

User Manual

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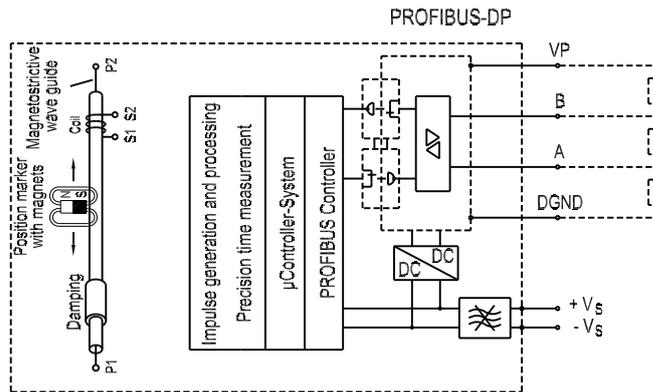
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1. General

PROFIBUS-DP is an open field bus in linear topology according to EN 50170/DIN 19245. Its protocol is oriented towards the ISO 7498 standard. PROFIBUS-DP has diverse monitoring and diagnostic functions, which are configured using an operating tool during installation.

The TWK-Magnosens displacement transducer with Profibus-DP interface is designed as a DP slave for direct connection to the profibus. It enables absolute measurement of up to 15 positions or 5 positions and 5 velocities with direct transmission of the digitised measured value data to the control system according to the RS 485 standard. The profibus interface is implemented with the aid of the Siemens ASIC SPC3 and is galvanically separated from the voltage supply. This enables transmission rates of 9600 Baud to 12 MBaud with an automatic Baud rate search and extremely fast response time.

Block circuit diagram:

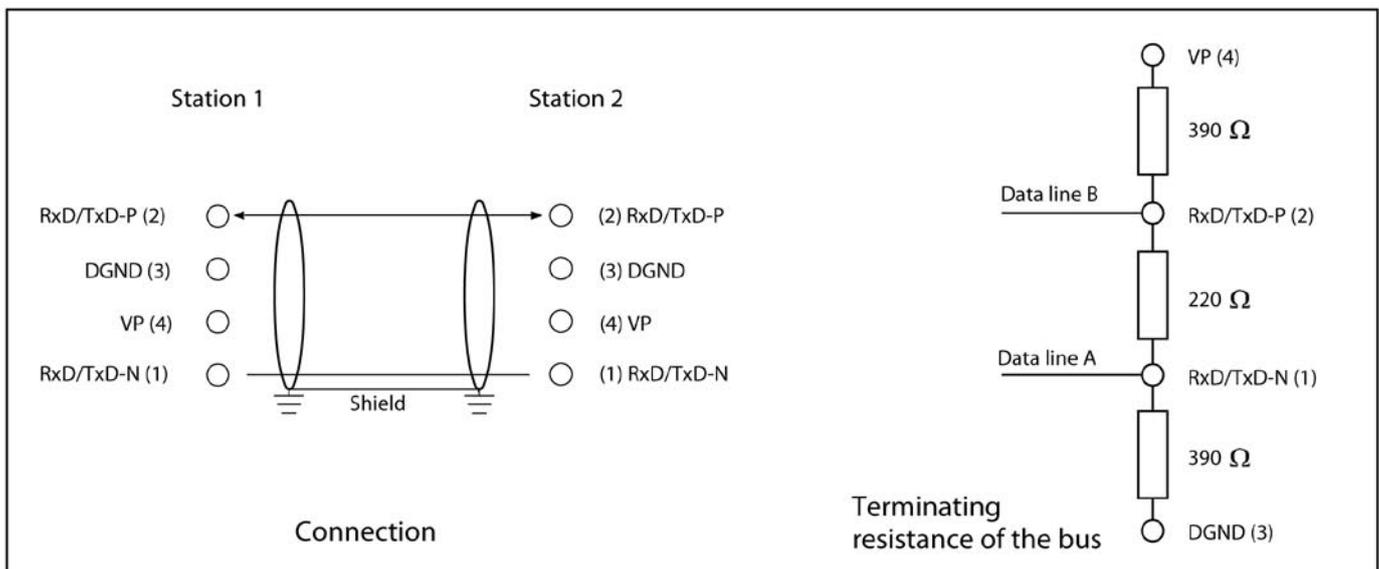


2. Installation instructions for PROFIBUS-DP - RS 485

2.1 Basic characteristics of RS-485 transmission technology

- Network topology Linear bus, terminal resistors for bus termination
Branch-off cables are only permissible for Baud rates < 1.5 MBit/s
- Cable Cable Screened, twisted cable
- Number of stations 32 stations in each segment without repeater
Can be extended up to 126 with repeaters
- Connectors Variants implemented in model series MSD/MPD:
Connection via 6-pin DIN connector or two M12 connectors for the Profibus and one M8 connector for the power supply.

Wiring and bus termination for PROFIBUS-DP (here: 6-pin DIN connector)



2.2 Transmission length

(Only for cable type A)

Baud rate [kBit/s]	9,6	19,2	93,75	187,5	500	1.500	12.000
Transmission length [m]	1200	1200	1200	1000	400	200	100

Cable type A specifications:

- Wave impedance: 135...165 W
- Distributed capacitance: < 30 pF/m
- Loop resistance: 110 W/km
- Wire diameter: 0,64 mm
- Wire cross-section: > 0.34 mm²

Also see: Installation Guideline for PROFIBUS -FMS/DP (Nr. 2.111/2 - PNO)
Implementation Guide to DIN 19245 Part 3 (Nr. 2.001/2 - PNO)

