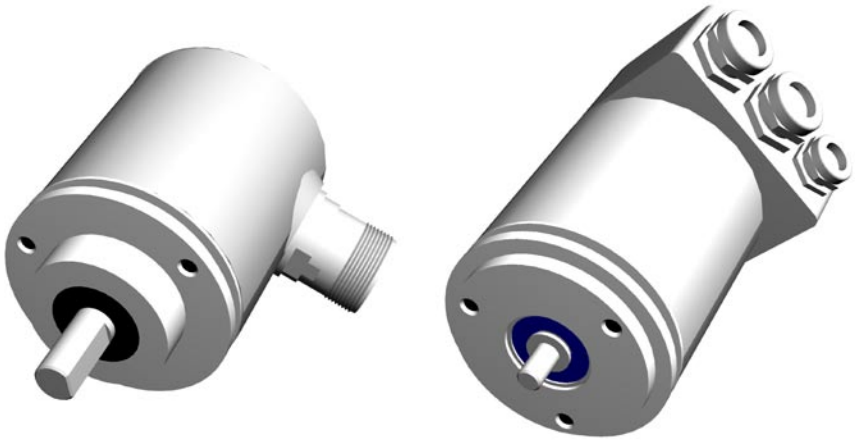
User Manual



Structure

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1. General

The encoder of the series KBD/ KRD are new developments in the area of fieldbus components.
Wide experience resulting out the series CRD be considered in the device design. Beside the increasing of the resolution (max. 16 bit) is a short diagnostics (max.16 byte) and a velocity signal now available.
The model KBD (max. 16 Bit) is a monotour and the model KRD (max. 28 bit) is a multitour encoder. In the data sheet 10941 are all relevants technical parameter described.

In the first part of the manual are the general premises for understanding the use of the encoder in PROFIBUS DP bus system and in the second part is a instruction and application software under Step 7 shown.

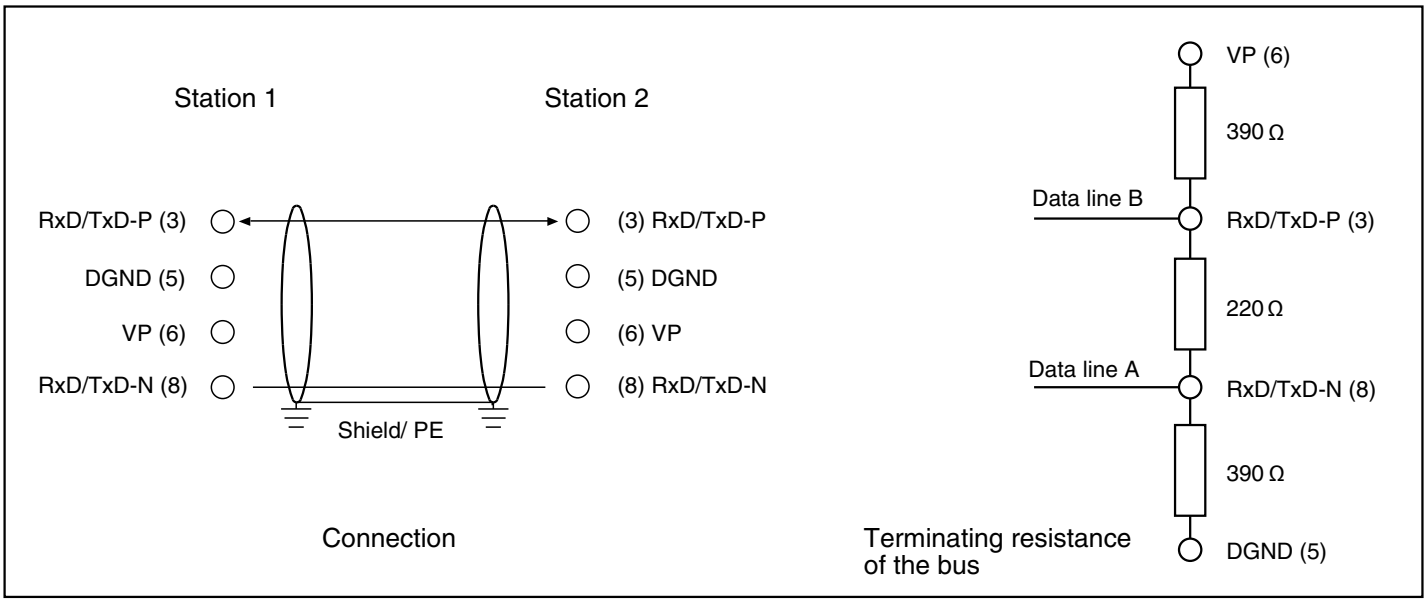
For the general understanding of the field bus system PROFIBUS as well as for further reading we would refer to the PROFIBUS-Nutzerorganisation PNO (www.profibus.com).

2. Installation instructions for PROFIBUS-DP - RS 485

Basic characteristics of RS-485 transmission technology:

- Network topology: Linear bus, terminating resistors for bus termination
  Stub lines are only permissible in the case of baudrates < 1.5 MBit/s
- Lead: Sheathed, twisted pair cable
- Number of stations: 32 stations in each segment without repeaters
  Can be extended up to 126 with repeaters.
- Plug-type connector: Variants implemented in the case of the KBD/ KRD model series:
  Round plug RS 25, 12-pin
  Connecting cap,
  D-SUB 9-pin or others on request
  (pin assignment according to /1/)

Wiring and bus termination for PROFIBUS-DP /2/, (Note: 9-pin Sub-D-plug)



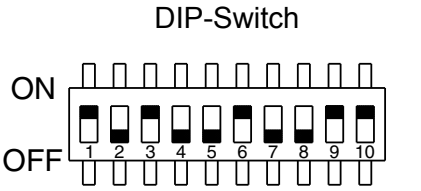
The encoder is connected via the 15-pin SUB-D plug. In the event of an error, the encoder can be replaced without time-consuming installation. The connecting cap is disconnected from the encoder by undoing 2 fastening screws (Note: O-ring seal)
(Note: The protection grade is only warranted at screwed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

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.
(Note: GSD file in accordance with encoder version).

