SIEMENS

MC-ENCODER

Absolute Value Encoder with PROFIBUS-DP

User Manual

Valid for

Product	*Version*
MC-ENCODER	*Firmware version* 9.9

08/2014

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

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indicates that death or severe personal injury **will** result if proper precautions are not taken.

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indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION
with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION
without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE
indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Preface

SIMOTION documentation

An overview of the SIMOTION documentation can be found in a separate list of references.

This documentation is included as electronic documentation in the scope of delivery of SIMOTION SCOUT. It comprises ten documentation packages.

The following documentation packages are available for SIMOTION V4.2:

- SIMOTION Engineering System

- SIMOTION System and Function Descriptions

- SIMOTION Service and Diagnostics

- SIMOTION IT

- SIMOTION Programming

- SIMOTION Programming - References

- SIMOTION C

- SIMOTION P

- SIMOTION D

- SIMOTION Supplementary Documentation

Additional information

Click the following link to find information on the the following topics:

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- Additional links to download documents

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1 General Information

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1.1 Absolute value encoders

This manual describes the commissioning and configuring of absolute value encoders with PROBIFUS DP interface. The device fulfills the requirements placed on a PROFIBUS slave in compliance with the PROFIBUS Standard and is certified by the PROFIBUS User Organization.

The basic principle of operation of the absolute measured value sensing is the optical scanning of a transparent coding disk which is coupled to the shaft to be measured. The position of the shaft can be determined by evaluating the code with a resolution of up to 8192 steps per revolution (13-bit).

For so-called multi-turn devices, other coding disks are coupled through step-down gearing. These subsequently coupled disks allow the number of shaft revolutions to be determined in absolute terms (up to 16384 revolutions = 14-bit).

For absolute value encoders with PROFIBUS DP, the position value, optically detected, is computed in an integrated microprocessor and the data is transferred via PROFIBUS.

1.2 Validity of the documentation and references

This documentation applies to absolute value encoders with PROFIBUS DP with the following Order No. [MLFB]: 6FX2001-5xPxx as of Version A10; this can be seen in the lowest line on the rating plate.

Variant (rating plate)	Identification (I&M0, p 964)	Introduction date	Introduction from Serial No.	Feature
A00		May 96		Release for general availability with 2xPG9, 1xPG7
A01		Nov 96		Connection cover is supplied with 3xPG9
A02		01.08.97		Gearbox modification; length shortened for MT, length shortened to 109 mm
A03		01.08.98		For multi-turn encoders, velocity signal averaged over eight measured values
A04		02.04.99	73871	Online parameterization LEDs in the connection cover Velocity output, now also for ST
A05		01.07.00	87133	New shaft version with increased degree of protection for synchronous flange
A06		04.07.02	114764	Connection cover with de-coupled continuing bus when the terminating resistor is switched-in
A07		17.09.02	117670	Software change: Improved rotary axis routine
A08		01.04.03	125568	Software change: DPV2 functionality (can be called using an additional GSD file) changeover to 13/25-bit; downwards compatibility for Class 1 or disabled scaling is implemented by adapting the encoder software.
A09		01.09.03	133050	Software change: Error message "Operating time alarm/incorrect limit value" rectified.
A10		01.03.04	144258	Sensor system innovated, change over to multi-turn 27-bit
A11		26.05.04	151904	Change only for 6FX2001-5LP25: Additional hole in the shaft and dowel pin provided Standard versions remain at A10
A12		16.08.04	156529	Parameter 964, sub-index 1-4 changed: Device type adapted to "7010" hex, version and date
A12		20.10.04	161000	Change, reset generator, basis sensor system
A13		20.10.2004	161000	Change, reset generator, basis sensor system – exclusion Problem: actual value jump when switched on
A14		01.11.2007	275887	Software change - position displacement in isochronous operation fault corrected
A15		27.06.2011	462881	Intermediate solution (new optosensor system, old controller printed circuit board)
FS: 17 (A17)	Hardware Version: 6.0 Firmware Version: 9.9.16			New sensor printed circuit board with integrated PROFIBUS interface, VPC3+S rather than DPC31, shorter variant with die-cast hood, supports the latest version of the PI/PNO-ENCODER profile (V4.2) with new PROFIBUS-ID 0x81A8. Spare-part compatible with older PR-IDs 0x0024 and 0x80F9, operating hours counter omitted.

Ausführung	GSD file	Version	Changes
A00			
A01			
A02			
A03			
A04	SIEM0024	Version 2.0	
A05	SIEM0024	Version 2.0	
A06	SIEM0024	Version 3.0	Modification to change over to DPC31; new encoder also functional with V2.0
A07	SIEM0024	Version 3.0	
A08	SIEM0024 SIEM80F9	Version 3.0 Version 1.0	Clock cycle synchronism and peer-to-peer data transfer implemented, can be called using a special GSD file "SIEM80F9.GSD"
A09	SIEM0024 SIEM80F9	Version 1.0 Version 3.0	
A10	SIEM0024 SIEM80F9	Version 4.0 Version 1.1	Both GSD files adapted to an extended measuring range (16384 revolutions)
A11	SIEM0024 SIEM80F9	Version 4.0 Version 1.1	
A12	SIEM0024 SIEM80F9	Version 4.0 Version 1.1	
A12	SIEM0024 SIEM80F9	Version 4.0 Version 1.4	Various changes "SIEM80F9": Default settings, comments
A13	SIEM0024 SIEM80F9	Version 4.0 Version 1.4	
A14	SIEM0024 SIEM80F9	Version 4.0 Version 1.4	
A15	SIEM0024 SIEM80F9	Version 4.0 Version 1.4	
FS: 17 (A17)	SIEM0024 SIEM80F9 SIEM81A8	Version 4.3 Version 1.4 Version 1.5	SIEM0024.gsd – version 4.3 supports 32-bit rather than 2 x 16-bit input values, operating hours counter omitted. SIEM81A8 supports PI/PNO-ENCODER profile 4.2

Note regarding GSD files

SIEM0024:
Standard DP functionality, new encoder also functional for old versions. As of A10, for correct teach-in operation, GSD version 4 or higher must be used. In addition to PI/PNO-ENCODER profile Class 1, Class 2 standard functionality with the GSD SIEM0024 also provides additional special functions (class 1.x, class 2.x).

SIEM80F9:
As of A08 for functions, clock cycle synchronism and peer-to-peer data transfer.

SIEM81A8:
New standard GSD for isochronous and non-isochronous operation of the encoders (PROFIBUS DPV1 and DPV2).
With this GSD, the encoder supports all classes (Class 1, Class 2, Class 3 and Class 4) of the PI/PNO-ENCODER profile.
We recommend that only the GSD SIEM81A8 is used for new projects in all applications.
The new GSD SIEM81A8 replaces the old SIEM0024 and SIEM80F9 GSDs. The new GSD SIEM81A8 improves and extends the usability and parameterization of the MC-ENCODER. The new GSD SIEM81A8 can be deployed as of version FS17 (firmware level 9.9).

1.3 PROFIBUS technology

PROFIBUS is a non-proprietary, open fieldbus standard which is defined by international Standards EN 50170 and EN 50254. There are three versions: DP, FMS and PA. SIEMENS absolute value encoders support the DP version and are designed for the usual data transfer rates of up to 12 Mbaud.

In addition to manufacturer-specific functions, the devices support all classes (Class 1 to Class 4) of the PI /PNO-ENCODER profile.
This device profile can be ordered from the PROFIBUS User Organization under Order No. 3.062.
Additional information on PROFIBUS can also be obtained from the PROFIBUS User Organization (functionality, manufacturer, products) as well as Standards and profiles:

PROFIBUS User Organization (PNO)
Haid-und-Neu-Straße 7
D-76131 Karlsruhe
Tel: +49 721 / 96 58 590
Fax: +49 721 / 96 58 589

2 Installation

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The absolute value encoder is connected-up through the so-called connecting cover. This is connected to the rotary encoder through a 15-pin D-Sub plug connector. It can be removed by releasing two screws at the rear of the device. Bus and power supply cables are fed into the connecting cover through cable glands and connected to screw terminals.

2.1 Settings in the connecting cover

2.1.1 Node address

A decimal rotary switch in the connecting cover is used to set the PROFIBUS node address. The weighting (x 10 or x 1) is specified at the switch. Permissible addresses lie between 1 and 99, whereby each one must be unique in the complete system. The device address is read-in from the absolute value encoder when the power supply voltage is switched-on.
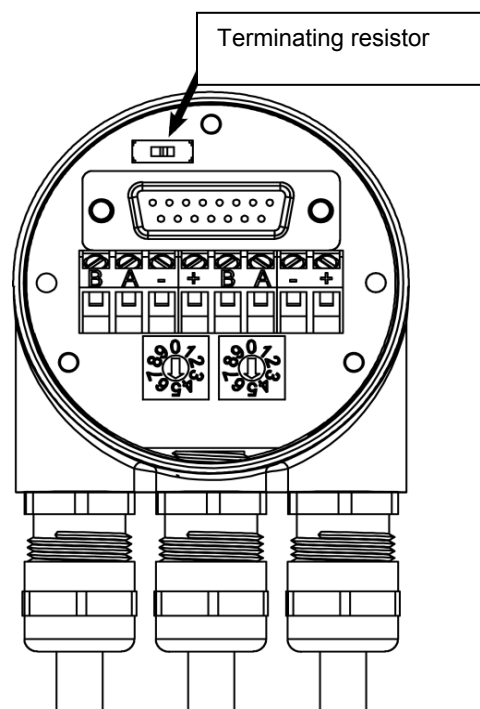
Programming with STEP 7

As an alternative, the node address can be set via the contoller by setting the rotary switch to 00. In HW Config of the STEP 7 software, the settings can be changed under Target system – PROFIBUS – PROFIBUS address. Address 126 is always specifed as default. This means that only one programming device can be connected.

Programming with parameter 918

When DPV2 (GSD file SIEM81A8.gsd) is used, the PROFIBUS address can also be reprogrammed via acyclical communication. This requires that the rotary switch is set back to 00.
In SIMOTION SCOUT, the programming must be made as shown in the following figure. For "Control immediately", the address is changed from 5 to 25 in this example.
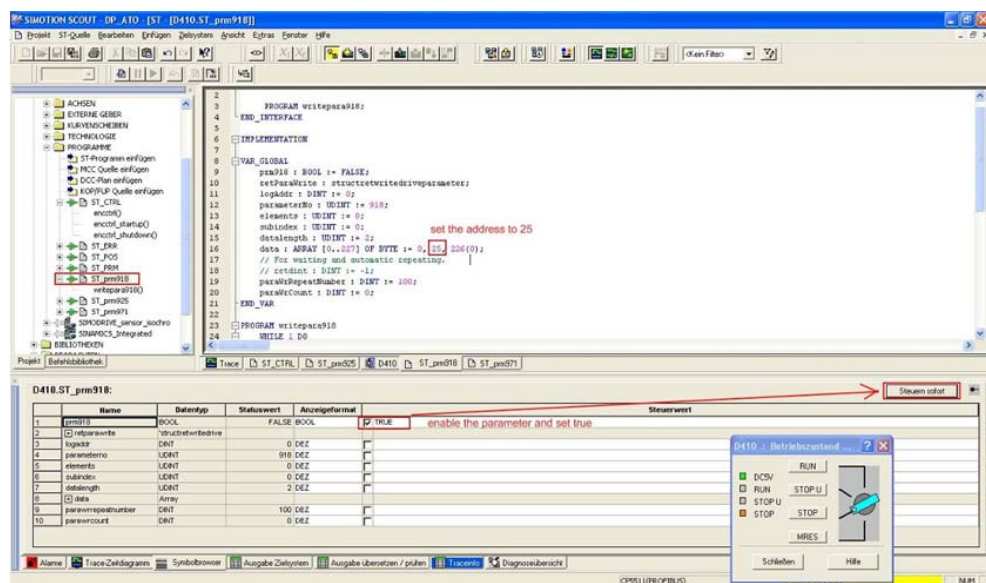
2.1.2 Bus termination

If the encoder is connected at the end or beginning of the bus line, the terminating resistor must be switched-in (slide switch in position "ON"):

R   R

ON [□■]   ON   [■□]

Node X   Last node
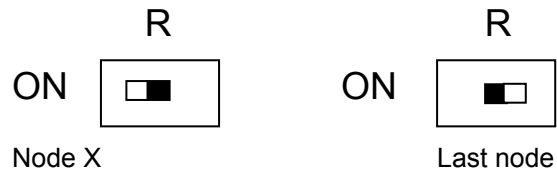
Note

 When the terminating resistor is switched-in, the bus out is de-coupled!

The bus has only been correctly terminated if the encoder is mounted to the connecting cover. If the encoder must be replaced in operation (hot swap), then we recommend that a separate active bus termination is used.

After the address has been set on the hardware side, and where necessary, the cable terminating-resistor switched-in, then the absolute value encoder can be commissioned.

2.2 Connecting-up the signal and power supply cables
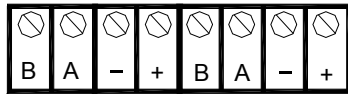
Terminal	Description
B (left)	Signal cable B, bus in
A (left)	Signal cable A, bus in
-	0 V
+	10 – 30 V
B (right)	Signal cable B, bus out
A (right)	Signal cable A, bus out
-	0 V
+	10 – 30 V

The power supply cables only have to be connected once (it doesn't matter at which terminals). When the terminating resistor is switched-in the bus out is de-coupled.

Absolute Value Encoder with PROFIBUS-DP
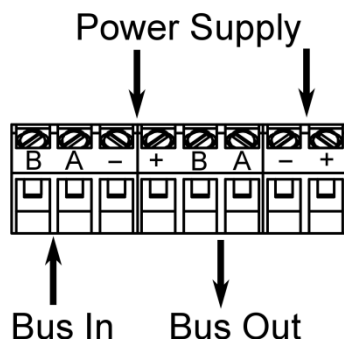
2.3 Connecting-up the connecting cover

1. Depending on the cable diameter, remove the outer cover of the cable and bare the braided screen to approx. 10 – 15 mm.
2. Push the nut and lamellar insert with sealing ring onto the cable.
3. Bend the braided screen to a right angle (90°) outwards.
4. Fold the braided screen in the outer cover direction, i.e. bend again by 180°.
5. Push the lamellar insert with sealing ring into the gland body and latch the anti-rotation element.
6. Tighten the dome nut with 3.5 Nm torque.

⚠️ Permitted cable diameter
5 – 9 mm for connection hood type
AH58-B1CS-3PG and
AH58-B1CS-3PG-VA

Installation notes

Not only the cable shields, but also the metallic housing of the measuring system and the subequent electronics act as shielding. The housing must have the same potential and be connected to the central functional ground of the machine via the machine body or a separate potential equalizing conductor. The potential-equalizing conductor should have a minimum cross-section of 6 mm^2.
Do not lay signal cables in the immediate vicinity of noise sources. Air clearance >100 mm.
A minimum clearance of 200 mm is normally required compared with the storage chokes.

Lay the signal cables as short as possible and without intermediate clamping. Shielded fieldbus cables must be deployed! The shielding must be laid EMC-conform.

For shared cable laying of signal cables with other disturbance-signal conducting cables in metallic cable ducts, an adequate decoupling is achieved with a grounded intermediate wall.

Einzelteile / Individual components

Dichtring / Sealing ring
Lamelleneinsatz / Lamellar insert
Schirmgeflecht / Braided screen
geschirmte Leitung / Shielded cable
Hutmutter / Dome nut
Zwischenstutzen / Gland body
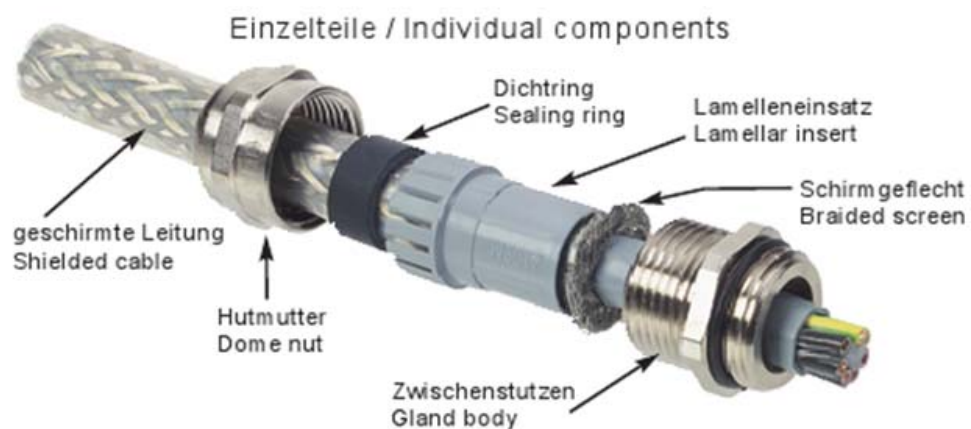
2.4 Connecting the shielded cable

In order to achieve the highest possible noise immunity, shielded cables transfer signals between the system components. The shields of these cables are connected at both ends. For specific system configurations an equalization current can flow through the cable shield which is connected at both ends. This is the reason that we recommend a potential bonding conductor.

2.5 Information on mechanically installing and electrically connecting-up the absolute value encoder

The following points should be observed:

- Do not drop the absolute value encoder or subject it to excessive vibration. The encoder is a precision device.

- Do not open the absolute value encoder housing (this does not mean that you cannot remove the cover). If the device is opened and closed again, then it can be damaged and dirt may enter the unit.

- The absolute encoder shaft must be connected to the shaft to be measured through a suitable coupling. This coupling is used to dampen vibrations and imbalance on the encoder shaft and also avoid inadmissibly high forces.

- Although SIEMENS absolute value encoders are rugged, when used in tough ambient conditions, they should be protected against damage using suitable protective measures. Care should be taken that they are not installed so that they can be used as handles or even steps.

- Only qualified personnel may commission and operate these devices. These are personnel who are authorized to commission, ground and tag devices, systems and circuits according to the current state of safety technology.

- It is not permissible to make any electrical changes to the encoder.

- Route the connecting cable to the absolute value encoder at a considerable distance away or completely separated from power cables with their associated noise. Completely shielded cables must be used for reliable data transfer, and good grounding must be provided.

- Cabling, establishing and interrupting electrical connections may only be carried-out when the equipment is in a no-voltage condition. Short-circuits, voltage spikes, etc. can result in erroneous functions and uncontrolled statuses which can even include severe injury and material damage.

- Before powering-up the system, check all of the electrical connections. Connections, which are not correct, can cause the system to function incorrectly and fault connections can result in severe injury and material damage.

3

3 Device Configuration

Absolute value encoders with PROFIBUS DP can be configured and parameterized corresponding to the requirements of the user. To do this, so-called GSD files, associated with the device, are downloaded into the configuring tool.
When configuring the encoders various "encoder classes" (PI/PNO-ENCODER, profile V1.1) or telegrams (PI/PNO-ENCODER, profile V4.x) can be selected. Selectable parameters and functionality of the device depend on the selected encoder class. Absolute value encoders support all encoder classes defined in the PI/PNO-ENCODER profile. This means that the functionality is not restricted from the hardware side and is exclusively defined by the user. In addition to the Class 1 and Class 2 encoder classes, described in the encoder profile, SIEMENS absolute value encoders offer additional encoder Class (version) 2.1, 2.2 with manufacturer-specific functions.

When configuring the device, configuration and parameter data are defined by selecting the encoder class. This data, saved in the PROFIBUS master is transferred once to the absolute value encoder when the system runs-up (configuration and parameterizing phase – "DDLM_Set_Prm"). It is not possible to change the configuration or parameters during operation (exception: "Commissioning mode" refer to Section 5.3).

After the configuration and parameter data have been received the absolute value encoder goes into "normal operation" (cyclic data transfer – "DDLM_Data_Exchange mode"). Among other things, the position value is transferred in this mode. The length and format of the data exchanged are also defined when configuring the device by selecting the appropriate encoder class.

