S20 special function module
SSI input and analog output

R911339283
Edition 03

Data sheet S20-SSI-AO-1/1

1 SSI interface for absolute encoders
1 analog output
0 - 10 V, ± 10 V, 0 - 5 V, ± 5 V
0 - 20 mA, 4 - 20 mA, ± 20 mA

08 / 2024

1 Description

The module is designed for use within an S20 station.
It is used to acquire data from absolute encoders with SSI interface with a maximum resolution of up to 56 bits.
The module supports encoders with gray and binary code.
Transmission speeds of up to 2 MHz are supported.
In addition, the module has an analog output which allows for specifying setpoints, e.g., for electrical and hydraulic drives.

Features

- Permanent surge protection against 24 V DC for all interfaces
- Permanent short-circuit protection for all interfaces
- 1 SSI interface
- Monitoring of the 24 V encoder supply
- Supports transmission speeds from 62.5 kHz to 2 MHz for SSI
- 8 -bit ... 56 -bit resolution
- Supports Gray and binary code
- 1 analog, bipolar output channel for the connection of either voltage or current signals
- Connection of actuators in 2-conductor technology
- Voltage ranges: 0 V ... 10 V, ±10 V, 0 V ... 5 V, ±5 V
- Current ranges: 0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA
- Device rating plate stored

This data sheet is only valid in association with the application description for the 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.
S20 special function module SSI input and analog output	S20-SSI-AO-1/1	R911172544	1

Accessories	Type	MNR	Pcs./Pkt.
S20 bus base module, narrow	S20-BS-S	R911173203	5
S20 Shield set	S20-SHIELD-SET	R911173030	1
Shield connection clamps, for shield on busbars, for conductor diameters ≤ 5 mm, contact resistance < 1 mΩ	S20-SHIELD-SK5	R911173282	10
Shield connection clamps, for shield on busbars, for conductor diameters ≤ 14 mm, contact resistance < 1 mΩ	S20-SHIELD-SK14	R911173286	10
PEN conductor busbar, 3x10 mm, length: 1000 mm	S20-SHIELD-NLS	R911173283	1

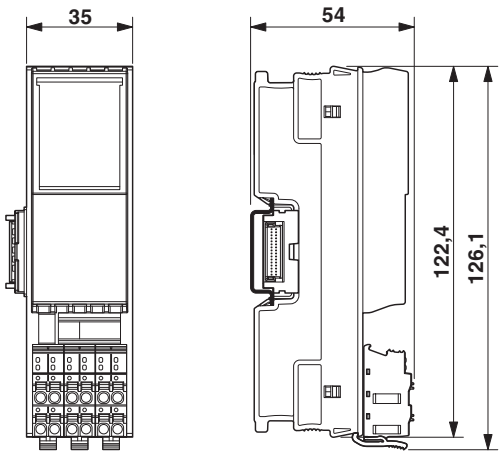
Documentation	Type	MNR	Pcs./Pkt.
Application description S20: System and Installation	DOK-CONTRL- S20*SYS*INS-AP..-EN-P	R911335988	1
Application description S20: Error Messages	DOK-CONTRL- S20*DIAG*ER-AP..-EN-P	R911344826	1

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 applies when a TH 35-7.5 DIN rail is used (in accordance with EN 60715).

General data	
Color	Housing: light gray (RAL 7035)
Weight	135 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)
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)
Overvoltage category	II (IEC 60664-1, EN 60664-1)
Degree of pollution	2 (IEC 60664-1, EN 60664-1)
Mounting type	DIN rail mounting
Mounting position	any (no temperature derating)

Connection data: S20 connector	
Connection method	Push-in connection
Conductor cross section, rigid	0.2 mm² ... 1.5 mm²
Conductor cross section, flexible	0.2 mm² ... 1.5 mm²
Conductor cross section [AWG]	24 ... 16
Stripping length	8 mm

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

Interface: Local bus	
Number of interfaces	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 consumption	max. 140 mA
Power consumption	max. 0.7 W

Feed-in of supply voltage (U_I)	
Supply voltage	24 V DC
Supply voltage range	19.2 V DC ... 30 V DC (including all tolerances, including ripple)
Current consumption	max. 60 mA (Supply of the SSI interface and the analog output (20 mA), without sensor supply)
Power consumption	max. 1.4 W (Supply of the SSI interface and the analog output (20 mA), without sensor supply)
Surge protection	electronic (35 V, 0.5 s)
Reverse polarity protection	Polarity protection diode
Transient protection	Suppressor diode

SSI interface	
Number	1
Connection method	Push-in connection
Connection technology	4-wire, shielded twisted pair cable
Description of the input	RS-422 interface in accordance with SSI specification
Encoder signals	Single-turn and multi-turn encoder, length measuring sticks
Clock frequency	to 2 MHz (Can be parameterized: 62.5 kHz, 125 kHz (default), 250 kHz, 500 kHz, 1 MHz, 2 MHz)
Parity	Even, odd or no parity
Resolution	8 ... 56 bit
Coding	Gray code, Binary code
Process data update	Depending on the encoder, clock frequency and data length used.
Surge protection	Electronic (35 V, permanent)
Short-circuit and overload protection	electronic
Transient protection	Shielding

Encoder supply	
24 V encoder supply	
Nominal output voltage	24 V DC (U_I - 0.5 V)
Voltage range	19.5 V DC ... 30 V DC (including all tolerances, including ripple)
Current carrying capacity	max. 500 mA
Surge protection	electronic (35 V, 0.5 s)
Short-circuit/overload protection	electronic
Transient protection	Shielding

Analog outputs	
Number of outputs	1
Connection method	Push-in connection
Connection technology	2-conductor (shielded, twisted pair)
Current output signal	0 mA ... 20 mA, 4 mA ... 20 mA, -20 mA ... 20 mA
Voltage output signal	0 V ... 5 V, -5 V ... 5 V, 0 V ... 10 V, -10 V ... 10 V
D/A converter resolution	16 bit
D/A conversion time	5 µs
Representation of output values	16 bits (15 bits + sign)
Data formats	IB IL, standardized representation
Load/output load current output	max. 500 Ω
Load/output load voltage output	> 2 kΩ
Tolerance, relative	typ. 0.1 % (of output range final value) see tables for tolerance values
Tolerance, absolute	see tables for tolerance values
Permissible cable length	max. 250 m
Surge protection	Electronic (35 V, permanent)
Short-circuit and overload protection	electronic
Transient protection	Suppressor diode

Input and output address area	
Input address area	12 Byte
Output address area	12 Byte

Configuration and parameter data in a PROFIBUS system	
Required parameter data	29 Byte
Required configuration data	7 Byte

Electrical isolation/isolation of the voltage areas	
Test section	**Test voltage**
Logic	500 V AC, 50 Hz, 1 min.
SSI I/O (24 V supply)	500 V AC, 50 Hz, 1 min.
Functional ground	500 V AC, 50 Hz, 1 min.
Analog I/O	500 V AC, 50 Hz, 1 min.

