FACTORY AUTOMATION

Manual

Absolute rotary encoder P**58

PROFIBUS interface

PEPPERL+FUCHS

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Indroduction

Impressum

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1 General

This manual describes commissioning and configuration of the absolute rotary encoder with PROFIBUS DP interface. The device satisfies requirements for a PROFIBUS slave according to the PROFIBUS standard and is certified by the PROFIBUS user organisation.

1.1 Declaration of conformity

Absolute rotary encoders of Series P**58 are developed and manufactured taking into consideration applicable European standards and directives.

Note

A corresponding declaration of conformity may be requested from the manufacturer.

The manufacturer of the product, Pepperl+Fuchs GmbH in D-68301 Mannheim, has a certified quality assurance program in accordane with ISO 9001.

ISO9001

1.2 Working principle

The basic principle of recording absolute measurement values is optical sensing of a transparent disk with a printed code that is connected to the shaft to be measured. The position of the shaft can be determined by evaluating the code at a resolution of up to 65,536 increments or "steps" per revolution (16 bits).

In the case of Multiturn devices, additional code disks can be included in the circuit with ratio reduction gears, which can be used to determine the absolute rotation speed of the shaft (up to 16,384 revolutions = 14 bits).

In the case of an absolute rotary encoder with a PROFIBUS interface, the optically recorded position value is calculated in an integrated microprocessor and is transferred with the PROFIBUS.

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1.3 PROFIBUS technology

PROFIBUS is a manufacturer independent, open fieldbus standard specified by international standards EN 50170 and EN 50254. There are 3 versions: DP, FMS and PA. The rotary encoders support the DP versions and are designed for commonly used transfer rate up to 12 MBaud.

In addition to manufacturer specific functions, the devices support Classes 1 and 2 according to the encoder profile. This device profile can be ordered from the PROFIBUS user organisation with order number 3.062. Additional information on PROFIBUS (functionality, manufacturer and products) as well as standards and profiles are also available here:

PROFIBUS User Organisation

Haid-und-Neu-Strasse 7

76131 Karlsruhe

Tel.:	+49 721 9658-590
Fax:	+49 721 9658-589
E-mail:	www.profibus.com

1.4 Symbols used

Warning

This symbol warns of a danger. Failure to heed this warning can lead to personal injury or death and/or damage to or destruction of equipment.


Attention

This symbol warns of a possible fault. Failure to observe the instructions given in this warning may result in the device and any facilities or systems connected to it developing a fault or even failing completely.


Note

This symbol draws your attention to important information.

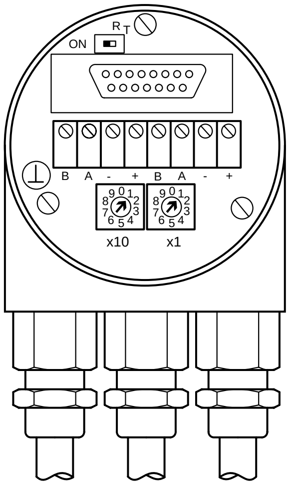
2 Installation

The connection hood is used to connect the rotary encoder. It is connected with a rotary encoder by means of a 15-pin sub-D plug and can be removed by loosening two screws on the back of the device. Bus and power supply lines are directed into the hood through cable glands and connected with screw terminals.

2.1 Settings in the connection hood

2.1.1 Member address

The PROFIBUS member address can be set with decimal rotary switches in the connection hood. The valency (x 10 or x 1) is specified on the switch. Possible addresses are between 1 and 99. Each address can occur only once in the system. The device address is read in by the rotary encoder when the power supply is turned on. Change of address by the master ("Set_Slave_Add") is not supported.



2.1.2 Bus terminator

If the rotary encoder is fitted as a terminal device, then the terminating resistor that is integrated into the device must be switched into the circuit. This is done with the slide switch in the connection hood:

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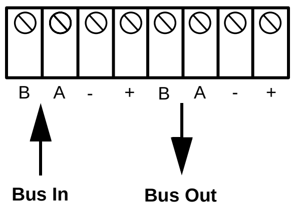
Note

When the terminating resistor is turned on, the rest of the bus (Bus Out) is disconnected.

The bus is not correctly terminated unless the rotary encoder is mounted on the connection hood. If the encoder needs to be replaced while the system is in operation, we recommend using a separate active bus termination.

After the address is set on the hardware side and the power terminating resistor has been switched into the circuit if necessary, the rotary encoder can be placed in operation.

2.2 Connection of signal and power supply lines



Terminal	Explanation
⊥	ground connection for power supply
B (left)	data line B (pair 1), Bus In
A (left)	data line A (pair 1), Bus In
(-)	0 V
(+)	10 V ... 30 V
B (right)	data line B (pair 2), Bus Out
A (right)	data line A (pair 2), Bus Out
(-)	0 V
(+)	10 V ... 30 V

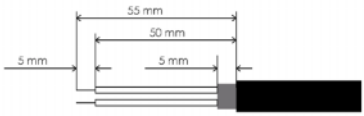
Note

Power supply lines only need to be connected once (no matter to which terminals). When the terminating resistor is turned on, the rest of the bus (Bus Out) is disconnected.

2.3 Wiring of connection hood

Proceed as follows in the wiring:

- Remove the pressure screw, pressure insert and cone from the cable gland.
- Remove about 55 mm of the bus line covering and about 50 mm of the screening mesh.
- Remove about 5 mm of insulation on the individual wires.
- After that, push the pressure screw and pressure insert onto the cable.
- Push the cone under the screen as shown in the drawing.
- Push the pressure screw, pressure insert and cone into the cable gland.
- Then tighten the pressure screw.



2.4 Connecting the screen line

To achieve the best interference immunity possible, the transfer of signals between the system components should be via shielded lines with a shield seating on either side. With certain system configurations an equalisation current can flow through the shield connected on both sides of the cables. Because of this, a potential equalisation line is recommended.

2.5 Notes on mechanical fitting and the electrical connection

Please observe the following items:

Do not drop the rotary encoder or expose it to significant vibration. It is a precision instrument.

Do not open the rotary encoder housing (this does not mean you should not remove the hood). Opening or closing the device improperly may damage it or result in contamination.

The rotary encoder shaft must be connected with the shaft to be measured by means of a suitable coupling. The purpose of this coupling is to absorb blows and imbalances and prevent major forces from reaching the rotary encoder shaft. Suitable couplings are available from Pepperl+Fuchs.

Rotary encoders are sturdy, but they should be protected by suitable protective measures when used in a very harsh environment. In particular, they should not be fitted to make them suitable for holding grips or stepping blocks.

Commissioning and operation of this electrical device must only be performed by qualified personnel. This means persons who are authorised to place devices, systems and circuits in service, ground them and identify them with appropriate markings according to the latest state of fail-safe technology.

No electrical changes must be made to the rotary encoder.

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The connection lines to the rotary encoder must be laid at a great distance (or separated in different compartments) from power lines that could cause interference. To ensure reliable data transfer, completely shielded cables must be used, and care must be taken to ground them properly.

Wiring jobs, and opening or closing electrical connections must only be performed when no voltage is present. Short circuits, voltage spikes and similar phenomena may result in improper functionality and uncontrolled states. They may also cause significant injury to persons or damage to property.

Before turning on the system, check all electrical connections. Connections that are not made correctly can result in improper functionality of the system. Wrong connections may result in significant injury to persons or damage to property.

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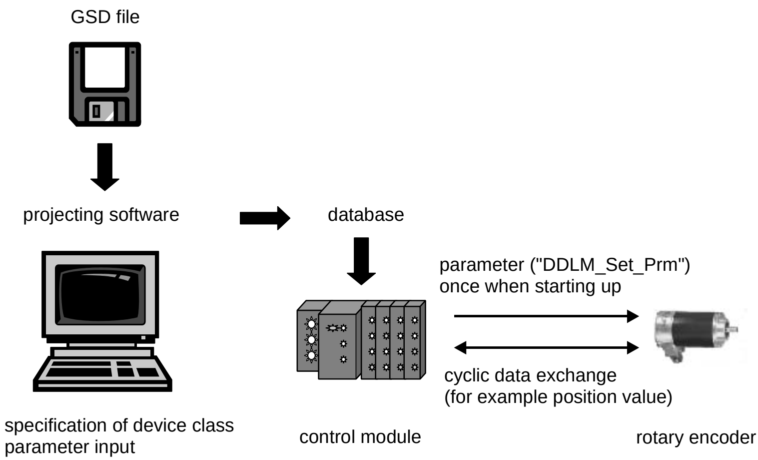
3 Device configuration

The rotary encoder with a PROFIBUS interface can be configured and parameters can be assigned to it according to the needs of the user. For this purpose, the GSD file associated with the device is loaded into the projecting tool. Various "encoder classes" as they are known are then available to select during projecting. The adjustable parameters and functionality of the device depend on the encoder class that is selected. Rotary encoders support all encoder classes described below, i. e. functionality is not limited on the hardware side. It is determined by the user alone. In addition to the encoder classes described in the encoder profile, "Class 1" and "Class 2", rotary encoders of Pepperl+Fuchs also offer additional encoder classes with manufacturer specific functions.

