The Drive & Control Company

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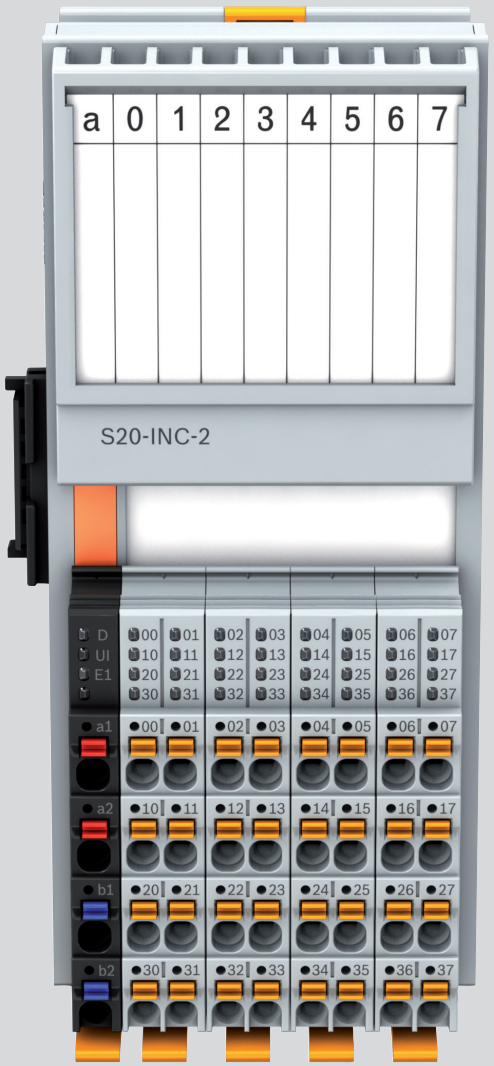
Rexroth IndraControl

S20 Function Module
S20-INC-2

Application Description
R911345595

Edition 01



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1 Using the Safety Instructions

1.1 Safety Instructions - Structure

The safety instructions are structured as follows:

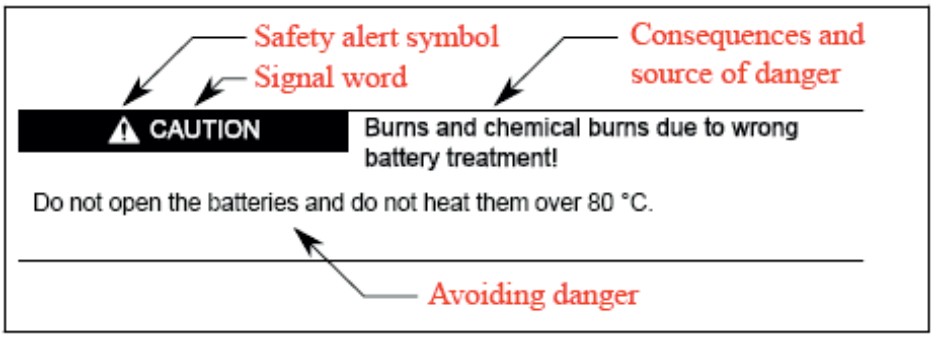

Fig. 1-1 Safety instructions - structure

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 meant to draw the reader's attention to the safety instruction and signifies the degree of danger.

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.

⚠ CAUTION

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

NOTICE

In case of non-compliance with this safety instruction, property damage could occur.

Using the Safety Instructions

2 Function Description of the Module

Please refer to the module's data sheet for the technical data of the module including the terminal point assignment and meaning of the diagnostic and status indicators.
It can be downloaded at www.boschrexroth.com/electrics.

2.1 General Functions

The module is designed for use within an IndraControl S20 station.
It is a two-channel module used for the bus-synchronous evaluation of the position of incremental encoders.

The module has two incremental encoder inputs (INC). In addition, it has six digital inputs (IN1 ... IN6) and two digital outputs (OUT1, OUT2) which can be controlled using process data.

The module has further inputs allowing you to perform the following functions:

- Saving specific values: latch inputs L1, L2
- Referencing: reference inputs Ref1, Ref2

You can start up the module with the default parameterization without having to parameterize it.

But you can also parameterize the channels with the engineering tool or the PDI object 0080_{hex}. The new parameterization is stored retentively. Thus, it will still be available after a voltage reset.

When the module is reparameterized, all channels will be stopped and then reparameterized. All channels will always be reinitialized, even if you have changed only one channel.

Features of the channels

- Acquiring digital signals of symmetrical or asymmetrical incremental encoders (5 V or 24 V) with an input frequency of up to 300 kHz
- Position acquisition with a 32-bit counter
- Double or quadruple evaluation of encoder signals
- Evaluating linear or rotary axes (determining the direction of rotation or motion)
- Saving of up to two intermediate values via an external input signal (latch input Lx)
- Various methods to set a reference point
- Hardware monitoring of the encoders
  - Monitoring of the encoder supply
  - Open circuit detection
  - Detecting faulty electrical signals with symmetrical encoders

Function Description of the Module

Terms used

Term	Explanation
Position	Position value calculated by means of a conversion factor. It is indicated as an unsigned 32-bit value (DWORD) in the IN process data.
Positive direction	Direction that will cause the position counter to increment.
Negative direction	Direction that will cause the position counter to decrement.
Referencing	Describes the process of setting a position value at a special position of the axis that is then used as a reference point.
PDI	**P**rocess data, **D**iagnostics, **I**nformation: acyclic data channel of the local bus

Fig. 2-1 Terms used

2.2 Functions of the Channels Used for Incremental Value Acquisition

The two channels for incremental value acquisition are used to evaluate signals from symmetrical or asymmetrical incremental encoders. The encoders provide signals enabling the module to define the current position and to make it available in the process data.