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

Conformance with EMC Directive 2014/30/EU	
Immunity test in accordance with EN IEC 61000-6-2	
Electrostatic discharge (ESD) IEC 61000-4-2	Criterion B, ±6 kV contact discharge, ±8 kV air discharge
Electromagnetic fields IEC 61000-4-3	Criterion A, Field intensity: 10 V/m
Fast transients (burst) IEC 61000-4-4	Criterion B, ±2 kV
Transient overvoltage (surge) IEC 61000-4-5	Criterion B, DC supply lines: ±0.5 kV/±1.0 kV (symmetrical/ unsymmetrical), ±1.0 kV to shielded I/O cables
Conducted interference IEC 61000-4-6	Criterion A, Test voltage 10 V
Noise emission test in accordance with EN IEC 61000-6-3	Class B

Approvals

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

5 Tolerance data

Tolerances at T_A = +25°C				
	Absolute tolerance		Relative tolerance	
	Typ.	Max.	Typ.	Max.
0 V ... 10 V, ±10 V	±10 mV	±30 mV	±0.1 %	±0.3 %
0 V ... 5 V, ±5 V	±5 mV	±15 mV	±0.1 %	±0.3 %
0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA	±20 µA	±60 µA	±0.1 %	±0.3 %

Typical data contains offset error, gain error, and linearity error in the respective default setting.

All tolerances indicated as a percentage are related to the positive output range final value.

The data is valid for nominal operation (U_I= 24 V) in the default configuration.

Default configuration: IB IL format

Please also observe the values for temperature drift and the tolerances under influences of electromagnetic interferences.

The maximum tolerance values represent the worst case measurement inaccuracy. Besides maximum offset and gain drift, they also comprise longtime drift as well as the maximum tolerances of the test and calibration equipment.

For the voltage output, load resistors up to 1 kΩ with an additional 0.3% tolerance can be connected.

Tolerance and temperature response at T_A = -25 °C ... +60 °C		
	Drift	
	Typical	Maximum
0 V ... 10 V, ±10 V	±15 ppm/K	±50 ppm/K
0 V ... 5 V, ±5 V	±15 ppm/K	±50 ppm/K
0 mA ... 20 mA, 4 mA ... 20 mA, ±20 mA	±15 ppm/K	±50 ppm/K

The drift values refer to the relevant output range final value.

The values refer to nominal operation with default settings.

Additional tolerances influenced by electromagnetic interference		
Electromagnetic fields	EN 61000-4-3/ IEC 61000-4-3	< 1.7 %
Fast transients (burst)	EN 61000-4-4/ IEC 61000-4-4	0 %
Conducted interference	EN 61000-4-6/ IEC 61000-4-6	0 %

All tolerances indicated as a percentage are related to the positive output range final value.

Additional tolerances may occur due to the influence of high-frequency electromagnetic interference caused by wireless transmission systems in the immediate vicinity. The specified values refer to nominal operation. The components are directly exposed to interference without the use of additional shielding measures (e.g., steel cabinet).
The tolerances specified above can be reduced through additional shielding for the I/O module (e.g., use of a shielded control box/control cabinet, etc.).

6 Signal rise times

Voltage step 0 V ... 10 V (typical values)

Load	Time for 0 % ... 99 %
R_L = 2 kΩ	25 µs
R_L = 2 kΩ II C_L = 10 nF	25 µs
R_L = 2 kΩ II C_L = 220 nF	175 µs
R_L = 2 kΩ + L_L = 3 mH	30 µs

Current step 0 mA ... 20 mA (typical values)

Load	Time for 0 % ... 99 %
R_L = 500 Ω	40 µs
R_L = 500 Ω II C_L = 10 nF	65 µs
R_L = 500 Ω II C_L = 220 nF	600 µs
R_L = 500 Ω + L_L = 3 mH	40 µs

Key to the tables

R_L	Ohmic load
C_L	Capacitive load
L_L	Inductive load
II	Parallel connection
+	Serial connection

7 SSI cable lengths

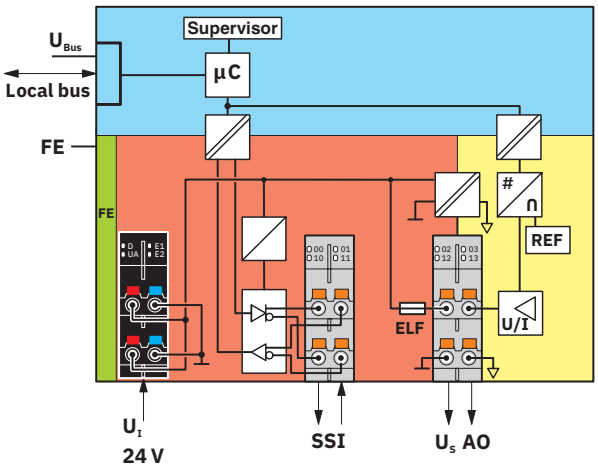
Clock frequency	Maximum cable length [m]
2 MHz	8
1 MHz	25
500 kHz	75
250 kHz	200
125 kHz	300
62.5 kHz	500

Reference cable: LIYCY(TP) 2*2*0.5 mm², 0.67 mH/km, 120 nF/km (between the wires)

The maximum cable length also depends on the encoder. Therefore, please also observe the information on the encoder used.

8 Internal circuit diagram

Fig. 1 Internal wiring of the terminal points



Key:

Local bus	Local bus
FE	Functional ground
Supervisor	Hardware monitoring
µC	Microcontroller
	Electrical isolation for data or power supply
	Power supply unit
# ∩	Digital/analog converter
U/I	Output level for current (I) or voltage (U)
REF	Reference voltage source
	Analog I/O reference ground
	Reference ground of supply voltage U_I
	RS-422 interface
	Electronic fuse
	Electrically isolated areas

9 For your safety

9.1 Intended use

Only use S20 modules in accordance with the information in this data sheet and in the application description for the S20 system, material number R911335988.

If the equipment is used in a manner not specified, the protection provided by the equipment may be impaired.

9.2 Qualification of users

The use of products described in this data sheet is oriented exclusively to electrically skilled persons or persons instructed by them. The users must be familiar with the relevant safety concepts of automation technology as well as applicable standards and other regulations.

9.3 Electrical safety

WARNING **Loss of electrical safety**

If used incorrectly, device safety may be impaired.

During installation, startup, and operation, observe the notes in this data sheet and the specifications in the application description for the S20 system, material number R911335988.

9.4 Installation

Only install the S20 modules in a control cabinet or junction box.

CAUTION: Fire hazard

- The device must be installed in the final protective housing, which provides sufficient resistance to mechanical strain and protection against the spreading of fire in accordance with the standards UL/IEC/EN 61010-1 and UL/IEC/EN 61010-2-201.
- The supply and external circuits intended to be connected to this device shall be galvanically separated from the mains supply or hazardous live voltage by reinforced or double insulation and meet the requirements of SELV/PELV (Class III) circuits of UL/CSA/IEC/EN 61010-1, UL/CSA/IEC/EN 61010-2-201.

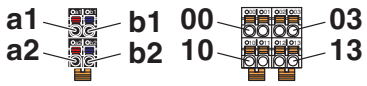
NOTICE **Damage to contacts or malfunction**

Physical overloads can result in damage to the terminal points.