Selecting the encoder class determines configuration and parameter data during projecting. This data that is stored in the PROFIBUS master is transferred to the rotary encoder once when the system starts up (configuration and parameter assignment phase "DDLM_Set_Prm"). It is not possible to change the configuration or parameters while the system is in operation (exception: "Commissioning mode" see section 5.3).

After the configuration and parameter data is received, the rotary encoder goes into "normal mode" (cyclic data exchange – "DDLM_Data_Exchange Modus"). In this mode the position value is transferred, among other things. The length and format of the exchanged data is also specified during projecting when the encoder class is selected.

3.1 Principle of data transfer



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3.2 Overview of encoder classes – functionality

Model number	Cyclic data exchange	Adjustable parameters	Other items
Class 1 singleturn	position value – 16-bit input	direction of rotation	-
Class 1 multiturn	position value – 32-bit input	direction of rotation	-
Class 2 singleturn	position value – 16-bit input preset value – 16-bit output	direction of rotation scaling	preset function
Class 2 multiturn	position value – 32-bit input preset value – 32-bit output	direction of rotation scaling	preset function
P+F 2.1 singleturn	position value (32-bit input) preset value/TEACH-IN (32-bit output)	direction of rotation scaling gear factor reduced diagnostics limit switch	preset function commissioning mode
P+F 2.1 multiturn	position value (32-bit input) preset value/TEACH-IN (32-bit output)	direction of rotation scaling gear factor reduced diagnostics limit switch	preset function commissioning mode
P+F 2.2 singleturn	position value (32-bit input) preset value/TEACH-IN (32-bit output) speed (16-bit input)	direction of rotation scaling gear factor reduced diagnostics limit switch unit of speed output	preset function commissioning mode speed output
P+F 2.2 multiturn	position value (32-bit input) preset value/TEACH-IN (32-bit output) speed (16-bit input)	direction of rotation scaling gear factor reduced diagnostics limit switch unit of speed output	preset function commissioning mode speed output

3.3 Overview of encoder classes – data format

Model number	Configuration (identifier)		Input words (encoder → master)	Output words (master → encoder)	For description see	
	hex	dec.			chap.	page
Class 1 singleturn (based on encoder profile)	D0	208	1	0	4	13
Class 1 multiturn (based on encoder profile)	D1	209	2	0		
Class 2 singleturn (based on encoder profile)	F0	240	1	1		
Class 2 multiturn (based on encoder profile)	F1	241	2	2		
P+F 2.1 singleturn	F1	241	2	2	5	17
P+F 2.1 multiturn	F1	241	2	2		
P+F 2.2 singleturn	F1 D0	241 208	2 1	2		
P+F 2.2 multiturn	F1 D0	241 208	2 1	2		

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4 Encoder classes of the PROFIBUS user organisation

Encoder classes Class 1 and Class 2 are different versions based on the encoder profile specified by the Encoder working group in the PROFIBUS user organisation (available from the PROFIBUS user organisation under order number 3.062).

4.1 Parameter assignment

The following table contains an overview of parameters that can be set using the encoder profile together with their layout in the parameter assignment telegram. Since parameters can generally be set by means of user-friendly input masks in the projecting tool, a detailed description of the parameter assignment telegram is typically not of interest to users.

Octet no.	Parameter	Bit no.	Details
1 ... 8	PROFIBUS standard parameter		
9	direction of rotation	0	section 4.1.1, page 13
	class 2 functionality	1	section 4.1.2, page 14
	commissioning diagnostics	2	section 4.1.3, page 14
	scaling function	3	section 4.1.4, page 14
	reserved	4	
	reserved	5	
	not used for Class 1 and Class 2	6	
	not used for Class 1 and Class 2	7	
10 ... 13	measurement steps/revolution		section 4.1.5, page 14
14 ... 17	overall resolution		section 4.1.6, page 15
18 ... 25	reserved (according to encoder profile)		
26 ...	not used for Class 1 and Class 2 (see versions P+F 2.1 and 2.2)		

4.1.1 Direction of rotation

The direction of rotation defines the counting direction of the output of the actual process value when the shaft is turning clockwise (cw) or counterclockwise (ccw) as seen when facing the shaft. The counting direction is specified by Bit 0 in Octet 9:

Octet 9 Bit 0	Direction of rotation (facing the shaft)	Output code
0	clockwise (cw)	rising
1	counterclockwise (ccw)	rising

Note

If Class 1 is selected, only the direction of rotation can be changed by parameter.

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4.1.2 Class 2 functionality

This switch can be used to limit rotary encoders with Class 2 functionality to Class 1 functionality. In other words, the capability to assign parameters is turned off. To use the functions of Class 2 rotary encoders, Bit 1 in Octet 9 must be set.

Octet 9 Bit 1	Class 2 functionality
0	turned off
1	turned on

4.1.3 Commissioning diagnostics

This function has no meaning for the Pepperl+Fuchs rotary encoder.

4.1.4 Scaling function

The scaling function enables parameter assignment of resolution per revolution and the selected overall resolution. This switch should always be turned on if you would like to use the functions of Class 2 (or of manufacturer specific classes).

Octet 9 Bit 3	Scaling function
0	turned off
1	turned on

4.1.5 Measurement steps per revolution

The "Measurement steps per revolution" is used to assign a desired number of steps in reference to 1 revolution to the rotary encoder.

If the value of the parameter exceeds the actual (physical) basic resolution of the encoder, the output value no longer consists of one step. In this case, a parameter error is displayed and the device does not switch into cyclic data exchange.

	Desired number of measurement steps per revolution			
Octet	10	11	12	13
Bit	31 ... 24	23 ... 16	15 ... 8	7 ... 0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

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4.1.6 Overall resolution

The "Overall resolution" parameter allows users to adjust the measurement range of the device: The rotary encoder increments up to the overall resolution assigned by parameter and then starts again at 0.

	Selected overall resolution in measurement steps			
Octet	14	15	16	17
Bit	31 ... 24	23 ... 16	15 ... 8	7 ... 0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

Example: If 100 steps have been selected per revolution with an overall resolution of 12,800, the rotary encoder starts again at zero after 128 revolutions and then counts up to 11,799 again.

For many projecting tools, the value must be divided up into high word and low word; for more information see also section 7.4, page 34

When entering the "Overall resolution" parameter, note also the following:

Note

If n steps have been selected per revolution, the overall resolution that is selected must not result in the period being longer than the maximum available (physical) number of revolutions of the device (see manufacturer's rating plate), i. e. for a Multiturn device running at 16,384 revolutions, the device resolution must be less than 16,384 times the number of steps per revolution set by parameter:

Overall resolution < measurement steps per revolution x number of revolutions (physical)

If this is not taken into consideration, the device indicates a parameter error and does not switch into cyclic data exchange.

*The period and thus the **overall resolution/measurement steps per revolution** must be an integer number. In addition, when 16,384 is divided by it, the result must be an even number (integer division with no remainder). The following expression must thus be true:*

(16,384 x measurement steps per revolution)/overall resolution = integer number

4.2 Data exchange in normal operation

The so-called DDLM_Data_Exchange mode is the normal state of operation for the system. On request, the rotary encoder sends current (position) values to the master. Vice versa, the rotary encoder is also capable of receiving cyclic data (for example the preset value for a Class 2 encoder).

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4.2.1 Transferring the actual process value

In the case of a Multiturn encoder, the current position value is transferred to the master as a 32 bit value (double word):

Similarly, transfer for a Singleturn encoder is as a 16 bit value (word).

Word	word 1																word 0															
Function	status bits							actual process value																								
Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	0	0	0	0	0	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

4.2.2 Preset function

The Preset function can be used to adjust the encoder zero point to the mechanical zero point of the system. Setting the preset value sets the actual value of the rotary encoder to the desired "Preset value". The necessary zero point offset is calculated by the device and stored zero-voltage-safe in an EEPROM (requires less than 40 ms).