3.1 Overview, data transfer principle
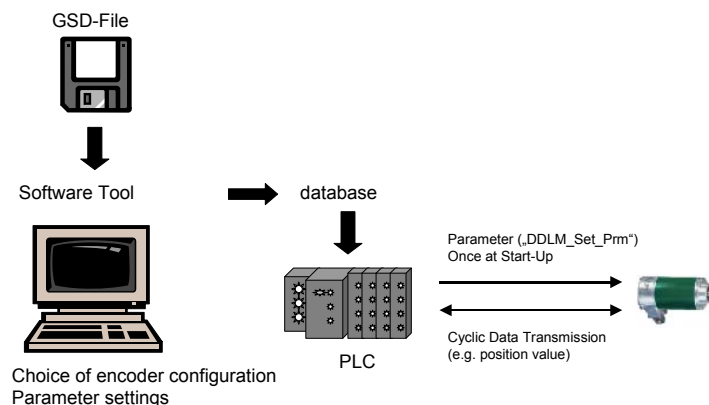
3.2 Overview, encoder classes with GSD SIEM0024

Designation	Cyclic data transfer	Parameters which can be set	Others
Class 1 single-turn	Position value –16-bit input	Direction of rotation	-
Class 1 multi-turn	Position value – 32-bit input	Direction of rotation	-
Class 2 single-turn	Position value – 16-bit input preset value – 16-bit output	Direction of rotation Gearbox factor	Preset function
Class 2 multi-turn	Position value – 32-bit input Preset value – 32-bit output	Direction of rotation Gearbox factor	Preset function
Class (version) 2.1 single-turn	Position value (32-bit input) Preset value/teach-in (32-bit output)	Direction of rotation Gearbox factor Reduced diagnostics Limit switch	Preset function Commissioning mode
Class (version) 2.1 multi-turn	Position value (32-bit input) Preset value/teach-in (32-bit output)	Direction of rotation Gearbox factor Reduced diagnostics Limit switch	Preset function Commissioning mode
Class (version) 2.2 single-turn	Position value (32-bit input) Preset value/teach-in (32-bit output) Velocity (16-bit input)	Direction of rotation Gearbox factor Reduced diagnostics Limit switch Units of the velocity output	Preset function Commissioning mode Velocity output
Class (version) 2.2 multi-turn	Position value (32-bit input) Preset value/teach-in (32-bit output) Velocity (16-bit input)	Direction of rotation Gearbox factor Reduced diagnostics Limit switch Units of the velocity output	Preset function Commissioning mode Velocity output

3.3 Overview, data format of the encoder classes

Designation	Configuration (ID)		Input words (AWC → master)	Output words (master → AWC)	Description, refer to	
	Hex	Dez			Section	Page
Class 1 single-turn (acc. to the PI/PNO-ENCODER profile)	D0	208	1	0	4	23
Class 1 multi-turn (acc. to the PI/PNO-ENCODER profile)	D1	209	2	0		
Class 2 single-turn (acc. to the PI/PNO-ENCODER profile)	F0	240	1	1		
Class 2 multi-turn (acc. to the PI/PNO-ENCODER profile)	F1	241	2	2		
Class (version) 2.1 single-turn	F1	241	2	2	5	29
Class (version) 2.1 multi-turn	F1	241	2	2		
Class (version) 2.2 single-turn	F1 D0	241 208	2 1	2		
Class (version) 2.2 multi-turn	F1 D0	241 208	2 1	2		

The following encoder classes are still supported due to ensure upwards compatibility. However, these encoder classes should not be used for new projects (description: Refer to the Appendix):

Designation	Hex	Dez	Input words	Output words	Section	Page
Class (version) 1.0 multi-turn	D3	211	4	0	A.1.3	99
Class (version) 1.1 multi-turn	D3 E1	211 225	4 0	0 2	A.1.2	99
Class (version) 2.0 multi-turn	F1 D0	241 208	2 1	2	A.1.1	99

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4 Class 1 / 2 with GSD SIEM0024

Encoder classes Class 1 and Class 2 are the versions according to the PI/PNO ENCODER profile defined by the Encoder Working Group in the PROFIBUS User Organization (this is available from the PNO under Order No. 3.062).
Encoder functionality in accordance with PI/PNO-ENCODER profile Class 1 and Class 2 is also available with the GSD SIEM81A8 and telegram 861. We recommend that GSD SIEM81A8 is used for new projects.

4.1 Note

Absolute value encoder as of version "A08"
In order to guarantee compatibility to previously supplied devices with a resolution of 4096 steps per revolution (versions < "A08"), as of version "A08" the absolute value encoders do not operate with the complete resolution of 8192 steps (13-bit) per revolution, but instead with 4096 steps per revolution (12-bit) scaled value:

1. Utilizing the device in Class 1

2. Utilizing the device in a higher class (Class 2 or manufacturer-specific) with disabled scaling function (parameter byte 9, bit 3)

3. Using the device in a higher class (Class 2 or manufacturer-specific) with disabled Class 2 functionality (parameter byte 9, bit 1)

In all three cases, the absolute value encoder generally operates with a 12-bit resolution (4096 steps) per revolution.

In order to use the full (that specified on the rating plate) resolution of 13 bits (8192 steps) per revolution, the device must be operated in Class 2 or in a manufacturer-specific class with the scaling function and with Class 2 functionality switched-in.

Absolute value encoder < "A10"
In order to ensure that compatibility is maintained to multi-turn encoders with 4096 revolutions that were previous supplied (version < "A10"). In the following cases, multi-turn angular encoders, as of version "A10" do not operate with the full 16384 revolutions but instead with the reduced number of 4096:

1. Utilizing the device in Class 1

2. Utilizing the device in a higher class (Class 2 or manufacturer-specific) with disabled scaling function (parameter byte 9, bit 3)

3. Using the device in a higher class (Class 2 or manufacturer-specific) with disabled Class 2 functionality (parameter byte 9, bit 1)

In all three cases, the absolute value encoder generally operates with the number rotations reduced to 4096.

In order to use the full (specified on the rating plate) number of 16384 revolutions (14-bit), the device must be operated in Class 2 or a manufacturer-specific Class with the scaling enabled and Class 2 functionality enabled.

4.2 Parameterization

The following table includes an overview of the parameters which can be set according to the PI/PNO-ENCORDER profile as well as their arrangement in the parameterizing telegram. Generally, parameters are set using user-friendly input masks in the configuring tool. This means that a precise description of the parameterizing telegram is normally of little interest to the user.

Octet (=byte) No.	Parameter	Bit No.	Details, refer to
1 ... 8	PROFIBUS Standard parameters		
9	Direction of rotation	0	Section 4.2.1
	Class 2 functionality	1	Section 4.2.2
	Activate "Commissioning Diagnostics"	2	Section 4.2.3
	Scaling function	3	Section 4.2.4
	Reserved	4	
	Reserved	5	
	Not used for Class 1 and Class 2	6	
		7	
10 ... 13	Measuring steps/revolution		Section 4.2.5
14 ... 17	Total resolution		Section 4.2.6
18 ... 25	Reserved (for the PI/PNO-ENCORDER profile)		
26	Not used for Class 1 and Class 2 (refer to Class (version) 2.1 and 2.2		

4.2.1 Direction of rotation

The direction of rotation defines the counting direction when the actual process value is output as the shaft rotates clockwise (CW) or counter-clockwise (CCW) when viewing the shaft. The count direction is defined by bit 0 in octet 9:

Octet 9 bit 0	Direction of rotation when viewing the shaft	Output code
0	Clockwise	Increasing
1	Counter-clockwise	Increasing

For Class 1, this is the only parameter, which can be set.

4.2.2 Activating/de-activating Class 2 functionality

Using this switch, Class 2 angular encoders can be restricted to the functionality of Class 1, i.e. the parameterizing capability is disabled. Bit 1 in octet 9 is set in order to use the functions of a Class 2 encoder.

Octet 9 bit 1	Class 2 functionality
0	Switched-out
1	Switched-in

4.2.3 Activating/de-activating commissioning diagnostics

This function has no significance for the SIMODRIVE sensor absolute value encoder.

4.2.4 Activating/de-activating the scaling function

The scaling function enables the resolution per revolution and the selected total resolution to be parameterized. This switch should always be switched-in, if the functions of Class 2 (or manufacturer-specific classes) are to be used.

Octet 9 bit 3	Scaling function
0	Switched-out
1	Switched-in

4.2.5 Measuring steps per revolution

The 'Measuring steps per revolution' parameter is used to program the absolute value encoder so that a required number of steps can be realized, referred to one revolution.

If a value greater than the basic resolution of the absolute value encoder is selected as resolution per revolution, the output code is no longer in single steps.

For absolute value encoders as of version "A06", in this case, a parameter error is displayed indicating that the device doesn't go into cyclic data transfer.

Octet	10	11	12	13
Bit	31 - 24	23 - 16	15 - 8	7 - 0
Data	231 to 224	223 to 216	215 to 28	27 to 20
	Required number of measuring steps per revolution			

4.2.6 Total resolution

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}
	Selected total resolution in measuring steps			

The user can adapt the measuring range of the device using the 'Total resolution' parameter: The absolute value encoder counts up to the parameterized total resolution and then starts again at 0.

Example: 100 steps are selected for each revolution, total resolution 12800, and then the absolute value encoder starts again at zero after 128 revolutions and then counts up to 11799.

For many configuring tools it is necessary to split-up the value into a high word and low word; also refer to Section 5.1.3.

When entering the parameter "Total resolution" the following must still be observed:

If n steps per revolution are selected, then the selected total resolution may not result in the fact that the periods are longer than the maximum available (physical) number of revolutions of the device (refer to the rating plate). For instance, for a multi-turn device with 16384 revolutions, the total resolution must be less than 16384 times the parameterized number of steps per revolution:

Total resolution < measuring steps per revolution x number of revolutions (physical revolutions)

If this is not observed, then the LEDs in the connecting cover display a parameterizing error and the device does not go into cyclic data transfer.

For older versions, when selecting the total resolution, an additional rule had to be observed (refer below). If the total resolution was not selected in compliance with this rule, when using the device on a so-called endless axis / rotary axis, when the physical zero was exceeded, a step was output. For new devices (version A06), this particular problem has been resolved using an internal software routine. This means that the rule, shown below, can be ignored for new devices.

Note

The internal software routine only intervenes if the device is operational. If the encoder shaft is rotated further than 4096 revolutions, and if the device is not connected to the power supply voltage, problems can occur. If this situation can occur in the application itself, the following rule should also be observed for new devices:

This functionality can reduce the service life, in particular, for high speeds with activated scaling because the offset value must be saved in an EPROM with limited write cycles. Including the other parameters, such as Preset, approximately 4.5 million write cycles are available.

Example: For 1000 rpm, operational time of 24 hours on 365 days and at 85° C, the service life is at least 12 years, although 40 years is typical.

The periods, i.e. total resolution / measuring steps per revolution must be an integer number. This must fit an integer number of times (integer multiple) in 16384. Thus, the following equation must apply:

(16384 x measuring steps per revolution) / total resolution = integer number

4.3 Data transfer in normal operation

The so-called DDLM_Data_Exchange mode is the normal status when operating the system. When requested to do so, the absolute value encoder sends actual (position) values to the master. On the other hand, the absolute value encoder can also receive cyclic data (e.g. the preset value for Class 2 encoders).

4.3.1 Transferring the actual process value

For multi-turn encoders, the actual position value is transferred to the master as a 32-bit value (double word):

Word	Word 1						
Function	Status bits						
Bit	31	30	29	28	27	26	25
	0	0	0	0	0	0	0

Word	Word 1								
Function	Status bits								
Bit	24	23	22	21	20	19	18	17	16
	X	X	X	X	X	X	X	X	X

Word	Word 0															
Function	Actual process value															
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Analog to this, for single-turn encoders, data is transferred as a 16-bit value (word). For Class 1 and Class 2 no status bits are included. The position value is max. 27 bits.

4.3.2 Preset function

The encoder zero point can be adapted to the mechanical zero of the system using the preset function. The actual rotary encoder value is set to the required "preset value" by setting the preset value. The device computes the required zero offset and saves this in an EEPROM so that it is non-volatile (this takes less than 40 ms). The preset value is activated by setting bit 31 in the (peripheral) output double word (this is transferred with a rising signal edge). The preset value is automatically set after the scaling parameters have been transferred, i.e. the preset value refers to the scaled actual value.
(This procedure is essentially the same for single-turn encoder versions – in this case, bit 15 is used to activate the preset value.)

	Bit	Status bits						
		31	30	29	28	27	26	25
Master → AWC		**1**	0	0	0	0	0	0
AWC → Master		0	0	0	0	0	0	0
Master → AWC		0	0	0	0	0	0	0
AWC → Master		0	0	0	0	0	0	0

	Bit	Data bits																								
		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 → AWC		Required value is transferred (= preset value)																								
AWC → Master		New = required actual process value is transferred here																								
Master → AWC		Reset bit 31 – normal mode																								
AWC → Master		New = required actual process value is transferred here																								

If high precision is required, the preset mode should only be executed when the encoder shaft is at a standstill. If the shaft moves quickly during this time, offsets can occur, as even when the preset value is set, bus propagation times occur (bus delay times). The preset value has max. 27 bits.

5 Class 2.1, 2.2 with GSD SIEM0024

5

Using the manufacturer-specific encoder classes, Class 2.x with GSD SIEM0024 the absolute value encoder offers, in addition to the functions in compliance with the PI/PNO-ENCODER profile, features such as commissioning mode (teach-in mode), velocity output and limit switch.
In older GSD SIEM0024 versions, "Version 2.1" and "Version 2.2" are also used to designate the class.

The transfer of the individual parameters in the parameterizing telegram is listed in the following table. The following also applies in this case: Generally, users apply the user-friendly input masks (input screen forms) in the configuring tool; the structure of the parameterizing telegram is only of marginal interest in exceptional cases.

Octet (byte) No.	Parameter	Bit No.	Details ref. Sect.	Details ref. Page
1 .. 8	PROFIBUS Standard parameters			
9	Direction of rotation	0	4.2.1	25
	Class 2 functionality	1	4.2.2	25
	Commissioning diagnostics	2	4.2.3	25
	Scaling function	3	4.2.4	25
	Reserved	4		
	Reserved	5		
	Activate manufacturer-specific parameters (octet 26)	6	5.1.1	30
	Reserved	7		
10 .. 13	Required measuring steps (ref. octet 26 bits 0 and 1)		5.1.2	31
14 .. 17	Total resolution		4.2.6	26
18 .. 25	Reserved			
26	Reference for required measuring steps	0	5.1.3	30
		1		
	Activate commissioning mode	2	5.1.4	32
	Reduced diagnostics	3	5.1.5	33
	Reserved	4		
	Activate lower software limit switch	5	5.1.6	33
	Activate upper software limit switch	6	5.1.6	31
	Activate the parameter from octet 27	7	5.1.1	30
27 .. 30	Lower limit switch		5.1.6	33
31 .. 34	Upper limit switch		5.1.6	33
35 .. 38	Physical measuring steps		5.1.7	33

Octet (byte) No.	Parameter	Bit No.	Details ref. Sect.	Page
39	Reserved	0		
	Absolute value encoder type (single-turn/multi-turn)	1	5.1.8	35
	Reserved	2		
	Reserved	3		
	Selecting the dimension units for velocity output	4	5.1.9	35
		5		
	Reserved	6		
	Reserved	7		

5.1 Parameters

The manufacturer-specific parameters are described in more detail in the following text. The description of the (also supported) parameters according to the PI/PNO-ENCODER profile should be taken from Section 4.

5.1.1 Activating the manufacturer-specific parameters

The manufacturer-specific parameter byte 26 is activated using bit 6 in octet 9.

In turn, the manufacturer-specific bytes 27-39 are activated in byte 26.

When selecting encoder class Class 2.x, this is implented automatically. These bits are only of significance if they are directly and manually parameterized in the hexadecimal notation.

Octet 9 bit 6	Octet 26
0	De-activated
1	Activated

Octet 26 bit 7	Octet 27 – 39
0	De-activated
1	Activated

5.1.2 Required measuring steps

The "required measuring steps" parameter is used to program the device so that any number of measuring steps (referred to a revolution), the complete measuring range or any partial measuring range can be covered.

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}
	Required measuring steps			

The parameter "Resolution reference" (refer to Section 5.1.3) is used to define the reference for the measuring steps entered here. If "per revolution" is selected here as reference for the requested measuring steps, then the measuring range can be adapted using the "Total resolution" parameter. In this case, the rules, listed in Section 4.2.6, should be carefully observed.
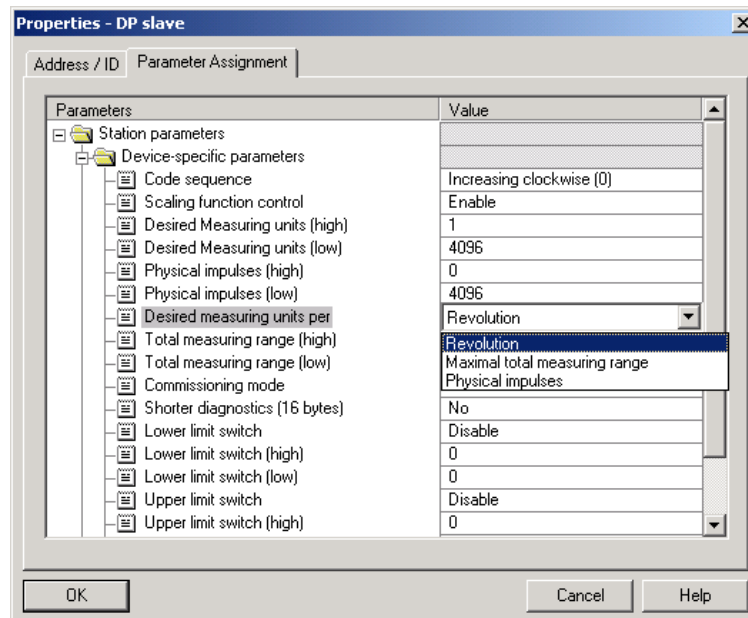
Note

For many configuring tools it is necessary to split-up the word into a high word and low word; also refer to Page 47.

5.1.3 Resolution reference

This parameter is used to specify the reference for the "Required measuring steps" (refer to Section 5.1.2) which is entered:

- Revolution
- Maximum total resolution
- Physical measuring steps

Requested resolution per **revolution**

In this case, the position value is scaled so that the position value increases by the number of required measuring steps at each revolution. In addition, in this particular case, the "Total resolution" parameter is evaluated. This can be used to adapt the measuring range (refer to Section 4.2.6).

Requested resolution per **maximum total resolution**

The requested measuring steps which are entered refer to the complete measuring range of the device, i.e. the device outputs the parameterized number of measuring steps over the complete (physical) number of revolutions.

Requested resolution per **physical measuring steps**

In this case, the required number of steps refers to the physical measuring steps, entered using parameter "Physical measuring steps" (also refer to Section 5.1.7). In this particular case physical steps mean the following: The numerical value which is read from the coding disk internally from the absolute value encoder (e.g. 4096 steps per revolution for the standard 12-bit version). Gearbox factors can be freely set using this option.

Reference	Octet 26 bit 0	Octet 26 bit 1
Per revolution	0	0
Per maximum total resolution	1	0
Per physical measuring steps (= steps specified in octet 35-38)	0	1

5.1.4 Activating the commissioning mode

Bit 2 in octet 26 represents a switch for the so-called commissioning mode. The commissioning mode is a specific status of the device which can be used to transfer additional parameters, extending beyond the preset value, to the absolute value encoder. When the commissioning mode has been activated, a so-called "teach-in" can be executed. This means that the gearbox factor can be determined by directly moving the system. In this particular mode (this can be identified at the unit as a result of the flashing green LED), the direction of rotation and scaling, set when configuring the system, are ignored and instead, the values saved in the EEPROM are used.
The device can also be continually operated in the commissioning mode; however, we recommend that the parameters, determined in the commissioning mode, are transferred to the configuration and the device is then subsequently used in the normal mode (this means that it is possible to replace the device without having to carry-out a new teach-in).
A detailed description of the commissioning mode is provided in Section 5.3.

Octet 26 bit 2	Commissioning mode
0	Disabled
1	Enabled

5.1.5 Reduced diagnostics

For some PROFIBUS masters, the full number of diagnostic bytes can result in problems (standard diagnostics: 57 bytes). Especially older masters often cannot process the full number of diagnostic bytes. With SIEMENS absolute value encoders it is possible to reduce the number of diagnostic bytes output from the absolute value encoder to 16. Only 16 diagnostic bytes are output if the "Class 1" device class is selected.

Octet 26 bit 3	Diagnostics
0	Standard = 57 bytes
1	Reduced = 16 bytes

5.1.6 Software limit switches

Two positions can be programmed which when violated (exceeded or fallen below), the absolute value encoder sets bit 27 in the 32-bit actual process value to "1". This bit is set to "0" between the two positions. Both limit switch values can be set as required by appropriately parameterizing them; however the value of the "Total resolution" parameter may not be exceeded. The limit switches are activated using bits 5 and 6 in octet 26.

Many configuring tools required that the value is split-up into a high word and low word; also refer to Page 56.

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}
	Lower limit switch in measuring steps (referred to the 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}
	Upper limit switch in measuring steps (referred to the scaled value)			
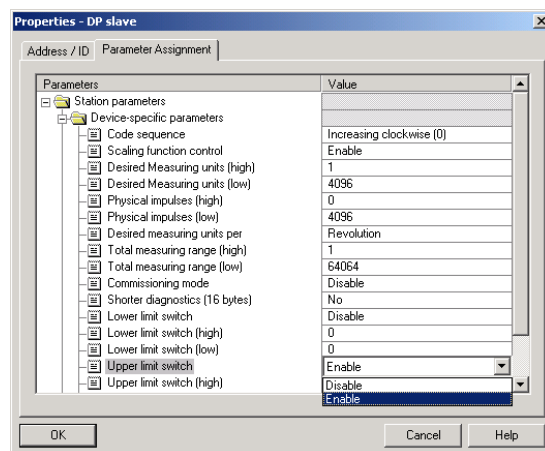
Octet 26 bit 5	Lower limit switch
0	Disabled
1	Enabled

Octet 26 bit 6	Upper limit switch
0	Disabled
1	Enabled

5.1.7 Physical measuring 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
	Physical measuring steps			

The device evaluates this parameter if the option "Physical measuring steps" is selected as reference for the required measuring steps (refer to Section 5.1.3). A gearbox factor can be freely set using the "Physical measuring steps". In this case it is specified as to how many measuring steps ("Required measuring steps") should be output for a specified sub-measuring range. This option is helpful if "uneven" scaling factors are to be entered.

Here is an example:
Problem: The absolute value encoder should output 400 steps over 3 revolutions. This number of steps cannot be set with the reference "Required measuring steps per revolution" (the "Required measuring steps" parameter would have to contain the value 133,333; however, in this case only integer numbers may be entered).

