Annex - Profibus Operation Manual

⚠ ATTENTION

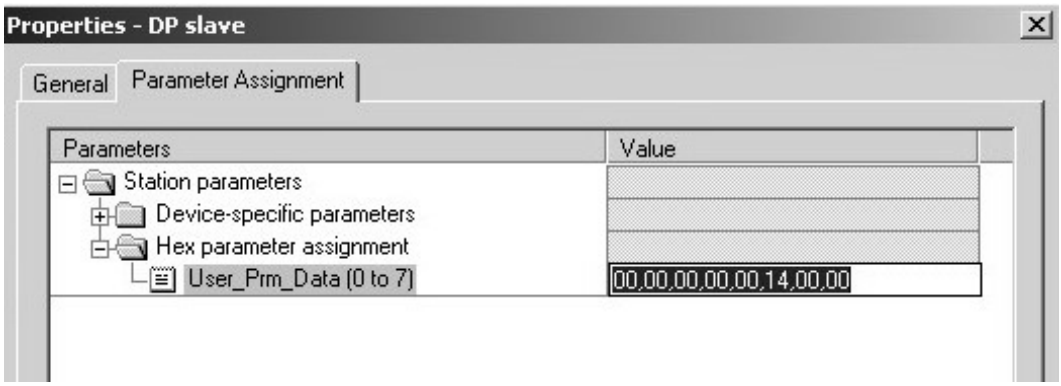
Following instructions are for special, customized sensor configurations of a new measurement task. The parameter settings have to be entered manually only by specialized automation personnel or trained service technicians who are familiar with Temposonics PROFIBUS-DP sensor programming and handling.

1. Parameters setting before operation

Parameter setting is strictly compliant with Profibus standard EN 50170. In this standard, the first 7 bytes are fixed. Bytes 8-10 contains the information required for the specific properties of Profibus Controllers SPC3 and for the bus protocol extension for acyclical data exchange (DPV 1).
The **MTS-specific settings** start from byte 11. The settings are pre-defined as **User_Prm_Data** in the GSD file, however, they can be changed during projecting. The projecting software mostly offers graphic display and menus for parameter selection (see below).

Note: Dependent on manufacturer, parameters may be omitted by the masters.

Fig. 1



Only 8-byte user parameters are displayed in the Step 7 SIMATIC Manager; these correspond to bytes 8-15 as shown below.

Profibus Standard Parameters (Profibus-Profile)

7				0	
7	**Byte 1**			0	Command
7	**Byte 2**			0	WD_Fact_1
7	**Byte 3**			0	WD_Fact_2
7	**Byte 4**			0	TSDR
7	**Byte 5**			0	Identification #
7	**Byte 6**			0	High / Low
7	**Byte 7**			0	Group_Ident
7	**Byte 8**			0	DPV1.1
7	**Byte 9**			0	DPV1.2
7	**Byte 10**			0	DPV1.3

ⓘ NOTE

Setup of reserved Bits and Bytes = 0 !

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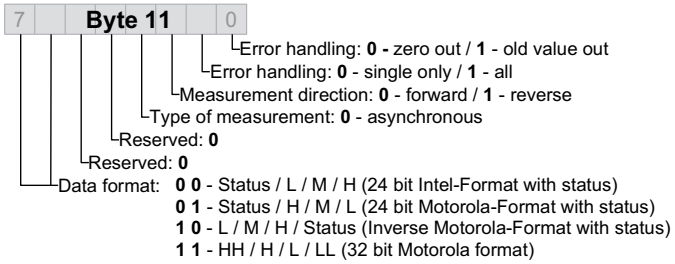
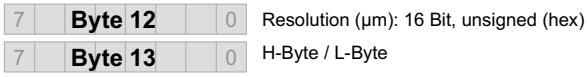
MTS Profibus-Parameters (MTS-Profile)