The preset value is activated by Bit 31 in the (peripheral) output double word (accepted with a rising edge). The preset value must be set after the scaling parameters are transferred, i. e. the preset value refers to the actual scaled value.

(The procedure can be applied to the Singleturn version with appropriate changes – in this case, Bit 15 is used to activate the preset value.)

		Status bits							**Data bits**																								
	Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Master → Encoder		**1**	0	0	0	0	0	0	transfer of desired value (= Preset value)																								
Encoder → Master		0	0	0	0	0	0	0	new = desired actual process value is transferred																								
Master → Encoder		0	0	0	0	0	0	0	reset Bit 31 – normal mode																								
Encoder → Master		0	0	0	0	0	0	0	new = desired actual process value is transferred																								

If very high precision is required, the preset value should only be set when the rotary encoder shaft is at rest. If the shaft moves very rapidly during this time, there may be shifts, since run times may occur through the bus while the preset value is being set.

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5 Manufacturer specific encoder classes

With manufacturer specific encoder classes P+F 2.1 and P+F 2.2, the rotary encoder offers, in addition to functions based on the encoder profile of the PROFIBUS user organisation, functions such as commissioning mode (TEACH-IN), speed output and limit switches.

The following table describes transfer of individual parameters in the parameter assignment telegram. Note also the following: Users will generally be using user-friendly input masks in the projecting tool. The structure of the parameter assignment telegram itself is only of interest in exceptional cases.

Octet no.	Parameter	Bit no.	Details
1 ... 8	PROFIBUS standard parameter		
9	direction of rotation	0	section 4.1.1, page 13
	Class 2 functionality	1	section 4.1.2, page 14
	commissioning diagnostics	2	section 4.1.3, page 14
	scaling function	3	section 4.1.4, page 14
	reserved	4	
	reserved	5	
	activate manufacturer specific parameters (Octet 26)	6	section 5.1.1, page 18
	reserved	7	
10 ... 13	desired measurement steps (reference: Octet 26 Bits 0 and 1)		section 5.1.2, page 18
14 ... 17	overall resolution		section 4.1.6, page 15
18 ... 25	reserved (according to encoder profile)		
26	reference for desired measurement steps	0 1	section 5.1.3, page 19
	activate commissioning mode	2	section 5.1.4, page 20
	reduced diagnostics	3	section 5.1.5, page 20
	reserved	4	
	activate lower software limit switch	5	section 5.1.6, page 20
	activate upper software limit switch	6	section 5.1.6, page 20
	activation of parameters starting at Octet 27	7	section 5.1.1, page 18
27 ... 30	lower limit switch		section 5.1.6, page 20
31 ... 34	upper limit switch		section 5.1.6, page 20
35 ... 38	physical measurement steps		section 5.1.7, page 21
39	reserved	0	
	rotary encoder type (singleturn or multiturn)	1	section 5.1.8, page 22
	reserved	2	
	reserved	3	
	selection of unit of measure for speed output	4 5	section 5.1.9, page 22
	reserved	6	
	reserved	7	

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5.1 Parameters

Manufacturer specific parameters are described in greater detail below. For a description of parameters based on the encoder profile (that are also supported), see section 4.

5.1.1 Activation of manufacturer specific parameters

- The manufacturer specific parameter byte 26 is activated with Bit 6 in Octet 9.
- Manufacturer specific Octets 27 ... 39 are further activated in Octet 26.

If Encoder class P+F 2.1 or P+F 2.2 is selected, this happens automatically. These bits only need to be considered if parameters are assigned "manually" in hexadecimal.

Octet 9 Bit 6	Octet 26
0	deactivated
1	activated

Octet 26 Bit 7	Octet 27 ... 39
0	deactivated
1	activated

5.1.2 Desired measurement steps

The parameter "Desired measurement steps" is used to program the device so that any number of measurement steps can be implemented in reference to one revolution, the entire measurement range or any given partial measurement range.

	Desired measurement steps			
Octet	10	11	12	13
Bit	31 ... 24	23 ... 16	15 ... 8	7 ... 0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

What the measurement steps refer to is specified with the parameter "Resolution reference" (see section 5.1.3). If "per revolution" is selected here as the reference for the desired measurement steps, the measurement range can be adjusted with the parameter "Overall resolution". The rules listed in section 4.1.6 must be taken into consideration for this.

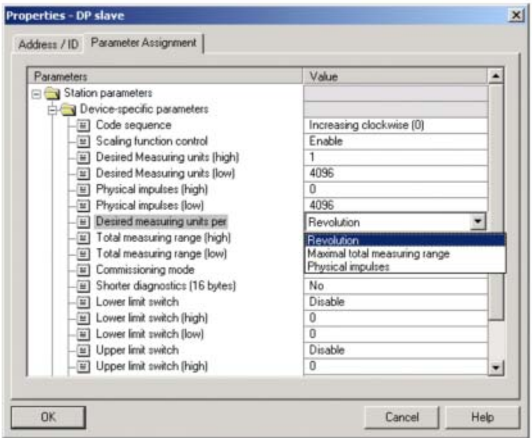
Note

For many projecting tools, the value must be divided up into high word and low word; for more information see section 7.4, page 34.

5.1.3 Resolution reference

This parameter is used to specify what the "desired measurement steps" that are entered should refer to (see section 5.1.2):

- Revolution
- maximum overall resolution
- Physical measurement steps



Desired resolution per revolution

In this case the position value is set in such a manner that it is incremented by the number of desired measurement steps for each revolution. In addition, in this case the "Overall resolution" parameter is evaluated. It can be used to adjust the measurement range (see section 4.1.6).

Desired resolution per maximum overall resolution

The desired measurement steps that are entered refer to the entire measurement range of the device, i. e. the device generates the number of measurement steps assigned by parameter over the entire (physical) number of revolutions.

Desired resolution per physical measurement steps

In this case, the desired number of steps refers to the physical measurement steps entered with the "Physical measurement steps" parameter (see also section 5.1.7). In this context, physical steps means the numeric value that is read internally from the code disk by the rotary encoder (for example 4,096 steps per revolution for the standard 12 bit version). Gear factors can be freely set with this option.

Reference	Octet 26 Bit 0	Octet 26 Bit 1
per revolution	0	0
per maximum overall resolution	1	0
per physical measurement steps (= steps specified in Octet 35 ... 38)	0	1

5.1.4 Activate commissioning mode

Bit 2 in Octet 26 represents a switch for "commissioning mode". Commissioning mode is a special state of the device in which additional parameters beyond the Preset value can be transferred to the rotary encoder. When commissioning mode is activated, you can perform "TEACH-IN", a form of programming in which the gear factor can be determined by moving the system directly. In this mode (recognisable by the flashing green LED) the direction of rotation and scaling set during projecting are ignored. Instead of them, values stored internally in EEPROM are used.

The device can also be operated long term in commissioning mode. We recommend, however, that you transfer the parameters determined in commissioning mode to projecting and then use the device in normal mode. (This makes it possible to replace the device without having to perform TEACH-IN again).

For a detailed description of commissioning mode, please refer to section 5.3.

Octet 26 Bit 2	Commissioning mode
0	turned off
1	turned on

5.1.5 Reduced diagnostics

For many PROFIBUS masters, the full number of diagnostic bytes (standard diagnostics: 57 bytes) may lead to problems. Often older masters in particular cannot work with the full number of diagnostic bytes. With rotary encoders, there is the possibility of reducing the number of diagnostic bytes generated by the rotary encoder to 16. If "Class 1" is selected as the device class, only 16 diagnostic bytes will be generated.

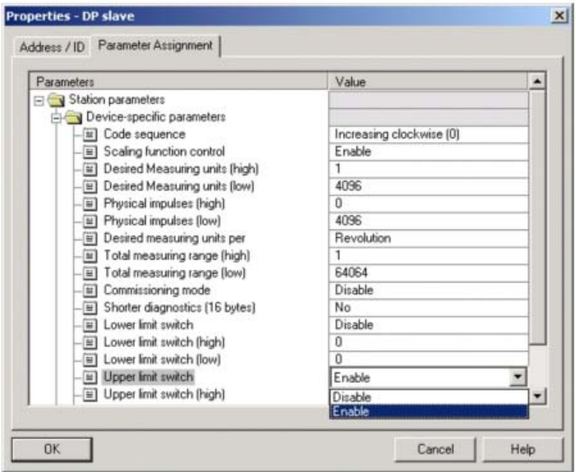
Octet 26 Bit 3	Diagnostic data length
0	standard = 57 bytes
1	reduced = 16 bytes

5.1.6 Software limit switches

Two positions can be programmed. If the value falls above or below these limits respectively, the absolute encoder sets Bit 27 to "1" in the 32-bit actual process value. The bit is set to "0" between these two positions. Both limit switch values can be set as desired with parameter assignment, but they must not exceed the value of the "Overall resolution" parameter. Limit switches are activated via Bits 5 and 6 in Octet 26.