2.3 Connection via a 6-pin DIN connector

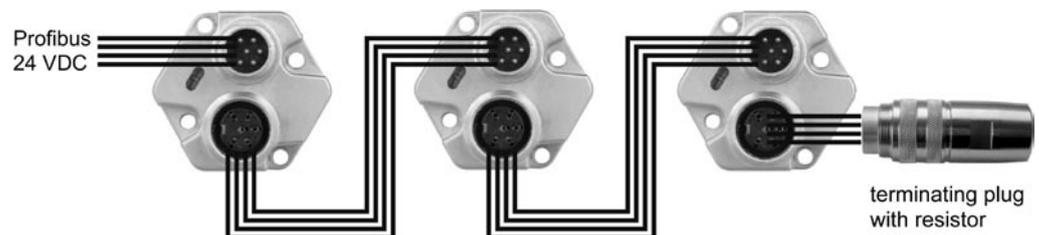
The Magnosens displacement transducers type „L01“ are connected to the profibus using two 6-pin DIN connectors:

- Pins on the device: Bus In (Receive/Transmit-Data A,B)
24 V Voltage Supply In
- Jack on the device: Bus Out (Receive/Transmit-Data A',B')
24 V Voltage Supply Out

A hybrid cable, carrying profibus and power supply, has to be used.

Bus termination at the final subscriber must be carried out via an external bus terminating connector, as available from TWK.

Principle bus structure:



(Connector assignment, see data sheet 11431)

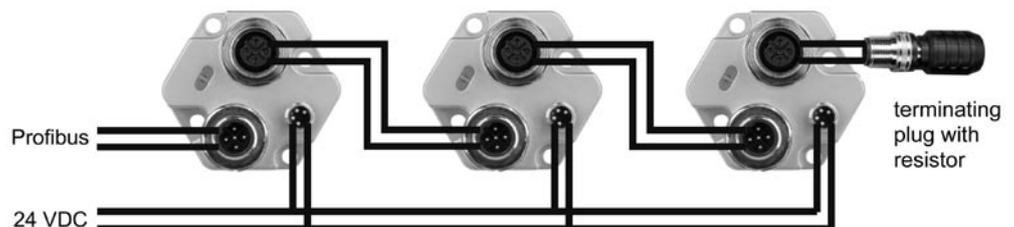
2.4 Connection via M12/M8 - connector

The magnosens transducers type „M01“ have separat connectors for power supply and Profibus.

The connectors on the device are:

- M12x5 pin: Bus In
- M12x5 socket: Bus Out
- M8x4 pin: 24 V power supply

Principle bus structure:



(Connector assignment, see data sheet 11431)

2.5 Address setting

The slave address is set via the bus by means of a class 2 master (e.g. Siemens S7 programming device, see Chapter 9.7). Assignment is carried out via software using the profibus service SetSlaveAddress. If this service is unavailable, the address can also be displayed and assigned using the TWK-Profibus-Programmer PMD-01 (connector M16) or PMD-02 (connector M12), data sheet 11190 respectively 11450.

The default setting for the address is 125.

3. Designing with the GSD file

To achieve a plug-and-play configuration for the profibus, the device's character is defined in the form of an electronic device data sheet (device master data file, also called a GSD file). These device master data files clearly and completely describe a transducer's characteristics in a defined format.

The Magnosens displacement transducer is connected to the bus system with the design tool (e.g. Siemens S7, see Chapter 9), which is based on GSD files. This enables the device master data to be read easily and input errors to be checked automatically.

There are two different GSD-files on the disk shipped with the encoder:

- TWK_MXD GSD-file for sensor with 1-15 positions without speed signal.
- TWK_MXDV GSD-file for sensor with 1-5 positions with speed signal.

Remark: For proper operation choose the matching GSD-file for your sensor.

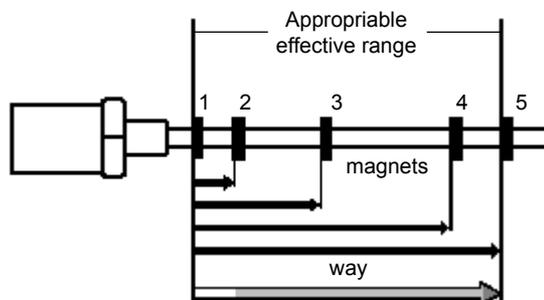
Once the GSD file has been integrated, the transducer can be configured for the specific customer with the following parameters via the design software:

- Measurement direction, forwards - backwards,
- Resolution: Can be selected from 2 to 1000 µm
- Error handling: Output to null or last measured value
- Measurement cycle non-synchronised or synchronised (optional)
- Cycle time (only for synchronous measuring)

4. Operating modes

The Magnosens displacement transducer with Profibus-DP interface may be supplied for operation with one or more position sensors (magnet)

- 1-magnet system: The sensor measures one displacement only
- Multi-magnet system: The sensor uses several magnets (1 - 15) to simultaneously measure the corresponding displacements on just one scale.



Attention! The magnets must lie at least 75 mm apart.

5. Parameter settings

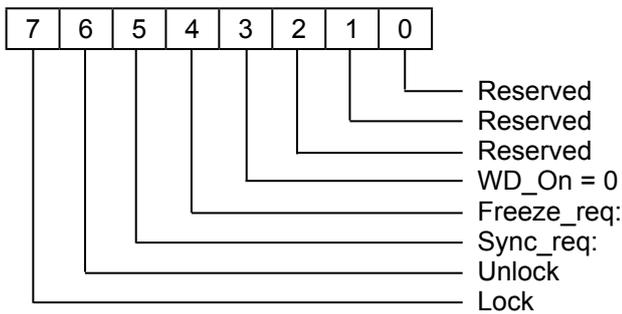
The displacement transducer is parameterised according to profibus standard EN 50170 (DIN 19245-3 decentralised periphery). In this case, the first 7 bytes are firmly specified by the standard. Byte 8 contains the information required for the specific characteristics of the Profibus Controller SPC3 and for extending the Profibus-DP protocol for acyclical data exchange (DPV 1). This extension is not taken into consideration in TWK's internal bus profile.

