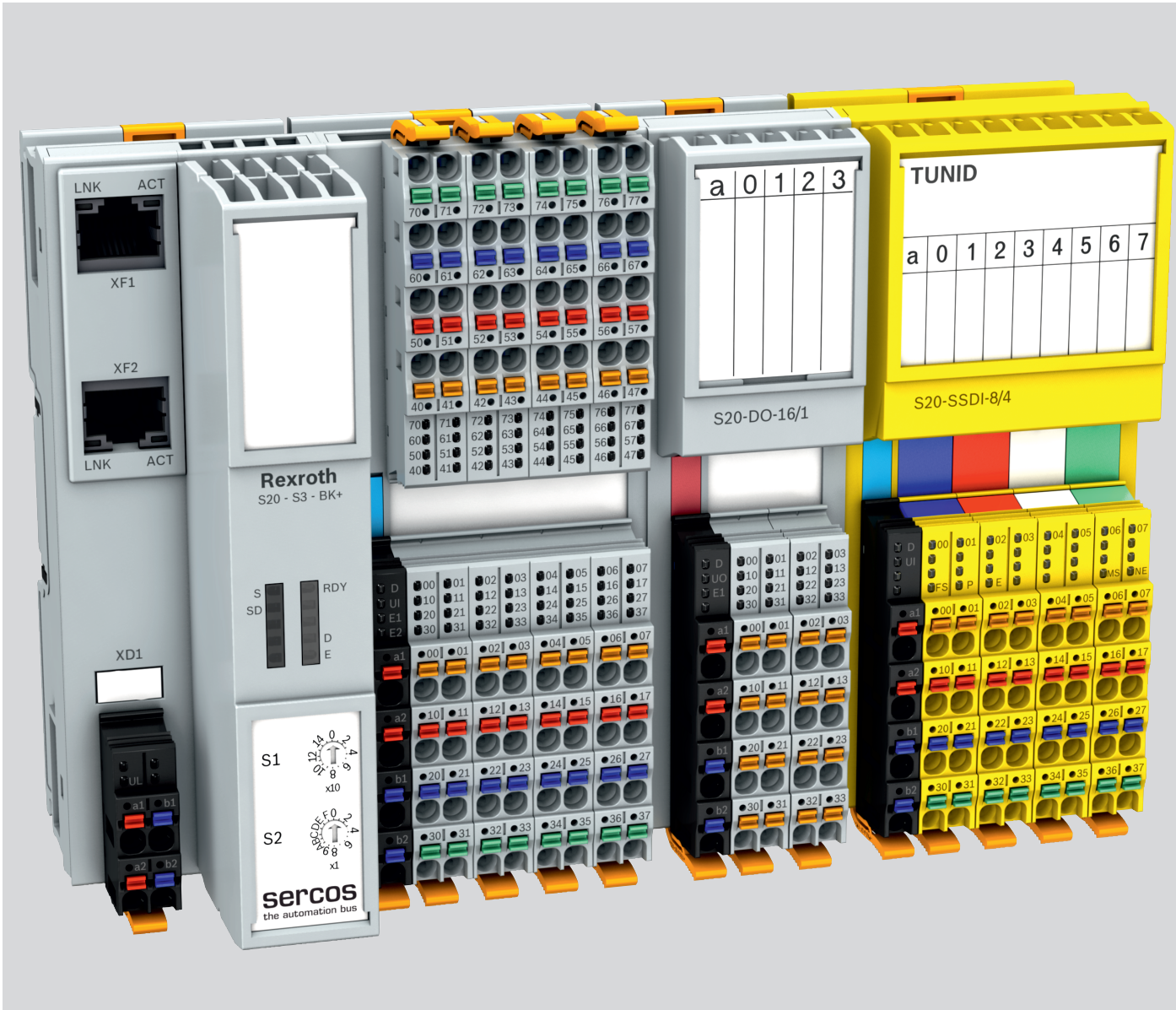
The Drive & Control Company

Rexroth
Bosch Group

IndraControl S20
System and Installation

Application Description
R911335988

Edition 02



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1 Use of the safety instructions

1.1 Structure of the safety instructions

The safety instructions are structured as follows:

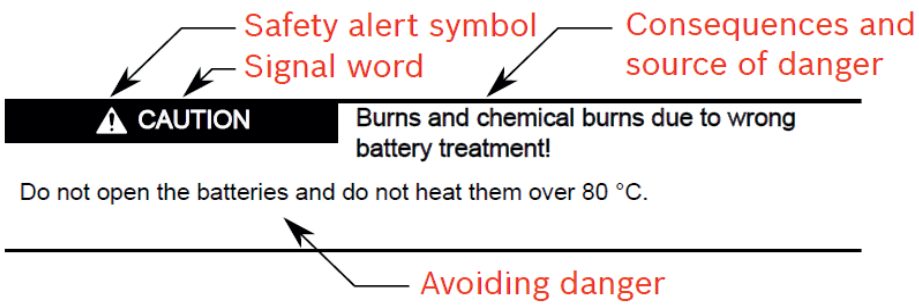


Abb. 1-1 Structure of the safety instructions

1.2 Explaining signal words and safety alert symbol

The safety instructions in this documentation contain specific signal words (danger, warning, caution, notice) and, if necessary, a safety alert symbol (according to ANSI Z535.6-2006).

The signal word is used to draw attention to the safety instruction and also provides information on the severity of the hazard.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words danger, warning and caution is used to alert the reader to personal injury hazards.

⚠ DANGER

In case of non-compliance with this safety instruction, death or serious injury **will** occur.

⚠ WARNING

In case of non-compliance with this safety instruction, death or serious injury **can** occur.

⚠ VCAUTION

In case of non-compliance with this safety instruction, minor or moderate injury can occur.

NOTICE

In case of non-compliance with this safety instruction, material damage can occur.

Use of the safety instructions

1.3 Symbols used

Hints are represented as follows:

This is an information.

Tips are represented as follows:

This is a tip for the user.

1.4 Signal graphic explanation on the device

Prior to the installation and commissioning of the device, refer to the device documentation.

2 Documentation landscape of IndraControl S20

2.1 Available documents

The documentation for the IndraControl S20 product group is modular, providing you with the optimum information to meet your requirements, for example, for installation or startup with software.

In the following table, the term “module” is used for the controller, bus coupler, and I/O module.

Document	Contents
System: information on the IndraControl S20 system	
Application description “IndraControl S20: System and Installation” (this document)	DOK-CONTRL-S20*SYS*INS-AP02-EN-P, material number R911335988 This application description is the generic system application description for IndraControl S20. It describes the system and everything about IndraControl S20 module mounting and wiring regardless of a higher-level network.
Application description “IndraControl S20: error messages”	DOK-CONTRL-S20*DIAG*ER-AP..-EN-P, material number R911344826 The application description lists all error messages for the system and provides remedial measures.
Module: basic information on a specific module	
Packing slips	A packing slip is provided with the module upon delivery. It contains key information for the electrical installation of a module or group of modules. This includes, for example: • Short description • Safety notes • Mounting/removal • Terminal point assignment
Application description for safety modules and controllers	The application description contains the complete information needed for use for each safety module and controller. This includes at least: • Description • Mounting/removal and power supply • Startup • Technical data and ordering data
Module-specific data sheets	The data sheet for each module contains the complete information needed for use. This includes at least: • Function description • Accessories • Technical data • Pin assignment/terminal point assignment • Local diagnostics and status indicators • Connection examples

Fig. 2-1 IndraControl S20 documentation

Documentation landscape of IndraControl S20

Document	Contents
Additional: information on a specific module	
Additional application descriptions	The additional application descriptions either describe: • A bus coupler connected to a network or • A specific module Each application description only describes the relevant module and/or bus-specific special features. Being a generic application description, the “DOK-CONTRL-S20*SYS*INS-AP02-EN-P” application description also applies.
Quick start guides	Quick start guides are available for various topics. A quick start guide describes the startup of a system or a module step by step using an example.
Application notes	Application notes provide additional information about special topics.
Up-to-date pdf	
Generate PDF	Clicking “PDF version” on the Internet provides you with up-to-date information on the product (see Chapter “Documentation on the Internet” on page 8). This includes at least: • Short description • Technical data • Dimensional drawing

Fig. 2-1 IndraControl S20 [...] documentation

2.2 Documentation on the Internet

The documentation can be downloaded at www.boschrexroth.com/electrics. It is available on the respective page for each specific module. During your search, take into account the differences between the “PDF version” and “Documentation”.

PDF version The “PDF version” provides you with selected and up-to-date information. It provides a **short overview** of the module.
The generated PDF file contains the essential product information. Additional information can be found under “Documentation”.

Documentation Under “Documentation” you can access the **complete** documentation for a module.
The module-specific data sheet and, if available, an application description for the module can be found under “Data sheet”.
The application description for the IndraControl S20 system is available under “Application description”.

2.3 Purpose of this document

This application description informs you about the IndraControl S20 system. It describes the system and everything about IndraControl S20 module mounting and wiring regardless of a higher-level network.

3 The IndraControl S20 product group

3.1 What is IndraControl S20?

IndraControl S20 is a modular I/O system for the control cabinet. Open to all Ethernet-based communication protocols, IndraControl S20 offers maximum flexibility. In addition, IndraControl S20 is fast as regards response times and installation, robust in terms of its design and mechanics, and at the same time very easy to operate.

It is used for the transmission of process signals to a higher-level controller. Various networks are supported.

3.2 Features

IndraControl S20 is fast

IndraControl S20 features shortest response times and fast synchronous signal processing. This reduces cycle times and helps to increase the machine output and productivity. In addition, the control quality and as a result the product quality increases thanks to the fast signal processing feature.

IndraControl S20 is as fast as parallel cabling, so the speed for data transmission is determined by the higher-level network.

- Synchronous to the higher-level network (depends on the bus coupler)
- Local bus cycle time in the µs range
- Fast I/O update times
- Fast and efficient station set-up

IndraControl S20 is robust

IndraControl S20 is particularly robust with regard to its design and mechanics. The high electromagnetic compatibility, noise immunity, and low emissions ensure problem-free use in the industrial environment and beyond.

IndraControl S20 is easy

Extremely user-friendly. Thanks to the Push-in connection technology, you can wire efficiently without tools – solid conductors or conductors with ferrules can be inserted directly into the terminal block. The color coding of the contact points enables fast and intuitive wiring – this saves installation time and therefore also costs.

In addition, intelligent marking systems from Bosch Rexroth simplify the individual I/O system marking.

Clear wiring: the design supports cabling from above and below. Module replacement is particularly fast with existing wiring.

Other properties

- High channel density
- Voltage ranges: 24 V DC (protective extra-low voltage) and up to 220 V DC/230 V AC (low voltage)
- Transmission speed in the local bus: 100 Mbps
- Communication to the higher-level system via an Ethernet-based protocol (e.g., PROFINET, Sercos, EtherCAT®, Modbus/TCP, EtherNet/IP™)
- Very good diagnostic properties for the IndraControl S20 system and application

3.3 Structure of an IndraControl S20 station

An IndraControl S20 station consists of individual modules that are snapped onto a DIN rail.
A controller or a bus coupler forms the head of the station. I/O modules are mounted next to it.
Bus base modules are used for the connection of the individual modules to one another and to the station head. The bus base modules are snapped onto the DIN rail side by side and thus form the local bus.

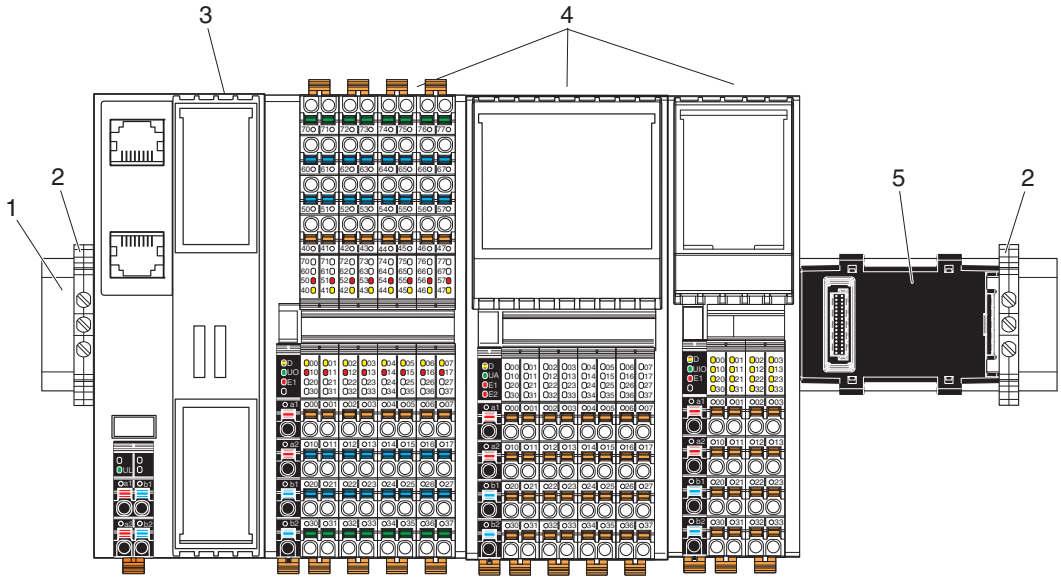


Fig. 3-1 Example of an IndraControl S20 station

1 DIN rail
2 End bracket (for securing the station; see “End brackets” on page 41)
3 Bus head (bus coupler or controller)
4 I/O modules
5 Bus base module

For detailed information about the function, properties, wiring, and parameterization, please refer to the module-specific documentation.

3.4 Product description

Modules with various functions are available within the IndraControl S20 product group.

The IndraControl S20 module consists of an electronics module, one or several connectors and a bus base module.

The electronics module can be changed without having to remove a wire from the connector.

The bus base modules are snapped onto the DIN rail side by side and thus form the local bus that connects the modules to one another.

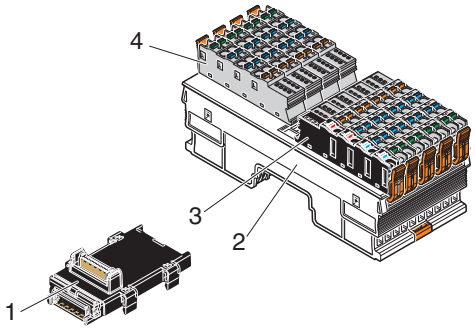


Fig. 3-2 Components of an IndraControl S20 I/O module

Key:

1 Bus base module
2 Electronics module
3 Connector for connecting the supply voltage
4 I/O connector

Versions Modules are available for the following automation tasks:

- Controller
- Bus couplers to integrate the IndraControl S20 station into various networks (PROFINET, Sercos, PROFIBUS, etc.).
- Input and output modules for digital and analog signals
- Modules for temperature recording
- Module for open and closed-loop control, and position detection
- Modules for communication
- ...

This product range is growing continuously.

Voltage ranges

IndraControl S20 modules are available for the protective extra-low voltage (PELV) and the low voltage range. You can use low-voltage and extra-low voltage modules directly next to each other within an IndraControl S20 station.

Voltage range	Product groups	Nominal voltage used	Permissible voltage range	Examples
Protective extra-low voltage	Low-level signal modules	24 V DC	19.2 V DC ... 30 V DC	S20-DI-16/4
Low voltage	Low-voltage modules	220 V DC 230 V AC	-300 V DC ... 300 V DC 24 V AC ... 230 V AC (50 Hz ... 60 Hz)	S20-DOR-4/2-220-AC

Fig. 3-3 Voltage ranges for IndraControl S20

The instructions given in this application description and in the module-specific documentation must be followed during installation and startup.
Particularly observe:
Chapter “Safety notes for mounting/removal” on page 37.

Mounting location

The IndraControl S20 modules meet IP20 degree of protection and can be used in closed control cabinets or in control boxes (terminal boxes) with IP54 degree of protection according to EN 60529 or higher.

The compact design means that the IndraControl S20 modules can be installed in standard terminal boxes. Please observe the mounting distances when selecting the housing (see Chapter “Mounting distances” on page 52).

Mounting

Each IndraControl S20 module consists of a bus base module and an electronics module. Snap the bus base modules onto the DIN rail without the need for tools and arrange the modules side by side. The local bus is created automatically when the bus base modules are installed next to one another.

Then, snap the electronics modules onto the DIN rail over the bus base modules.

See Chapter “Mounting and removing modules” on page 37.

Removal

Only a standard tool is necessary for removing the electronics module (e.g., a bladed screwdriver with a blade width of 2.5 mm).

See Chapter “Mounting and removing modules” on page 37.

Bus connection (network)

The IndraControl S20 station is integrated in the network using a controller or bus coupler.

Local bus

There is an interface to the local bus on the bottom of the modules. Bus base modules are used to carry the communications power and the bus signals from the controller or bus coupler through the IndraControl S20 station. The bus base module is supplied as standard with each module.

Please note the special feature of the bus couplers:
The bus base is integrated for the bus couplers S20-PN-BK and S20-S3-BK.
For all other bus couplers, a separate bus base module is included in the scope of delivery.

The maximum number of IndraControl S20 modules within a station is 63. The actual number of modules within an IndraControl S20 station may be limited by the supplied logic current, the current consumption of the connected modules, and the system limits of the controller or bus coupler. See Chapter “Maximum number of modules” on page 42.

The IndraControl S20 product group

Connectors

The IndraControl S20 modules have connectors for connecting the power supply and the I/O. The connectors have spring-cage terminal blocks. Suitable wires can be connected with Push-in technology (see Chapter “Conductor cross sections and stripping/insertion lengths” on page 56).

Connecting the supply voltage

The communications power for the IndraControl S20 station is supplied at the controller or bus coupler. The voltage for the module’s I/O is supplied separately to each I/O module (see Chapter “Connecting the power supplies” on page 62).

I/O connection

Sensors or actuators are connected with connectors using 1, 2, 3 or 4-wire technology (see Chapter “Connecting sensors and actuators” on page 66).

Depending on the module, the sensor/actuator cables are connected in one direction (at the bottom) or in two directions (at the top and at the bottom).

FE connection

At the bottom of each module there is at least one FE spring (metal contact) creating a functional earth ground connection when the module is snapped onto a grounded DIN rail.

Web-based management

By means of the web-based management integrated into the controllers and some bus couplers, you have the option to display static and dynamic information of the controller using a standard browser. The status and diagnostic functions can be displayed on a graphical user interface by means of read access via a device network connection.
In addition, specific controller/bus coupler properties can be configured via web-based management.

Diagnostics

The IndraControl S20 system provides comprehensive diagnostics:

- Remote diagnostics
- Process diagnostics (e.g., cycle time monitoring)
- Communication diagnostics
- Module diagnostics (status of the IndraControl S20 module)
- I/O diagnostics (status of sensors/actuators)

For the diagnostic options of a specific module, please refer to the module-specific data sheets.

Reset button

The reset button provided on the controllers and bus couplers can only be operated with a pointed object (e.g., a pen) and is therefore protected against accidental activation.

If the reset button is actuated during operation, the controller or bus coupler is restarted.

Using the reset button, the controller or bus coupler can also be reset to the default settings.

For more detailed information on the reset button, please refer to the module-specific documentation.

3.5 Intended use

IndraControl S20 controllers, bus couplers, and I/O modules should only be used according to the instructions given in the module-specific documentation and this application description (see Chapter “Technical data” on page 93). Bosch Rexroth accepts no liability if the modules are used for anything other than their designated use.

4 IndraControl S20 modules at a glance

4.1 IndraControl S20 order code

The order code helps you to identify the function of a module.

	Product group	System	Function	Number of inputs or outputs	Conductor connection	Function extension
Examples:	S20	PN	BK			
	S20		DI	16	/4	
	S20		AI	4		UTH
	S20		DOR	4	/2	220-AC

Product group	S20	IndraControl S20
System	PN	PROFINET
	S3	Sercos
	PB	PROFIBUS DP
	EC	EtherCAT®
	ETH	Ethernet (Modbus/TCP)
	EIP	EtherNet/IP™
Function	BK+	Bus coupler in BK+ housing (with separate bus base)
	BK	Bus coupler S20-PN-BK, S20-S3-BK: BK housing with integrated bus base
	DI	Digital input
	DO	Digital output
	DOR	Relay output
	SSDI	Safe digital input
	SSDO	Safe digital output
	P(SDI, SDO)	PROFIsafe
	PSDI	Safe digital input
	PSDO	Safe digital output
	AI	Analog input
	AO	Analog output
	CNT	Counter
	INC	Incremental encoder input
	SSI	SSI interface for absolute encoders
	RS UNI	Communication module for serial data transmission via RS-232 or RS-485/422
	PWR	Supply

Fig. 4-1 Structure of the order codes

IndraControl S20 modules at a glance

Number of inputs or outputs	1 ... 64	1 ... 64 channels
Connection technology (for digital modules only)	/4	4-wire technology
	/3	3-wire technology
	/2	2-wire technology
	/1	1-wire technology
Function extension	HS	High speed
	RTD	Analog input for the connection of resistance temperature detectors
	UTH	Analog input for the connection of thermocouple sensors
	I	Current
	U	Voltage
	2A	2 A outputs
	AC	Low voltage range AC (nominal output voltage 230 V AC)
	220-AC	Low voltage range AC and DC (nominal output voltage 230 V AC, 220 V DC)
	110/220DC	Low voltage range DC (Nominal voltage 110 V DC, 220 V DC)

Fig. 4-1 Structure of the order codes [...]

The standard modules are supplied with the bus base module and IndraControl S20 connectors. The connectors are mounted to the electronics module, and the bus base module is supplied as a separate part.
Bus base modules are also available as replacement items.
Please refer to the module-specific page at www.boschrexroth.com/electrics and click on the “Order details” tab to see whether a module-specific connector set is available as replacement item.

