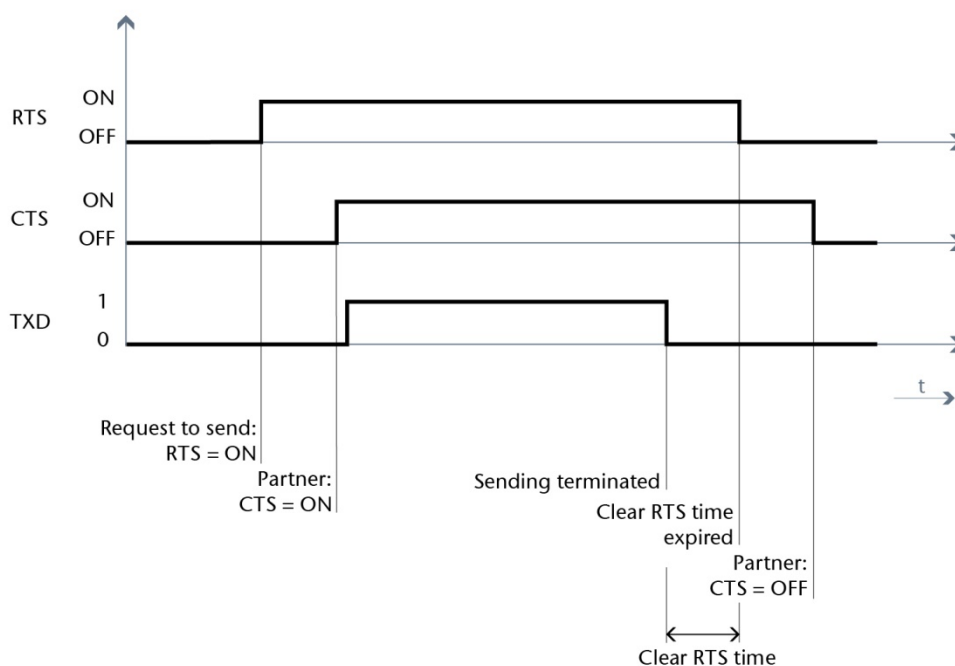
7.1.11 Data flow control via XON and XOFF / software handshake

The handshake procedure controls the data flow between the 1SI serial interface and the communication partner. Sending characters makes it possible to prevent having data lost during transmission when the speed of data processing of the communication partner differs.

The data flow control via software handshake is implemented in the 1SI serial interface as follows:

- If the 1SI serial interface is configured in the operating mode with "Data flow control via XON and XOFF", the 1SI serial interface transmits the XON character.

- If the receive buffer overflows with more than 4,096 bytes or 250 frames, the 1SI serial interface sends the XOFF character. If the communication partner nonetheless continues to transmit, a corresponding error is sent to the TB20 master and the received data of the last frame is discarded.

- If a frame is fetched by the bus master and the receive buffer is ready to receive, the 1SI serial interface transmits the XON character.

- If the 1SI serial interface receives the XOFF character, further transmission is aborted. If no XON is received after the configured time, the transmission is aborted and an error message is generated.

- If the XON character is sent within the waiting time, the remaining bytes of the previously aborted frame are sent.

7.1.12 Data flow control via manual reading and control of RS-232 escort lines

The RS-232 escort lines can be read with the help of the function blocks FB4 S_VSTAT. The information is provider to the user via the respective block parameters.

The function block FB5 S_VSET makes it possible to use the parameter inputs of the block to set or reset the interface outputs accordingly.

When configuring the modules with automatic operation of the RS-232 escort lines or the data flow control using RTS/CTS, manual control of the named escort lines is not possible. The reading of all RS-232 escort lines with the help of the FB S-VSTAT is not affected by this.

7.2   ASCII configuration

Parameters for operating mode ASCII: 19 bytes

	7	6	5	4	3	2	1	0
Par 0	Operating mode: ASCII-8 or 32 byte							
Par 1	Reserved			Termina-tion	Interface			
Par 2	Reserved			Dyn. frames	Data flow control			
Par 3	reserved	Baud rate						
Par 4	Data bits		Stop bits		Parity		Buffer at startup	Overwrite buffer
Par 5	XON character							
Par 6	XOFF characters							
Par 7-8	Waiting time on XON							
Par 9-10	Waiting time for CTS = ON							
Par 11-12	Waiting time for RTS = OFF							
Par 13	Frame end							
Par 14-15	Character delay time							
Par 16	End character 1							
Par 17	End character 2							
Par 18	Frame length							

Agreements are needed for the serial data transfer between the two communication partners.

The <u>default</u> settings are underlined.

Parameters	Description	Value range
Operating mode		<u>1 = ASCII (8 byte)</u> 2 = ASCII (32 byte)
Termination	Internal termination with 120 Ohm. Irrelevant for RS232	<u>0 = No</u> 1 = Yes
Interface		<u>1 = RS232</u> 2 = RS422 (full-duplex) 3 = RS485 (half-duplex)
Dynamic frames	With dynamic frames, the 1SI serial interface can buffer several messages of different lengths.	1 = Yes / 0 = No
Data flow control	The transmission is synchronized through the data flow control if the communication partners are working at different speeds.	<u>0 = None</u> 1 = XON/XOFF 2 = RTS/CTS 3 = Automatic detection
Baud rate	Transmission speed in bits per second	0 = 110 1 = 300 2 = 600 3 = 1200

		4 = 4800
		<u>5 = 9600</u>
		6 = 14400
		7 = 19200
		8 = 38400
		9 = 57600
		10 = 76800
		11 = 115200
Data bits	Bits per character	1 = 7 data bits
		<u>2 = 8 data bits</u>
Stop bits	Number of bits that mark the end of the information words	<u>1 = 1 stop bit</u>
		2 = 2 stop bits
Parity	Parity check is used to detect incorrectly transmitted information words None: Data is sent without a parity bit. Odd: The parity bit is set; the total number of data bits with the signal state "1" is odd, including the parity bit Even: The parity bit is set; the total number of data bits with the signal state "1" is even, including the parity bit Any: Parity is not checked when data is received. When transmitting, it behaves like with the setting "Even"	0 = None 1 = Odd <u>2 = Even</u> 3 = Any
Buffer at startup	The receive buffer is automatically cleared when the operating mode is changed from STOP to RUN	<u>0 = Delete the receive buffer upon startup</u> 1 = Do not delete the receive buffer upon startup
Overwrite buffer	It is possible to prevent buffered frames from being overwritten when the 1SI serial interface receives a new frame, but the receive buffer has not yet been deleted. This prevents old received frames from being lost.	0 = Overwriting of the buffer <u>1 = Prevent overwriting of the buffer</u>
XON / XOFF character:		0x00 to 0xFF with 8 data bits 0x00 to 0x7F with 7 data bits <u>Default XON: 0x11, default XOFF: 0x13</u>
Waiting time on XON		20-655350 in increments of 10 ms <u>Default: 200 (10 * 200 = 2000 ms)</u>
Waiting time for CTS = ON		20 to 655350 in increments of 10 ms <u>Default: 200 (10 * 200 = 2000 ms)</u>
Waiting time for RTS = OFF:		0 to 655350 in increments of 10 ms <u>Default: 200 (10 * 200 = 2000 ms)</u>
Frame end	Detecting the end of the reception frame Expiration of character delay time	<u>0 = character delay time</u> 1 = reception of the end character 2 = number of characters