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

DIP-switch - address setting

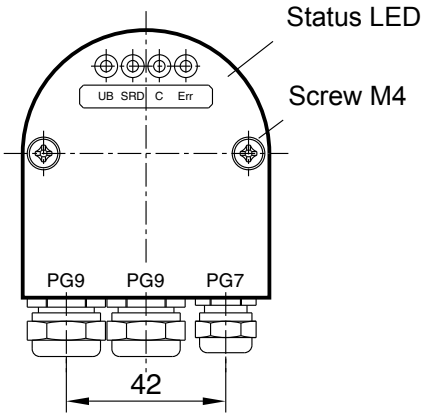
DIP switch - terminating resistors										
Switch	1	2	3	4	5	6	7	8	9	10
On = 1	LSB						MSB	nc	Terminating resistors	
Off = 0	Address 1 to 128 adjustable								No terminating resistors	
	(Default address: 123)									



Terminating resistors switched on

The following status LED are located in the rear wall of the connecting cap

Status LED (connecting cap)				
	UB	SRD	C	Err
Incorrect configuration	x	x		x
Impermissible parameter	x		x	x
Encoder error	x			x
Class 1 device configuration ok	x	x		
Class 2 device configuration ok	x	x	x	
x = LED on, UB = Supply voltage, Err = Error message, C = Class, SRD = Data transfer				



Transmission length depending on transmission speed for cable type A							
Baud rate (kBit/s)	9,6	19,2	93,75	187,5	500	1500	1200
Transmission length in (m)	1200	1200	1200	1000	400	200	100

Cable type A specifications:

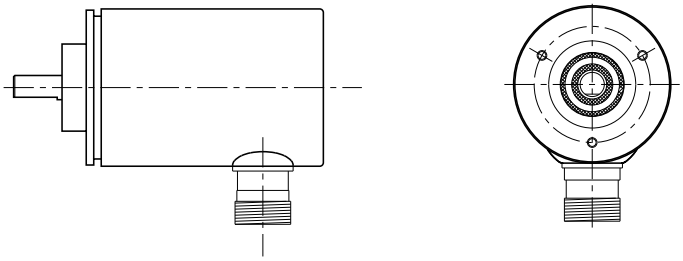
Characteristic impedance:	135...165 Ohm
Capacitance per unit length coating:	< 30 pF/m
Load resistance:	110 Ohm /km
Core diameter:	0.64 mm
Core cross-section:	> 0.34 mm²

also see:
Installation guideline for PROFIBUS - FMS/DP (No. 2.111)
Implementation guide DIN E 19245 Part 3 (No. 2.041)

2.1 Connection of encoder with RS plug

The-pin assignment for the 12-pin RS plug (Note: Numeration of the-pins in clockwise direction (view facing contact side of the bushing), encoder: Bushing) conforms to the profile definition for encoders /1/.

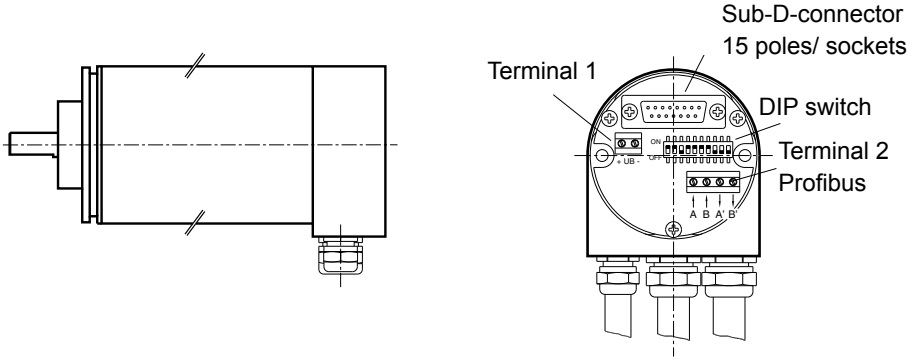
The terminating resistors must be implemented in the counterplug or in the subsequent electronics. When delivered, each encoder with RS plug has the default address 123. Via the DP master, it is possible to change the address of a DP slave. The slave address which is to be newly assigned must lie within the range 1-126 (DDLM_Set_Slave_Add).



2.2 Connection of encoder with connecting cap

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:

- ☐ PG 7: Voltage supply for the encoder (24 VDC +/-)
- ☐ PG 9: Bus in (Receive/transmit data A,B)
- ☐ PG 9: Bus out (Receive/transmit data A',B')



3. 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, F1 and F3 configurations. The F0 configuration has the data format 1 word input data, 1 word output data, consistency, F1 contains 2 word input data, 2 word output data, consistency and F3 contains 4 word input data, 4 word output data. The F3 contains beside the position value additional the velocity signal. The Class 2 funtionality remains constant at identification F3.

ID Identification/ Configuration

Configuration function (DDLM_Chk_Cfg)					
Selection	Class	Data	Identifier byte	Comment	Assignment Octet No. and MSB/ LSB
32 Bit In/Out 32 Bit Velocity	2	64 Bit In/ Output data	F3	KRD, Velocity signal	Octet1/ Bit 63: MSB Octet 4/ Bit 32: LSB Position value Octet 5/ Bit 31: MSB Octet 8/ Bit 0: LSB Velocity signal
Class 2 32 Bit In/out	2	32 Bit In/ Output data	F1	KRD	Octet 1/ Bit 7: MSB Octet 4/ Bit 0: LSB
Class 2 16 Bit In/Out	2	16 Bit In/ Output data	F0	KRD/KBD	Octet 1/ Bit 7: MSB Octet 2/ Bit 0: LSB
Class 1 32 Bit In	1	32 Bit Input data	D1	KRD	Octet 1/ Bit 7: MSB Octet 4/ Bit 0: LSB
Class 1 16 Bit In	1	16 Bit Input data	D0	KRD/KBD	Octet 1/Bit 7: MSB Octet2/ Bit 0: LSB

4. 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 subscriber in the bus. The control of the preset value (see below) is listed as an example of output data at this point.

4.1 Actual position value (Input data)

The actual position value is output in 16, 32 or 64 bit data format (input data), also see identification of the encoder.

Actual position value (DDLM_Data_Exchange) 16 bit data format (Identification F1/D1)

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 (DDLM_Data_Exchange) 32 bit data format (Identification F1/D1)

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

Actual position value (DDLM_Data_Exchange) 64 bit data format (Identification F3)

Input data								
Octet	1	2	3	4	5	6	7	8
Bit	63 - 56	55 - 48	47 - 40	39 - 32	31 - 24	23 - 16	15 - 8	7 - 0
Data	2^{63}- 2^{56}	2^{55}-2^{48}	2^{47}- 2^{40}	2^{39}- 2^{32}	2^{31}- 2^{24}	2^{23}- 2^{16}	2^{15}- 2^{8}	2^{7}-2^{0}
	MSB			LSB	MSB			LSB
	Position value				Velocity signal			

4.2 Set preset value (Output data)

The set preset value function should only be executed when the encoder shaft is stationary!
In order to compare machine position values and the absolute position of the encoder, setting the preset value is unavoidable in certain cases. The preset value is the position value which is displayed in the reference point. The possibility of setting the preset value is available in the case of the TWK encoder with class 2 functionality.The user must note the fact that the preset value must lie within the total measuring range in units - 1. In particular, this must be taken into consideration when changing the total measuring range in units.The preset value (binary code) is transmitted in data exchange mode by setting bit 31 (32 bit data format) or bit 15 (16 bit data format).

