TWK ELEKTRONIK

T-series encoders with PROFIBUS interface

Accompanying data sheet TRD 11868

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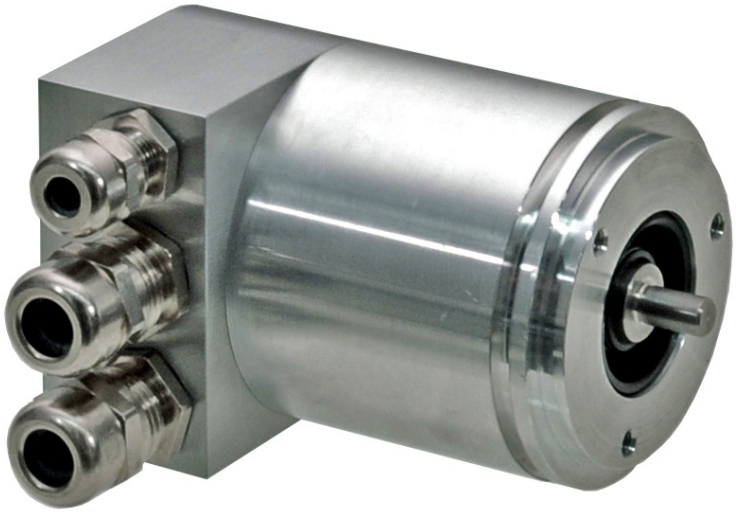

User manual

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1. Safety instructions

1.1 Scope of validity

This user manual applies exclusively to the following rotary encoders with PROFIsafe interface:

- TRDxx-xxxxxxR4096C2ZD01

1.2 Documentation

The following documents must be noted:

- The owner's system-specific operating instructions
- This user manual
- Data sheet number TRD 11868
- The pin assignment enclosed with the device
- Installation instruction TZY 10206 enclosed with the device

1.3 Proper use

TWK-ELEKTRONIK GmbH's rotary encoders and linear transducers are used to record rotary and linear positions, and make their measured values available as an electric output signal. As part of a system, they must be connected to the downstream electronics and must only be used for this purpose.

1.4 Commissioning

- The relevant device must only be set up and operated using this document and the documentation specified in point 1.2.
- Protect the device against mechanical damage during installation and operation.
- The device must only be commissioned and set up by a specialist electrician.
- Do not operate the device outside of the limit values which are specified in the data sheet.
- Check all electrical connections before commissioning the system.

2. General

The PROFIBUS encoders are designed for direct connection to PROFIBUS-DP. The interface is implemented with the SPC3 Siemens PROFIBUS controler. The protocol corresponds to the DP-Slave Class 2 functionality in accordance with the Profibus-Profile for Encoders, No. 3.062.

The first part of the user manual deals with the fundamental prerequisites for understanding the use of an encoder in the PROFIBUS DP, whilst the second part provides instructions for use with the Siemens Step7 software, including example software.

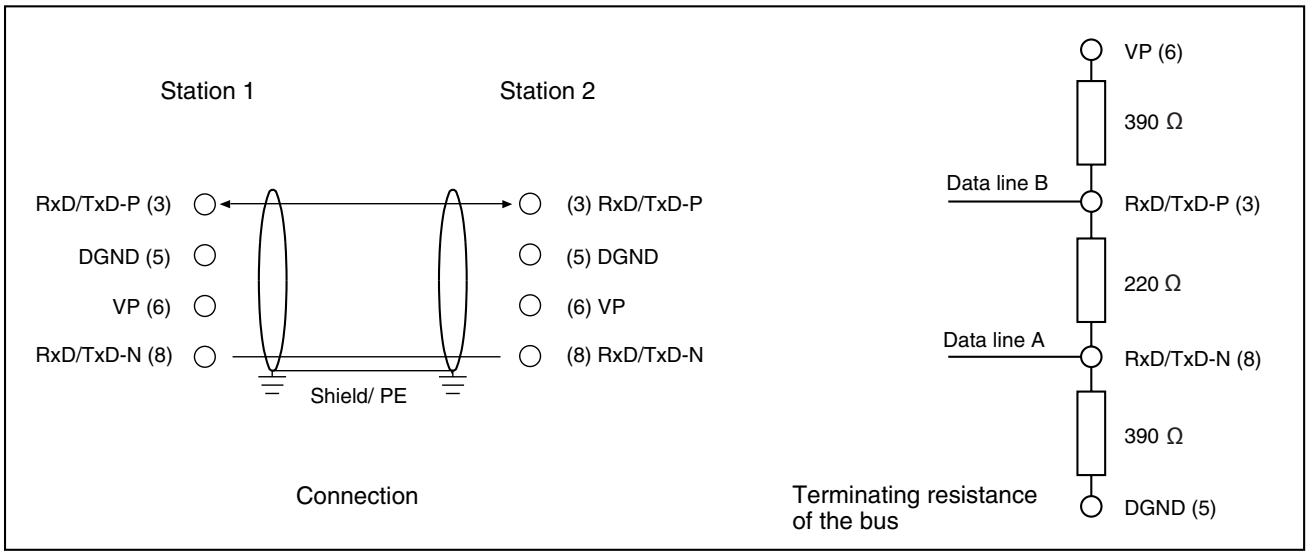
For a general understanding of the PROFIBUS field bus system we would like to refer to the PROFIBUS system description /2/ of the user organisation PNO (www.profibus.com) and to the corresponding IEC standards /3/ /4/.

3. Installation instructions for PROFIBUS-DP - RS 485

Fundamental characteristics of the RS-485 transmission technology:

- ☐ Network topology: Linear bus, terminating resistors for bus termination
  Stub lines are only permissible with baud rates < 1.5 MBit/s
- ☐ Line: Shielded, twisted pair cable
- ☐ Number of stations: 32 stations in each segment without repeaters
  Can be extended to 126 with repeaters.