Remedy:
The "Physical measuring steps" is selected as reference for the requested measuring steps.
Using the actual (physical) resolution of the device (rating plate), the number of physical measuring steps is determined over the required measuring range. For an absolute value encoder with 12-bit standard resolution this would be, for example, in this particular case

4096 steps/revolution x 3 revolutions = 12288 steps

This value is now entered as "Physical measuring steps" parameter; the actually required step number of 400 is entered under "Required measuring steps". The absolute value encoder now outputs 400 steps over a measuring range of 12288 physical steps (i.e. over 3 revolutions).

Summary: 12 bit standard resolution
Scaling function   : Activated
Requested measuring steps (high)   : 0
Requested measuring steps (low)   : 400
Physical measuring steps (high)   : 0
Physical measuring steps (low)   : 12288

Requested resolution per   : Physical measuring steps
Overall resolution of the measuring steps (high)   : 0
Overall resolution of the measuring steps (high)   : 400

Summary: 13 bit standard resolution
Scaling function   : Activated
Requested measuring steps (high)   : 0
Requested measuring steps (low)   : 400
Physical measuring steps (high)   : 0
Physical measuring steps (low)   : 24576
Requested resolution per   : Physical measuring steps
Overall resolution of the measuring steps (high)   : 0
Overall resolution of the measuring steps (high)   : 400

Note

Many configuring tools require that the value is split-up into a high word and low word; also refer to Page 57.

5.1.8 Absolute value encoder type

The type of the absolute value encoder (single-turn or multi-turn) is defined in bit 1 of octet 39. When the encoder class is selected this is realized automatically. The user must only observe these parameters if the parameterization is done directly in the hexadecimal code.

Octet 39 bit 1	Type
0	Single-turn
1	Multi-turn

5.1.9 Dimension units of the velocity

The units in which the velocity is output (Class 2.x) is set using this parameter. This basis is saved in bit 4 and 5 of the octet 39.

Units	Bit 4	Bit 5
Steps/second	0	0
Steps/100 ms	1	0
Steps/10 ms	0	1
Revolutions/minute	1	1

5.2 Data transfer in the normal mode

For manufacturer-specific encoder class Class 2.x, the actual process value is generally transferred as 32-bit value (double word). In addition to 25 bits, which are provided for the position value, 7 additional bits are used as status bits. The master sends the preset value and additional control bits to the absolute value encoder in the (peripheral) output double word.

For a device Class (version) 2.2, the actual velocity is transferred in an additional (peripheral) input word:

ID	F1 hex				D0 hex	
AWC → Master	Status + actual position value				Velocity	
	Status + 2^{24}	$2^{23} - 2^{16}$	$2^{15} - 2^{8}$	$2^{7} - 2^{0}$	$2^{15} - 2^{8}$	$2^{7} - 2^{0}$

Master → AWC	Preset value + control bits			
	Control + 2^{24}	$2^{23} - 2^{16}$	$2^{15} - 2^{8}$	$2^{7} - 2^{0}$

The status bits in the input double word have the following significance:

Bit 28	Bit 27	Bit 26	Bit 25	Significance
				Ready 0 = absolute value encoder not ready 1 = absolute value encoder ready
				Operating mode 0 = commissioning mode 1 = normal mode
				Software limit switch 0 = lower limit switch ≤ actual value ≤ upper limit switch 1 = actual value > upper limit switch or actual value < lower limit switch
				Direction of rotation 0 = increasing in the clockwise rotation (when viewing the shaft) 1 = increasing in the counter-clockwise rotation (when viewing the shaft)

5.3 The commissioning mode

If the absolute value encoder is switched into the commissioning mode using the appropriate parameterization, then gearbox factors can be directly determined in the system using a so-called "teach-in".

The absolute value encoder signals when it is in the commissioning mode by the flashing green LED in the connecting cover and using bit 26 in the input double word (this is set to 0).

In the commissioning mode, the parameters, set in the configuring (direction of rotation, scaling) are ignored and instead the values, saved in the internal EEPROM, are used. If the direction of rotation and gearbox factor are changed in the commissioning mode, then the new values are saved in the EEPROM and the device operates with these values.

The principle mode of operation in the commissioning mode is as follows:
- The device is installed in the system.
- The commissioning mode is switched-in using the appropriate parameterization (refer to Section 5.14).
- If required, the direction of rotation is modified.
- The system is moved into the initial position.
- The start command for the teach-in is transferred to the absolute value encoder.
- The system is moved to the end position.
- The required step number is transferred to the absolute value encoder with the teach-in stop command.
- The preset value is set.
- The values, determined in the teach-in phase are transferred into the configuring (parameter).
- The commissioning mode is switched-out in the parameterization.

5.3.1 Setting the direction of rotation

In the commissioning mode, the direction of rotation in which the output code increases, can be changed online. The actual direction of rotation is displayed using bit 28 in the input double word (0: increasing/1: decreasing in the clockwise direction of rotation). The direction of rotation can be reversed using bit 28 in the output double word.

	Bit	Status bits							Data bits																								
		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 → AWC		0	0	0	**1**	0	0	0	The direction of rotation is changed via bit 28																								
AWC → Master		0	0	0	**0/1**	0	0	1	Absolute value encoder acknowledged in bit 0 and bit 28 with a new direction of rotation																							**0/1**
Master → AWC		0	0	0	**0**	0	0	0	The changeover operation is completed by resetting bit 28																								
AWC → Master		0	0	0	**0/1**	X	0	1	The actual process value is output with a modified direction of rotation																								

The direction of rotation which is set is saved in a non-volatile fashion in the EEPROM.

5.3.2 Starting teach-in

After the system has been moved to the beginning of the measuring range, the teach-in start command is transferred to the absolute value encoder. The device now internally starts the measuring to determine the gearbox factor.

		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 → AWC		0	1	0	0	0	0	0	Teach-in is started by setting bit 30
AWC → Master		0	1	0	X	X	0	1	The absolute value encoder acknowledges the start of teach-in by setting bit 30
Master → AWC		0	0	0	0	0	0	0	Bit 30 is reset
AWC → Master		0	1	0	X	X	0	1	The non-processed actual value is output (gearbox factor = 1, preset is not active)

Note

The gearbox factor is internally set to 1 and the zero offset is deleted.

5.3.3 Stopping teach-in

After the system has been moved over the measuring range using the teach-in stop command, the step number, required over the traversing measured distance is transferred. In this case it must be ensured that the physical resolution is not exceeded (e.g. 3000 steps for quarter of a revolution). Positive and negative directions of rotation and if the zero is possibly exceeded, are automatically taken into account. The measuring distance moved through may not exceed 2047 revolutions.
The absolute value encoder transfers the total resolution, calculated by the device, as response to the teach-in stop command. This value should be documented and used later in the configuring/parameterization for normal operation of the system. After this procedure has been completed, the device operates with the new scaling factor which has just been determined. This is then saved in the EEPROM in a non-volatile fashion.

		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 → AWC		0	0	1	0	0	0	0	Number of required steps over the measuring distance moved through
AWC → Master		0	1	1	X	X	0	1	The complete resolution for the new gearbox factor is transferred (this should be documented)
Master → AWC		0	0	0	0	0	0	0	Bit 29 is reset
AWC → Master		0	0	0	X	X	0	1	Output of the actual value including the gearbox factor

In order that the encoder can be subsequently replaced without requiring a new teach-in procedure, the total resolution, determined by the encoder, should be transferred into the configuring. This is realized by entering the complete resolution, determined in the teach-in phase (and documented) into the parameter field "Required measuring steps" (refer to Section 5.1.2). The "Resolution reference" switch is then set to "Maximum total resolution" (refer to Section 5.1.3). For the new configuration it must be ensured that the direction of rotation (refer to Section 4.2.1) is correctly entered – the setting in the commissioning mode must also be taken into account in the parameterization. The commissioning mode can then be disabled via the parameterization and the rotary encoder is now used in the "normal mode".

5.3.4 Preset value

The preset value is set in essentially the same way as the procedure described in Section 4.3.2. The only difference: For the manufacturer-specific classes, class (version) 2.1, 2.2, when the preset value is set, this is acknowledged using a status bit.

	Bit	Status bits							Data bits																								
		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 → AWC		1	0	0	0	0	0	0	The required value is transferred (= preset value)																								
AWC → Master		1	0	0	0	0	0	1	New = required actual process value is transferred																								
Master → AWC		0	0	0	0	0	0	0	Bit 31 is reset – normal mode																								
AWC → Master		0	0	0	0	0	0	1	New = required actual process value is transferred																								

6

6 Diagnostic Class 1/2

6.1 Overview

When requested by the master, in the DDLM_Slave_Diag mode, a series of data is transferred. There are 57 diagnostics data items. Exception: Reduced diagnostics (refer to Section 5.1.5). The diagnostics data is output according to the PROFIBUS Standard (octet 1-6) and the PI/PNO ENCODER profile rules (as of octet 7).

Diagnostics function	Data type	Diagnostics octet no.	Encoder class
Station status 1 (ref. to: PROFIBUS Standard)	Octet	1	1
Station status 2 (ref. to: PROFIBUS Standard)	Octet	2	1
Station status 3 (ref. to: PROFIBUS Standard)	Octet	3	1
Diagnostics Master Add	Octet	4	1
PNO identification number	Octet	5,6	1
Extended 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 32	15, 16	1
Additional alarm messages	Octet String	17	2
Supported alarm messages	Octet String	18, 19	2
Alarm messages	Octet String	20, 21	2
Supported alarms	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	-
Zero offset	Unsigned 32	32 - 35	2
Manufacturer-specific: Offset value	Unsigned 32	36 - 39	2
Parameterized resolution per revolution	Unsigned 32	40 - 43	2
Parameterized total resolution	Unsigned 32	44 - 47	2
Serial number	ASCII String	48 - 57	2

6.2 Diagnostic messages which are supported

The implemented diagnostics messages are described in more detail below.

6.2.1 Expanded diagnostics header

The length of the extended diagnostic bytes, including diagnostics header, is contained in diagnostics byte 7.

6.2.2 Memory errors

Bit 4 in diagnostics byte 8 is used to display whether a memory error has occurred. Memory error means in this case, that the angular encoder EEPROM no longer functions correctly and the preset value is no longer saved so that it is kept during power outages (non-volatile data storage).

Bit	Definition	0	1
4	Memory error (defect in the EEPROM)	No	Yes

6.2.3 Operating state

The operating parameters which are set can be interrogated using diagnostics byte 9.

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 Encoder type

The angular encoder version can be interrogated using diagnostics byte 10.

Byte 10	Definition
0	Single-turn angular encoder
1	Multi-turn angular encoder

6.2.5 Single-turn resolution

The hardware resolution per revolution of the angular encoder can be interrogated via diagnostic bytes 11-14.

6.2.6 Number of revolutions

The number of revolutions of the angular encoder which can be differentiated between on the hardware side, can be interrogated using diagnostic bytes 15 and 16. The two standard values are 1 for single-turn and/or 16384 for multi-turn.

6.2.7 Profile version

The profile version of the angular encoder is saved in diagnostic bytes 24 and 25:

Byte	24	25
Bit	15 - 8	7 - 0
Data	2^7 to 2^0	2^7 to 2^0
	Service No.	Index

6.2.8 Software version

The software version of the angular encoder is saved in diagnostic bytes 26 and 27.

Octet	26	27
Bit	15 - 8	7 - 0
Data	2^7 to 2^0	2^7 to 2^0
	Service No.	Index

6.2.9 Operating time

The operating time of the device is contained in diagnostic bytes 28 to 31. While the supply voltage is present, the "operating time" value is stored in the absolute value encoder every 6 minutes in intervals of 0.1 hour.

6.2.10 Zero offset

The zero offset is output in diagnostic bytes 32 to 35.

6.2.11 Parameterized resolution per revolution

The parameterized resolution per revolution is saved in diagnostic bytes 40 to 43. This value is only valid, if the gearbox factor was calculated in the parameter mask using the setting "Resolution per revolution" (refer to Section 5.1.3).
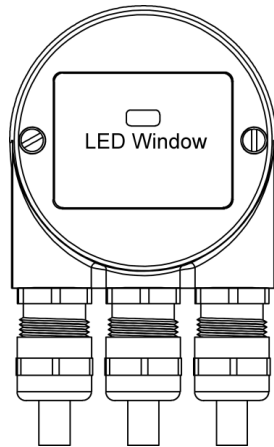
6.2.12 Parameterized total resolution

The parameterized and calculated total resolution can be read-out of diagnostic bytes 44-47.

6.2.13 Serial number

Diagnostic bytes 48 - 57 are provided for a serial number. This signal has presently not been implemented. The bytes are pre-assigned hex 2A (default value).

6.3 Status signals using LEDs in the connecting cover

The connecting cover has two LEDs, which optically represent the status of the bus at the angular encoder. The red LED displays errors and the green LED displays the status of the angular encoder. Each LED can have one of three conditions: dark, bright, flashing. From the nine combination possibilities, six are used to display various conditions.

If problems occur when commissioning the device, then initially the status of the LEDs should be checked; these can often provide important information regarding the possible cause of the error.

| No.	Red LED	Green LED	Status signal/possible cause
1	Dark	Dark	Power supply missing
2	Bright	Bright	Absolute value encoder is ready, but after the power was connected, it still had not received configuration data. Possible causes: Address incorrectly set, bus cables incorrectly connected
3	Bright	Flashing	Parameterizing or configuring error, i.e. the encoder receives configuring or parameterizing data with the incorrect length or inconsistent data. Possible cause: For example, the total resolution has been set too high
4	Flashing	Bright	Encoder ready, but is not addressed from the master (for example an incorrect address was addressed).
5	Bright	Dark	Encoder doesn't receive data for a longer period (approx. 40 sec) (for example, the data line has been interrupted).
6	Dark	Bright	Standard operation in the Data Exchange mode.
7	Dark	Flashing	Commissioning mode in the Data Exchange mode.

7 Operation with SIMATIC

7

7.1 Configuration with STEP 7

7.1.1 Reading-in the GSD files

When used for the first time, the GSD file (SIEM0024.gsd) must be installed in order to include the absolute value encoder in the Hardware Catalog. To do this, the "Install new GSD .." item should be selected in the "HW Config" window of the SIMATIC Manager under the menu item "Options". The appropriate GSD file (SIEM81A8.gsd or SIEM0024.gsd" or the German version SIEM81A8.gsd or SIEM0024.gsg) should be selected.
The GSD file can be obtained from SIEMENS.
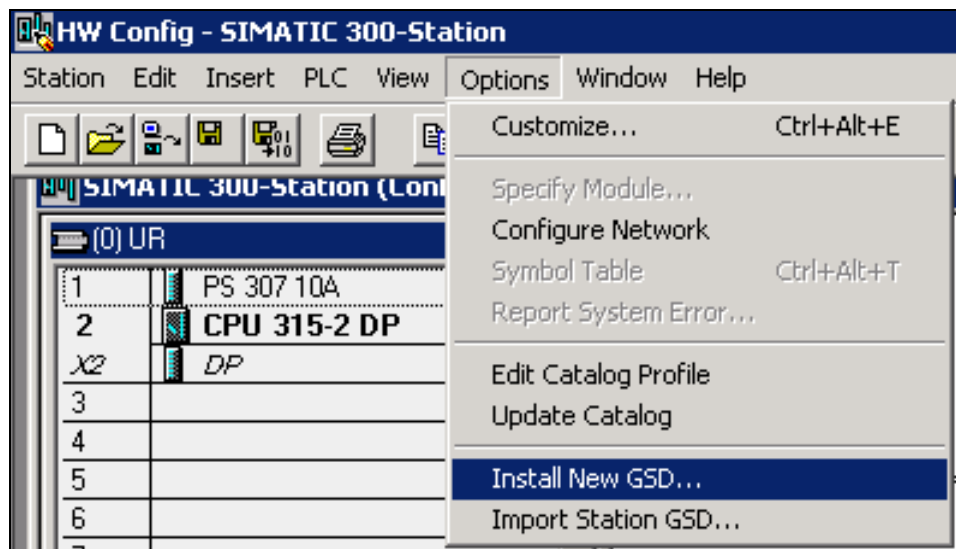
After the GSD file has been read-in, the absolute value encoder appears in the Hardware Catalog under "PROFIBUS DP" - "Other field devices" - "Encoder" - "MC-ENCODER".

For more recent versions of the "SIMATIC Manager" the sensor is already included in the Hardware Catalog.

7.1.2 Configuring the absolute value encoder

After the PROFIBUS network has been configured in the hardware configurator under the menu item "Insert" – "Master system", the absolute value encoder can be selected from the Hardware Catalog and inserted in the network. To do this, the "MC-ENCODER" (previously "SIMODRIVE sensor") device is coupled to the bus by drag & drop (or by double-clicking on the module with the bus selected).
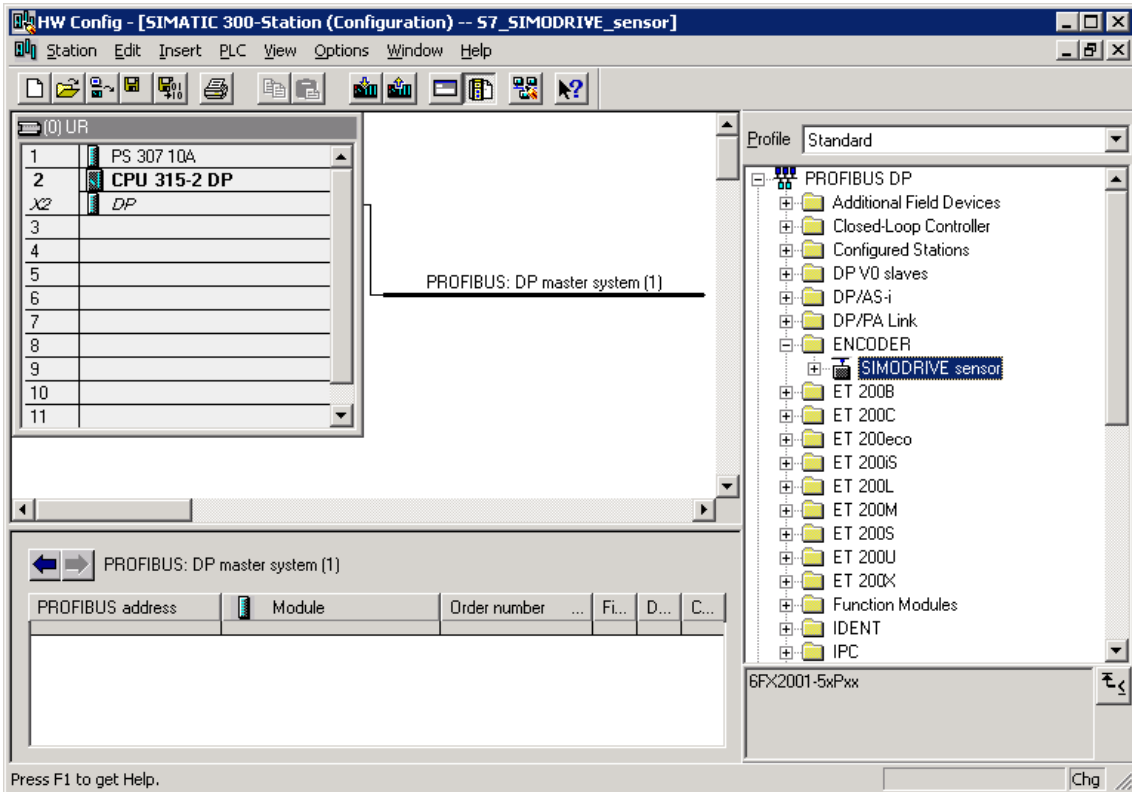

After the device has been inserted, the node address of the slave device is entered. This must match the address set in the connecting cover.
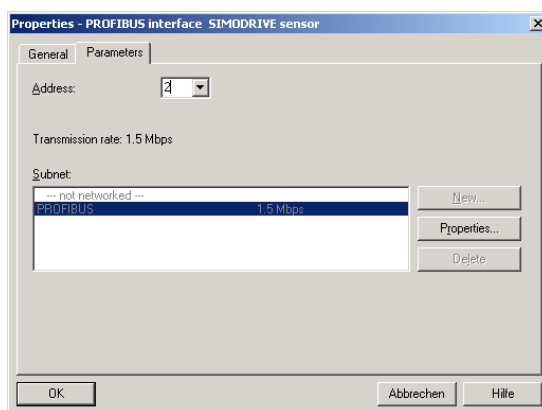
7.1.3 Selecting the device class

As described in Chapter 3, the functionality of the device depends on the selected encoder class when the GSD SIEM0024 is used. After the device, as described, has been inserted in the PROFIBUS network, the required device class can now be selected. In this case, one of the modules, listed in the Hardware Catalog under "MC-ENCODER" (previously "SIMODRIVE sensor") can be dragged&dropped at slot 1 (Table in the lower section of the station [node] window.):
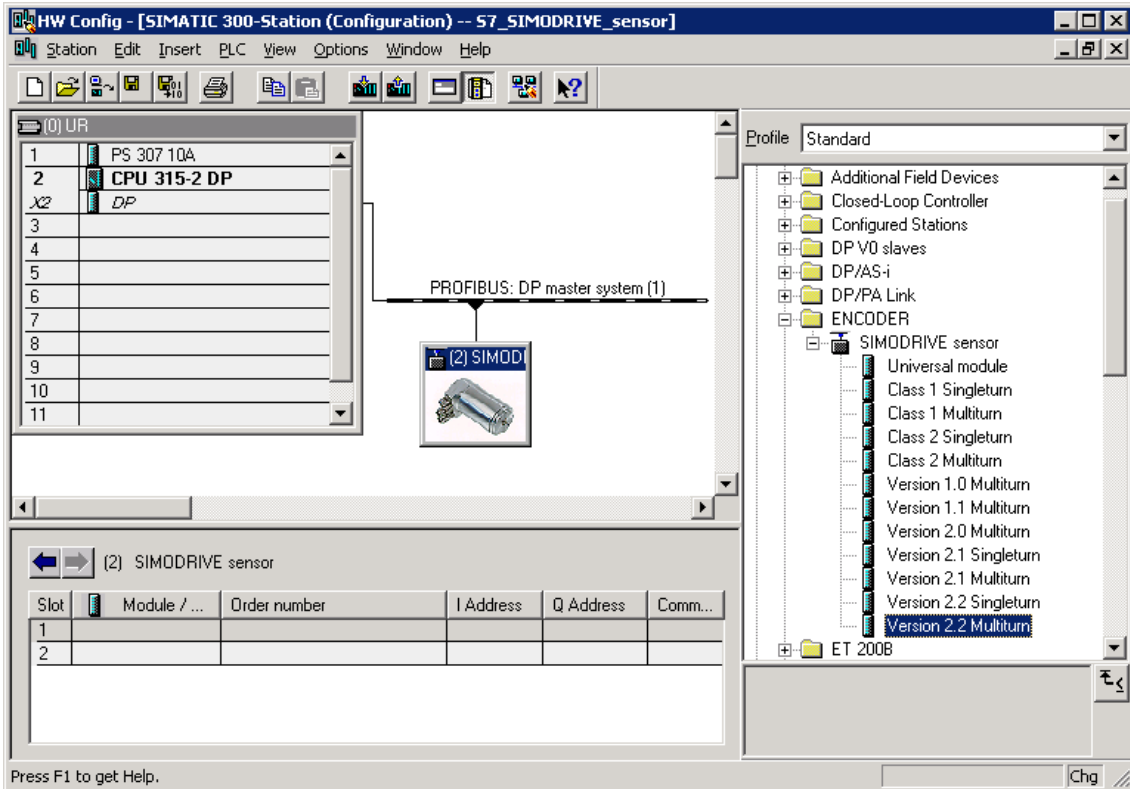
7.1.4 Parameterization

Select the absolute value encoder to be parameterized in the configuring and then double-click on slot 1 (Table in the lower area of the station [node] window). The dialog box "Properties DP slave" is displayed. The default addresses (if required) of the device can be changed here.