2.2.1 Position Acquisition

The encoder interfaces for position acquisition evaluate the tracks A and B that are generated by the encoder with regard to the number of pulses and direction. A 32-bit counter is used for pulse counting. A positive direction will cause the counter to increment, a negative direction will cause it to decrement. Different signal edges are evaluated depending on the specified scanning rate.

2.2.1.1 Position Value

32-bit position value The position acquired by counting the input pulses is represented as an unsigned 32-bit value and mapped to the process data.

Conversion factor During parameterization, you can set a conversion factor that consists of a numerator and denominator, each representing an unsigned 16-bit value. By using the conversion factor, you can adapt the position included in the process data so that, for example, it is directly indicated in millimeters or inches. The conversion factor (numerator/denominator) must always be less than 1.

Example 1500 pulses correspond to 1 cm => conversion factor: 1/1500 (or 10/15000)

During parameterization, enter all position data (reference value, modulo value) in relation to the conversion factor. The indicated latch value is also based on the conversion factor.

In the example, these values are indicated in centimeters.

2.2.1.2 Scanning Rate - Double and Quadruple

You can specify during parameterization how the two position input signals (tracks A and B) should be evaluated. The module allows for both the double and quadruple evaluation of signals.

Using the double evaluation option, the counter is incremented by a rising edge of signal A and decremented by a falling edge.

Using the quadruple evaluation option, the counter is incremented or decremented with every edge of both signals (A and B).

2.2.1.3 Maximum Input Frequencies

The maximum input frequency is 300 kHz, regardless of the channel wiring.

Function Description of the Module

2.2.1.4 Axis Types

Linear axis

The position can be acquired using a linear axis function. With this acquisition type, the position is counted from 0 up to the maximum counter value.

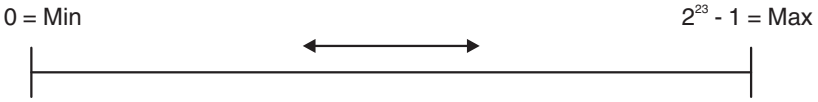

Fig. 2-2 Linear axis

Rotary axis

The position can be acquired using a rotary axis function. The number of increments per rotation is set as a parameter (modulo value). This value determines when the position has returned to the zero value. The counter state is between 0 and modulo - 1.

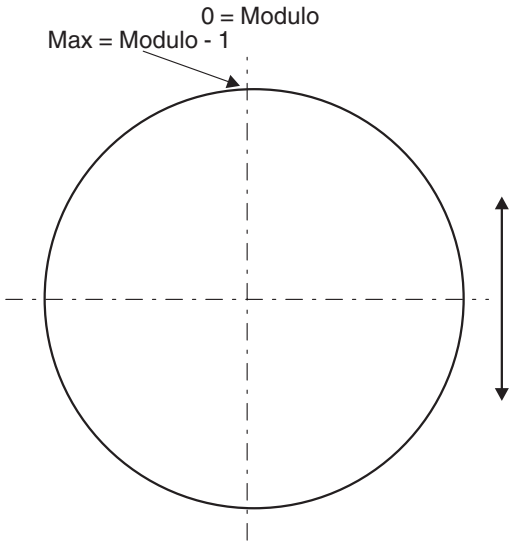

Fig. 2-3 Rotary axis

2.2.1.5 Encoder Types

The module is able to evaluate symmetrical and asymmetrical encoders. You can specify the encoder type during parameterization.

Symmetrical encoders

Symmetrical encoders refer to encoders with the differential signals A, B, and Z.

Asymmetrical encoders

Asymmetrical encoders refer to encoders with signals referenced to ground A, B, and Z.

2.2.2 Referencing

With regard to incremental encoders, referencing is absolutely necessary because the current position of the module is not known after a restart. Referencing means to move to a special position depending on the structure and to set the reference value at this position.

There are three options to set the reference point:

- Setting the reference point via the process data
- Setting the reference point via a signal at the reference input
- Setting the reference point via the Z signal of the encoder

You can specify the type of referencing during channel parameterization.

Only one reference method can be selected for each channel.
For example, when parameterizing the reference method via the Z signal, it will not be possible to use the other reference methods without reconfiguring the channel.

2.2.2.1 Setting the Reference Point via the Process Data

In order to set the reference point as precisely as possible using the process data, the axis should be at a standstill.

The reference point can only be set as long as referencing is enabled via the corresponding bit (Enable_Refx).

The reference point is set if the corresponding process data bit of the channel (Set_Refx) changes from 0 to 1.

No reference point will be set in state 1 or 0 or when the state changes from 0 to 1.

2.2.2.2 Setting the Reference Point via a Signal at the Reference Input

In order to set the reference point as precisely as possible when referencing via the reference input, the axis should be moved as slowly as possible.

The reference point is set if a corresponding edge is detected at the digital reference input. Optionally, the setting of the reference point may also depend on the current direction. The following options are available for referencing to the reference input:

- Referencing to the **rising** edge of the reference input **regardless** of the direction
- Referencing to the **falling** edge of the reference input **regardless** of the direction
- Referencing to the **rising** edge of the reference signal in **positive** direction
- Referencing to the **falling** edge of the reference signal in **positive** direction
- Referencing to the **rising** edge of the reference signal in **negative** direction
- Referencing to the **falling** edge of the reference signal in **negative** direction

If the corresponding combination of edge and direction is detected, the reference value is set for this position.

2.2.2.3 Setting the Reference Point to the Z Signal of the Encoder

In order to set the reference point as precisely as possible when referencing via the Z signal, the axis should be moved as slowly as possible.