	The frame end is recognized when the character delay time has expired. Reception of the end character The frame end is recognized when the end characters are received. Perception of a fixed number of characters The frame end is recognized by the frame length. All frames to be received must have the same length.	
Character delay time	Time that may elapse between the receipt of two characters	1–65535 ms Default: 4 ms
End character 1	The selected end characters limit the length of the frame Only takes effect with the end criterion "Receipt of the end character."	0x00 to 0xFF with 8 data bits 0x00 to 0x7F with 7 data bits Default: 0x03
End character 2	The selected end characters limit the length of the frame Only takes effect with the end criterion "Receipt of the end character."	0x00 to 0xFF with 8 data bits 0x00 to 0x7F with 7 data bits Default: 0x0
Frame length upon receipt	Frame length for data with a fixed number of characters.	1–224 characters Default: 100

7.3   3964R protocol

The 3964R protocol controls the data transfer for a point-to-point connection between the serial interface 1SI and a communication partner connected to this serial interface. The 3964R protocol expands the bit transmission with a backup layer.

7.3.1   Control characters

The 3964R protocol adds control characters to the payload data during data transmission (backup layer). With these control characters, both communication partners can check whether the data has arrived completely and without errors.

In the case of the 3964R protocol, the following control characters are used:

- **STX (02H):** Start of Text;
  Start of the character sequence to be transmitted

- **DLE (10H):** Data Link Escape;
  Data transmission switch (positive acknowledgment)

- **ETX (03H):** End of Text;
  End of the character sequence to be transmitted

- **BCC:** Block Check Character;
  Block check sum character

- **NAK (15H):** Negative Acknowledge;
  Negative response

7.3.2   Conduct upon occurrence of the character DLE in the payload data

If the payload data to be transmitted contain the control character DLE, this is transmitted twice (DLE doubling) to differentiate from the control character DLE when establishing and clearing the connection on the transmission line. The recipient reverses the DLE doubling again.

7.3.3   Block checksum

In the case of the transmission protocol 3964R, data security is increased by an additionally sent BCC (Block Check Character). All data bytes are XOR-linked for the calculation of the block check sum. The formation begins with the first payload data byte (1st byte after the control character STX) and ends after the character DLE ETX when clearing the connection. The block check sums character is transmitted as the last character.

In the case of a DLE doubling (see chapter 7.3.2), the DLE character is incorporated twice into the BCC formation.

7.3.4 Transmitting data

Data transmission from the 1SI serial interface to the serial communication partner
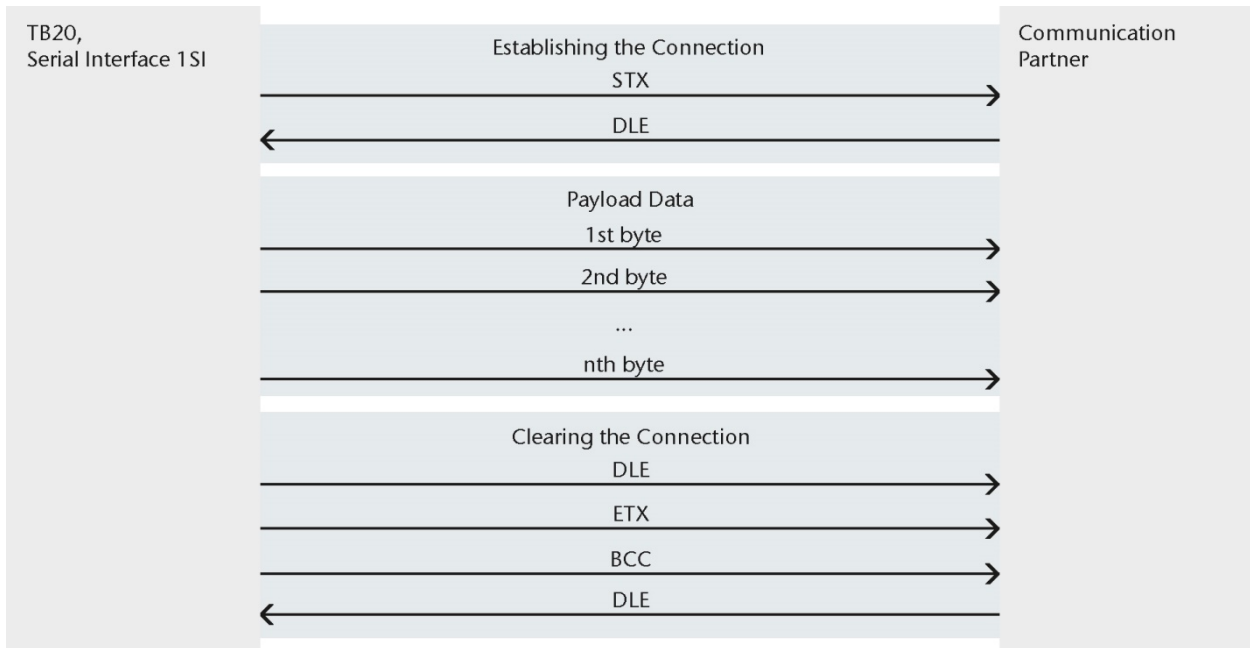
7.3.5 Establishing a connection

In order to establish the connection, the serial interface 1SI transmits the control character STX. If the communication partner answers with the character DLE prior to expiration of the acknowledgment delay time, the serial interface 1SI switches to transmission mode. If the communication partner answers with NAK, any other character (except DLE) or if the acknowledgment delay time expires without a reaction, the serial interface 1SI repeats the establishing of the connection. Following the configured number of connection attempts, the serial interface 1SI cancels the establishing of a connection and transmits the character NAK to the communication partner. The serial interface 1SI also reports the error to the TB20 master.