TWK-specific settings start from byte 11 onwards (octets 9 and 10 are reserved for additional DP extensions). The settings are already pre-assigned in the device master data file as User_Prm_Data.

However, they may be changed during the design process. The design software generally offers a graphical depiction and menus for selecting parameters (like Siemens S7, see Chapter 9). In individual cases, the parameters have to be entered manually; they are therefore described in detail in the following.

5.1 Standard parameters

Octet 1



Octet 2 = WD_Fact_1

Octet 3 = WD_Fact_2

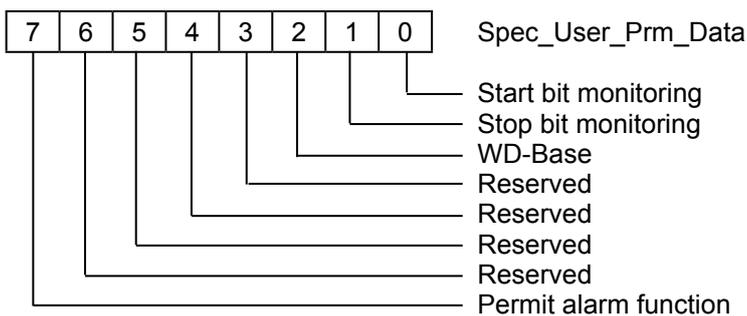
Octet 4 = min T_{SDR}

Octet 5 = ID number 2nd byte

Octet 6 = ID number 1st byte

Octet 7 = Group_Ident

Octet 8



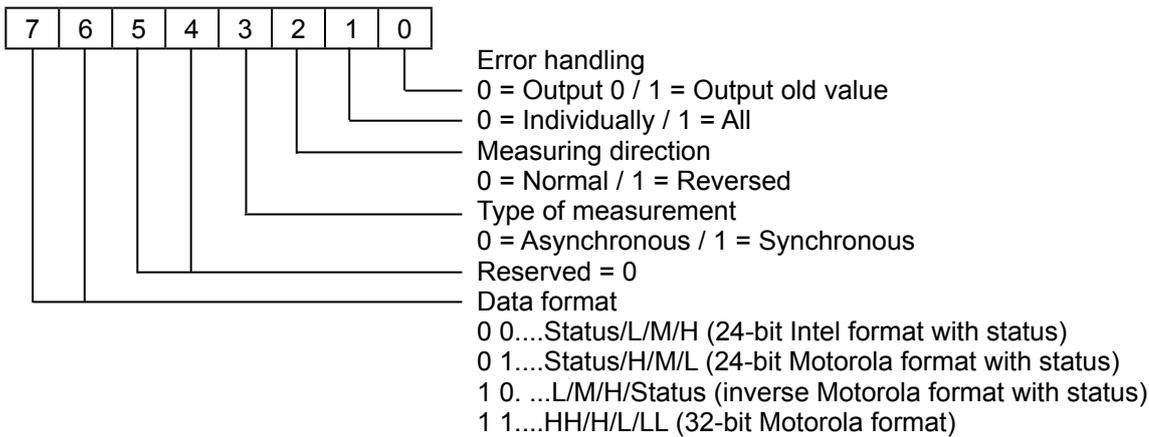
Octet 9 Reserved for acyclical data transfer

Octet 10 Reserved for acyclical data transfer

Assign 0 to reserved bits and bytes!

5.2 TWK profile parameters

Octet 11



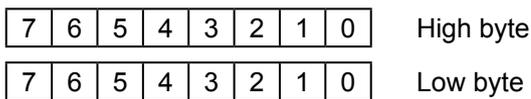
Error handling enables the behaviour of the position values to be determined in the event of an error (e.g. magnet outside of the permissible measuring range). In the case of „Output 0“, the position value null is output in the event of an error, or the last, valid measured value in the case of „Output old value“. Bit 1 can be used to set this behaviour for the defective position ring („Individually“) or for all position values („All“).

The **data format** of the measured position and speed (input data) can be selected using bits 6 + 7. This does not influence the output or preset data, but serves solely to easily adapt the data formats to the various control systems.

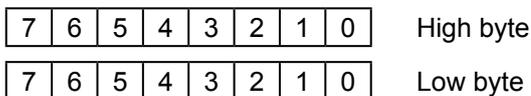
Although no status is transmitted in format 4), error polling can be carried out by setting error handling (octet 11) to 0 = Output 0. This causes the measured value to switch to 00000000 if an error occurs. In normal measuring mode without preset, 00000000 is not achieved; this value therefore reliably indicates the error status.

The synchronous type of **measurement** is a special function and is based on direct profibus communication between the PC and transducer, without an industrial, programmable control system. In this case, internal measurement is temporally synchronised with data transmission. This function is not to be confused with the Profibus-DP's SYNC and FREEZE options, which the transducer also supports. Only the asynchronous type of measurement is possible in normal profibus mode.