The "Parameterizing" tab should be selected to enter parameters.

The parameters of the device are now entered here.
After the "Device-specific parameter" folder has been selected, then, depending on the encoder class which has been selected, different parameters can be entered.
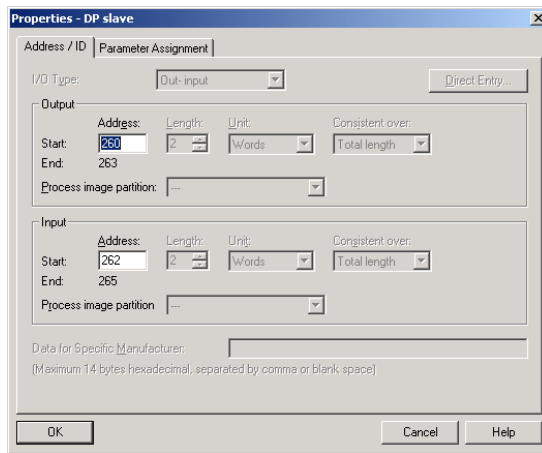
If there are several possibilities in the fields located to the right, then an additional selection window opens with a double-click. On the other hand, numerical values are directly entered.
The example indicates the parameter selection for Version 2.2 – the device class with the highest functionality.
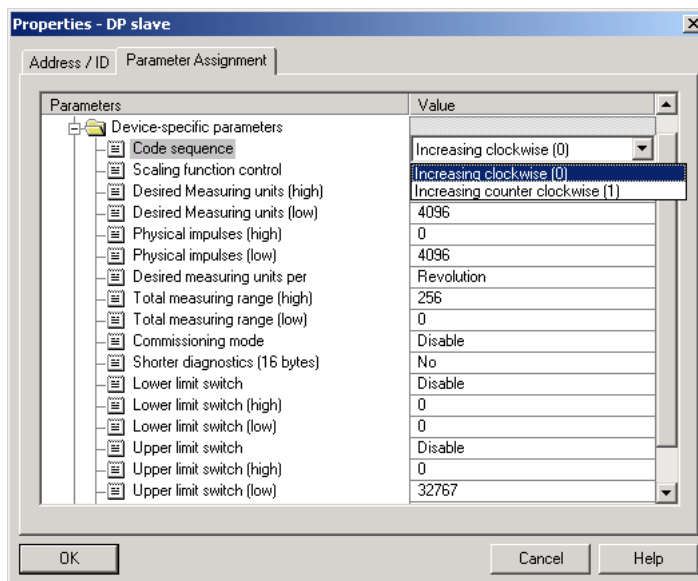
As a result of the STEP 7 configuring software, 32-bit parameter values (e.g. total resolution, limit switch, etc.) are split-up into high and low words.

Example

| Decimal	Hexadecimal		Hexadecimal	Decimal
129600	00 01 FA 40	High word:	00 01	1
		Low Word:	FA 40	64064

Decimal value "1" is now entered in the high field and decimal value "64064" in the low field.

Or:
Divide the value by 65536 – enter the integer part of the result into the high word and the remainder into the low word:

129600 / 65536 = 1.977539 → integer part = **1** → high word: 1
129600 – 1 x 65536 = 64064 → remainder = **64064** → low word = 64064

The data can also be directly entered in the hexadecimal format. However, this is significantly more complex; if possible this alternative should not be used.
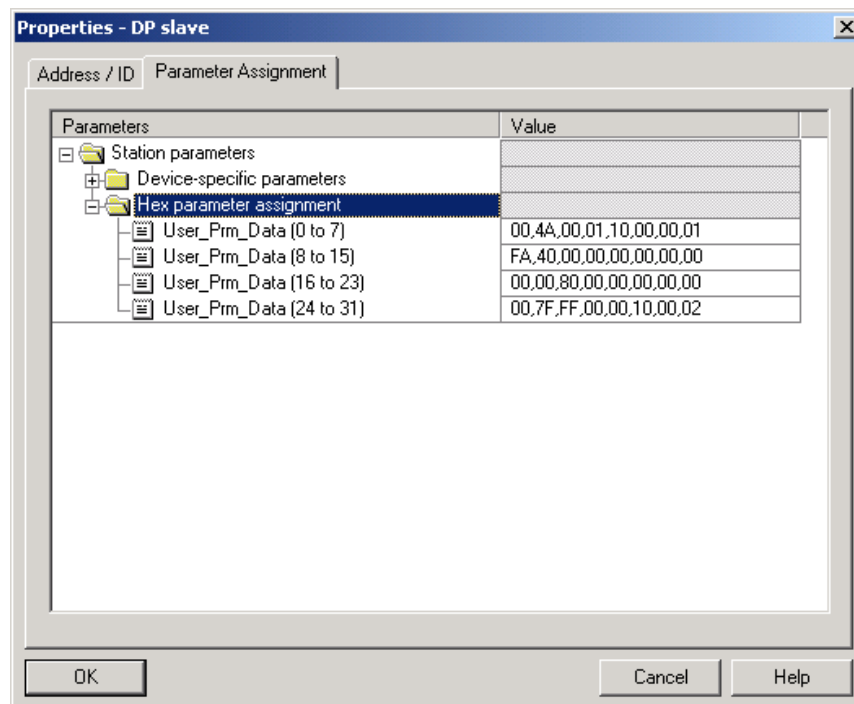
7.2 Access to cyclical data

7.2.1 S7 commands for access to I/O encoder addresses in the S7 CPU

Search for the appropriate example for your application, and modify it for your application!
The command sequence can be programmed depending on the encoder class (e.g. multi-turn, Class 2, see item 4), for example, in an FC26 provided it is not assigned, or in any other free function block, in a network (e.g. NW 1).

1. Single-turn encoder, Class 1: Position value - 16-bit input (only the actual value is read)
- Direction of rotation -

Refer to the HW configuration of the SIMATIC Manager for the slot of the DP node:
E.g. DP node address 26, slot 1 with E-address 296 - 297, two bytes are assigned.

S7 command:
L PEW 296   Status word that indicates the current actual position value!

2. Multi turn encoder, Class 1: Position value - 32-bit input (only the actual value is read)
- Direction of rotation -

Refer to the HW configuration of the SIMATIC Manager for the slot of the DP node:
E.g. DP node address 26, slot 1 with E-address 296 - 299, four bytes are assigned.

S7 command:
L PED 296   Status word that indicates the current actual position value!

3. Single-turn encoder, Class 2: Position value - 16-bit input
Preset value - 16-bit output
- Direction of rotation / gearbox factor -
- Preset function -

Refer to the HW configuration of the SIMATIC Manager for the slot of the DP node:
E.g. DP node address 26, slot 1 with E-address 296 - 297, A-address 296 - 297, each are assigned two bytes.

S7 command:
L MW 296   Control word
T PAW 296
L PEW 296   Status word

4. Multi-turn encoder, Class 2:   Position value - 32-bit input
Preset value - 32-bit output
- Direction of rotation / gearbox factor -
- Preset function -

Refer to the HW configuration of the SIMATIC Manager for the slot of the DP node:
E.g. DP node address 26, slot 1 with E-address 296 - 299, A-address 296 - 299,
each are assigned four bytes.

S7 command:
L   MD   296   Control word
T   PAD   296
L   PED   296   Status word

5. Single-turn encoder, Class (version) 2.1:
Position value - 32-bit input
Preset value / teach-in - 32-bit output
- Direction of rotation / gearbox factor /   reduced diagnostics / limit
  switch -
- Preset function / commissioning mode -

Refer to the HW configuration of the SIMATIC Manager for the slot of the DP node:
E.g. DP node address 26, slot 1 with E-address 320 - 323, A-address 320 - 323,
each are assigned four bytes.

S7 command:
L   MD   320   Control word
T   PAD   320
L   PED   320   Status word

6. Multiturn encoder, Class (version) 2.1:
Position value - 32-bit input
Preset value / teach-in - 32-bit output
- Direction of rotation / gearbox factor / reduced diagnostics / limit
  switch -
- Preset function / commissioning mode -
Refer to the HW configuration of the SIMATIC Manager for the slot of the DP node:
E.g. DP node address 26, slot 1 with E-address 320 - 323, A-address 320 - 323,
each are assigned four bytes.

S7 command:
L   MD   320
T   PAD   320
L   PED   320

7. Single-turn encoder, Class (version) 2.2:
Position value - 32-bit input
Preset value / teach-in - 32-bit output
Speed - 16-bit input
- Direction of rotation / gearbox factor / reduced diagnostics / limit
  switch / unit of the speed output -
- Preset function / commissioning mode / speed output -
Refer to the HW configuration of the SIMATIC Manager for the slots of the DP
node: E.g. DP node address 26, slot 1 with E-address 320 - 323 and slot 2 with E-

address 324 - 325, slot 1 with A-address 320 - 323, E-addresses four plus two bytes, A-addresses four bytes assigned.

S7 command:

L	MD	320	Control double word
T	PAD	320	
L	PED	320	Status double word
SLD		7	The control bits 25 - 31 are zeroized!
SRD		7	
T	MD	420	Auxiliary double word
L	PEW	324	
T	MW	324	Speed output status word

8. Multi-turn encoder, Class (version) 2.2:

>>> Position value - 32-bit input
>>> Preset value / teach-in - 32-bit output
>>> Speed - 16-bit input

> - Direction of rotation / gearbox factor / reduced diagnostics / limit switch / unit of the speed output -
> - Preset function / commissioning mode / speed output -

Refer to the HW configuration of the SIMATIC Manager for the slots of the DP node: E.g. DP node address 26, slot 1 with E-address 320 - 323 and slot 2 with E-address 324 - 325, slot 1 with A-address 320 - 323, E-addresses four plus two bytes, A-addresses four bytes assigned.

S7 command:

L	MD	320	Control double word
T	PAD	320	
L	PED	320	Status double word
SLD		7	The control bits 25 - 31 are zeroized!
SRD		7	
T	MD	420	Auxiliary double word
L	PEW	324	
T	MW	324	Speed output status word

7.3 Diagnostics

## 7.3.1 SFC51 system function - "RDSYSST"

The SFC51 - "RDSYSST" system function reads a parts list of the SZL (= system status list). The parts lists are virtual lists, i.e. they are compiled by the CPU only on request.
The content of the SZL (= system status list) can only be read but not changed by query functions.
SFC51 is included in the STEP 7 basis software scope of supply in the Standard Library version x.y. The system function is located under "System Function Blocks".

Procedure

1. Open the "SIMATIC Manager".
2. Select "File" → "Open".
   The "Open Project" window opens and offers four tabs: "User projects", "Libraries", "Sample projects" and "Multi-projects".
3. Open the "Libraries" tab.
4. Select "Standard library" and click the "OK" button.
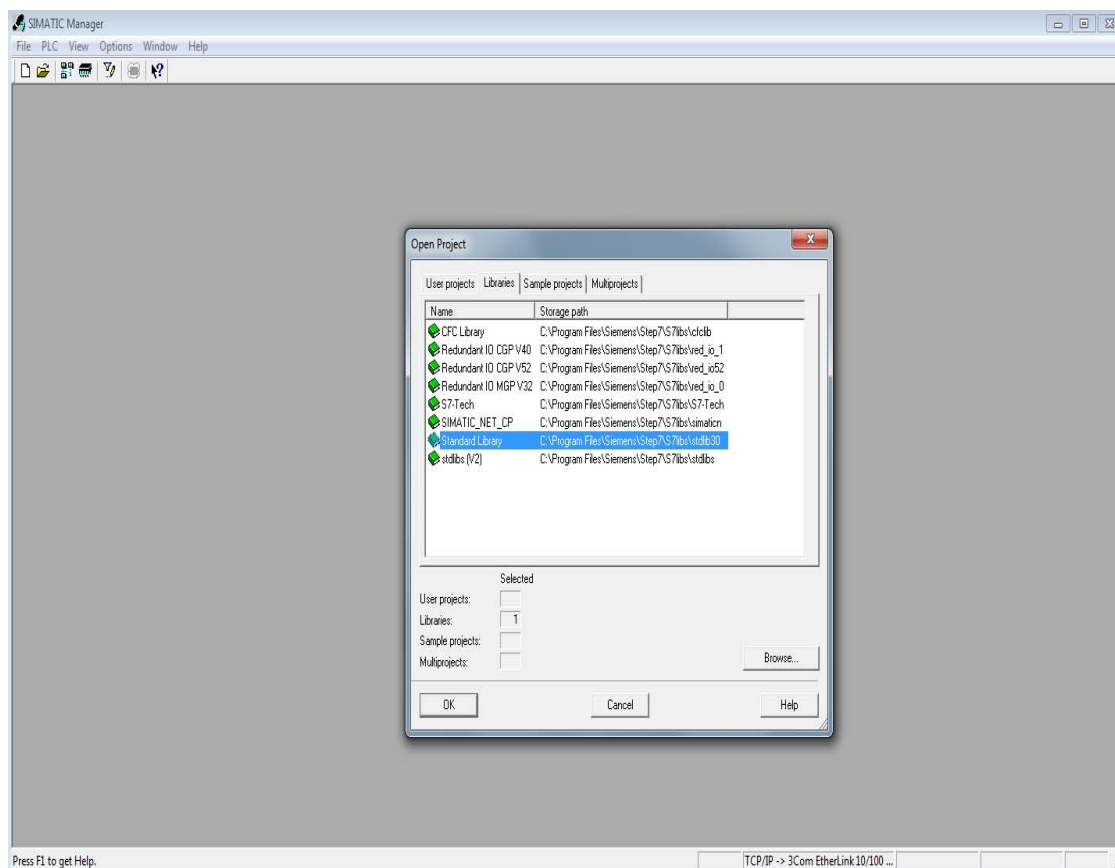
5. The standard "library" opens.
6. Select under "System", "Function Blocks" → "Blocks".
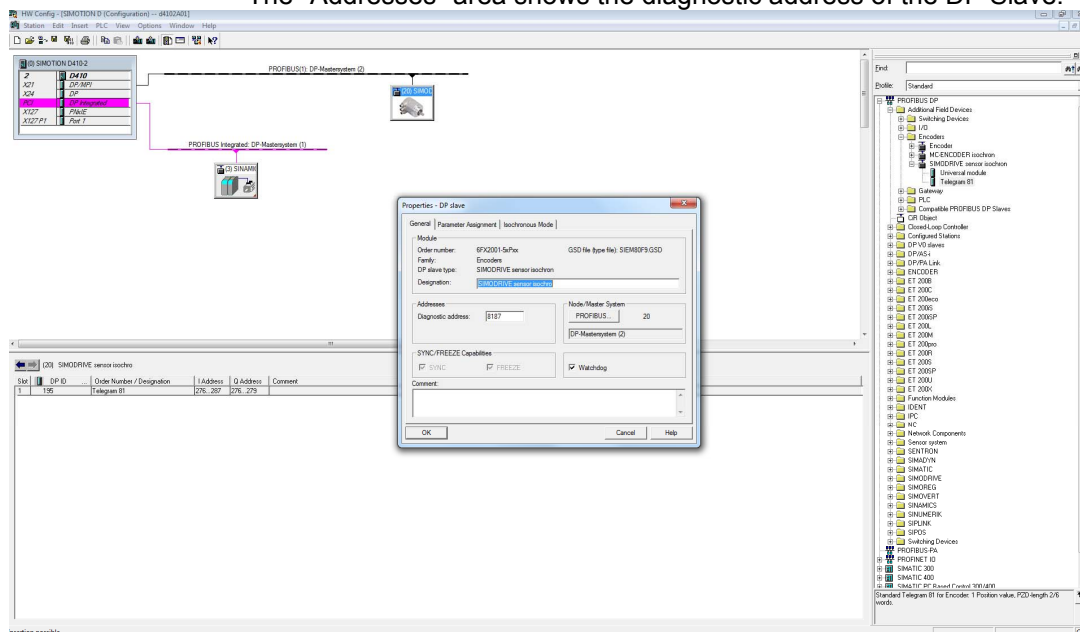7. Copy SFC51 to the S7 project.
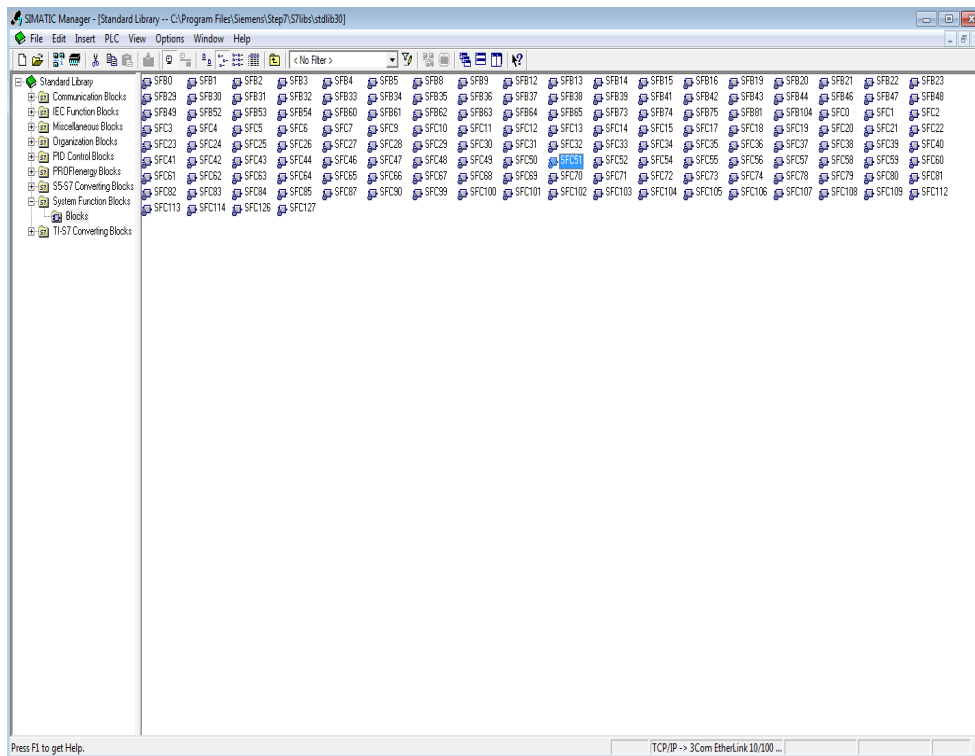
7.3.2 Diagnostic address of the slave node (PROFIBUS sensor)

To find the diagnostic address of the slave node, proceed as follows:

1. Open the SIMATIC Manager.
2. Select "HW config" and double-click the encoder symbol.
   The "Properties - DP-Slave" window opens.
   The "Addresses" area shows the diagnostic address of the DP Slave.

7.3.3 Example: Parameterize SFC51

Prerequisite

- The slave node has been assigned DP address 26 in the "HW Config" of the "SIMATIC Manager".
- The diagnostic data is fetched from the absolute value encoder with the complete number of 57 diagnosis bytes.