Octet 26 Bit 5	Lower limit switch
0	turned off
1	turned on

Octet 26 Bit 6	Upper limit switch
0	turned off
1	turned on



For many projecting tools, values must be divided up into high word and low word; for more information see section 7.4, page 34

	Lower limit switch in measurement steps (in reference to scaled value)			
Octet	27	28	29	30
Bit	31 ... 24	23 ... 16	15 ... 8	7 ... 0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

	Upper limit switch in measurement steps (in reference to scaled value)			
Octet	31	32	33	34
Bit	31 ... 24	23 ... 16	15 ... 8	7 ... 0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

5.1.7 Physical measurement steps

This parameter is evaluated by the device if "Physical measurement steps" was selected as the reference for the desired measurement steps
(see section 5.1.3).

A gear factor can be freely selected using "Physical measurement steps". The user specifies in this process how many measurement steps ("Desired measurement steps") should be generated for a specified partial measurement range. This option is helpful if you will be entering "uneven" scaling factors.

	Physical measurement steps			
Octet	35	36	37	38
Bit	31 ... 24	23 ... 16	15 ... 8	7 ... 0
Data	2^{31} to 2^{24}	2^{23} to 2^{16}	2^{15} to 2^{8}	2^{7} to 2^{0}

Example:

Problem: The rotary encoder must generate 400 steps over 3 revolutions.

This number of steps cannot be set with the "Desired measurement steps per revolution" reference (the "Desired measurement steps" would have to contain the value 133,333 but only whole numbers can be entered in this case).

Solution:

"Physical measurement steps" is selected as a reference for the desired number of steps.

The number of physical measurement steps over the desired measurement range is determined based on the actual (physical) resolution of the device (see the manufacturer's rating plate). For an absolute encoder with a standard resolution of 12 bits, for example, this would be

4,096 steps/revolution x 3 revolutions = 12,288 steps in this case

This value is then entered as the "Physical measurement steps" parameter and the actual number of steps desired, 400, is entered under "Desired measurement steps". The rotary encoder now generates 400 steps for a measurement range of 12,288 physical steps (i. e. for 3 revolutions).

Note

For many projecting tools, the value must be divided up into high word and low word; for more information see also section 7.4, page 34

5.1.8 Rotary encoder type

The type of rotary encoder (singleturn or multiturn) is specified in Bit 1 of Octet 39. This happens automatically if the encoder class is selected. The user only needs to make note of this parameter if parameter assignment is made directly in hexadecimal.

Octet 39 Bit 1	Type
0	singleturn
1	multiturn

5.1.9 Unit of measure for speed

You can use this parameter to adjust the unit for speed output (Class P+F 2.2). This base value will be stored in Bits 4 and 5 of Octet 39.

Unit	Bit 4	Bit 5
steps/second	0	0
steps/100 ms	1	0
steps/10 ms	0	1
revolutions/minute	1	1

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5.2 Data exchange in normal mode

For manufacturer specific encoder classes P+F 2.1 and P+F 2.2, the actual process value is transferred as a 32-bit value (double word). In addition to 25 bits that are used for the position value, another 7 bits are used as status bits. The master sends the Preset value to the rotary encoder along with the control bits in the (periphery) output double word.

The current speed value is transferred as well in an additional (periphery) input word in device class P+F 2.2:

Identifier	**F1 hex**				**D0 hex**	
Enc. → Master	status + actual position value				speed	
	status + 2^{24}	2^{23} ... 2^{16}	2^{15} ... 2^{8}	2^{7} ... 2^{0}	2^{15} ... 2^{8}	2^{7} ... 2^{0}

Master → Encoder	**Preset value + control bits**			
	control + 2^{24}	2^{23} ... 2^{16}	2^{15} ... 2^{8}	2^{7} ... 2^{0}

The meanings of the status bits in the input double word are as follow:

<table>
<tr><th rowspan="5">Bit 28</th><th rowspan="4">Bit 27</th><th rowspan="3">Bit 26</th><th rowspan="2">Bit 25</th><th>Meaning</th></tr>
<tr><td>ready for operation
0 = rotary encoder not ready for operation
1 = rotary encoder ready for operation</td></tr>
<tr><td colspan="2">operating mode
0 = commissioning mode
1 = normal mode</td></tr>
<tr><td colspan="3">software limit switch
0 = lower limit switch = actual value = upper limit switch
1 = actual value > upper limit switch or actual value < lower limit switch</td></tr>
<tr><td colspan="4">direction of rotation
0 = rising clockwise (as seen facing the shaft)
1 = rising counterclockwise (as seen facing the shaft)</td></tr>
</table>

5.3 Commissioning mode

If the rotary encoder is switched into commissioning mode using parameter assignment, gear factors can be determined directly on the system using a process called "TEACH-IN".

Commissioning mode is indicated by the rotary encoder by the flashing green LED in the connection hood and by Bit 26 in the input double word (set to 0).

In commissioning mode, parameters set in projecting mode (direction of rotation and scaling) are ignored. Instead of them, values stored internally in EEPROM are used. If the direction of rotation and gear factor are changed in commissioning mode, the new values are stored in EEPROM and the device will then use these new values.

The main procedure in commissioning mode is as follows:

- Install the device into the system.
- Turn on commissioning mode with parameter assignment (see section 5.1.4).
- If necessary, adjust the direction of rotation.
- Move the system to its initial position.
- Transfer the Start command for TEACH-IN to the rotary encoder.
- Move the system to its end position.
- Use the TEACH-IN stop command to transfer the desired number of steps to the rotary encoder.
- The preset value is set.
- Transfer the values determined in TEACH-IN to projecting (parameters).
- Commissioning mode is turned off in parameter assignment.

5.3.1 Setting the direction of rotation

The direction of rotation in which the output code rises can be changed online in commissioning mode. The current direction of rotation is displayed with Bit 28 in the input double word (0: rising/1: falling, clockwise). The direction of rotation can be changed with Bit 28 in the output double word.

		Status bits							Data bits																								
	Bit	31	30	29	**28**	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Master → Encoder		0	0	0	**1**	0	0	0	changeover of direction of rotation via Bit 28																								
Encoder → Master		0	0	0	**0/1**	0	0	1	rotary encoder acknowledged in Bit 0 and Bit 28 with new direction of rotation																								**0/1**
Master → Encoder		0	0	0	**0**	0	0	0	changeover is ended by resetting Bit 28																								
Encoder → Master		0	0	0	**0/1**	X	0	1	output of actual process value with modified direction of rotation																								

The direction of rotation that is set is saved zero-voltage-safe in EEPROM.

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5.3.2 TEACH-IN start

After the system has been moved to the beginning of the measurement range, the TEACH-IN start command is transferred to the rotary encoder. The device will now start the measurement for determining the gear factor internally.

	Status bits							Data bits
Bit	31	**30**	29	28	27	26	25	24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Master → Encoder	0	**1**	0	0	0	0	0	start of TEACH-IN by setting Bit 30
Encoder → Master	0	**1**	0	X	X	0	1	rotary encoder acknowledges start of TEACH-IN by setting Bit 30
Master → Encoder	0	**0**	0	0	0	0	0	reset Bit 30
Encoder → Master	0	**1**	0	X	X	0	1	output of uncalculated feedback value (gear factor = 1, Preset not active)

Note

The gear factor is set to 1 internally; the zero point offset is deleted.

5.3.3 TEACH-IN stop

After the system is moved over the measurement range with the TEACH-IN stop command, the number of steps desired over the measurement path must be transferred. Care should be taken that the physical resolution is not exceeded. Positive and negative direction as well as the zero point having been exceeded are automatically taken into consideration. The measurement path that is traversed must not exceed 2,047 revolutions.

In response to the TEACH-IN stop command, the rotary encoder transfers the overall resolution calculated by the device. This value should be noted and accepted later for normal operation of the system in projecting/parameter assignment.