The reference point is set if a Z signal of the encoder is detected. Optionally, the setting of the reference point may also depend on the current direction. The following options are available for referencing to the Z signal:

- Referencing to the Z signal **regardless** of the direction
- Referencing to the Z signal in **positive** direction
- Referencing to the Z signal in **negative** direction

If the corresponding combination of Z and direction is detected, the reference value is set for this position.

This option can only be used if latching to the Z signal is not intended.

2.2.2.4 Reference Control via Process Data

Referencing is enabled or disabled using a bit variable in the process data (Enable_Refx). To enable referencing, the following parameterization options are available:

- Enable referencing only once:
  Referencing is enabled only once until a reference point is set. To start referencing, a change from 0 to 1 must be detected at the bit.
  In order to restart referencing, the bit must first be reset to 0.
- Enable referencing permanently:
  As long as the process data item is set to 1, the reference point is reset every time the corresponding reference condition is fulfilled.
  If the bit is 0, referencing will not be carried out.

You can set this behavior during channel parameterization using object 0080_{hex} (RefPDEnableMode).

Referencing must always be enabled via the process data before the other mechanisms become operative.

2.2.2.5 Option: Reference Control via Ref input

This method can only be parameterized when referencing to the Z signal of the encoder.

The reference point is set if the condition for Z is true **and** the reference input is in the parameterized state.

Parameterization for the reference input is as follows:

- Referencing if the reference input = 0
- Referencing if the reference input = 1

You can set this behavior during channel parameterization using object 0080_{hex} (RefZSetMode).

Example for one-time referencing to Z and enabling via reference input

Parameterization (for one channel):

Parameter	Value	Description
RefPDEnaMode	0_{bin}	Enable referencing only once
RefMode	07_{hex}	Z signal without direction
RefZSetMode	01_{bin}	Set the reference point only if the reference input is 1

Fig. 2-4 Referencing example

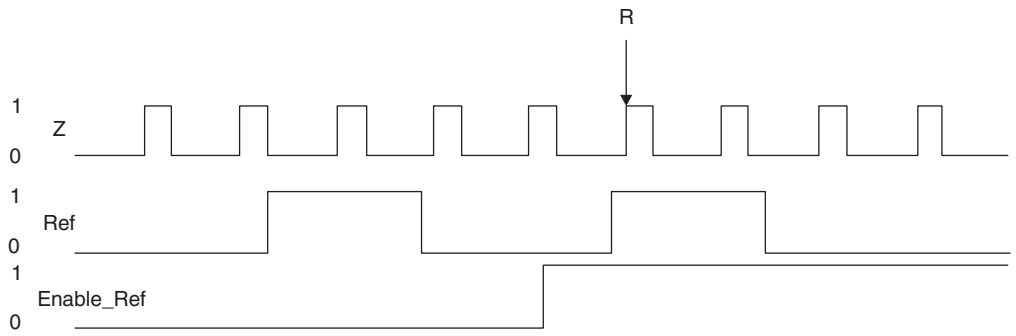

Fig. 2-5 Referencing to Z signal if the reference input = 1

Z	Z signal
Ref	Reference input
Enable_Ref	Bit in the process data to enable referencing
R	Reference point

2.2.2.6 Saving the Current Reference Point Position

If referencing was successful, this is indicated via a status bit and the last valid position is saved.

You can read this saved position on a per channel basis using the RefPosValues PDI object.

2.2.2.7 Behavior of IN Process Data Bits during Referencing

The status of the reference process is indicated in the IN process data using two bits per channel.

Active referencing is indicated by the Run_Ref bit.
Successful referencing is indicated by the Compl_Ref bit.
In addition, the state of the reference input is indicated.

Behavior of the Run_Ref bit

The Run_Ref bit changes to 1 if the parameterized condition for the Enable_Ref bit is detected in the IN process data.

Using the “One-time referencing if Enable_Refx 0 → 1” option (object 0080_{hex}, RefPDEnableMode = 0_{bin}), the bit is set when the OUT process data bit changes from 0 to 1. If the parameterized reference condition is detected, the bit is reset.

Using the “Permanent referencing if Enable_Refx = 1” option (object 0080_{hex}, RefPDEnableMode = 1_{bin}), the Run_Ref bit remains = 1 as long as the Enable_Ref bit = 1.

Behavior of the Compl_Ref bit

The behavior of the Compl_Ref bit depends on the parameterization of the Enable_Ref bit in the OUT process data.

Using the “One-time referencing with Enable_Refx 0 → 1” option (object 0080_{hex}, RefPDEnableMode = 0_{bin}), the bit is set after the reference point has been successfully set. The bit remains set to 1 until a new reference process is started.

Using the “Permanent referencing if Enable_Refx = 1” option (object 0080_{hex}, RefPDEnableMode = 1_{bin}), the Compl_Ref bit changes to 1 when setting the reference point for the first time. Thereafter, the state changes with every new successful setting of the reference point. If a new reference process is started, the bit is always initially set to 0.

2.2.3 Latch Function

The latch function saves the current position. Latching of the current position is triggered by a signal at the latch input or the Z signal.

If the parameterized combination of signal edge and direction is detected, the current position is saved. The saved value is entered in the corresponding IN process data. The following parameterization options are available for the latch input or Z:

- Latching the position on a **rising** edge at the latch input **regardless of the direction**
- Latching the position on a **falling** edge at the latch input **regardless of the direction**
- Latching the position at a **rising** edge at the latch input in **positive** direction
- Latching the position at a **falling** edge at the latch input in **positive** direction
- Latching the position at a **rising** edge at the latch input in **negative** direction
- Latching the position at a **falling** edge at the latch input in **negative** direction
- Latching the position to Z **without** direction evaluation (only if Z is not the reference input)
- Latching the position to Z in **positive** direction (only if Z is not the reference input)
- Latching the position to Z in **negative** direction (only if Z is not the Ref input)

Only one input can be used for latching, either the latch input of the channel or the Z signal.