The following explanations refer to the 32 bit data format.
Set preset value (DDLM_Data_Exchange)

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	Preset value			

Example: Setting the preset value e.g. 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	Preset value: 8			

Following the receipt of this message, an offset value (from the current actual position value and preset value) is calculated by the encoder.

If the output position value is equal to the preset value, bit 31 can be reset by the master, as the preset mode is terminated. The timing diagrams are specified in a separate TY sheet. After bit 31 = 0 has been reset, the encoder operates in normal operating mode.

The offset value is stored in the diagnostic data and can be read in the event of a power failure and restarting (Also see Diagnostic messages in chapter 6).

5. 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 TSDR) Octet 5 - Ident_Number) 19 Octet 6 - Ident_Number) 63 hex 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	

Operating Parameter (DDLM_Set_Prm)				
Octet No.	**Parameter**	**Data**	**Class**	**Comment**
9/ Bit 0	Code sequence	0: CW, increasing clockwise 1: CCW, increasing counter clockwise	1,2	
9/ Bit 1	Class functionality	0: not supported 1: supported	1,2	
9/ Bit 2	Commissioning diagnostic control	0: not supported	optional	
9/ Bit 3	Scaling funtion status	0: disabled 1: enabled	2	
9/ Bit 6	Velocity unit	0: Steps/ 10 ms 1: Steps/ 100 ms	2	
9/ Bit 7	Short diagnostic: 16 Byte	0: not supported 1: supported	2	
10 (MSB) - 13 (LSB)	Singleturn resolution	1 to 65536 steps/revolution	2	
14 (MSB) - 17 (LSB)	Total measuring steps	KBD: 1 to 65536 steps KRD: 1 to 268.435.456 steps	2	
18-29				

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.)

5.1 Definition of the programming parameters

Operating parameters (definition of the operating mode of the encoder)

- Code sequence: The code sequence defines the direction of rotation in which the position value corresponds to increasing values (viewed in the direction of the shaft).
  - ☐ CW - clockwise ☐ CCW - counter clockwise
- Class 2: This operating parameter serves to distinguish between encoders with class 1 or class 2 functions.
  - ☐ Class 1: Code sequence, release of the class 2 functions
  - ☐ Class 2: Contains class 1 functions
Scaling function control (see below)
short diagnosis, velocity signal
- Diagnostic: The diagnostic routine enables the extensive examination of all encoder components to ensure perfect routine:functional capability. The routine is run through each time the device is switched on. If faults are determined by the diagnostic routine, these are displayed with the alarm bit. This function is not currently supported.
- Scaling function The scaling function control the parameterisation of the single turn resolution and the total measuring steps. This function is only effective when changing the single turn resolution and total measuring steps parameter. Following the execution of scaling function control, the position value is recalculated and issued.
- Velocity signal The velocity signal are detailed described in chapter 5.2.
- Short diagnosis For some applications (depending from the kind of PLC) it is necessary to work with a short diagnosis. In this case the encoder works only with 16 diagnostic bytes.

5.2 Notes to the velocity signal

General remarks to identification F3:

- 32 bit positions data and 32 bit velocity signal
- 64 bit In/Out data
- Class 2 functionality are supported in the full range (see identification F1)
- Update rate of the position value ca. 700 us
- Take over of the reference value are ca. 3 s
- The velocity signal won't issued, if a false parameter set is programming

The calculation of the velocity signal does not take place on the programmed parameter single turn resolution and total number of steps. The physical position values to the time t_1 and (t_1 + x) are used. The encoder works internally with two different time base, see also the parameter velocity unit.

Velocity Unit	time base
Steps/10ms	1 ms
Steps/100ms	10 ms

The velocity signal is the arithmetical mean over 16 measured values. The velocity signal is updated to 16 ms (time base: t = 1 ms) or 160 ms (time base: t = 10 ms).

Calculation of speed

Adjustment: Velocity unit = Steps/100 ms
Revolutions per minutes [min^{-1}] = Indicated value x 10 x 60 / 65536

Revolutions per minute	Indicated value (hex)
4000 min^{-1}	6AAAA
3000 min^{-1}	50000
2000 min^{-1}	35555
1000 min^{-1}	1AAAA
500 min^{-1}	D555
100 min^{-1}	2AAA
10 min^{-1}	444

Adjustment: Velocity unit = Steps/10 ms
Revolutions per minute [min^{-1}] = Indicated value x 100 x 60 / 65536

Revolutions per minute	Indicated value (hex)
4000 min^{-1}	AAAA
3000 min^{-1}	8000
2000 min^{-1}	5555
1000 min^{-1}	2AAA
500 min^{-1}	1555
100 min^{-1}	444
10 min^{-1}	6D