4.2 Controller

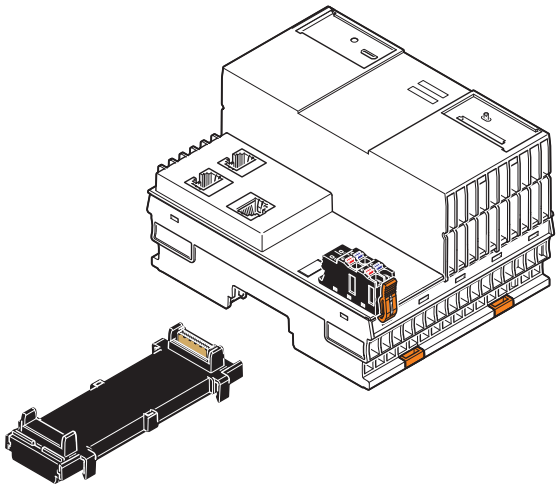


Fig. 4-2 Example: XM21

As the head of an IndraControl S20 station, the modular controller with Ethernet and IndraControl S20 local bus connection provides the function of a controller.

A class XM2x controller is the ideal controller for medium-sized to complex applications in which networking options as well as a particularly short processing and response speed are required.

Optional extension modules increase the integration possibilities. These modules are installed next to each other on the left side of the controller. The service-friendly design easily reduces installation and startup costs.

Please refer to the DOK-CONTRL-XFE**EXTMOD-IT..-EN-P operating instructions, material number R911345570 for further information.

4.3 Bus coupler

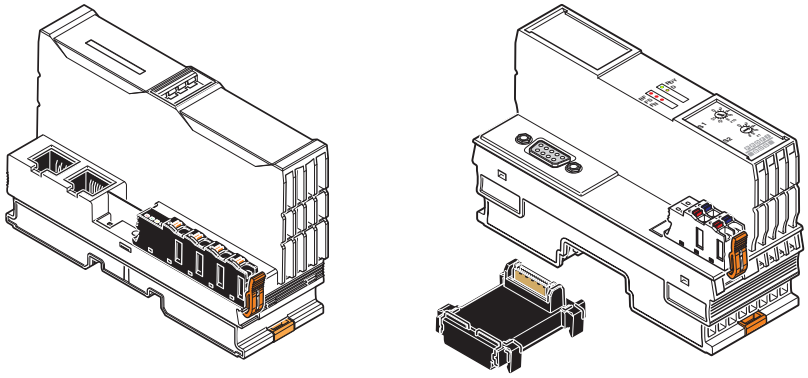


Fig. 4-3 Example: S20-PN-BK (BK housing) and S20-PB-BK (BK+ housing)

As the head of an IndraControl S20 station, the bus coupler with a network and an IndraControl S20 local bus connection represents the link between your network and the IndraControl S20 station.

Bus system/network	Bus coupler (examples)
PROFINET	S20-PN-BK, S20-PN-BK+
PROFIBUS DP	S20-PB-BK
EtherNet/IP™	S20-EIP-BK
Ethernet (Modbus/TCP)	S20-ETH-BK
Sercos	S20-S3-BK, S20-S3-BK+
EtherCAT®	S20-EC-BK

Fig. 4-4 Supported bus systems/networks

4.4 Input/output modules

4.4.1 Overview

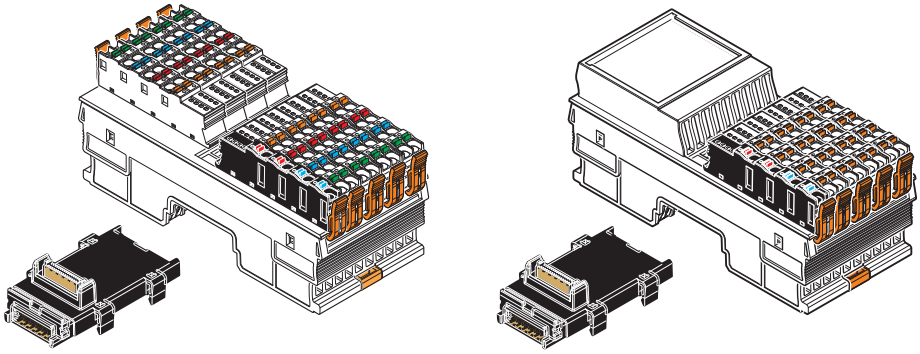


Fig. 4-5 Example: S20-DI-16/4 and S20-AO-8

Modules are available with various functions. These include, for example, the modules listed below. The text in brackets indicates the function according to the order code.

- Digital input and output modules (DI, DO, DOR)
- Analog input and output modules (AI, AO)
- Digital input and output modules for the low voltage range (220 DC, AC)
- Temperature recording modules (RTD, UTH)
- Module for open and closed-loop control, and position detection (CNT/INC)
- Module for communication (RS, UNI)
- Function module (SSI-AO)
- Safety modules with safe digital inputs and outputs (PSDI, PSDO, see Chapter “Safety modules with safe digital inputs or outputs” on page 20)
- Power module for the communications power U_{Bus} (see Chapter “Power module for the communications power U_{Bus}” on page 20)
- ...

4.4.2 Safety modules with safe digital inputs or outputs

The safety modules are to be used in an IndraControl S20 station at any point in a safe system (e.g., PROFIsafe).

Depending on the version, the modules either have safe digital inputs or outputs. They can be parameterized according to the specific application and enable the integration of sensors and actuators in the safe system.

For more detailed information on these modules, please refer to the module-specific user documentation.

4.4.3 Power module for the communications power U_{Bus}

If the maximum load of the controller or bus coupler for the IndraControl S20 local bus supply (communications power U_{Bus}) is reached, you can use this power module to provide this voltage again.

5 Housing versions, design, and dimensions

5.1 Housing versions

Various housing versions are available in the IndraControl S20 portfolio; they are shown in Fig. 5-1.

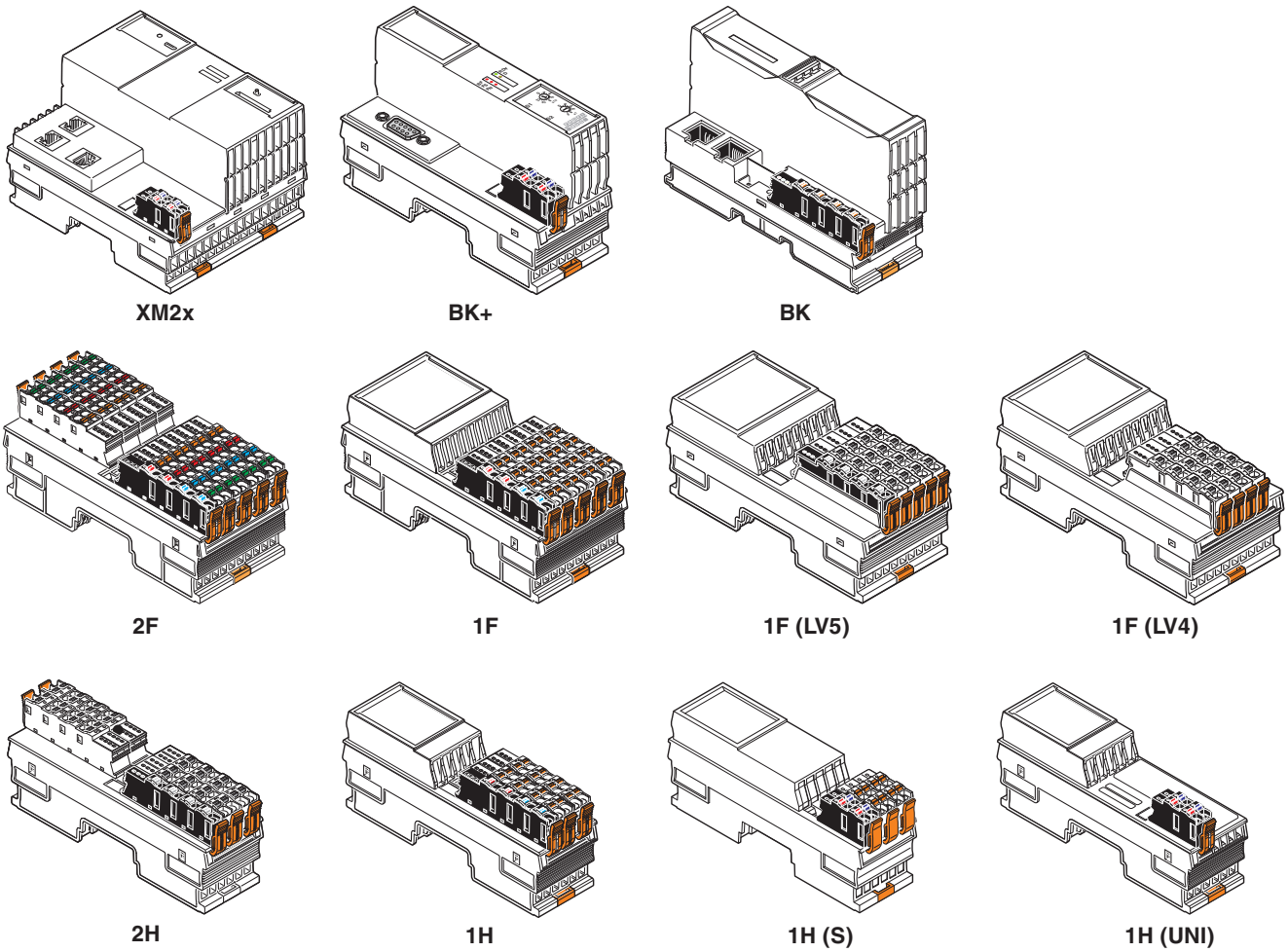


Fig. 5-1 Housing versions

Housing versions, design, and dimensions

Housing type	Special feature	Example	Design	Dimensions
XM2x	Class XM2x controller Separate bus base module	XM21	See application description for the controller*	Fig. 5-6 on page 26
BK+	S20-xx-BK bus coupler Separate bus base module	S20-PB-BK, S20-PN-BK+, S20-S3-BK+	Fig. 5-4 on page 24	Fig. 5-7 on page 26
BK	Bus coupler Integrated bus base	S20-PN-BK, S20-S3-BK		Fig. 5-8 on page 26
2F	Wide housing, 2 terminal fields	S20-DI-16/4 S20-DO-16/3	Fig. 5-5 on page 25	Fig. 5-9 on page 27
1F	Wide housing, 1 terminal field	S20-AI-8 S20-DI-32/1		Fig. 5-10 on page 27
1F (LVx) 1F (LV4)	Wide housing, 1 terminal field, **l**ow **v**oltage 4 connectors	 S20-DOR-4/2-220-AC		 Fig. 5-15 on page 29
2H	Narrow housing, 2 terminal fields			Fig. 5-11 on page 27
1H	Narrow housing, 1 terminal field			
1H	Long connectors	S20-AI-4-UTH S20-RS-UNI		Fig. 5-12 on page 28
1H (S)	Short connectors	S20-SSI-AO-1/1		Fig. 5-13 on page 28
1H (UNI)	Universal	S20-PWR		Fig. 5-14 on page 28

Fig. 5-2 Housing versions

* Application description for the controller:
DOK-CONTRL-IC*XM2*****-IT..-EN-P, material number R911340667

5.2 Basic design of IndraControl S20 modules

5.2.1 Class XM2x controller

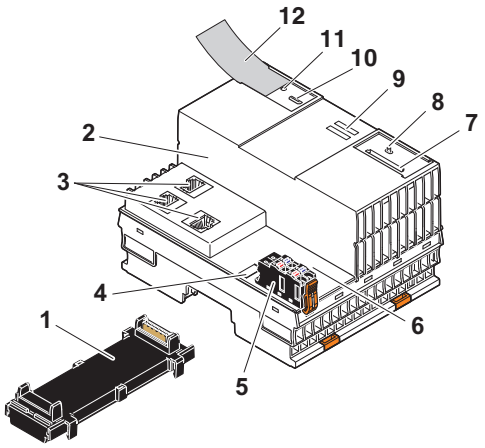


Fig. 5-3 Design of an XM21 controller

1 Bus base module
2 Electronics module
3 Ethernet interfaces
4 Function identification and FE tab:
A 2.8 mm FE tab for optional functional earth ground connection is located under the function identification (see application description for the controller DOK-CONTRL-IC*XM2*****-IT..-EN-P, material number R91340667)
5 Connector for connecting the communications power U_L
6 USB interface
7 Slot for the parameterization memory
8 Mode selector switch
9 Diagnostics and status indicators (here: LEDs)
10 Programming interface
11 Reset button
12 Insert label

Housing versions, design, and dimensions

5.2.2 Bus coupler

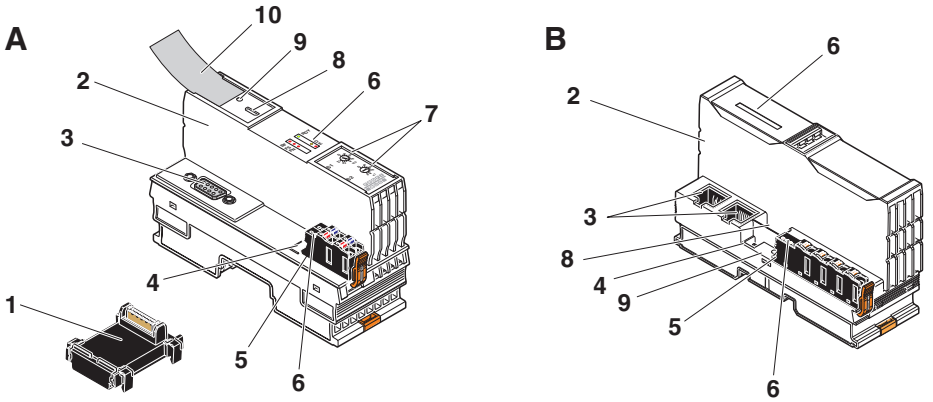


Fig. 5-4 Design of a bus coupler

A	BK+ housing	e.g., S20-PB-BK
B	BK housing	S20-PN-BK, S20-S3-BK

1 Bus base module
The bus base is integrated in the module for the S20-PN-BK and S20-S3-BK bus couplers (BK housing).
For all other bus couplers (BK+ housing), a separate bus base module is included in the scope of delivery.

2 Electronics module

3 Bus connection (here: Ethernet connections, PROFIBUS connection)

4 Function identification

5 Connector for connecting the communications power U_L

6 Diagnostics and status indicators (here: LEDs)

7 Rotary coding switch

8 Service interface

9 Reset button

10 Insert label

On the underside of the module, there are two FE springs for connecting the functional earth ground via the DIN rail. These are not shown in Fig. 5-4. They are illustrated in Fig. 8-1 on page 72.

5.2.3 Input/output module (electronics module)

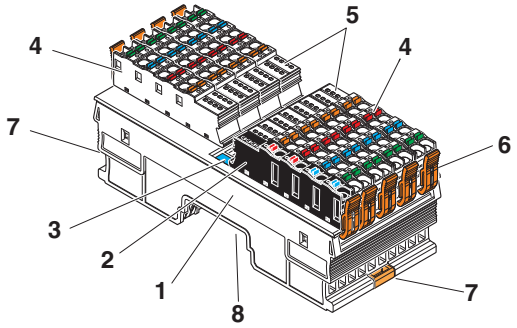


Fig. 5-5 Design of an input/output module (example: S20-DI-16/4)

1 Electronics module
2 Connector for connecting the I/O supply voltage (U_I, U_O, U_{IO}, or U_A)
3 Function identification
4 Connectors for connecting the I/O
5 Diagnostics and status indicators
6 Locking latches of the I/O connectors
7 Base latch for latching to the DIN rail (2 x)
8 Device connector for connecting to the local bus via the bus base module (at the bottom, not illustrated)

On the underside of the module, there is at least one FE spring for connecting the functional earth ground via the DIN rail. This is not shown in Fig. 5-5. It is illustrated in Fig. 8-1 on page 72.

Housing versions, design, and dimensions

5.3 IndraControl S20 module dimensions

5.3.1 XM2x controllers and bus couplers

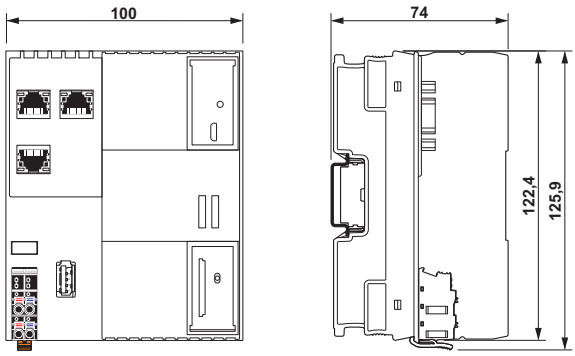


Fig. 5-6 *Nominal dimensions of the controller housing (type XM2x: e.g., XM21)*

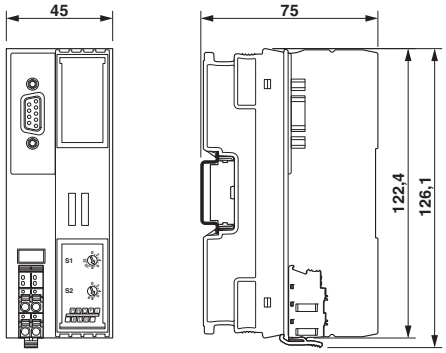


Fig. 5-7 *Nominal dimensions of the bus coupler housing with separate bus base (type BK+: e.g., S20-PB-BK, S20-PN-BK+)*

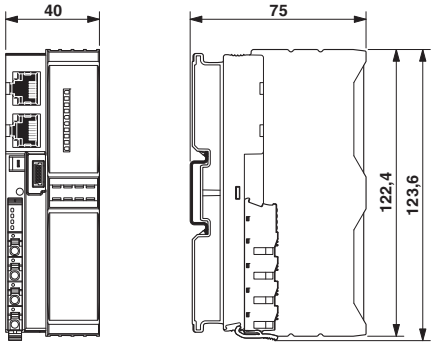


Fig. 5-8 *Nominal dimensions of the bus coupler housing with integrated bus base (type BK: e.g., S20-PN-BK)*

5.3.2 I/O modules for the 24 V area

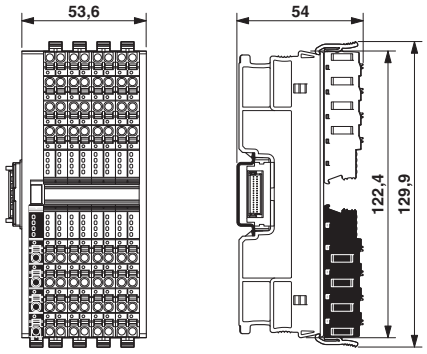


Fig. 5-9 *Nominal dimensions of the F housing with two terminal fields (type 2F: e.g., S20-DI-16/4, S20-DO-16/3)*

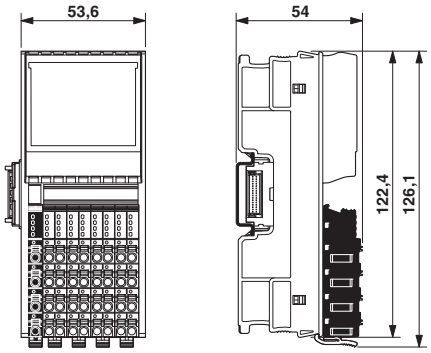


Fig. 5-10 *Nominal dimensions of the F housing with one terminal field (type 1F: e.g., S20-AI-8, S20-DI-32/1)*

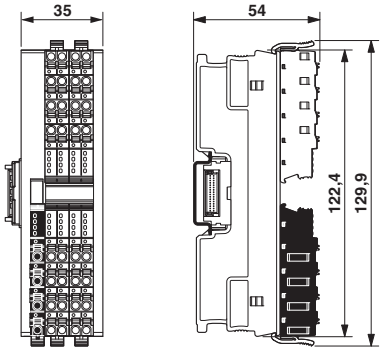


Fig. 5-11 *Nominal dimensions of the H housing with two terminal fields (type 2H)*

Housing versions, design, and dimensions

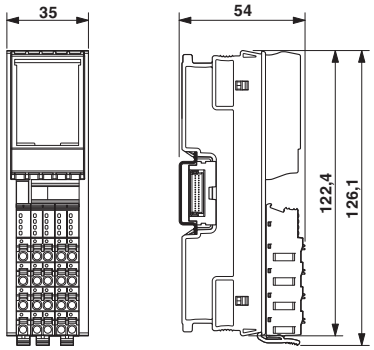


Fig. 5-12 *Nominal dimensions of the H housing with one terminal field (type 1H: e.g., S20-DI-16/1-HS, S20-AI-4-UTH, S20-RS-UNI)*

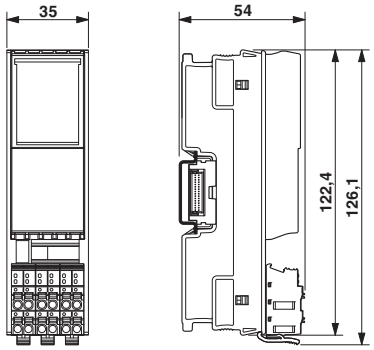


Fig. 5-13 *Nominal dimensions of the H housing with one terminal field and short connectors (type 1H (S): e.g., S20-SSI-AO-1/1)*

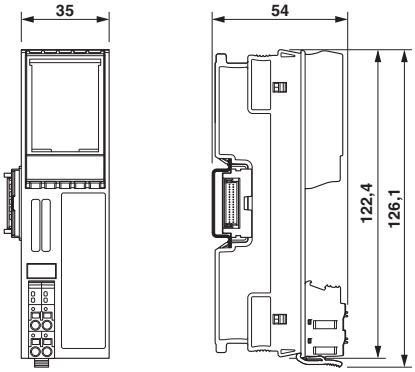


Fig. 5-14 *Nominal dimensions of the H housing with one terminal field and short connectors (type 1H (UNI): e.g., S20-PWR)*

5.3.3 I/O modules for the low voltage area

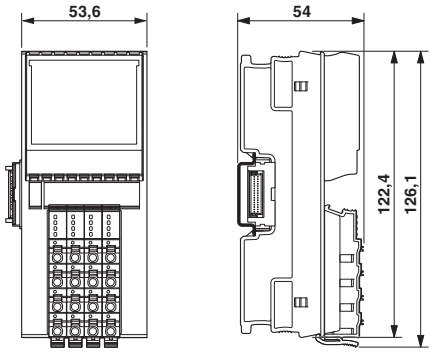


Fig. 5-15 Nominal dimensions of the F housing for the low voltage area with one terminal field and four connectors (type 1F-LV4: e.g., S20-DOR-4/2-220-AC)

Housing versions, design, and dimensions

5.4 Bus base modules

Bus base modules connect the modules to each other.