2.3 Digital Inputs and Outputs

Digital inputs All inputs that are not required for INC functions are used as digital inputs 0 V to 24 V. The current input status is indicated as a bit in the process data (1 = “High” state, input is set).

Refx and Lx inputs The status of the Refx inputs (terminal points 10, 14) and Lx (terminal points 11, 15) is mapped to the process data, even if they have no special function (latch function disabled or Ref function without reference input) (1 = “High” state, input is set).

Digital outputs The digital outputs can be controlled using the respective process data bit.
The outputs are not automatically controlled by the module.
(1 = “High” state, output is set).

2.4 Bus-Synchronous Operation

The module operates synchronously to the local bus. The respective bus coupler synchronizes the local bus with the higher-level bus.

Synchronous input acquisition With each latch-in signal of the local bus, all channels are read in at a defined time. The MinimalCycleTime is 355 µs. If the latch-in signal were to arrive in shorter intervals than this time, the reading process would be omitted and the module would wait for the next latch-in signal. The jitter of the synchronization pulse is smaller than 1 µs.

Function Description of the Module

2.5 Module Diagnostics

Diagnostics are reported to the bus coupler or controller through the mechanism provided in the local bus. Depending on the diagnostic mechanisms provided in the higher-level bus, the diagnostic data is evaluated or mapped to the higher-level bus system by the bus coupler or controller.

Input voltage of the I/O (U_I) In the event of a loss or when falling below the minimum voltage of the I/O supply, the module reports a warning. In this case, the module is no longer ready to operate. All the values supplied are invalid.

24 V encoder supply A short circuit or overload at the 24 V output of the encoder supplies is reported. Both outputs are diagnosed separately.

5 V encoder supply A short circuit or overload at the 5 V output of the encoder supplies is reported. Both outputs are diagnosed separately.

Input signals of the connected encoder The encoder input signals are checked for short circuits and open circuits. The Z signal is only monitored if it has been assigned a function (latching or referencing) during parameterization.
This error is even reported if no encoder is connected. If the corresponding channel is disabled, the associated encoder monitoring is also disabled.

Digital outputs The digital outputs are checked for overload.

Parameterization memory The stored parameterization is checked via the checksum during module startup. If no valid parameterization is found, a corresponding diagnostics is generated.

Program memory The internal program memory is checked via the checksum during module startup. If an error is found, the correct startup is prevented and the module restarted. If the error still occurs, replace the module.

3 Data Transmission via Process Data

The process data is divided into IN and OUT process data. The OUT process data refers to the data that is sent from the master to the module. It includes process data for controlling the INC channels and the digital output.

The IN process data refers to the data that is sent from the module to the master. It includes the module and encoder status, the input states, the position and the latch value.

The module has a process data width of ten words.

The numbering in the following figures indicates the order in which the bytes and words are transmitted.
In general, the Motorola format is used, where the most significant bit (byte) is transmitted first.
When the module is used in a Sercos station, the Intel format applies where the least significant byte is transmitted first.

3.1 OUT Process Data

The OUT process data words of the controller occupy ten words. Of these ten words, only word 0 is used. The other words are reserved, set them to 0. The words are structured as follows:

Word 0															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Res.	Res.	Res.	Res.	Res.	OUT1	Set_ Ref1	Enable _Ref1	Res.	Res.	Res.	Res.	Res.	OUT2	Set_ Ref2	Enable _ Ref2

Word 1 ... word 9
Reserved

Bit for channel		Designation	Meaning	
1	2			
10	2	OUTx	= 1:	Output x is set (high)
			= 0:	Output x is reset (low)
9	1	Set_Refx	0->1:	Reference point of channel x is set immediately You can set the reference point only if the type of referencing is parameterized accordingly: Object 0080_{hex}, type of referencing = 00_{bin}
8	0	Enable_Refx	0->1:	Parameterized referencing of channel x is enabled Object 0080_{hex}
		Res.		Reserved Set reserved bits to 0

Fig. 3-1 Meaning of the bits in output word 0

Data Transmission via Process Data

3.2 IN Process Data

The IN process data words occupy ten words in the controller. IN process data contains general states of the module, states of the channels, and the corresponding counter and latch values. The words are structured as follows:

Word 0															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Diag1	Res.	Latch_ IN1	Ref_ IN1	Compl_ Ref1	Run_ Ref1	Dir1	Run State1	Diag2	Res.	Latch_ IN2	Ref_ IN2	Compl_ Ref2	Run_ Ref2	Dir2	Run State2

Word 1															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Res	Res	IN6	IN5	IN4	IN3	IN2	IN1	Res	Res	Res	Res	Res	Res	Res	Res

Word 2
Position 1 high word
Word 3
Position 1 low word
Word 4
Latch 1 high word
Word 5
Latch 1 low word
Word 6
Position 2 high word
Word 7
Position 2 low word
Word 8
Latch 2 high word
word 9
Latch 2 low word

Bit for channel		Designation	Meaning
1	2		
8	0	RunStatex	= 1: Encoder is moving = 0: Encoder in idle state
9	1	Dirx (Direction)	Acquired counting direction of channel x = 1: Positive direction = 0: Negative direction
10	2	Run_Refx	Enable referencing of channel x = 1: Referencing of channel x is enabled = 0: Referencing of channel x is not enabled
11	3	Compl_Refx	Referencing of channel x was successful = 1: Is set after the first reference point has been set = 0: Is reset if Enable_Refx = 0
12	4	Ref_IN1	Status of reference input Refx = 1: High = 0: Low
13	5	Latch_INx	Status of latch input Lx = 1: High = 0: Low
14	6	Res.	Reserved Set reserved bits to 0
15	7	Diagx	Diagnostics = 1: Diagnostics present for channel x = 0: No diagnostics present