Overflow = 8888 8888 (32-bit-value) at rpm ≥ 4000 min^{-1}

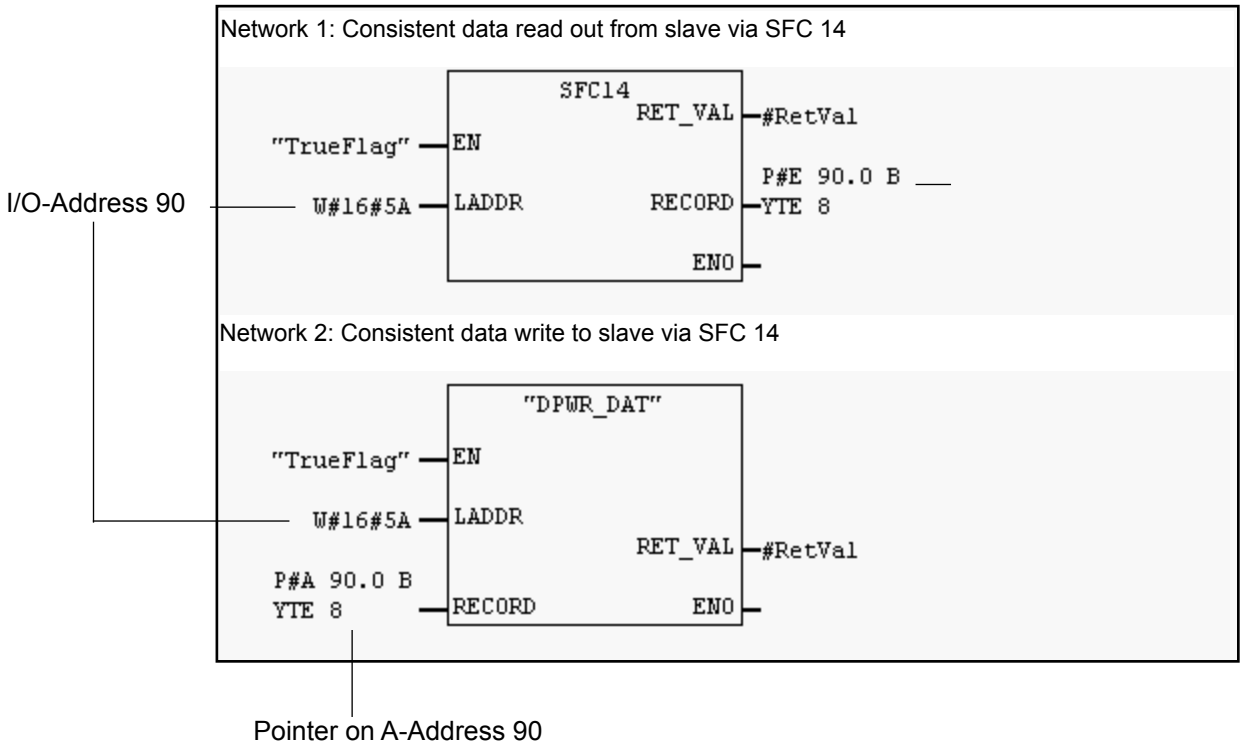
Access to I/O data of the encoder

The PLC S7 (Siemens) works not with the i/O data format from the length of 8 byte.

Hence the 8 byte input data and 8 byte output data at the identification F3 of the encoder must fetched with the system function logic arrays SFC14 and SFC15. These system function blocks are in the PLC available and can call up in the OB, FB or FC. As parameters must the Enable-Marker (here TrueFlag), a variable for the Return value (here RetVal) and the I/O address (here 90_{dez} respectively $5A_{hex}$) wich are defined in the hardware catalogue, assigned.

The input data are available on the module output 'RECORD' of the SFC 14 and the output data must assigned on the module input 'RECORD' of the SFC 15.

The type of the parameter 'RECORD' is Any-Pointer and must be a pointer to a 8 byte great Array. When for the I/O- address again used a pointer, then the data following in the periphery area under this address are available. Also the data are observable in the variable table on this addresses.



6. Diagnostic messages (DDLM_Slave_Diag)

Explanations regarding the diagnostic information:

6.1 Standard diagnostic information (Octet 1-6):

For detailed description, see IEC 61158 /3/
(Note: Octet 5,6: Manufacturer identification: 1963 hex)
This manufacturer identification number is stored in the PNO, and identifies the subscriber as a TWK encoder.

6.2 Device-related diagnosis

In the range from Octet 7 up to max. 244 (according to standard /3/), the DP slave may store its specific diagnosis.

Diagnostic information (DDLM_Slave_Diag)			
Diagnostic Octet No.	**Parameter**	**Data**	Encoder Class
1-6	Standard diagnostic information		
Device-related diagnosis			
7	Extended header byte		
8	Alarm messages	4: Memory error	1,2
9	Operating mode/ encoder status	0: code sequence	1,2
		1: Class 2 functionality	
		2: Commissioning diagnostic control	
		3: Scaling funtion status	
		6: Velocity unit	
		7: Short diagnostic: 16 Byte	
10	Encoder type	01 hex: Absolute encoder	1,2
11 (MSB) - 14 (LSB)	Single turn resolution	1 to 65536 (steps per revolution)	1,2
15 (MSB) - 16 (LSB)	Measurement range	1 to 4096 revolutions	1,2
End of diagnosis data for class 1 encoder and short diagnostic!			
17	Additional alarm messages		2
18-19	Supported alarm messages	4: Memory error	2
20-21	Warning messages		2
22-23	Supported warning messages		2
24-25	Profile version	e.g. 01.00	2
26-27	Software version	e.g. 01.00	2
28-31	Operating time	FFFF FFFF hex	2
32-35	Offset value	e.g. 00FF 230F hex	2
36-39	Manufacturer offset value	not implemented	2
40 (MSB) - 43 (LSB)	Single turn resolution	1-65536 steps per revolution	2
44 (MSB) - 47 (LSB)	Total measuring units	1- 268.435.456 steps	2
48-57	Serial number	2A2A2A2A2A2A2A2A2A2A hex	2
58-59	reserved	00 00 hex	2
60-63	Manufacturer specific diagnosis	see below	2

6.2.1 Manufacturer specific diagnosis (Octet 60-63)

Manufacturer specific diagnosis (Octet 60-63)				
Octet No.	**Bit**	**Definition**	**Comment**	**Possible error rectification**
60	0-7	Currently not assigned		
61	0-7	Currently not assigned		
62	0	ErrEE	EEPROM error	Reset encoder
	1	ErrMSA	MSA error	Reset encoder
	2	ErrXRAM	External RAM error	Reset encoder
	3	ErrExp	Cap error	Reset encoder
	4	IniFlg	Reinitialisation of EEPROM	
	5-7	Currently not assigned		
63	0	ErrCRC0	CRC0 error	Reprogramming and rebooting of the encoder
	1	ErrCRC1	CRC1 error	Reprogramming and rebooting of the encoder
	2	ErrPar	Incorrect revolution parameter	Reprogramming
	3	ErrSkla	Scaling error	Is covered by communication
	4	ErrMem	ROM code error	Reset encoder
	5	ErrInt	Internal controller error	Reset encoder
	6	ErrPre	Preset value error	Input preset value* within total measuring range in units -1
	7	ErrStat	Unknown order from communication	Proper order from communication

* At input of faulty preset values must set the preset control bit 31 to zero before you can set the accurate preset value again (see chapter 4.2).

6.2.2 Example of diagnostic message

Diagnosis in hex format															
Octet	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
00-15	00	0C	00	02	19	63	39	00	02	01	00	01	00	00	10	00
16-31	00	00	10	00	00	00	00	01	00	01	00	FF	FF	FF	FF	0B
32-47	27	EA	D4	00	00	00	00	00	01	00	00	10	00	00	00	2A
48-63	2A	2A	2A	2A	2A	2A	2A	2A	2A	00	00	00	00	00	00	

Diagnosis messages				
Octet	**Parameter**	**Data**		**Comment**
1-6	Standard diagnostic information	01	00 hex	
		02	0C hex	Response monitoring activated, bit 2 set to 1
		03	00 hex	
		04	02 hex	Parameterisation via master with address 02
		05-06	1963 hex	Ident_Number
7	Extended header byte	39 hex		63 diagnosis byte
8	Alarm messages	00 hex		No alarms are present
9	Operating mode	0A hex		CW, class 2, diagnosis no, scaling yes, Velocity unit: steps/10ms, not short diagnostic
10	Encoder type	01 hex		Multitour, absolute
11-14	Single turn resolution	10000 hex		65536 steps per revolution
15-16	Measuring range	1000 hex		4096 revolutions
17	Additional alarm messages	00 hex		No alarms are present
18-19	Supported alarm messages	0010 hex		Memory error is supported
20-21	Warning messages	0000 hex		currently not supported
22-23	Supported warning messages	0000 hex		currently not supported
24-25	Profile version	0100 hex		Hardware version: 1.00
26-27	Software version	0108 hex		Software version: 1.08
28-31	Operating time	FFFF.FFFF hex		
32-35	Offset value	0000.0000 hex		
36-39	Manufacturer offset value	0000.0000 hex		currently not supported
40-43	Single turn resolution	10000 hex		65.536 steps per revolution
44-47	Total measuring units	10000000 hex		268.435.456 total measuring units
48-57	Serial number	2A2A2A2A2A2A2A2A2A2A hex		
58-59	reserved	0000 hex		
60-63	Manufacturer specific diagnosis	0000.0000 hex		No errors are present

7. Simatic Step7

This Chapter explains the procedure for integrating the TWK encoder into the profibus of Siemens S7 control system, and the set up and the utilisation of the example programmes for Step7. The basis of the documentation is Step 7 Version 5.0.

