IndraControl
S20 function module
KNX interface

R911393977
Edition 01

Data sheet S20-KNX-1

1 channel KNX interface
Communication in accordance with EN 50090 (ISO/IEC 14543-3)

04 / 2019

1 Description

The module is designed for use within an IndraControl S20 station.
It is used as a single-channel interface to the KNX bus.

Features

- Power is supplied from the KNX bus and the local bus
- Electrical isolation of the KNX bus
- Device rating plate stored
- Diagnostic and status indicators

This data sheet is only valid in association with the application description for the IndraControl S20 system, material number R911335988.

Make sure you always use the latest documentation.
It can be downloaded under www.boschrexroth.com/electrics.

2 Table of contents

3 Ordering data

Description	Type	MNR	Pcs./Pkt.
IndraControl S20 function module KNX interface	S20-KNX-1	R911174966	1

Accessories	Type	MNR	Pcs./Pkt.
IndraControl S20 bus base module, narrow	S20-BS-S	R911173203	5
Connector set	S20-CNS-2S-O/D/UI/E1/E2	R911173804	1

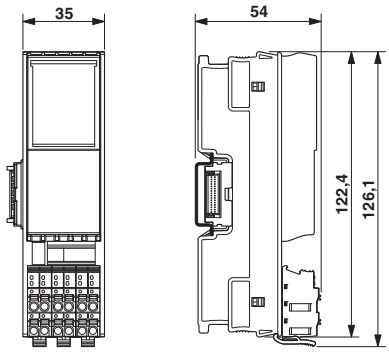
Documentation	Type	MNR	Pcs./Pkt.
Application description for the IndraControl S20: System and Installation	DOK-CONTRL-S20*SYS*INS-AP..-EN-P	R911335988	1
Application description for IndraControl S20: Error Messages	DOK-CONTRL-S20*DIAG*ER-AP..-EN-P	R911344826	1

Additional ordering data

For additional ordering data (accessories), please refer to the product catalog at www.boschrexroth.com/electrics.

4 Technical data

Dimensions (nominal sizes in mm)



Width	35 mm
Height	126.1 mm
Depth	54 mm
Note on dimensions	The depth is valid when a TH 35-7,5 DIN rail is used (according to EN 60715).

General data	
Color	light grey RAL 7035
Weight	119 g (with connectors and bus base module)
Ambient temperature (operation)	-25 °C ... 60 °C
Ambient temperature (storage/transport)	-40 °C ... 85 °C
Permissible humidity (operation)	5 % ... 95 % (non-condensing)
Permissible humidity (storage/transport)	5 % ... 95 % (non-condensing)

General data	
Air pressure (operation)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Air pressure (storage/transport)	70 kPa ... 106 kPa (up to 3000 m above sea level)
Degree of protection	IP20
Protection class	III, IEC 61140, EN 61140, VDE 0140-1

Connection data: S20 connector	
Connection method	Push-in connection
Conductor cross section solid / stranded	0.2 mm^2 ... 1.5 mm^2 / 0.2 mm^2 ... 1.5 mm^2
Conductor cross section [AWG]	24 ... 16
Stripping length	8 mm

Observe the specifications for the conductor cross sections in the application description for the IndraControl S20 system, material number R911335988.

Interface: KNX	
Number	1
Connection method	Push-in connection
Transmission speed	9600 Baud
Supply voltage	typ. 30 V DC (Bus voltage)
Current consumption	typ. 3.2 mA (From KNX bus) max. 4 mA (From KNX bus)
Communication standard	EN 50090 (ISO/IEC 14543-3)
Surge protection	electronic (35 V, 0.5 s)
Reverse polarity protection	Polarity protection diode
Transient protection	Suppressor diode

Interface: Local bus	
Number	2
Connection method	Bus base module
Transmission speed	100 Mbps

Supply of the local bus (U_{Bus})	
Supply voltage	5 V DC (via bus base module)
Current draw	typ. 60 mA max. 70 mA
Power consumption	max. 350 mW

Electrical isolation/isolation of the voltage areas	
Test section	**Test voltage**
5 V supply (logic) / KNX (including PROG and GND)	500 V AC, 50 Hz, 1 min.
5 V supply (logic)/functional earth ground	500 V AC, 50 Hz, 1 min.
KNX (including PROG and GND) / functional ground	500 V AC, 50 Hz, 1 min.