7.3.6 Payload data transmission

If a connection is successfully established, the payload data contained in the output buffer of the serial interface 1SI are sent to the communication partner together with the selected transmission parameters (baud rate, number of data bits, ...). This monitors the time interval of the arriving characters. The distance between two characters may not exceed the character delay time.

7.3.7 Clearing a connection

If the communication partner transmits the character NAK during an ongoing transmission, the serial interface 1SI cancels the block and repeats it in the manner described above. In the case of a different character, the serial interface 1SI initially waits for the expiration of the character delay time and then transmits NAK in order to bring the communication partner to an idle state. The serial interface 1SI then begins transmitting again with the STX establishing of a connection. After the buffer content is transmitted, the serial interface 1SI adds the characters DLE, ETX and the block checksum BCC as end code and waits for an acknowledgment character (DEL). If the communication partner transmits the character DLE within the acknowledgment delay time, the data block has

been accepted without errors. If the communication partner answers with NAK, any other character (except DLE), a distorted character, or if the acknowledgment delay time expires without a reaction, the serial interface 1SI repeats the establishing of the connection STX.

Following the expiration of the configured number of transmission attempts to send the data block, the serial interface 1SI cancels the process and sends NAK to the communication partner.

The serial interface 1SI also reports the error to the TB20 master.

7.3.8   Initialization conflict

If a communication participant doesn't respond to the transmission query (character STX) of the communication partner with the acknowledgment DLE or NAK within the acknowledgment delay time, but instead with the character STX, an initialization conflict has occurred. Both devices are attempting to carry out an existing transmission job. The device with the lower priority withdraws its transmission job and responds with the character DLE.

The device with the higher priority transmits its data in the previously described manner. Following the clearing of the connection, the device with the lower priority carries out its transmission job.

The priority of the serial interface 1SI is determined by configuration.
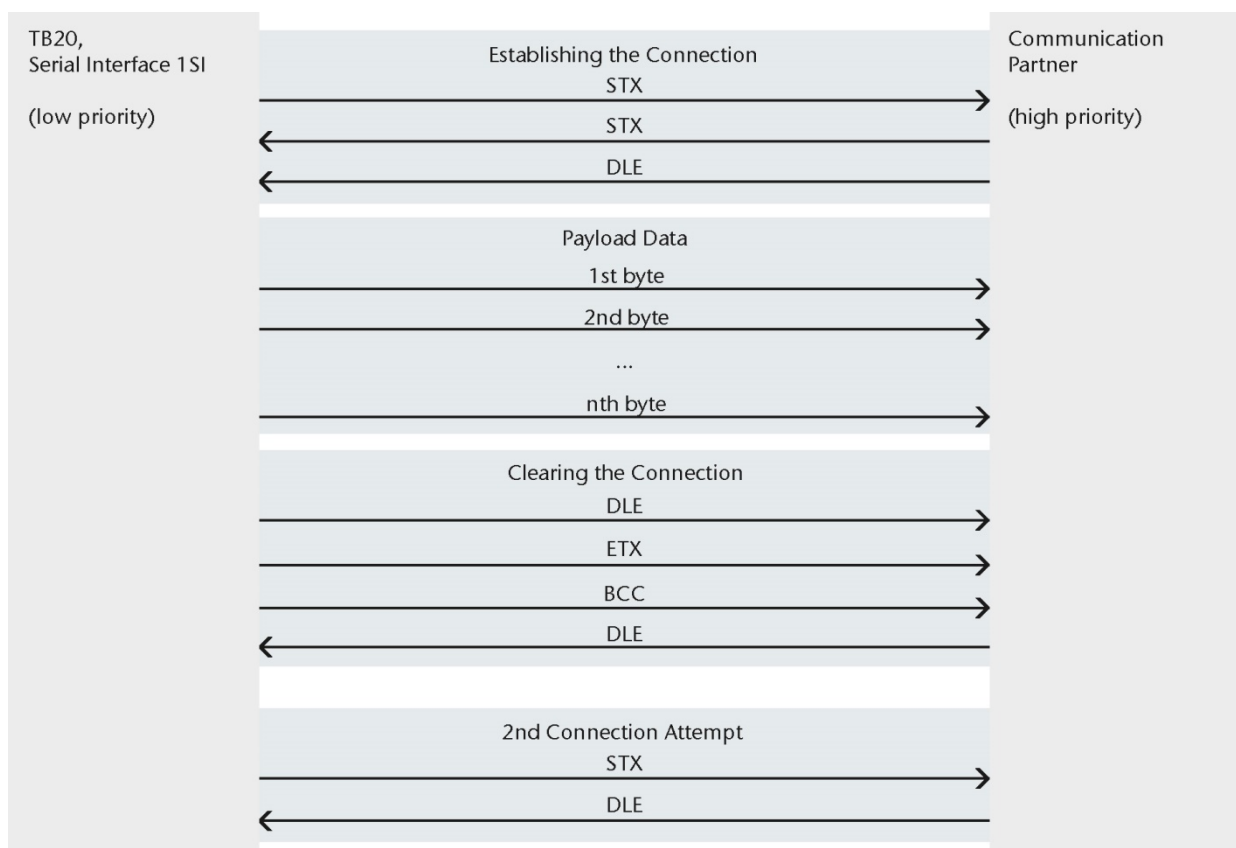
7.3.9   Receiving data

Data transmission from the communication partner to the serial interface 1SI
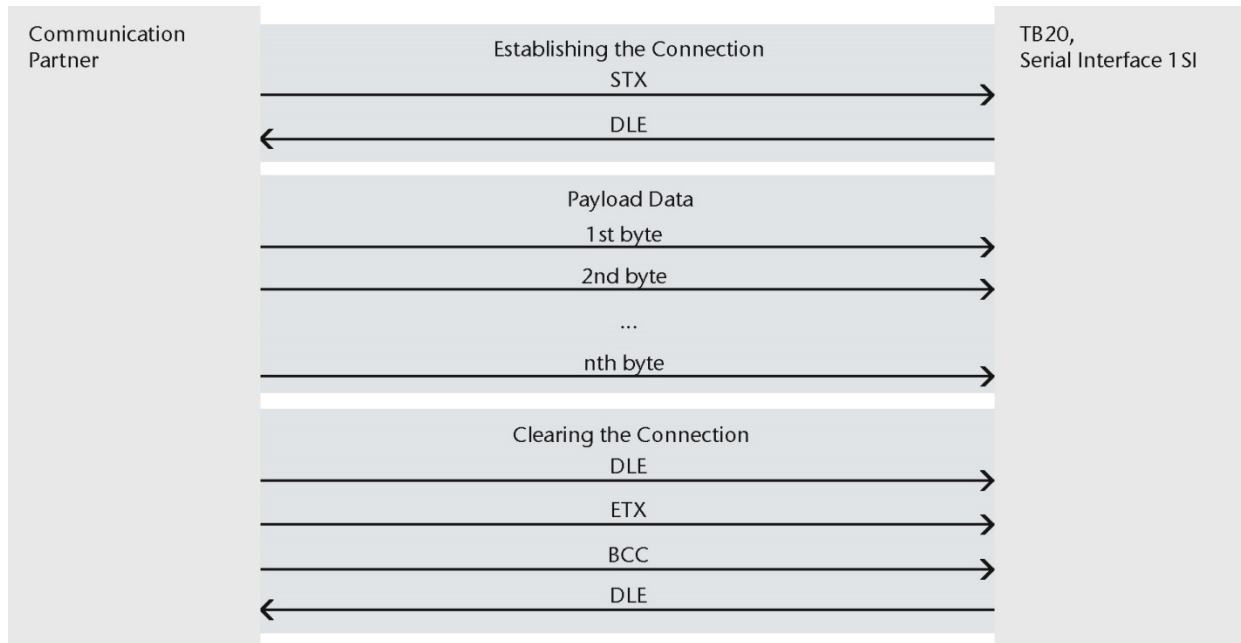
7.3.10   Establishing a connection