- Relieve strain in the connected cables.

10 Terminal point assignment

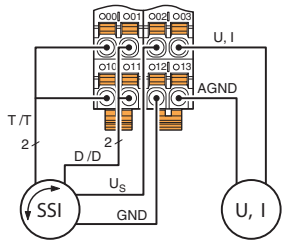
Fig. 2 Terminal point assignment



Terminal point	Color	Assignment	
Supply voltage input			
a1, a2	Red	24 V DC (U_I)	Feed-in encoder/analog supply (bridged internally)
b1, b2	Blue	GND	Reference potential of the supply voltage (bridged internally)
SSI interface			
00	Orange	T	Clock
10	Orange	/T	Clock inverted
01	Orange	D	Data
11	Orange	/D	Data inverted
02	Orange	U_S	24 V encoder supply
12	Orange	GND U_S	Reference potential for 24 V encoder supply
Analog output			
03	Orange	U/I	Analog output voltage/current
13	Orange	AGND	Reference potential for analog output

11 Connection example

Fig. 3 Example connection of an SSI sensor and an analog actuator for current or voltage



12 Connection notes

NOTE **Damage to the electronics/measuring error**

Always connect the analog actuators using shielded twisted-pair cables.

Unshielded cables may lead to values outside the specified tolerance limits in environments subject to heavy noise.

For installation in a control cabinet: Connect the cable shield to the functional ground at a suitable point immediately after entry into the control cabinet. Route the cable in the control cabinet in a shielded manner.

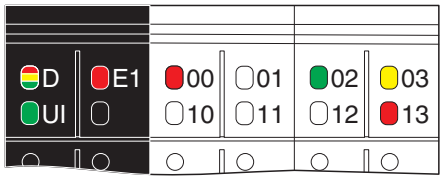
If a closed control cabinet is not available, connect the shield to a shield bus.

For the best possible connection directly in front of the module, use the S20 SHIELD-SET shield connection set (R911173030) in combination with the S20-SHIELD-NLS busbar (R911173283).

For more information on shielding, please refer to the application description for the S20 system, material number R911335988.

13 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	Flashing green	The device is ready to operate, communication within the station is OK. The data is **not** valid. The controller or higher-level network is not delivering valid data. There is no error on 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 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	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	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	Encoder/analog supply is present.
			Off	Encoder/analog supply not present.
E1	Red	Group error	On	U_I supply not present or Error of the SSI interface, the encoder supply or the analog output.
			Off	No error
00	Red	SSI error	On	SSI error occurred.
			Off	No error
02	Red/green	Encoder supply	Green on	Encoder supply is OK.
			Red on	Short circuit or overload of the encoder supply
			Off	Encoder supply not present.
03	Yellow	Output status	On	Analog output value ≥ 5% of positive measuring range final value
			Off	Analog output value is < 5% of the positive measuring range final value
13	Red	Diagnostics of the output	On	Wire break/short circuit/overload of the output.
			Off	No error

14 Function description of the SSI interface

The SSI interface is a unidirectional serial interface for an absolute encoder.

The interface has the following features which can be parameterized using the process data or the PDI channel:

Function	Value
Resolution of the SSI encoder in bits	8 bits to 56 bits
Clock frequency of the SSI encoder	62.5 kHz, 125 kHz (default), 250 kHz, 500 kHz, 1 MHz, 2 MHz
Parity of the encoder signal	None (default)
	Even
	Odd
Coding	Binary (default)
	Gray
Other functions that can be parameterized	Number of status bits in the encoder signal
	Encoder signal in standard or fir-tree format
	Error message after one error or after up to three errors depending on the parameterization
	Size of the entire frame in fir-tree format
	Low byte position in the data frame in fir-tree format
	Encoder monitoring on/off
	Inverted or normal encoder signal direction
	Gear ratio
	Offset for the position value
	In the event of an error: Hold last position / transmission of substitute value / output of zero value output / output of final value
Other functions	Resetting position to zero via process data

For the parameters, please refer to the encoder data sheet. They may also result from the application.

Specify the parameterization using the PDI objects. The objects are described beginning in Section „Parameters, diagnostics and information PDI".

The parameters are stored in the module. After a module reset they are loaded automatically.

14.1 Description of SSI functions

Reading the position value

The position is read cyclically from the encoder via the SSI interface.

The time period for reading the position value is determined by the data bits to be transmitted and the encoder transmission speed.

The data is transmitted via two differential clock lines and two differential data lines. The first clock serves to accept the current position and the following clocks serves to transmit it to the module.

The speed the data is transmitted from the encoder to the module depends on the parameterized transmission speed and the cable length between the encoder and module.

Zero position

To define a zero position, the current position can be set to zero using the process data bit.

To exactly define the zero position, the axis must be fix and the position must not change.

When setting a position to zero, the current position is read from the encoder and subtracted from the current position value. This is done automatically. Setting to zero is independent of the offset.

To verify the zero value it can be read back using object 0083_{hex} (ZeroOffset). This function corresponds to a digital set input of an encoder.

Since not all encoders have this type of input, you can also specify the zero position via the set bit.

The position is only set to zero, if the set bit changes from 0 to 1. Prior to the next set process, first set the bit to 0 again.

Direction of travel or rotation

You can invert the direction of travel or rotation of the encoder. This inverts the physical direction of rotation of the encoder. Use the ParaTable (0080_{hex}) object for parameterization.

Offset for the position value

You can specify an offset for the position value. This value is added to the absolute value read from the encoder. The maximum offset value size is 2^{56}-1. Parameterize the offset using the ParaTable (0080_{hex}) object.

Gear ratio

A gear ratio can be specified for the position value. It allows for position conversion, e.g., into centimeters [cm] or degrees [°]. The converted value is transmitted in the input data.

Always specify the offset in relation to the gear ratio.

The gear ratio consists of a numerator and denominator, each with a size of 16 bits.

Parameterize the gear ratio using the ParaTable (0080_{hex}) object. Observe that division by zero is not permitted. Do not use 0 as the denominator of the gear ratio. This would lead to a parameterization error.

Make sure that the gear ratio always is ≤1.

Gray or binary code

The module connects to encoders that provide an absolute value in binary code or in gray code. The value transmitted via the process data always is binary encoded. The values is converted in the module. Parameterize the code used by the encoder via the ParaTable (0080_{hex}) object.

Fir-tree format

The module also supports reading of encoded absolute values in fir-tree format. The user data is arranged with an offset in the data frame. The frame is filled with leading and trailing zeros.

Example:

<table>
<tr><td colspan="13">29-bit data frame</td></tr>
<tr><td>0</td><td>...</td><td>0</td><td>m8</td><td>...</td><td>m1</td><td>s10</td><td>...</td><td>s1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
<tr><td colspan="3" rowspan="2"></td><td colspan="3">8 bit multi-turn</td><td colspan="3">10 bit single-turn</td><td colspan="4" rowspan="2">4-bit position offset</td></tr>
<tr><td colspan="6">18-bit position value</td></tr>
</table>

To interpret the fir-tree format correctly it is useful to specify the length of the data frame as well as the offset of the user data within the frame in addition to the encoding and resolution of the encoder (length of position value).
This information is not required if transmission of the position value is right-aligned and not in fir-tree format.