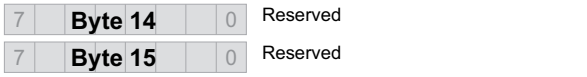


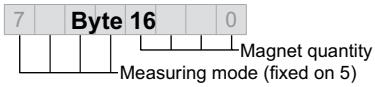
Note

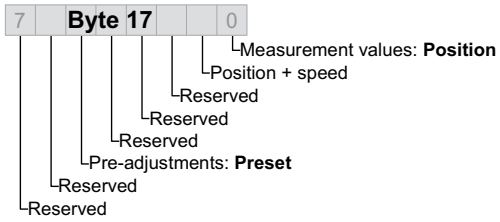
The format of measurement data transmission to the PLC (input data) is selectable by bits 6 + 7 of byte 11. Without affecting the output and preset data, this serves only for easy adaptation to the data formats of the different PLCs. Dependent on data format selected for the position data, the optional speed is formatted as 32-bit Intel or Motorola data.



Note: Following two parameter is valid for using the synchronous measurement function only.







ATTENTION: Setup for all bits: 1 - Functional selection / 0 - Reserved

NOTE!
The parameters will be transferred from control unit to the sensor after setup.

For parameterizing see example no. 1 behind.

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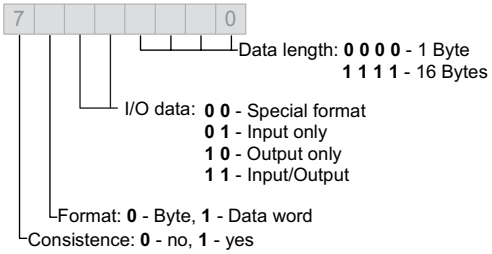
2. Configuration of Input/Output data

The PLC produces the configuration data **independently** and transfers this data to the sensor **during** parameterization. The data is stored in the GSD-file and contains magnet quantity information. For each sensor module a configuration byte is produced. It describes the input and output data length, the consistence and the format in byte format.

Structure of the configuration byte



Note: Length of user data between PLC and Sensor is dependent on quantity of measuring values.

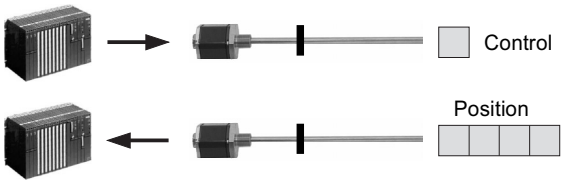
Input data: PLC << Sensor

Each magnet provides always a 4 Byte position value and additional 4 Byte if speed will be measured.

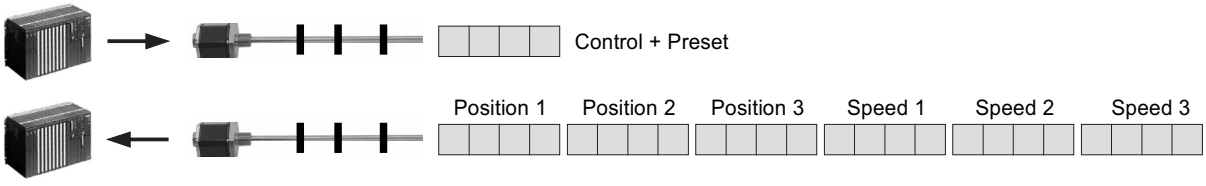
Output data: PLC >> Sensor

PLC provides always 1 control-byte to sensor and additional 3 byte if Preset will be used, independently of magnet numbers.

Example A (1 Magnet): 1 Position without Preset
- 1 byte consistent from PLC to sensor and 4 byte consistent back
- Configuration data: 0x93, 0xA0



Example B (3 Magnets): 3 Positions, Speed and Preset
- 4 byte consistent from PLC to sensor and 6 x 4 byte consistent back
- Configuration data: 0x93, 0x93, 0x93, 0x93, 0x93, 0x93, 0xA3



After check up configuration data, the sensor enters data exchange mode (**Data_Exch)** and transfers/receives the parameterized data constantly.
If the configuration data verification fails, the sensor transmits a diagnostics message to the master and waits for the **(Wait_Cfg)** correct data.