In the idle state, when no transmission job needs to be processed, the serial interface 1SI waits for the connection to be established by the communication partner. If the serial interface 1SI receives any character (except STX or NAK) while in the idle state, it waits for the expiration of the character delay time and then transmits the character NAK.

7.3.11   Payload data transmission

If the serial interface 1SI receives the character STX and has an empty receive buffer available, it responds with DLE. Incoming receive characters are now filed in the receive buffer. If two consecutive DLE characters are received, only one DLE character is incorporated into the receive buffer.

After each receive character, the next character is waited for during the character delay time. If the character delay time expires without receiving, the NAK character is sent to the communication partner. The serial interface 1SI also reports the error to the TB20 master.

If during the establishing of the connection with STX there is no empty receive buffer available, a waiting period of 400 ms starts. If following this period there is still no empty receive buffer available, the serial interface 1SI reports the error (see chapter 9). The serial interface 1SI also transmits the character NAK and returns to the idle state. The serial interface 1SI otherwise transmits the character DLE and receives the data in the manner described above.

7.3.12 Clearing a connection

If transmission errors (lost character, frame error, parity error, etc.) occur during reception, reception continues until the clearing of a connection and NAK is then sent to the communication partner. A repetition is then anticipated. If the block still can't be received without errors after the number of repeat attempts indicated during configuration, or if the repetition is not started by the communication partner within a block waiting period of 4 s, the serial interface 1SI cancels the reception. The serial interface 1SI also reports the error to the TB20 master.

If the serial interface 1SI recognizes the character sequence DLE ETX BCC, the reception is ended and the received block check character BCC is compared with the internally created checksum. If the block check character is correct and no other reception errors have occurred, the serial interface 1SI transmits the character DLE and returns to the idle state.

In the event of an incorrect BCC or another reception error, the serial interface 1SI sends NAK to the communication partner and waits the block waiting period of 4 s before making a new attempt. If the block can't be received following the configured number of transmission attempts, or if no further attempt is made during the block waiting period, the serial interface cancels the 1SI. The serial interface 1SI also reports the error to the TB20 master.

Note: As soon as it is ready for operation, the serial interface 1SI transmits the character NAK once to the communication partner to bring it to the idle state.

7.3.13 Configuration of 3964R protocol

Parameters for operating mode 3964(R): 10 bytes

	7	6	5	4	3	2	1	0
Par 0	Operating mode: 3964(R) - 8 or 32 byte							
Par 1	Diagnosis alarm	Break detection	Block check	Termina-tion	Interface			
Par 2	Preliminary assignment Reception line	Baud rate						
Par 3	Data bits		Stop bits		Parity		Buffer at startup	Priority
Par 4–5	Character delay time							
Par 6-7	Acknowledgment delay time							
Par 8	Connection attempts							
Par 9	Transmission attempts							

Agreements are needed for the serial data transfer between the two communication partners.

Parameters	Description	Value range
Operating mode (UINT8)		4 = 3964 (8 byte) 8 = 3964 (32 byte)
Block check:	The transmission is synchronized through the data flow control if the communication partners are working at different speeds.	0 = no block check (3964) 1 = block check (3964R)
Termination	Internal termination with 120 Ohm. (Irrelevant for RS232)	0 = No 1 = Yes
Interface		1 = RS232 2 = RS422

Baud rate	Transmission speed in bits per second	0 = 110 1 = 300 2 = 600 3 = 1200 4 = 4800 5 = 9600 6 = 14400 7 = 19200 8 = 38400 9 = 57600 10 = 76800 11 = 115200
Data bits	Bits per character	1 = 7 data bits 2 = 8 data bits
Stop bits	Number of bits that mark the end of the information words	1 = 1 stop bit 2 = 2 stop bits
Parity	Parity check is used to detect incorrectly transmitted information words None: Data is sent without a parity bit. Odd: The parity bit is set; the total number of data bits with the signal state "1" is odd, including the parity bit Even: The parity bit is set; the total number of data bits with the signal state "1" is even, including the parity bit Any: Parity is not checked when data is received.	0 = None 1 = Odd 2 = Even 3 = Any
Buffer at startup	The receive buffer is automatically cleared when the operating mode is changed from STOP to RUN	0 = Delete the receive buffer upon startup 1 = Do not delete the receive buffer upon startup

Character delay time		1 – 65,535 ms Default: 200 (10 * 200 = 2000 ms)
Acknowledgment delay time		20 - 655.350 ms <u>Default: 200 (10 * 200 = 2000 ms)</u>
Connection attempts		1 – 255 <u>Default: 6</u>
Transmission attempts		1 – 255 <u>Default: 6</u>
Priority		<u>0 = Low</u> 1 = High

The <u>default</u> settings are underlined.

Process alarms:

- None

Diagnosis capabilities:

- Configuration errors

- Underflow / overflow buffer

- Internal module error

- Message errors

8 Reference data for communication with bus masters

8.1 Data exchange between the master and the serial interface

To operate the 1SI serial interface behind a communications module, corresponding function modules must be provided in the master controller program.

The 1SI serial interface transmits data of 4, 8, or 32 bytes, input or output, with consistency over the entire length. The 1SI serial interface uses the 4-, 8-, or 32-byte input/output memory for data transmission to and from the master via a bus.