Status bits

The module supports transmission of up to eight status bits of the encoder. The module reads these bits and maps them in the input process data.

Mapping of the status bits is right-aligned in the provided area of the IN process data.

The module itself does not evaluate the status information but forwards it without processing.

It is then added to the specified data frame size and received from the encoder. By default, there are no status bits.

During module parameterization specify the number of status bits using the ParaTable (0080_{hex}) object.

If you have parameterized a reverse rotation, this refers only to the position data.

Example:

<table>
<tr><td colspan="3">28-bit data frame</td><td colspan="4">Status bits</td></tr>
<tr><td>D</td><td>...</td><td>D</td><td>S</td><td>S</td><td>S</td><td>S</td></tr>
</table>

14.2 SSI interface and encoder diagnostics

Parity check

The module can be parameterized to automatically perform a parity check of the position value. ODD and EVEN modes are supported. During the parity check, the number of ones in the position value are counted. Depending on the mode, an even number of ones results in a parity bit of 1 (EVEN) or 0 (ODD). The encoder attaches the parity bit to the position as a bit.

In the module, the parity bit obtained is compared to the calculated parity. If the two values differ, a diagnostic message is transmitted to the controller after one to three consecutive parity errors (according to the parameterization).

The NON option deactivates the parity check.

Choose the parity check mode according to the information in the encoder data sheet.

Example for parity calculation in EVEN mode:

28-bit data frame	Parity bit
0001011010000111100001110010	1

12 * 1 = 12 ⇒ Even number ⇒ Parity = 1

Received in the parity bit: 1

Correct parity value.

28-bit data frame	Parity bit
0001011010000111100001110010	0

12 * 1 = 12 ⇒ Even number ⇒ Parity = 1

Received in the parity bit: 0

Parity error

Number of parity errors allowed

This parameter is only applicable if the parity check is active. Use this parameter to determine the number of consecutive parity errors before the "SSI error" status bit is set and a diagnostic message is transmitted. Depending on the parameterization a diagnostic message is generated after one error or up to three consecutive errors.

For the application, this means that as long as the number of permissible consecutive parity errors is not exceeded, a diagnostic message is not triggered. The last position value in the process data received without errors is retained until the next valid value is received.

If permitted by the application, this parameter can be used to artificially make the transmission path to the SSI encoder, in harsh EMC environments, less sensitive and thus increase system availability.

Encoder not connected/wire break

The data signal immediately before and after data exchange monitors whether an encoder is connected properly, whether there is a wire break, or whether no encoder is connected. Before data exchange, the signal must be HIGH (idle state or inactive state) and immediately after data exchange it must be LOW. If not, there is an encoder error and the associated diagnostic message is generated.

The SSI standard permits that the encoder behavior differs. This means that monitoring can be deactivated in the parameterization using a bit.

Monitoring should also be deactivated if no encoder is connected and if only the AO channel of the module is to be used.

Substitute value behavior

A substitute value behavior can be parameterized for the event of an error on the SSI channel. In the event of an error the substitute value is transmitted in the IN process data as the position value.

Parmameterize the behavior using the PF_Code (0030_{hex}) object and the substitute value using the PDIN_Subst (0031_{hex}) object. The substitute value behavior and the parameterized substitute value are stored in the module and loaded again after power-up.

In addition to the substitute value a diagnostic bit is set in the process data and the corresponding diagnostic code is reported via the error mechanism of the bus system.

For all errors relating the the SSI channel the substitute value is loaded into the process data.

15 Function description of the analog output

The analog output can be parameterized as current or voltage output.

The resolution of the analog values is 16 bits (15 bits + sign bit).

Depending on the parameterization, the values are either specified in IB IL format or standardized representation.

If the module is operated as an AO module and no SSI encoder is connected to it, the SSI channel parameters must be parameterized in order for error monitoring to be deactivated. This ensures that a missing encoder is not interpreted as an error.

For the parameterization options for the AO channel, please refer to Section “Parameter table (0080_{hex}: ParaTable)”.

Substitute value behavior

The behavior of the output in the event that process data is missing can be parameterized for the analog output.

Parameterize the behavior using the ResetCode object (0024_{hex}) and the substitute value using the PD-Out_Subst object ($002F_{hex}$) object.

The parameterized behavior and the parameterized substitute value are not stored in the module. The zero value is always output when starting up. If the zero value should not be output in the event of a reset, reparameterize the reset behavior after every module restart.

16 Process data

The module uses six words of IN process data and six words of OUT process data.

The process data consists of the process data for the SSI channel and the process data for the analog output.

The following data is transmitted in the OUT process data:

- SSI SetZero bit used for setting the position to zero
- Analog output value

The following data is transmitted in the input process data:

- Status information of the SSI channel
- Current position read
- Current analog output value or a corresponding error code

16.1 OUT process data

MSB															LSB
Word 0															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Reserved								Reserved							SSI-SetZero
Word 1															
Reserved															
Word 2															
Reserved															
Word 3															
Reserved															
Word 4															
Reserved															
Word 5															
Analog value (AO output data)															

Specify the analog output value in the selected format.

The SSI-SetZero bit is used to set the current position to 0. The position is set to zero when the bit changes from 0 to 1. If the position is to be set to 0 again, the SSI-SetZero bit must first be reset to 0.

The output value has the following structure:

V	Analog value

Key:

V	Sign bit

In the IB IL format a diagnostic code is mapped to the input data in the event of an error.

Code (hex)	**Cause**
8002	Wire break
8003	Short-circuit
8010	Parameter table invalid
8020	Faulty supply voltage
8040	Device faulty

16.2 IN process data

MSB															LSB
Word 0															
15	**14**	**13**	**12**	**11**	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
SSI status 7	SSI status 6	SSI status 5	SSI status 4	SSI status 3	SSI status 2	SSI status 1	SSI status 0	SSI error	Reserved					SSI SetZeroDone	SSI inverted
Word 1															
SSI position of word 3															
Word 2															
SSI position of word 2															
Word 3															
SSI position of word 1															
Word 4															
SSI position of word 0															
Word 5															
Analog value (AO output data) or error															

Meaning of the bits

Name	**Meaning**	
SSI error	These bits indicate the error state of the channel.	
	= 0:	Channel without errors
	= 1:	Error
SSI SetZeroDone	= 1:	The position has successfully been set to 0 after the SSI-SetZero bit in the OUT process data was set from 0 to 1. The bit remains set until the SSI-SetZero bit in the OUT process data is reset to 0.
SSI inverted	This bit indicates if the SSI direction of travel or rotation was inverted.	
	= 0:	Not inverted
	= 1:	Inverted
SSI status x (x = 0 ... 7)	Encoder status bits. You only need to take these bits into consideration if the encoder status bits have been parameterized. Bits that are not used equal 0. The encoder status bits are represented just as they were received (left-aligned).	