Procedure

1. Open the "SIMATIC Manager".
2. Click "INSERT" → "S7 block" → "3 function".
3. Enter a free "FC number", "Symbolic name", etc. in the Properties function.
    Example:
    Name: FC260
    Symbolic name: Fetch octet values
    Symbol comment: SFC51
    Creation language: STL
4. Select under "S7 Program (1)" → "Blocks" and click "FC260".
5. Program the following commands:
    FC260: SIMODRIVE PROFIBUS DP Encoder
    Enter a comment, e.g. fetch the octet values with the SFC51.

Network 1: Fetch the diagnostic data (octet values)

```
SFC51 - Fetch octet values
MC-ENCODER PROFIBUS DP
CALL "RDSYSST"           // Call SFC51
REQ :=M262.1             // 1 = Initiate the processing
SZL_ID :=W#16#B4         // Diagnostic data of the DP slave DP address 26
INDEX :=W#16#1FFB        // Diagnostic addr. 8187 dec = 1FFB hex
RET_VAL :=MW260          // The error code is entered during the processing
BUSY :=M262.0            // Read operation being processed
SZL_HEADER:= "DIAG_STRUCT".STAT0  // SZL_Header is DB51.DBX0.0
DR :=P#DB260.DBX0.0 BYTE 60
```

Explanations:
REQ = 1 :   The processing initiation is set when all parameters have been specified.

SZL_ID = B4 hex: The attached "SFC51 _RDSYSST.pdf" description in the appendix is described as follows under "SZL_IDs" in "Diagnostic data on modules":
00B4 - Diagnostic data of a DP slave, configured diagnostic address of the DP slave.

INDEX = 1FFB hex : Diagnostic address of the DP slaves (DP 26) is 8187 dec = 1FFB hex.

RET_VAL = MW260 If an error occurs while processing the SFC, the associated error code is entered in the flag word. Refer to the description of the "SFC51 _RDSYSST.pdf" under "Error information" – "Error code".

BUSY :=M262.0 True: Read operation being processed.

SZL_HEADER:= P#DB51.DBX0.0 Refer to the description of the "SFC51 _RDSYSST.pdf" – "SZL_HEADER".
Is the structure of the SZL header.

DR :=P#DB260.DBX0.0 BYTE 60 Target area for the read SZL parts list.
In this case, the diagnostic data is fetched, starting at DB260, DB0 to DB56, namely 57 data bytes.

8

8 DPV2 Functionality- General Information

The latest generation of SIEMENS PROFIBUS absolute value encoders supports the new PROFIBUS functionality – isochronous operation and slave-to-slave communication.

8.1 Isochronous operation

Isochronous communication (equidistance) forms the basis for synchronizing several drives. In this case, PROFIBUS slaves are synchronized to a cyclic clock cycle signal (GC) sent by the master as "Global-Control-Command". The instants in time where the actual value is sensed (T_I) and the setpoint transfer (T_O) within the bus cycle (T_{DP}) can be selected in the configured software. This means that the position values of several axes can be simultaneously sensed to a precision of just microseconds.
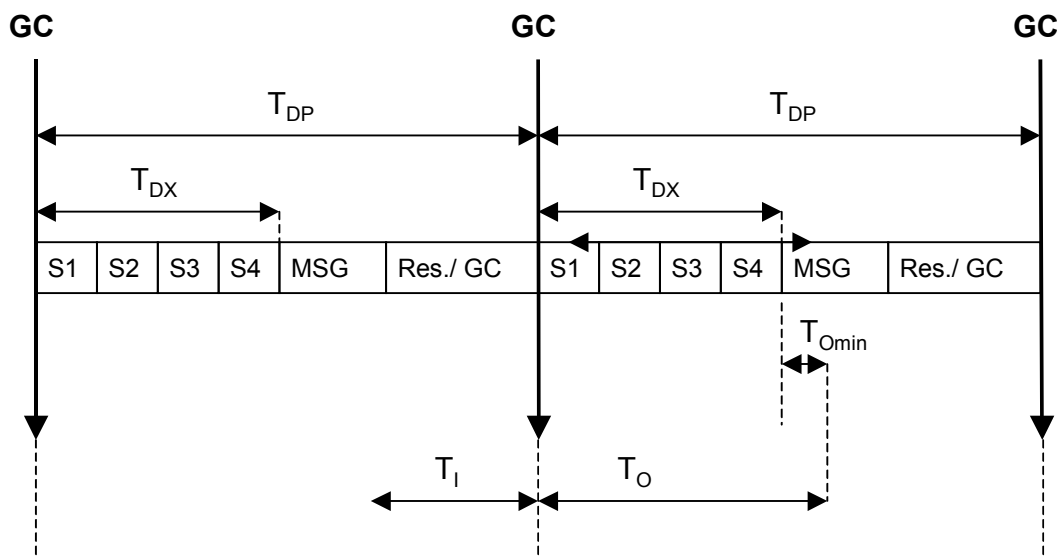
8.2 Slave-to-slave communication

The slave-to-slave communication function allows PROFIBUS slave devices to "listen to" the actual values of other slaves and use these as setpoints. A slave device, which provides its actual values to other slaves is called a "Publisher". Devices which listen to the actual values of other slaves are called "Subscribers". A master must initiate slave-to-slave communication and this can be implemented within one DP cycle.

9

9 Class 3 / 4 Isochronouser Operation

The absolute value encoder must be operated with the GSD file "SIEM80F9.GSD" in order to be able to use the new functionality. If the device was previously used with another GSD file, then the operating voltage must initially be withdrawn and then it must be switched-in again. An example in Section 13 explains how the device should be configured.

As of version FS17 (A17), the GSD file "SIEM81A8.gsd" provides the following functions:
- Encoder Class 3 and Class 4 functionality in accordance with PI/PNO-ENCODER profile V4.1
- Compatibility mode (compatible control word in accordance with PI/PNO-ENCODER profile V3.1)
- Alarm channel
- Siemens telegram 861 (corresponds to encoder Class 2)
Flexible selection of the parameter change rights

9.1 Run-up

The device runs-up to cyclic operation in several phases:

9.1.1 Slave parameterization, configuration

Parameter and configuration data are transferred from the master to the slave. The parameter structure and possibilities of assigning parameters (parameterization) are described in more detail in Section 10.
Telegram type 81 (in accordance with the PROFIdrive profile) is provided as configuration. Telegram 81 is described in detail in Section 9.2.

As of version FS17, when using the GSD file SIEM81A8.gsd, the manufacturer-specific telegram 861 is available. Telegram 861 corresponds to the Class 2 function in the PI/PNO- ENCODER profile V1.1.

Telegrams 81 and 861 can be used in isochronous and non-isochronous applications.

Telegram type	Output data	Input data	ID (specific ID format)
81	2 words	6 words	0xC3,0xC1,0xC5,0xFD,0x00,0x51
860	4 word	4 words	0xC3,0xC1,0xC1,0xFD,0x03,0x5C

9.1.2 Synchronizing to the clock cycle Global Control

As soon as the slave application detects the "Operate" state and receives valid Data_Exchange telegrams, synchronization to the clock cycle Global Control is started. Initially, a bus cycle time of T_{DP} (from the parameterization, refer to Section 10.3.2) is assumed and the tolerance window width is a multiple of the parameterized time T_{PLL_W} (refer to Section 10.3.8). During the synchronization phase, the bus cycle T_{DP} is adapted to the real bus cycle and the tolerance window is decreased down to the parameterized window width T_{PLL_W} (refer to Section 10.3.8).

The slave application starts with the clock cycle monitoring after synchronization has been completed. More detailed information on this can be taken from the PROFIdrive profile.

If the maximum permissible number of clock cycle failures is exceeded, the error bit is set in the status word, the appropriate error code (refer to Section 12.3) is output and the slave application re-attempts to synchronize itself.

9.1.3 Synchronizing the slave application to the master sign-of-life

After having successfully synchronized to the clock cycle Global Control, the slave application attempts to synchronize itself to the master sign-of-life. It expects that the master sign-of-life character counter increments itself at each cycle of the master application. The cycle time of the master application must be transferred via the parameter T_{MAPC} (refer to Section 10.3.3). Synchronization can start at any value of the master sign-of-life. If the value range of the master sign-of-life character was run-through once error-free, then the synchronization phase is considered to have been completed and the monitoring of the master sign-of-life character starts. More detailed information on this subject can be taken from the PROFIdrive profile.

If a "Sign-of-life error" occurs, the error bit is set in the status word, the appropriate error code is output and the slave application re-attempts to re-synchronize itself.

9.1.4 Synchronizing the master application to the slave sign-of-life character

After the slave application has been successfully synchronized to the master sign-of-life character, the slave sign-of-life character is set to a value not equal to 0 and incremented with each bus cycle. This means that the master application can now synchronize to the slave sign-of-life character.

9.1.5 Cyclical operation

In cyclical operation, the slave application monitors the sign-of-life character of the master application. If the sign-of-life character is missing, the slave application attempts automatically to resynchronize itself. Provided the master sign-of-life character remains available without error, the slave sign-of-life character is incremented in each bus cycle and can be monitored by the master application.

9.2 Telegram type 81

Telegram type 81 (based on the PROFIdrive profile) is transferred in cyclic data transfer:
Output data (master to the absolute value encoder)
2 x 16 bits (consistent)

STW2	G1_STW1

Input data (absolute value encoder to the master)
2 x 16 bits + 2 x 32 bits (consistent)

ZSW2	G1_ZSW1	G1_XIST1	G1_XIST2

STW2 (16 bits): Master sign-of-life character
4-bit counter, left justified. The master application starts the master sign-of-life character at any value between 1 and 15. The master increments the counter in each master application cycle. The value range extends from 1 to 15; a value of "0" indicates an error and is skipped in error-free operation.

X	X	X	X	0	0	0	0	0	0	0	0	0	0	0	0
Counter				Unused											

ZSW2 (16 bits): Slave sign-of-life character
4-bit counter, left justified. The slave application starts the slave sign-of-life character at any value between 1 and 15 after it has been successfully synchronized to the clock cycle. The slave increments the counter in each DP cycle. The value range extends between 1 – 15, a value of "0" indicates an error and is skipped in error-free operation.

X	X	X	X	0	0	0	0	0	0	0	0	0	0	0	0
Counter				Unused											

G1_STW1 (16 bits): Encoder control word

Bit	Value	Significance	Description
0 .. 10			Reserved, presently it is not used
11	0/1	"Home position mode"	Specifies whether the actual value is set to an absolute value or is to be shifted by a specific value. 0: set home position (absolute) 1: shift home position
12	1	Set preset/request shift	The preset value is set (or the value shifted) with the rising edge. Default (preset value, shift): 0
13	1	Request transfer, actual value 2	Requests that the actual value is additionally transferred in G1_XIST2. The additional actual value is generally transferred in the current version.
14	1	"Park encoder"	If this bit is set, then the encoder does not output any error messages.
15	1	Acknowledge encoder error	Acknowledges/resets an encoder error.

G1_ZSW1 (16 bits): Encoder status word

Bit	Value	Significance	Description
0 .. 10			Reserved, presently it is not used
11		Acknowledges encoder error being processed	This bit is set if it takes longer than one bus cycle to reset an error after acknowledgement.
12	1	Acknowledgement, set preset/shift value	
13	1	Acknowledgement, transfer actual value 2	The actual value is additionally transferred in G1_XIST2
14	1	Acknowledgement "Park encoder"	Acknowledgement "Park encoder": The encoder does not output any error messages.
15	1	Encoder fault	This indicates an encoder fault. The fault code is output in G1_XIST2.

G1_XIST1 (32 bits): Actual value (position)
The absolute position value is output in G1_XIST1. The output is realized left justified. The "Shift factor" (number of bits through which the position value is shifted) can be read-out using parameter P979 (non-cyclic).

G1_XIST2 (32 bits): Actual value 2/error codes
An additional actual value (right justified) is transferred in G2_XIST2. A possible shift can be read-out using the non-cyclic parameter P979. When an error situation occurs, error codes are output depending on the encoder control word.
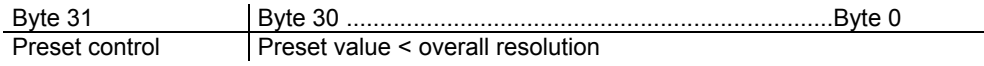
9.3 Telegram 861

In cyclical data exchange, the position values are also transferred isochronously for telegram 861. As for DPV0 (Class 2 functionality), any arbitrary preset value can be activated during the data exchange by setting bit 31.

Input data (absolute value encoder on the master): 4 bytes
Position value - 32-bit unsigned integer

Byte 0	Byte 1	Byte 2	Byte 3
MSB			LSB
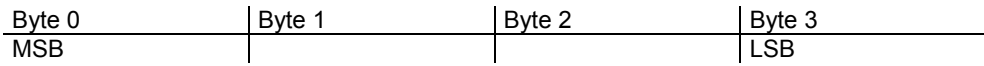
Output data (absolute value encoder on the master): 4 bytes
Preset - 32-bit unsigned integer

Byte 31	Byte 30 ....Byte 0
Preset control	Preset value < overall resolution

10

10 Isochronous Operation - Parameterizion

The parameters which can be set and the various engineering/configuring possibilities are now described in the following.

10.1 Parameter – overview

The parameter data is transferred in the parameterizing telegram as so-called "Structured_Prm_Data" blocks:

Byte No.	Parameter	Data type	Details
1-7	PROFIBUS Standard parameters		Refer to the PROFIBUS Standard
8-10	DPV1 bytes		
11-14	Block header, user parameters	4 x Unsigned8	
15 Bit 0	Direction of rotation	Bit	10.2.1
15 Bit 1	Scaling/preset/activate direction of rotation	Bit	10.2.2
15 Bit 3	Scaling function	Bit	10.2.2
15 Bit 2, 4- 7	Reserved		Presently not used
16 - 19	Measuring steps/revolution	Unsigned32	10.2.3
20 - 23	Total resolution	Unsigned32	10.2.4
24	Maximum failures, master sign-of-life character	Unsigned8	10.2.5
28	Parameterization priority		10.2.6
25 - 31	Reserved		Presently not used
32 - 35	Block header, isochronous parameters	4 x Unsigned8	
36	Version	Unsigned8	
37 – 40	T_{BASE_DP}	Unsigned32	10.3.1
41 - 42	T_{DP}	Unsigned16	10.3.1
43	T_{MAPC}	Unsigned8	10.3.3
44 - 47	T_{BASE_IO}	Unsigned32	10.3.4
48 – 49	T_I	Unsigned16	10.3.5
50 – 51	T_O	Unsigned16	10.3.6
52 - 55	T_{DX}	Unsigned32	10.3.7
56 - 57	T_{PLL_W}	Unsigned16	10.3.8
58 - 59	T_{PLL_D}	Unsigned16	10.3.9

10.2 Device-specific parameters

The following device-specific parameters can be set to adapt the absolute value encoder to the particular application:

10.2.1 Direction of rotation

The direction of rotation defines the direction in which the counter of the output of the actual process value counts when the shaft rotates clockwise (CW) or counter-clockwise (CCW) when viewing the shaft. The count direction is defined by bit 0 in byte 15:

Octet 15 bit 0	Direction of rotation when viewing the shaft	Output code
0	Clockwise (CW)	Increasing
1	Counter-clockwise (CCW)	Increasing

10.2.2 Scaling/preset/counting direction

Using this switch, for the absolute value encoder, the scaling, preset and direction of rotation change functions can be either enabled or disabled.

This switch is important if the device is to be operated with the minimum time T_I of 125 µs. This is only possible if scaling, preset and direction of rotation selection are disabled. In this particular case, the encoder rejects all data that is transferred using the parameters "direction of rotation", "measuring steps per revolution" and "total resolution" and instead uses the following default settings:

Direction of rotation: Increasing in the clockwise sense
Measuring steps per revolution: 8192
Total resolution: 33554432

If the functionality "scaling, preset and direction of rotation" is enabled, then the following must be carefully observed:

T_I must be greater than or equal to 375 µs. Because a smallest Ti of 125 µs is specified in the GSD, a Ti smaller than 375 µs can be set in the HW Config and in HWCN. However, while establishing a connection, a parameteriization error occurs for activated "Scaling / preset / direction of rotation" parameter and the encoder does not enter the run state.

The time which elapses between the setpoint being accepted (T_O) up to the actual value latch (T_I) must be a minimum of 375 µs.

Octet 15 bit 1	Scaling/preset/direction of rotation change
0	Disabled
1	Enabled

In order that scaling can be executed, bit 3 must be additionally set in octet 15 (default setting):

Octet 15 bit 3	Scaling function
0	Disabled
1	Enabled

10.2.3 Measuring steps per revolution

The 'Measuring steps per revolution' parameter assigns the absolute value encoder the required number of steps referred to 1 revolution.

If the parameter value exceeds the actual (physical) basic resolution of the encoder, then the output value is no longer in single steps. In this particular case, a parameter error indicates that the device does not go into the cyclic data transfer mode.

Octet	16	17	18	19
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}
	Required measuring steps per revolution			

10.2.4 Total resolution

Octet	20	21	22	23
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}
	Selected total resolution in measuring steps			

The user can adapt the measuring range of the device using the 'Total resolution' parameter: The absolute value encoder counts up to the parameterized total resolution and then restarts at 0.

Example: 100 steps are selected for each revolution, the total resolution is 12800 and then the absolute value encoder restarts after 128 revolutions and then counts again up to 11799.

For many configuring tools it is necessary to split-up the value into a high word and low word (refer to the User Manual). The following should be carefully observed when entering the parameter "Total resolution":

If n steps per revolution were selected then the selected total resolution may no longer result in the fact that the periods are longer than the maximum number of revolution of the device which are available (physically) (refer to the rating plate). This means, for a multi-turn device with 16384 revolutions, the total resolution must be less than 16384 x the parameterized number of steps per revolution:

Total resolution < measuring steps per revolution x number of revolutions (physical)

If this is not observed, the device outputs a parameter error and does not go into the cyclic data transfer mode.

10.2.5 Maximum master sign-of-life character failures

The maximum permissible number of master sign-of-life character failures can be parameterized in parameter byte 24. Default: 1.

10.2.6 New features for GSD version SIEM81A8

Encoder Class 4 functionality

The "Encoder Class 4 functionality" parameter specifies whether scaling, preset and counting direction applies to the values in XIST1.

Caution

For activated "Encoder Class 4 functionality", TI must be greater than or equal to 375 µs. Because a smallest Ti of 125 µs is specified in the GSD, a Ti smaller than 375 µs can be set in the HW Config and in HWCN.
While establishing a connection, a parameteriization error occurs for activated "Encoder Class 4 functionality" and the MC-ENCODER does not enter the run state.

Preset affects XIST1

The "Preset affects XIST1" parameter specifies whether or not for activated Class 4 functionality the preset value affects the XIST1.

Scaling function

The "Scaling function" parameter specifies whether or not for activated Class 4 functionality the scaling affects the XIST1.

Diagnostics via alarm channel

This parameter specifies the length of the diagnostic telegrams.

Compatibility mode V3.1

This parameter specifies whether the rotary transducer should operate compatible to PI/PNO-ENCODER profile 3.1.

Function	Compatibility mode (=0)	Compatibility mode (=1)
Control via the controller (STW2_ENC)	Ignored; the control word (G1_STW) and setpoint values are always valid. Control requests (ZSW2_ENC) are not supported and are set to 0.	Supported
User parameter "Maximum master sign-of-life failures"	Parameter change right is supported: • **PRM**: Parameter telegram from the HW Config is used during the	Parameter change right is supported; • **PRM:** Parameter telegram from

Function	Compatibility mode (=0)	Compatibility mode (=1)
	PLC ramp-up. P925 calls are ignored. • **PD-Param:** NV values are used during the PLC ramp-up. P925 can be used to set the online monitoring. Original setting On Sign-of-life character tolerated * **. • **PRM+PD_Param:** The offline setting from the HW Config is used during the PLC ramp-up. During running operation, P925 can be used to set the optional monitoring online * **.	the HW Config is used during the PLC ramp-up. P925 calls are ignored. • **PD-Param:** NV values are used during the PLC ramp-up. P925 can be used to set the online monitoring. Original setting On Sign-of-life character tolerated * **. • **PRM+PD_Param:** The offline setting from the HW Config is used during the PLC ramp-up. During running operation, P925 can be used to set the optional monitoring online * **.
Diagnostics via alarm channel	Errors are output via G1_XIST2. The output of errors via the standard alarm channel can be activated/deactivated via a parameter.	Errors are always output via the standard alarm channel (diagnostic address).
P965 – profile version	31 (V3.1)	41 (V4.1)

* • The error counter is not reset. Existing errors may need to be reset manually.
  • Values > 255 cause the following error: LOW-HIGH-LIMIT-EXCEEDED = 0x02.
  • The values are used immediately for the error monitoring.
** Values may need to be stored in NV (non-volatile) memory.

Parameterisation prioriy

This can be used to set from which source the MC-ENCODER parameters should be initialized during the ramp-up (start of the MC-ENCODER):
• The controller (sent during the PLC start-up via PRM; can be set by the user in the HW Config on the device under "Parameters")
  - OR -
• The rotary transducer (stored values)
  -OR -
• The controller and the rotary transducer (behavior in accordance with PI/PNO-ENCODER profile V3.1)

10.3 Isochronous parameters

Some of the isochronous parameters are set by the user and others by the configuring tool. The individual parameters are briefly described below:

10.3.1 T_{BASE_DP}

Timebase of the DP cycle time T_{DP}.
Units: 1/12 µs
Set to 125 µs using the GSD file.