Bus base modules carry the communications power and the bus signals from the bus coupler or controller through the IndraControl S20 station (local bus).

A bus base module is supplied as standard with each IndraControl S20 module. Excluded from this are bus couplers in the BK housing into which the bus base is integrated.

NOTICE **Malfunction**

Ensure you insert the bus base module belonging to the relevant module.
Bus base modules with different overall widths and functions are available (e.g., red bus base module for the power module).

Versions

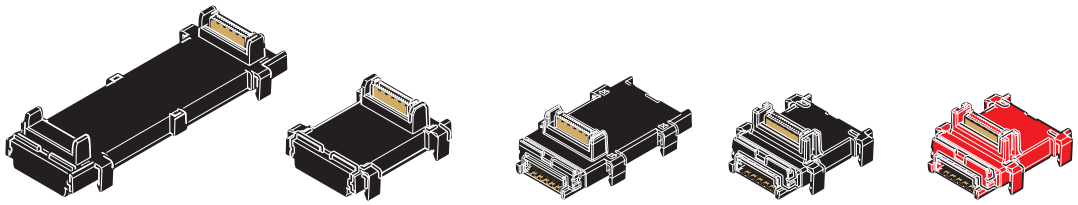


Fig. 5-16 Bus base modules

No.	Type	MNR	For use with
1	XA-BS01	R911342346	XM2x controller
2	S20-BS-BK	R911173392	Bus coupler BK+ housing
3	S20-BS	R911172540	F housing
4	S20-BS-S	R911173203	H housing
5	S20-BS-PWR	R911173865	Power module

Fig. 5-17 Bus base modules

Basic design

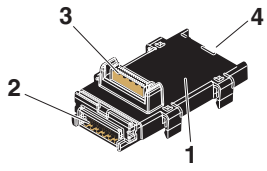


Fig. 5-18 Bus base module design

1 Bus base module
2 Connection to the bus coupler or the previous bus base module (connector)
3 Connection of the local bus to an I/O electronics module (socket)
4 Connection for the following bus base module (socket)

5.5 IndraControl S20 connector

The IndraControl S20 connectors accept cables up to 1.5 mm^2 and a stripping length of 8 mm. Detailed information on the conductor cross sections and stripping lengths can be found in Chapter “Conductor cross sections and stripping/insertion lengths” on page 56.

5.5.1 Versions and dimensions

Various IndraControl S20 connector versions are available.

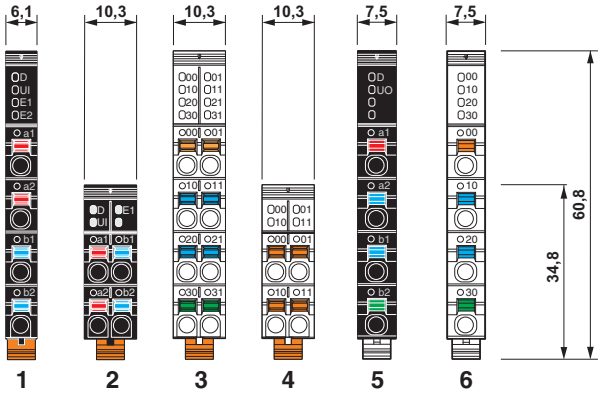


Fig. 5-19 Connectors: versions and dimensions

No.	Color	Use	Examples of use
24 V area			
1	Black RAL 9005	Feeding the supply voltages	S20-PN-BK, S20-S3-BK S20-DI-..., S20-DO-... S20-AI-..., S20-AO-... S20-CNT-INC-2/2
2			XM2x S20-xx-BK(+) S20-SSI-AO-1/1
3	Light gray RAL 7035	I/O connection (protective extra-low voltage)	S20-DI-..., S20-DO-... S20-AI-..., S20-AO-... S20-CNT-INC-2/2
	Zinc yellow RAL 1018	I/O connection (safety modules, protective extra-low voltage)	S20-PSDI-8/4 S20-PSDO-8/3
4	Light gray RAL 7035	I/O connection (protective extra-low voltage)	S20-SSI-AO-1/1
230 V area			
5	Black RAL 9005	Feeding the supply voltages	
6	Light gray RAL 7035	I/O connection (low voltage)	S20-DOR-4/2-220-AC

Fig. 5-20 Connectors: versions and dimensions

Housing versions, design, and dimensions

5.5.2 Basic design

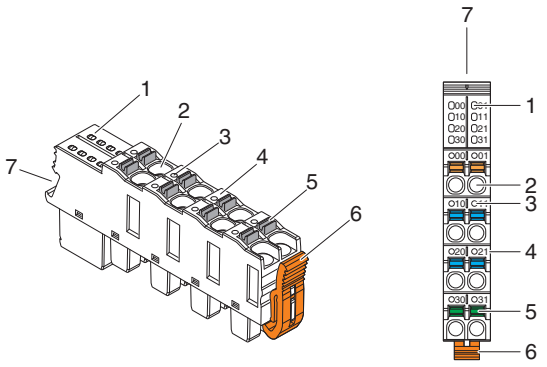


Fig. 5-21 Basic design of an IndraControl S20 connector

1 Local diagnostics and status indicators
2 Terminal point
3 Touch connection
4 Terminal point marking
5 Spring lever; color of the spring lever corresponds to the function (see Chapter “Color and marking” on page 33)
6 Locking latch
7 Space for connector marking

5.6 Color and marking

Housing

The following housing colors are currently used for the electronics module:

Color	Similar RAL color	Use
Light gray	RAL 7035	Standard modules
Zinc yellow	RAL 1018	Safety modules

Fig. 5-22 Electronics module housing colors

Connector

All connectors for the voltage supply are completely black (RAL 9005).

The bottom parts of the connectors for the I/O connection are black (RAL 9005). The upper parts match the color of the housing, i.e., light gray or zinc yellow.

Function identification

The module functions are color coded (1 in Fig. 5-23).

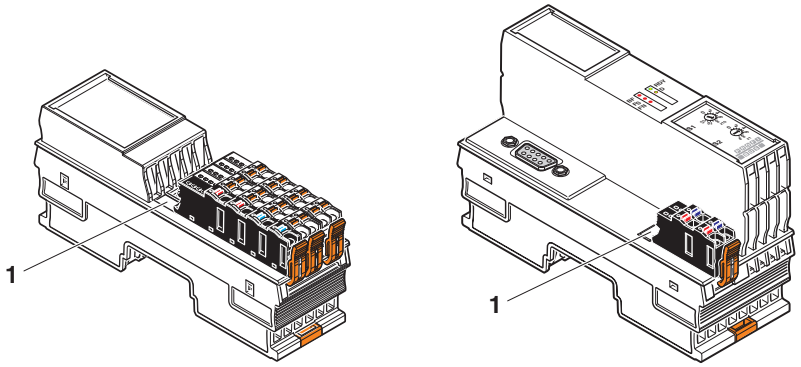


Fig. 5-23 Color coding of the module function

The following colors indicate the function:

Color	Similar RAL color	Function of the module
Light blue	RAL 5012	Digital input
Flame red	RAL 3000	Digital output
Signal violet	RAL 4008	Digital input and output
Pale green	RAL 6021	Analog input, temperature recording
Zinc yellow	RAL 1018	Analog output
Pastel orange	RAL 2003	Function: open and closed-loop control, communication, position detection
Pure white	RAL 9010	Bus coupler, controller, boost

Fig. 5-24 Color coding of the module function

Housing versions, design, and dimensions

Connections Apart from the IndraControl S20 connectors, all connections are consecutively numbered, e.g., X1, X2 for Ethernet connections.

Operating elements Operating elements are marked according to their function, e.g., rotary coding switches with S1 and S2 including the switch positions.

Display elements Diagnostics and status indicators are marked with the function, e.g., D, E, UI, 00, 01, ...
(1 in Fig. 5-25).

Terminal points The terminal points are consecutively numbered, e.g., a1, b1, 00, 01, ... (2 in Fig. 5-25).

The associated colored spring lever indicates the function (signal, potential)
(3 in Fig. 5-25).

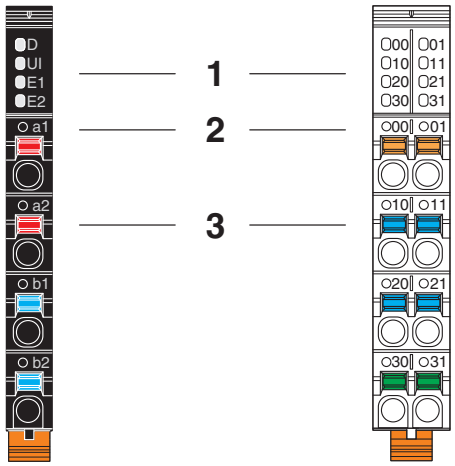


Fig. 5-25 Marking of the terminal points and the LEDs on the connectors

Color	Function of the terminal points	
	Low-level signal	**Low voltage**
Orange	Signal	Signal
Red	24 V DC	230 V AC, 220 V DC, relay main contact
Blue	GND	N (neutral conductor)
Green	FE (functional earth ground)	PE (protective conductor)

Fig. 5-26 Color coding of terminal point function

For the marking and function identification of a module, please refer to the module-specific data sheet.

Additional marking options

In addition to the standard markings detailed above, you can also custom-mark the module using a zack marker strip or an insert label.

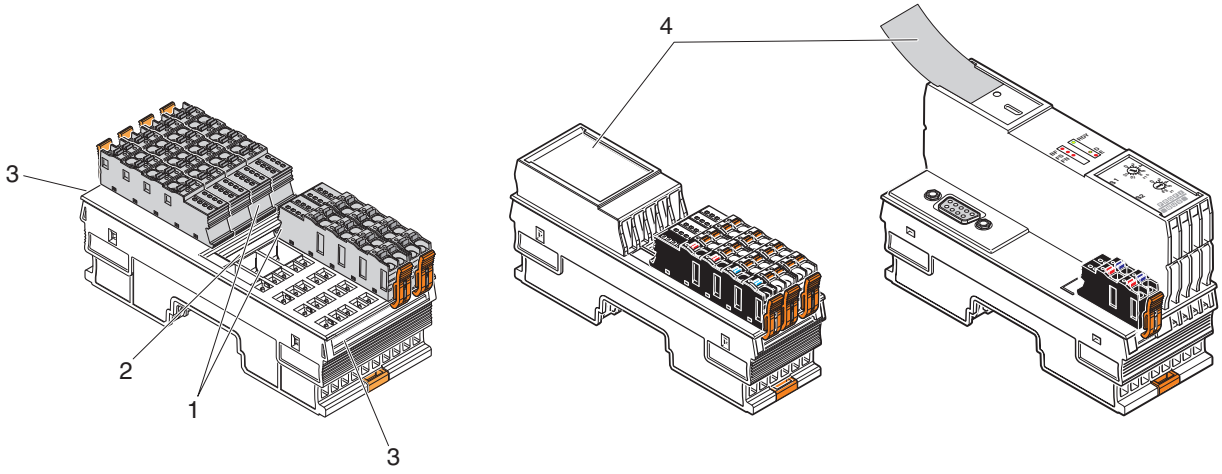


Fig. 5-27 Individual marking options

1 Space for connector marking
2 Space for module marking
3 Space for slot marking
4 Insert label

Ordering data can be found in Chapter “Ordering data” on page 97.

Slot and connector marking

Each slot on the module and the associated connector can be marked individually to ensure clear assignment between the slot and connector (1 and 3 in Fig. 5-27).

Housing versions, design, and dimensions

6 Mounting and removing modules

6.1 Unpacking the modules

The modules are supplied in a packaging together with a packing slip with installation instructions. Please read the complete packing slip carefully before unpacking the module.

6.2 Safety notes for mounting/removal

6.2.1 General safety notes

NOTICE **Electrostatic discharge**

The modules contain components that can be damaged or destroyed by electrostatic discharge. When handling the modules, observe the necessary safety precautions against electrostatic discharge (ESD) according to EN 61340-5-1 and IEC 61340-5-1.

NOTICE **Electrical damage due to inadequate external protection**

Fuse does not trip in the event of an error

Provide external fuses for the 24 V area of each module. The power supply unit must be able to supply four times the nominal current of the external fuse, to ensure that it trips in the event of an error.

NOTICE **Disregarding this warning may result in damage of the contacts or malfunction**

Before working on the a module, disconnect the module from the I/O devices and power.

For an I/O module, this means:
Disconnect the connected I/O devices from the power.
Switch off the I/O supply voltage at the relevant module. The communications power that is supplied at the bus coupler/controller is still available.

For a bus coupler/controller, this means:
Disconnect the communications power supply at the bus coupler/controller.

NOTICE **Damage to the contacts when tilting**

If the modules tilt, you can damage the contacts.

Place and also remove the modules onto/from the DIN rail vertically.

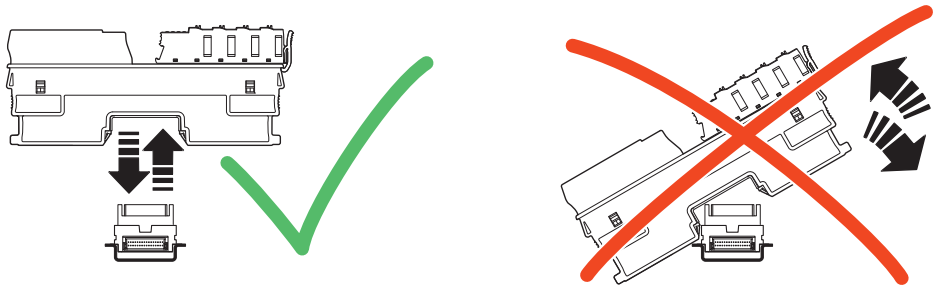


Fig. 6-1 Placing/removing the module vertically

When using modules in the low voltage area, please also observe Chapter “Additional safety notes for the low voltage area” on page 39. Additionally observe the information in the module-specific data sheets.

6.2.2 Additional safety notes for the low voltage area

Installing the system

Install the system according to the requirements of EN 50178.

Only qualified personnel may work on IndraControl S20 modules in the low voltage area.

Qualified personnel are people who, because of their education, experience, and instruction and their knowledge of relevant standards, regulations, accident prevention, and service conditions, have been authorized by those responsible for the safety of the system to carry out any required operations and who are able to recognize and avoid any possible dangers.
(Definitions for skilled workers according to EN 50110-1:1996).

⚠ WARNING **Dangerous contact voltage**

Please be aware of dangerous contact voltages when working on circuits that do not meet protective extra-low voltage requirements.

The IndraControl S20 modules for the low voltage area may only be mounted and removed when the power supply is disconnected.

When working on the modules and wiring, always switch off the supply voltage and ensure it cannot be switched on again.

The IndraControl S20 modules for the low voltage area must only be operated in a closed control cabinet.

Failure to observe these instructions can lead to damage to health or even life-threatening injury.

⚠ WARNING **Dangerous contact voltage in the event of ground faults**

The IndraControl S20 modules for the low voltage area must only be operated in grounded networks.

☞ Additionally observe the information in the module-specific data sheets.

6.3 Basic information about mounting

Mounting location

The IndraControl S20 modules meet IP20 degree of protection and can be used in closed control cabinets or control boxes (terminal boxes) with IP54 degree of protection according to EN 60529 or higher.

The compact design means that most of the IndraControl S20 modules can be installed in standard terminal boxes. Please observe the mounting distances when selecting the housing (see Chapter “Mounting distances” on page 52).

IP20 degree of protection

Insert the connectors onto the electronics modules in order to achieve IP20 degree of protection.

DIN rail

All IndraControl S20 modules are mounted on 35 mm standard DIN rails. The preferred height of the DIN rail is 7.5 mm (corresponds to TH 35-7.5 according to EN 60715).

The recommended DIN rails from Bosch Rexroth or recommended mounting straps from Lütze can be found in Chapter “Ordering data” on page 97.

Mount the modules **vertically** on the DIN rail. This way, the module does not need to be tilted and it provides easy installation and removal, even in confined spaces.

The distance between the DIN rail fasteners must not exceed 200 mm. This distance is necessary for the stability of the rail when mounting and removing modules.

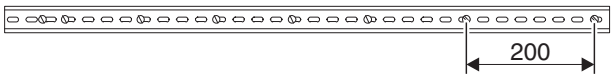


Fig. 6-2 Fixing the DIN rail (in mm)

NOTICE **Electrical damage from the fixing elements**
Danger of malfunction

If the fixing elements (screw, rivet, etc.) are too high, the bus base modules are not correctly snapped onto the DIN rail.

For fixing the DIN rail, only use elements with a maximum installation height of 3 mm.

Mounting position

Wall mounting on a horizontal DIN rail on the wall is the preferred mounting position (Fig. 6-3, A). This mounting position provides optimum air flow for the modules.

Other mounting positions are possible, however, temperature derating may be required. Observe the ambient temperatures provided in the module-specific documentation.

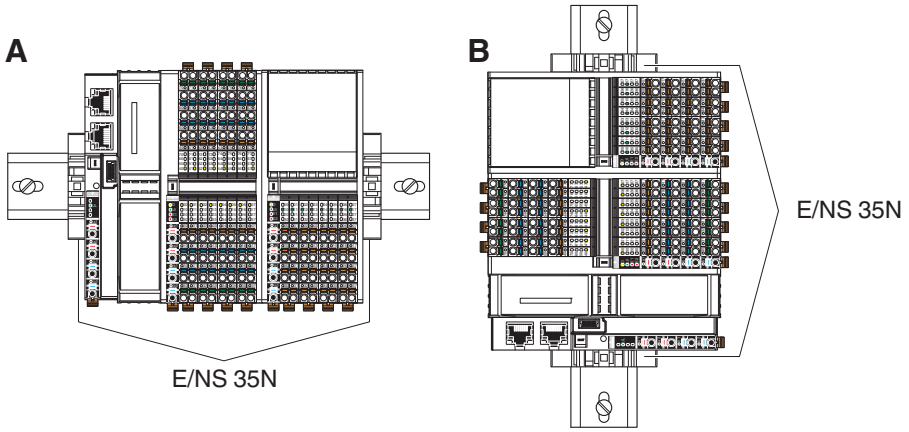


Fig. 6-3 Mounting positions for an IndraControl S20 station

The module-specific documentation specifies whether any other mounting position than the preferred mounting position is not permitted.

End brackets

Mount end brackets on both sides of the IndraControl S20 station (see also Fig. 6-3). The end brackets ensure that the IndraControl S20 station is correctly mounted. They secure the station on both sides and keep it from moving from side to side on the DIN rail.

Always attach the left end bracket of the station when beginning to mount the station. This ensures the following:

- It prevents the station from slipping on the DIN rail.
- The space for the end bracket is secured.
- There is a counter pressure for the insertion force that occurs when the bus base modules are installed next to the bus coupler.
- For bus couplers in the BK housing: if the bus coupler needs to be replaced you have enough space to separate the bus coupler from the bus base modules.

Mounting position	Ambient conditions	End bracket
Horizontal; Fig. 6-3, A	Normal	E/NS 35N
	High shock and vibration load	
Other; Fig. 6-3, B	Normal	
	High shock and vibration load	

Fig. 6-4 Recommended end brackets

Mounting and removing modules

Tools

No tools are required for mounting the modules.

A standard tool, e.g., a bladed screwdriver with a blade width of 2.5 mm, is necessary for removing the electronics modules and using the spring levers.

Order of the modules

The modules on the DIN rail can be put in any order behind the bus coupler. To ensure functionality, mount the modules side by side, without a gap.

If you are using modules with overall shielding braid, installing them next to each other is recommended in order to make optimum use of the busbar for overall shielding braid.

Maximum number of modules

The maximum number of IndraControl S20 modules within a station is 63.

The actual number of modules within an IndraControl S20 station may be limited by the supplied logic current, the current consumption of the connected modules, and the system limits of the bus coupler.

The bus coupler, controller or the power module for the communications power provide the power supply for the local bus. In the module-specific documentation, this current value is specified as “Power supply at U_{Bus}”.

The total current consumption of all IndraControl S20 modules arranged in the station must not exceed this maximum current. The logic current consumption values are specified for each module in the module-specific data sheet as “Current consumption from U_{BUS}”.

The current supplied by the bus coupler, controller or the power module and the maximum current that can be taken up by the connected modules, are noted in the device description files (e.g., gsdml file). You can use these maximum currents in the engineering tool for configuration in order to prevent an overload of the communications power.

NOTICE **Electronics may be damaged if overloaded**

Observe the current consumption of each device when configuring an IndraControl S20 station. It is specified in every module-specific data sheet and may vary. As such, the permissible number of devices that can be connected therefore depends on the station structure.