7.1 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 subnetwork.

7.1.1 Installation of the GSD-file

Close all projects in the hardware configuration.

- Insert the diskette provided by TWK into your disk drive.
- In the hardware configuration, select Install new GSD under Options.
- Select the GSD file which corresponds to your encoder from the diskette:
  Version with connecting cap: e.g. KBDZ16.GSD, KRDZ28.GSD
  Version with plug connection: e.g. KBDL16.GSD, KRDL28.GSD
- Update the Step7 hardware catalogue via Options, Update Catalog.

7.1.2 Installation of the TWK encoder symbol

Via the installation of the TWK encoder symbol, your encoder is not depicted as an unknown subscriber in the hardware configuration, but assumes the appearance of your encoder. This is not, however, of significance as regards the function of the encoder.
In order to install the symbol (bitmap), copy the file: **KBD_Z_an.BMP** or **KBD_L_an.BMP** (respectively **KRD_Z_an.BMP** oder **KRD_L_an.BMP)** from A:\Bitmaps\ into the C:\Siemens\Step7\S7Data\NSBMP\ directory (if C: is your S7 drive). The symbols first appear after restarting the Simatic Manager.

7.1.3 Selection of the TWK encoder from the Step7 hardware catalogue

After opening the hardware catalogue, you will find, under Profibus-DP, Additional Field Devices, Encoder, the TWK profibus-encoder KRD plug (encoder in plug version) or Encoder CRD cap (encoder with connecting cap) e.g.

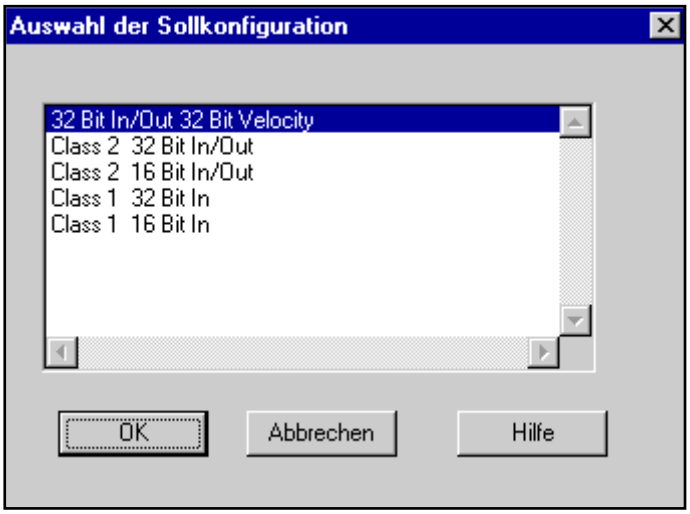
TWK KBD/Z - 16 Bit
TWK KBD/L - 16 Bit
TWK KRD/Z - 28 Bit
TWK KRD/L - 28 Bit.

Now open your project, mark the bus and integrate the encoder into the bus by double-clicking onto the corresponding line in the hardware catalogue (e.g. TWK KBD/Z - 16 Bit).

7.1.4 Configuration of the encoder

After the appropriate encoder type has been selected in the (hardware) Catalog, the following window appears for the selection of encoder functionality and single turn resolution.

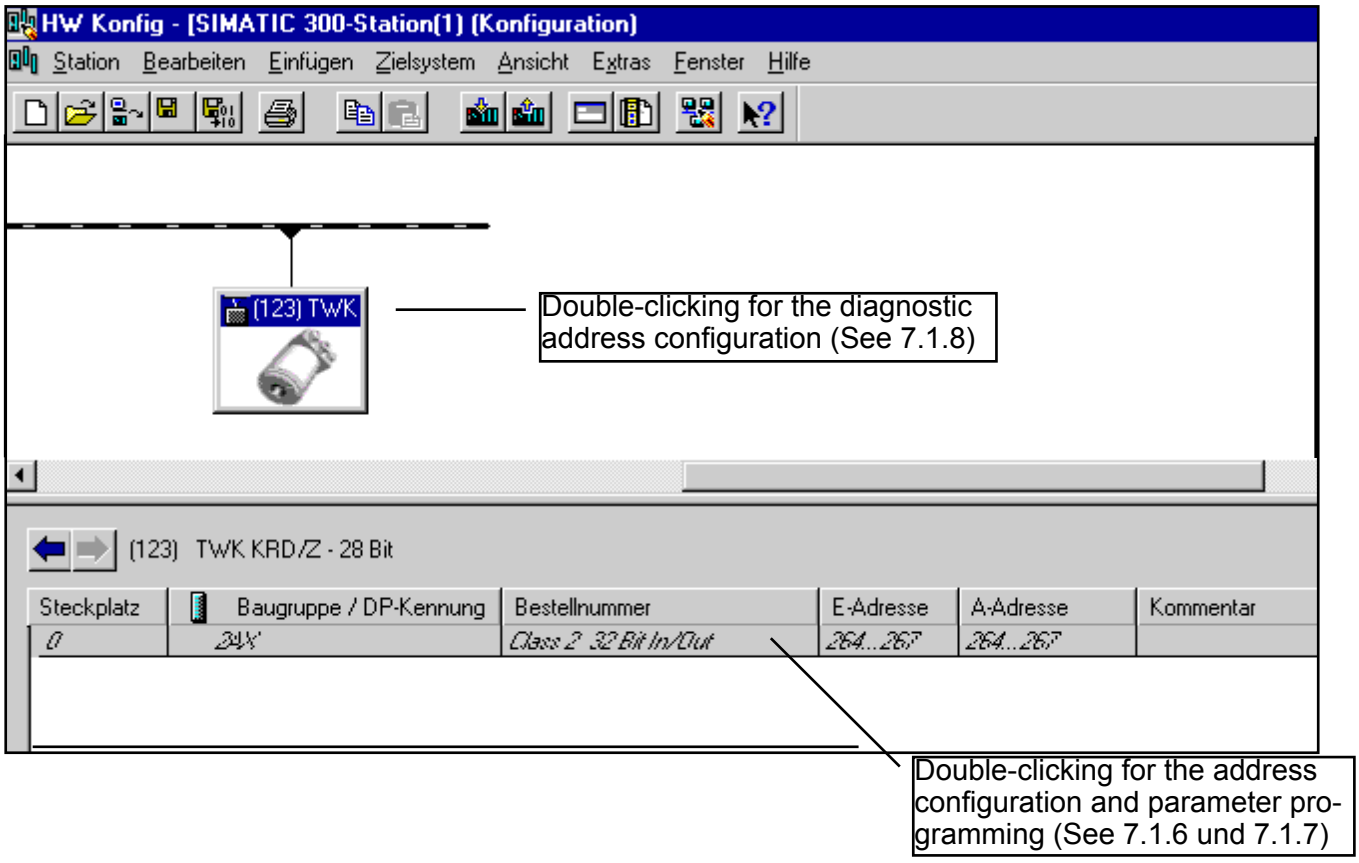
In this case, select class 1 or class 2 functionality and 16, 32 or 64 bit data frame in accordance with your requirements. (See chapter 3)