10.3.2 T_{DP}

DP cycle time
Units: T_{BASE_DP}

Comprises the following:
- Duration of the cyclic utility [service]: This depends on the number of slaves and telegram length
- Duration of the non-cyclic utility [service]: This depends on the maximum length of the DPV1 telegrams
- Duration up to the new DP clock cycle: GAP, token transfer, reserve, Global Control

The minimum DP cycle time, resulting from the secondary conditions, should be listed as recommendation when configuring the system; however it is still possible to enter higher values. The maximum value for T_{DP} is, for absolute value encoders, 32 ms – the (theoretical) minimum value is 500 µs.

10.3.3 T_{MAPC}

Cycle time of the master application. This is specified as a multiple of T_{DP} and is used to evaluate the master sign-of-life character.

10.3.4 T_{BASE_IO}

Timebase of T_I and T_O (instants in time of the actual value sensing/setpoint transfer).
Units: 1/12 µs
This is set to125 µs using the GSD file.

10.3.5 T_I

Instant in time of the actual value sensing referred to the end of the cycle.
Units: T_{BASE_IO}

The following rules apply:
The minimum time for T_I (this is also specified in the GSD file) is only 125 µs if the scaling is <u>disabled</u> using the device-specific parameter.
T_I must be at least 375 µs if the scaling function is used.

Further, a minimum time must be maintained between the instants that the setpoint is transferred (this is defined using T_O) and the actual value sensing (this is defined using T_I). This minimum time is 125 µs when the scaling function is disabled and 375 µs when the scaling function is enabled.

10.3.6 T_O

Instant in time that the setpoint is accepted referred to the start of the cycle.

Units: T_{BASE_IO}

For an absolute value encoder, the setpoint is a preset value and various calculations must be carried-out internally before the actual value sensing. This means that a minimum time must be maintained between the instant that the setpoint is accepted (this is defined by T_O) and the actual value sensing (defined by T_I). When the scaling function is disabled, this minimum time is 125 µs, and when enabled, 375 µs.

Further, the following must apply: $T_O > T_{DX} + T_{O\_MIN}$

10.3.7 T_{DX}

Data_Exchange_time

Units: 1/12 µs

This is the time which is required for the cyclic data transfer. This depends on the number of slaves and telegram lengths.

10.3.8 T_{PLL_W}

Half the tolerance window width.

Units: 1/12 µs

Clock cycles within the tolerance window, defined here, which the encoder identifies as being valid. When synchronizing, initially the encoder starts with a multiple of the tolerance window width and then reduces the window down to the parameterized window width.

10.3.9 T_{PLL_D}

Delay time of the clock cycle signal.

Units: 1/12 µs

This is internally added to the configured cycle time T_{DP}

10.4 Slave-to-slave communication

In order to use the slave-to-slave communication function, the slave-to-slave communication links must be defined in the configured software. The absolute value encoder operates as Publisher. This means that so-called Subscribers can directly "listen to" the encoder data.

The procedure when generating/creating slave-to-slave communication links can be taken from the documentation of the respective configuring tool.

11

11 Parameter und Parameterkanal

Acyclical services (DS 47 read, DS 47 write) and the PROFIdrive parameter channel protocol can access the following parameters.
The following parameters are supported read-only (R):

Parameter no.	Significance	Data type	R/W
922	Telegram type	Unsigned16	R
964	Device identification	Array[n] Unsigned16	R
965	Profile number	Octet String 2	R
979	Sensor format	Array[n] Unsigned32	R

When the "SIEM81A8" GSD file is used, the following additional read (R) or write (W) parameters are available:

Parameter no.	Meaning	Data type	R/W
918	PROFIBUS address	Unsigned16	R/W
925	Number of tolerated sign-of-life character errors	Unsigned16	R/W
971	Save the encoder parameterization in the internal non-volatile memory (NV-RAM)	Unsigned16	R/W
972	(Warm start) oft he des MC-ENCODER	Unsigned16	R/W
975	DO identification	Unsigned16	R/W
980	List with the numbers of the available parameters	Unsigned16	R/W
1000	Preset 16-bit value	Unsigned16	R/W
65000	Preset 32-bit value	Unsigned32	R/W
65001	Operating status	Unsigned16	R

More detailed information on the individual parameters can be taken from the PROFIdrive profile.

12

12 Diagnostics Class 3 / 4

12.1 PROFIBUS diagnostics

Six diagnostics bytes are output in accordance with the PROFIBUS Standard:

Diagnostics function	Data type	Diagnostics, octet number
Station status 1 (refer to: PROFIBUS Standard)	Octet	1
Station status 2 (refer to: PROFIBUS Standard)	Octet	2
Station status 3 (refer to: PROFIBUS Standard)	Octet	3
Diagnostics, master address	Octet	4
PNO ID number	Octet	5, 6

12.2 Status signals using the LEDs in the connecting cover

Various (fault) states of the devices are displayed using the two LEDs in the connecting cover:

No.	Red LED	Green LED	Status signal / possible cause
1	Dark	Dark	Power supply missing
2	Bright	Bright	The absolute value encoder is ready, but has still not received configuration data after the power was connected. Possible causes: Incorrectly set address, bus cables incorrectly connected
3	Bright	Flashing	Parameterization or configuration error The absolute value encoder receives configuration or parameter data with the incorrect length or inconsistent data. Possible cause: E.g. the total resolution was set too high
4	Flashing	Bright	Absolute value encoder is ready, but has still not been addressed from the master. (e.g. the incorrect address is being used)
5	Bright	Dark	Absolute value encoder does not receive any data for a long period (approx. 40 seconds, e.g. the data line is interrupted)
6	Dark	Bright	Normal operation in the data exchange mode.

12.3 Error codes in G1_XIST2

Encoder errors are displayed by setting error bits in the encoder status word (bit 15). The appropriate error codes are output in G1_XIST2:

Error code (hex)	Significance	Description
0001	Sensor group error	Sensorik faulty (only Version >FS17 (A17) and GSD SIEM81A8).
0002	Low-High-Limit exceeded	Values for the "maximum master sign-of-life faults" >255 (only as of version A16 and GSD file SIEM81A8).
0F01	Command not supported	The command is not supported (e.g. requested via the control word).
0F02	Master sign-of-life error	This is set if (after the encoder has been synchronized to the master sign-of-life character) the maximum permissible number of sign-of-life character errors has been exceeded.
0F04	PLL synchronization error	This is set, if after the synchronization to the clock cycles the maximum permissible number of clock cycle failures has been exceeded.

13

13 Configuring Example for Isochr. Operation

13.1 Downloading the GSD file

When used for the first time, the GSD file (SIEM10F8.gsd) must be installed in order to include the absolute value encoder in the hardware catalog.
Select in the "HW Config" window of the SIMATIC Manager the "Install GSD files..." item and the appropriate "SIEM81A8.gsd" GSD file under the "Extras" menu item.
The GSD file can be obtained from SIEMENS.
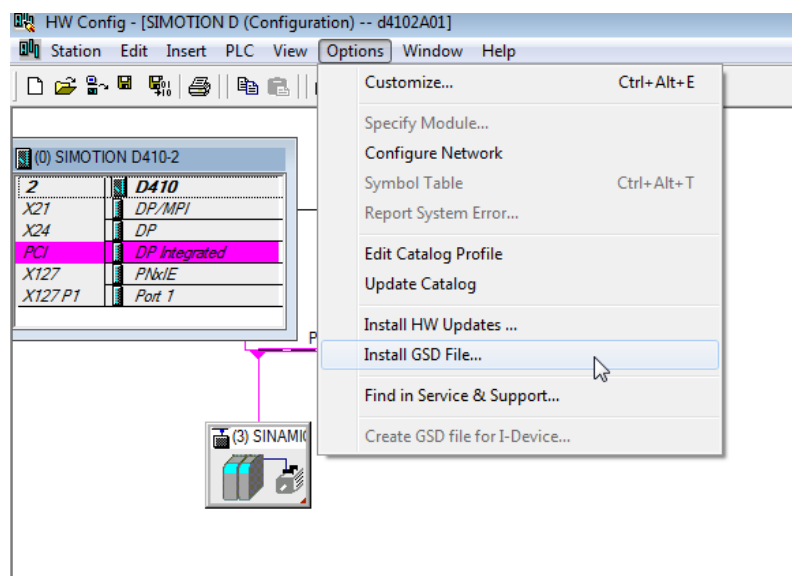
After the GSD file has been downloaded, the absolute value encoder appears in the Hardware Catalog under "PROFIBUS DP" - "Other field devices" - "Encoder" - "MC-Encoder isochronous".

13.2 Configuring the absolute value encoder

After the PROFIBUS network has been configured in the hardware configurator under the menu item "Insert" – "Master system" the absolute value encoder can be selected from the Hardware Catalog and inserted in the network. To do this, the "SIMODRIVE sensor isochronous" device is coupled to the bus by drag & drop (or by double-clicking on the module with the bus selected).
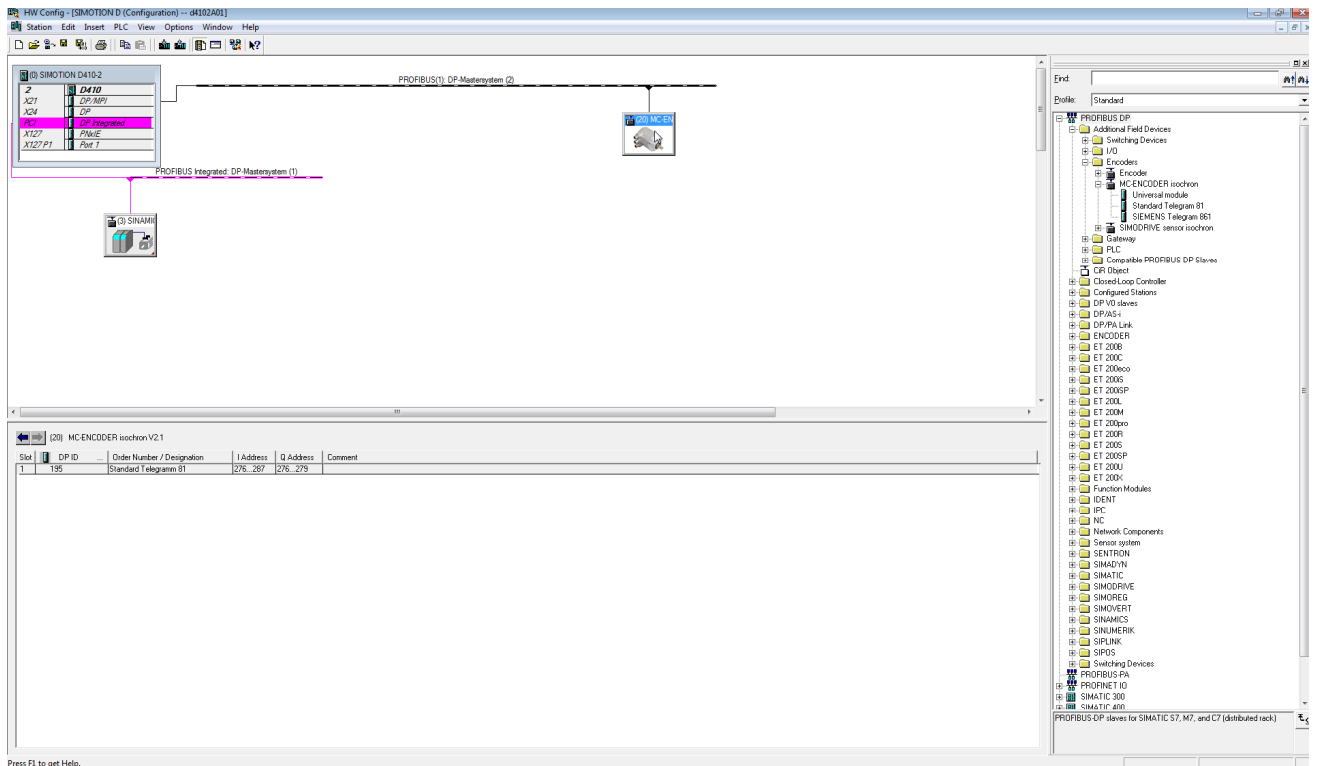
After the device has been inserted, the node address of the slave device is entered. This must match the address set in the connecting cover.
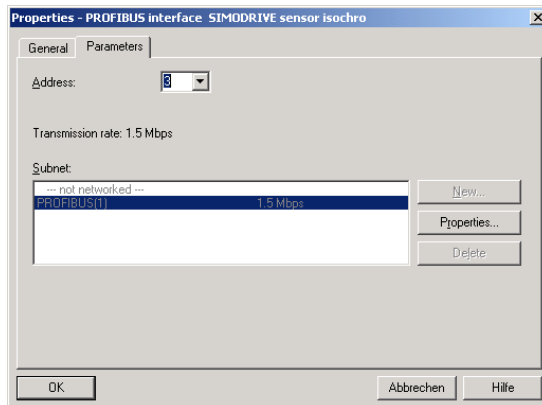
13.3 Telegram selection

After the device was inserted, as described, in the PROFIBUS network, the telegram can now be selected. Currently, only telegram type 81 is supported. The module is dragged and dropped at slot 1 (table in the lower section of the station [node] window).

13.4 Parameterization

13.4.1 Device-specific parameters

The dialog box "DP slave properties" is displayed by double-clicking on the encoder to be parameterized. The "parameterizing" table should be selected to enter parameters.
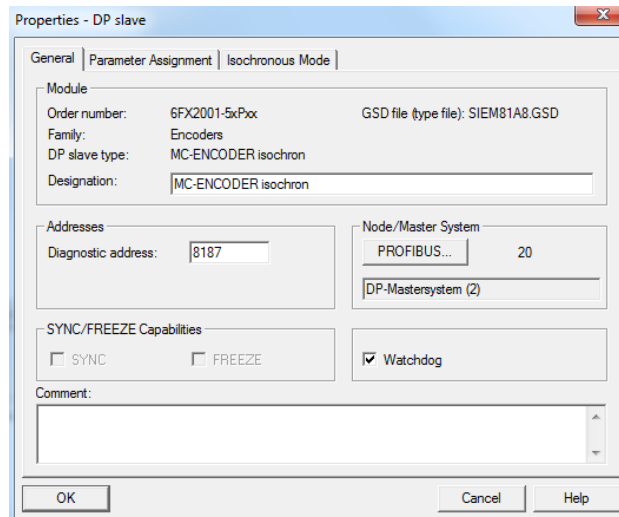
Various parameters of the device can be defined under (Device-specific parameter) (refer to Section 10.2).
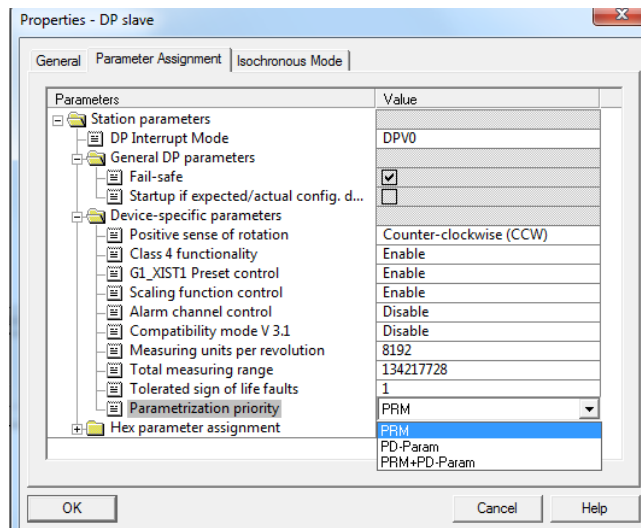
We recommend for the parameter change rights to set the "PRM" setting (complete parameterization via this parameterization screen). The "Encoder Class 4 functionality" parameter should be activated only when you really need the scaling function or the direction of rotation inversion function on the encoder for your application.

If the encoder is operated isochronously on a SIMOTION or SIMATIC 1200/1500 controller (connected with TO external encoder), the "Encoder Class 4 functionality" parameter should be set to "switched off".

13.4.2 Isochronous parameters

Initially, the "Equidistance" function should be configured in the PROFIBUS network (an appropriate master must be selected that supports this functionality):

In the network view double-click on the PROFIBUS subnet.
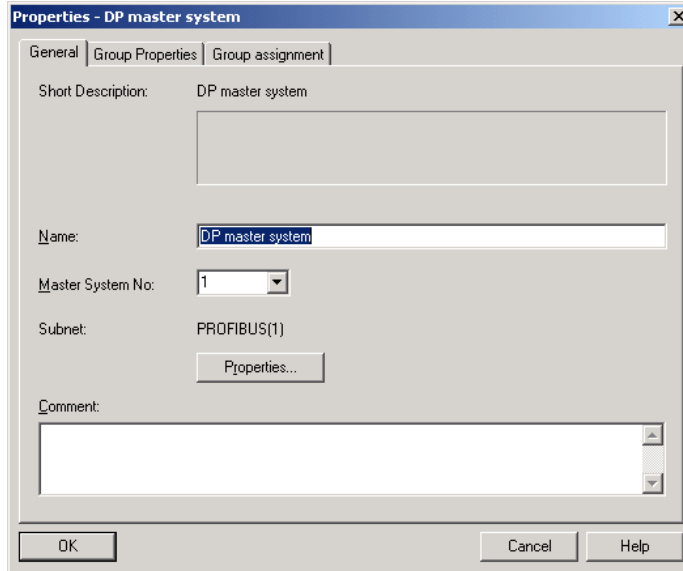
After selecting the "Properties" button in the Properties dialog box select the "Network Settings" tab.

Select the "DP" profile and click the "Options" button.
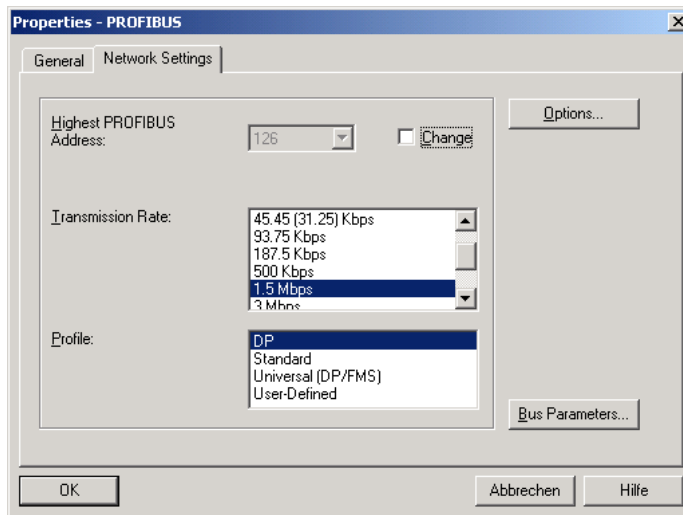
In the subsequent dialog box, activate the "Activate equidistant bus cycle" checkbox and select the required equidistant (isochronous) DP cycle.
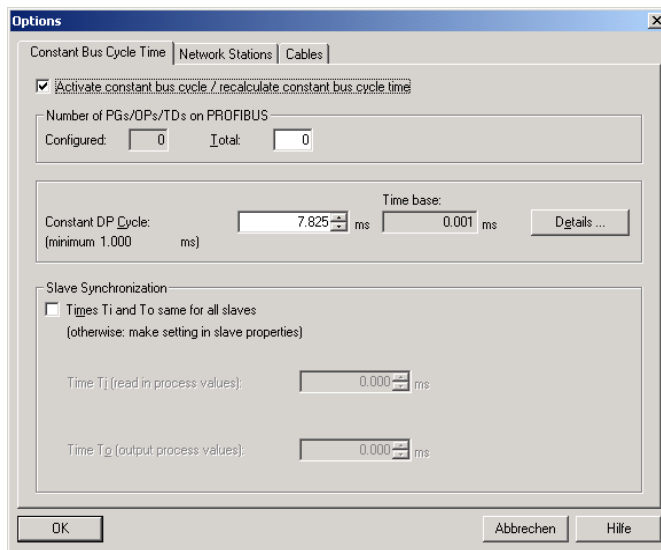
Double-click on the slave to be parameterized and select the "Equidistant" tab.

Activate the "Synchronize DP slave to DP cycle" checkbox.

Select the required times for T_I and T_O. In this case, observe the minimum and maximum values as well as the rules from Section 10.3.5 and 10.3.6.
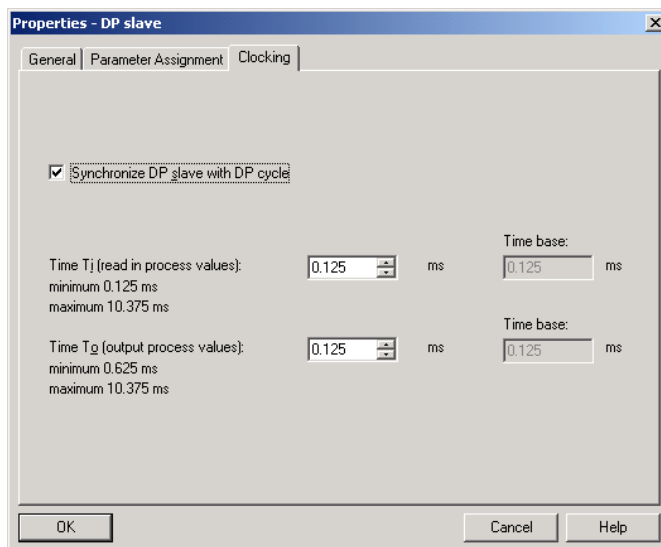
After all of the slaves have been configured and parameterized, the equidistant times for the bus system should be again checked and possibly adapted.

14

14 Operating with SIMOTION

In the following chapter the configuration and operation of the encoder with the SIMOTION controllers is shown. In this example SIMOTION SCOUT Version 4.2 is used..