Octet 12 and octet 13: Resolution in µm, 16-bit, no prefix

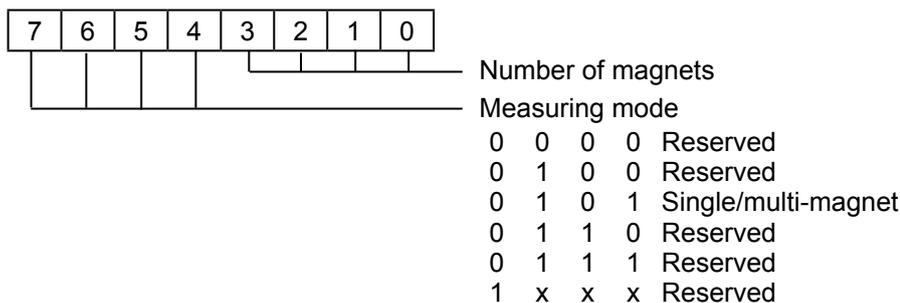


Octet 14 and octet 15 = Cycle time in µsec, synchronous, 16-bit, no prefix



Note: This parameter is only significant to use of the special synchronous function

Octet 16



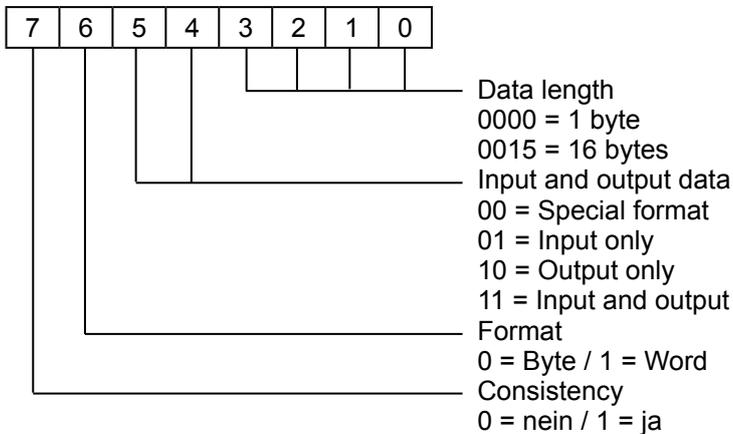
Octet 17



6. Configuration

Following successful parameterisation, the transducer awaits the configuration data. Essentially, the configuration describes the length of the input and output data. In this case, at least two bytes must be transmitted to the transducer (1 byte for the input data length/data to the control system and 1 byte for the output data length/data from the control system).

The configuration byte is structured as follows:



6.1 Input data

In the TWK-internal profile, these data are of a modular structure, i.e. a position module must be configured for each parameterised position magnet for multi-magnet measurement. During data exchange, the input data length for a position is then 4 bytes (1 byte status data/3 bytes position data) and for a velocity 4 bytes (only for sensors with speed signal).

6.2 Output data

The data length for the output data is always at least 1 byte. This byte is used to guarantee that the measured data are synchronised with data transmission if they have been parameterised. If the preset function is selected in the parameters, an additional 3 bytes, which contain the preset value, are then transmitted. During data exchange, the length of the output data is then either:

- No preset: 1 byte control data
- Preset: 4 bytes (1 byte control data / 3 bytes preset)

Example

Configuration data = 0 x 93, 0 x A0:

- 1 position module (4 bytes input data)
- 1 control byte (1 byte output data)

Configuration data = 0 x 93, 0 x 93, 0 x A3:

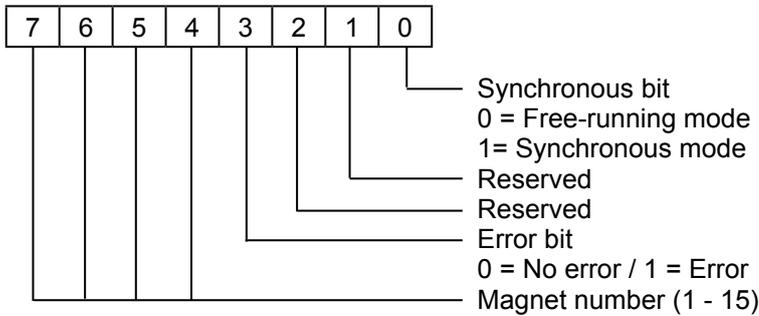
- 2 position modules (8 bytes input data)
- 1 control byte with preset function (4 bytes output data)

7. Data exchange

In the TWK profile, one status byte (input data) and one control byte (output data) are always transmitted. If multi-magnet measurement has been parameterised, a separate status byte is also transmitted for each position. The status byte contains the number of the magnet and an error bit, which indicates whether an error has occurred during the current measurement. This is reset as soon as valid position values are available again.

7.1 Input data (transducer -> control system)

Status Byte



The synchronous bit indicates the status of the special synchronous function. If an error has occurred during a measurement, the error bit is set. In this case, the magnet number which is also transmitted enables individual evaluation for error handling in the control system. Causes of errors include, e.g. departure from the measurement range or differences between the designed and actual number of magnets.

Position

7	6	5	4	3	2	1	0
7	6	5	4	3	2	1	0
7	6	5	4	3	2	1	0

Low byte
 Medium byte
 High byte

Speed (only sensors with speed signal)

7	6	5	4	3	2	1	0
7	6	5	4	3	2	1	0
7	6	5	4	3	2	1	0
7	6	5	4	3	2	1	0

LL
 L
 H
 HH

The input data may be transmitted to the control system in 4 formats. Parameter selection is carried out via octet 11.