7.1.5 Allocation of profibus address

If 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, in the case of the cap version, via dip switches (See Chapter 2.2) and, in the case of the plug version, via software (See Chapter 7.2). In addition, select your planned profibus in the Subnet, and quit the window with OK.

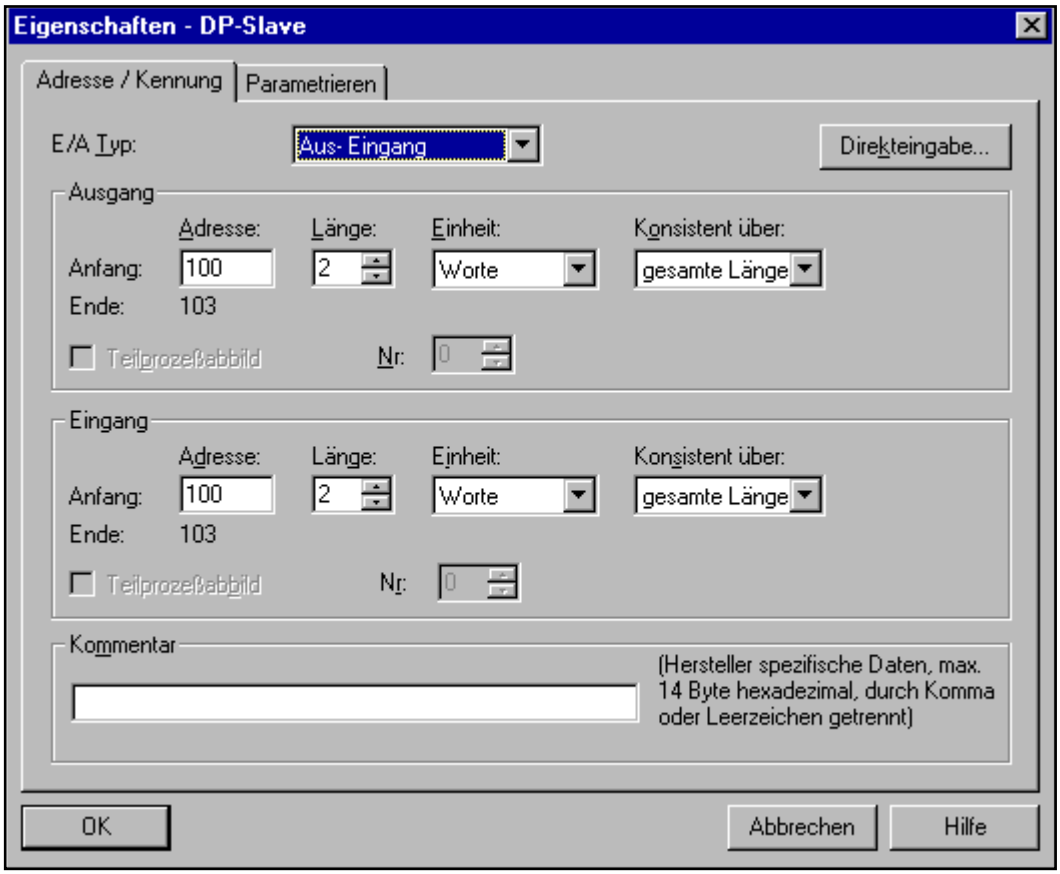
The encoder subsequently appears as a subscriber in your profibus. Depending on the configuration and address, this may appear as follows:



The value for Module / DP-ID results from the configuration which is selected. The values for I/O address are default values which may vary depending on the control system.

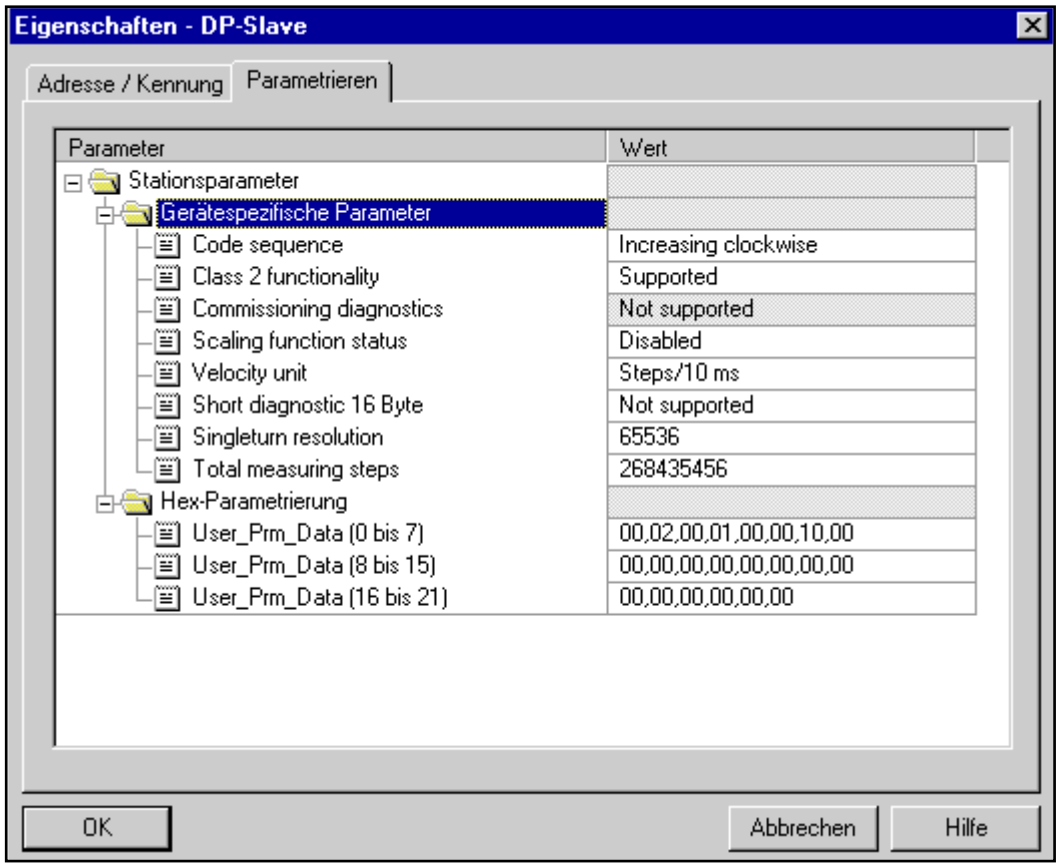
7.1.6 Setting the I/O addresses (S7 addresses)