Mechanical tests	
Vibration resistance in acc. with EN 60068-2-6/ IEC 60068-2-6	5g
Shock in acc. with EN 60068-2-27/IEC 60068-2-27	30g
Continuous shock according to EN 60068-2-27/ IEC 60068-2-27	10g

Conformance with EMC Directive 2014/30/EU	
Noise immunity test in accordance with EN 61000-6-2	
Electrostatic discharge (ESD) EN 61000-4-2/ IEC 61000-4-2	Criterion B, 6 kV contact discharge, 8 kV air discharge
Electromagnetic fields EN 61000-4-3/IEC 61000-4-3	Criterion A, 10 V/m
Fast transients (burst) EN 61000-4-4/IEC 61000-4-4	Criterion B, 2 kV
Transient overvoltage (surge) EN 61000-4-5/ IEC 61000-4-5	Criterion B, ±1 kV cable to ground, 42 Ω, 0.5 µF
Conducted interference EN 61000-4-6/IEC 61000-4-6	Criterion A; Test voltage 10 V
Noise emission test according to EN 61000-6-3	Class B

Approvals

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

5 Internal circuit diagram

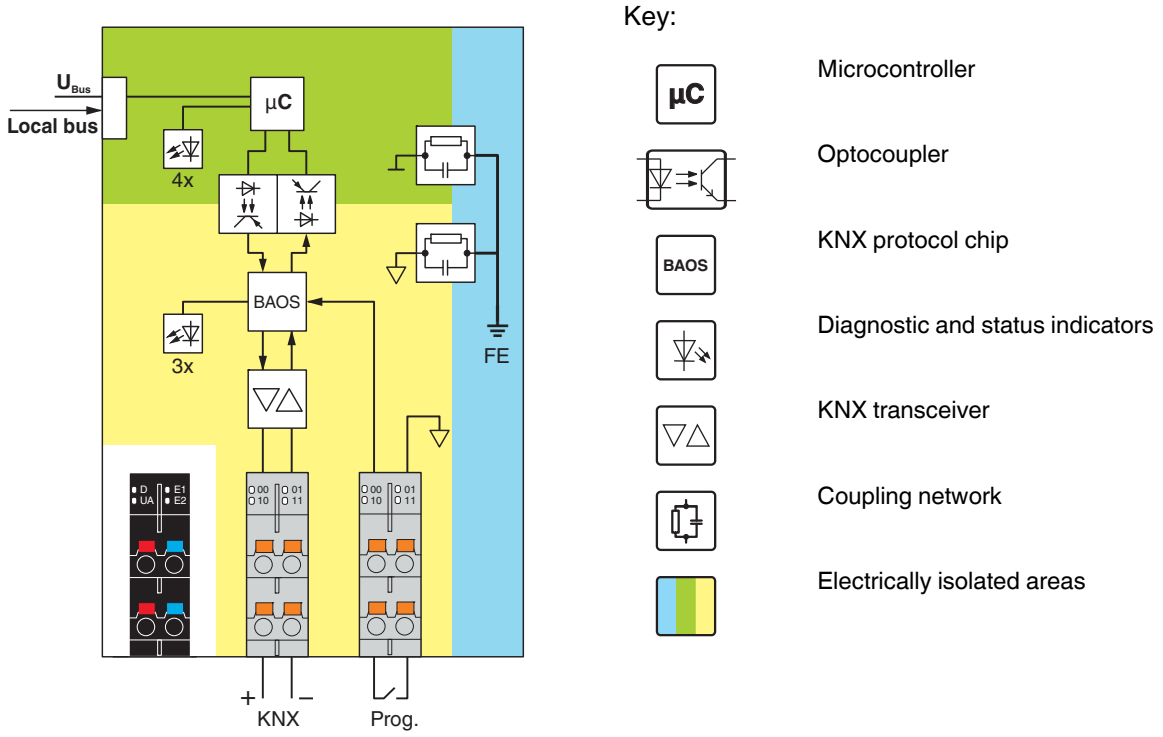


Fig. 1 Internal wiring of the terminal points

6 Terminal point assignment

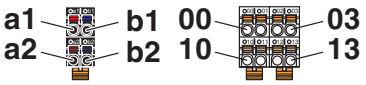


Fig. 2 Terminal point assignment

Terminal point	Color	Assignment	
Connector 1			
a1, a2	Red	Not used (bridged internally)	
b1, b2	Blue	Not used (bridged internally)	
KNX			
00, 10	Orange	KNX+	KNX bus positive (bridged internally)
01, 11	Orange	KNX-	KNX bus negative (bridged internally)
PROG			
02, 12	Orange	PROG	Programming button (bridged internally)
03, 13	Orange	GND_PROG	Reference potential for programming button (bridged internally)

You can use connector 1 for potential routing of the 24 V supply voltage. However the voltage is not used by the module.

6.1 Programming button

At the PROG connector, you can connect a button between PROG and GND for activating and deactivating programming mode. Typically, this connector remains unused and is only bridged once for a short time by the ETS5 for programming.

ETS5 is a PC configuration tool for KNX.

6.2 Programming mode

You can activate or deactivate programming mode by briefly bridging the PROG and GND_PROG connections (approx. 1 second).

When the red PROG LED lights up, the module is in programming mode.

Only press the programming button briefly (for no more than approx. 1 second). If you press the button longer or hold it down, the module will not switch to programming mode. There is also the danger of inadvertently resetting the module to the factory settings.

If the button is pressed while the module is in programming mode, programming mode will be deactivated. However, active programming will be terminated first.

6.3 Reset of KNX settings