Wiring and bus termination for PROFIBUS-DP (9-pin sub-D connector):



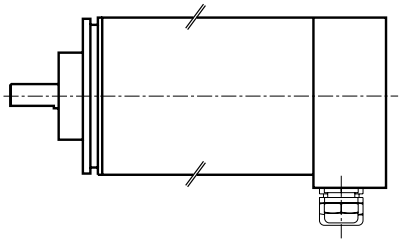
Transmission length depending on transmission speed for cable type A							
Baud rate (kBit/s)	9,6	19,2	93,75	187,5	500	1.500	12.000
Transmission length in (m)	1200	1200	1200	1000	400	200	100

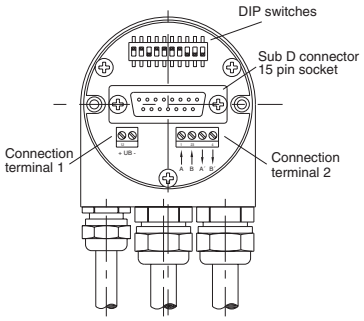
Cable type A specifications:

Characteristic impedance:	135...165 Ohm
Capacitance per unit length coating:	< 30 pF/m
Loop resistance:	110 Ohm /km
Core diameter:	0.64 mm
Core cross-section:	> 0.34 mm²

also see:
Installation guideline for PROFIBUS -FMS/DP (PNO No. 2.111/2)
Implementation guide DIN 19245 Part 3 (PNO No. 2.001/2)

3.1 Encoder TRD with connecting cap ZKD





The connecting cap for triple connection technology is a T-coupler, which is installed in the PROFIBUS.
It is equipped with three PG connections, which are subdivided as follows:

- ☐ Cable gland M12x1.5: Voltage supply for the encoder (24 VDC)
- ☐ Cable gland M16x1.5: Bus in (signal data A, B)
- ☐ Cable gland M16x1.5: Bus out (signal data A‘, B‘)

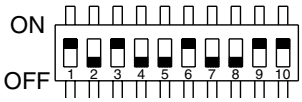
The encoder is connected via the 15-pin SUB-D plug. In the event of an error, the encoder can be replaced without time-consuming installation. The connecting cap is disconnected from the encoder by undoing 2 fastening screws (Note: O-ring seal)

Setting the station/subscriber address is carried out via the DIP switches in the connecting cap.The address range lies between 1 and 126 (Default address: 123). The address cannot be changed via the DDLM_Set_Slave_Add service.

Setting the terminating resistors is carried out via the 10-fold DIP switch (9,10) in the connecting cap, which ay be activated as lead termination as required.

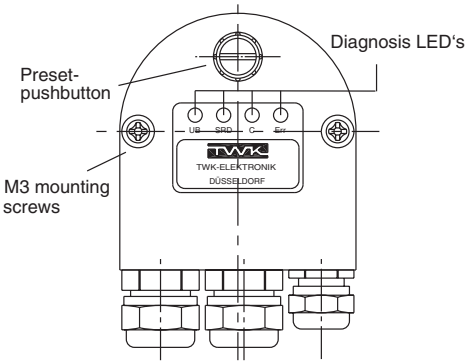
DIP switch – address setting/terminating resistors

Switch	1 2 3 4 5 6 7	8	9	10
ON = 1	2^0 2^1 ... 2^7	n.c.	Termination resistors on	
OFF = 0	Address 1 - 126 can be set (123: Default address)		Termination resistors off	



Status LED (connecting cap)

	VS	SRD	C	Err
Incorrect configuration	x	x		x
Impermissible parameter	x		x	x
Code error (see diagnosis bytes 62 - 63)	x			x
Class 1 configuration o.k.	x	x		
Class 2 configuration o.k.	x	x	x	
VS - power supply, Err - error, C - class, SRD - data traffic				



4. Configuration function (DDLM_Chk_Cfg)

The absolute encoders with PROFIBUS-DP are classified as follows:

Encoder with Class 1 functionality

Class 1 devices are characterised by the fact that only the position value (16 bit or 32 bit) of the encoder is transmitted via the bus. No parameterisation of encoder parameters is carried out. In this case, a distinction is made between the D0 and D1 configurations. The D0 configuration contains the data format: 1 word input data, consistency and D1 contains 2 word input data, consistency.

Encoder with Class 2 functionality

Class 2 devices are characterised by the fact that they can be parameterised via the bus. In this case, a distinction is made between the F0 and F1 configurations. The F0 configuration has the data format 1 word input data, 1 word output data, consistency and F1 contains 2 word input data, 2 word output data, consistency. The configuration F3 contains in addition a 32 Bit velocity value.

Possible configuratons of the encoder:

Configuration function (DDLM_Chk_Cfg)				
Selection	**Class**	**Data**	**Identifier byte**	**Comment**
32 Bit In/Out and 32 Bit Velocity	2	64 Bit In/Output data	F3	Only with firmware versions 1.02 and higher
Class 2 32 Bit In/ Out	2	32 Bit In/ Output data	F1	
Class 2 16 Bit In/ Out	2	16 Bit In/ Output data	F0	
Class 1 32 Bit In	1	32 Bit Input data	D1	
Class 1 16 Bit In	1	16 Bit Input data	D0	

5. Data exchange function (DDLM_Data_Exchange)

Input data are data which are transmitted from the peripheral devices to the master or into the bus. Output data are data which are transmitted from the master to the slave subscribers. Reference value control (see below) is listed here as an example of output data.

5.1 Actual position value

The actual position value is output in 16- or 32-bit data format (input data), also see configuration of the encoder. The velocity value (configuration F3) is output as 32 bit integer value. The leading sign is positiv for increasing and negativ for decreasing position values. The dimension can be changed via the programming parameters (see chapter 6.1)

Actual position value 16-bit data format (configuration F0/D0)

Input-Data		
Octet	1	2
Bit	(MSB) 15 - 8	7 - 0 (LSB)
Data	2^{15} - 2^{8}	2^{7} - 2^{0}
	Position value	

Actual position value 32-bit data format (configuration F1/D1)

Input-Data				
Octet	1	2	3	4
Bit	(MSB) 31 - 24	23 - 16	15 - 8	7 - 0 (LSB)
Data	2^{31} - 2^{24}	2^{23} -2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Position value			

Actual position and velocity value 64-bit data format (configuration F3)

Input-Data								
Octet	1	2	3	4	5	6	7	8
Bit	(MSB) 31 - 24	23 - 16	15 - 8	7 - 0 (LSB)	(MSB) 31 - 24	23 - 16	15 - 8	7 - 0 (LSB)
Data	2^{31} - 2^{24}	2^{23} -2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}	2^{31} - 2^{24}	2^{23} -2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Position value				velocity value			

5.2 Set reference value

The Set reference value function should only be carried out when the encoder shaft is stationary!

In order to compare machine position values and the absolute position of the encoder, setting the reference value is unavoidable in certain cases. The reference value is the position value which is displayed in the reference point. The TWK encoder with class 2 functionality offers the option of setting the reference value. The user must note the fact that the reference value must lie within the range of values (0 to total measuring steps - 1). In particular, this must be taken into consideration when changing the total measuring steps. The reference value is transferred in data exchange mode by setting bit 31 (32-bit data format) or bit 15 (16-bit data format).

The following depictions refer to the 32-bit data format.