Fig. 3-2 Meaning of the bits in input word 0

Bit	Designation	Meaning
8	IN1	Digital input 1 (terminal point 00)
9	IN2	Digital input 2 (terminal point 01)
10	IN3	Digital input 3 (terminal point 04)
11	IN4	Digital input 4 (terminal point 05)
12	IN5	Digital input 5 (terminal point 20)
13	IN6	Digital input 6 (terminal point 24)
		= 1: Input set = 0: Input not set
Other	Res.	Reserved Set reserved bits to 0

Fig. 3-3 Meaning of the bits in input word 1

The words 2 to 9 indicate the current position and latch values.

The position and latch values are transmitted in relation to the conversion factor as 32-bit integer values. Possible decimal places are not taken into consideration.

Data Transmission via Process Data

4 Parameters, Diagnostics and Information

PDI = Parameters, diagnostics, and information

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

For information on the PDI, please refer to the application description for the IndraControl S20 system, MNR R911335988.

The standard objects and manufacturer-specific application objects stored in the module are described in the following chapters.

The following applies to all tables below:

Data type	Meaning
Var	Single, simple variable
Array	String of simple variables of the same data type
Record	String of simple variables of different data types or of the same data type with different lengths
Visible string	Byte string with ASCII characters that can be printed only, terminated with 00_{hex}
Octet string	Byte string with any contents
Unsigned 8	Value without sign, only positive values from 00_{hex} ... FF_{hex}
Unsigned 16	Value without sign, only positive values from 0000_{hex} ... $FFFF_{hex}$
Unsigned 32	Value without sign, only positive values from 0000 0000_{hex} ... FFFF $FFFF_{hex}$

Fig. 4-1 Explanation of object codes and data types

Abbreviation	Meaning
N	Number of elements
L	Length of an element in bytes
R	Read
W	Write

Fig. 4-2 Abbreviations in the table headers

Every visible string is terminated with a zero terminator (00_{hex}). The length of a visible string element is therefore one byte larger than the amount of user data.

Parameters, Diagnostics and Information

4.1 Standard Objects

4.1.1 Objects for Identification (Device Rating Plate)

Index [hex]	Object name	Object code	Data type	N	L	Rights	Meaning	Contents
Manufacturer								
0001	VendorName	Var	Visible string	1	17	R	Vendor name	Bosch Rexroth AG
0002	VendorID	Var	Visible string	1	7	R	Vendor ID	006034
0012	VendorURL	Var	Visible string	1	28	R	Vendor URL	http://www.boschrexroth.com
Module - general								
0004	DeviceFamily	Var	Visible string	1	20	R	Device range	I/O function module
0006	Product-Family	Var	Visible string	1	17	R	Product range	IndraControl S20
000E	CommProfile	Var	Visible string	1	4	R	Communication profile	633
000F	DeviceProfile	Var	Visible string	1	5	R	Device profile	0010
0011	ProfileVersion	Record	Visible string	2	11; 20	R	Version designation of device profile	2011-12-07; Basic Profile V2.0
003A	VersionCount	Array	Unsigned 16	4	2	R	Version counter	E.g., 0005 0000 0000 0000
Module - special								
0005	Capabilities	Array	Visible string	1	8	R	Properties	Syncl_0
0007	ProductName	Var	Visible string	1	19	R	Product code	S20-INC-2
0008	SerialNumber	Var	Visible string	1	16	R	Serial number	xx xx xx xx xx xx xx x (e.g., 7260201123456BC)
0009	ProductText	Var	Visible string	1	47	R	Product text	2 incremental encoder inputs
000A	OrderNumber	Var	Visible string	1	11	R	MNR	R911173559
000B	Hardware-Version	Record	Visible string	2	11; 4	R	Hardware version	E.g., 2010-06-21; AA1
000C	Firmware-Version	Record	Visible string	2	11; 6	R	Firmware version	E.g., 0000-00-00, V1.00
000D	PCH Version	Record	Visible string	2	11; 6	R	Parameter channel version	E.g., 2010-01-08; V1.00
0037	DeviceType	Array	Octet string	1	8	R	Module identification	00 00 10 14 00 00 00 F5
Use of the device								
0014	Location	Var	Visible string	1	59	R/W	Installation location	Can be filled out by the user
0015	Equipment-Ident	Var	Visible string	1	59	R/W	Equipment identifier	Can be filled out by the user
0016	Appl-DeviceAddr	Var	Unsigned 16	1	2	R/W	User-defined device number	Can be filled out by the user

Fig. 4-3 Objects for identification

4.1.2 Object for Multilingual Support

Index [hex]	Object name	Object code	Data type	N	L	Rights	Meaning	Meaning
0017	Language	Record	Visible string	2	6; 8	R	Language	en-us; English

Fig. 4-4 Object for multilingual support

4.1.3 Objects for Diagnostics

Index [hex]	Object name	Object code	Data type	N	L	Rights	Meaning/contents
0018	DiagState	Record		6	22	R	Diagnostic state; see page 21
0019	ResetDiag	Var	Unsigned 8	1	1	W	Reset diagnostics; see page 23

Fig. 4-5 Objects for diagnostics

4.1.3.1 Diagnostic State (0018_{hex}: DiagState)

This object is used for a structured message of an error.
The content of the DiagState object is transmitted to the bus coupler within the framework of the diagnostic mechanism. Depending on the higher-level bus system, the message is transmitted to the respective master by the bus coupler. Adaptations to the message are possible. The structure and content of the diagnostic messages as sent by the module are shown here.