Install a power module for the communications power or create an additional station if the maximum current consumption at U_{Bus} is reached.

System limits of the bus coupler

For information regarding the system limits of the bus coupler or controller used, please refer to the module-specific documentation. The system limits include:

Network	Bus coupler	System limits
Sercos	S20-S3-BK+	Amount of process data
PROFINET	S20-PN-BK+	Amount of process data
PROFIBUS	S20-PB-BK	Amount of process data
		Amount of parameter data
		Amount of configuration data

Fig. 6-5 System limit examples

The amount of process data and the amount of parameter and configuration data for PROFIBUS are documented in the module-specific data sheet for each I/O module.

If the system limits of the bus coupler or controller are reached, create a new station.

Design example of an IndraControl S20 station

See Chapter “Example of an IndraControl S20 station” on page 11.

6.4 Mounting modules

Please refer to Chapter “Safety notes for mounting/removal” on page 37.

Note that bus couplers in the BK housing with the integrated bus base are mounted differently than in the F-BK housing with a separate bus base module.

No tools are required for mounting the IndraControl S20 modules.

- First mount the end bracket on the DIN rail.

6.4.1 Controllers and bus couplers in the BK+ housing

Mounting bus base modules

- First install the bus base module for the controller/bus coupler and all bus base modules necessary for the station onto the DIN rail (Fig. 6-6, A).

NOTICE **Malfunction**

Ensure you insert the bus base module belonging to the relevant module.
Bus base modules with different overall widths and functions are available.

- Push each subsequent bus base module into the connection of the previous bus base module (Fig. 6-6, B).

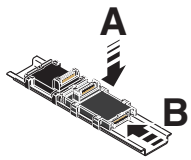


Fig. 6-6 Connecting bus base modules to each other

It is not possible to snap a bus base module onto the previous bus base module if there is already an electronics module on it. In this case, first remove the last electronics module before snapping on more bus base modules.

Snapping the controller/bus coupler on

- Place the controller/bus coupler **vertically** on the first bus base module and the DIN rail until it snaps into place with a click.
  Make sure that the device connector for the bus base connection is situated above the corresponding socket on the bus base module.

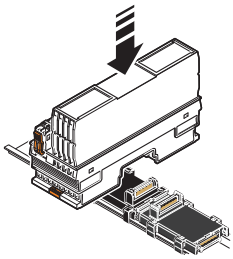


Fig. 6-7 Snapping the bus coupler on

Connecting the network

Connect the network according to the specifications given in the module-specific documentation.

6.4.2 Bus coupler in the BK housing (S20-PN-BK and S20-S3-BK)

Snapping the bus coupler on

Note that you need at least 5 mm of space to slide an S20-PN-BK or S20-S3-BK bus coupler to the left if you want to remove it (e.g., for a replacement).

- Place the bus coupler **vertically** on the DIN rail until it snaps into place with a click (Fig. 6-8).

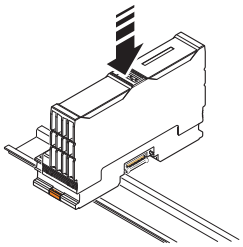


Fig. 6-8 Snapping the bus coupler on

Mounting bus base modules

- Place all bus base modules required for the station on the DIN rail (Fig. 6-9, A). Observe the proper orientation of the bus base modules. When mounting on horizontal DIN rails on the wall, the logo must be readable and the laser-engraved arrow should point towards the bus coupler.
- Push the bus base modules into the connection of the bus coupler or the previous bus base module (Fig. 6-9, B).

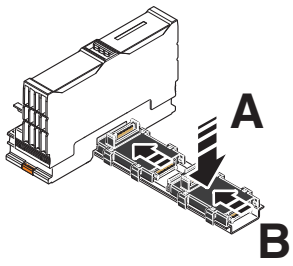


Fig. 6-9 Connecting bus base modules with each other and with the bus coupler

It is not possible to snap a bus base module onto the previous bus base module if there is already an electronics module on it. In this case, first remove the last electronics module before snapping on more bus base modules.

Connecting the network

Connect the network according to the specifications given in the module-specific documentation.

6.4.3 Input/output modules

- Place the necessary input/output modules **vertically** on the corresponding bus base module and DIN rail until they audibly click into place.
  Pay attention to the correct position.
  Make sure that the device connectors for the bus base connection are situated above the corresponding sockets on the bus base module.

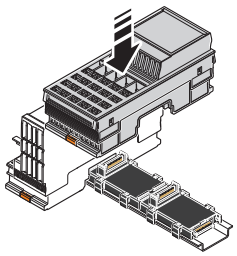


Fig. 6-10 Mounting input/output modules

If you are using analog modules, mount the necessary shield connection elements.

For connecting the shield, Bosch Rexroth recommends the IndraControl S20 shield connection set “S20-SHIELD-SET”.

When using the S20-SHIELD-SET, mount the elements in the following order:

1. Bus base module
2. Shield bus holder
3. Electronics module

See also Chapter “Connecting the shield using the IndraControl S20 shield connection set” on page 74.

6.5 Removing modules

Please refer to Chapter “Safety notes for mounting/removal” on page 37.

A standard tool, e.g., a bladed screwdriver with a blade width of 2.5 mm is necessary for removing modules.

6.5.1 Removing connectors or cables

Removing the network connector

- Remove the network connector, if present, according to the specifications in the module-specific documentation.

Supply connector, I/O connector

- Prior to module removal, also remove the connectors or cables, if present, from the module.
  - If no cables are inserted, the connectors do not need to be removed.
  - If cables are inserted, either remove the connectors from the module or the cables from the connectors.
    The cables should only be removed from the connector if you wish to change the wiring or no longer wish to use the connector.

Removing cables

See Chapter “Removing cables from the terminal point” on page 61.

Removing the IndraControl S20 connectors

See Chapter “Inserting/removing a connector” on page 51.

6.5.2 Controller, bus coupler in the BK+ housing, and input/output modules

The controller, bus coupler and each input/output module can be removed individually from the station.

- Insert a suitable tool (e.g., bladed screwdriver) first in the upper **and** then in the lower snap-on mechanism (base latches) of the module and release it (Fig. 6-11, Fig. 6-12, A). The base latches are locked in place in the open position.
- Remove the electronics module **perpendicular** to the DIN rail (Fig. 6-11, Fig. 6-12, B). The base latches return to the idle position again.

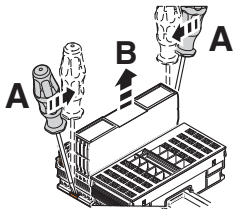


Fig. 6-11 Removing the bus coupler

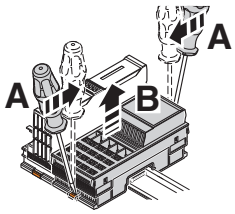


Fig. 6-12 Removing an input/output module

The bus base module remains on the DIN rail.

Bus base module

Please proceed as follows if, after having removed modules, you want to remove bus base modules as well:

- If a module is located on the neighboring bus base module to the left, remove it.

If the bus base module is in the end position:

- Remove the bus base module from the connection of the previous bus base module by sliding it approximately 5 mm to the right (A).
- Insert a suitable tool (e.g., bladed screwdriver) into the latches on one side (B, B1, B2) one after the other.
- Swivel the bus base module upwards and remove it (C).

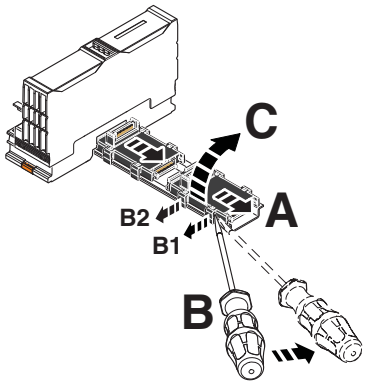


Fig. 6-13 Removing the bus base module

If the bus base module to be removed is inside the station:

- If possible, push the following bus base modules and any fitted modules approximately 15 mm to the right.
  In doing so, disconnect the bus base module you want to remove from the following bus base module.
- If it is not possible to slide the following bus base modules and modules, detach the modules, and, starting at the end of the station, remove the bus base modules.
- Disconnect the bus base module to be removed from the connection of the previous bus base module by sliding it approximately 5 mm to the right (A).
- Insert a suitable tool (e.g., bladed screwdriver) into the latches on one side (B, B1, B2) one after the other.
- Swivel the bus base module upwards and remove it (C).
- Push the rest of the station back to the left until the bus base modules touch each other again.

6.5.3 Bus coupler in the BK housing (S20-PN-BK and S20-S3-BK)

NOTICE **Module can be damaged when removed forcibly**
Risk of damage to components

The bus coupler can only be removed from the station after the bus coupler has been slid to the left and thereby disconnected from the subsequent module.

NOTICE **Damage to the FE contacts**

Pushing the bus coupler on the DIN rail can result in damage to the FE contacts. Check the contacts following removal of the bus coupler.

- Remove the left end bracket.
- Disconnect the bus coupler from the subsequent bus base module by sliding it approximately 5 mm to the left (A). It must be completely removed from the neighboring bus base module.
- Insert a suitable tool (e.g., bladed screwdriver) first in the upper **and** then in the lower snap-on mechanism (base latches) of the bus coupler and release it (B). The base latches are locked in place in the open position.

You can swap steps A and B. In this case, make sure to align the bus coupler properly to avoid damage of the bus contacts.

- Remove the bus coupler **perpendicular** to the DIN rail (C). The base latches return to the idle position again.

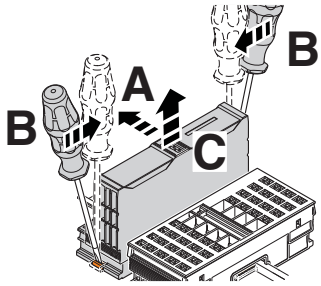


Fig. 6-14 Removing the bus coupler

6.6 Inserting/removing a connector

6.6.1 Removing a connector

- Release the locking latch (A), tilt the connector slightly upwards (B) and remove it from the module (C).

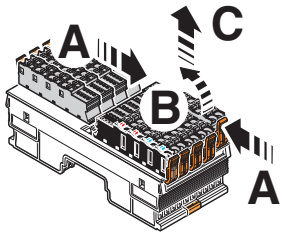


Fig. 6-15 Removing a connector

6.6.2 Inserting a connector

- Place the connector vertically in its position and press firmly. Ensure that it engages with a click.

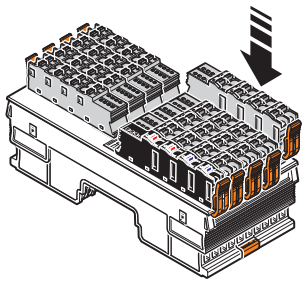


Fig. 6-16 Snapping a connector on

6.7 Replacing a module

- To replace a module, proceed as described in Chapters “Removing modules” on page 47 and “Mounting modules” on page 43.
- Once replaced, restore all the necessary connections.

When replacing a controller:

Observe any notes for replacement in the module-specific documentation.

6.8 Mounting distances

The space required for cable routing depends on the number of cables to be installed and must be left free at the top and/or at the bottom.

For the distances of the upper and lower cable ducts or the cable routing to the modules, please refer to Fig. 6-18 to Fig. 6-19.

In addition to the specified dimensions, provide adequate space for mounting and removal of the connectors and cables.

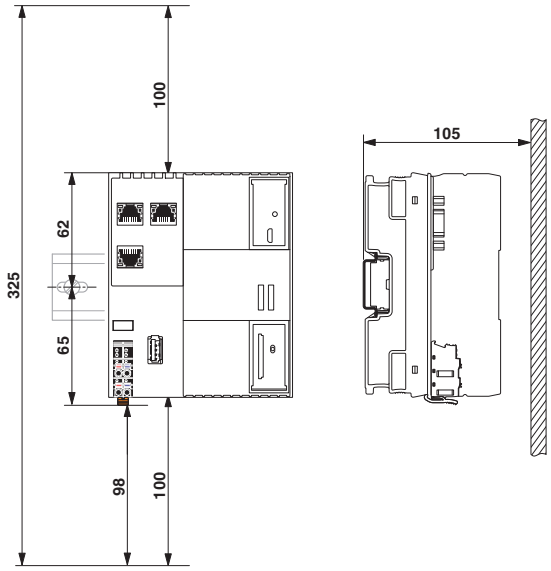


Fig. 6-17 Mounting distances: XM2x controller (dimensions rounded)

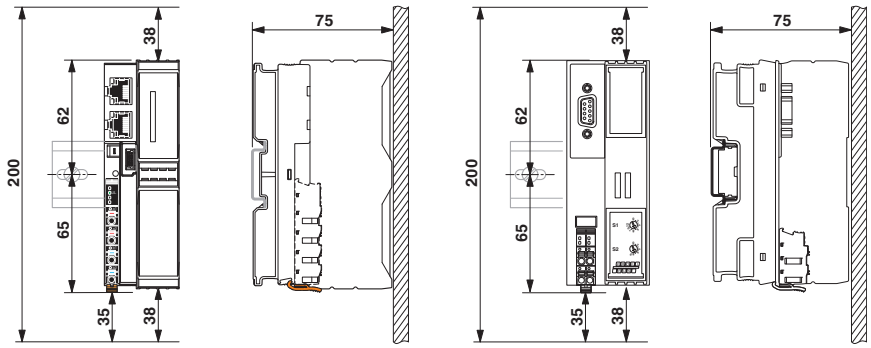


Fig. 6-18 Mounting distances: bus coupler (dimensions rounded)

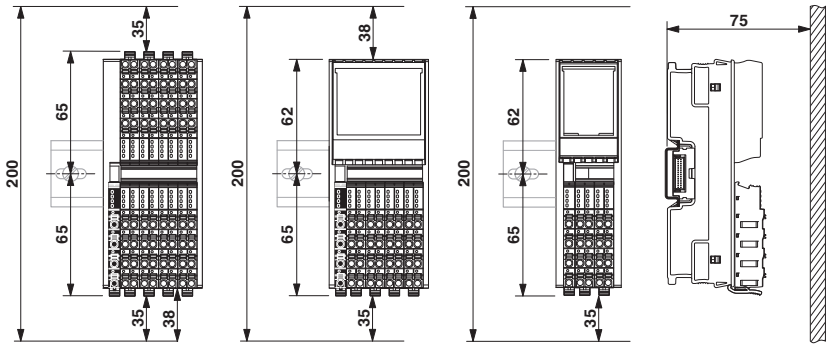


Fig. 6-19 Mounting distances: I/O modules (dimensions rounded)

If the distances are smaller, the minimum bending radius of the cables, easy handling during installation, and a clear structure cannot be guaranteed.

Mounting and removing modules

7 Connecting and removing cables

7.1 Connections and cables in the IndraControl S20 system

All electrical connections are plug-in.

The network cables on the controller/bus coupler are connected via D-SUB or RJ45 connectors depending on the network.

The cables for the I/O devices and supply voltages are connected via IndraControl S20 connectors.

Each terminal point, both for the periphery of the I/O modules (I/O connectors) as well as for the communications power, sensor, and actuator supply (power connectors), is designed for a maximum current of 8 A.

The current can be reduced when used in applications in which an UL approval is required. Observe any specifications in the module-specific packing slip and the rating on the modules.

When using IndraControl S20 modules you can use shielded and unshielded, solid and stranded cables, with or without ferrules.

Please observe the following when wiring:

- Twist stranded cable ends.
- Make sure to install the conductor in the middle of the wiring space, especially with small cross sections.

If using ferrules, use those which correspond to the specifications in Chapter “Conductor cross sections and stripping/insertion lengths” on page 56.
Make sure the ferrules are properly crimped.

Connecting and removing cables

7.2 Conductor cross sections and stripping/insertion lengths

For electrical and/or thermal reasons, it may not be possible to use the minimum conductor cross sections specified here for certain modules. Therefore, always observe the information in the module-specific documentation.

Conductor cross sections

Conductor	Cross section
Solid	0.5 mm^2 ... 1.5 mm^2
Stranded with ferrule without insulating collar (A ...)	
• According to DIN 46228-1 sleeve length 10 mm	0.25 mm^2 ... 1.5 mm^2
Stranded with ferrule with insulating collar (AI ...)	
• According to DIN 46228-4 sleeve length 8 mm	0.25 mm^2 ... 1.0 mm^2
• According to DIN 46228-1 sleeve length 10 mm	0.25 mm^2 ... 1.5 mm^2

Fig. 7-1 Permissible conductor cross sections for Push-in connection technology (without using the spring lever for inserting the conductor)

Stranded cables without ferrules are not suitable for Push-in connection technology without simultaneous actuation of the spring lever.

Conductor	Cross section
Solid	0.2 mm^2 ... 1.5 mm^2
Stranded without ferrule	0.2 mm^2 ... 1.5 mm^2
Stranded with ferrule without insulating collar (A ...)	0.25 mm^2 ... 1.5 mm^2
Stranded with ferrule with insulating collar (AI ...)	0.25 mm^2 ... 1.5 mm^2

Fig. 7-2 Permissible conductor cross sections when using the spring lever for inserting the conductor

Conductor	Cross section
AWG	24 ... 16

Fig. 7-3 Permitted AWG conductor cross sections

Stripping/ insertion lengths

NOTICE **Malfunction when the conductor is not securely fixed**

Make sure that the stripping length of a conductor without ferrule or the insertion length of a conductor with ferrule corresponds to the specifications in order to ensure secure hold and correct function.

The crimping form must be trapezoidal. The relevant tools can be found in the Bosch Rexroth product range.

Conductor without ferrule: stripping length 8 mm

Conductor with ferrule: insertion length 8 mm or 10 mm

Ferrules: see Chapter “Ordering data for accessories” on page 97.

Crimping pliers for trapezoidal crimp: CRIMPFOX 6 or CRIMPFOX 6T, see Chapter “Ordering data for accessories” on page 97.

TWIN ferrules

NOTICE **Malfunction when using wrong ferrule**

TWIN ferrules are not permitted in the IndraControl S20 system.

Connecting and removing cables

7.3 Terminal point, associated spring lever, and associated touch connection

When using the screwdriver, pay attention to the position of the spring lever to the assigned terminal point.

When testing the signal with a measuring probe, pay attention to the position of the touch connection to the assigned terminal point.

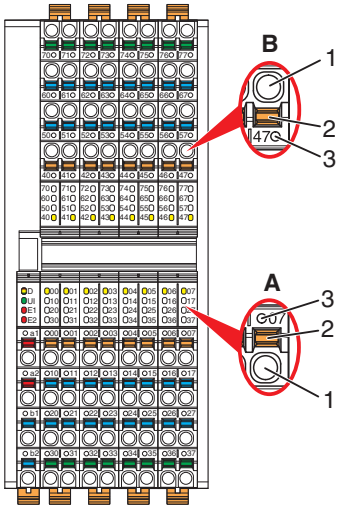


Fig. 7-4 Terminal point with associated spring lever, and associated touch connection

A	Cable outlet at the bottom	Spring lever and touch connection **above** the terminal point
B	Cable outlet at the top:	Spring lever and touch connection **below** the terminal point (B)
1	Terminal point	
2	Spring lever	
3	Touch connection	

7.4 Connecting unshielded cables

Wire the connectors according to your application.

For the terminal point assignment, please refer to the corresponding module-specific documentation.

When wiring, proceed as follows:

- Strip 8 mm off the cable.

Solid cable/ferrules with direct connection technology (Push-in)

- When using solid cables from 0.5 mm^2 onwards or cables with ferrules: Insert the cable into the terminal point. The wire is clamped automatically.

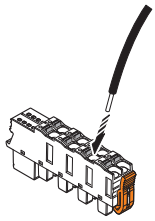


Fig. 7-5 Connecting a solid unshielded cable

Stranded cable without ferrules

- When using stranded cables:
  Open the spring by pressing the screwdriver onto the spring lever (Fig. 7-6, A).
  Use, for example, a bladed screwdriver with a blade width of 2.5 mm.
  Bosch Rexroth recommends the SZS 0,4x2,5 screwdriver (see Chapter “Ordering data” on page 97).
- Insert the cable in the terminal point (B).
- Remove the screwdriver to secure the cable.

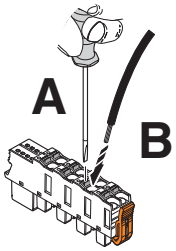


Fig. 7-6 Connecting a stranded cable

After installation, it is advisable to mark the cables in addition to the module and connectors.
Marking the module: see Chapter “Color and marking” on page 33.

Connecting and removing cables

Inserting the connector

- Place the connector vertically in its position and press firmly. Make sure that the locking latch snaps in.

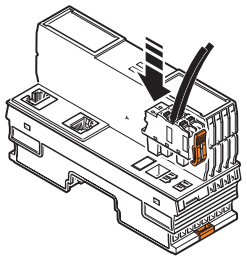


Fig. 7-7 Inserting the connector

7.5 Connecting shielded cables

Please also observe the information in Chapter “Shielding concept” on page 73 for shielding.

Connect the shield before the module.

When connecting the cables, proceed as follows:

Stripping the cables and connecting the shield

- Strip approximately 20 mm off the outer sheath of the cable at the required distance from the end of the cable (a in Fig. 7-8).
  The necessary distance a depends on the distance to the busbar.
- Strip 8 mm off the wires.

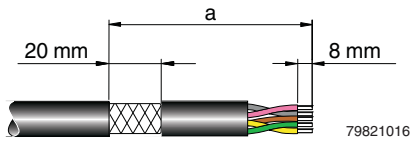


Fig. 7-8 Connecting the shielded cable

- If present, remove the protective foil.
- Lay the cable with the braided shield under a shield clamp and tighten it with a screw.
  Malfunctions will then be lead via a busbar to the support brackets, which are connected to the grounded DIN rail.
  Ordering data can be found in Chapter “Ordering data” on page 97.