It is possible to reset the KNX configuration without ETS5. This may be necessary if the module cannot be reset to the default state with ETS5.

Perform a master reset to reset the module.

- Disconnect the module from the power supply (KNX bus) for a few seconds.
- Connect PROG to GND_PROG and restore the power supply.
- Disconnect the connection between PROG and GND_PROG after at least 3 seconds.

The PROG LED flashes very briefly and around 3 seconds later the module is ready to operate again. All configurations are reset to the default settings. The physical address is now 15.15.255.

7 Connection example

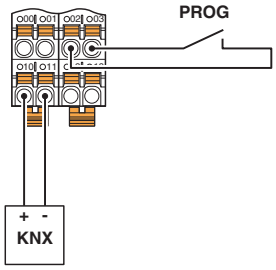


Fig. 3 Typical connection of the KNX bus and the programming button

8 Connection note

The total length of the conductors for connecting the programming button may not exceed 1 meter.

9 Local diagnostic and status indicators

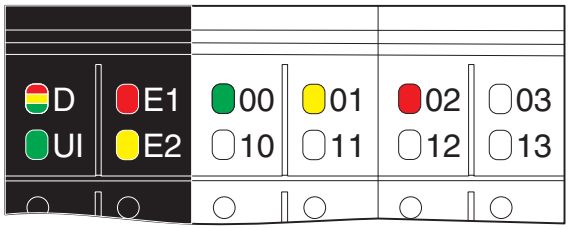


Fig. 4 Local diagnostic and status indicators

Designation	Color	Meaning	State	Description
D	Red/ yellow/ green	Diagnostics of local bus communication		
		Run	Green on	The device is ready for operation, communication within the station is OK. All data is valid. An error has not occurred.
		Active	Green flashing	The device is ready for operation, communication within the station is OK. The data is **not** valid. No valid data provided by the controller/ higher-level network. There is no error on the module.
		Device application not active	Green/yellow flashing	The device is ready for operation, communication within the station is OK. Output data **cannot** be outputted and/or input data **cannot** be read. There is a fault on the periphery side of the module..
		Ready	Yellow on	The device is ready for operation but did not detect a valid cycle after power-up.
		Connected	Yellow flashing	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	Red flashing	The device is ready for operation but there is no connection to the previously existing device.
		Power down	Off	Device is in (power) reset.
UI	Green	U_{Input}	On	Supply voltage is present (supply from U_{Bus}).
			Off	Supply voltage is not present or processor error.
E1	Red	Module error	On	There is an error that affects the entire module.
			Off	There is no module error.
E2	Yellow	Channel error	On	There is a warning that only affects individual channels.
			Off	There is no warning for a channel.
00	Green	KNX Power	On	Voltage is present at the KNX bus.
			Off	Voltage is not present at the KNX bus.
01	Yellow	KNX	On	Data transmission on the KNX bus.
			Off	No data transmission on the KNX bus.
02	Red	PROG	On	The module is in programming mode.
			Off	The module is not in programming mode.