You can access this object only via subindex 0 and read the complete object.

0018_{hex}: DiagState (Read)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Record	22	Diagnostic state	Complete diagnostic information	
1	Unsigned 16	2	Error number	0 ... 65535_{dec} Consecutive error number since the last reset or the error memory reset	
2	Unsigned 8	1	Priority	00_{hex}	No error
				01_{hex}	Error still pending
				02_{hex}	Warning still pending
				03_{hex}	Message still pending
				81_{hex}	Error eliminated
				82_{hex}	Warning eliminated
				83_{hex}	Message eliminated
3	Unsigned 8	1	Channel	00_{hex}	No error
				01_{hex}	Error of channel INC1
				02_{hex}	Error of channel INC2
				FF_{hex}	Error not related to a specific channel
4	Unsigned 16	2	Error code	See the following table	
5	Unsigned 8	1	More follows	00 (not supported)	
6	Visible string	15	Text (14 characters)	See the following table	

Fig. 4-6 Diagnostic state

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The message with the priority 81_{hex} , 82_{hex} or 83_{hex} is a one-time internal message to the bus coupler that is implemented onto the error mechanisms of the higher-level system by the bus coupler.

Error code and related text:

Error	Error code	Text	Remark	Priority	Channel
No error	0000_{hex}	StatusOk	Diagnostics not available	00_{hex}	FF_{hex}
Short circuit or overload at the 24 V supply	5112_{hex}	24V Supply No x	Diagnostics of 24 V encoder supply No. x (x = 1 or 2)	01_{hex}	FF_{hex}
Short circuit or overload at the 5 V supply	5113_{hex}	5V Supply No x	Diagnostics of 5 V encoder supply No. x (x = 1 or 2)	01_{hex}	FF_{hex}
Short circuit or overload at the output	3300_{hex}	Output x	Output x (x = 1 or 2)	01_{hex}	FF_{hex}
Input error of incremental encoder	8600_{hex}	Encoder input signal error	One of the following errors has occurred: • Faulty input signal at the encoder input • Short circuit • No encoder connected	01_{hex}	01_{hex} 02_{hex}
No valid parameterization found in the module's memory	6300_{hex}	ParameterSet not ok	See "6300_{hex}: No valid parameterization found in the module's memory"	01_{hex}	FF_{hex}

Fig. 4-7 Error code and related text for diagnostic messages with "Error" priority

6300_{hex}: No valid parameterization found in the module's memory

This error indicates that no valid parameterization has been found.

This error occurs during a restart of the module when the parameterization is to be loaded from the memory and no valid parameterization has been found.

The error can be reset using object 0019_{hex} (reset diagnostics) or object $002D_{hex}$ (reset parameterization). You can parameterize the channels with object 0080_{hex}. The module functions until the next voltage reset occurs. However, it cannot be guaranteed that the parameterization is stored. We recommend to replace the module.

Resetting the diagnostic counter and the diagnostic status

You can delete the diagnostic counter and the diagnostic status with object 0019_{hex}.

4.1.3.2 Reset Diagnostics (0019_{hex}: ResetDiag)

You can delete the diagnostic memory of the memory and acknowledge the diagnostic messages with this object.

0019_{hex}: ResetDiag (Write)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Unsigned 8	1	Reset diagnostics	00_{hex}	Permit all diagnostic messages
				02_{hex}	Delete and acknowledge all pending diagnostic messages that have not been read out
				05_{hex}	Delete and acknowledge the current diagnostic message
				06_{hex}	Delete and acknowledge the complete diagnostics and does not permit any new diagnostic messages
				Other	Reserved

Fig. 4-8 Reset diagnostics

4.1.4 Objects for Process Data Management

Index [hex]	Object name	Object code	Data type	N	L	Rights	Assignment/meaning
0025	PDIN	Var	Octet string	1	20	R	IN process data: xxxx...; See Chapter 4.1.4.1
0026	PDOUT	Var	Octet string	1	20	R/W	OUT process data: xxxx...; See Chapter 4.1.4.2
0027	GetExRight	Var	Unsigned 8	1	1	R/W	Enable write access to PDOUT
001D	Password	Var	Octet string		Max. 40	W	Password to enable PDOUT

Fig. 4-9 Objects for process data management

4.1.4.1 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 Chapter “IN Process Data” on page 16.

0025_{hex}: PDIN (Read)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
00	Octet string	20	Complete IN process data. The data is transmitted in the same order as in the process data channel.
01	Unsigned 8	1	Status of channel 1 (process data, word 0, bit 15 ... bit 8)
02	Unsigned 8	1	Status of channel 2 (process data, word 0, bit 7 ... bit 0)
03	Octet string	2	Status of digital inputs (process data, word 1, bit 15 ... bit 8)
04	Unsigned 32	4	Position value of channel 1
05	Unsigned 32	4	Latch value of channel 1
06	Unsigned 32	4	Position value of channel 2
07	Unsigned 32	4	Latch value of channel 2

Fig. 4-10 IN process data

Parameters, Diagnostics and Information

4.1.4.2 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 Chapter “OUT Process Data” on page 15.

0026_{hex}: PDOUT (Read/Write)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
00	Octet string	20	Complete OUT process data. The data is transmitted in the same order as in the process data channel. All output data is transmitted, including the unused data.
01	Unsigned 8	1	Control byte of channel 1
02	Unsigned 8	1	Control byte of channel 2
03	Octet string	18	Reserved

Fig. 4-11 OUT process data

4.1.4.3 Get Exclusive Rights (0027_{hex}: GetExRight)

You can request exclusive rights for writing the OUT process data via the PDI channel with this object. Following a positive confirmation, the data is no longer updated via the process data channel, but is only available via the PDI channel. The OUT process data is changed with the OUT process data object (see also Chapter “Controlling the Process Data via the PDI Channel” on page 25).