After this procedure, the device works with the new scaling factor that has just been determined. It is stored zero-voltage-safe in EEPROM.

	Status bits							Data bits
Bit	31	30	**29**	28	27	26	25	24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Master → Encoder	0	0	**1**	0	0	0	0	number of desired steps via measurement path traversed
Encoder → Master	0	1	**1**	X	X	0	1	determination of overall resolution for new gear factor (should be noted for later reference)
Master → Encoder	0	0	**0**	0	0	0	0	reset Bit 29
Encoder → Master	0	0	**0**	X	X	0	1	output of actual value calculated with the new gear factor

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To make it possible to replace the encoder later without having to repeat the TEACH-IN procedure, the overall resolution determined by the encoder should be transferred to projecting. This is done by entering the overall resolution that was determined during TEACH-IN (and noted for future reference) in the parameter field "Desired measurement steps" (see section 5.1.2) and then setting the "Resolution reference" switch to "Maximum overall resolution" (see section 5.1.3). Care must be taken in the reconfiguration that the direction of rotation (see section 4.1.1) is entered correctly. The setting in commissioning mode must also be observed when assigning parameters. Then commissioning mode can be turned off with parameter assignment. The rotary encoder is now used in "normal mode".

5.3.4 Preset value

The preset value can be set in a manner similar to the procedure described in section 4.2.2. The only difference is that setting of the preset value is confirmed for manufacturer specific classes P+F 2.1 and P+F 2.2 by a status bit:

		Status bits							**Data bits**																								
	Bit	**31**	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Master → Encoder		**1**	0	0	0	0	0	0	transfer of desired value (= Preset value)																								
Encoder → Master		**1**	0	0	0	0	0	1	new = desired actual process value is transferred																								
Master → Encoder		0	0	0	0	0	0	0	reset Bit 31 – normal mode																								
Encoder → Master		0	0	0	0	0	0	1	new = desired actual process value is transferred																								

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6 Diagnostic messages

6.1 Overview

In the "DDLM_Slave_Diag" operating mode, diagnostic data is transferred from the rotary encoder to the master on request. The number of diagnostic bytes is 57. Exception: Reduced diagnostics (see section 5.1.5). Output of diagnostic data is based on the specifications of the PROFIBUS standard (Octets 1 ... 6) or on the encoder profile (starting at Octet 7).

Diagnostic function	Data type	Diagnostic Octet number	Encoder class
Station status 1 (see: PROFIBUS standard)	Octet	1	1
Station status 2 (see: PROFIBUS standard)	Octet	2	1
Station status 3 (see: PROFIBUS standard)	Octet	3	1
Diagnostic master address	Octet	4	1
Profibus user organisation ID number	Octet	5, 6	1
Advanced diagnostics header	Octet string	7	1
Alarm messages	Octet string	8	1
Operating status	Octet string	9	1
Encoder type	Octet string	10	1
Resolution per revolution (hardware)	unsigned 32	11 ... 14	1
Number of revolutions (hardware)	unsigned 16	15, 16	1
Additional alarm messages	Octet string	17	2
Supported alarm messages	Octet string	18, 19	2
Warning messages	Octet string	20, 21	2
Supported warning messages	Octet string	22, 23	2
Profile version	Octet string	24, 25	2
Software version	Octet string	26, 27	2
Operating time	unsigned 32	28 ... 31	2
Reference point shift	unsigned 32	32 ... 35	2
Manufacturer specific: offset values	unsigned 32	36 ... 39	2
Resolution per revolution as assigned by parameter	unsigned 32	40 ... 43	2
Overall resolution as assigned by parameter	unsigned 32	44 ... 47	2
Serial number	ASCII string	48 ... 57	2

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6.2 Supported diagnostic messages

Individual diagnostic entries are explained below in greater detail.

6.2.1 Advanced diagnostics header

Diagnostic Octet 7 contains the length of advanced diagnostics (including the diagnostics header itself).

6.2.2 Memory error

Bit 4 in diagnostic Octet 8 indicates whether a memory error has occurred.

In this context, a memory error means that the EEPROM of the rotary encoder is no longer functioning properly and zero-voltage-safe storage (for example of the zero point offset) is no longer ensured.

Bit	Definition	0	1
4	memory error (defect in EEPROM)	no	yes

6.2.3 Operating status

Diagnostic Octet 9 can be used to query operating parameters that are set by parameter assignment.

Bit	Definition	0	1
0	direction of rotation	cw	ccw
1	Class 2 functionality	off	on
2	diagnostic routine	off	on
3	scaling function	off	on

6.2.4 Rotary encoder type

Diagnostic Octet 10 can be used to query the version of the rotary encoder.

Octet 10	Definition
0	singleturn rotary encoder
1	multiturn rotary encoder

6.2.5 Singleturn resolution

Diagnostic Octets 11 ... 14 can be used to store the physical resolution per revolution of the rotary encoder.

6.2.6 Number of revolutions

Diagnostic Octets 15 and 16 can be used to query the physical number of distinguishable revolutions. Standard values are 1 for Singleturn and 4,096 for Multiturn.

6.2.7 Operating time warning

Bit 4 of diagnostic Octet 20 displays the warning message for exceeding the operating time. The bit is set after 10^5 hours.

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6.2.8 Profile version

The profile version of the rotary encoder is stored in diagnostic Octets 24 and 25:

	Revision no.	**Index**
Octet	**24**	**25**
Bit	15 ... 8	7 ... 0
Data	2^7 ... 2^0	2^7 ... 2^0

6.2.9 Software version

The software version of the rotary encoder is stored in diagnostic Octets 26 and 27.

	Revision no.	**Index**
Octet	**26**	**27**
Bit	15 ... 8	7 ... 0
Data	2^7 ... 2^0	2^7 ... 2^0

6.2.10 Operating time

Diagnostic Octets 28 ... 31 contain the operating time of the device. When power supply voltage is applied, the "Operating time" value is stored again once every 6 minutes in the rotation encoder in increments of 0.1 hours.

6.2.11 Reference point shift

The zero point offset is available for output in diagnostic Octets 32 ... 35.

6.2.12 Resolution as assigned by parameter

Diagnostic Octets 40 ... 43 store the resolution per revolution as assigned by parameter. This value is only valid if the gear factor has been calculated with the setting "Resolution per revolution" in the parameter mask (see section 5.1.3).

6.2.13 Overall resolution as assigned by parameter

The overall resolution assigned by parameter or calculated is stored in diagnostic Octets 44 ... 47.

6.2.14 Serial number

Diagnostic Octets 48 ... 57 are provided for a serial number according to the encoder profile.

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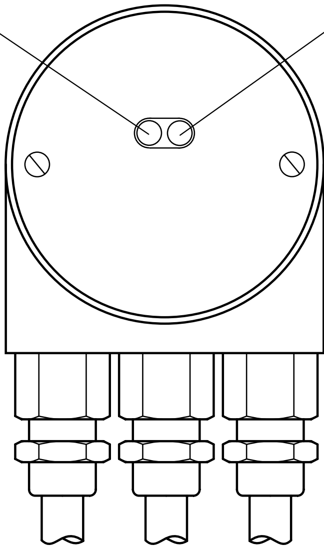
6.3 Status information of LEDs

The connection hood is equipped with two LEDs that provide a visual indication of the operating status on the rotary encoder. The red LED serves to display errors, while the green LED displays the status of the rotary encoder. Each LED can be in one of three states: On, Off, or Flashing. Of the nine possible combinations of these states, only seven are used to indicate a special status.

If problems occur while the device is being placed in service, the status of the LEDs should first be checked. Often this makes it possible to draw conclusions regarding the cause of the error.