10 Communication with KNX

On the KNX side, the module acts like a normal KNX device. This task is performed by a special chip (BAOS chip). ETS5 is used for the programming on the KNX side.

The BAOS chip is connected to the controller via an electrically isolated, serial connection. Control via the local bus process data largely corresponds to that of the S20-RS-UNI serial terminal block with transparent protocol.
Logical communication with the BAOS chip takes place via the BAOS protocol, which is embedded in FT1.2 data frames for serial transmission.

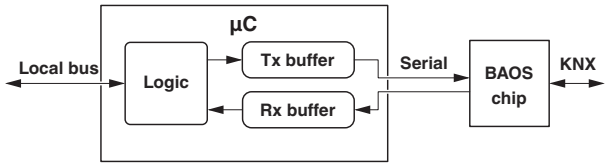


Fig. 5 Communication with KNX

Local bus	Transparent protocol of the S20-RS-UNI
Serial	FT1.2 data frames with BAOS protocol packets as payload

A detailed description of the BAOS and FT1.2 protocols is provided in the “KNX BAOS Binary Protocol” document from WEINZIERL ENGINEERING GmbH.

Bosch Rexroth offers a PLC KNX function library which covers communication (including the FT1.2 protocol) between the application and BAOS. PLC function blocks are also available for the KNX data points.

Auto-Acknowledge

The BAOS chip expects the FT1.2 packets it sent to be acknowledged (Acknowledge byte, $E5_{hex}$). If acknowledgment is not received in good time, the BAOS chip resends the packet (after approx. 50 ms).

To reduce the time pressure on the controller, these acknowledgments for the BAOS chip are generated by the firmware itself. This also effectively prevents BAOS packets being received multiple times. The controller therefore must not and need not acknowledge the FT1.2 packets from the BAOS chip itself.

This Auto-Acknowledge function makes a major difference for the S20-RS-UNI.

11 Mass storage and transmission

The module stores the received serial data in an intermediate buffer until it is requested from the serial interface by the bus controller board or the device.

Serial data traffic is handled via a protocol that is virtually the same as the transparent protocol of the S20-RS-UNI module.

Receive memory	Transmit memory
4 kbytes	1 kbyte

The serial data is forwarded in the same format it is received from the serial interface or from the bus side.

When the receive memory is full, subsequently received characters are discarded. An error pattern is not stored in the receive buffer.

12 Process data

You do not need to parameterize the module. It is set for communication with the BAOS chip.

The module and the higher-level controller exchange data exclusively via the process data channel.

The module has 13 words of process data. These are made up of 3 bytes of frame data and a maximum of 23 bytes of user data.

Assignment of the 13 process data words

Word	0		1		2		...	12	
Byte in the Motorola format	0	1	2	3	4	5	...	24	25
Byte in the Intel format	1	0	3	2	5	4	...	25	24
OUT	K/P	00_{hex}	L	D	D	D	...	D	D
IN	K/P	S	L	D	D	D	...	D	D

K/P Command/parameter

S Status bits

L Length: Number of characters to be written (OUT) or to be read (IN)

D Data

The byte representation in the Motorola format, also called Big Endian (high order byte at starting address) corresponds to the INTERBUS standard representation. All byte representations in the data sheet have this format.

The byte representation in the Intel format is also called Little Endian (low order byte at starting address).

The command is used to determine the function. The actually transmitted data depends on the command.

13 Process data word 0

13.1 Control word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	Command			OUT parameter				Reserved							

Set the reserved bits to 0.