Make sure the shield is as close as possible to the signal terminal points.
When using twisted pair cables, keep the cable twisted until just before the terminal point.

NOTICE

The busbar is only for shielding the modules, not for the strain relief of the connected cables.

Wiring connectors

- Connect the cables to the connector. To do this, proceed as described in Chapter “Connecting unshielded cables” on page 59.

7.6 Removing cables from the terminal point

- To remove a cable from the terminal point, press on the spring lever with a suitable tool (e.g., bladed screwdriver with a blade width of 2.5 mm). This opens the leg spring connection of the relevant terminal point (Fig. 7-9, A).
- Remove the conductor (Fig. 7-9, B).

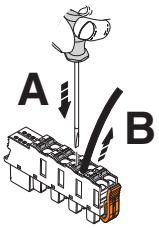


Fig. 7-9 Removing the cable

7.7 Connecting the power supplies

7.7.1 IndraControl S20 system supply

To operate an IndraControl S20 station, you must provide the supply voltage for the bus coupler, the local bus (communications power of the connected modules) and the sensors and actuators.

Unshielded cables are usually sufficient for connecting the power supplies. Connect them as shown in Chapter “Connecting unshielded cables” on page 59.

For the connector pin assignment of the supply voltage connections, please refer to the module-specific documentation.

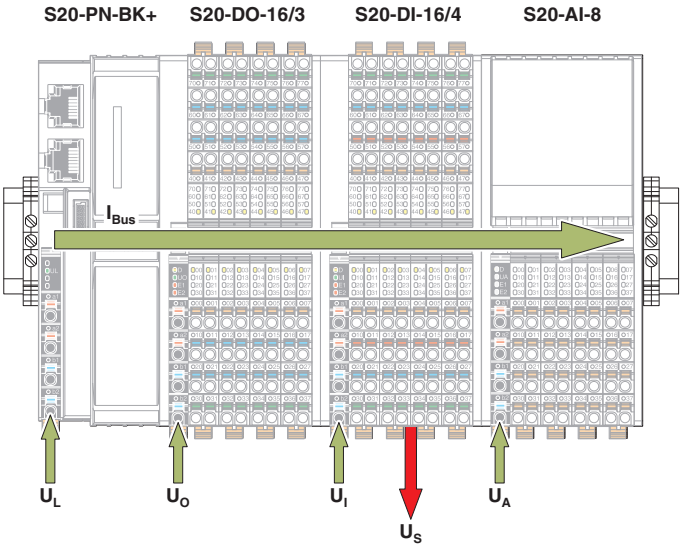


Fig. 7-10 Supply voltages in the IndraControl S20 system

Key:

U_L	(U_{Logic})	Communications power supply
U_{Bus}	(U_{Bus})	Power supply of the IndraControl S20 local bus (generated from U_L)
U_I	(U_{Input})	Supply for digital input modules Sensor supply/encoder supply (S20-CNT-INC-2/2) Encoder supply/analog supply (S20-SSI-AO-1/1)
U_S	(U_{Sensor})	Sensor supply (generated from U_I)
U_O	(U_{Output})	Supply for digital output modules
U_{IO}	($U_{Input/Output}$)	Supply for digital input and output modules
U_A	(U_{Analog})	Supply for analog modules
I_{Bus}	(I_{Bus})	Power supply for the local bus

For information regarding which supply voltage is used with a module, please refer to the module-specific documentation.

7.7.2 Power supply requirements

Choose a power supply unit that is suitable for the currents in your application. The selection depends on the bus configuration and the resulting maximum currents.

⚠ WARNING **Loss of electrical safety when using unsuitable power supplies / hazardous shock currents**

The IndraControl S20 low-level signal controllers, bus couplers, and modules are designed exclusively for protective extra-low voltage (PELV) operation according to EN 60204-1. Only PELV according to the defined standard may be used for supply purposes.

Only use power supply units that ensure safe isolation according to EN 50178 and EN 61010-2-201. They prevent short circuits between the primary and secondary circuit.

⚠ WARNING **Dangerous contact voltage in the event of ground faults**

The IndraControl S20 modules for the low voltage area must only be operated in grounded networks.

Observe the information in the module-specific documentation.

7.7.3 Supply at the controller or bus coupler

Communications power (U_L) is supplied at the controller or bus coupler. It supplies the module electronics (logic) of the controller or bus coupler. Additionally, it generates the communications power for the local bus (U_{Bus}), which supplies the connected modules with logic current.

If the communications power U_L is switched off, the local bus will shut down.

7.7.4 Supply at the power module

If the maximum load of the bus coupler for the local bus supply (communications power U_{Bus}) is reached, you can use a power module to provide this voltage again.

To this end, apply a 24 V DC voltage (U_L) to the module from which U_{Bus} is generated.

NOTICE **Malfunction**

The power module only boosts the U_{Bus} voltage when it is snapped onto the associated red bus base module and when the U_{Bus} voltage is available in the bus segment before the power module.

7.7.5 Supply at the input/output modules

The inputs and outputs, as well as the sensors, are supplied directly at each module.

The input and output power supply ($U_I/U_O/U_{IO}/U_A$) should be installed and fused independent of the communications power (U_L). In this way, the local bus can continue to run, even if some I/O devices are switched off. This also prevents unnecessary interference couplings between I/O and logic.

The use of separate power supply units for U_L and $U_I/U_O/U_{IO}/U_A$ may be necessary in environments with a lot of interference.

7.7.6 Jumpers in power connectors, potential forwarding, and fusing

Terminal points a1 and a2, as well as b1 and b2 are jumpered in the power connector. You can therefore use one of the terminal points for supply and the second terminal point for forwarding a potential respectively.

NOTICE	**Module damaged when overloaded**

Please note that the maximum current carrying capacity of a terminal point of 8 A must not be exceeded.

Protect the supply accordingly.

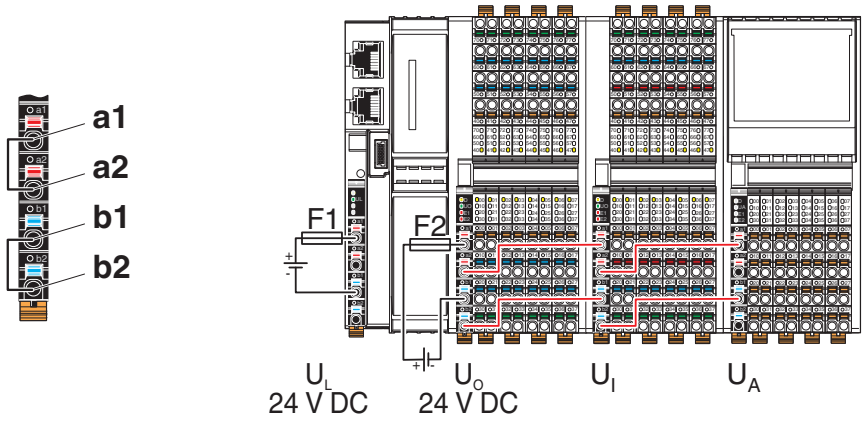


Fig. 7-11 Jumpering in the power connector and example of potential forwarding

F1, F2 Protecting the supply voltage using suitable fuses (see module-specific documentation)

Considering the current carrying capacity of the terminal points, the potential forwarding shown in Fig. 7-11 must not be used when the digital output module is fully loaded (e.g., S20-DO-16/3 current consumption at U_O is 8 A, maximum).

7.7.7 Parallel supply

If the maximum current consumption is greater than 8 A for a module, however, you wish to fully load the module, the supply voltage can be supplied in parallel. The module can now be loaded with 16 A, maximum.

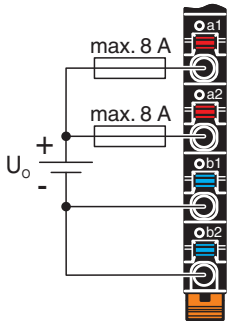


Fig. 7-12 Parallel supply of the supply voltage

7.8 Connecting the network

Your network cable is connected to a controller or bus coupler.

Connect the network according to the module-specific documentation.

7.9 Connecting sensors and actuators

Sensors and actuators are connected using the I/O module connectors.

Connect the unshielded cables as described in Chapter “Connecting unshielded cables” on page 59.

Connect the shielded cables as described in Chapter “Connecting shielded cables” on page 60.

7.9.1 Connection technology for sensors and actuators

The input/output modules of the IndraControl S20 product group normally permit the connection of sensors and actuators in 1, 2, 3 or 4-wire technology.

The relevant module-specific data sheets indicate which connection technology is possible for the individual modules.

7.9.2 Connections used for low-level signal digital input and output modules

For the actual terminal point assignment, please refer to the corresponding module-specific data sheet. It also provides a connection example.

Connection	Representation in the figure	1-wire	2-wire	3-wire	4-wire
Sensor signal IN	IN	X	X	X	X
Sensor supply U_S	U_S (+24 V)	–	X	X	X
Ground GND	GND	–	–	X	X
Grounding/FE shielding	FE (⏚)	–	–	–	X

Fig. 7-13 Overview of the connections used for low-level signal digital input modules

X Used

– Not used

Connection	Representation in the figure	1-wire	2-wire	3-wire
Actuator signal OUT	OUT	X	X	X
Actuator supply U_O	U_O (+24 V)	–	–	–
Ground GND	GND	–	X	X
Grounding/FE shielding	FE (⏚)	–	–	X

Fig. 7-14 Overview of the connections used for low-level signal digital output modules

X Used

– Not used

7.9.3 Connecting digital sensors and actuators using different connection technologies

1-wire technology

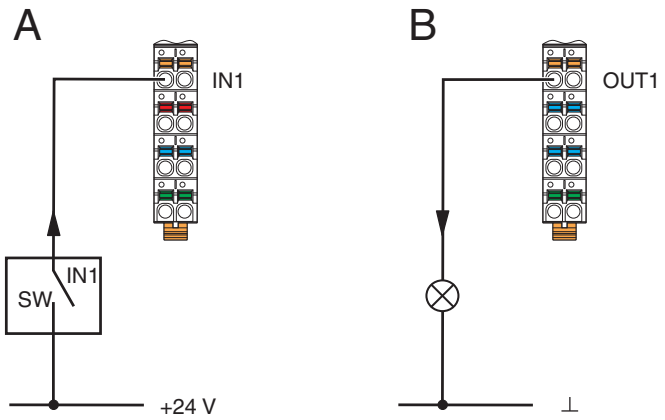


Fig. 7-15 1-wire connection for digital modules

Sensor

Fig. 7-15, A, shows the connection of a 1-wire sensor.

- The SW switch provides the input signal.
- The sensor signal is routed to the IN1 terminal point.
- The sensor is supplied with a 24 V voltage.

NOTICE **Malfunction**

To ensure the correct function, supply the sensors and U_I from a power supply with a common GND as the reference potential.

Actuator

Fig. 7-15, B, shows the connection of a 1-wire actuator.

- The actuator is supplied with voltage by output OUT1.
- The load is switched directly via the output.

NOTICE **Malfunction**

To ensure the correct function, make sure that GND of the actuators and GND of the supply voltage U_O, which supplies the actuators, have the same potential.

Connecting and removing cables

2-wire technology

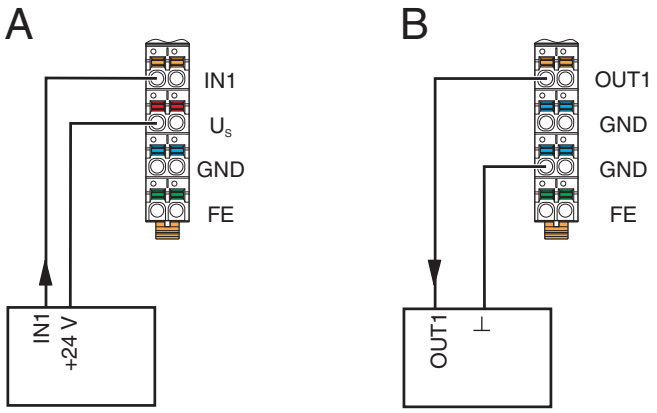


Fig. 7-16 2-wire connection for digital modules

Sensor Fig. 7-16, A, shows the connection of a 2-wire sensor.

- The sensor signal is routed to the IN1 terminal point.
- The sensor is supplied by voltage U_S.

Actuator Fig. 7-16, B, shows the connection of an actuator.

- The actuator is supplied with voltage by output OUT1.
- The load is switched directly via the output.

3-wire technology

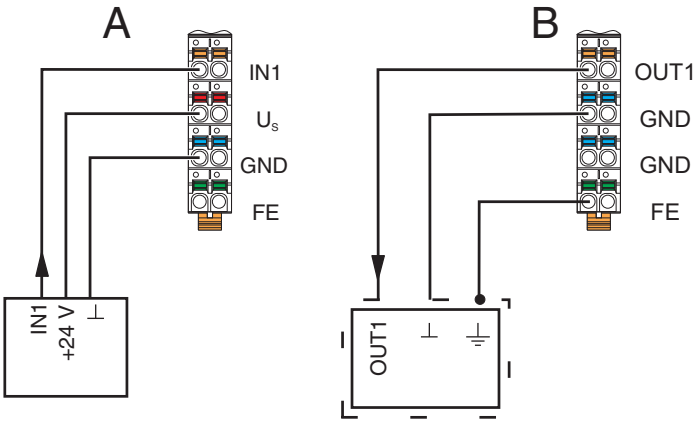


Fig. 7-17 3-wire connection for digital modules

Sensor Fig. 7-17, A, shows the connection of a 3-wire sensor.

- The sensor signal is routed to the IN1 terminal point.
- The sensor is supplied with power via terminal points U_S and GND.

Actuator Fig. 7-17, B, shows the connection of a shielded actuator.

- The actuator is supplied by output OUT1.
- The load is switched directly via the output.
- The actuator is grounded via the FE terminal point.

4-wire technology

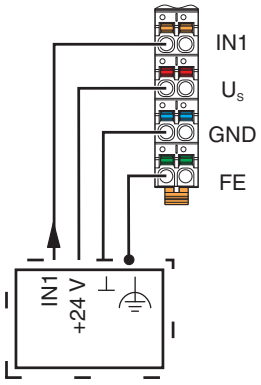


Fig. 7-18 4-wire connection for digital modules

Sensor Fig. 7-18 shows the connection of a shielded 4-wire sensor.

- The sensor signal is routed to the IN1 terminal point.
- The sensor is supplied with power via terminal points U_S and GND.
- The sensor is grounded via the FE terminal point.

7.9.4 Redundant signals

If you are using I/O modules redundantly, connect the modules as shown in Fig. 7-19.

In the example, the two modules are located in two IndraControl S20 stations.

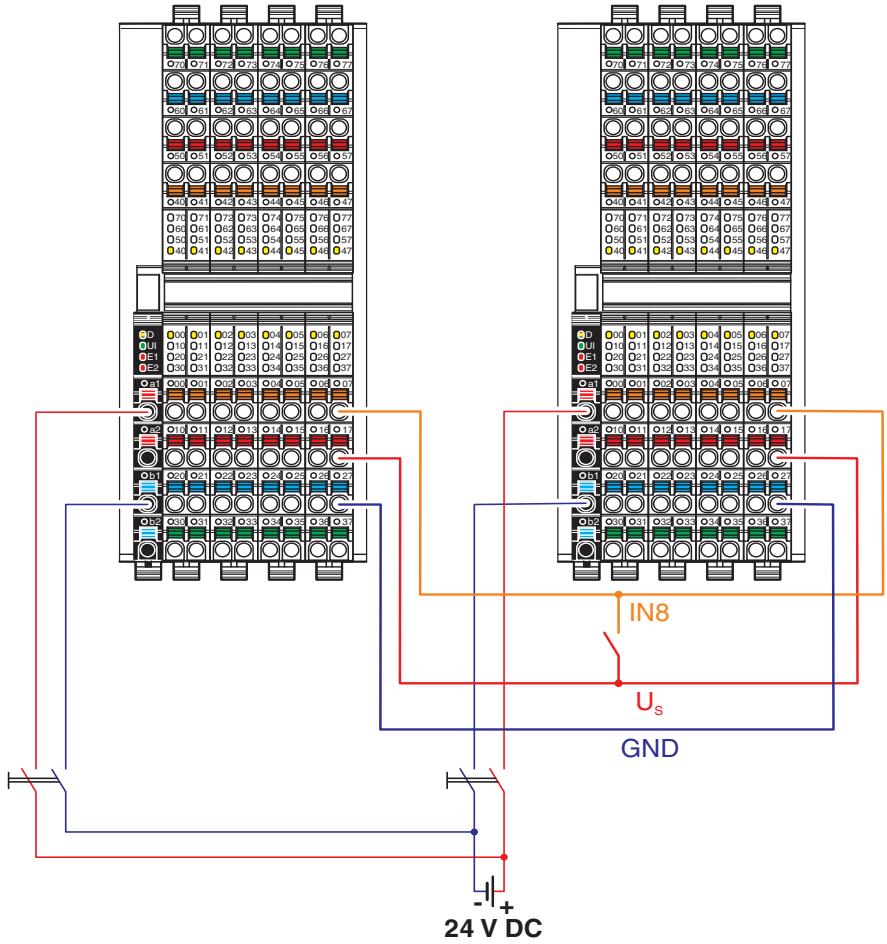


Fig. 7-19 Example: connection for redundant use

IN8	Digital input 8
U_S	Sensor supply
GND	Reference potential

⚠ CAUTION Malfunction

To avoid malfunction, make sure that the GND connection shown in Fig. 7-19 is established as the reference potential to the redundant signal inputs.

Make sure that, in the event of a short circuit of the sensor supply, the effects are limited by providing decoupling (longitudinal diode).

8 Grounding and shielding

8.1 Grounding concept

Within an IndraControl S20 station, a distinction is made between functional earth ground (FE) and protective earth ground (PE).

Protective earth grounding (PE)

Protective earth grounding protects people and machines against hazardous voltages. To avoid these dangers, as far as possible, correct grounding, taking the local conditions into account, is vital.

Functional earth grounding (FE)

Functional earth ground is only used to discharge interference. It does not provide shock protection for people.

Functional earth grounding is used to improve noise immunity. All devices must be grounded so that any possible interference from connectors for data transmission is shielded and discharged to ground.

8.1.1 Protective earth ground (PE)

Protective earth ground is a low-impedance current path that minimizes the risk to a user in the event of an error (including a high voltage and/or current error between an electrical circuit and ground).

According to the electrical design, the IndraControl S20 low-voltage modules correspond to protection class 2 devices and therefore do not require grounding. However, IP20 protection is not sufficient for protection class 2, which means that the modules only become real protection class 2 devices when used with a control cabinet or an installation box.

8.1.2 Functional earth ground (FE)

Functional earth ground is a low-impedance current path between circuits and ground. It is not designed as a safety measure but rather, for example, for the improvement of noise immunity.

Functional earth ground is used in the 24 V DC area (protective extra-low voltage).

To ensure reliable functional earth grounding, please observe the following:

1 The modules have at least one FE spring (metal clip, 1 in Fig. 8-1) at the bottom. This spring establishes an electrical connection to the DIN rail when the module is mounted.
The bus coupler has one FE spring, the I/O modules have one or two FE springs.
Use grounding terminal blocks to connect the DIN rail to protective earth ground. The modules are then also grounded when they are snapped onto the DIN rail.

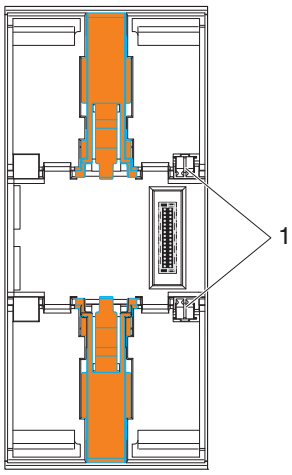


Fig. 8-1 FE spring (1)

2 When using modules for surge protection (TRABTECH), connect their functional earth ground directly to the grounded DIN rail.
Do not connect the functional earth ground of the modules for surge protection to an IndraControl S20 module (e.g., to an FE contact of an IndraControl S20 connector).
This ensures that interference is discharged before it enters the IndraControl S20 module. Only then is good electromagnetic compatibility ensured.

8.2 Shielding concept

Shielding is used to reduce the effects of interference on the system.

8.2.1 Shielding with IndraControl S20

In the IndraControl S20 system, shielded cables are used with the following modules:

- Network cables
- Connecting cables
  - On modules for analog signals (analog input, analog output, temperature recording)
  - On special-function and acquisition modules

Observe the following points when shielding:

- Connect the shield to a module before the signal connection.
- Ensure a large surface connection of the shield.
- Make sure there is good contact between the shield and shield bus (synonyms: neutral busbar, busbar).
- Do not damage or squeeze the wires.
- When connecting the shielding, observe the specifications for wiring.
- Make sure the shield is as close as possible to the signal terminal point.

8.2.2 Shielding when connecting analog sensors and actuators

- Always connect analog sensors and actuators with shielded, twisted pair cables.
- Connect the shield via a shield bus. (see Fig. 8-9)

When connecting the cables, observe the information in the module-specific data sheet.

- As a rule, shielding must only be connected directly to the PE potential on one side. This is to prevent any occurrence of equipotential bonding currents via the shielding (see Fig. 8-9 and Fig. 8-10).
- If necessary, integrate the shielding concept for analog I/O cables in the system concept. For example, it is advisable to use a central FE shield connection at the control cabinet entry (see Fig. 8-10).

For connecting the shield, Bosch Rexroth recommends the IndraControl S20 shield connection set “S20-SHIELD-SET”.