Double-clicking onto the “Slot 0” line opens the Properties - DP slave window with the Address / ID and Parameter Assignment registers. In the Address / ID registers, under output (in the case of class 2 encoder only) and input, the addresses under which the encoder is to be addressed in S7 must be allocated. The other entries in this register should not be changed. The following Figure depicts an example of this register for a class 2 encoder with 32 bit single turn resolution.
For the example programme, please input address 100 for outputs and inputs.



7.1.7 Parameterisation of the encoder

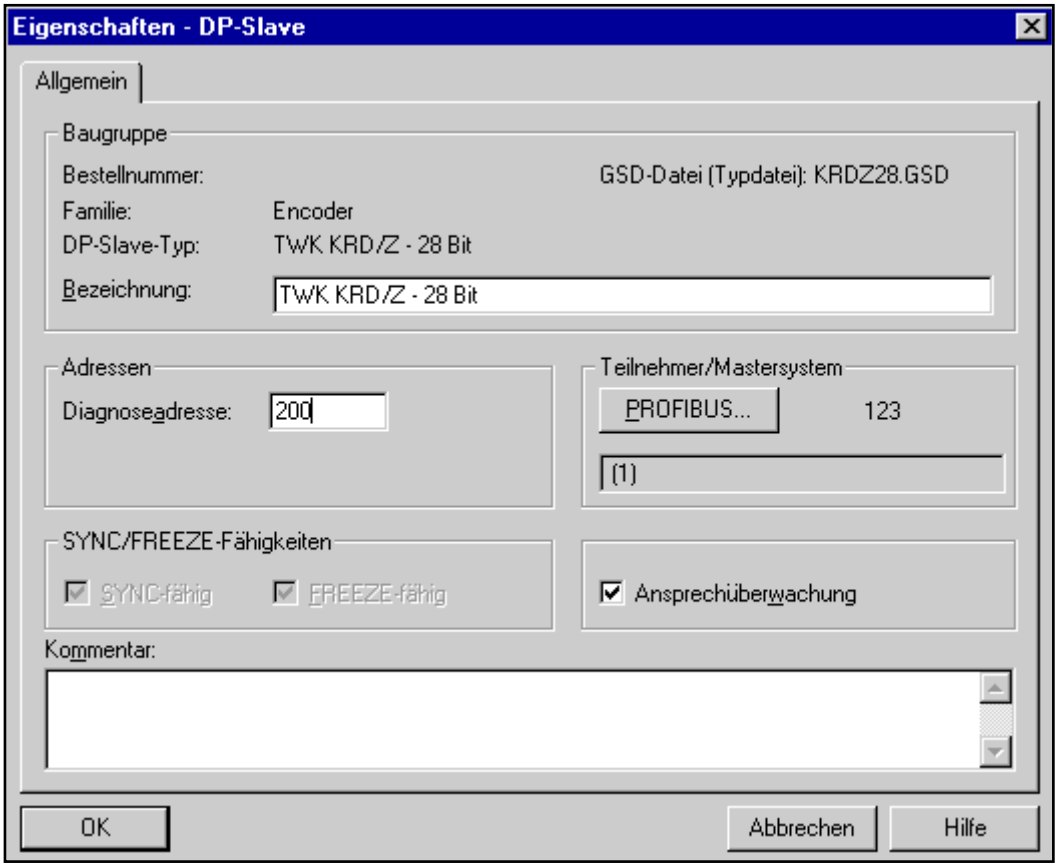
Via the Parameter Assignment register, the following window, in which the characteristics of the encoder can be defined, is accessed. The parameters of a class 2 slave are shown. In the case of a class 1 slave, only the code sequence parameter can be set here.
(See chapter 5)



7.1.8 Setting the diagnostic address

Setting the diagnostic address is only required if the special profibus diagnostic functions are used within the S7 programme.
So that the diagnostic range of the encoder can be accessed within the S7 programme, a special S7 diagnostic address must be allocated to this. This address may lie within the entire peripheral range of the control system. It does not, therefore, occupy any input/output addresses.

By double-clicking onto the encoder symbol, the Properties - DP slave window appears with the General register.
For the example programme please specify diagnostic address 200 for the first encoder and 202 for the second encoder.



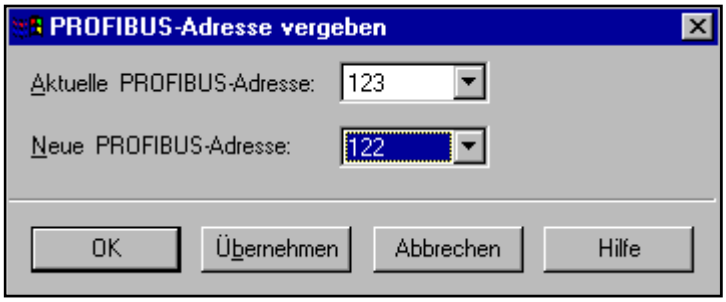
Following confirmation with OK, the encoder is configured and parameterised. The hardware configuration can now be translated and transferred into S7.

7.2 Setting the subscriber address in the case of the plug-version encoder

Setting the address of the plug-version KBD/ KRD under S7 is possible with a profibus protocol-capable MPI card from Siemens (e.g.: CP5611).
According to Siemens, the prerequisites for allocating a new address are as follows:

1. No DP master is contained in the PROFIBUS network.
2. At least one DP slave exists in the PROFIBUS network.
3. A PROFIBUS address has already been directly allocated to each DP slave in the PROFIBUS network (either via software via PG - DP slave direct connection or via setting the switches on the DP slave; Assignment is DP slave-dependent, therefore consult the DP slave manual)
4. You have connected the programming device to the PROFIBUS network via a stub line (See the manual regarding the DP master).
   (See on-line help under Assignment of profibus address” in the Simatic Manager)

I.e. if the encoder is not the only slave on the profibus/MPI card, all slaves contained in the bus must possess a unique (allocated only once) address, and the master (S7-CPU) must be disconnected from the bus. It is therefore impossible, for example, to simultaneously connect two encoders with address 123 to the bus and to then assign a new address to one of the two.
If the encoder whose address is to be changed has already previously been used in bus operation, this must be rendered potential-free before it can be set to a new address.
Address setting is carried out in the Simatic Manager under “PLC , Assign PROFIBUS Address”. If the encoder is connected to the profibus/MPI interface of your programming device, the depicted dialogue appears.