Commands

Code (bin)	Code (hex)	Command
000	0	Read number of characters received and fill level of the receive buffer
001	1	Transmit characters
010	2	Store characters temporarily
011	3	OUT parameter = 0_{hex}: Read characters
		OUT parameter = C_{hex}: Read firmware version
		OUT parameter = E_{hex}: Read counters
100	4	Reserved
101	5	Toggling command 1: Transmit characters
110	6	Toggling command 2: Store characters temporarily
111	7	Toggling command 3: Read characters

Command toggling

Command toggling is used to execute a command on a terminal again. In this way, a second command code is available for the same function.

This applies for the following commands:

- Transmit characters
- Store characters temporarily
- Read characters
- Read counters

Here, bit 14 is used for toggling. If, for example, you wish to transmit character strings in sequence, use command code 001_{bin} for the first transmission and then use 101_{bin} and 001_{bin} alternately.

13.2 Status word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
St	Command			IN parameter				Status bits							

St Error bit

Reasons for an error bit set:

- Invalid parameter for the specified command
- Failure of the I/O voltage (KNX supply voltage)

Status bits

7	6	5	4	3	2	1	0
0	Transmit buffer not empty	Transmit buffer full	Receive buffer full	0	0	0	Receive buffer not empty

Transmit buffer not empty	
Code (bin)	**Meaning**
0	Empty
1	Not empty, transmission in progress

Transmit buffer full	
Code (bin)	**Meaning**
0	Not full
1	Full

Protocol	Meaning: transmit buffer full
Transparent	Space remaining in the transmit buffer ≤ 30 characters

Receive buffer full	
Code (bin)	**Meaning**
0	Not full
1	Full

Protocol	Meaning: receive buffer full
Transparent	Space remaining ≤ 15 characters

Receive buffer not empty	
Code (bin)	**Meaning**
0	Empty
1	Not empty, characters to be read are available

14 Commands

14.1 “Read number of characters received and fill level of the receive buffer” command

For the transparent protocol, the command result is the number of characters that have been received but not yet read.

The number is a 16-bit value and is mapped to word 1.

This command can be used to first reach a minimum number of characters before transmitting the "Read characters" command.

The fill level of the receive buffer is specified in byte 4 as the command result.

Process data assignment for the “Read number of characters received and fill level of the receive buffer” command

Word	0		1		2		...	12	
Byte	0	1	2	3	4	5	...	24	25
OUT	00_{hex}	00_{hex}	xx	xx	xx	xx	...	xx	xx
IN	00_{hex}	Status bits	Number of characters received		Fill level	xx	...	xx	xx

Fill level	
Byte 4	**Number of kbytes free**
00_{hex}	4
01_{hex}	< 3
02_{hex}	< 2
03_{hex}	< 1

14.2 “Transmit characters” command

The transmit data located in the process data is stored in the transmit memory. From there the data is transmitted directly via the interface.

A maximum of 23 characters can be transmitted.

Specify the number of characters to be transmitted in the third byte.

If there are characters in the intermediate buffer, these are transmitted first.

After the command has been executed successfully, the intermediate buffer is cleared.

You must use the “Store characters temporarily” command for packets containing more than 23 characters. This is required in order to ensure correct synchronization with the Auto-Acknowledge function. Otherwise an FT1.2 Acknowledge can squeeze in and destroy the packet.

Process data assignment for the “Transmit characters” command with 23 characters (Z1 - Z23)

Word	0		1		2		...	12	
Byte	0	1	2	3	4	5	...	24	25
OUT	10_{hex}	00_{hex}	23_{dec}	Z1	Z2	Z3	...	Z22	Z23
IN	10_{hex}	Status bits	xx	xx	xx	xx	...	xx	xx

Reasons for an error bit set:

- Byte 2 (number of characters to be transmitted) = 0 or > maximum user data length (23 characters)

14.3 "Store characters temporarily" command

If more than 23 characters are to be transmitted, the transmit data located in the process data is stored in an intermediate buffer which can store up to 340 characters. No characters are transmitted. The “Transmit characters” command is used to transmit temporarily stored data. In this way, blocks of up to 340 characters can be transmitted without a break.