Output-Data					
Octet	1		2	3	4
Bit	31	(MSB)30 - 24	23 - 16	15 - 8	7 - 0 (LSB)
Data	1/0	2^{30} - 2^{24}	2^{23} - 2^{16}	2^{15} - 2^{8}	2^{7} - 2^{0}
	Preset Control	Reference value			

5.3 Example: Set reference value in 32-bit data format

Output-Data				
Octet	1	2	3	4
Bit	31	30 - 0		
Data	1	00.0000.0000.0000.0000.0000.0000.1000		
	Preset Control	Reference value: 8		

After receiving this message, an offset value (from the current actual position value and the reference value) is calculated by the encoder. If the output position value is identical to the reference value, bit 31 can be reset by the master, as preset mode is ended. The timing diagrams are specified in a separate TY sheet

Return to normal operating mode 32-bit data format

Output-Data				
Octet	1	2	3	4
Bit	31	30 - 0		
Data	0	00.0000.0000.0000.0000.0000.0000.1000		
	Preset Control	Reference value: 8		

After bit 31 = 0 has been reset, the absolute encoder operates in **normal operating mode.** The resulting offset is saved in the encoders non volatile memory an can be read out with the diagnoctic data., (chapter 7).

6. Programming parameters for class 1/2 encoder (DDLM_Set_Prm)

The parameterisation data are comprised from bus-specific data and DP slave-specific data.

Bus-specific data: Octet 1-7
- Octet 1 – Station status
- Octet 2 - WD_Fact_1
- Octet 3 - WD_Fact_2
- Octet 4 - Min. station delay responder (min T_{SDR})
- Octet 5 - Ident_Number
- Octet 6 - Ident_Number
- Octet 7 - Group_Ident

DP slave-specific data:
- Octet 8-9 Class 1 encoder (2 byte User_Prm_Data)
- Octet 8-29 Class 2 encoder (22 byte User_Prm_Data)

(See below for description)

Overview of the parameters

Octet number	Parameter	Data	Class
8			
9	Operating mode		1/2
10(MSB) - 13(LSB)	Singleturn resolution	1 to 4096 (8192) steps/revolution	2
14(MSB) - 17(LSB)	Total measuring steps	1 to 16.777.216 (33554432) steps	2
18 - 29			

The values in brackets represents the TRDxx-xx8192R4096C2Zxx.

6.1 Definition of the programming parameters

6.1.1 Operating mode

Logic table for Octet 9 (Operating parameters)

Bit number	Parameter	Data	Class	Remarks
Bit 0	Code sequence	0: CW: Increasing clockwise	1,2	
		1: CCW: Increasing counter clockwise		
Bit 1, 2	reserved			
Bit 3	Scaling function status	0: disabled	2	enables the scaling for resolution and total measuring range
		1: enabled		
Bit 4, 5	reserved			
Bit 6	Velocity unit	0: Steps / 10 ms	2	firmware version 1.02 or higher
		1: Steps / 100 ms		
Bit 7	Short diagnostic	0: disabled	2	shortens the diagnostic data to 16 byte
		1: enabled	2	

Description:

- Code sequence: The code sequence defines the rotational direction in which the position value corresponds to ascending values (looking at the shaft).

  ☐ CW - clockwise ☐ CCW - counter clockwise

- Velocity unit: See chapter 6.2
- Scaling: The scaling function enables parameterisation of the resolution and the total measuring function: steps. Following release of the scaling function, the position value is recalcu lated and output.
- Short diagnostic: Due to market requirements that not every PLC supports 63 diagnostic bytes, this aspect has been taken into consideration with short diagnostic (16 bytes).

6.1.2 Measuring units per revolution (Octet 10-13)

Operating parameter	**resolution**			
Octet	10	11	12	13
Bit	(MSB) 31-24	23-16	15-8	7-0 (LSB)
Data	2^{31}-2^{24}	2^{23}-2^{16}	2^{15}-2^{8}	2^{7}-2^{0}

6.1.3 Total measuring range in units (Octet 14-17)

Operating parameter	**total measuring steps**			
Octet	14	15	16	17
Bit	(MSB) 31-24	23-16	15-8	7-0 (LSB)
Data	2^{31}-2^{24}	2^{23}-2^{16}	2^{15}-2^{8}	2^{7}-2^{0}

Note: It must be noted that the calculation of the number of revolutions is carried out in 2^n powers internally within the encoder. Regardless of this requirement, the user may programme the desired total measuring range in units and the desired single turn resolution in accordance with the application. During calculation, the encoder accesses the next highest 2^n power if required. In this case, the values are designated as the actual single turn resolution or as the actual total measuring range in units, and are displayed as the output value.

Example:	desired total measuring range in units	:	20480
	desired single turn resolution	:	4096
	desired number of revolutions	:	5
	internal encoder calculation		
	actual total measuring range in units	:	32768
	actual single turn resolution	:	4096
	calculated number of revolutions	:	8

(Note: The above mentioned note must be taken into consideration in the event of irreversible operation. In the example which is described, the position 0 is only achieved after 32767 steps and not, as desired, after 20479 steps.)

6.2 Remarks to the velocity signal

The calculation of the velocity signal does not take place on the programmed parameter single turn resolution and total number of steps. It is always based on a resolution of 4096 steps per turrn. The physical position values to the time t_1 and (t_1 + x) are used.

The encoder velocity value can be converted into rpm as follows:

Setting velocity unit = steps / 10 ms:
rpm [min-1] = indicated value x 6000 / 4096

Setting velocity unit = steps / 100 ms:
rpm [min-1] = indicated value x 600 / 4096

6.3 Examples for parameterisation (User_Prm_Data)

Class 1 encoder (9 parameter bytes, inclusive 7 bytes bus specific data)*

Class 1 encoder				
	bus specific data		operating status	remarks
octet	01 - 07	08	09	
data		00	00	Bit 0=0 code sense: CW Bit 1=0 class1
data		00	01	Bit 0=1 codesense: CCW Bit 1=0 class1

Class 2 encoder (29 parameter data, inclusive 7 bytes bus specific data)*

Class 2 encoder							
	bus specific data		operating status		steps/ turn	total steps	
octet	01 - 07	08	09		10 - 13	14 - 17	18 - 29
data		00	0A	Bit 0=0 code sense: CW Bit 1=1 class 2 Bit 2=0 no diagnosis Bit 3=1 scaling on	1.000	1.000.000	
data		00	0B	Bit 0=1 code sense: CCW Bit 1=1 class 2 Bit 2=0 no diagnosis Bit 3=1 scaling on	100	10.000	

* example contains only DP-slave specific parameter data

7. Diagnostic messages (DDLM_Slave_Diag)

7.1 Standard diagnostic information (Octet 1-6):

Note: Octet 5,6: Manufacturer identification: TRD: 1962 hex. The manufacturer identification is stored in the PNO and identifies the subscriber as a TWK encoder.