8.2.3 Connecting the shield using the IndraControl S20 shield connection set

The shield connection set consists of two shield bus holders and two SK 5 shield connection clamps. This shield connection set can be used to connect cable shields in an IndraControl S20 station in the vicinity of the modules.

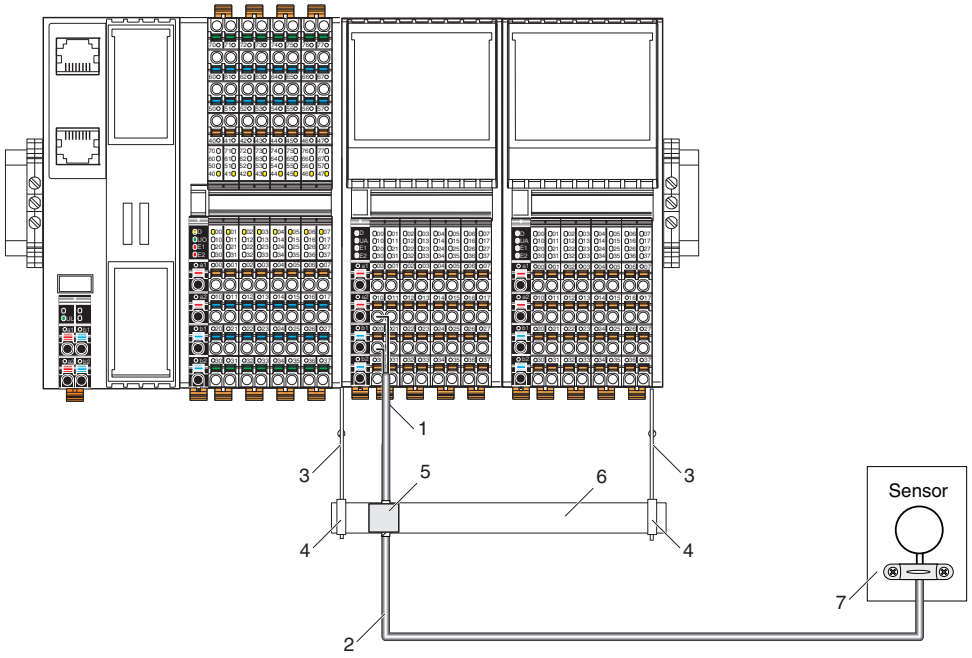


Fig. 8-2 Connecting the shield with the S20-SHIELD-SET

1 Lead the analog cable into the connector, making sure to maintain the cable insulation.

2 Use shielded twisted pair cables.

3 Shield bus holder

4 SK 5 shield connection clamps (2 pcs. included in the S20-SHIELD-SET) for securing the busbar (accessory) on the shield bus holder

5 Shield connection clamp for shield support on the busbar (SKS ..., see Chapter “Ordering data for accessories” on page 97)
Connect the shield directly to the FE potential.
Connect the shield for the entire analog transmission path to FE potential at only one point. In this example, this point is the busbar.

6 Busbar (NLS-CU 3/10 ..., see Chapter “Ordering data for accessories” on page 97)

7 Lead the sensor cable into the sensor, making sure to maintain the cable insulation.

IndraControl S20 shield connection set

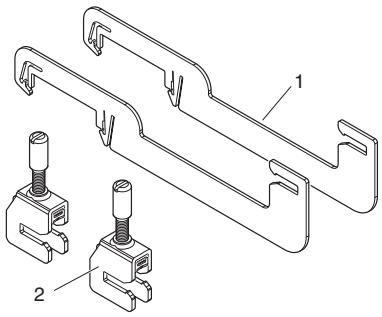


Fig. 8-3 Set components

1 Shield bus holders (2 pcs.)

2 SK 5 shield connection clamps for securing the busbar on the shield bus holder (2 pcs.)

Contact is made with the shield on the busbar using shield connection clamps (both are available as accessories). Select the shield connection clamp according to the cable cross section and type (SK or SKS), see Chapter “Material for shield connection” on page 97.

Assembly

Mount the shield bus holders after mounting the bus base modules and before mounting the electronics modules.

Polished surfaces indicate the positions of the shield bus holders on the bus base modules.

The maximum distance between two adjacent shield bus holders should not exceed 215 mm (e.g., four modules with four connectors next to each other).

If the busbar is secured using more than two shield bus holders, distribute the holders equally over the width of the busbar.

If using a shield bus holder at the end of an IndraControl S20 station, mount the shield bus holder after the last module. In this case, it is not positioned above a bus base module. Secure the shield bus holder using an end bracket (accessory).

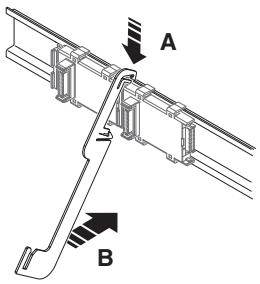
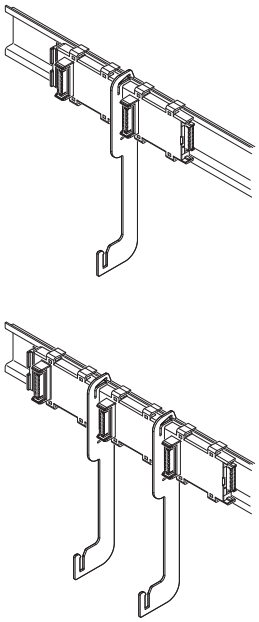


Fig. 8-4 Hooking the shield bus holder on

- Hook the shield bus holder onto the DIN rail.

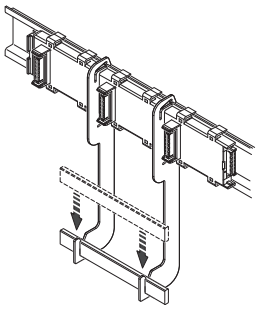
Grounding and shielding



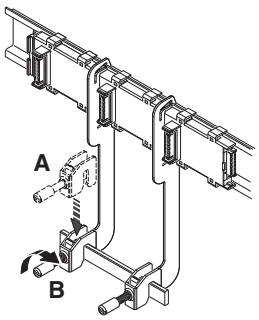
- Snap the shield bus holder onto the DIN rail.

- Then snap on the second shield bus holder.

Fig. 8-5 Snapping on the shield bus holders

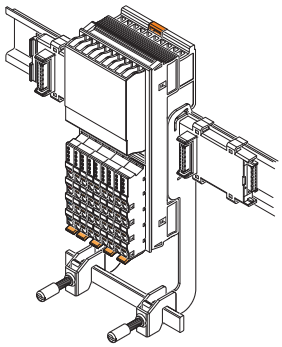


- Push the busbar into the shield bus holder.



- Secure the busbar using the SK 5 shield connection clamps included in the scope of supply.

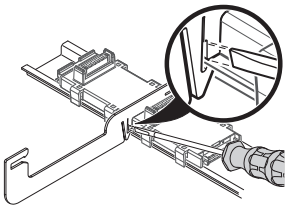
Fig. 8-6 Mounting the busbar



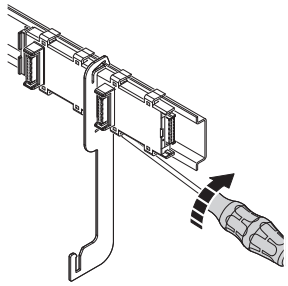
- Mount the electronics modules.

Fig. 8-7 Mounting the electronics modules

Removal For removal, use a screwdriver with a blade width of 4 mm (see accessories for examples).



- First, remove the adjacent electronics modules (to the right and left of each shield bus holder).
- Insert the screwdriver in the release slot.



- Turn the screwdriver to release the locking clip from the DIN rail.
- Remove the shield bus holder.

Fig. 8-8 Removing the shield connection

The locking clip may become deformed following contact with the screwdriver. In this case, bend it back into shape prior to reassembly.

Grounding and shielding

8.2.4 Connecting the shielding to a busbar

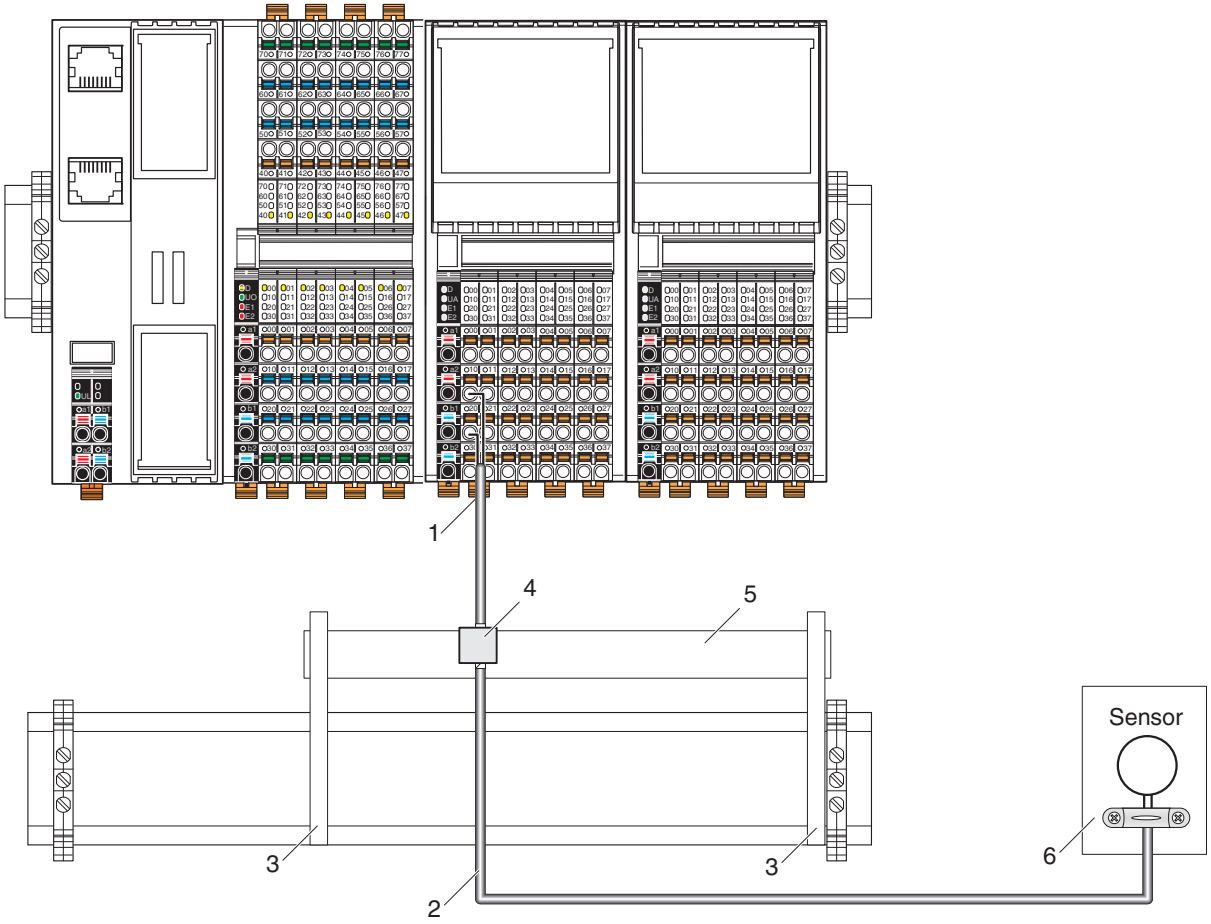


Fig. 8-9 Connecting the shielding to a busbar

1 Lead the analog cable into the connector, making sure to maintain the cable insulation.

2 Use shielded twisted pair cables.

3 Support bracket (AB ..., see Chapter “Ordering data for accessories” on page 97)

4 Shield connection clamp for shield support on the busbar (SKS ..., see Chapter “Ordering data for accessories” on page 97)
Connect the shield directly to the FE potential.
Connect the shield for the entire analog transmission path to FE potential at only one point. In this example, this point is the busbar.

5 Busbar

6 Lead the sensor cable into the sensor, making sure to maintain the cable insulation.

8.2.5 Integrating analog shielding in a concept with central equipotential bonding at the control cabinet entry

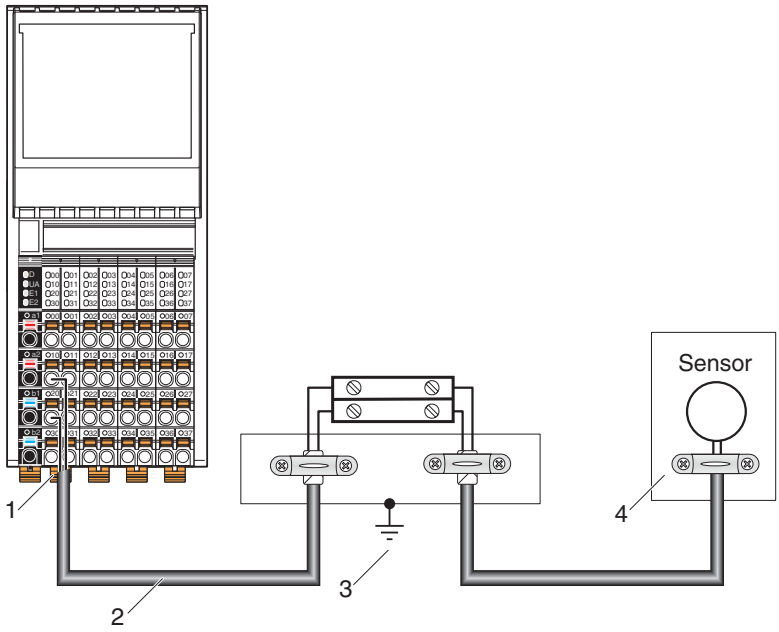


Fig. 8-10 *Integration of analog shielding in a concept with central equipotential bonding at the control cabinet entry*

1 Lead the analog cable into the connector, making sure to maintain the cable insulation.

2 Use shielded twisted pair cables.

3 Connect the strain relief directly to the FE potential.
Connect the shield for the entire analog transmission path to FE potential at only one point. In this example, this point is the marshalling level.

4 Lead the sensor cable into the sensor, making sure to maintain the cable insulation.

NOTICE **Functions may be impaired**

When integrating the shielding of analog I/O cables in an equipotential bonding concept, make sure that direct connection to the FE potential is only made at one point (e.g., at the central grounding point of the marshalling level).

Grounding and shielding

9 Diagnostics and status indicators

All IndraControl S20 modules are provided with diagnostics and status indicators for quick local error diagnostics. They enable the clear localization of system errors (bus errors) or I/O errors.

Diagnostics The diagnostics indicators (red, yellow or green) provide information about the state of the module and, in the event of an error, provide information about the type and location of the error. The module is functioning correctly if all of the green LEDs are on.

Status The status indicators (yellow) display the status of the relevant input/output and the connected I/O device.

Extended diagnostics Some modules have extended diagnostics. A short-circuit or an overload of the sensor supply, for example, can be detected and reported. If a short circuit occurs at an output, some output modules can diagnose each channel individually. Information about the supply voltage is also reported. Information about I/O errors is sent to the controller with precise details of the error type and is displayed using status indicators.

The diagnostics indicators D, UA, E1, E2 show the current status. This status is not saved. This means, for example, that an open circuit or overrange is indicated via the LEDs. If the respective error has been removed and no other error has occurred, the LEDs indicate the error-free state again.
The error is not saved on the module.
For some modules, however, the DiagState object (0018_{hex}) is used to report some specific errors to the controller.

Please refer to the module-specific documentation for information regarding the diagnostics and status indicators on each module and their meaning.

All possible positions for diagnostics and status indicators are equipped with light guides on the S20 connectors.
Since not every position has its own LED on the printed-circuit board, there are some light guides without any function.
Examples:
A20-AI-8: The light guides 00 ... 07, 10 ... 17, 20 ... 27, and 30 ... 37 **do not have** any function.
S20-DI-32/1: The light guides 00 ... 07, 10 ... 17, 20 ... 27, and 30 ... 37 **have** a function.

Please refer to the module-specific documentation for information regarding the diagnostics and status indicators on each module and their meaning.

9.1 Indicators on controllers

For more information regarding the diagnostics and status indicators of the controller, please refer to the corresponding documentation: DOK-CONTRL-IC*XM2*****-IT..-EN-P, material number R911340667.

Diagnostics and status indicators

9.2 Indicators on bus couplers

Bus couplers have power supply indicators, as well as network and module indicators.

Indicators for the power supply are located on the power connector. The other indicators are located on the module.

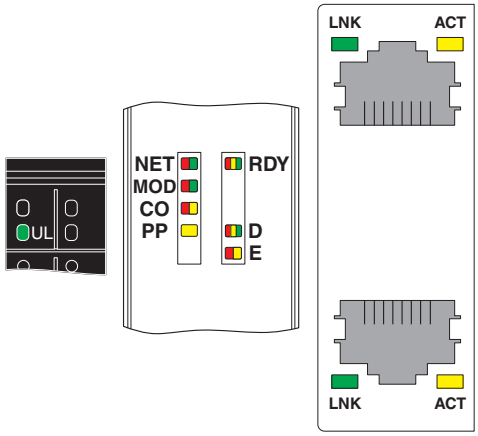


Fig. 9-1 Indicators on bus couplers (example: S20-EIP-BK)

All bus couplers in a F-BK housing have the following indicators:

Designation	Color	Meaning	State	Description
U_L	Green	U_{Logic}	ON	Communications power supply present
			OFF	Communications power supply not present
RDY	Green/ yellow/ red	Ready	Green ON	Device is ready to operate.
			Flashing green/yellow	Communications power undervoltage or surge voltage
				Overtemperature
			Yellow ON	Firmware/bus coupler is booting.
			Flashing yellow	Firmware update is being performed.
			Flashing yellow/red	Firmware update has failed.
			Flashing red	Faulty firmware
			Red ON	Rotary coding switches are set to an invalid/reserved position.
			OFF	Device is not ready for operation.

Fig. 9-2 Indicators on bus couplers

Designation	Color	Meaning	State	Description
D	Red/yellow/green	Diagnostics for local bus communication		
		Run	Green ON	The station is ready for operation, communication within the station is OK. All data is valid. There are no faults.
		Active	Flashing green	The station is ready for operation, communication within the station is OK. The data is **not** valid. Valid data from the controller/higher-level network is not available. There is no fault in the module.
		Ready	Yellow ON	Ready: The station is ready for operation; no data is being exchanged.
			Flashing yellow	Access via USB (service)
			Flashing yellow/red	Local bus error during active I/O check
			Flashing red	Local bus error on startup
				Possible causes: • Configuration cannot be generated, information is missing from a device. • Chip version of a device is <V1.1. • The desired and actual configuration are different. • No local bus device connected. • The maximum number of local bus devices is exceeded.
			Red ON	The station is ready for operation but has lost connection to at least one device.
				Possible causes: • Communication error • Local bus device has been removed or a configured device is missing. • Reset at a local bus device • Serious device error at a local bus device (local bus device can no longer be accessed)
		Power down	OFF	Device is in (power) reset.
E	Yellow/red	Error	Yellow ON	I/O warning at a local bus device
			Red ON	I/O error at a local bus device
			OFF	No I/O messages present

Fig. 9-2 Indicators on bus couplers [...]

Further diagnostics and/or status indicators may also be available.

Please refer to the bus coupler documentation for the diagnostics and status indicators on the bus coupler and their meanings.

Diagnostics and status indicators

9.3 Indicators on input/output modules

The LEDs of the input/output modules are located on the connectors.

9.3.1 LEDs on the power connectors

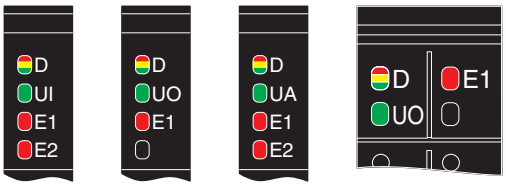


Fig. 9-3 LEDs on the power connectors (examples)

Designation	Color	Meaning	State	Description
D	Red/yellow/green	Diagnostics for local bus communication		
		Run	Green ON	The device is ready for operation, communication within the station is OK. All data is valid. There are no faults.
		Active	Flashing green	The device is ready for operation, communication within the station is OK. The data is **not** valid. Valid data from the controller/higher-level network is not available. There is no fault in the module.
		Device application not active	Flashing green/yellow	The device is ready for operation, communication within the station is OK. Output data **cannot** be output and/or input data **cannot** be read. There is a fault on the I/O side of the module.
		Ready	Yellow ON	The device is ready for operation, but has still not detected a valid cycle after power-on.
		Connected	Flashing yellow	The device is not (yet) part of the active configuration.
		Reset	Red ON	The device is ready for operation, but has lost the connection to the bus head.
		Not connected	Flashing red	The device is ready for operation, but there is no connection to the previous device.
		Power down	OFF	Device is in (power) reset.
U_x	Green	U_x	ON	I/O supply is present.
			OFF	I/O supply is not present.
E1/E2	Red	Error	ON	Error, see module-specific documentation
			OFF	No error

Fig. 9-4 LEDs on the power connectors

Voltages U_x:

U_I	(U_{Input})	Supply for digital input modules; sensor/encoder supply
U_O	(U_{Output})	Supply for digital output modules
U_{IO}	($U_{Input/Output}$)	Supply for digital input and output modules
U_A	(U_{Analog})	Supply for analog modules

Refer to the module-specific documentation for information about the diagnostics and status indicators on each module and their meanings.

9.3.2 LEDs on the I/O connectors

The LEDs on the I/O connectors are numbered according to the terminal points. All LED locations are numbered even when they are not used.