Inputs (data/feedback): n bytes. n = 8 or 32, depending on operating mode

	7	6	5	4	3	2	1	0
ID 0	Coordination byte							
ID 1	Input data byte 0							
ID 2	Input data byte 1							
ID ..	Input data byte ..							
ID ..	Input data byte ..							
ID n-1	Input data byte n-2							

Outputs (control interface): n bytes. n = 8 or 32, depending on operating mode

	7	6	5	4	3	2	1	0
OS 0	Coordination byte							
OS 1	Output data byte 0							
OS 2	Output data byte 1							
AB ..	Output data byte ..							
AB ..	Output data byte ..							
AB n-1	Output data byte n-2							

The master writes data to the inputs and outputs and reads data from the inputs and outputs:

- In the first byte of the output memory of the 1SI serial interface, the master releases a job to the 1SI serial interface.

- The 1SI serial interface transmits the job code in the input memory and thus accepts the job.

- The master exchanges data via segments 3, 7, or 31 bytes (as many segments as are required in accordance with the I/O size) until all data of the job is transferred.

The first byte of the segment is a coordination byte, which serves to synchronize the transfer of the segment between the master and the 1SI serial interface; see the figure below. The other bytes of the I/O memory contain data of the job.

Data exchange between the CPU and the 1SI serial interface:

Transmission of data from the master to the 1SI serial interface	
Byte	Content
0	Coordination byte
1	Data byte 0
2	Data byte 1
…	…
n	Data byte N

Transmission of the data from the 1SI serial interface to the master	
Byte	Content
0	Coordination byte
1	Data byte 0
2	Data byte 1
…	…
n	Data byte N
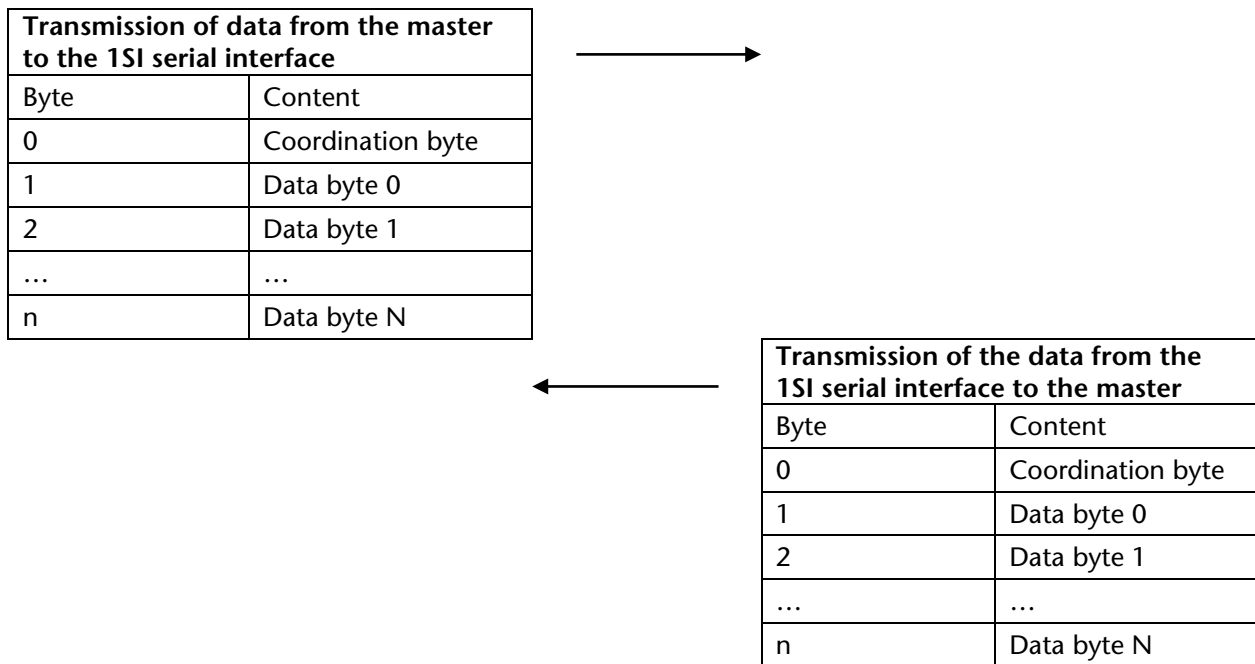
n = 3, 7, or 31, depending on the module variant of the 1SI serial interface

8.2   Coordination byte

The coordination byte (byte 0) synchronizes the data transfer between the master and the 1SI serial interface.

Table: Coordination byte

Byte segment	Description							
Job byte written by the master	Bit	7	6	5	4	3	2	1	0
	Reserve		Job code			Fault	Sequence number		
Bit 7	Reserved for special applications. For evaluations of the coordination byte, this bit needs to be hidden.							
Job code	Is set by the CPU to initiate a job.							
Sequence number	**Send job**: Is increased by the bus master to 1 when the bus master sends another segment to the 1SI serial interface or **Receive job:** Is taken each time from input byte 0 of the bus master when the bus master of the interface module receives a new segment in the correct order. Indicates the last valid sequence number when the error bit is set. (Value goes from 1 to 7).							
Fault	Is set by the bus master to indicate that a segment has not been received in the correct order. The sequence number field indicates the last valid sequence number.							
Job byte written by the 1SI serial interface	Bit	7	6	5	4	3	2	1	0
	Reserve		Job code			Fault	Sequence number		
Bit 7	Reserved for special applications. For evaluations of the coordination byte, this bit needs to be hidden.							
Job code	Is taken over by the 1SI serial interface to acknowledge that the job was accepted.							
Sequence number	**Send job:** Is taken each time from output byte 0 of the 1SI serial interface if the module receives a new segment in the correct order from the bus master. Indicates the last valid sequence number when the error bit is set. **Receive job:** Is increased by 1 by the module if the module sends another segment of the bus master (the value goes from 1 to 7).							

Fault	The error bit of the receiver is monitored by the sender for a segmented transaction. Reactions when the error bit is set:
	   Sender bus master (send job): The bus master sends the segments again, starting with the next segment after the number reported by the receiver.
	   Sender module (receive job): The 1SI serial interface interrupts transmission of the Rx frame to the user with error message 0x0551 in the status word. The 1SI serial interface waits for acknowledgment of the error message (idle). After completion of the current error sequence, the aborted Rx frame is again reported or made available for collection by the user.							

8.3   Definitions of the job codes

The jobs are assigned to bits 4 to 6 in the coordination byte.