Structure of input data:

Sensors without speed signal

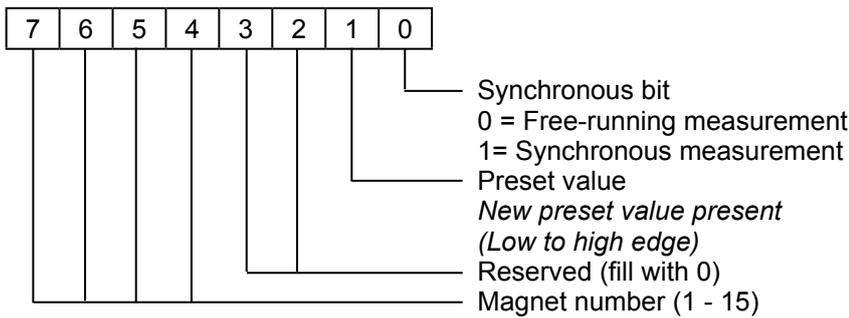
3	2	1	0	3	2	1	0	3	2	1	0	3	2	1	0
4 Byte position magnet 1				4 Byte position magnet 2				4 Byte position magnet 3				and so on			

Sensors with speed signal

3	2	1	0	3	2	1	0	3	2	1	0	3	2	1	0	3	2	1	0
4 Byte position + speed magnet 1				4 Byte position + speed magnet 2				4 Byte position + speed magnet 2				and so on							

7.2 Output data (control system -> transducer)

Control byte



The lowest-value bit is required for the special synchronous function. This bit is otherwise filled with 0. Preset mode enables the measurement position to be individually defined for each transducer. A separate zero point can therefore be defined for each magnet, or the scale can be calibrated to the mechanics. To do this, the magnet number for which a preset is to be transmitted is specified in the control byte, and a preset value is pre-specified. When bit 2 changes from Low (0) -> High (1), this value is transmitted to the transducer. This means that the current magnet position has been re-defined to the preset value. This re-definition of the scale is stored internally. To do this, the transducer calculates a correction factor for offsetting the measured position. This correction factor is then also visible in the diagnostic data.

Preset

7	6	5	4	3	2	1	0	Low byte
7	6	5	4	3	2	1	0	Medium byte
7	6	5	4	3	2	1	0	High byte

8. Diagnosis

A DP slave's diagnostic information is sub-divided into standard and DP slave-specific diagnostic information.

The first 6 bytes provide the standard diagnosis and byte 7 (header byte) specifies the length of the subsequent slave-specific diagnosis in bytes, including the header.

8.1 Standard diagnosis

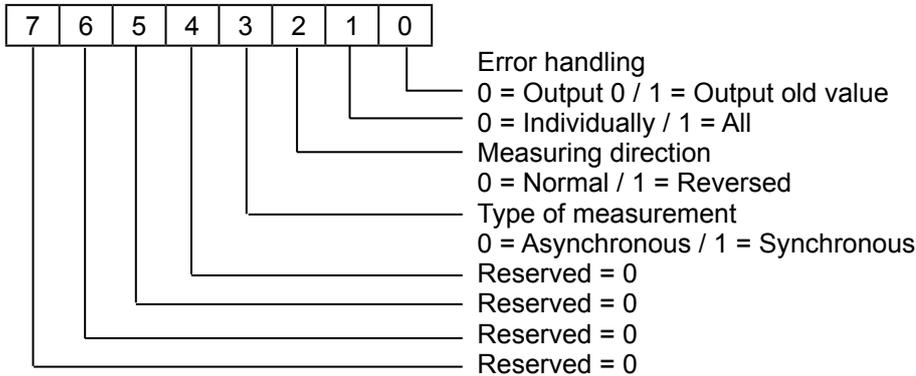
- Octet 1 = Station status_1
- Octet 2 = Station status_2
- Octet 3 = Station status_3
- Octet 4 = Master address after parameterisation
- Octet 5 = ID number High byte
- Octet 6 = ID number Low byte
- Octet 7 = Header byte extended diagnosis

For further information, see DIN 19245-3.

8.2 Device-related diagnosis

Octet 8 = Reserved

Octet 9



Octet 10 and octet 11: Resolution in µm, without prefix, 16-bit

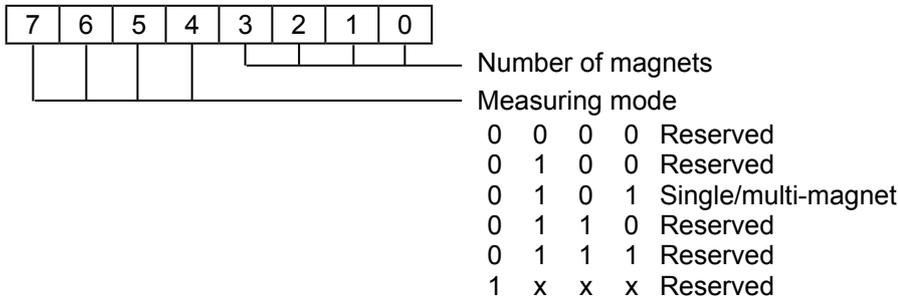


Octet 12 and octet 13: Cycle time in µsec, synchronous, without prefix, 16-bit

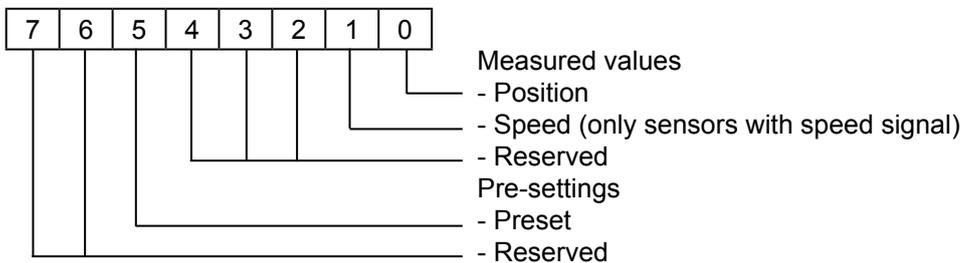


Note: This parameter only has one meaning for use of the special synchronous function.