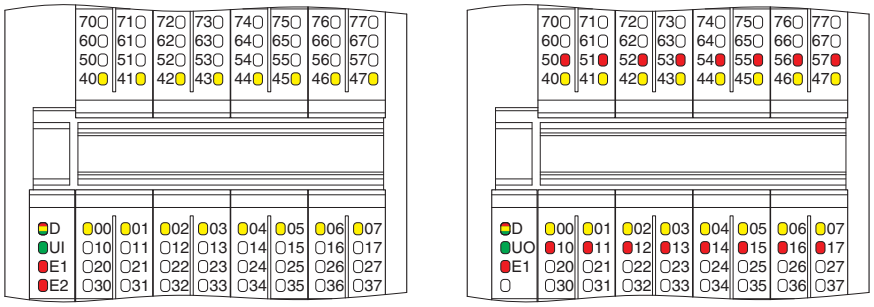


Fig. 9-5 LEDs on the I/O connectors (e.g., S20-DI-16/4, S20-DO-16/3)

Designation	Color	Meaning	State	Description
xx	**Yellow**	Status of the input or output	ON	Corresponding input/output set
			OFF	Corresponding input/output not set
yy	**Red**	Diagnostics of the output	ON	Error at the output
			OFF	No error at the output

Fig. 9-6 LEDs on the I/O connectors

xx	Channel identification
yy	Channel identification

Fig. 9-6 lists commonly used LEDs. More LEDs may also be found on the modules.
The available LEDs of a module and their meanings can be found in the module-specific documentation.

9.4 Reporting diagnostics via PDI

The malfunctions indicated by the local diagnostics and status indicators are also mapped in PDI object 0018_{hex} (DiagState).

Detailed information can be found in Chapter “Objects for diagnostics” on page 105 and in the module-specific data sheet.

Diagnostics and status indicators

10 Process, parameter, and diagnostic data

The IndraControl S20 local bus is used for the transmission of process data and parameter data.

10.1 Process data

IndraControl S20 devices have at least eight bits of process data. If less than eight bits are used, they occupy the least significant bits of the byte.

The significance of the data corresponds to the Motorola format (Big Endian).

The significance of the data bytes declines as the number goes up.

For the process data assignment and the assignment of the process data to the terminal points of a module, please refer to the module-specific data sheet.

10.2 Parameter and diagnostic data (PDI channel)

Parameter and diagnostic data as well as other information is transmitted via the PDI channel (PDI = Parameters, Diagnostics, and Information).

The PDI channel is used in addition to the process data channel in the IndraControl S20 system for the demand-oriented, acyclic transmission of parameter and diagnostic data as well as other information. Each IndraControl S20 I/O module has this channel and can use it independently of the process data.

Services can be used to access communication objects created in the IndraControl S20 I/O module via the PDI channel. These objects can be used, for example, to set measuring ranges, to specify the substitute value behavior of outputs in the event of a bus error, or to read I/O diagnostic details.

In most cases, the objects are accessed automatically, e.g., when writing the start parameterization during the bus coupler's startup.

The objects created in the IndraControl S20 I/O module are:

- General standard objects (index 0001_{hex} ... $003D_{hex}$)
  Every I/O module has these objects.
  For more detailed information on these objects, please refer to Chapter "General standard objects" on page 102.
- Manufacturer-specific application objects (index 0080_{hex} ... $5FFF_{hex}$, $FF8F_{hex}$)
  These objects are specified by the device manufacturer and have device-specific variables.
  For more detailed information on these objects, please refer to the module documentation.

You can access these objects using services.

Service	Meaning
Read	Reading an object

Table 10-1 Services

Process, parameter, and diagnostic data

Service	Meaning
Write	Writing an object
Fetch	Fetching an object that has been reported by the slave via the PDI messaging mechanism without the master application knowing which object is meant.
Write/Read	Writing/reading an application object. If access in the application is successful, instead of the positive confirmation, an object and the corresponding data are transferred to the master.

Table 10-1 Services

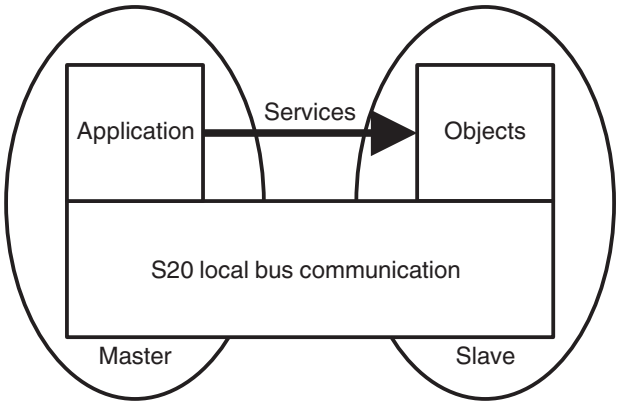


Figure 10-1 PDI components

Every service access consists of a request and the associated confirmation. Only one service can be processed for an I/O module at a time.

The service structure depends on the higher-level system. For more information, please refer to your system documentation.

10.3 Saving data: startup and other parameters

Defined parameters and other parameters are available as startup parameters for each IndraControl S20 module.

Startup parameters (Flash)

Startup parameters are stored retentively (in a non-volatile way, permanently) in the flash memory.

Startup parameters include the application object parameters, e.g., parameter table, substitute value, filter time, etc. As soon as valid parameters are specified for these objects, they are stored retentively on the module.

Due to the storage technology used, parameters that are stored retentively can only be written for a specific number of times (100,000 up to 1,000,000 times, typically). They are not suitable for being changed cyclically.

NOTICE **Damage to the flash memory during cyclic write access**

The flash memory is only designed for a limited number of write access operations. Make therefore sure that write access operations are not performed too often and, in particular, not cyclically.

Observe this behavior when programming function blocks.

Other parameters (RAM)

Other parameters are stored temporarily (in a volatile way) in the RAM.

Process, parameter, and diagnostic data

11 IndraWorks software support

IndraWorks - universal framework for all engineering tasks

The IndraWorks engineering framework provides you with all the tools required for starting up your drives and controllers in a unified way.

Project management including the data management for device configurations, visualizations, and the PLC program enables both the transparent representation and data consistency.

Based on CODESYS V3, IndraWorks includes all editors according to the 3rd edition of the IEC 61131-3 for comfortable programming of your PLC application.

Intuitive wizards and a comprehensive online help gradually guide you through all engineering steps from device configuration via the generic application template up to the parameterization of technology functions.

Using the IndraWorks offline parameterization, you can set the configuration of all planned devices and use all parameters in the PLC application, without the need for connection to the real system.

A comprehensive range of tools for startup and service activities (e.g., multi-channel oscilloscope, logic analyzer and debugging functions of the PLC logic) offer various status messages and system diagnostics at the touch of a button.

NOTICE

Please be aware that the software is only meant to **support** you. The project engineer is responsible for the correctness of the configuration.

For more information on the software, visit:
http://www.boschrexroth.com/de/de/produkte/engineering/open-core-engineering/die-features-von-open-core-engineering/software-tools/software-tools-3

IndraWorks software support

12 Technical data and ordering data

Observe additional documentation.

For the system data of your network, please refer to the corresponding documentation.
If you are using IndraControl S20 in a system with other product groups, also observe the technical data for these product groups. Please refer to the associated documentation for this technical data.
For safety applications, please refer to the documentation for the safety modules used.
Please refer to the associated documentation when using an XM2x controller.

The following values are standard values for the preferred mounting position (wall mounting on horizontal DIN rail).
For different values, please refer to the module-specific documentation.

The technical data does not claim to be complete. Technical modifications reserved.

12.1 Technical data

System data	
Number of devices supported in an IndraControl S20 station	63 devices, maximum
Maximum current consumption of the IndraControl S20 modules	See module-specific data sheet

When configuring an IndraControl S20 station, observe the communications power supply through the bus coupler, the controller or the power module, as well as the current consumption of each device. This data may vary depending on the module and is given in the module-specific documentation. Create a new station or install a power module for the communications power if the maximum current consumption at U_{Bus} is reached. In addition, the maximum number of devices may be limited by the controller/bus coupler system data. Observe the information in the module-specific documentation.

See also Chapter “Maximum number of modules” on page 42.

General data (standard values; for deviations see module-specific documentation)	
Ambient temperature	
Ambient temperature (operation)	-25°C ... +60°C
Ambient temperature (storage/transport)	-40°C ... +85°C
Temperature change	5 K/min (non-condensing permitted)
Permissible humidity (operation/storage/transport)	5% ... 95% (non-condensing)
Permissible air pressure (operation/storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20

Technical data and ordering data

General data (standard values; for deviations see module-specific documentation) [...]	
Protection class	Low-level signal: III, IEC 61140, EN 61140, VDE 0140-1 Low voltage, mounted in an adequate housing with at least IP54 degree of protection: II, IEC 61140, EN 61140, VDE 0140-1
Air clearances and creepage distances	Low-level signal: according to EN 60664-1 Low voltage: according to EN 61010-2-201
Housing material	Plastic
Pollution degree	Low-level signal: 2, EN 60664-1 Low voltage: 2, EN 61010-1
Overvoltage category	Low-level signal: II, EN 60664-1 Low voltage: III, EN 61010-1

Mechanical tests (standard values; for deviations see module-specific documentation)	
Vibration resistance according to EN 60068-2-6/IEC 60068-2-6	5g
Shock test according to EN 60068-2-27/IEC 60068-2-27	30g
Bump endurance test according to EN 60068-2-27/IEC 60068-2-27	10g

Conformance with EMC Directive 2014/30/EU (for deviations and detailed values see module-specific documentation)	
Noise immunity test according to EN 61000-6-2	
Electrostatic discharge (ESD), EN 61000-4-2/IEC 61000-4-2	Criterion B
Electromagnetic fields, EN 61000-4-3/IEC 61000-4-3	Criterion A
Fast transients (burst), EN 61000-4-4/IEC 61000-4-4	Criterion B
Transient surge voltage (surge), EN 61000-4-5/EN 61000-4-5	Criterion B
Conducted interference, EN 61000-4-6/IEC 61000-4-6	Criterion A
Noise emission test according to EN 61000-6-3	
Radio disturbance characteristics, EN 55022	Class B

Low-voltage modules: developed according to IEC 61850-3 (for deviations and detailed values see module-specific documentation)	
Electrostatic discharge (ESD), EN 61000-4-2/IEC 61000-4-2	Criterion A
Electromagnetic fields, EN 61000-4-3/IEC 61000-4-3	Criterion A
Fast transients (burst), EN 61000-4-4/IEC 61000-4-4	Criterion A
Transient surge voltage, EN 61000-4-5/IEC 61000-4-5	Criterion A
Conducted interference, EN 61000-4-6/IEC 61000-4-6	Criterion A
Immunity against magnetic fields, EN 61000-4-8/IEC 61000-4-8	300 A/m continuous, 1000 A/m for 1 s
Immunity against attenuated oscillating magnetic fields, EN 61000-4-10/IEC 61000-4-10	100 A/m
Immunity to conducted common mode interference, EN 61000-4-16/IEC 61000-4-16	30 V continuous, 300 V for 1 s
Attenuated oscillating waves, EN 61000-4-18/IEC 61000-4-18	1 kV symmetrical, 2.5 kV asymmetrical
Radio disturbance characteristics, EN 55022	Class B

Interface for IndraControl S20 local bus	
Connection method	Bus base module
Transmission speed	100 Mbps

24 V supply (U_L, U_I, U_O, U_{IO}, U_A)	
Nominal voltage	24 V DC
Ripple	±5%
Maximum permissible voltage range	19.2 V DC ... 30.0 V DC (including all tolerances, ripple included)
Connection	IndraControl S20 connector

The local bus supply (communications power) U_{Bus} is generated from communications power U_L (24 V).

230 V supply (U_O)	
Nominal voltage	230 V AC
Maximum permissible voltage range	-300 V AC ... 300 V AC (including all tolerances, 50 Hz ... 60 Hz)
Connection	IndraControl S20 connector

NOTICE **Damage to the electronics**

Provide external protection for the module.

Local bus supply (supplies the bus logic of the connected modules)	
Remark	The U_L communications power is supplied on the bus coupler, controller or power module for the communications power. The communications power U_{Bus} is generated from this communications power U_L and distributed over the bus base modules. These two voltages are not electrically isolated. The current through the local bus I_{Bus} is short-circuit-proof.
Connection	Bus base modules
Communications power (U_{Bus})	5 V DC
Maximum load current in the local bus (I_{Bus})	See controller, bus coupler or power module documentation

Voltage dips and interruptions of the I/O supply	
Intensity PS1	Interrupt time <1 ms
Time interval between voltage dips	<1 s
Behavior	Criterion A A supply voltage dip of <1 ms has no effect.
Intensity PS2	Interrupt time <10 ms
Time interval between voltage dips	<1 s
Behavior	Criterion C Bus disconnection, all system outputs are reset.

Technical data and ordering data

IndraControl S20 connector/connection method/cable cross sections

For electrical and/or thermal reasons, it may not be possible to use the minimum conductor cross sections specified here for certain modules. Therefore, always observe the information in the module-specific documentation.

Designation	IndraControl S20 connector
Connection method	Push-in connection
Maximum load capacity of the contacts	8 A
Cable cross section (typical)	0.2 mm^2 ... 1.5 mm^2; AWG 24 ... 16 See Chapter “Conductor cross sections and stripping/insertion lengths” on page 56
Stripping lengths	8 mm or 10 mm; See Chapter “Conductor cross sections and stripping/insertion lengths” on page 56

Electrically isolated areas

See module-specific documentation

Test voltages (standard values for the 24 V area; for deviations and low-voltage area see module-specific documentation)

For information about the test voltages between the network and other potential areas, please refer to the documentation for the bus coupler.

Isolating distance	Test voltage
5 V local bus, 24 V communications power/functional earth ground	500 V AC, 50 Hz, 1 min
5 V local bus, 24 V communications power/24 V voltage of the digital or analog inputs/outputs	500 V AC, 50 Hz, 1 min
24 V voltage of the digital or analog inputs/outputs/functional earth ground	500 V AC, 50 Hz, 1 min

Approvals

For the latest approvals, visit www.boschrexroth.com/electrics.

12.2 Ordering data

The complete product catalog is available in electronic form at www.boschrexroth.com/electrics.

Ordering data for the IndraControl S20 modules and corresponding connectors

For the ordering data for the IndraControl S20 module and corresponding connectors, please refer to the corresponding data sheet.

Ordering data for accessories

Description	Type	MNR	Pcs./Pkt.
Mounting material			
End clamp set (containing 2 E/NS 35N end brackets)	SUP-M01-ENDHALTER	R911170685	1
Material for shield connection			
Please observe the available space when selecting the shield connection clamps.			
Shield connection set (contains 2 busbar holders and 2 SK 5 shield connection clamps)	S20-SHIELD-SET	R911173030	1
Shield connection clamp for applying the shield on busbars; to be secured with screws			
5 mm diameter	S20-SHIELD-SK5	R911173282	10
14 mm diameter	S20-SHIELD-SK14	R911173286	10
Busbar, 10 mm x 3 mm, 1 m long	S20-SHIELD-NLS	R911173283	1

Ordering data for documentation

The module-specific documentation can be downloaded at www.boschrexroth.com/electrics.
Make sure you always use the latest documentation.

Technical data and ordering data

13 Technical appendix

13.1 Transmission speed

Within an IndraControl S20 station communication takes place over a fast, cyclic and equidistant local bus. The typical cycle time is less than 50 µs.

13.2 Typical cycle time on the local bus

The typical cycle time on the local bus is calculated according to the formula:

$$t = 2\ \mu s + n * 1\ \mu s$$

Where:

t	Typical cycle time on the local bus
n	Number of modules attached to the bus coupler

The typical cycle time for a station of five modules is:

$$t = 2\ \mu s + n * 1\ \mu s$$

$$t = 2\ \mu s + 5 * 1\ \mu s$$

$$t = 7\ \mu s$$

13.3 Response times for an IndraControl S20 system

In general, the response time for an I/O system is the time from reading in the input, processing in the controller to setting the output.

It includes:

- The time for copying to the bus heads (bus coupler or controller; 1 in Fig. 13-1)
- The cycle time of the local bus (2)
- The conversion time in the I/O modules (3)
- The update time of the higher-level network (4)
- The processing time (cycle time) in the controller (5)
- If applicable, the required synchronization latency periods between the individual subsystems (Shannon sampling theorem)

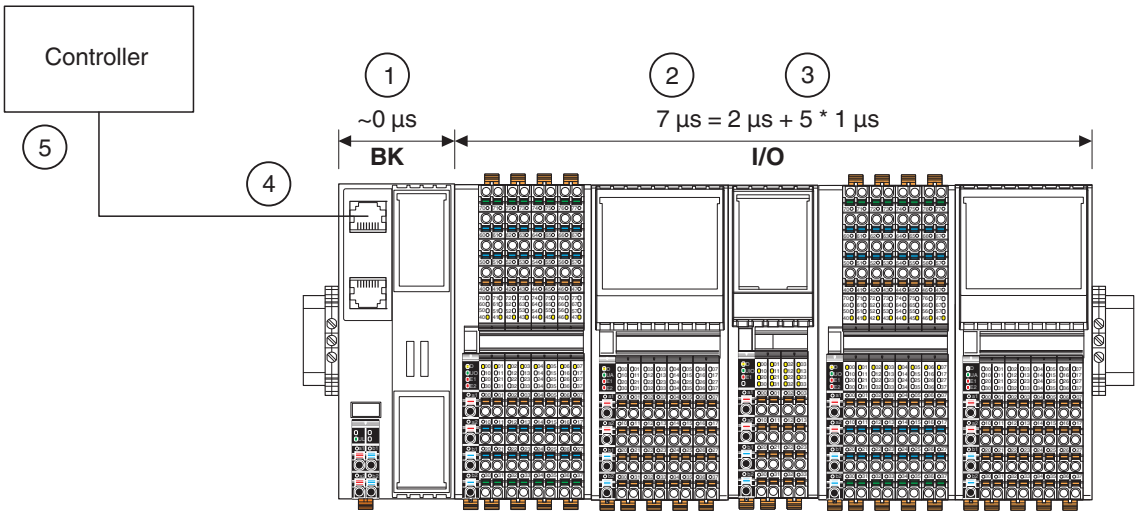


Fig. 13-1 Response times of the overall system

Typical processing times for an IndraControl S20 system:

1	Time for copying to the IndraControl S20 bus head	~ 0 µs
2	Cycle time of the IndraControl S20 local bus	Here: 7 µs
3	Conversion time in the IndraControl S20 I/O modules (depends on the I/O application)	E.g., 100 µs, 10 µs, 1 µs Here: 1 µs per module
4	Cycle time of the higher-level network (depends on the higher-level network)	E.g., PROFINET IRT with 250 µs
5	Controller cycle time	1 ms
6	Synchronization times	In the worst case, the times of all individual components are double

Fig. 13-2 Typical processing times in the overall system (example)

The example makes it clear that when determining the response time of the overall system, IndraControl S20 represents the smallest proportion by far and therefore can normally be ignored.

13.4 Communication objects

Communication objects are stored on each module. You can access these objects with read, write or read and write services via the PDI channel or via the hardware configurator (e.g., PC Worx or STEP 7).

For an detailed description of all communication objects, please refer to the Basic Profile online at www.interbusclub.com under “Downloads, INTERBUS Profile”.

This document describes only the objects used for IndraControl S20. These include general standard objects and manufacturer-specific application objects.

The following applies for the tables below:

Abbreviation	Meaning
N	Number of elements
L [bytes]	Length of the element in bytes
R	Read
W	Write

Fig. 13-3 Key for the following tables

Object type	Data type	Meaning
Var		Object with only one element (simple variable)
Array		Object with several simple variables of the same data type with the same length
Record		Object with several simple variables of different data types or of the same data type with different lengths
	Visible string	Byte string with only printable ASCII characters The byte string finishes with 00_{hex} (null-terminated) and is therefore one byte longer than the user data.
	Octet string	Byte string with any contents
	Unsigned 8	Value without sign, only positive values 00_{hex} ... FF_{hex}
	Unsigned 16	Value without sign, only positive values 0000_{hex} ... $FFFF_{hex}$
	Unsigned 32	Value without sign, only positive values 0000 0000_{hex} ... FFFF $FFFF_{hex}$

Fig. 13-4 Object and data types

Visible string:
In the following tables and the module-specific data sheets, the null termination of a visible string is not provided in the Content column, only the pure user data is stated. This means that there is always one byte more stated for the length of the object than is available as user data. In the following tables this is indicated by “+1”. In the data sheets, the entire length of the object is always stated.

Communication objects

13.4.1 General standard objects

The standard objects include:

- Objects for identification
- Object for multilingual support
- Objects with object descriptions
- Objects for diagnostics
- Objects for process data management

13.4.1.1 Objects for identification

These objects describe the manufacturer, the device, and device application and form the device rating plate.

The bold entries in Fig. 13-5 are identical for all IndraControl S20 modules from Bosch Rexroth. All other entries may vary depending on the individual module.