⚠ WARNING **Disregarding the following information may result in malfunction**

- The exclusive rights are reset each time a connection is aborted or the bus is reset.
- This action may have serious consequences for the connected process. This is why this object is password-protected.

0027_{hex}: GetExRight (Read, write)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Unsigned 8	1	Get exclusive rights	00_{hex}	Transmit OUT process data via the process data channel
				01_{hex}	Transmit OUT process data via the PDI channel
				Other	Reserved

Fig. 4-12 Get exclusive rights

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

You can transmit a password with this object. For example, you can enable the writing of OUT process data via the PDI channel (see also Chapter “Controlling the Process Data via the PDI Channel” on page 25).

The password for this module is “Superuser”.

$001D_{hex}$: Password (Write)			
Subindex	**Data type**	**Length in bytes**	**Meaning**
0	Octet string	Max. 40	Password

Fig. 4-13 Password

4.1.5 Controlling the Process Data via the PDI Channel

You can always read IN process data with the Read IN process data object (0025_{hex}).

You can always read OUT process data with the Read OUT process data object (0026_{hex}).

To overwrite the OUT process data of the module via the PDI channel, you have to enable this option first. To do this, proceed as follows:

- Enter the correct password (“Superuser” as ASCII characters ($53\ 75\ 70\ 65\ 72\ 75\ 73\ 65\ 72_{hex}$)) into the Password object ($001D_{hex}$).
- Change access from the process data channel to the parameter channel. To do this, write the value 01_{hex} to the Get exclusive rights object (0027_{hex}).

If both steps are carried out correctly, it is only possible to modify the OUT process data via write access to object 0026_{hex} (PDOUT). Process data which is sent via the process data channel to the module is not taken into consideration by the module and does not have any effect so that a collision of values is avoided.

If you wish to set the process data again using the process data channel, proceed as follows:

- Enter the correct password (“Superuser” as ASCII characters ($53\ 75\ 70\ 65\ 72\ 75\ 73\ 65\ 72_{hex}$)) into the Password object ($001D_{hex}$).
- Change access from the parameter channel to the process data channel. To do this, write the value 00_{hex} to the Get exclusive rights object (0027_{hex}).

Access via the process data channel is always enabled after a module restart (voltage reset) or reset to the default settings.

Before you can access the Get exclusive rights object (0027_{hex}), you have to enter the valid password in the Password object ($001D_{hex}$), even if the write access is returned via PDI. This prevents unintentional writing to the Get exclusive rights object (0027_{hex}).

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4.1.6 Objects for Device Management

Index [hex]	Object name	Object code	Data type	N	L	Rights	Assignment
002D	ResetParam	Var	Unsigned 8	1	1	W	Reset parameterization

Fig. 4-14 Objects for device management

4.1.6.1 Reset parameterization ($002D_{hex}$: ResetParam)

You can reset the module parameterization to the default settings using this object.

$002D_{hex}$: ResetParam (Write)					
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**	
0	Unsigned 8	1	Reset parameterization	00_{hex}	No action
				01_{hex}	Module is reset to the default settings
				Other	Reserved

Fig. 4-15 Reset parameterization

The following steps are carried when resetting the parameterization:

- Loading the default parameterization to both channels
- Resetting the parameterization memory to the default settings
- Deleting all stored position values
- Setting the current positions to 0
- Deleting diagnostics that are not related to the hardware of the module (overflow, etc.)

4.2 Application Objects

These objects can be used to specify device-specific parameters or to read device-specific data.

Index [hex]	Object name	Object code	Data type	N	L	Rights	Assignment
0080	ParamTable	Record				R/W	Parameter table; see page 27
0092	RefPosValues	Array	Unsigned 32	2 (10)	4	R	Position when setting the reference value; see page 31

Fig. 4-16 Application objects

In the engineering tool, the parameters can be selected via a pull-down menu. If you do not use an engineering tool, parameterize the module using PDI objects.

4.2.1 Parameter Table (0080_{hex}: ParaTable)

Parameterize the module using this object.

Parameterize the complete module when you access via subindex 0.
Parameterize a single channel when you access via the subindexes 1 or 2.

The written parameter record is stored in the module and reloaded from the memory when the module is powered up.

The current states and counter values are reset with the parameterization and the current channel configuration is reloaded. This is also true when only a single channel is parameterized via the subindexes.

0080_{hex}: ParamTable (Read, write)				
Subindex	**Data type**	**Length in bytes**	**Meaning**	**Contents**
0	Record	28	Parameterization of the entire module The parameter records for channel 1 and 2 are transmitted one after the other.	See subindexes
3	Record	14	Parameter record for channel 1	See "Structure of a parameter record for one channel" on page 28
4	Record	14	Parameter record for channel 2	

Fig. 4-17 Parameter table

Set all reserved bits to 0 in the parameter table.