7.2 Device-related diagnosis

Diagnostic information (DDLM_Slave_Diag)			
Diagnosis octet number	**Parameter**	**Data**	**Device class**
1-6	Standard diagnostic information		
Device-related diagnostic information			
7	Extended diagnostic range		
8	Alarm messages	Bit 4: Memory error	1,2
9	Operating mode	Bit 0: Code sequence	1,2
		Bit 1 - 2: reserved	
		Bit 3: Scaling function	
		Bit 4 - 5: reserved	
		Bit 6: Velocity unit	
		Bit 7: Short diagnostic: 16-byte	
10	Encoder type	01 hex: Absolute multiturn encoder	1,2
11 (MSB) - 14 (LSB)	Resolution	1 to 4096 (8192) steps per revolution	1,2
15 (MSB) - 16 (LSB)	Measuring range	1 to 4096 turns	1,2
End of the diagnostic data for class 1 encoders and with short diagnostic!			
17	Additional alarm messages		2
18-19	Supported alarm messages	Bit 4: Memory error is supported	2
20-21	Warnmeldungen	not used	2
22-23	Unterstützte Warnmeldungen	not used	2
24-25	Profile version	E.g. 01.00	2
26-27	Software version	E.g. 01.01	2
28-31	Operating time	FFFF FFFF hex	2
32-35	Offset value	0000 0000 hex	2
36-39	Manufacturer offset value	0000 0000 hex	2
40 (MSB) - 43 (LSB)	Resolution (S/R)	1 - 4096 (8192) steps per revolution	2
44 (MSB) - 47 (LSB)	Total measuring steps	1 - 16.777.216 (33.554.432) steps	2
48-57	Serial number	2A2A2A2A 2A2A2A2A 2A2A hex	2
58-59	Reserved	00 00 hex	2
60-63	Manufacturer-specific diagnosis	See point 7.3	2

The values in brackets represents the TRDxx-xx8192RxxxxC2ZD01.

7.3 Manufacturer-specific diagnosis (Octet 60-63)

Manufacturer-specific diagnosis octet number	Bit	Definiton	Remark	Error rectification
60	0 - 7	Reserved		
61	0 - 7	Reserved		
62	0	ErrEE	EEPROM error	Reset encoder
	1	ErrMSA	MSA error	Reset encoder
	2	ErrXRAM	External RAM error	Reset encoder
	3	ErrExp	Connecting cap error	Reset encoder
	4	IniFlg	EEPROM re-initialisation	
	5 - 7	Reserved		
63	0	ErrCRCO	CRC0 error	Reprogramming and rebooting of the encoder
	1	ErrCRC1	CRC1 error	Reprogramming and rebooting of the encoder
	2	ErrPar	Incorrect value for the number of revolutions	Reprogramming
	3	ErrSkal	Scaling error	Covered by communication
	4	ErrMem	ROM code error	Reset encoder
	5	ErrInt	Internal controller error	Reset encoder
	6	ErrPre	Reference value error	Reference value input* within the range of values: 0 to total measuring steps -1
	7	ErrStat	Unknown job from communication	Proper job from communication

* On inputting an incorrect preset value, preset control bit 31 (see Chapter 5.2) must be set to zero before setting a correct preset value.

7.4 Example of diagnosis message

Diagnosis in hexadecimal format																
Octet	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
00-15	00	0C	00	01	19	62	39	00	02	02	00	00	10	00	10	00
16-31	00	00	10	00	00	00	00	01	00	01	01	FF	FF	FF	FF	00
32-47	00	00	00	00	00	00	00	00	00	10	00	01	00	00	00	2A
48-63	2A	2A	2A	2A	2A	2A	2A	2A	2A	00	00	00	00	00	00	

Diagnosis octet number	Parameter	Data		Remark
1 - 6	Standard diagnostic information	01	00 hex	
		02	0C hex	Response monitoring activated, bit 2 set to 1
		03	00 hex	
		04	01 hex	Parameterisation by master with address 1
		05 - 06	1962 hex	Ident. number TRD
7	Extended header byte	39 hex		63 diagnostic bytes
8	Alarm messages	00 hex		No alarm
9	Operating mode	02 hex		CW, class 2, diagnosis: No, scaling: No, no short diagnostic
10	Encoder type	01 hex		Absolute multiturn encoder
11 - 14	Resolution	1000 hex		4096 steps/revolution
15 - 16	Measuring range	1000 hex		4096 revolutions
17	Additional alarm messages	00 hex		No alarm
18-19	Supported alarm messages	0010 hex		Memory error is supported
20-21	Warning messages	0000 hex		Not used
22-23	Supported warning messages	0020 hex		Not used
24-25	Profile version	01.00		Hardware version: 1.00
26-27	Software version	01.01		Software version 1.00
28-31	Operating time	FFFF FFFF hex		Not supported
32-35	Offset value	0000 0000 hex		Not supported
36-39	Manuf. offset value	0000 0000 hex		Not supported
40-43	Resolution	1000 hex		4096 S/R
44-47	Total measuring steps	1.000.000 hex		16.777.216 steps
48-57	Serial number	2A2A2A2A 2A2A2A2 A2A2A hex		Not supported
58-59	Reserved	0000 hex		
60-63	Manufacturer-specific diagnosis	0000 0000 hex		No error

8. Simatic Step7

This chapter explains the procedure for integrating the TWK encoder into the profibus of a Siemens S7 control system plus the structure and the use of the example programmes for Step7. The documentation is based on Step7 version 5.5.

8.1 Integration of the TWK profibus encoder

Prerequisites: You have configured your hardware in accordance with the structure of your control system and have installed a profibus sub net.

8.1.1 Installation of the GSD file

- The GSD-file and the encoder symbols (bitmaps) are available under www.twk.de menu Documentation
- Close all projects in the hardware configuration.
- In the hardware configuration, select **Install GSD files** under **Options**.
- Select the appropriate GSD file:

Article number of the encoder	GSD file
TRDxx-xx4096R4096C2ZD01	TRDZ24.GSD
TRDxx-xx8192R4096C2ZD01	TRDZ25.GSD

  - The encoder symbol is also installed automatically.