Table: Job codes

Bit	6	5	4	Hex. value	
	0	0	0	0_H	Idle
	0	0	1	1_H	Send
	0	1	0	2_H	Receive
	0	1	1	3_H	Read V.24 signal status
	1	0	0	4_H	Write V.24 signals
	1	0	1	5_H	Transfer parameters: Additional parameters can be set with this job.
	1	1	0	6_H	Reserved
	1	1	1	7_H	Job sent acknowledgment

Rules for writing job codes

For writing job codes in the coordination byte, the following rules apply, with which the bus master and the 1SI serial interface can synchronize the data transfers:

- Before the user program of the bus master can write a job code in the output coordination byte, it needs to see an idle code from the input coordination byte of the 1SI serial interface.

- Before the user program of the bus master can write the first segment in the output byte 1 ... n, it must see the acknowledgment code (that is, the assumed job code) in the input coordination byte of the assembly.

- If the user program sees job acknowledgment codes that differ from those sent by the user program, it may not write to the output byte 0 ... n until it has again seen an idle code from the input coordination byte of the 1SI serial interface. This happens when two separate jobs are executed in the same cycle, both jobs see the idle code, and both write a different job code to the output byte. Because of the asynchronous cycle between the bus master cycle and the bus cycle, it is not ensured that the job will reach the 1SI serial interface first. Therefore, each job must be able to wait for the end of another job before it is processed.

Definitions of the status words

In the following examples of data transmissions, the 1SI serial interface uses the bytes 1 and 2 for the status message in some responses to the bus master.

Reception status of the 1SI serial interface

When the 1SI serial interface is idle (job acknowledgment byte 0 = 00_H), it displays its reception status. The reception status is stored in bytes 1 and 2.

Table: Reception status

Status	Meaning
0000_H	No received message available
0001_H	Received message or receive frame available
$0B01_H$	The receive buffer is filled to more than 2/3rds.

Order of the bytes in the word

For data transfers between the bus master and the 1SI serial interface, the byte with the highest value is transmitted first in all 16-bit words (such as status and length).

8.3.1 Sequence for sending data from the bus master to the 1SI serial interface

The table is an example of sending a message from the bus master to the 1SI serial interface. The character string "helmholztb20seriellmodul" is sent. The latency time from one cycle until response with the sequence number arises when the CPU cycle of the bus master is almost equal to the bus cycle.

Bus master cycle	Bus master writes to 1SI serial interface	Bus master reads from 1SI serial interface

Cycle 1.

User program reads the idle code

	Byte 0	1	2	3	4	5	6	7
←	00_H	$nnnn_H$		xx_H	xx_H	xx_H	xx_H	xx_H
	Ack. job	Status		No meaning				

Bus master writes the job for sending

Byte 0	1	2	3	4	5	6	7	
10_H	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H	→
Job	No meaning							

Cycle 2.

User program continues to read the idle code

	Byte 0	1	2	3	4	5	6	7
←	00_H	$nnnn_H$	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H
	Ack. job	Status		No meaning				

Bus master repeats the job for sending

Byte 0	1	2	3	4	5	6	7	
10_H	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H	→
Job	No meaning							

Cycle 3.

User program reads the response from the 1SI serial interface

	Byte 0	1	2	3	4	5	6	7
←	10_H	$nnnn_H$	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H
	Ack. job	Status		No meaning				

Bus master sends the first segment

Byte 0	1	2	3	4	5	6	7	
11_H	0016_H		'h'	'e'	'l'	'm'	'h'	→
Job	Transmission length		Data					

Cycle 4.

User program reads the response from the 1SI serial interface

	Byte 0	1	2	3	4	5	6	7
←	10_H	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H
	Ack. job	No meaning						

Bus master repeats the first segment

Byte 0	1	2	3	4	5	6	7	
11_H	'o'	'l'	'z'	't'	'b'	'2'	'0'	→
Job	Data							

Bus master cycle	Bus master writes to 1SI serial interface	Bus master reads from 1SI serial interface

5. User program reads the response from the 1SI serial interface

	Byte 0	1	2	3	4	5	6	7
←	11H	xxH	xxH	xxH	xxH	xxH	xxH	xxH
	Ack. job	No meaning						

No error is displayed; the bus master sends the second segment

Byte 0	1	2	3	4	5	6	7	
12H	's'	'e'	'r'	'i'	'e'	'l'	'l'	→
Job	Data							

6. User program reads the response from the 1SI serial interface

	Byte 0	1	2	3	4	5	6	7
←	12H	xxH	xxH	xxH	xxH	xxH	xxH	xxH
	Ack. job	No meaning						

No error is displayed; the bus master sends the third segment

Byte 0	1	2	3	4	5	6	7	
13H	'm'	'o'	'd'	'u'	'l'	xxH	xxH	→
Job	Data					No meaning		

7. User program reads the response from the 1SI serial interface

	Byte 0	1	2	3	4	5	6	7
←	13H	xxH	xxH	xxH	xxH	xxH	xxH	xxH
	Ack. job	No meaning						

No error is displayed; the bus master sends the fourth segment

Byte 0	1	2	3	4	5	6	7	
14H	'm'	'o'	'd'	'u'	'l'	xxH	xxH	→
Job	Data					No meaning		

8. User program reads the response from the 1SI serial interface

	Byte 0	1	2	3	4	5	6	7
←	13H	xxH	xxH	xxH	xxH	xxH	xxH	xxH
	Ack. job	No meaning						

The bus master waits for acknowledgment after the fourth segment

Byte 0	1	2	3	4	5	6	7	
14H	'm'	'o'	'd'	'u'	'l'	xxH	xxH	→
Job	Data					No meaning		

9. User program reads the response from the 1SI serial interface

	Byte 0	1	2	3	4	5	6	7
←	14H	xxH	xxH	xxH	xxH	xxH	xxH	xxH
	Ack. job	No meaning						

The bus master does not receive a new job; the outputs remain the same.
The bus master waits for the last acknowledgment of the 1SI serial interface

Byte 0	1	2	3	4	5	6	7	
14H	'm'	'o'	'd'	'u'	'l'	xxH	xxH	→
Job	Data					No meaning		

Bus master cycle	Bus master writes to 1SI serial interface								Bus master reads from 1SI serial interface	
n.	n bus master cycles later, the user program sees the response of the 1SI serial interface									
		Byte 0	1	2	3	4	5	6	7	
	←	74_H	$nnnn_H$		xx_H	xx_H	xx_H	xx_H	xx_H	
		Ack. job	No meaning							
-	The CPU of the bus master writes the idle code to the job and terminates the job.									
	Byte 0	1	2	3	4	5	6	7		
	00_H	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H	xx_H		
	Job	No meaning								

8.3.2 Sequence for receiving data in the bus master from the RS232 serial interface

The table is an example of receiving a message in the bus master from the 1SI serial interface. The character string "helmholz" is received. The I/O memory is 8 bytes. The bus cycle is less than the CPU cycle of the bus master, so that no latency time is created in the module.