14.1 Applications

In general, there are two use case for operation of the encoder with SIMOTION:

- MC-ENCODER together with TO "External encoder": The MC-ENCODER is used as sensor device for the TO "External encoder". In this case, the encoder is typically operated isosynchronously (IRT device).
  The encoder is completely controlled by the TO.
  Sign-of-life monitoring is automatically used.
  Telegrams 81 are used.

- MC-ENCODER operated directly from AWP:
  The encoder telegram is directly accessed from the user program. The MC-ENCODER is completely controlled and managed by the user program. Telegram 860 is typically used.

In addition, SIMOTION provides system functions for accessing parameters online via the noncyclic standard parameter channel for the MC-ENCODER. You can use these system functions for both of the applications described above.

14.2 MC-ENCODER used together with TO External encoder

The following steps are necessary in order to configure the MC-ENCODER at SIMOTION as sensor at the TO " External encoder.

For the general procedure to create and configure MC-ENCODER in the HW Config, refer to the chapter Configuration and chapter Operating with STEP7

You can find the online parameter access via the parameter channel in the chapter Online parameter access, see Chapter 14.4.
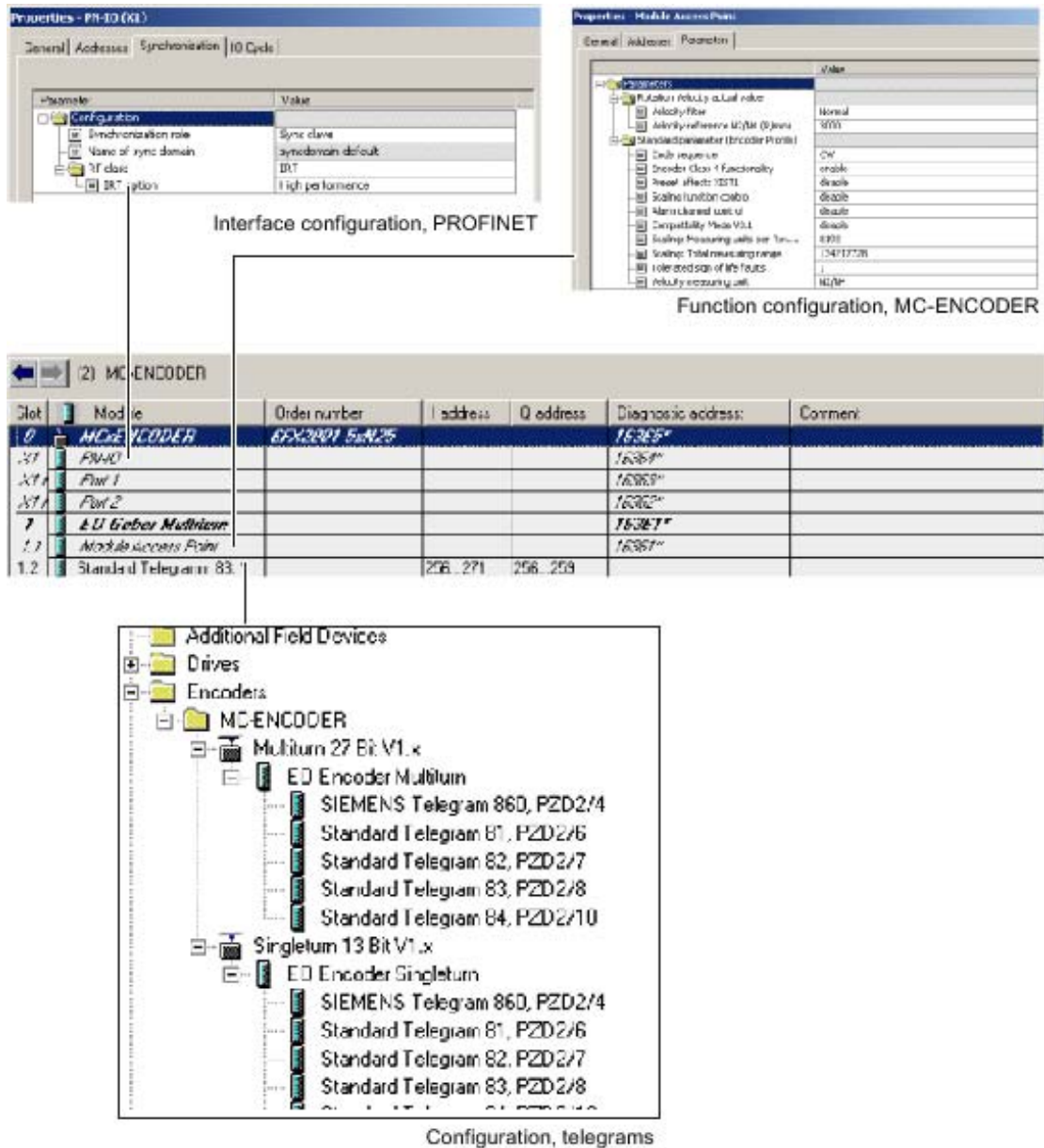
Configuring MC-ENCODER in HW-Config

For this particular application, select the following settings::

- IRT communication (IRT with high performance)

- Cycle time and Ti identical to the drive axes

- Select the telegram 81

- Set the encoder parameters:
  Accept the default setting.

Example

The following example shows the configuration settings for the MC-ENCODER in HW Config for telegram 83 and a reference speed (100%) of 3000 rpm.

Interface configuration, PROFINET

Function configuration, MC-ENCODER

Configuration, telegrams

Creating and configuring TO „External encoder"

Insert a TO "External encoder" in the project and run the wizards for the external encoder configuration.

Select the following settings:

- Encoder type: rotary

- Encoder type: absolute encoder or absolute encoder, cyclic, absolute

- Encoder mode: SSI
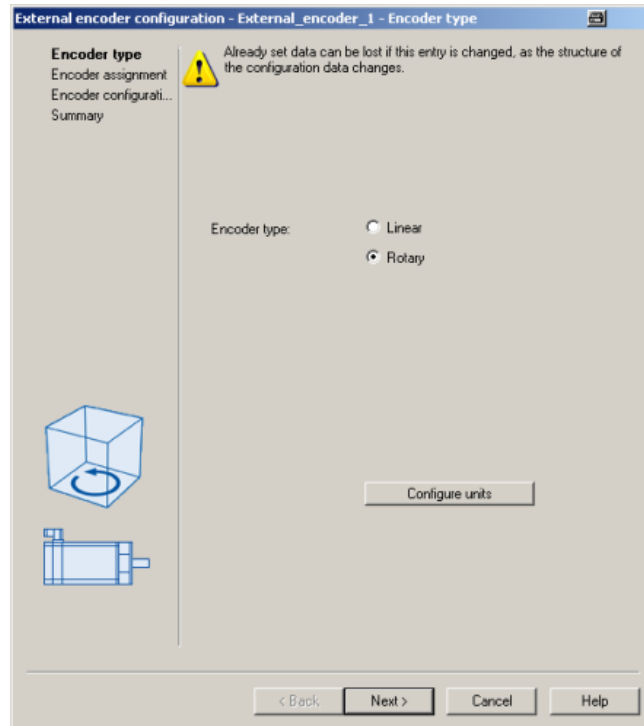
- Encoder pulse number: 8.192

- Fine resolution: 0

- Fine resolution, absolute value in Gn_XIST2: 0
- Data width, absolute value without fine resolution:
  - 27 (for multiturn encoder)
    or
  - 13 (for singleturn encoder)
  - Encoder monitoring: activate
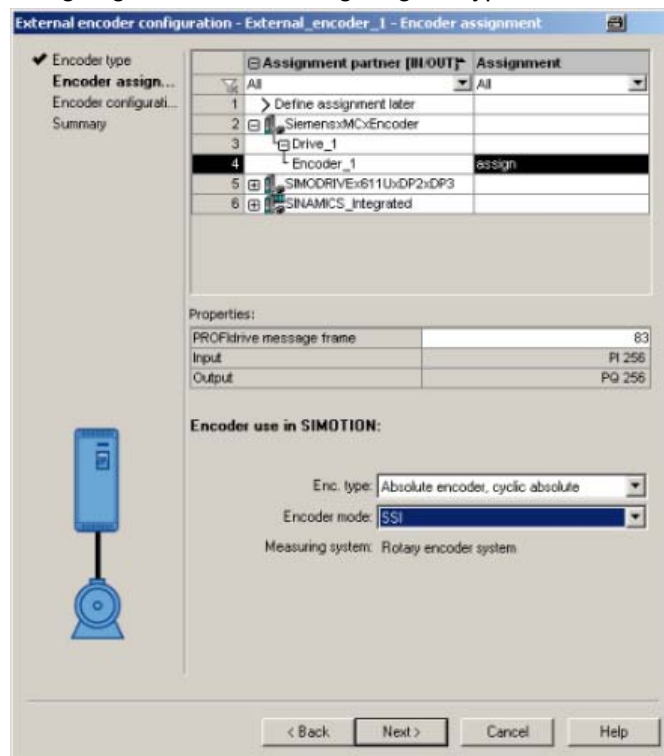
Procedere

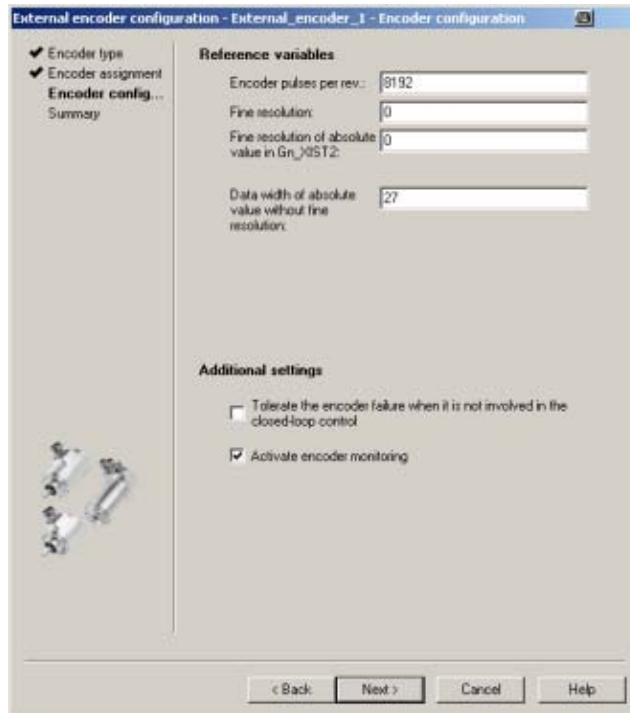1. Inserting an encoder
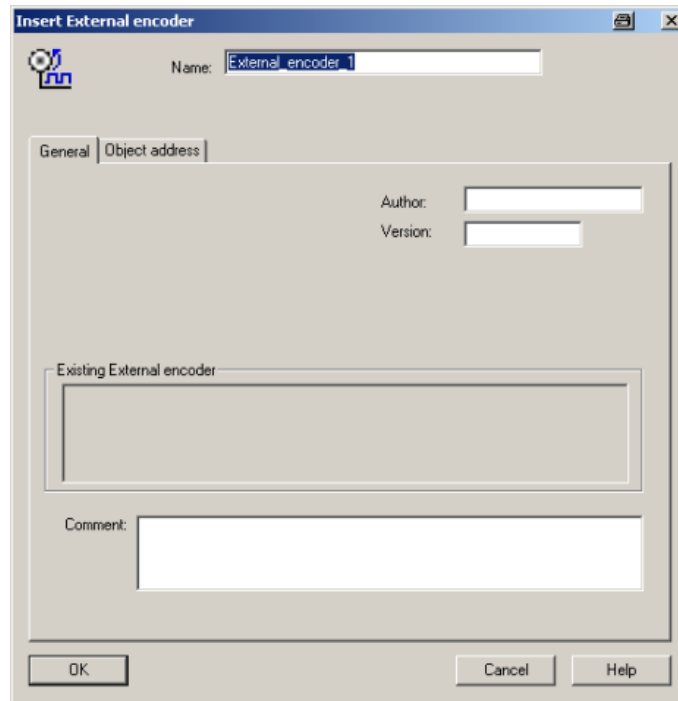
2. Configuring the encoder type.

3. Assigning an encoder, configuring the type and mode.
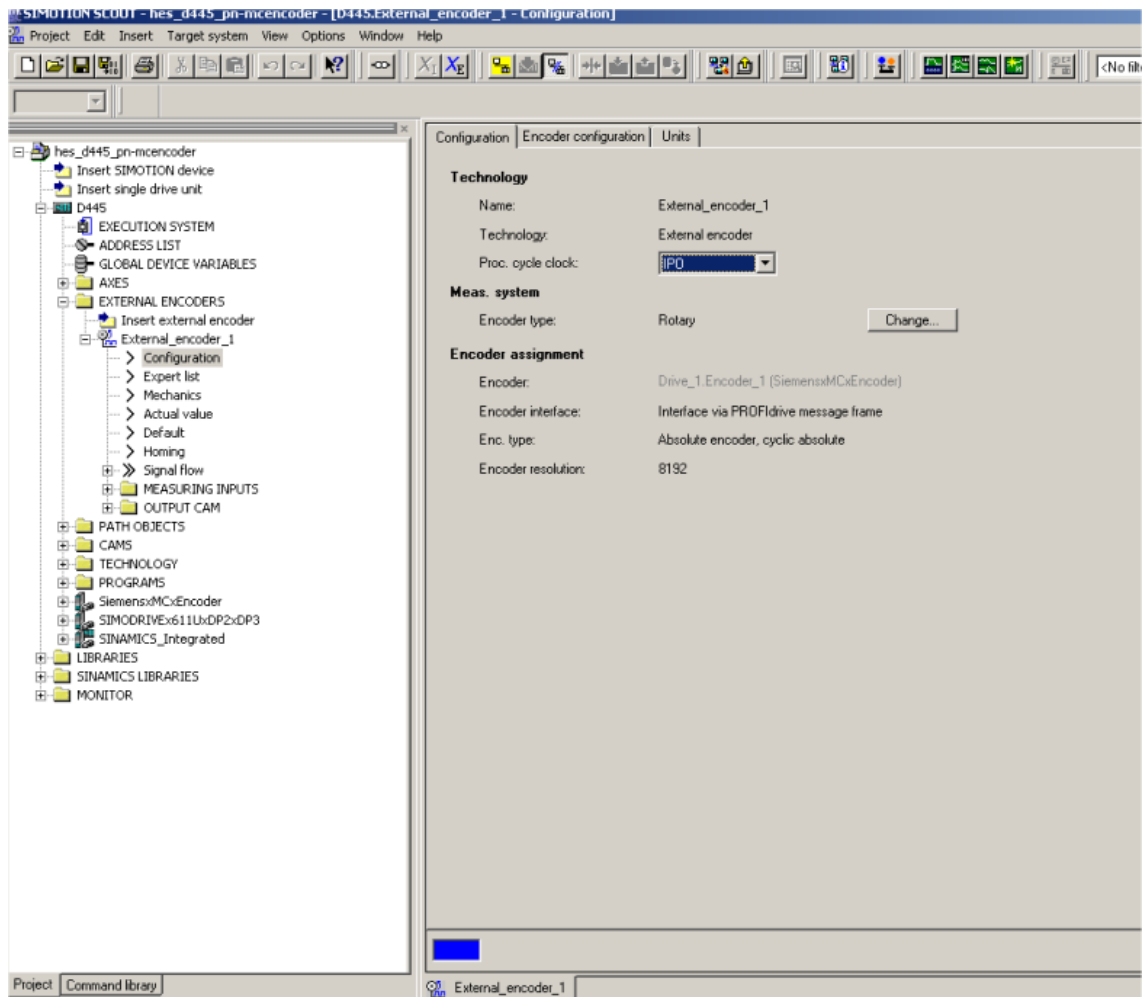
4. Configuring an encoder
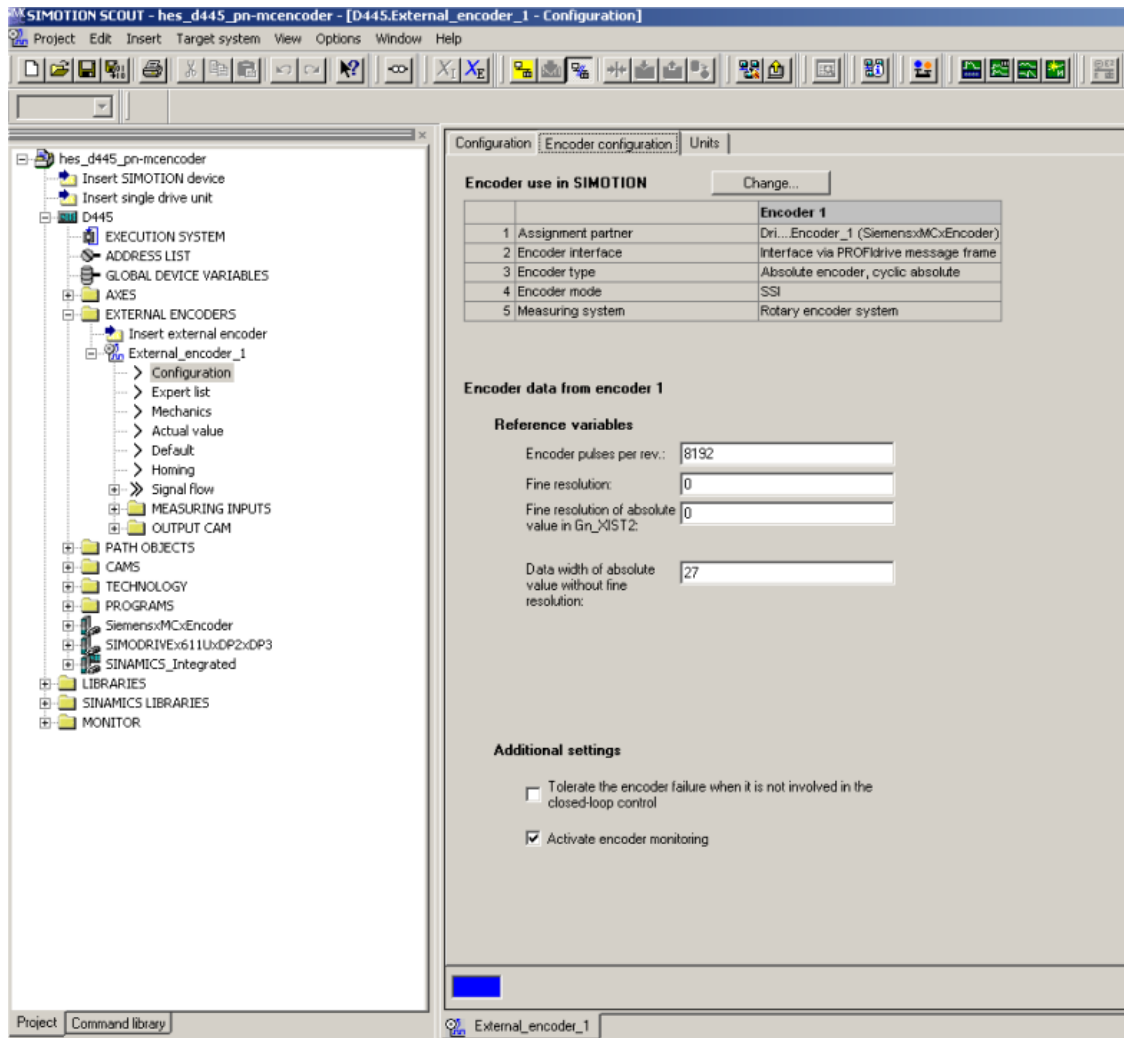

5. TO configuration, summary

Example

After the MC-ENCODER has been successfully configured at the TO, the following configuration settings are shown at the TO "External encoder".
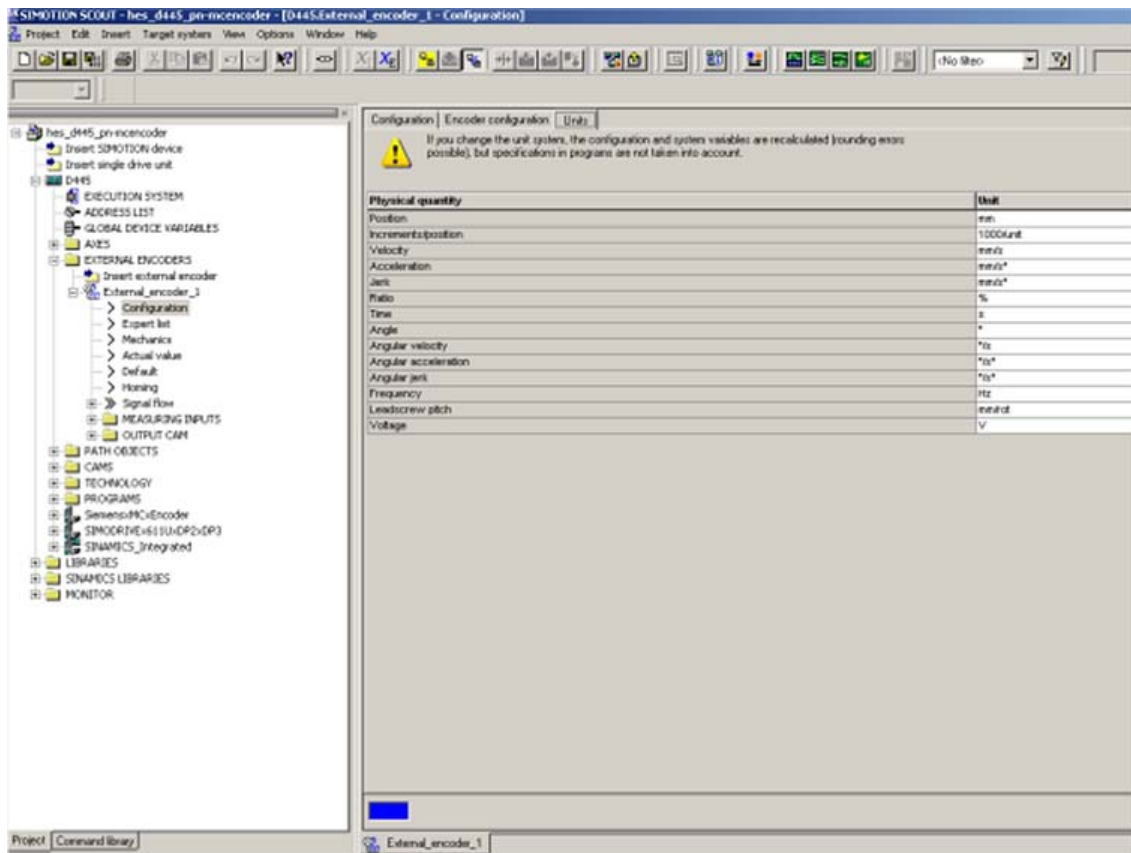
Register „Configuration"

Register „Encoder configuration"

Register „Units"

Using the velocity actual value NIST from MC-ENCODER

The TO "External encoder" can calculate its internal velocity actual values as follows:

- From the internal position actual values
- From the external velocity value NIST_B of the MC-ENCODER

Using the expert list of the TO, you parameterize which velocity actual value is used in TO.