The current position read from the encoder is represented in word 1 to word 4 of the input process data (right-aligned). The module can be used to read encoders with an 8-bit to 56-bit resolution. If the resolution is less than 56 bits, the position is represented right-aligned and unused bits are filled with 0.

Word 1 is the high word of the position and bit 15 the most significant bit.

Word 4 is the low word of the position and bit 0 the least significant bit of the position.

The position is always represented as a 64-bit value; the nine most significant bits are always 0.

In word 5 of the IN process data the analog output value is mirrored from the OUT process data, or a corresponding error code is indicated (see error codes of the analog channel [for the Inline format only]).

The analog value is represented with 15 bits plus sign bit. Representation is left-aligned.

17 Significant values

17.1 Significant values in IB IL format

Output data		0 V ... 10 V	±10 V	0 V ... 5 V	±5 V	0 mA ... 20 mA	±20 mA	4 mA ... 20 mA
hex	dec	V	V	V	V	mA	mA	mA
7FFF ... 7F01		+10.837	+10.837	+5.419	+5.419	+21.6747	+21.6747	+21.3397
7F00	32512	+10.837	+10.837	+5.419	+5.419	+21.6747	+21.6747	+21.3397
7530	30000	+10.0	+10.0	+5.0	+5.0	+20.0	+20.0	+20.0
3A98	15000	+5.0	+5.0	+2.5	+2.5	+10.0	+10.0	+12.0
0001	1	+333.33 µV	+333.33 µV	+166.67 µV	+166.67 µV	+0.6667 µA	+0.6667 µA	+4.0005333
0000	0	0	0	0	0	0	0	+4.0
FFFF	-1	0	-333.33 µV	0	-166.67 µV	0	-0.6667 µA	+4.0
C568	-15000	0	-5.0	0	-2.5	0	-10.0	+4.0
8AD0	-30000	0	-10.0	0	-5.0	0	-20.0	+4.0
8100	-32512	0	-10.837	0	-5.419	0	-21.6747	+4.0
80FF ... 8000 *		Hold last value	Hold last value	Hold last value	Hold last value	Hold last value	Hold last value	Hold last value
8001	Overrange	+10.837	+10.837	+5.419	+5.419	+21.6747	+21.6747	+21.3397
8002	Wire break	Hold last value	Hold last value	Hold last value	Hold last value	Hold last value	Hold last value	0
8080	Underrange	0	-10.837	0	-5.419	0	-21.6747	Hold last value

* Without 8001, 8002, 8080

17.2 Significant values in standardized representation format

Output data		0 V ... 10 V	±10 V	0 V ... 5 V	±5 V	0 mA ... 20 mA	±20 mA	4 mA ... 20 mA
hex	dec	V	V	V	V	mA	mA	mA
8001	Overrange (output)	+10.837	+10.837	+5.419	+5.419	+21.674	+21.674	+21.3397
7FFF ... 54AB	-	+10.837	+10.837	+5.419	+5.419	+21.674	+21.674	+21.3397
54AA	21674	+10.837	+10.837	+5.419	+5.419	+21.674	+21.674	+21.3397
4E20	20000	+10.837	+10.837	+5.419	+5.419	+20.0000	+20.0000	+21.3397
3E80	16000	+10.837	+10.837	+5.419	+5.419	+16.000	+16.000	+20.0000
2710	10000	+10.0000	+10.0000	+5.419	+5.419	+10.0000	+10.0000	+14.000
1388	5000	+5.0000	+5.0000	+5.0000	+5.0000	+5.0000	+5.0000	+9.000
0001	1	+0.001	+0.001	+0.001	+0.001	+0.001	+0.001	+4.001
0000	0	0	0	0	0	0	0	+4.000
FFFF	-1	0	-0.001	0	-0.001	0	-0.001	+4.000
EC78	-5000	0	-5.000	0	-5.000	0	-5.000	+4.000
D8F0	-10000	0	-5.419	0	-5.419	0	-10.0000	+4.000
B1E0	-20000	0	-10.837	0	-5.419	0	-20.000	+4.000
AB56	-21674	0	-10.837	0	-5.419	0	-21.674	+4.000
AB55 ... 8100	-	0	-10.837	0	-5.419	0	-21.674	+4.000
8002	Wire break	Hold last value	Hold last value	Hold last value	Hold last value	Hold last value	Hold last value	0
8080	Underrange	0	-10.837	0	-5.419	0	-21.6747	Hold last value

18 Parameter, diagnostics and information (PDI)

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

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

The following applies to all tables below:

Abbreviation	Meaning
Length in bytes	Maximum length of the elements in bytes
R	Read
W	Write
[x]	Number of elements in an array or record

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 S20 system, material number R911335988.

19 Standard objects

19.1 Objects for identification (device rating plate)

You can only access these objects via subindex 00, i.e., you access the entire object in each case. If an object contains several elements, the content is listed in the table in a structured way, e.g. hardware version divided into date and version.

Index (hex)	Object name	Data type	Length in bytes	Rights	Meaning	Contents
Manufacturer						
0001	VendorName	Visible String	17	R	Vendor name	Bosch Rexroth AG
0002	VendorID	Visible String	7	R	Vendor ID	006034
0012	VendorURL	Visible String	28	R	Vendor URL	http://www.boschrexroth.com
Module - general						
0004	DeviceFamily	Visible String	20	R	Device family	I/O function module
0006	ProductFamily	Visible String	4	R	Product family	S20
000E	CommProfile	Visible String	4	R	Communication profile	633
000F	DeviceProfile	Visible String	5	R	Device profile	0010
0011	ProfileVersion	Record [2] of Visible Strings	32	R	Profile version	2011-12-07; Basic - Profile V2.0
0017	Language	Record [2] of Visible Strings	14	R	Language	en-us; English
Module - special						
0005	Capabilities	Array [1] of Octet Strings	8	R	Capabilities	SyncI_0 (from index -AB1)
0007	ProductName	Visible String	15	R	Product name	S20-SSI-AO-1/1
0008	SerialNo	Visible String	16	R	Serial number	xx xx xx xx xx xx xx x (e. g., 7602012346BC125)
0009	ProductText	Visible String	48	R	Product text	1 absolute encoder (SSI) input, 1 analog output
000A	OrderNumber	Visible String	11	R	Item No.	R911172544
000B	HardwareVersion	Record [2] of Visible Strings	15	R	Hardware version	e.g., 2020-04-26; AA1
000C	FirmwareVersion	Record [2] of Visible Strings	17	R	Firmware version	e. g., 2010-06-21; V1.10
000D	PChVersion	Record [2] of Visible Strings	17	R	PDI version	2010-01-08; V1.00
0037	DeviceType	Octet string	8	R	Device type	00 10 10 0C 00 00 00 $F2_{hex}$
003A	VersionCount	Array [4] of UINT16	8	R	Version counter	e. g., 0007 0001 0001 0001_{hex}
Use of the device						
0014	Location	Visible String	59	R/W	Location	Can be completed by the user.
0015	EquipmentIdent	Visible String	59	R/W	Equipment identifier	Can be completed by the user.
0016	ApplDeviceAddr	UINT16	2	R/W	Application-specific device address	Can be completed by the user.