8.1.2 Selection of the TWK encoder from the Step7 hardware catalogue

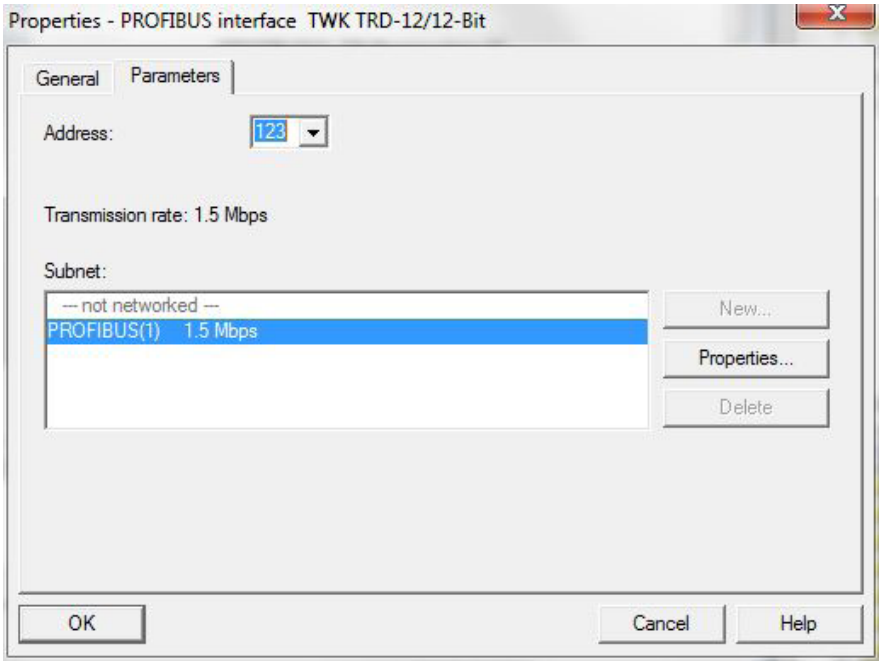
- After opening the hardware catalogue, you will find the profibus encoder under **Profibus-DP, Additional Field Devices, Encoders.**
- Now open your project, mark the bus and integrate the encoder into the bus by double-clicking onto the cor responding line of the hardware catalogue.

8.1.3 Allocation of the profibus address

Once you have selected your nominal configuration, the following window, in which you must specify the profibus address set in the encoder, appears. For the example programmes, please select address 123 for the first and address 122 for the second encoder here.

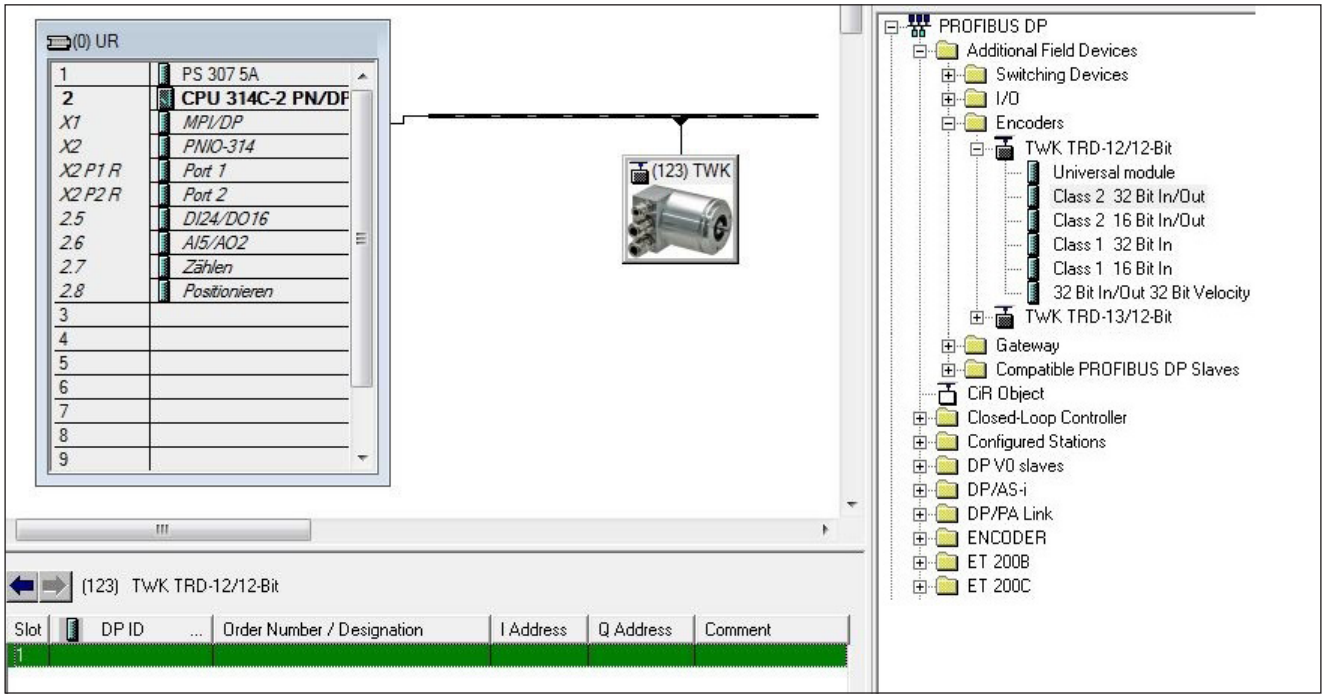
Note: The profibus address of the encoder is set via the dip switch. (Refer to chapter 3.1)

In addition, select your planned profibus in the Sub net field, and quit the window with OK.