This displays the current address of the encoder, and requests the input of the new profibus address. If this is confirmed with Apply, the new address is stored in the encoder in a zero-voltage-protected manner. The dialogue subsequently displays the new address as the current address.

7.3 Example programmes

On the diskette which is supplied by TWK, path \S7_BSP\ contains several S7 archive files, 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. The diskette contains 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, com ments 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, com ments in English

7.3.1 Das Projekt TWKDPCL1

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 hand ling for a class 1 encoder. It contains, amongst other things, OB86 for detecting the failure of the encoder, and OB82 for detecting a diagnostic request on the part of the encoder. Step7 system function SFC13 is used to read the diagnostic range out. (The diagnostic range of the class 1 encoder is 16 bytes. See Chapter 6)

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).

7.3.2 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 diagnostic range is 63 bytes.
Program Diag2:	Once again, Diag2 is the variant of Diag1 which is extended to encompass two encoders.

7.3.3 Installation of the example programmes

Prerequisites

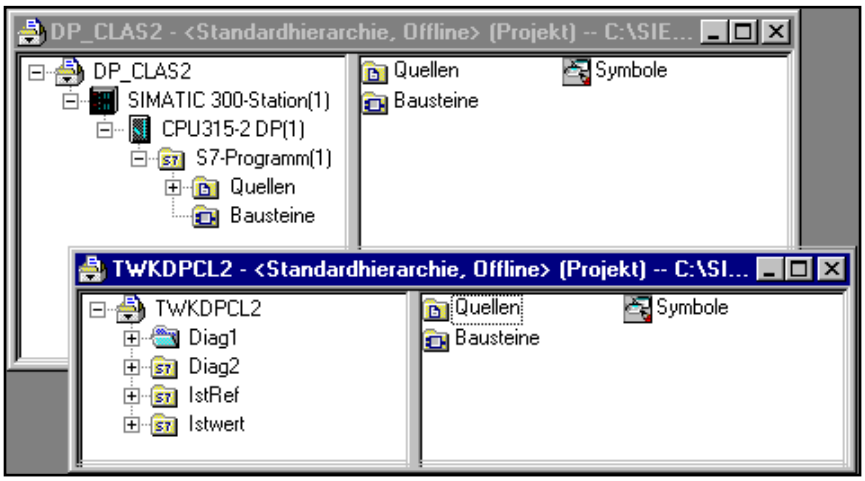
You have generated a project and have inserted a control system into this with its hardware configuration. This may appear as follows, for example:

In the hardware configuration, you have connected one or two encoders with the following settings to a profibus subnetwork (See chapter 7.1).

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

Installation

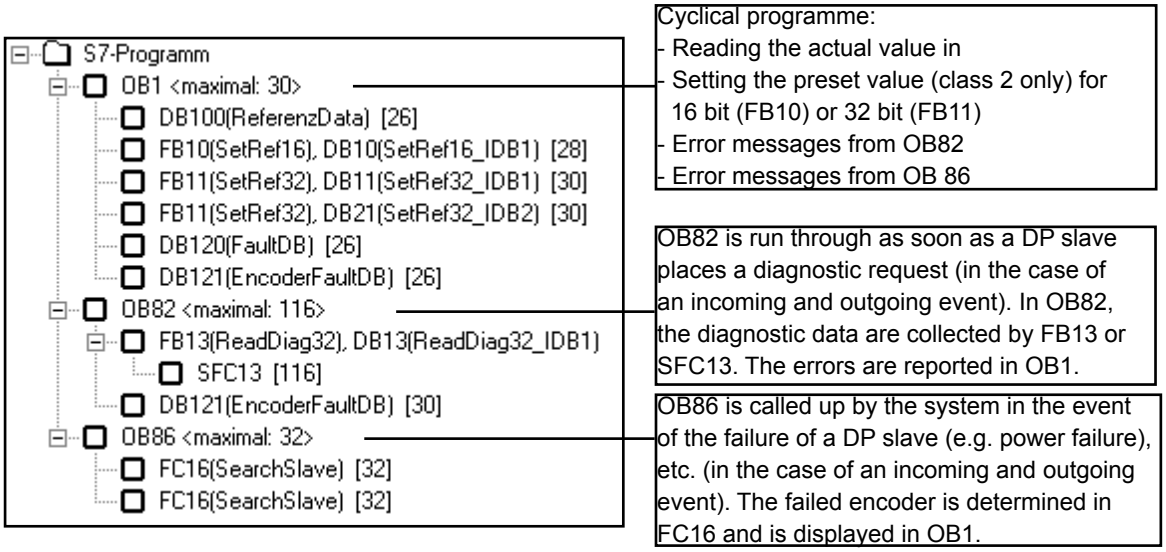
- In the Simatic Manager, select File, Retrieve. Change the file type to *.arj and select the class 1 or class 2 project in the \S7_BSP\ directory on the enclosed diskette.
- In the next window, specify your project directory (normally S7proj) .
- Via integration with OK, the dearchiving programme is 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 on the next Page.
- Select a subordinate S7 programme folder of the TWK example project. (In this case, either Diag1, Diag2, IstRef or Istwert. Also see chapter 7.3.1)



- Copy all of the module container's modules from the selected programme folder (e.g. Diag1 from TWKDPCL2) into your own project's still empty module container (e.g. S7 programme (1) from DP_ CLAS2). (Note: Each module 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 ActualRef or Diag1/2 program me, you must, in order to set the preset 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 preset value, with your signals.
- Transfer all modules 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 ActualRef and Diag1/2 programme only: Enter a preset 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 preset value lies outside of the parameterised measurement range of the encoder, the correspon-ding error message is set in OB1.

7.3.4 Explanations regarding the example programmes

Each programme folder contains a symbol table, which contains all global variables of the maximum ex-pansion (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 can 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.

8. Literature

/1/ PROFIBUS Profile for Encoders, Order No. 3.062 1997,
PROFIBUS Nutzerorganisation e. V.
Haid-und-Neu-Str. 7
D-76131 Karlsruhe

/2/ The NEW RAPID WAY to PROFIBUS DP, Order-No. 4.072, PROFIBUS Nutzerorganisation e. V.

/3/ PROFIBUS DP Specification IEC 61158 Type 3 and IEC 61784

/4/ SIMATIC NET
SPC3 Siemens PROFIBUS Conroller Hardware Description
Siemens AG

Appendix: 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. The 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.