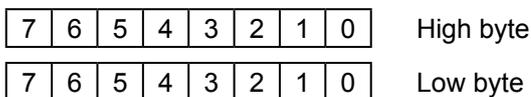
Octet 14



Octet 15



Octet 16 and octet 17: Measuring length in millimetres, without prefix, 16-bit



Octet 18, octet 19, octet 20, octet 21: Production number, 32-bit, without prefix

7	6	5	4	3	2	1	0	High byte
7	6	5	4	3	2	1	0	
7	6	5	4	3	2	1	0	
7	6	5	4	3	2	1	0	Low byte

Octet 22, octet 23, octet 24: Measuring signal run time, (Grd: ...m/s), see transducer rating plate, 24-bit, no prefix

7	6	5	4	3	2	1	0	High byte
7	6	5	4	3	2	1	0	
7	6	5	4	3	2	1	0	Low byte

In preset mode, the stored factors are additionally displayed for preset calculation:

Octet 25, octet 26, octet 27: Preset value magnet 1, 24-bit, no prefix

7	6	5	4	3	2	1	0	High byte
7	6	5	4	3	2	1	0	
7	6	5	4	3	2	1	0	Low byte

etc.

Octet 67, octet 68, octet 69: Preset value magnet 15, 24-bit, no prefix

7	6	5	4	3	2	1	0	High byte
7	6	5	4	3	2	1	0	
7	6	5	4	3	2	1	0	Low byte

9. Siemens S7

This Chapter explains the procedure for integrating the Magnosens displacement transducer into the profibus within a Siemens S7 control system. The documentation is based on Step 7 Version 5.2.

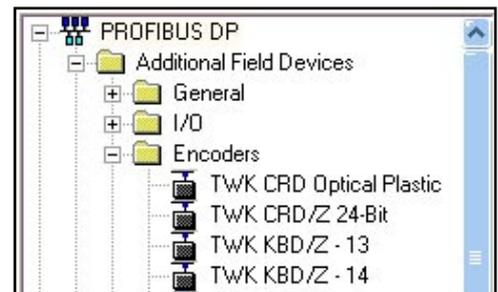
9.1 Installation of the GSD - file

- Close all projects in the hardware configuration
- Insert the diskette supplied by TWK into your drive
- In the hardware configuration, select „Install new GSD“ under „Options“.
- Select the GSD file on the diskette.
 - TWK_MxD.GSD Sensors without speed signal
 - TWK_MxDV.GSD Sensors with speed signal

The Magnosens can subsequently be found in the hardware catalogue under:

Profibus-DP → Other field devices → Encoder

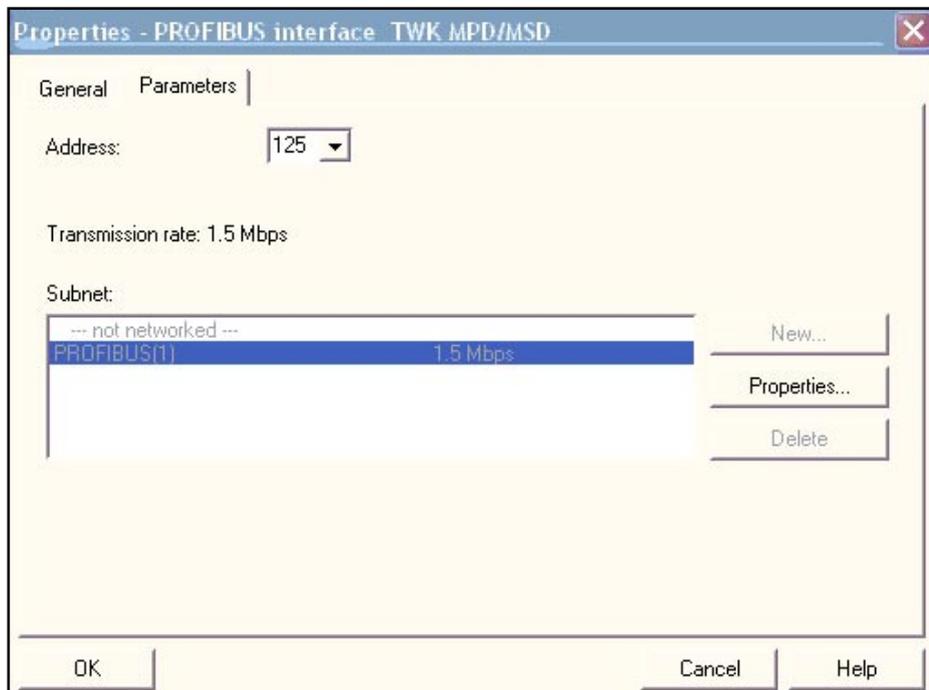
(Example: Sensors without speed)



9.2 Integrating the transducer

- Now open your project in the hardware configuration
- Mark the bus and integrate the transducer into the bus by double-clicking onto the transducer in the hardware catalogue.

The following dialogue then appears:



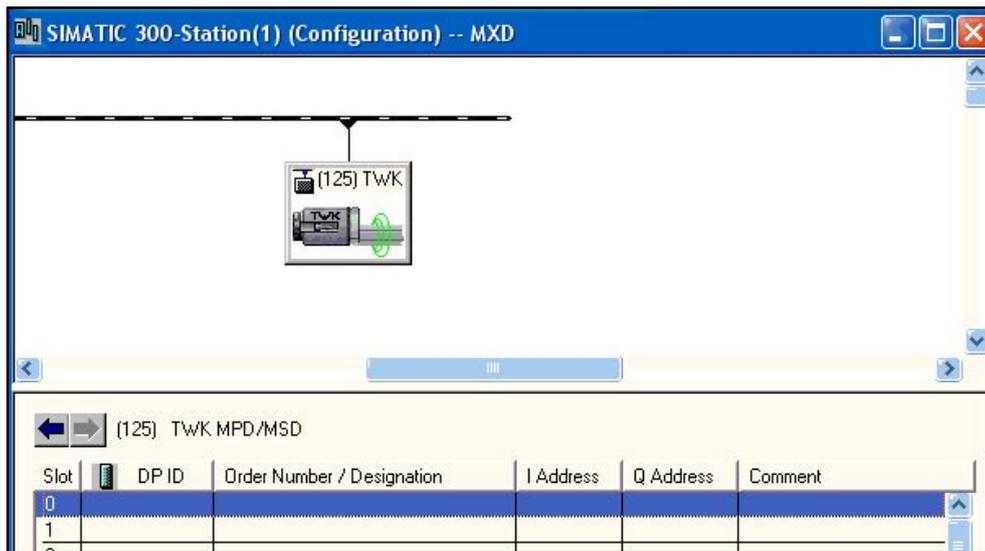
- Here, please enter the profibus address set at the transducer (the default address is 125). To change the transducer address, see Chapter 9.7.