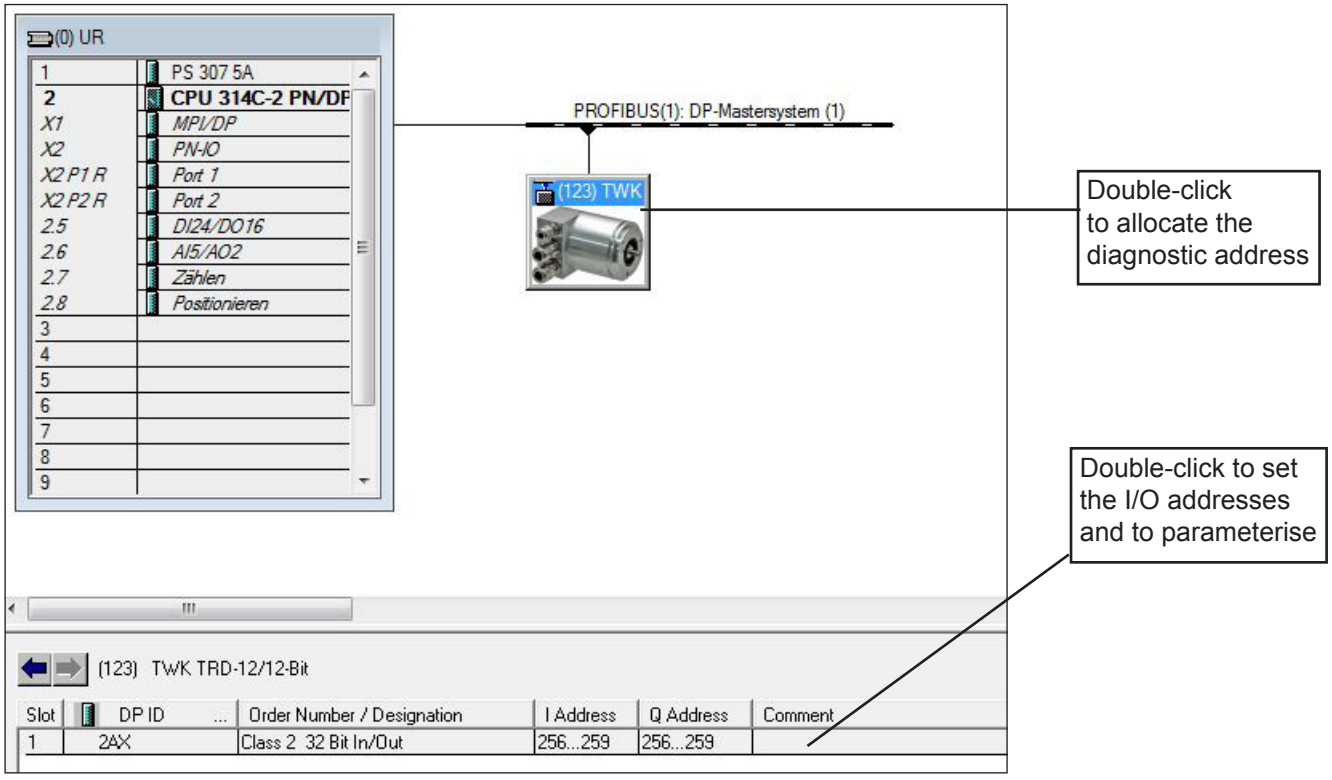


8.1.4 Select module

Now please select the module suitable for your application via a double click from the hardware catalogue. The available modules correspond the possible configurations of the encoder listed in chapter 4.



This could look like the following picture:

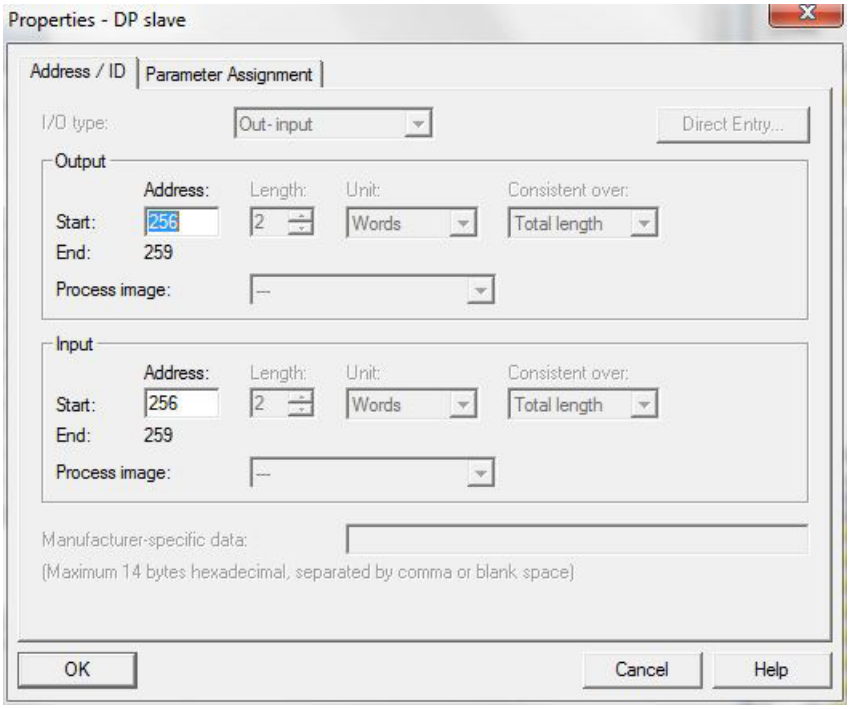


The **DP ID** value results from the selected configuration. The I/O address values are default values which vary depending on the control system.

8.1.5 Setting the I/O addresses (S7 addresses)

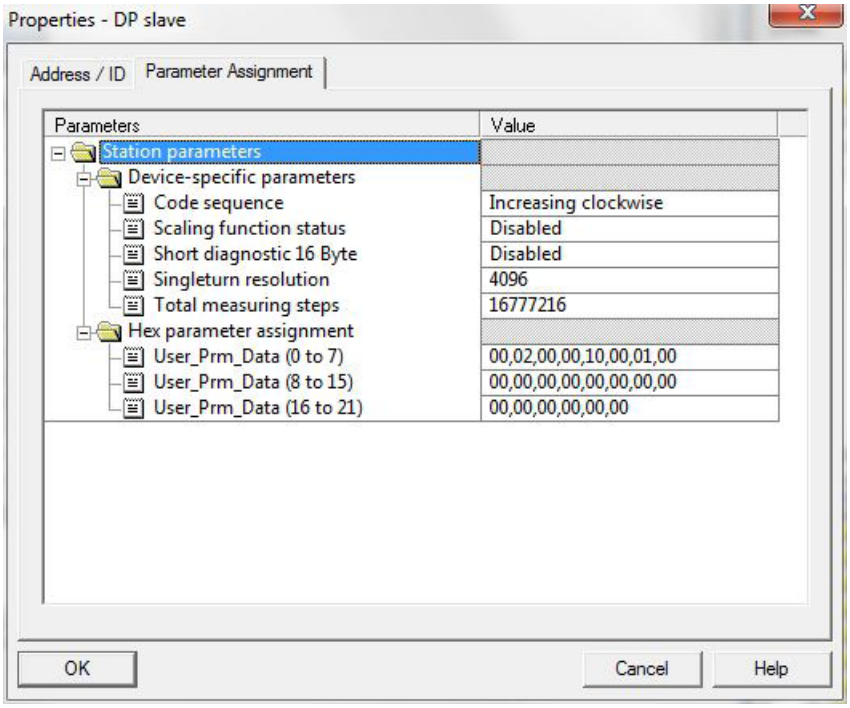
Double-clicking onto the „Slot 0“ line opens up the **Properties – DP slave** window with the **Address / ID** and **Parameter Assignment** registers. The addresses for the encoder, under which this is to be addressed in the S7, must be assigned under output (for class 2 encoder only) and input in the **Address / ID** register. This register‘s other entries should not be changed. The following figure shows an example of this register for a class 2 encoder with 32-bit resolution.

For the example programme, please enter adress 100 for outputs and inputs.



8.1.6 Parameterisation of the encoder

Via the **Parameter Assignment** register, the following window, in which the properties of the absolute encoder can be defined, is accessed. The parameters of a class 2 slave are shown. In the case of the class 1 slave, only the code sequence parameter can be set here.