Process data assignment for the “Store characters temporarily” command with 23 characters (Z1 - Z23)

Word	0		1		2		...	12	
Byte	0	1	2	3	4	5	...	24	25
OUT	20_{hex}	00_{hex}	23_{dec}	Z1	Z2	Z3	...	Z22	Z23
IN	20_{hex}	Status bits	xx	xx	xx	xx	...	xx	xx

Reasons for an error bit set:

- Byte 2 (number of characters to be transmitted) = 0 or > maximum user data length (23 characters)
- Not enough space in the intermediate buffer

14.4 "Read characters" command

A maximum of 23 characters can be read.

Process data assignment for the “Read characters” command with 23 characters (Z1 - Z23)

Word	0		1		2		...	12	
Byte	0	1	2	3	4	5	...	24	25
OUT	30_{hex}	00_{hex}	xx	xx	xx	xx	...	xx	xx
IN	30_{hex}	Status bits	23_{dec}	Z1	Z2	Z3	...	Z22	Z23

14.5 "Read counters" command

This command can be used to read several counters. The counters are used for interface diagnostics.

Process data assignment for the “Read characters” command

Word	0		1		2		3		4		5		6	
Byte	0	1	2	3	4	5	6	7	8	9	10	11	12	13
OUT	$3E_{hex}$	00_{hex}	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx	xx
IN	$3E_{hex}$	Status bits	Number of valid characters received		Number of invalid characters received (parity, overrun or framing errors)		Number of characters transmitted		Reserved					

15 Parameter, diagnostics and information (PDI)

Parameter and diagnostic data as well as other information is transmitted as objects via the PDI channel of the IndraControl S20 station.

In IndraWorks, these parameters are displayed in the configurator.

The standard and application objects stored in the module are described in the following section.

The following applies to all tables below:

For an explanation of the data types, please refer to the application description for the IndraControl S20 system, material number R911335988.

Abbreviation	Meaning
A	Number of elements
L	Length of the elements in bytes
R	Read
W	Write

Each visible string is terminated with a null terminator (00_{hex}). The length of a visible-string-type element is therefore at least one byte larger than the number of user data items.
If the number of user data items plus null terminator is smaller than the specified length of the element, the visible string will be populated with a null character (00_{hex}).

For detailed information on PDI objects, please refer to the application description for the IndraControl S20 system, material number R911335988.

16 Standard objects

16.1 Objects for identification (device rating plate)

Index (hex)	Object name	Data type	A	L	Rights	Meaning	Contents
Manufacturer							
0001	VendorName	Visible String	1	32	R	Vendor name	Bosch Rexroth AG
0002	VendorID	Visible String	1	7	R	Vendor ID	006034
0012	VendorURL	Visible String	1	58	R	Vendor URL	http://www.boschrexroth.com
Module - general							
0004	DeviceFamily	Visible String	1	20	R	Device family	I/O function module
0006	ProductFamily	Visible String	1	32	R	Product family	IndraControl S20
000E	CommProfile	Visible String	1	4	R	Communication profile	634
000F	DeviceProfile	Visible String	1	5	R	Device profile	0010
0011	ProfileVersion	Record of Visible Strings	2	11; 21	R	Profile version	2018-04-19; Basic profile V3.0
0017	Language	Record of Visible Strings	2	6; 8	R	Language	en-us; English
Module - special							
0005	Capabilities	Array of Visible Strings	1	8	R	Capabilities	FwUpdt0
0007	ProductName	Visible String	1	32	R	Product name	S20-KNX-1
0008	SerialNo	Visible String	1	22	R	Serial number	xx xx xx xx xx xx xx x (e. g., 7602012346BC125)
0009	ProductText	Visible String	1	58	R	Product text	KNX interface
000A	OrderNumber	Visible String	1	32	R	Order No.	R911174966
000B	HardwareVersion	Record of Visible Strings	2	11; 11	R	Hardware version	e.g., 2013-04-26; AA1
000C	FirmwareVersion	Record of Visible Strings	2	11; 11	R	Firmware version	e.g., 2017-07-14; 100
000D	PChVersion	Record of Visible Strings	2	11; 11	R	PDI version	e. g., 2010-06-21; V1.00
0037	DeviceType	Octet string	1	8	R	Device type	0802 0014 0000 $00B5_{hex}$
003A	VersionCount	Array of UINT16	4	4 * 2	R	Version counter	e.g. 0009 0002 0001 0100_{hex}
003D	WakeUpTime	UINT16	1	2	R	Start time until ready to operate in ms	500
Use of the device							
0014	Location	Visible String	1	58	R/W	Location	Can be completed by the user.
0015	EquipmentIdent	Visible String	1	58	R/W	Equipment identifier	Can be completed by the user.
0016	ApplDeviceAddr	UINT16	1	2	R/W	Application device address	Can be completed by the user.