Bus master cycle	Bus master writes to 1SI serial interface								Bus master reads from 1SI serial interface					

Bus master cycle	description
n	For n-1 cycles, the CPU of the bus master reads the idle code of the 1SI serial interface until in cycle n the status is displayed that a received message is present.

n

For n-1 cycles, the CPU of the bus master reads the idle code of the 1SI serial interface until in cycle n the status is displayed that a received message is present.

←

Byte 0	1	2	3	4	5	6	7
00_H	$nnnn_H$	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H
Ack. job	Status	No meaning					

Status	0000_H = No received message available
	0001_H = Received message available
	$0B01_H$ = Receive buffer is more than 2/3rds full

The CPU of the bus master writes the job for receipt

Byte 0	1	2	3	4	5	6	7
20_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H
Job	No meaning						→

n+1

The user program reads the response of the 1SI serial interface; the 1SI serial interface acknowledges receipt, responds with the first segment, and increases the sequence number.

←

Byte 0	1	2	3	4	5	6	7
21_H	0006_H		'h'	'e'	'l'	'm'	'h'
Ack. job	Length		Data				

The bus master reads the job for acknowledgment of the 1st segment

Byte 0	1	2	3	4	5	6	7
21_H	XX_H						
Job	No meaning						→

n+2

The bus master reads the 2nd segment from the 1SI serial interface

←

Byte 0	1	2	3	4	5	6	7
22_H	'o'	'l'$_H$	'z'	XX_H	XX_H	XX_H	XX_H
Ack. job	Data			No meaning			

The bus master reads the job for acknowledgment of the 2nd segment

Byte 0	1	2	3	4	5	6	7
22_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H
Job	No meaning						→

n+3

After the first receive transaction is terminated, the 1SI serial interface returns to the idle state.

←

Byte 0	1	2	3	4	5	6	7
00_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H
Ack. job	Status US		No meaning				

- The bus master ends the job.

8.3.3 Sequence for reading the V.24 signal status

The table is an example of how the CPU reads the status of the V.24 signals from the 1SI serial interface. The I/O memory is 8 bytes.

Bus master cycle	Bus master writes to 1SI serial interface								Bus master reads from 1SI serial interface	
1.	The user program reads the idle code from the 1SI serial interface									
	Byte 0	1	2	3	4	5	6	7		
←	00_H	$nnnn_H$		XX_H	XX_H	XX_H	XX_H	XX_H		
	Ack. job	Status		No meaning						
	The bus master writes the job for writing the V.24 signals									
	Byte 0	1	2	3	4	5	6	7		
	30_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	→	
	Job	No meaning								
2.	The user program reads the response from the 1SI serial interface									
	Byte 0	1	2	3	4	5	6	7		
←	31_H	$nnnn_H$		XX_H	XX_H	XX_H	XX_H	XX_H		
	Ack. job	Signals*)		No meaning						
	The bus master writes the acknowledgment and accepts the sequence number.									
	Byte 0	1	2	3	4	5	6	7		
	31_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	→	
	Job	No meaning								
3.	After the first receive transaction is terminated, the 1SI serial interface returns to the idle state.									
	Byte 0	1	2	3	4	5	6	7		
←	00_H	$nnnn_H$	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H		
	Ack. job	Status		No meaning						
-	The bus master ends the job.									

* Signal states

MSB	LSB							
00	0	0	0	DCD	CTS	RTS	DSR	DTR
	7	6	5	4	3	2	1	0

8.3.4   Sequence for writing V.24 signals

The table is an example of how the CPU writes V.24 signals to the 1SI serial interface. The I/O memory is 8 bytes.

Bus master cycle	Bus master writes to 1SI serial interface								Bus master reads from 1SI serial interface	
1.	The user program reads the idle code from the 1SI serial interface									
	Byte 0	1	2	3	4	5	6	7		
	← 00_H	$nnnn_H$		XX_H	XX_H	XX_H	XX_H	XX_H		
	Ack. job	Status		No meaning						
	The bus master writes the job for reading the V.24 signal status									
	Byte 0	1	2	3	4	5	6	7		
	10_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H →		
	Job	Signal states*)		No meaning						
2.	The user program reads the response from the 1SI serial interface									
	Byte 0	1	2	3	4	5	6	7		
	← 40_H	$nnnn_H$	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H		
	Ack. job	Status		No meaning						
	The bus master writes the idle state to the job byte									
	Byte 0	1	2	3	4	5	6	7		
	00_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H →		
	Job	No meaning								
3.	After the transaction is terminated, the 1SI serial interface returns to the idle state.									
	Byte 0	1	2	3	4	5	6	7		
	← 00_H	$nnnn_H$	XX_H	XX_H	XX_H	XX_H	XX_H	XX_H		
	Ack. job	Status		No meaning						
-	The bus master ends the job.									

* Signal states

MSB	LSB							
00	0	0	0	DCD	CTS	RTS	DSR	DTR
	7	6	5	4	3	2	1	0

8.3.5 Example sequence for XON/XOFF

Bus master cycle	Bus master writes to 1SI serial interface				Bus master reads from 1SI serial interface				
1.	User program reads the idle code								
					Byte 0	1	2	3	
				←	00_H	$nnnn_H$		XX_H	
					Ack. job	Status		No meaning	
	Job: Send parameter code (1 0 1 or 5H) plus sequence number 0								
	Byte 0	1	2	3					
	50_H	XX_H	XX_H	XX_H	→				
	Job	No meaning							
2.	User program reads the response from the 1SI serial interface								
					Byte 0	1	2	3	
				←	50_H	XX_H	XX_H	XX_H	
					Ack. job	No meaning			
	The job has been accepted, the CPU of the bus master sends the first segment								
	Byte 0	1	2	3	Job: Continue parameter and increment sequence number				
	51_H	20_H	0004_H		Data flow: Code for data flow parameter				
	Job	Data flow	Transmission length		→				
3.	User program reads the response from the 1SI serial interface								
					Byte 0	1	2	3	
				←	51_H	XX_H	XX_H	XX_H	
					Ack. job	No meaning			
	No error is displayed; the CPU of the bus master sends the second segment								
	Byte 0	1	2	3					
	52_H	$0B_H$	$0D_H$	00_H	→				
	Job	DC1	DC3	Waiting time for XON after XOFF - MSB					
4.	User program reads the response from the 1SI serial interface								
					Byte 0	1	2	3	
				←	52_H	XX_H	XX_H	XX_H	
					Ack. job	No meaning			
	No error is displayed; the CPU of the bus master sends the third segment								
	Byte 0	1	2	3					
	53_H	$C8_H$	XX_H	XX_H	→				
	Job	Waiting time for XON after XOFF - LSB	No meaning						

Bus master cycle	Bus master writes to 1SI serial interface	Bus master reads from 1SI serial interface

5.	User program reads the response from the 1SI serial interface						

					Byte 0	1	2	3
				←	53_H	XX_H	XX_H	XX_H
					Ack. job	No meaning		

Bus master repeats the third segment and waits for job end acknowledgment

Byte 0	1	2	3	
53_H	$C8_H$	XX_H	XX_H	→
Job	Waiting time for XON after XOFF - LSB	No meaning		

6.	User program reads the response from the 1SI serial interface

	Byte 0	1	2	3
←	73_H	XX_H		XX_H
	Ack. job	Status		No meaning

The CPU of the bus master writes the idle code to the job and terminates the job.