19.2 Miscellaneous standard objects

Index (hex)	Object name	Data type	Length in bytes	Rights	Meaning/contents
Diagnostics objects					
0018	DiagState	Record [6]	27	R	Diagnostic state
0019	ResetDiag	UINT8	1	R/W	Handling diagnostic messages
Objects for process data management					
0024	ResetCode	UINT16	2	R/W	Substitute value behavior during bus reset (PD-OUT)
0030	PF_Code	UINT16	2	R/W	Substitute value behavior during I/O error (PDIN)
0025	PDIN	Record [3]	12	R	Input process data
0026	PDOUT	Record [3]	12	R	Output process data
0027	GetExRight	UINT8	1	R/W	Get exclusive process data write rights
002F	PDOUT_Subst	UINT16	2	R/W	Substitute value for the OUT process data
0031	PDIN_Subst	Octet string	8	R/W	Substitute value for the IN process data in the event of an error in the connected I/O devices
Objects for device management					
001D	Password	Octet string	10	W	Password
0029	ParamSetWrite-Control	UINT8	1	R/W	Parameter set write control
002A	ConflictDictionary	Octet string	12	R	Conflict dictionary
002D	ResetParam	UINT8	1	W	Reset parameterization
002E	CheckSum	UINT32	4	R	Checksum

19.3 Diagnostics state (0018_{hex}: DiagState)

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

Read all information via subindex 00 to receive all information on an error number. Access to individual elements of the object is not permitted.

0018_{hex}: Diagnostics state (read)					
Element	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Record [6]	27	Diagnostic state	Complete diagnostics information	
1	UINT16	2	Error number	$0 \ldots 65535_{dec}$	
2	UINT8	1	Priority	00_{hex}	No error
				01_{hex}	Error
				02_{hex}	Warning
				81_{hex}	Error removed
				82_{hex}	Warning eliminated
3	UINT8	1	Channel/group/module	00_{hex}	No error
				01_{hex}	SSI channel
				02_{hex}	AO channel
				FF_{hex}	Entire device
4	UINT16	2	Error code	See table below	
5	UINT8	1	Additional information	00_{hex}	
6	Visible String	20	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.

Error and status of the local diagnostics and status indicators

Element	**2**	**3**	**4**	**6**								
Error	**Priority**	**Channel/ group/ module**	**Error code**	**Text**	**Process data**	**LED**						
	hex	**hex**	**hex**		**hex**	**D**	**UI**	**E1**	**00**	**02**	**03**	**13**
No error	00	00	0000	Status OK	xxxx	X	●	○	○	◐	X	○
Overload of the analog output or short circuit	01	02	2130	Short-circuit	--	X	X	●	X	X	○	●
Faulty 24 V supply (Short-circuit/overload)	01	01	5112	24 V supply fail	8020	X	X	●	X	◑	X	X
Supply voltage faulty (feed-in for encoder/ analog supply (U_I))	01	FF	5160	Supply fail	8020	X	○	●	●	◑	○	●
No or faulty comparison values	01	02	6301	CS FLASH	--	☼	X	●	○	X	○	●
Parameter table invalid	01	FF	6320	Invalid para	8010	☼	X	●	●	X	○	●
Encoder error	01	01	7300	Sensor/encoder fail	xxxx	X	X	●	●	X	X	X
Wire break at analog output	01	02	7710	Open circuit	xxxx	X	X	●	X	X	○	●

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

In the event of an error on the SSI channel, word 0, bit 7 “SSI error” is additionally set in the IN process data.

Once the cause of the fault has been removed, the message is automatically reset.

Conditions for generating the error messages

SSI channel

Short circuit of the two cables, D and /D 7300_{hex}

Open circuit of the two cables, D and /D 7300_{hex}

Via the data line the sensor/encoder only indirectly detects cross circuits and interruptions on the clock line. Other short circuits or interruptions (e.g., cross circuit to FE or single-wire interruptions) are not detected.

24 V encoder supply U_S

Encoder supply is faulty. 5112_{hex}

Short-circuit/overload of the encoder supply. 5112_{hex}

Encoder supply not present 5160_{hex}

AO channel

AO channel error when parameterized as voltage output: short circuit or overload message 2130_{hex}

AO channel error when parameterized as voltage output: short circuit or overload message 7710_{hex}

A short circuit or wire break is detected when the output value is >5% of the output range final value.

19.4 Handling diagnostic messages (0019_{hex}: ResetDiag)

You can use this object to specify how the module should handle diagnostic messages.

0019_{hex}: Handling diagnostic messages (read, write)				
Subindex	**Data type**	**Length in bytes**	**Contents**	
			Code (hex)	**Meaning**
0	UINT8	1	00	Permit all diagnostic messages (default)
			02	Delete and acknowledge all diagnostic messages that are still pending
			03	Delete and acknowledge all diagnostic messages and reset the error counter
			05	Deletes and acknowledges the last diagnostic message
			06	Delete and acknowledge all diagnostic messages and do not permit new diagnostic messages
			Other	Reserved

19.5 Substitute value behavior during bus reset (PDOUT) (0024_{hex}: ResetCode)

This object is used to configure the behavior of the output when a bus reset is detected.

The parameterized behavior and the parameterized substitute value are not stored in the module. The zero value is always output when starting up. If the zero value should not be output in the event of a reset, reparameterize the reset behavior after every module restart.

0024_{hex}: substitute value behavior during bus reset (PDOUT) (read, write)					
Subindex	**Data type**	**Length in bytes**	**Contents**		
			Code (hex)	**Meaning**	**Default value**
0	UINT16	2	0000	Output of zero value (0 V / 0 mA / 4 mA) at output	
			0001	Output of final value (10 V / 5 V / 20 mA) at output	
			0002	Hold last value	0002
			0003	Substitute value (PDOUT): Copy the substitute value from the “Substitute value for the output process data” object ($002F_{hex}$)	

Special features

- You can only access this object via subindex 0, i. e., you access the entire object.

For error message, see object 0080_{hex}.

19.6 Substitute value behavior during I/O error (PDIN) (0030_{hex}: PF_Code)

This object is used to parameterize which position value is transmitted via the process data in the event of an error.

0030_{hex}: Substitute value behavior during I/O error (PDIN) (read, write)					
Subindex	**Data type**	**Length in bytes**	**Contents**		
			Code (hex)	**Meaning**	**Default value**
0	UINT16	2	0000	Zero value	0000
				Output of 0 as position	
			0001	Final value	
				Output of the maximum value based on the parameterized encoder resolution	
			0002	Hold last value	
				Holding of the last valid position value	
			0003	Position substitute value	
				Output of a parameterized substitute value. Parameterize the substitute value in object “PDIN_Subst” (0031_{hex}). To enable a defined error code to be output, the substitute value can also be greater than the maximum value of the current encoder resolution.	

19.7 Input 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/contents**
00	Record [3]	12	Input process data
01	Octet string	2	Status of the SSI channel (word 0)
02	Octet string	8	Position value of the SSI channel (word 1 ... 4)
03	INT16	2	Mirroring of the analog output value or error code (word 5)

19.8 Output 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, write)			
Subindex	**Data type**	**Length in bytes**	**Meaning/contents**
00	Record [3]	12	Output process data
01	Octet string	2	SSI control data
02	Octet string	8	Reserved
03	INT16	2	Analog output value

Observe the notes in the section "Writing the analog values via the PDI channel".