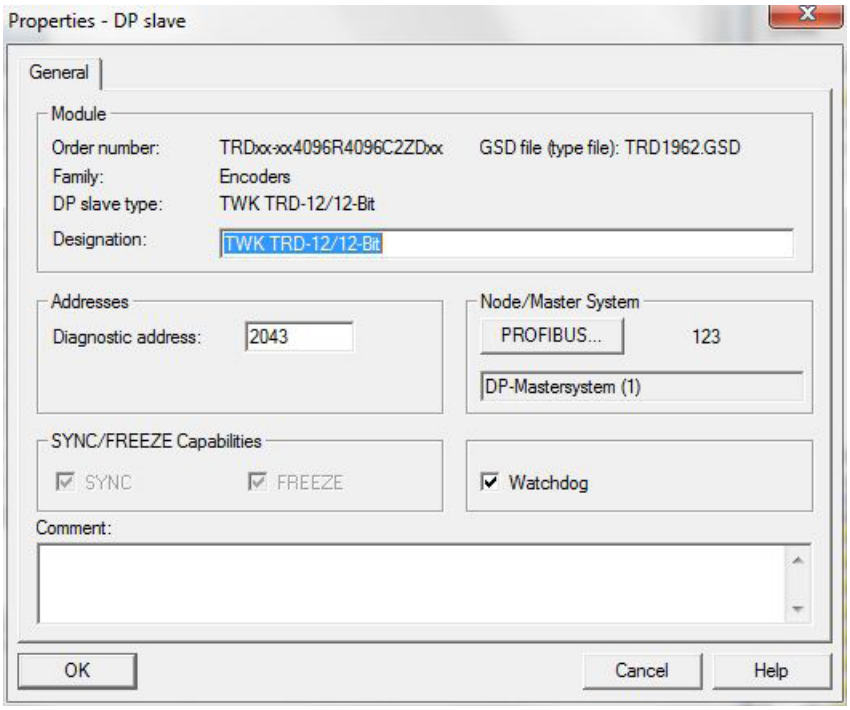


8.1.7 Setting the diagnostic address

So that the encoder‘s diagnostic area can be accessed within the S7 programme, it is necessary to assign a specific S7 diagnostic address to it. This may lie within the entire periphery area of the control system. It does not therefore occupy any input/output addresses.

The **Properties – DP** slave window with the **General** register appears by double-clicking onto the encoder symbol.

For the example programme, please specify diagnostic address 200 for the 1st encoder and 202 for the 2nd encoder.



The encoder is configured and parameterised after confirming with OK.
The hardware configuration can now be translated and transferred to the S7.

8.2 Example programmes

In the internet several S7 archive files are available, which contain S7 example programmes which have been generated by TWK for working with the TWK profibus encoder. The programmes have been developed for a CPU315-2DP, and have been designed such that no periphery other than a TWK profibus encoder is required. There is one project for encoders with class 1 functionality and one for encoders with class 2 functionality. Each project contains several programme folders for different application cases. The standard ”Sources” and ”Blocks” folders are located beneath the programme folders.

The TWK examples only contain modules which have been generated with the KOP/FUP/AWL Editor. The generation language was FUP. Within the modules, comprehensive documentation is made available on the basis of network comments.

TWK cannot undertake to provide any guarantee for the function of these programmes on customers' systems/control systems.

Programmes in the archive files:

- TWKDPCL1.ARJ : Class 1 project with Diagnosis and Istwert programme folders, comments in German
- TWKDPCL2.ARJ : Class 2 project with Diagnosis, IstRef and Istwert programme folders, comments in German
- DP_C1_GB.ARJ : Class 1 project with Diagnosis and Istwert programme folders, comments in English
- DP_C2_GB.ARJ : Class 2 Project with Diagnosis, IstRef and Istwert programme folders, comments in English

Because of a modification in the handling of the used system function SFC13 the examples for the diagnosis in the above programmes do not work with actual CPUs. Therefore a new programm example is available (please refer to the additional information in document no. 12532).

- Diag_neu: reading of diagosis data with SFC13 with german comments
- Diag_new: reading of diagosis data with SFC13 with english comments

8.2.1 The TWKDPCL1 project

The following Figure shows the class 1 project programme folders:

Program Istwert: The program Istwert is comprised only of an OB1 and is intended to briefly show the manner in which the actual position value of the encoder is accessed within the S7 programme.

Program Diag1: In addition to the program Istwert, the Diag1 programme also contains error handling for a class 1 encoder. It contains, amongst other things, OB86 for detecting the failure of the encoder, and OB82 for detecting a diagnosis request on the part of the encoder. Step7 system function SFC13 is used to read the diagnosis range out. (The diagnosis range of the class 1 encoder is 16 bytes. See Chapter 7)

Program Diag2: The Diag2 programme provides the same functionality as Diag1, but is designed for two encoders.

Within each programme, a selection may be made between functions for a 16 or 32 bit-wide encoder input. To achieve this, either the 16 or the 32 bit function is simply provided with a ”1” signal (one-marker M 0.1) at the EN input, and the non-required function with a ”0” signal (zero-marker M 0.0).

8.2.2 The TWKDPCL2 project

The class 2 project contains the following programme folders:

Program Istwert: Identical to class 1 programme

Program IstRef: The program IstRef contains the reading out of the actual position value and, in addition, the setting of a preset value, which is possible in the case of class 2 functionality.

Program Diag1: In the same manner as Diag1 from the class 1 project, the Diag1 programme contains the error handling of a class 2 encoder. In this case, the scope of the diagnosis range is 63 bytes.

Program Diag2: Once again, Diag2 is the variant of Diag1 which is extended to encompass two encoders.

8.2.3 Installation of the example programmes

Prerequisites:

- You have generated a project and have inserted a control system into this with its hardware configuration.

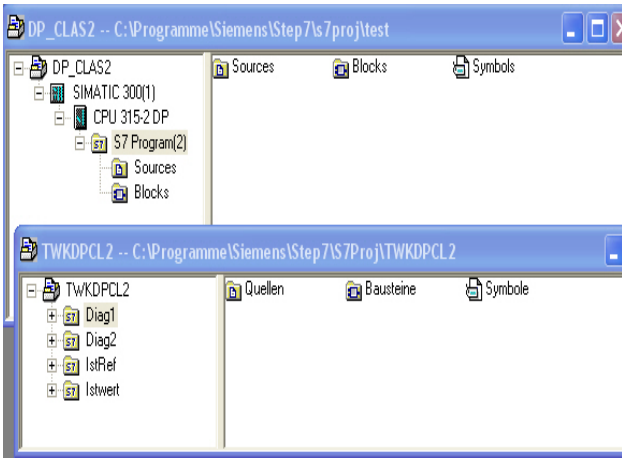
  This may appear as follows, for example:

· In the hardware configuration, you have connected one or two encoders with the following settings to a profibus subnetwork:

First encoder:	Profibus address 123 Inputs/outputs: From address 100 Diagnosis address: 200
Poss.: Second encoder:	Profibus address 122 Inputs/outputs: From address 110 Diagnosis address: 202

Installation:

- In the Simatic Manager, select **File**, **Retrieve**. Change the file type to *.arj and select the downloaded file
- In the next window, specify your project directory (normally S7proj).
- Via integration with OK, the dearchiving programme is started. After terminating this, you will find your selected TWK example project in your S7 project directory.
- If you now select **File**, **Open**, **User project**, you will be provided with a list of the projects available on your system. If the example project is not yet available here, select **Browse** and search for the TWKDPCL1.s7p (or TWKDPCL2.s7p) file under the TWK example project.
- Open the example project so that you now have both projects, your own and the example project, open. This may then, for example, look like the figure.