No.	red LED	green LED	Status information/possible cause
1	off	off	no power supply
2	on	on	rotary encoder is ready for operation, but has not yet received any configuration data based on voltage; possible causes: address set incorrectly, bus line incorrectly connected
3	on	flashing	error in parameter assignment or configuration the rotary encoder is receiving configuration or parameter assignment data of incorrect length or inconsistent data; possible cause: (for example) overall resolution set to high
4	flashing	on	rotary encoder is ready for operation, but is not being accessed by the master (for example the wrong address may be accessed)
5	on	off	rotary encoder has not received any data for some time (approx. 40 seconds) (the data line may be interrupted)
6	off	on	normal operation in Data Exchange mode
7	off	flashing	commissioning mode in Data Exchange mode

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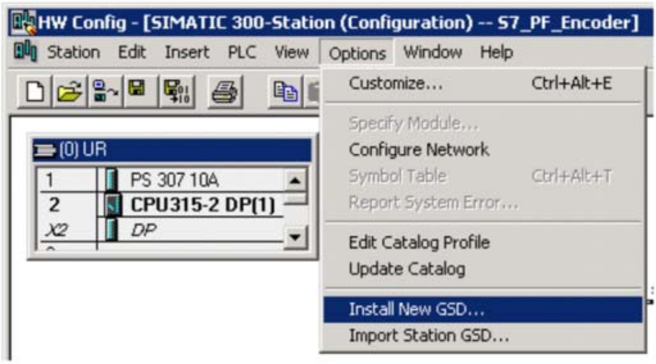
7 Sample configuration

Commissioning of the rotary encoder is described below, using the STEP7 projecting tool (V5.1) and the CPU 315-2DP (with an integrated PROFIBUS interface) as examples. For questions related to other projecting tools, please contact the manufacturer in question.

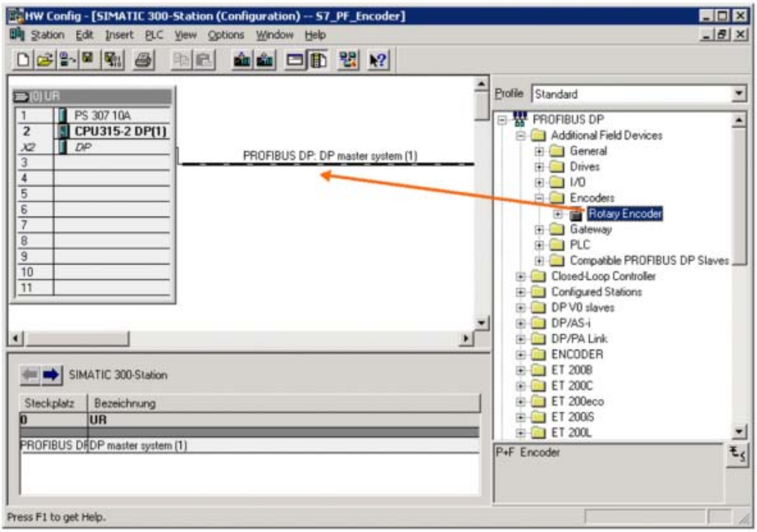
7.1 Reading the GSD file

The first time it is used, the GSD file must be installed ("PFDG5046.gsd") to accept the rotary encoder in the hardware catalogue. Select "Install new GSD" in the "HW Config" window and select the GSD file ("PFDG5046.gsd").



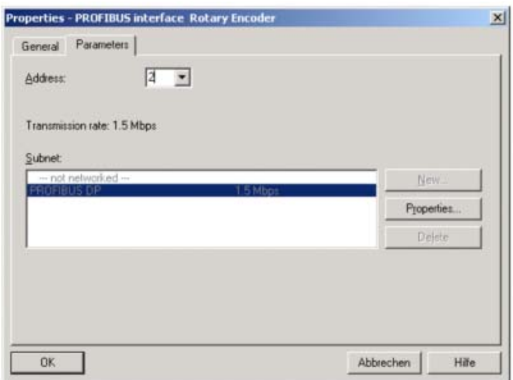
After the GSD file is read, the rotary encoder appears in the hardware catalogue under "PROFIBUS-DP" – "Other field devices" – "Encoders" –"Rotary encoders".

7.2 Projecting the rotary encoder



After the PROFIBUS network has been configured in the hardware configurator using the menu item "Insert" – "Master system" the absolute encoder can be selected from the hardware catalogue and inserted into the network. To do this, connect the "Encoder" device to the bus using Drag and Drop (or double click on the module with the bus marked).

After the device has been inserted, the station address of the slave device must be entered. It must agree with the address set in the connection hood.



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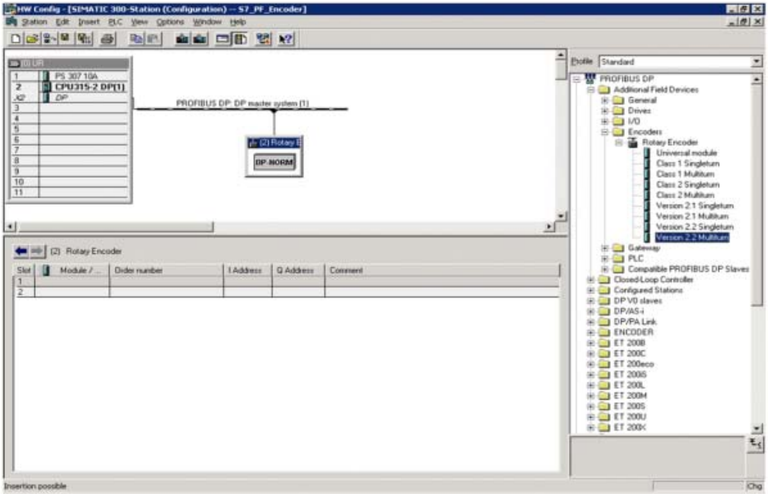
7.3 Selecting the device class

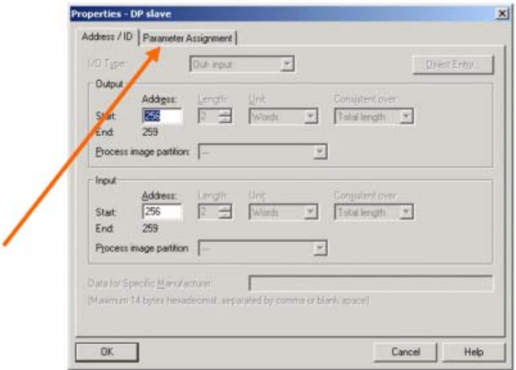
As described in section 3, the functionality of the device depends on which encoder class is selected. After the device has been inserted into the PROFIBUS network as described above, the desired device class can then be selected. To do this, drag one of the modules listed in the hardware catalogue under "Rotary encoders" to mounting station 1 using Drag and Drop (Table in the lower part of the station window):



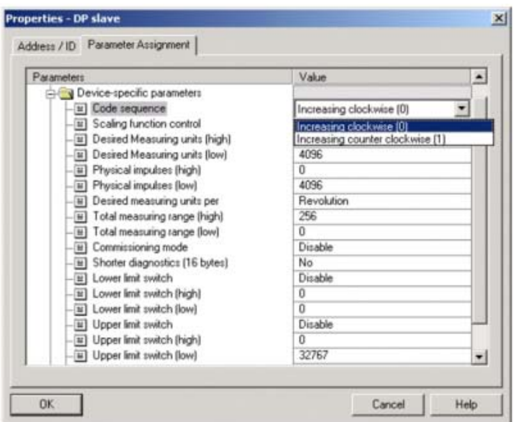
7.4 Parameter assignment

Mark the rotary encoder to which you want to assign parameters in projecting and then double click on mounting station 1 (table in the lower part of the station window). The "DP slave properties" dialog window appears. You can change the default address of the device here if you want to.

To enter parameters, select the "Parameter assignment" properties tab.



Next, enter the parameters of the device. After selecting the "Device-specific parameters" folder, various parameters can be entered, depending on the encoder class that is selected. If there is a selection between multiple options in the fields on the right, an additional selection window appears when you double click. On the other hand, numeric values can be entered directly. The example shows parameter selection for version P+F 2.2 – the device class with the greatest functionality.



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As required by the STEP 7 projecting software, 32-bit parameter values (for example overall resolution, limit switches, etc.) are divided into high word and low word.

Example:

Decimal	Hexadecimal		Hexadecimal	Decimal (input)
129,600	00 01 FA 40	high word	0001	1
		low word	FA 40	64,064

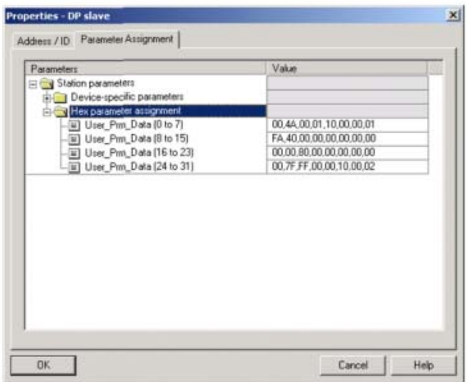
The decimal value "1" is entered in the high field, while the decimal value "64,064" is entered in the low field.

or:

Divide the value by 65,536 and enter the integer portion of the result into the high word, the remainder portion into the low word:

129,600/65,536 = 1,977539	→	integer portion = **1**	→	high word:1
129,600 – 1 x 65,536 = 64,064	→	remainder = **64,064**	→	low word = 64,064

It is also possible to enter parameters directly as hex values. However, this is significantly more complicated. If possible, it should be avoided.