Parameters, Diagnostics and Information

Structure of a parameter record for one channel

Word x															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
First byte transmitted								Second byte transmitted							

Word 0															
15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
RefZSetMode		RefPDEnaMode	EncTyp	SampRate		AxTyp	ChActv	LatchMode				RefMode			

Word 1
Num
Word 2
Denom
Word 3
RefVal word 1 (high word)
Word 4
RefVal word 0 (low word)
Word 5
ModuloVal word 1 (high word)
Word 6
ModuloVal word 0 (low word)

Word/ bit	Designation	Length	Used with axis type l = linear r = rotary	Description		Default
Word 0						
15, 14	RefZSet-Mode	2 bits	l, r		Setting the reference point Only relevant if referencing to the Z signal has been selected (RefMode > 07_{hex})	
				00_{bin}	Disabled	00_{bin}
				01_{bin}	Setting the reference point if the reference input *Ref* = 1	
				10_{bin}	Setting the reference point if the reference input *Ref* = 0	
				11_{bin}	Reserved	
13	RefPDEna Mode	1 bit	l, r		Enabling the reference mode (*RefMode*)	
				0_{bin}	One-time referencing if Enable_Refx 0 ⟶ 1	0_{bin}
				1_{bin}	Permanent referencing if Enable_Refx = 1	
12	EncTyp	1 bit	l, r		Encoder type (connection)	
				0_{bin}	Symmetrical	0_{bin}
				1_{bin}	Asymmetrical	

Fig. 4-18 Meaning of the bits

Word/ bit	Designation	Length	Used with axis type l = linear r = rotary	Description		Default
11, 10	SampRate	2 bits	l, r		Scanning rate	
				00_{bin}	Reserved	
				01_{bin}	Reserved	
				10_{bin}	Double	
				11_{bin}	Quadruple	11_{bin}
9	AxTyp	1 bit	l, r		Axis type	
				0_{bin}	Linear	0_{bin}
				1_{bin}	Rotary	
8	ChActv	1 bit	l, r		Active or inactive channel (affects monitoring and error messages)	
				0_{bin}	Channel inactive	0_{bin}
				1_{bin}	Channel active Activate the channel only if an encoder is connected, otherwise you will get the error message 8600_{hex} (see Fig. 4-7 on page 22).	
7 ... 4	LatchMode	4 bits	l, r		Evaluation of the latch input	
				00_{hex}	Function off	00_{hex}
				01_{hex}	Rising edge at latch input	
				02_{hex}	Falling edge at latch input	
				03_{hex}	Rising edge at latch input, positive direction only	
				04_{hex}	Falling edge at latch input, positive direction only	
				05_{hex}	Rising edge at latch input, negative direction only	
				06_{hex}	Falling edge at latch input, negative direction only	
				07_{hex}	Z signal without direction evaluation	
				08_{hex}	Z signal, positive direction only	
				09_{hex}	Z signal, negative direction only	
				$0A_{hex}$ ... $0F_{hex}$	Reserved	

Fig. 4-18 Meaning of the bits

Parameters, Diagnostics and Information

Word/ bit	Designation	Length	Used with axis type l = linear r = rotary	Description		Default
3 ... 0	RefMode	4 bits	l, r		Referencing type: evaluation of process data, the reference input or Z signal (see also Chapter “Referencing” on page 9)	
				00_{hex}	Referencing via process data	00_{hex}
				01_{hex}	Referencing to the rising edge of the signal at the reference input	
				02_{hex}	Referencing to the falling edge of the signal at the reference input	
				03_{hex}	Referencing to the rising edge of the signal at the reference input in positive direction	
				04_{hex}	Referencing to the falling edge of the signal at the reference input in positive direction	
				05_{hex}	Referencing to the rising edge of the signal at the reference input in negative direction	
				06_{hex}	Referencing to the falling edge of the signal at the reference input in negative direction	
				07_{hex}	Referencing to the Z signal without direction evaluation	
				08_{hex}	Referencing to the Z signal in positive direction	
				09_{hex}	Referencing to the Z signal in negative direction	
				$0A_{hex}$ ... $0F_{hex}$	Reserved	
Word 1 ... word 6						
Word 1	Num	16 bits	l, r		Numerator of the conversion factor Value range: 1 ... 2^{16}-1 (see also Chapter “Conversion factor” on page 7)	1
Word 2	Denom	16 bits	l, r		Denominator of the conversion factor Value range: 1 ... 2^{16}-1 (see also Chapter “Conversion factor” on page 7)	1
Words 3, 4	RefVal	32 bits	l, r		Reference value Value range: 0 ... 2^{32}-1	0
Words 5, 6	ModuloVal	32 bits	r		Modulo value (number of pulses per rotation of the rotary axis - 1) Value range: 0 ... 2^{32}-1	1000

Fig. 4-18 Meaning of the bits

4.2.2 Reference Positions Object (0092_{hex}: RefPosValues)

You can read the last reference positions of the channels with this object.

Read all values when you access via subindex 0.
Read the reference position of a channel when you access via subindexes 1 or 2.

0092_{hex}: RefPosValues (Read)			
Subindex	**Data type**	**Length in bytes**	**Meaning/contents**
0	Array of simple variable	8	Saved reference position of both channels
1	Simple variable	4	Saved reference position of channel 1
2	Simple variable	4	Saved reference position of channel 2

Fig. 4-19 Reference positions

The values are always transmitted by taking the conversion factor into account. The values are transmitted as 32-bit integer values. Decimal places are not considered.

Parameters, Diagnostics and Information

5 Disposal

5.1 Take-Back

Our products can be returned to our premises free of charge for disposal. However, the products must be free of impurities like oil, grease or other impurities.

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

Send the products "free domicile" to the following address:

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

5.2 Package

The packaging materials consist of cardboard, plastic material, wood or expanded polystyrene (EPS). The packaging materials can be recycled without any problem.

For ecological reasons, please refrain from returning the empty packages to us.

Disposal

6 Service and Support

We provide a worldwide service network for an optimum and fast support of your needs. Our experts are there for you. You can contact us 24/7.

Service Germany

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

Contact the Service Helpdesk & Hotline 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 service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

We can help you more quickly and efficiently if you have the following information ready:

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

Service and Support

Notes

The Drive & Control Company

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Bosch Group

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