Example

The following screenshot shows the setting options using the TO parameter "encoderValueType". In this particular example, the following values are relevant:

[0]: ROTARY_SYSTEM   The velocity is calculated in the TO from the position.

[4]: POSITION_AND_PROFIDRIVE_   The velocity is taken from the encoder
      ENCODER_NISTB   signal NIST_B.

21	SensorControlConfig	Toleration of encoder errors				
22	SensorNist	Actual speed value extrapolation				
23	dataAdaption	Switch encoder parameter adaptati...	[91] NO	-	Restart	'EnumYesNo' = enum/DINT
24	encoderIdentification	Encoder identification	[2] DPMASTER	-	Download	'EnumAxisEncoderIdentification' = enum/DINT
25	encoderMode	Encoder mode	[2] SSI_MODE	-	Download	'EnumAxisEncoderMode' = enum/DINT
26	encoderSystem	Encoder system	[0] ROTARY_SYSTEM	-	Download	'EnumAxisEncoderSystem' = enum/DINT
27	encoderType	Encoder type	[3] SENSOR_CYCLIC_ABSOLUTE	-	Download	'EnumAxisEncoderType' = enum/DINT
28	encoderValueType	Actual value type	[4] POSITION_AND_PROFIDRIVE_ENCODER_NIST_B	-	Download	'EnumAxisEncoderValueType' = enum/DINT
29	Extrapolation	Actual value smoothing				
30	Gear	Load gear			Value: 4 = Calculate actual position values and velocity from DP protocol (standard message frame 83)	
31	SmoothingFilter	Actual value smoothing				
32	StandStillSignal	Standstill signal				
33	typeOfAxis	Axis type	[0] REAL_AXIS	-	Download	'EnumEncoderIdentification' = enum/DINT

14.3 MC-ENCODER used directly from AWP

The following steps are necessary in order to use the MC-ENCODER directly from a SIMOTION user program as sensor

Access via telegram 860, 861

You can freely select the settings corresponding to the requirements of your particular application.

The simplest option of accessing the position supplied from the MC-ENCODER from the user program is by using telegram 861. If you use telegram 860, the user program does not have to use any control or status word when transferring the pure position. Further, the user program does not have to generate or monitor a sign-of-life, as telegram 860 has no sign-of-life monitoring. To simplify the position calculation in the user program, parameterizable help functions for scaling as well as to set a preset position value are available in the MC-ENCODER.

Access using telegram 81, 82, 83, 84

If you control the MC-ENCODER using telegrams 81, 82, 83 or 84, then in the user program, you must program the control and status words, where relevant, also sign-of-life counting and monitoring according to the standard PI/PNO-ENCODER profile or PROFIdrive profile.

Example

Variable list for MC-ENCODER cyclic data in SIMOTION Scout.
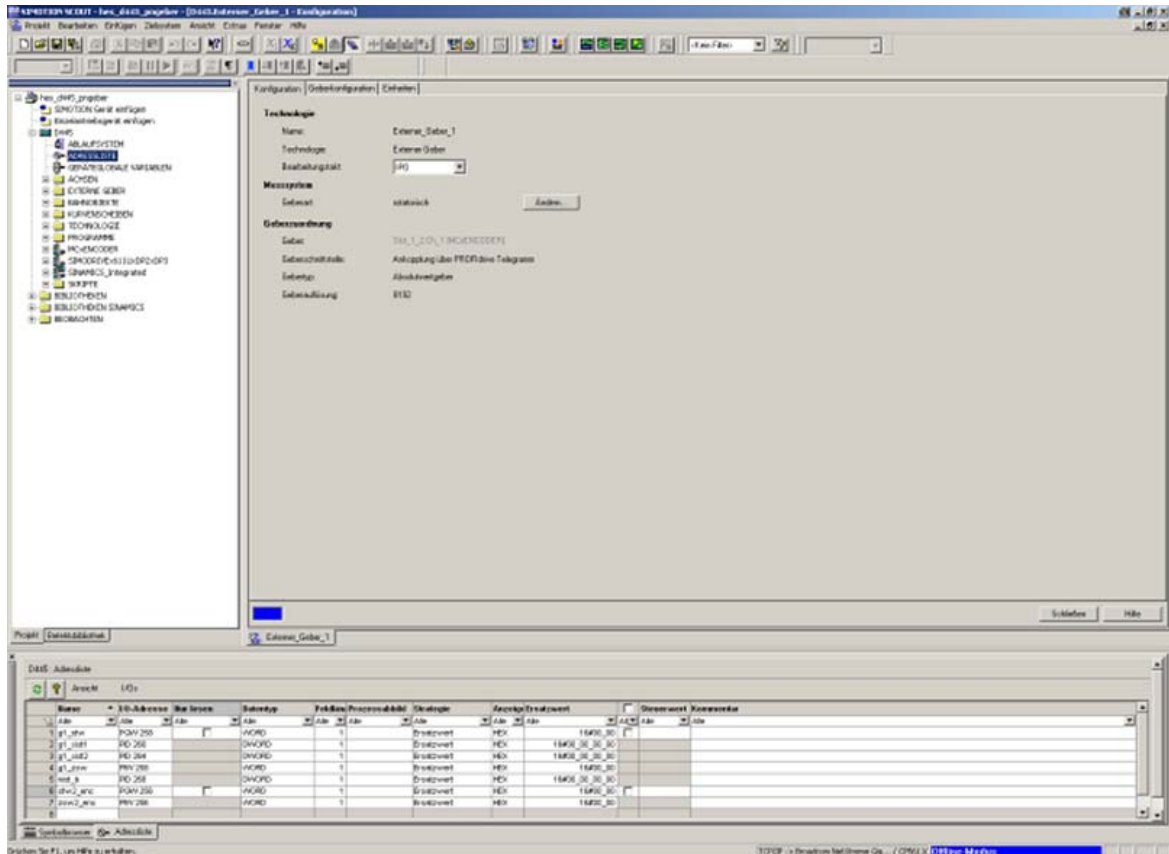
14.4 Online-Parameterzugriff

Online parameter access via the parameter channel

To access the parameters of the MC-ENCODER online, the encoder has the standard parameter channel. For the encoder, the access point to this parameter channel is at the telegram submodule (module 1) via the data record DS47.

Access to the parameter channel is realized via the non-cyclic communication channel, and is therefore possible from the controller as well as from a supervisor. The access protocol for the parameter channel is standardized in the PROFIdrive profile.

Online parameter access using SIMOTION system functions

To simplify online parameter access, SIMOTION provides the appropriate system functions. These system functions can be generally used for the encoder, independent of whether the MC-ENCODER is interconnected with a TO – or is directly controlled by the user program.

The following SIMOTION system functions are available for simple online access to the parameters of the MC-ENCODER:

– _readDriveParameter: reading the value of an individual parameter

– _readDriveMultiParameter: reading the values of several parameters at the same time

– _writeDriveParameter: writing the value of an individual parameter

Example

ST Program to read the reference parameters for the speed actual value in signal NIST_A or NIST_B:

```
INTERFACE
     PROGRAM readParaRefSpeed; // Motion Task.

END INTERFACE
IMPLEMENTATION
     VAR_GLOBAL

          refSpeed : REAL := 0.0;

          readP2000 : structretreaddriveparameter;

     END_VAR

     PROGRAM readParaRefSpeed

        readP2000:=_readdriveparameter(

           logaddress := 256,

           parameternumber := 2000,

           nextcommand := WHEN_COMMAND_DONE,

           Commandid := _getCommandId( )

        );

        IF ((readP2000.functionResult = 0) AND (readP2000.parameterResult = 0)) THEN //
        Conversion to real.

        refSpeed := BIGBYTEARRAY_TO_ANYTYPE (byteArray := readP2000.data);

        END_if;

     END_PROGRAM

END IMPLEMENTATION
```

15 Technical Data

15

15.1 Electrical data

General design	According to DIN VDE 0160 Protective Class III, degree of pollution 2, overvoltage Category II
Power supply voltage	10 - 30 VDC (absolute limit values)
Buffering supply voltage	The absolute value encoder has an internal buffering to bridge a temporary failure of the supply voltage < 1 ms. If temporary failures longer thab 1 ms are to be expected, an external buffering, e.g. with an external power supply, must be provided.
Power drain	Max. 2.5 watts
EMC	Noise emission according to EN 61000-6-4 Noise immunity according to EN 61000-6-2
Bus connection	Electrically isolated through an opto-coupler
Interface	Line driver according to RS 485
Baud rates	12 Mbaud; 6 Mbaud; 3 Mbaud; 1.5 Mbaud; 500 kbaud; 187.5 kbaud; 93.75 kbaud; 45.45 kbaud; 19.2 kbaud; 9.6 kbaud
Resolution	8192 steps/revolution
Number of revolutions which are sensed	1 or 16384
Scale accuracy	$\pm$ ½ LSB
Step frequency LSB	Max. 800 kHz
Code type	Binary
Electrical lifetime	> 10^5 h
Addressing	Using a rotary switch in the connecting cover

Note

The absolute angular encoder may only be operated with extra-low safety voltage.

15.2 Mechanical data

Housing	Aluminum	
Flange	Synchronous flange	Clamping flange
Diameter of the solid shaft	6 mm	10 mm
Shaft length	10 mm	20 mm
Diameter of the hollow shaft with reducing adapter	15 mm 8 mm, 10 mm, 12 mm	
Shaft loading	Axial 40 N, radial 110 N	
Friction torque	$\leq$ 3 Ncm	
Rotor moment of inertia	$\approx$ 30 gcm^2	
Lifetime, mechanical	Refer to the table	
Speed	6000 RPM (continuous operation)	
Shock immunity (EN 60068-2-27)	$\leq$ 100 g (half sine, 6 ms)	
Continuous shock immunity (EN 60028-2-29)	$\leq$ 10 g (half sine, 16 ms)	
Vibration immunity (EN 60068-2-6)	$\leq$ 10 g (10 Hz ... 2000 Hz)	
Connection	Connecting cover with terminal strip as T distributor	
Weight (incl. connecting cover)	Single-turn Multi-turn	Approx. 500 g Approx. 700 g

Minimum mechanical lifetime

	Lifetime in 10^8 revolutions at F_a/F_r		
	40 N/60 N	40 N/80 N	40 N/110 N
Clamping flange	247	104	40
Synchronous flange	822	347	133

15.3 Ambient conditions

Operating temperature	-40 ... + 85° C
Storage temperature	-40 ... + 85° C
Relative air humidity	98% (without moisture condensation)
Degree of protection (EN 60529)	
Housing/enclosure	IP 65
Shaft	IP 64

Certification

Certificate	Comment
UL verified	File E251481

15.4 Dimension drawings

Synchronous flange

Clamping flange
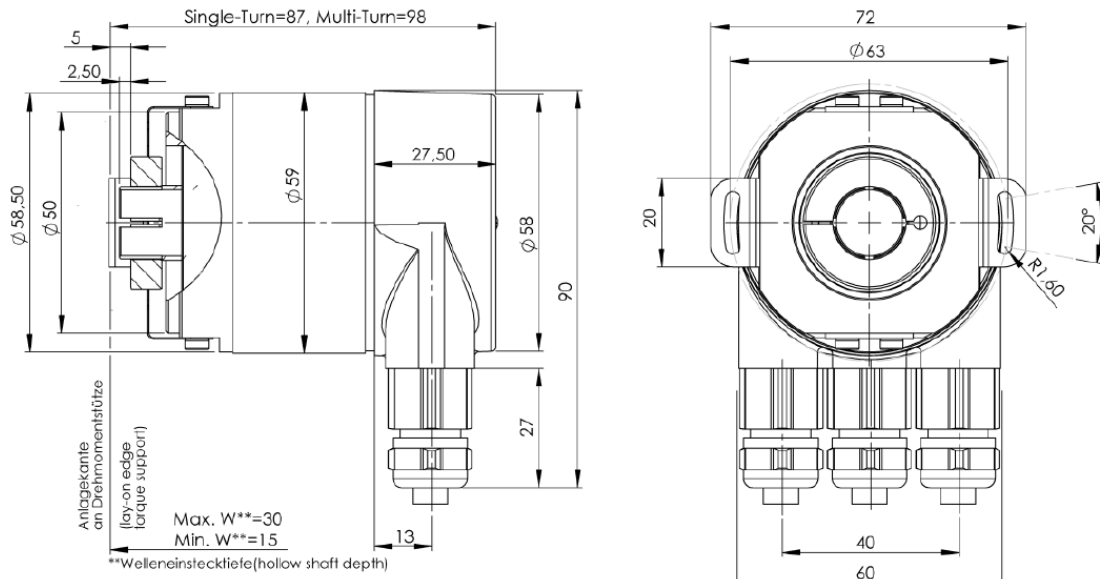
Hollow shaft

Mounting instructions

The clamping ring may only be tightened onto the hollow shaft if the angular encoder is inserted on the drive element shaft.

The diameter of the hollow shaft can be reduced to 12 mm, 10 mm or 8 mm using a reducing adapter. This reducing adapter is simply inserted into the hollow shaft. We do not recommend thinner drive element shafts due to the mechanical load.

The permissible shaft motions of the drive element are listed in the table:

	Axial	Radial
Static	± 0.3 mm	± 0.5 mm
Dynamic	± 0.1 mm	± 0.2 mm

Certification

Certificate	Comment
UL verified	File E251481

A Appendix

A

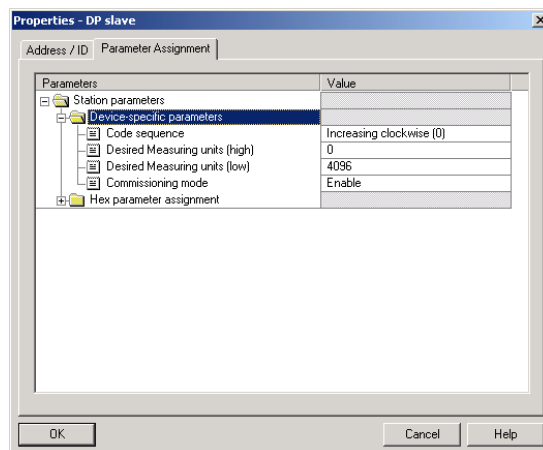## A.1 Additional encoder classes

The encoder classes, listed in the following, are still supported for reasons regarding upwards compatibility. However, they should no longer be used for new projects.

A.1.1 Class (version) 2.0 multi-turn

This version only differs from the Version 2.2 by the fact that there are fewer parameters available in the configuring tool screen.

A.1.2 Class (version) 1.1 multi-turn

This is an older version. Previously, it was unofficially designated as a so-called Class "3". It behaves just like Class 2, but in addition outputs the velocity. It is still available, if a user does not wish to make any changes; however, it should no longer be used for new systems.

A.1.3 Class (version) 1.0 multi-turn

Position value and velocity outputs are available without the possibility of making a preset. This should no longer be used.

A.2 FAQ Absolute value encoders, PROFIBUS

Problem

When using one of the following PROFIBUS masters and for encoder classes higher than Class 1, problems occur when running-up the system (bus fault, encoder does not log-on):

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

Possible cause

Under certain circumstances, the master does not support the full number of diagnostic bytes (57 bytes) provided by the absolute value encoder.

Remedy

If possible, the maximum number of diagnostics data per slave should be increased in the master.
If this is not possible, then the absolute value encoder can either be used as Class1 device (16 diagnostic bytes) or one of the manufacturer-specific classes is selected Class (version) 2.1 or 2.2 and "Reduced diagnostics" is enabled in the parameterization (refer to Section 5.1.5).

Problem

For COM PROFIBUS Version 5.0, the absolute value encoder cannot be configured together with the S5-95U.

Cause

The S5-95U does not support the full complement of diagnostics data (57 bytes). For COM PROFIBUS V5.0, the GSD entry "Max_Diag_Data_Len=57" is checked and it is prevented from configuring together with the S5-95U.

Remedy

Use COM PROFIBUS Version 3.3, select one of the manufacturer-specific classes Class (version) 2.1 or 2.2 and activate the shortened diagnostics (parameter).
It is only possible to use the device with COM PROFIBUS V5.0 using a modified GSD file (the slave key "Max_Diag_Data_Len" must be modified).

Problem

PLC and master interface are switched-in, the bus is active, but the absolute value encoder does not log-on.

Remedy

To start, check the state of the LEDs in the connecting cover (refer to Section 6.3); under certain circumstances, information can be obtained about the possible fault causes.
Both LEDs dark: Check the power supply!
Both LEDs bright:
The device is not receiving parameters and configuration data. Check the address setting in the connecting cover. Check that the bus lines (cables) are correctly connected (BUS IN/BUS OUT). Check the configuration.
Red LED bright, green LED flashing:
Parameter error! Check the parameterization: E.g. total resolution (refer to Section 4.2.6)

Problem

Bus faults sporadically occur.

Possible cause

The terminating resistors are not correct

Remedy

Check the terminating resistors!
The 220 Ω terminating resistor must be switched-in at the beginning <u>and</u> at the end of the bus segment. Measure the resistance between the two data lines! To do this, the power supply must be powered-down and a measurement made between connections "A" and "B" in the connecting cover. The measured resistance value must be approx. 110 Ω (220 Ω parallel 220 Ω).

Possible cause

EMC problems

Remedy

Check as to whether the selected baud rate is permissible for the cable length; if required, use a lower baud rate. Check that the connecting cover is correctly located and ensure that the cables have been correctly routed regarding EMC.

A.3 Terminology

Terminating resistor	Resistor to adapt bus cables; terminating resistors are always required at the end of a cable or segment.
Address	A number, which is assigned to each node, no matter whether it is a master or slave. The setting is realized in the connecting cover using rotary switches so that it is non-volatile.
Baud rate	Data transfer rate specified as the number of bits transferred per second (baud rate = bit rate).
Bus node	Device, which can send, receive or amplify data via the bus.
Configuring	When configuring, the master signals the angular encoder how it is to behave, e.g. the number of input and output words (also refer to DDLM_Set_Prm).
DDLM	Direct Data Link Mapper. Interface between PROFIBUS DP functions and the encoder software.
DDLM_Data_Exchange	Operating status of the bus, for standard data transfer.
DDLM_Set_Prm	Operating status of the bus, in which configuration data is sent.
DDLM_Slave_Diag	Operating status of the bus, in which diagnostics data is requested from the slave (e.g. absolute value encoder).
DP	Distributed peripherals
Diagnostics	Identification, localization, classification, display, additional evaluation of faults, errors and messages.
Freeze	This is a master command to the slave. This allows the master to freeze the statuses of the inputs to their instantaneous value. The input data is only updated again, when the master sends the UNFREEZE command.
GSD file	Master device data file, in which the slave-specific properties and characteristics are defined. The GSD is a file, which is made available for most PROFIBUS nodes (stations) by the manufacturer. The GSD formats are unified, so that the corresponding control software can access it (also refer to Type file).
Master	Bus nodes, which can send data on their own initiative, and define which slave should send data.
MC-ENCODER	Brand name of the SIEMENS PROFIBUS/PROFINET Encoder for Motion Control applications (former brand name "Simodrive Sensor").
Octet	Data unit of 8 bits = 1 byte
Parameterization	Transfers specific values (such as resolution per revolution, direction of rotation, etc.) from the master to the slave (in this case: absolute value encoder). This is realized when the system runs-up.

PROFIBUS	Process Fieldbus, European fieldbus standard, which is defined in the PROFIBUS Standard. This specifies functional, electrical and mechanical characteristics for a bit-serial fieldbus system.
Slave	Bus node, which essentially only sends data when instructed to do so by the Master. Absolute value encoders are always slaves.
Type file	Similar to a GSD file – is used by older engineering/configuring tools.
Word	Is frequently used, but not in a unified fashion, for a data unit of 2 bytes.

Absolute Value Encoder with PROFIBUS-DP
User Manual - 08/2014, 6SN1197-0AB10-0BP5

I Index

I.1 Index