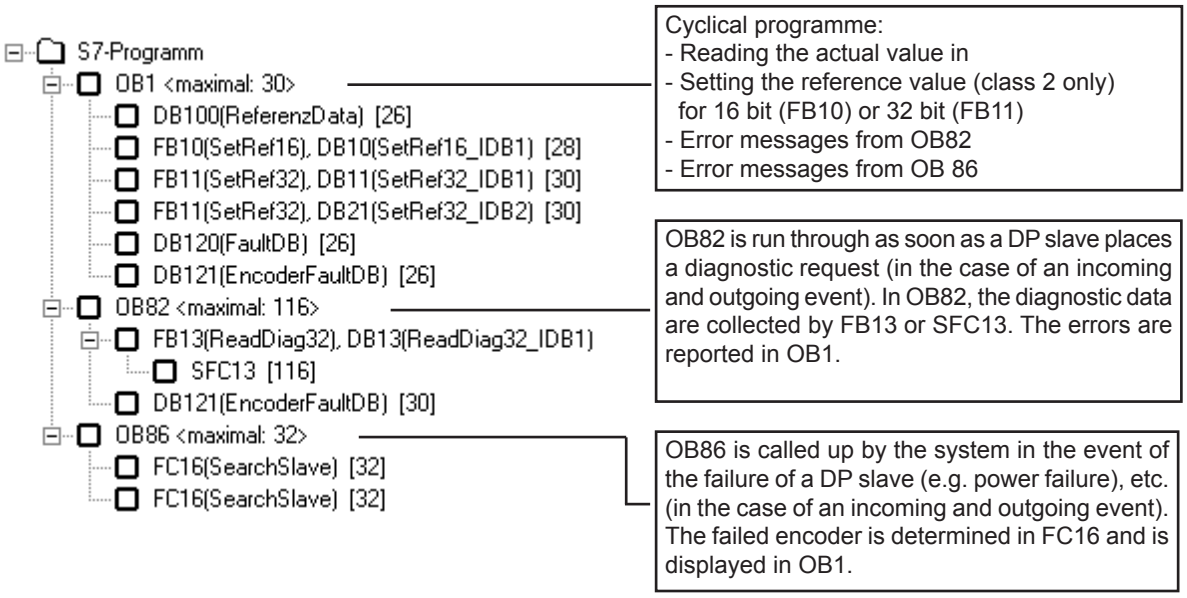


- Select a subordinate S7 programme folder of the TWK example project. In this case, either Diag1, Diag2, IstRef or Istwert.
- Copy all of the block container‘s blocks from the selected programme folder (e.g. Diag1 from TWKDPCL2) into your own project‘s still empty block container (e.g. S7 programme (4) from DP_CLAS2). (Note: Each block container, even an empty one, contains at least one OB1; this is, of course, also empty, and can therefore be overwritten.)
- If you have installed a class 2 16-bit encoder and have selected the IstRef or Diag1/2 programme, you must, in order to set the reference value, release the FB10 in the OB1, i.e. supply the EN input with M 0.1 and block the FB11 (s), i.e. supply the EN input with M 0.0.
- If necessary, replace the M 1.0 – Acknowledge message and the M 10.0 (and M 10.1 in the case of two encoders).
- Set the reference value with your signals.
- Transfer all blocks into the control system.
- Now call up the OB1 in the on-line view, and switch **Test, Observe** on, in order to have the current values of the encoder displayed on the monitor.
- For IstRef and Diag1/2 programme only: Enter a reference value into DB100 data doubleword 0 (for the second encoder, DB100 data doubleword 8), and set this with the M 10.0 (or M 10.1). If the reference value lies outside of the parameterised measurement range of the encoder, the corresponding error message is set in OB1.

8.2.4 Explanations regarding the example programmes

Each programme folder contains a symbol table, which contains all global variables of the maximum expansion (class 2 project, Diag2 programme).

The programme structure of this maximum expansion is explained in the following. The reference data provide the following overview: (The symbolic name is always contained in the round brackets).



The entire diagnostic range of the disturbed encoder is always read out via system function SFC13 (16 bytes in the case of class 1 and 63 bytes in the case of class 2). The address of this slave is provided by OB82 in its local data.

Only the manufacturer-specific error message bits are evaluated, and of these, only those which may occur in data exchange mode (in normal bus operation). Errors which only occur during bus initialisation cannot be detected by OB82. In this case, the error messages must be read out via the **Diagnosing hardware** function of the Step7 package.

9. Scope of delivery

The scope of delivery includes:
- Encoder with DP interface
- Pin assignment TY XXXXX (depending on the device variant)

Remark:

The GSD-file, the complete documentation and the example programms are available for download in the internet www.twk.de under documentation

10. Literature

/1/ PROFIBUS Profile for Encoders, Order No. 3.062
http://www.profibus.com/downloads/Profiles

/2/ PROFIBUS system description
http://www.profibus.com/downloads/Technical Descriptions & Books

/3/ IEC 61158 - Digital data communication for measurement and control - Fieldbus for use in industrial control systems

/4/ IEC 61784 - Profile sets for continuous and discrete manufacturing relative to fieldbus use in industrial control systems

Appendix A: Encoder terms

Parameter:	Explanation
Measuring units per revolution:	The single turn resolution specifies the number of measuring units per revolution (360°).
Measuring range:	The measuring range specifies the maximum number of revolutions. Specification of the revolutions must be carried out in 2^n powers.
Total measuring range in units:	The total measuring range in units is revealed as follows: Total measuring range in units = Single turn resolution x Measuring range
Code sequence:	The code sequence specifies the direction of rotation in which the output code of the encoder corresponds to increasing values. A distinction is made between the following depending on the direction of rotation: CW - clockwise, clockwise direction of rotation CCW - counter clockwise, anti-clockwise direction of rotation (viewed in the direction of the shaft)
Preset value:	The preset value is the value which appears in the encoder's output value parameter according to the preset function.