19.9 Request exclusive write access (0027_{hex}: GetExRight)

This object allows you to determine which channel (process data channel or PDI channel) gets the rights for writing the outputs.

0027_{hex}: Request exclusive write access (read, write)				
Subindex	**Data type**	**Length in bytes**	**Contents**	
			Code (hex)	**Meaning**
0	UINT8	1	00	Rights for writing output data over the PD channel (process data channel)
			01	Rights for writing output data via the PDI channel

All other values are invalid and will be acknowledged with an error.

Please note the following for your process:
The parameterization in object 0027_{hex} “Rights for writing the output data via the PDI channel” overwrites the output process data transmitted via the process data channel with the values from object 0026_{hex} PDOUT.
From now on, changes to the output process data can only be made via the PDI object. Changes on the process data channel will have no effect.
If the value from the process data channel is to be used again, write access must be changed to “Rights for writing the output data via the PD channel (process data channel)” via the GetExRight object.
After a power reset, the values transmitted via the process data channel are always valid.

19.10 Substitute value for the OUT process data ($002F_{hex}$: PDOUT_Subst)

Use this object to parameterize the substitute value that is to be output at the analog output if process data is missing. The condition is that option 0003 is selected in the “Substitute value behavior when process data is missing” object (0024_{hex}).

In the case of valid parameters, the parameterization is stored in the module permanently.

After resetting, the module works with the last permanently stored data. Upon delivery, the module works with the default data (default settings).

$002F_{hex}$: Substitute value for the OUT process data (read, write)			
Subindex	**Data type**	**Length in bytes**	**Meaning/contents**
0	UINT16	2	Replace output process data

Two bytes are available for the AO channel.

The value is used in parameterized format.

Example:

AO channel: 5 V, format standardized representation

$13\ 88_{hex}$

Special features

- You can only access this object via subindex 0, i. e., you access the entire object.
- In the case of valid parameters, the object is stored permanently.
- The parameterized value is compared with the selected output range. If the substitute value does not correspond to the output range, an error message is issued.

For error message, see object 0080_{hex}.

19.11 Substitute value for the IN process data (0031_{hex}: PDIN_Subst)

This object is used to parameterize the substitute value for the IN process data in the event of an error of the connected I/O devices.

However, option 0003 must have been selected in the “Peripheral fault selection code” object (0030_{hex}).

The substitute value may be higher than the maximum value of the current encoder resolution. In this way, a specifically defined error code can be output.

In the case of valid parameters, the parameterization is stored in the module permanently.

After resetting, the module works with the last permanently stored data. Upon delivery, the module works with the default data (default settings).

0031_{hex}: Ersatzwert für die Eingangsprozessdaten (read, write)			
Subindex	**Data type**	**Length in bytes**	**Meaning/contents**
00	Octet string	8	Substitute IN process data

19.12 Password ($001D_{hex}$: Password)

By entering the "Superuser" password you permit writing to the "Exclusiv right received" object. These rights are required to transmit process data over the PDI channel.

$001D_{hex}$: Password (write (access-protected))			
Subindex	**Data type**	**Length in bytes**	**Meaning/contents**
0	Octet string	10	Password

19.13 Parameter record write control (0029_{hex}: ParamSetWriteControl)

This object is used to control block parameterization.

0029_{hex}: Parameter record write control (read/write)				
Subindex	**Data type**	**Length in bytes**	**Meaning/contents**	
			Code (hex)	**Meaning**
0	UINT8	1	00	Termination of block parameterization
			01	Initiation of block parameterization

Block parameterization serves to enable the joint transfer of interdependent parameters.

If you attempt to parameterize dependent parameters individually, this may result in the error message “Dependency of other parameter not taken into consideration”. Block parameterization should be used in this case.

The plausibility check for the parameterization data is disabled during block parameterization, the data is only stored temporarily. However, the data length and subindex are checked.

The plausibility check is only performed when block parameterization is terminated with data item 00_{hex}.

If the check was completed with no errors, the temporarily stored parameterization data is applied and stored in the Flash memory.

If errors were detected in the temporarily stored parameterization data, the service is acknowledged negatively.
The exact cause of the error can be read in object $002A_{hex}$. The error codes are indicated by object 0080_{hex}.

You do not necessarily have to write all the startup objects.

The following actions are carried out when the parameter contents are modified:

Write control changes from 00_{hex} to 01_{hex}: initiation of block parameterization

- Block parameterization is initiated
- Conflict dictionary is reset

Write control changes from 01_{hex} to 00_{hex}: termination of block parameterization

- Block parameterization is terminated
- Individual parameterization is active
- Parameterization is checked for compatibility

  Parameters are compatible:
  - The parameter contents are accepted.
  - Write access to the write control parameter is acknowledged positively.

  Parameters are not compatible:
  - The old contents of all the parameters required for block parameterization remain in effect.
  - The conflict dictionary is updated.
  - Write access to the write control parameter is acknowledged negatively.

Error code in the event of negative acknowledgment:

Code (hex)	Additional code (hex)	Meaning	Corrective
0801	0040	Dependent values were not taken into consideration.	Check the parameterization.

The block parameterization is permanently stored in the device description files for the module. This means that whenever the module is parameterized using a tool, the block parameterization is automatically launched at the start of parameterization and terminated at the end of parameterization.

To use block parameterization without tools, proceed in the following sequence:

- Initiate block parameterization by writing the value 01_{hex} to object 0029_{hex}.
- Write the parameter table (ParaTable) to object 0080_{hex}.
- Write the substitute value behavior when process data is missing (ResetCode) to object 0024_{hex}.
- Write the substitute value for the OUT process data in the event of an error (PDOUT_Subst) to object $002F_{hex}$.
- Terminate block parameterization by writing the value 00_{hex} to object 0029_{hex}.

19.14 Conflict dictionary (002A$_{hex}$: ConflictDictionary)

This object contains the indices and error messages (additional code) for the parameters involved in the conflict.

002A$_{hex}$: Conflict dictionary (read)			
Subindex	**Data type**	**Length in bytes**	**Meaning/contents**
0	Octet string	12	Conflict dictionary

Meaning	**Length in bytes**	**Example**	
Subslot	1	00	No subslot
Index	2	00 2F	PDOUT_Subst
Subindex	1	01	Substitute value for OUT1
Parameter number	2	0001	
Error code and class	2	0080	
Additional error code	4	0000 0140	Substitute value for OUT1 outside the limit values

19.15 Reset parameterization (002D$_{hex}$: ResetParam)

This object is used to reset the module to the default settings.

To reset the parameters, value 01$_{hex}$ must be transferred during write access. All other values are invalid and will be acknowledged with an error.

Then the default settings of the channels are loaded and all the user-set parameters are reset.

19.16 Checksum (002E$_{hex}$: CheckSum)

The data of the startup objects is verified with this checksum. The checksum only changes if an object relevant for startup has been changed. The checksum is therefore suitable for comparing the parameterization.