16.2 Miscellaneous standard objects

Index (hex)	Object name	Data type	A	L	Rights	Meaning/contents	Startup parameters	
Diagnostics objects								
0018	DiagState	Record	1 1	123	R	Diagnostic state	No	*
Objects for process data management								
0025	PDIN	Octet string	1	20	R	Input process data	No	*
0026	PDOUT	Octet string	1	20	R	Output process data	No	*
Objects for parameter channel management								
0021	PChTimeout	UINT16	1	2	R/W	Parameter channel monitoring time, 500 ms	No	

The objects marked in the last column with an * are described in more detail in the next sections.

The description of the other objects is to be found in the application description for the IndraControl S20 system, material number R911335987.

16.3 Diagnostics objects

Diagnostics state (0018_{hex}: DiagState)

This object is used for a structured message of an error.

0018_{hex}: Diagnostics state (read)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
00	Record	Max. 123	Diagnostic state	Current diagnostic state of the device in short form	
01	UINT16	2	Error number	0 ... 65535_{dec}	
02	UINT8	1	Priority	00_{hex}	No error
				01_{hex}	Error
				02_{hex}	Warning
				81_{hex}	Error removed
				82_{hex}	Warning eliminated
03	UINT8	1	Channel	00_{hex}	No error
				01_{hex}	Channel 1
				FF_{hex}	entire device
04	UINT16	2	Error code	See table below	
05	UINT8	1	More follows	00_{hex}	
06	Octet string	2	Reserved	0000_{hex}	
07	UINT8	1	Submodule number	00_{hex}	
08	Octet string	8	Function group	GENERAL, TX, RX	
09	Octet string	4	More follows	0000 0000_{hex}	
0A	UINT8	1	Text length	Length of the following diagnostic text in bytes	
0B	Visible String	Max. 99 + 1	Diagnostic text	See table below	

The message with priority 81_{hex} or 82_{hex} is a one-off, internal message to the bus coupler. The bus coupler transfers this error message to the error mechanisms of the higher-level system.

After all errors have been eliminated, it is automatically reset.

Error and status of the local diagnostics and status indicators

Subindex	**02**	**03**	**04**	**08**	**0B**							
Error	**Priority**	**Channel**	**Error code**	**Function group**	**Text**	**LED**						
	hex	**hex**	**hex**			**D**	**UI**	**E1**	**E2**	**00**	**01**	**02**
No error	00	00	0000	GENERAL	Status OK	◐	●	○	○	X	X	X
Receive buffer full	02	01	815A	RX	Rx buffer full	◐	●	○	●	X	X	X
Transmit buffer full	02	01	8152	TX	Tx buffer full	◐	●	○	●	X	X	X
No KNX supply	02	01	3402	GENERAL	No external KNX bus supply	◐	●	○	●	○	○	○
Device error	01	FF	6100	GENERAL	Firmware checksum error! Execute firmware update	☼	●	●	○	X	X	X

Key:

X	The LED is not affected by this error.		
○	Off	◐	Green on
●	On	☼	Flashing green/yellow

16.4 Objects for process data management

16.4.1 IN process data (0025_{hex}: PDIN)

You can read the IN process data of the module with this object.

The structure corresponds to the representation in the "Process data" section.

0025_{hex}: IN process data (read)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Octet string	26	Input process data

16.4.2 OUT process data (0026_{hex}: PDOUT)

You can read or write the OUT process data of the module with this object.

The structure corresponds to the representation in the "Process data" section.

0026_{hex}: OUT process data (read)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Octet string	26	Output process data

17 Device descriptions

The device is described in the device description files. These files are available for download at www.boschrexroth.com/electrics in the download area of the bus coupler used.

DOK-CONTRL-S20*KNX*1**-DA01-EN-P

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