Byte 0	1	2	3
00_H	XX_H	XX_H	XX_H
Job	No meaning		

9   Error handling

The serial interface module outputs an error as a response to the following conditions:

- If the send job is longer than 224 bytes, the 1SI serial interface responds with a job end acknowledgment and the status word contains the error code. The bus master writes an idle code to the job and terminates the job.

- If a receive job is sent to the 1SI serial interface and the received message contains an error, the 1SI serial interface takes over the receive job code with the sequence number zero and the status word contains the error code. The bus master writes an idle code to the job and terminates the job.

- If a receive job is sent to the 1SI serial interface and there is no received message available, the 1SI serial interface takes over the receive job code with the sequence number zero and the status word contains the value 0101_H. This is not an error condition, but it prevents the 1SI serial interface from being disabled in receive job mode and waits for a receive message, so that transmission jobs can be executed. The bus master writes an idle code to the job and terminates the job.

Table: Error codes in the status word

Status word (hexadecimal)	Error description
0702_H	Only 3964(R): Error while establishing connection Following the transmission of STX, NAK or any character was received (except DLE or STX).
0703_H	Only 3964(R): Acknowledgment delay time (QVZ) exceeded Following the transmission of STX, no response was received by the partner during the acknowledgment delay time.
0704_H	Only 3964(R): Cancellation by partner One or more characters were received by the partner during running transmission operation.
0705_H	Only 3964(R): Negative acknowledgment during transmission
0706_H	Only 3964(R): Error at end of connection - The partner refused the frame at the end with NAK or any character (except DLE). or - The acknowledgment character (DLE) was received too early.
0707_H	Only 3964(R): Acknowledgment delay time at the connection end or response monitoring time following transmission frame exceeded No response from the partner after the clearing of the connection with DLE ETX within the acknowledgment delay time.
0708_H	Only ASCII driver: CTS = ON or XON – waiting period expired.
$070B_H$	Only 3964(R): Initialization conflict can't be remedied Occurs when both parties are set to high priority.
$070C_H$	Only 3964(R): Initialization conflict can't be remedied Occurs when both parties are set to low priority.

0802_H	Only 3964(R): Error while establishing connection: • One or more characters were received (except NAK or STX) when not running. or • Following a received STX, additional characters were sent by the partner without waiting for the DLE response. Following mains power-ON of the partner: • The module receives an undefined character while the partner is switching on.
0805_H	Only 3964(R): Logic error during reception Following reception of DLE, another character was received (except DLE or ETX).
0806_H	Character delay time (ZVZ) exceeded • Two consecutive characters were not received within the character delay time or Only for 3964(R): • During the establishing of the connection, the 1st character after sending the DLE was not received within the character delay time.
0807_H	Only 3964(R): Frame length not permitted: A frame with the length 0 was received (frame without payload data).
0808_H	Only 3964(R): Error with block check character BCC: The internally formed value of the BCC doesn't agree with the BCC received by the partner at the connection end.
0809_H	Only 3964(R): The number of repetitions must be set identically at the partner.
080A_H	The receive buffer is full
080C_H	An error occurred during transmission • A transmission error (parity error, stop bit error, overflow error) was detected. Only for 3964(R): • Repetitions are begun when a transmission error occurs during transmission or reception operations. • When a disrupted character is received in the idle state, the error message occurs immediately in order to promptly detect disruptive influences in the transmission line.
0810_H	Only ASCII driver: A parity error occurred
0811_H	Only ASCII driver: A character frame error occurred
0812_H	Only ASCII driver: Additional characters were received after CTS was set to Off or XOFF was sent.
0818_H	Only ASCII driver: CTS or DSR were switch to Off within a transmission process.
0850_H	The receive frame is greater than the parameterized length or greater than the maximum allowed length.
0B01_H	The receive buffer has reached a level greater than 2/3rds.
1B41_H	Number of bytes indicated at the parameter LEN of the FBs not permitted • Valid value range 1 to 224 bytes

10   General technical specifications

Order no.	600-400-7BA31
Module type	1SI serial interface
Cable length (shielded) RS232 RS422/485	 max. 15 m max. 1200 m
Electrically isolated from backplane bus	Yes
Power dissipation	Max. 0.7 W
Power supply for modules	5 V DC, max. 130 mA
Certifications	CE, UL pending
Noise immunity	DIN EN 61000-6-2 "EMC Immunity"
Interference emission	DIN EN 61000-6-4 "EMC Emission"
Vibration and shock resistance	DIN EN 60068-2-8:2008 "Vibration" DIN EN 60068-27:2010 "Shock"
Isolation voltage	500 V
Protection rating	IP 20
Relative humidity	95% r H without condensation
Installation position	Any
Permissible ambient temperature	0 °C to 60 °C
Transport and storage temperature	-20 °C to 80 °C
Dimensions (H x W x D)	110 mm x 25 mm x 73 mm
Weight	Approx. 120 g
Hot-pluggable	Yes

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.

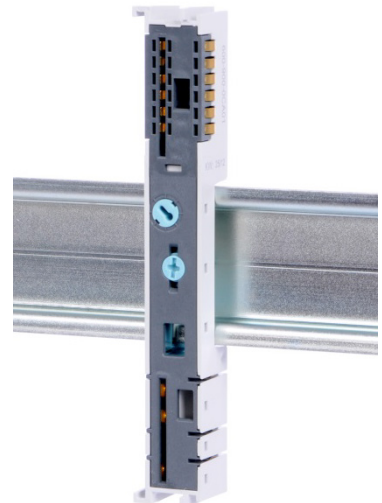### 11.1.3 Power and isolation base module

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   Front connector, 10-pin

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

11.2.2   Front connector, 20-pin

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

11.3   Electronic modules

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

11.4   Final bus cover

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