20 Application objects

Index (hex)	Object name	Data type	Length in bytes	Rights	Meaning/contents
0080	ParaTable	Record [2]	22	R/W	Parameter table
0083	ZeroOffset	UINT16 [4]	8	R	Read offset

20.1 Parameter table (0080_{hex}: ParaTable)

Parameterize the module using this object.

In the case of valid parameters, the parameterization is stored in the module permanently.

After resetting, the module works with the last permanently stored data. Upon delivery, the module works with the default data (default settings).

Even when only writing individual parameters, normal operation is interrupted in order to store the configuration, and the module runs through an application reset.

Prior to parameterizing the substitute values, the 0080_{hex} object must be parameterized. The substitute values can be parameterized in any order.

0080_{hex}: Parameter table (read, write)				
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Default value**
0	Record	22	Read/write all elements	See subindices
1	UINT16	20	SSI channel parameterization	0000_{hex}
2	UINT16	2	AO channel parameterization	0000_{hex}

20.1.1 SSI channel parameterization

Parameterization word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Word 0															
Clock frequency								Resolution							
Word 1															
Reserved															
Word 2															
Sensor settings															
Number of status bits				Number of errors allowed			Parity		Reserved		Encoder monitoring	Data format	Reserved	Position encoding	Direction
Word 3															
Frame offset								Frame size							
Word 4															
Gear ratio (numerator)															
Word 5															
Gear ratio (denominator)															
Word 6															
Position offset of word 3															
Word 7															
Positions offset of word 2															
Word 8															
Positions offset of word 1															
Word 9															
Positions offset of word 0															

Word	Bit	Parameter	Meaning	Value range		Default
0	15 ... 8	Clock frequency	Clock frequency of the SSI encoder	See "Clock frequency" table		01_{hex}
0	7 ... 0	Resolution	Resolution of the SSI encoder in bits	08_{hex} ... 38_{hex}		08_{hex}
1	15 ... 0	Reserved		0000_{hex}		0000_{hex}
2	15 ... 0	Sensor settings				
	15 ... 12	Number of status bits	Number of status bits in the encoder signal	0_{dec} ... 8_{dec}	No status bit up to eight status bits	0_{dec}
	11, 10	Number of errors allowed	Number of parity errors allowed	00_{bin}	0	00_{bin}
				01_{bin}	1	
				10_{bin}	2	
				11_{bin}	3	
	9, 8	Parity	Parity of the encoder signal	00_{bin}	None	00_{bin}
				01_{bin}	Even	
				10_{bin}	Odd	
				11_{bin}	Reserved	
	7, 6	Reserved		00_{bin}		00_{bin}
	5	Encoder monitoring	Encoder monitoring on/off	0_{bin}	Monitoring active	1_{bin}
				1_{bin}	Monitoring off	
	4	Data format	Encoder signal in standard or fir-tree format	0_{bin}	Standard	0_{bin}
				1_{bin}	Fir tree	
	3	Reserved		0_{bin}		0_{bin}
	2, 1	Position encoding	Encoding of encoder signal	00_{bin}	Binary	00_{bin}
				01_{bin}	Reserved	
				10_{bin}	Reserved	
				11_{bin}	Gray	
	0	Direction	Inverted or normal encoder signal direction	0_{bin}	Not inverted	0_{bin}
				1_{bin}	Inverted	
3	15 ... 8	Frame offset	Low byte position in the data frame in fir-tree format	1 ... 47_{dec}		1
	7 ... 0	Frame size	Size of the entire frame in fir-tree format	9 ... 56_{dec}		9
4	15 ... 0	Gear ratio (numerator)	Gear ratio numerator	1 ... 65535_{dec}		1
5	15 ... 0	Gear ratio (denominator)	Gear ratio denominator	1 ... 65535_{dec}		1
6 ... 9	15 ... 0	Positions offset of word x	Offset for the word x position value	0 ... 2^{56}-1_{dec}		0

Reserved bits must always be set to 0. Values that do not equal 0 are acknowledged with an error.

Clock frequency

Code (bin)	Meaning
00	62.5 kHz
01	125 kHz
02	250 kHz
03	500 kHz
04	1 MHz
05	2 MHz
Other	Reserved

Resolution

The resolution refers to the number of bits of the pure position value. This also applies to the fir-tree format.

For fir-tree format only: Specify the size of the entire frame and the position of the low byte in the data frame in addition to the encoder resolution.

The resolution does not include the parity bit. If a parity is parameterized, the maximum possible resolution is reduced by 1 bit.

Offset for the position value

The high byte of the position offset is located in the high byte of word 6. The low byte of the offset is located in the low byte of word 8.

20.1.2 AO channel parameterization

Parameterization word

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Reserved						Data format		Reserved				Output range			

Reserved bits must always be set to 0. Values that do not equal 0 are acknowledged with an error.

Output range

Code (hex)	Output range
0	**0 V ... 10 V (default)**
1	±10 V
2	0 V ... 5 V
3	±5 V
4	0 mA ... 20 mA
5	±20 mA
6	4 mA ... 20 mA
7 ... F	Reserved

Data format

Code (bin)	Data format
00	**IB IL (default)**
01	Reserved
10	Reserved
11	Standardized representation

20.2 Read offset (0083_{hex}: ZeroOffset)

When setting the position to zero using the SSI-SetZero bit, an offset is generated.

This object can be used to read this offset as a raw value. In this way, you can make corrections at the encoder position.

The object consists of four words creating a 64-bit value. The words are transmitted in the following order: word 3 ... word 0. The value has the data width of the encoder resolution and is right-aligned. Unused bits are set to 0. The value does not include the gear ratio and the offset set via the 0080_{hex} object.

21 Writing the analog values over the PDI channel

PDI = Parameters, Diagnostics and Information

The exclusive right must be changed first, if the analog values are not to be output via the process data, but via the PDI channel. To do this, proceed as follows.

- Write the ASCII string "Superuser" to the "Password" ($001D_{hex}$) object.
- Write the value 01_{hex} to the “Request exclusive write access” object (0027_{hex}).

You may now write to the "Output process data" (0026_{hex}) object.

22 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.

23 Bus-synchronous operation

Valid from index AB1.

The module operates synchronously to the local bus if it has been parameterized via block parameterization.

Parameter settings that are modified later, especially where changes are made to the resolution and/or the transmission frequency of the SSI, distort synchronization.

The minimum cycle time depends on the encoder setting and is calculated according to the following formula:

t_{min} = 298 µs + A * 1/f

Where:

t_{min}	Minimum cycle time
298 µs	Internal processing time of the module
A	Resolution of the SSI encoder in bits See “Parameterization of the SSI channel, resolution”.
f	Clock frequency of the SSI encoder See “Parameterization of the SSI channel, clock frequency”.

Observe the minimum cycle time so that the module indicates the current position on every cycle.
If the actual cycle time is less than the calculated minimum cycle time, the module is operating as quickly as it can and the position is not provided synchronously on every x-th cycle.

DOK-CONTRL-S20*SSI*AO1-DA03-EN-P

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