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8 Technical data

8.1 Electrical data

General design	based on DIN VDE 0160, protection class III, accumulation level 2, overvoltage category II
Power supply	10 V DC ... 30 V DC (absolute limit values)
Power consumption	max. 2.5 Watt
EMC	emitted interference in accordance with EN 61000-6-4 interference rejection in accordance with EN 61000-6-2
Bus interface	galvanically isolated by optocoupler
Interface	line driver in accordance with RS 485
Baud rates	12 MBaud; 6 MBaud; 3 MBaud; 1.5 MBaud; 500 kBaud; 187.5 kBaud; 93.75 kBaud; 19.2 kBaud; 9.6 kBaud
Resolution	standard: 8.192 steps/revolution optional: 65,536 steps/revolution
Number of revolutions recorded	standard: 4,096 revolutions optional: 16,384 revolutions
Spacing accuracy	± 2 LSB at 16 bits, ± 1 LSB at 13 bits, ± 0,5 LSB at 12 bits
Step frequency	max. 100 kHz
Code type	binary code
Expected service life, electrical	> 10^5 h
Addressing	adjustable via rotary switch in connection hood

Attention

Absolute rotary encoders must only be operated at low protective voltage.

8.2 Mechanical data

Housing	aluminium or stainless steel	
Flange	servo flange	clamping flange
Shaft diameter	6 mm	10 mm
Shaft length	10 mm	20 mm
Shaft load	axial 40 N, radial 110 N	
Moment of friction	≤ 3 Ncm	
Moment of inertia of the rotor	≈ 30 gcm^2	
Expected service life	> 10^5 h for 1000 min^{-1}	
Speed	max. 12,000 min^{-1}	
Shock (EN 60068-2-27)	≤ 100 g, 6 ms	
Vibration (EN 60068-2-6)	≤ 10 g, 10 Hz ... 2000 Hz	
Connection	connection hood with terminal strip as T distributor	
Weight (including connection hood)	singleturn	aluminium: ca. 550 g stainl. steel: ca. 1.100 g
	multiturn	aluminium: ca. 600 g stainl. steel: ca. 1.200 g

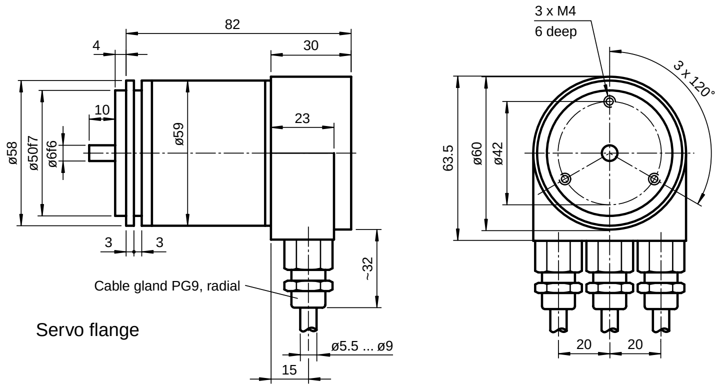
8.3 Ambient conditions

Working temperature range	-40 °C ... +85 °C
Storage temperature range	-40 °C ... +85 °C
Relative humidity	98 % (no moisture condensation)
Protection class (EN 60529)	
Housing side	IP65
Shaft side	IP64 (without shaft seal) IP66 (with shaft seal)

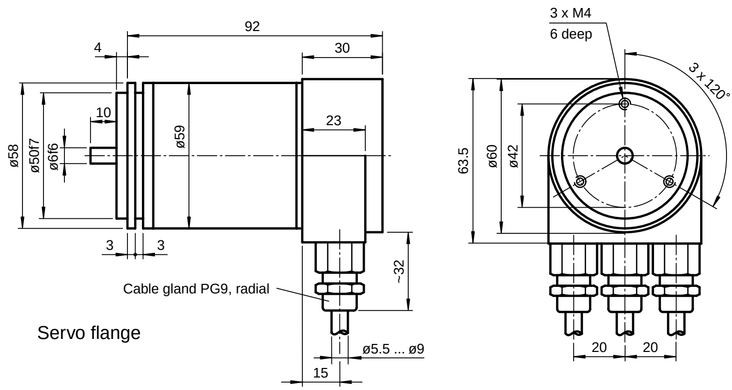
8.4 Dimensional drawings

8.4.1 Rotary encoder with servo flange

Singleturn design

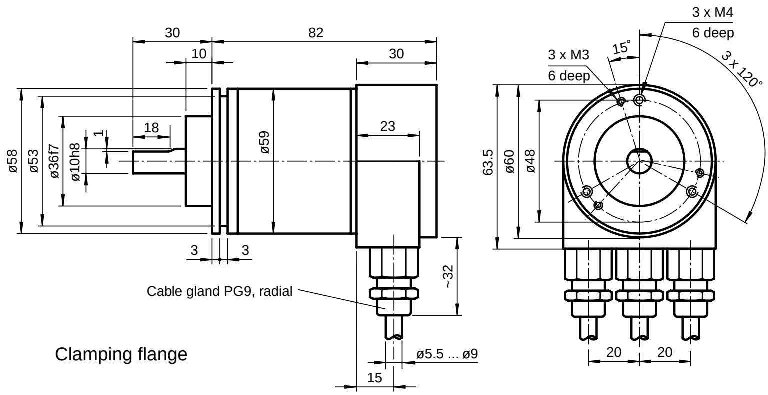


Multiturn design

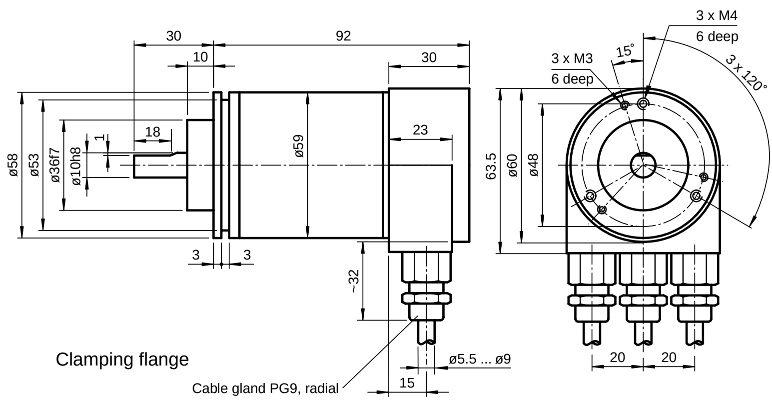


8.4.2 Rotary encoder with clamp flange

Singleturn design



Multiturn design



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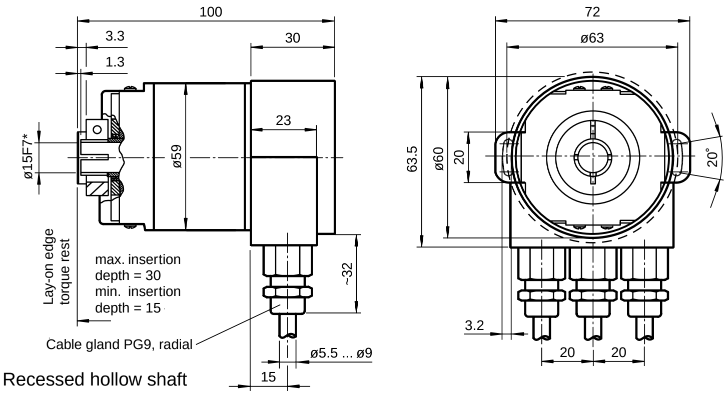
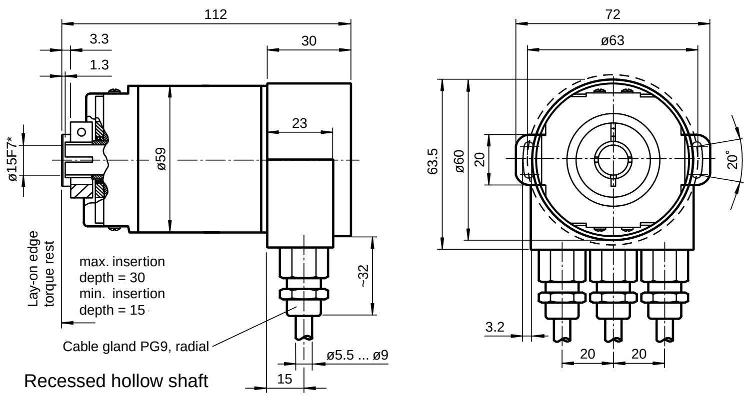
8.4.3 Rotary encoder with recessed hollow shaft