Index [hex]	Object name	Object type	Data type	N	L [bytes]	Rights	Meaning	Content/example
Manufacturer								
0001	VendorName	Var	Visible string	1	15 + 1	R	Manufacturer name	**Bosch Rexroth AG**
0002	VendorID	Var	Visible string	1	6 + 1	R	Manufacturer ID	**006034**
0012	VendorURL	Var	Visible string	1	29 + 1	R	Manufacturer URL	**http://www.boschrex-roth.com**
Module - general								
0004	DeviceFamily	Var	Visible string	1	57 + 1, max.	R	Device range	... (e.g., I/O analog IN)
0006	ProductFamily	Var	Visible string	1	32 + 1	R	Product range	**IndraControl S20**
000E	CommProfile	Var	Visible string	1	3 + 1	R	Communication profile	**633**
000F	DeviceProfile	Var	Visible string	1	4 + 1	R	Device profile	**0010**
0011	ProfileVersion	Record		2		R	Profile version	
.1	BuildDate	Var	Visible string	1	10 + 1	R	Version date	2011-12-07
..2	Version	Var	Visible string	1	19 + 1 39 + 1, max.	R	Version ID	Basic profile V2.0
003A	VersionCount	Array		4		R	Version count; unique consecu-tive numbering for the version of the corresponding component	E.g., 0007 0001 0000 0000
.1	ProfileVersion	Var	Unsigned 16	1	2	R	Profile 06 for basic profile V2.0	xx xx_{hex} (e.g., 0007)
.2	PChVersion	Var	Unsigned 16	1	2		PDI version	xx xx_{hex} (e.g., 0001)
.3	HardwareVer-sion	Var	Unsigned 16	1	2		Hardware version	xx xx_{hex} (e.g., 0001)
.4	FirmwareVer-sion	Var	Unsigned 16	1	2		Firmware version	xx xx_{hex} (e.g., 0001)

Fig. 13-5 Objects for identification (device rating plate)

Index [hex]	Object name	Object type	Data type	N	L [bytes]	Rights	Meaning	Content/example
Module - specific (for a specific module)								
0005	Capabilities	Array	Visible string	N	8	R	Properties	(e.g.: Nothing) See "Properties (0005_{hex}: capabilities)" on page 104
0007	ProductName	Var	Visible string	1	57 + 1, max.	R	Product name	... (e.g., S20-DI-64/1)
0008	SerialNo	Var	Visible string	1	10 + 1	R	Serial number	xx xx xx xx xx xx xx x (e.g., 7602012346BC125)
0009	ProductText	Var	Visible string	1	57 + 1, max.	R	Product text	... (e.g., 64 digital input channels)
000A	OrderNumber	Var	Visible string	1	7 + 1	R	Material number	xxxxxxxxxx (e.g. R911173340)
000B	HardwareVersion	Record		2		R	Hardware version	
.1	BuildDate	Var	Visible string	1	10 + 1	R	Version date	YYYY-MM-DD
..2	Version	Var	Visible string	1	39 + 1, max.	R	Version ID	xxx (e.g., 01)
000C	FirmwareVersion	Record		2		R	Firmware version	
.1	BuildDate	Var	Visible string	1	10 + 1	R	Version date	YYYY-MM-DD
..2	Version	Var	Visible string	1	39 + 1, max.	R	Version ID	xxx (e.g., --, V1.10)
000D	PChVersion	Record		2		R	Parameter channel version	
.1	BuildDate	Var	Visible string	1	10 + 1	R	Version date	YYYY-MM-DD
..2	Version	Var	Visible string	1	39 + 1, max.	R	Version ID	xxx (e.g., --, V1.00)
0037	DeviceType	Var	OctetString	1	8	R	Module identification	xx xx xx xx xx xx xx xx_{hex} (e.g., 00 20 00 08 00 00 00 $A6_{hex}$)
Use of the device								
0014	Location	Var	Visible string	1	57 + 1, max.	R/W	Installation location	... (e.g., Please fill in ...); Can be filled out by the user.
0015	EquipmentIdent	Var	Visible string	1	57 + 1, max.	R/W	Equipment identifier	... (e.g., Please fill in ...); Can be filled out by the user.
0016	ApplDeviceAddr	Var	Unsigned 16	1	2	R/W	Application-specific device address	... (e.g., Please fill in ...); Can be filled out by the user.

Fig. 13-5 Objects for identification (device rating plate) [...]

Communication objects

Properties (0005_{hex}: capabilities)

This object indicates the properties and functions the device has in addition to the basic functions. At the moment, the following properties exist:

Contents	Meaning
Nothing	No additional functions
SyncI_0	The slave supports synchronization of the inputs.
SyncO_0	The slave supports synchronization of the outputs.
Energ_0	Currently without function, prepared for future applications.

Fig. 13-6 Properties

13.4.1.2 Object for multilingual support

With this object you can read the currently valid language and, if more languages are available, select one.

Index [hex]	Object name	Object type	Data type	N	L [bytes]	Rights	Meaning	Content/example
0017	Language	Record		2		R/W	Object for language selection of the device; The currently valid language may be accessed or changed here.	
.1	Language-Code	Var	Visible string	1	5 + 1	R/W	Language code	**en-us**
.2	NameLanguage	Var	Visible string	1	49 + 1, max.	R/W	Language name	**English**

Fig. 13-7 Object for multilingual support

13.4.1.3 Object with object descriptions

For startup and servicing it is sometimes necessary to know not only the target parameterization, but also the actual parameterization of the device. This requires that you know the implemented application objects. These objects and their meanings can be read with the objects for object description. These objects are only applicable to tools and are therefore not described in more detail here. For a more detailed description, please refer to the basic profile, if necessary.

Index [hex]	Object name	Object type	Data type	N	L [bytes]	Rights	Meaning
0038	ObjDescrReq	Record	Record	2	2; 1	R/W	Object whose description was requested
0039	ObjDescr	Record	Record	16		R/W	Description of the object whose index was requested

Fig. 13-8 Objects for object description

13.4.1.4 Objects for diagnostics

These objects describe the diagnostic state of the device and any connected I/O devices, as well as options for resetting diagnostics.

Index [hex]	Object name	Object type	Data type	N	L [bytes]	Rights	Meaning
0018	DiagState	Re-cord		6		R	Diagnostic state
.1	Lfd.Nr.	Var	Unsigned 16	1	2	R	Consecutive error number since the last reset or error memory reset
.2	Priority	Var	Unsigned 8	1	1	R	Priority of the message. 1: highest priority
.3	Channel/ Group/Mod-ule	Var	Unsigned 8	1	1	R	Channel, group or module on which the error occurred. FF: entire device
.4	Code	Var	Octet string	1	2	R	Error code
.5	MoreFollows	Var	Bit string 8	1	1	R	Additional information on malfunction; not used with IndraControl S20 up to now
.6	Text	Var	Visible string	1	50 + 1, max.	R	Plain text message. Default: status OK
0019	ResetDiag	Var	Unsigned 8	1	1	W	Reset diagnostics: deletes the corresponding diagnostic memory and acknowledges the message

Fig. 13-9 Objects for diagnostics

For the specific content of these objects, please refer to the module-specific data sheet.

Communication objects

13.4.1.5 Objects for process data management

These objects describe the IN and/or OUT process data.

Index [hex]	Object name	Object type	Data type	N	L [bytes]	Rights	Meaning
0024	ResetCode	Array	Unsigned 16	N	N * 2	R/W	Substitute value behavior when process data is missing
0025	PDIN	Octet string	Octet string	1	PD length	R	IN process data (from the device to the master) If the process data is structured (e.g., several channels), this object should also be structured and individual structure elements be accessed via the subindex.
0026	PDOUT	Octet string	Octet string	1	PD length	R/W	OUT process data (from the master to the device) If the process data is structured (e.g., several channels), this object should also be structured and individual structure elements be accessed via the subindex.
0027	GetExRight	Simple variable	Unsigned 8	1	1	R/W (access-protected)	Request exclusive write access
002F	PDOUT_-Subst	Octet string	Octet string	1	PD length	R/W	Substitute value for the OUT process data in the event of an error
0031	PDIN_Subst	Octet string	Octet string	1	PD length	R/W	Substitute value for the IN process data in the event of an error
003B	PDIN_Descr	Record	Record	N x 3		R	Description of the IN process data structure N = number of elements of the PDIN object
.1	Type	Visible string	Visible string	1	7 + 1	R	Type of I/O data item
.2	ChNo	Unsigned 16	Unsigned 16	1	2	R	Number of channels
.3	ChLength	Unsigned 16	Unsigned 16	1	2	R	Length of a channel
003C	PDOUT_Descr	Record	Record	N x 3			Description of the OUT process data structure N = number of elements of the PDOUT object
.1	Type	Visible string	Visible string	1	7 + 1	R	Type of I/O data item
.2	ChNo	Unsigned 16	Unsigned 16	1	2	R	Number of channels
.3	ChLength	Unsigned 16	Unsigned 16	1	2	R	Length of a channel

Fig. 13-10 Objects for process data management

For the specific content of objects 0024_{hex} ... 0031_{hex}, please refer to the module-specific data sheet.

Objects $003B_{hex}$ and $003C_{hex}$ are only applicable to tools. For a more detailed description, please refer to the basic profile, if necessary.

13.4.2 Manufacturer-specific application objects

Manufacturer-specific application objects are module-specific and are documented in each of the module-specific data sheets.

For example, parameterization of individual channels for analog modules or parameterization of filter times for digital input modules is implemented using these objects.

13.4.3 Value ranges

Make sure to observe the permissible value ranges during module parameterization.
If invalid values are specified for an object, these are not saved and an error message is generated.

13.5 Synchronization

13.5.1 Synchronization in general

Some IndraControl S20 modules offer a synchronization option.

To use this property, synchronization must be consistently supported from the clock master in the higher-level network to the I/O modules.

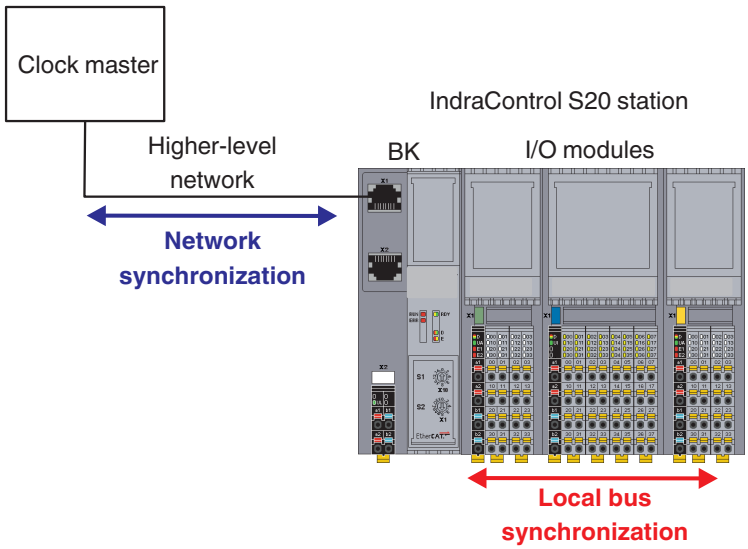


Fig. 13-11 Network and local bus synchronization

Clock master In the overall system, the clock master is the unit which determines the synchronization times and time points and sends out a synchronization clock signal. Generally this is the network controller.

Higher-level network The higher-level network is the communication system which links the controller and the head of the IndraControl S20 station. This network must support synchronization.

The head of an IndraControl S20 station can be a bus coupler or an XM2x controller. Currently, only some bus couplers support synchronization.

Synchronization

Bus coupler The bus coupler is the link between the higher-level network and the IndraControl S20 station. It must support synchronization according to the definition of the higher-level network and transfers the synchronization parameters and signals to the IndraControl S20 station.

Examples of bus couplers which support the synchronization mechanisms for a network

Network	Bus coupler	Synchronization mechanism of the network	Remark
EtherCAT®	S20-EC-BK	SM-synchronous	Asynchronous
		DC-synchronous	The bus cycle of the local bus is synchronized with the EtherCAT® cycle. The implemented distributed clock unit is used to synchronize the processes in a temporal manner.
Sercos	S20-S3-BK+	Asynchronous	Asynchronous
		Clock-synchronous	Cyclical master-slave communication with one of the cycle times to be selected during initialization.

Fig. 13-12 Synchronization mechanisms of the bus couplers

Exemplary illustration of the synchronization mechanisms

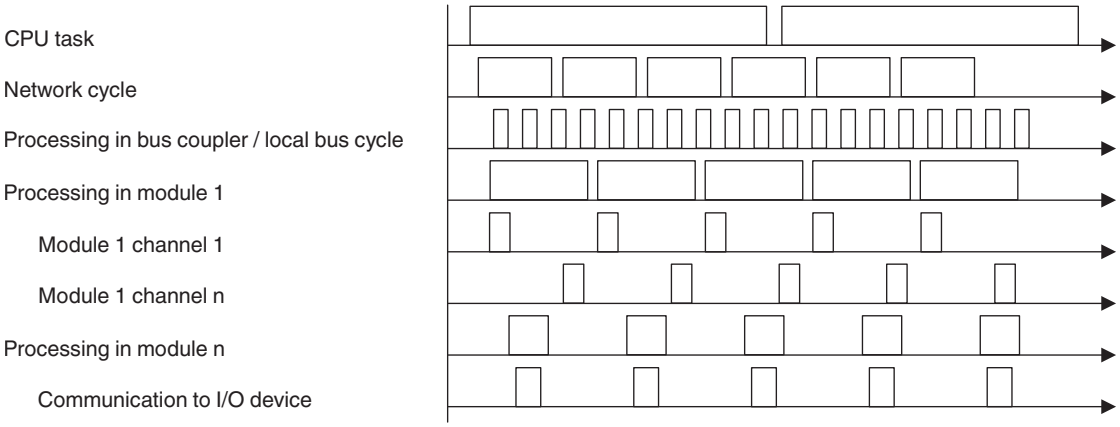


Fig. 13-13 Asynchronous

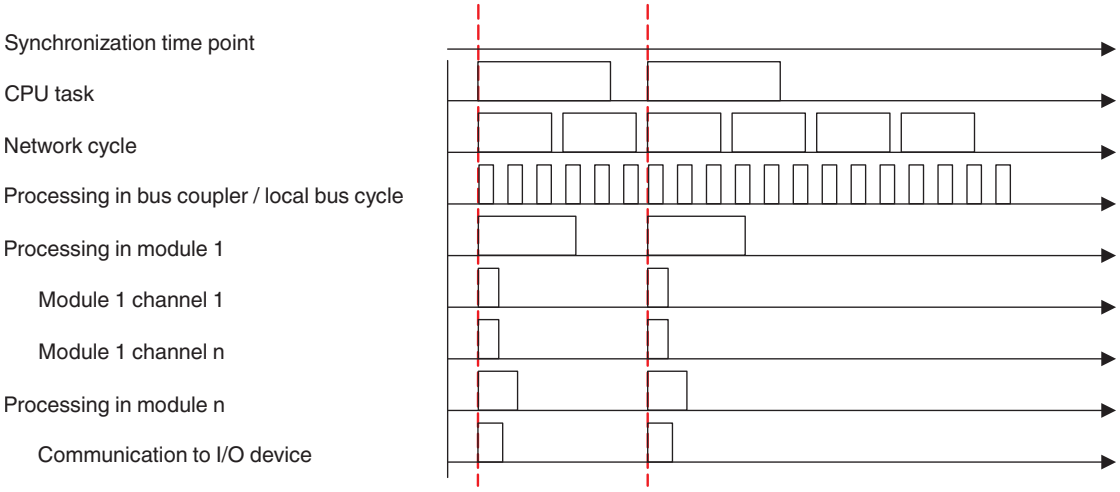


Fig. 13-14 Synchronous

I/O modules

Not all I/O modules support local bus synchronization.
In the case of modules which support local bus synchronization, the property SyncI_0 (synchronization of inputs) or SyncO_0 (synchronization of outputs) is specified in the “Capabilities” object (0005_{hex}).

In the case of an I/O module which works asynchronously, its input or output signals are read or output at a time point determined by the higher-level network. The data is consistent, i.e., all data for a module is processed at the same time point.

In order for the clock master in the higher-level network to calculate the exact time point for an input/output, the module provides the bus coupler/controller with various information, such as the minimum possible repeat time, signal processing length, and required run-up for the transfer of the data. These values are either permanently set in the module or are dynamically determined based on the parameterization.

The values are read by the bus coupler/controller and made available to the clock master. The synchronization time point determined by the clock master, which can be different for each module, is set by the bus coupler/controller in each module that can be synchronized.

In this way, synchronism requirements within a station of a few nanoseconds are achieved. The precision of the overall system is essentially determined by the higher-level network options and its clock master.

Modules which do not support synchronous processing do not affect a synchronous system. They do not accept or transfer the values at a specific time, instead they do this as fast as possible.

13.5.2 Synchronization options

Modules can either support synchronization or not. When a module can be synchronized, you can use the function or deactivate it, depending on the application.

Module property	Use	Remark
Cannot be synchronized	Asynchronous	
Can be synchronized	Asynchronous	If synchronization is not required for your application or is not useful, then deactivate synchronous mode.
	Synchronous	The modules are to be synchronized. Select the modules in a suitable manner and set their parameters accordingly. See also Chapter 13.5.3, “Conditions for local bus synchronization”.

Fig. 13-15 Synchronization options

13.5.3 Conditions for local bus synchronization

To make good use of this function, the following conditions must be met:

1. The higher-level controller must support synchronization mechanisms for the network.
2. The bus coupler must support synchronization mechanisms for the network.
3. At least one module in the local bus must support local bus synchronization.

13.6 Substitute value behavior (failsafe behavior)

The substitute value behavior defines the module behavior when process data is missing.

Once a module has exchanged valid process data for the first time after switching on the power supply, the substitute value behavior is activated.

If valid process data is missing (e.g., in the event the connection is aborted), the module changes to the substitute value behavior.

Typically, the substitute value behavior is parameterized using the engineering tool or object 0024_{hex} “Substitute value behavior when process data is missing”. The following values are available:

Code (hex)	Behavior	Example: S20-AO-4
0000	Output of zero values	Output of zero values (0 V/0 mA/4 mA) at the output
0001	Output of final values	Output of final values (10 V/5 V/20 mA) at the output
0002	Hold last value	Hold last value
0003	Substitute value	Acceptance of substitute values of the “Substitute OUT process data” object ($002F_{hex}$)

Fig. 13-16 Possible settings for the substitute value behavior

To determine whether, and if yes, which substitute value behavior can be parameterized for a module, please refer to the module-specific data sheet.

For digital modules of the IndraControl S20 system, the outputs are always reset to “0 in the event of a local bus or U_O failure.

Substitute value behavior (failsafe behavior)

Overview regarding the behavior of analog output modules from the S20 portfolio with an environment not being ready for operation

	Substitute value behavior	**Behavior upon local bus failure**	**Behavior upon U_A failure**
With an environment not being ready for operation due to ...	**E.g., PLC stop, fieldbus interruption**	**E.g., U_{Bus} failure, local bus interruption**	**I/O supply failure at the module**
Description	**Controllable module state, as the higher-level system (bus coupler, controller, ...) is able to provide a substitute value via the S20 local bus.**	**It is no longer possible to influence the module outputs, as a higher-level system has been disconnected. The module behaves according to the hardware structure of its output circuit used.**	**The output drivers are no longer supplied due to a supply voltage failure at the module (U_A).**
S20-AO-8 R911172538	As set in the “user-defined parameters”	Last value is held	Outputs at 0 V/0 mA
S20-SSI-AO-1/1 R911172544	As set in the “user-defined parameters”	Last value is held	Outputs at 0 V/0 mA
S20-AIAO-2 R911173743	As set in the “user-defined parameters”	Last value is held	Outputs at 0 V/0 mA
S20-AI6-AO2-SSI2 R911173120	As set in the “user-defined parameters”	Outputs at 0 V/0 mA	Outputs at 0 V/0 mA
S20-AO-4 R911173248	As set in the “user-defined parameters”	Outputs at 0 V/0 mA	Outputs at 0 V/0 mA

Fig. 13-17 Behavior of analog output modules with an environment not being ready for operation

The analog outputs of the **S20-AO-8**, **S20-SSI-AO-1/1,** and **S20-AIAO-2** modules hold their last values in the event of an S20 local bus failure. Concrete applications of this are, for example, ventilation flaps or cooling pumps which should hold their previous settings in the event of a fault. If 0 V/0 mA are required at the input of the I/O connected to the module (e.g., for hydraulic axes), the signal needs to be interrupted by a relay.

The **S20-AO-4** and **S20-AI6-AO2-SSI2** modules reset their analog outputs to 0 V/0 mA in the event of an S20 local bus failure.

The S20-AO-8, S20-SSI-AO-1/1, and S20-AIAO-2 modules hold the last value of the analog ouput(s) if the local bus fails. This is appropriately documented in the data sheets.

The S20-AO-4 and S20-AI6-AO2-SSI2 modules reset their outputs to 0 V/0 mA in the event of a local bus failure. This behavior is also documented accordingly.

14 Disposal

14.1 General information

Dispose the products according to the respective valid national standard.

14.2 Return

For disposal, our products can be returned free of charge. However, the products must be free of remains like oil and grease or other impurities.

Furthermore, the products returned for disposal must not contain any undue foreign substances or components.

Send the products free of charge to the following address:

Bosch Rexroth AG
Electric Drives and Controls
Bürgermeister-Dr.-Nebel-Straße 2
D-97816 Lohr am Main, Germany

14.3 Packaging

The packaging material consists of cardboard, plastics, wood or styrofoam. Packaging material can be recycled anywhere.

For ecological reasons, please do not return empty packages.

14.4 Batteries and accumulators

Batteries and accumulators can be labelled with this symbol.

The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin.

The end user within the EU is legally obligated to return used batteries. Outside the validity of the EU Directive 2006/66/EC keep the stipulated directives.

Used batteries can contain hazardous substances, which can harm the environment or the health of the individual when they are stored incorrectly or disposed of.

After use, the batteries or accumulators contained in Rexroth products have to be disposed of according to the country-specific collection system.

Disposal

15 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries.
You can contact us **24/7**.

Service Germany

Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the **Service Hotline** and **Service Helpdesk** under:

Phone:	**+49 9352 40 5060**
Fax:	**+49 9352 18 4941**
E-mail:	service.svc@boschrexroth.de
Internet:	http://www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances
- Type plate specifications of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your e-mail address)

Service and support

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Notes

The Drive & Control Company

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