The transducer then appears as a subscriber in your profibus.

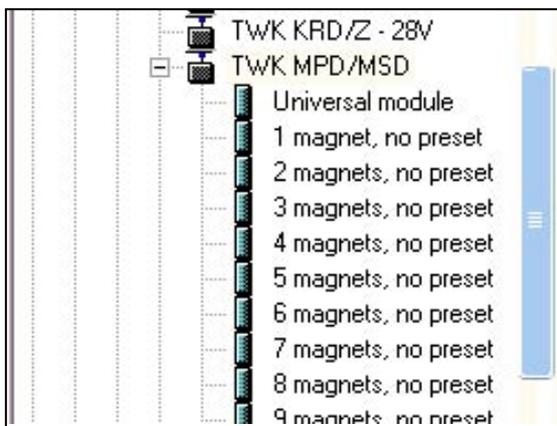
9.3 Inserting the modules

Once the transducer has been integrated into the bus, the desired module must be selected to configure the I/O data.

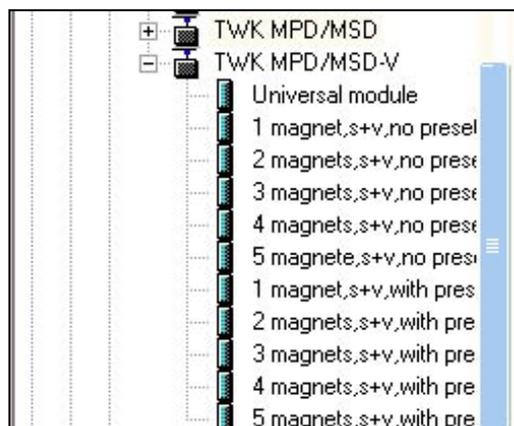
- Mark the line Bay 0



- To show the modules of the transducer open the directory of the transducer in the hardware catalogue.
- Select your module by a double click



Sensors without speed



Sensors with speed

The selected module then appears with its inputs and outputs as of bay 0:

Slot	DP ...	Order Number / Designation	I Address	Q Address	Comment
0	147	1 magnet and preset	256...259		
1	163	-> 1 magnet and preset		256...259	

Sensors without speed

Slot	D...	Order Number / Designation	I Address	Q Address	Comment
0	147	1 magnet,s+v,with preset	256...259		
1	147	-> 1 magnet,s+v,with preset	260...263		
2	163	-> 1 magnet,s+v,with preset		256...259	

Sensors with speed

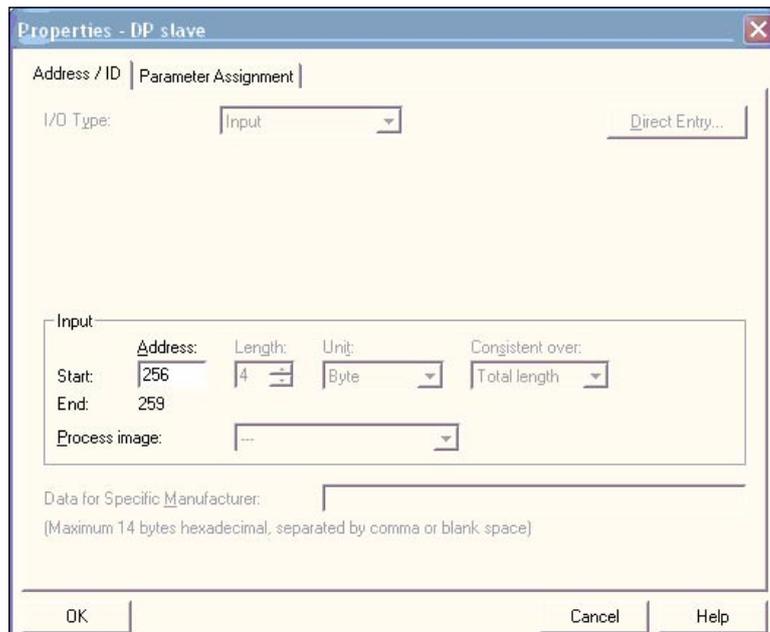
The number of occupied input/output bytes depends on the number of magnets and whether or not preset has been selected. In sensors without speed signal each magnet occupies 4 bytes of input data (control byte and position) . In sensors with speed signal each magnet occupies 8 bytes of input data (control byte, position and speed). As an output, however, the sensor only occupies 1 byte (status only) or 4 bytes (status and preset) in total (see Chapter 7, Data exchange).

9.4 Setting the I/O addresses

Addresses have to be assigned for the input and output data to enable access to the transducer data from the S7 user programme.

- To assign the input address, double-click onto the input data module, in this case bay 0 (see above).