Singleturn design



* shaft can be reduced to ø10F7 or ø12F7 by using an adapter

Multiturn design



* shaft can be reduced to ø10F7 or ø12F7 by using an adapter

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9 Appendix

9.1 Type code, model number

P			5	8		–				A	G	R	0	B	N	–	1	2	1	3

Number of bits singleturn
13 8,192 (standard)
16 65,536

Number of bits multiturn
12 4,096 (standard)
14 16,384

Option 2
N not extended

Output code
B binary

Option 1
0 no option

Exit position
R radial

Connection type
AG removable housing cover with terminal compartment

Shaft dimension/flange version
011 shaft Ø10 mm x 20 mm with clamp flange
032 shaft Ø6 mm x 10 mm with servo flange
F1A recessed hollow shaft Ø10 mm x 30 mm
F2A recessed hollow shaft Ø12 mm x 30 mm

Housing material
N Aluminium, powder-coated
I Inox

Principle of operation
M multiturn
S singleturn

Shaft version
S recessed hollow shaft
V solid shaft

Data format
P PROFIBUS

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9.2 Troubleshooting

Problem

If one of the following PROFIBUS masters is used, problems occur when the system starts up if encoder classes higher than Class 1 are used (bus malfunction, encoder does not report):

- SIEMENS S5-95U
- Master connection SIEMENS IM 308-B
- Softing PROFIboard
- Allen Bradley 1785 PFB/B
- Mitsubishi A1SJ 71PB92D

Possible cause

Masters do not support the full number of diagnostic bytes (57 bytes) made available by absolute encoders in some circumstances.

Solution

If this is a possibility, the maximum amount of diagnostic data per slave should be increased in the master.

If this is not a possibility, the absolute encoder can either be used as a Class1 device (16 diagnostic bytes), or one of the manufacturer specific P+F classes can be selected (P+F 2.1 or 2.2), in which case "Reduced diagnostics" should be turned on in parameter assignment (see section 5.1.5).

Problem:

For COM PROFIBUS version 5.0, the P+F absolute encoder cannot be projected together with the S5-95U.

Cause

The S5-95U does not support the full amount of diagnostic data (57 bytes).

For the COM PROFIBUS version 5.0, the GSD entry "Max_Diag_Data_Len=57" is checked and projecting together with the S5-95U is prevented.

Solution

Use COM PROFIBUS version 3.3, select one of the manufacturer specific P+F classes (P+F 2.1 or 2.2), and activate reduced diagnostics (parameter).

Use with COM Profibus Version 5.0 is only possible with a modified GSD file (the slave key "Max_Diag_Data_Len" must be changed).
For COM PROFIBUS version 5.0, the P+F absolute encoder cannot be projected together with the S5-95U.

Problem

The PLC and master connection are turned on and the bus is active, but the absolute encoder is not reporting.

Solution

First, check the status of the LEDs in the connection hood (see section 6.3). In some cases this will allow you to draw conclusions to determine what the cause of the error is.

- Both LEDs off: Check the power supply!
- Both LEDs on: The device is not receiving any parameters or configuration data. Check the address setting in the connection hood. Check for correction connection of bus lines (BUS IN/BUS OUT). Check projecting.
- Red LED on, green LED flashing: Parameter error! Check parameter assignment: (for example the overall resolution (see section 4.1.6)

Problem

Bus malfunctions occur sporadically.

Possible cause

Terminating resistors not correct

Solution

Check terminating resistors!

A terminating resistor of 220 Ω must be switched into the circuit at the beginning and end of the bus segment. Measure the resistance between the two data lines! To do this, turn off the power supply and measure in the connection hood between connections "A" and "B". The measured resistance value must be approximately 110 Ω (parallel 220 Ω).

Problem

Bus malfunctions occur sporadically.

Possible cause

EMC problems

Solution

Check whether the baud rate that is set is permissible for the line length. It may be necessary to use a lower baud rate. Check the connection hood to ensure the shield is connected properly and that the cable is laid properly for EMC.

9.3 Terms

Term	Meaning
Address	A number that is assigned to each bus station regardless of whether it is a master or slave. For a rotary encoder, it can be adjusted in the connection hood with decimal rotary switches and is retained in memory even when the power is turned off.
Baud rate	The speed of a data transfer; indicates then number of bits transferred per second (baud rate = bit rate).
Bus station	A device that is capable of sending, receiving or amplifying data via the bus.
Configuration	During configuration, the master specifies properties of the slave, for example the number of input and output words. (→ DDLM_Set_Prm).
DDLM	Direct Data Link Mapper. The interface between PROFIBUS DP functions and the encoder software.
DDLM_Data_Exchange	The operating status of the bus in which "normal" data traffic occurs.
DDLM_Set_Prm	The operating status of the bus in which configuration data is transferred.
DDLM_Slave_Diag	The operating status of the bus in which diagnostic data is requested by the slave (for example rotary encoder).
Diagnostics	Detection, pinpointing, classification, display and further evaluation of faults, malfunctions and messages.
DP	Local peripherals
Encoder	Alternative designation for absolute rotary encoder
Freeze	A master command to the slave. The master is thus able to freeze the states of the inputs to the current value. Input data is not updated again until after the UNFREEZE command is sent.
GSD file	Device master data file (in german: Geräte-Stammdaten-Datei). A file in which slave-specific properties are specified. The GSD is a file that is made available by the manufacturer for most PROFIBUS stations. The formats of the GSD are specified in a uniform manner, thus facilitating access to them by the corresponding control software. (→ type file).
Master	A bus station that is able to send data "of its own initiative". It also determines which slave should send data at any given time. (→ Slave)
Octet, Byte	A data unit of 8 bits = 1 byte
Parameter assignment	Transfer of specific parameters (in this case, for example resolution per revolution, direction of rotation, etc.) from the master to the slave (in this case the rotary encoder). Parameter assignment is performed when the system starts up.
PROFIBUS	Process Fieldbus, a european fieldbus standard specified in the PROFIBUS standard. It assigns functional electrical and mechanical properties to a bit-serial fieldbus system.

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Term	**Meaning**
Rotary encoders	Alternative designation for absolute rotary encoder
Slave	A bus station that essentially sends data only in response to the command of a → master. Rotary encoders are always slaves by definition.
Terminating resistor	Resistance to line adjustment with bus cable; terminating resistors; always required at cable and segment ends.
Type file	Similar to a GSD file; used by older projecting tools.
Word	Frequently, but not uniformly used for a data unit of 2 bytes.

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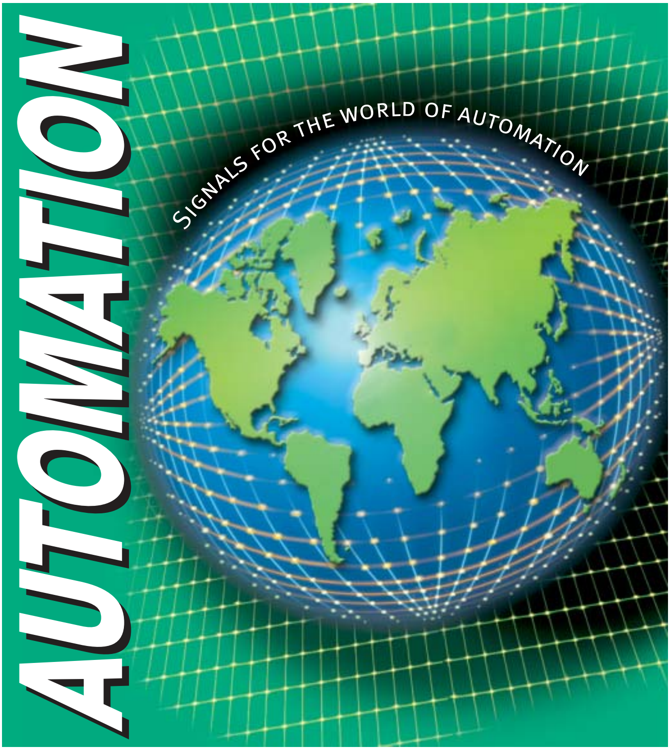

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