The following window appears:



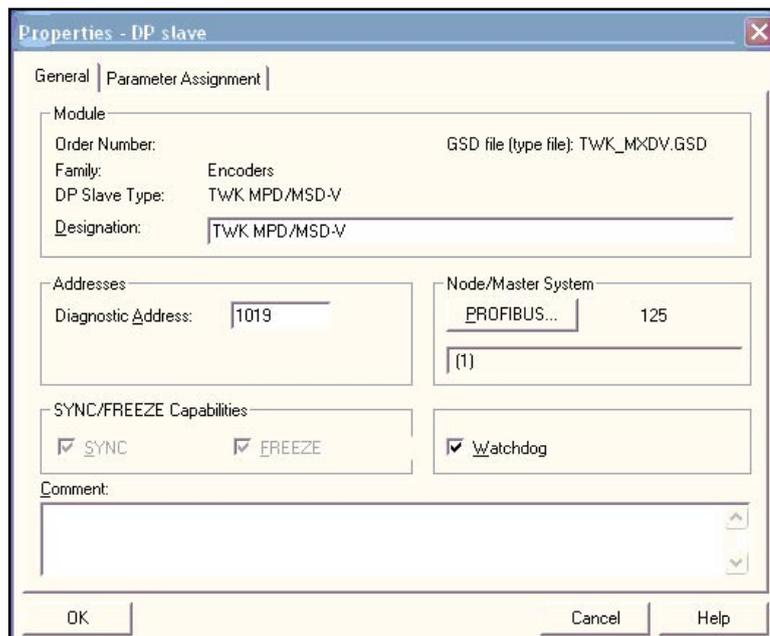
- Then assign an input address for the input data (status and position)
- Repeat the process for each additional magnet.
- Finally, assign the address for the output data (control byte and poss. preset)

The transducer is now integrated and can be operated with its standard parameters. If you would like to adapt the transducer to your circumstances and/or access its diagnostic data from the user programme, however, you may parameterise it and assign a diagnostic address.

9.5 Setting the diagnostic address

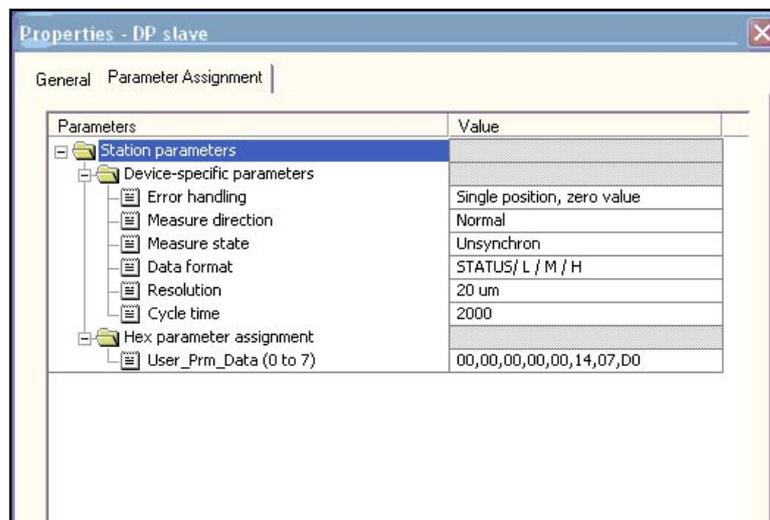
If you wish to access the Magnosens diagnostic data (see Chapter 8) from the user programme, a diagnostic address must be assigned to it.

- Double click onto the sensor icon.
- Enter a diagnostic address in the following dialogue.



9.6 Parameterisation

- Click onto the Parameterise register in the same dialogue.



In sensor with speed signal the parameters „Measure state“ and „Cycle time“ are dropped.

- Change the parameters according to your application (for an explanation of the parameters see Chapter 5.2).
- Store, translate and transfer your hardware configuration into the control system.

The configuration and parameterisation are stored in the profibus master and are transferred to the subscriber each time the bus is booted or a subscriber is changed.

9.7 Setting the profibus address

The transducer’s profibus address is set via the software. This can be carried out either via a class 2 master or the PMD-01 Programmer available from TWK (see data sheet 11190) or PMD-02 (see data sheet 11450).

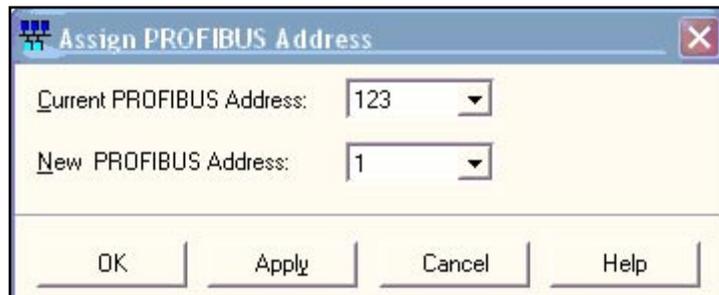
Setting using a profibus protocol-capable MPI card from Siemens (CP5611) is described in the following.

Prerequisites:

1. There is no DP master on the PROFIBUS network.
2. At least one DP slave exists in the PROFIBUS network.
3. Each connected DP slave already possesses a profibus address which occurs only once in the bus.(The MxD default address is 125)
4. The programming device has been connected to the PROFIBUS network using a branch-off line.
5. The interface has been switched to the profibus protocol via „Set PG-PC interface“.

Procedure:

- In the Simatic manager’s main menu, select „Target system / Profibus / Assign profibus address“. The following dialogue appears after a short while.



- The slave whose slave address is to be changed must now be selected under „Current PROFIBUS address“.
- Subsequently set the new address desired for this slave under „New PROFIBUS address“.
- After confirming the selection with „Accept“ and closing the dialogue with „OK“, the new address is stored in the transducer, where it is protected against zero voltage.