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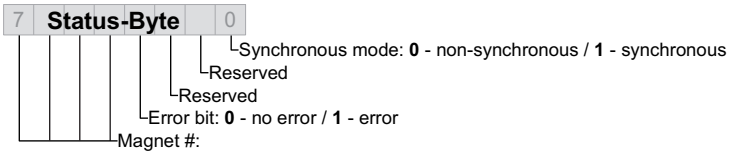
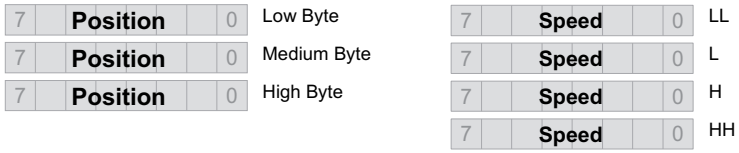
3. Data exchange

In the MTS profile, one status byte (input data) and one control byte (output data) are always transmitted. With multiple magnet measurement a status byte for each position is also transmitted. The status byte contains the magnet number and an error bit, which indicates errors during measurement and is reset when the position values are valid again.

Input data: PLC << Sensor



Note The synchronous bit indicates the status of the synchronous special function. With measurement error, the error bit is set. Thereby, the magnet number which was also transmitted permits individual evaluation for error handling in the PLC. Error causes are e.g. out-of-range or differences between projected and actual number of magnets. With faulty number of magnets, the assignment of magnet number and measured value can be faulty as well. When removing the 4th magnet with e.g. 5 magnets projected, the value measured last contains magnet number 4 ! Dependent on selected parameter, magnet number 5 contains the old measured value of magnet 5, or value zero.

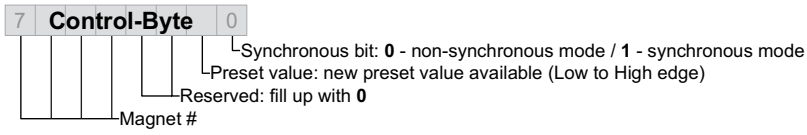


The input data can be transmitted to the control system in 4 formats. Parameter selection is via byte 11 (see ahead).

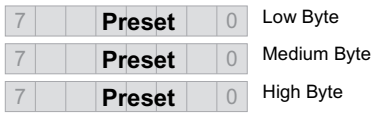
	s (Position)	v (Speed)
1)	Status, L, M, H	LL .....HH
2)	Status, H, M, L	HH.....LL
3)	L, M, H, Status	LL.....HH
4)	HH, H, L, LL	HH, H, L, LL

Note Although no status is transmitted in format 4, error polling is possible by setting the error handling (byte 11) to 0 = output Null. This causes the measured value shows 00000000 in case of error. During normal operation without Preset, 00 00 00 00 is not reached. Therefore, this value provides safe error status signalling.

Output data: PLC >> Sensor



Note The least significant bit serves for the synchronous special function. Otherwise, this bit is 0. The Preset mode permits individual definition of the measurement position for each sensor. E.g. individual zero adjustment for each magnet or mechanical calibration of the sensing rod are possible. For this purpose, the magnet number for which a Preset must be transmitted is specified in the control byte, and a Preset value is defined. This value is transmitted to the sensor when bit 2 changes from low (0) to high (1). Now, the actual magnet position is redefined for the Preset value. This redefinition of the sensing rod is stored internally. For this, the sensor determines a corrective factor for calculation of the measured position. This corrective factor is also available in the diagnosis data.



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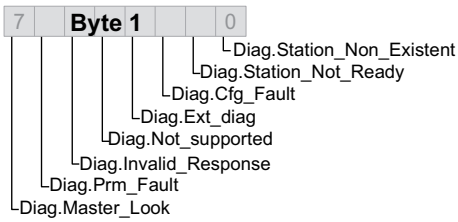
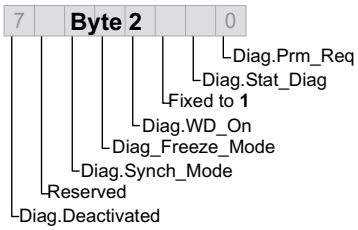
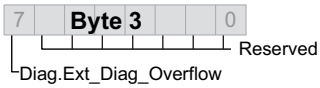
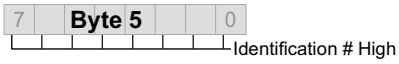
4. Diagnostics (Current status during operation)

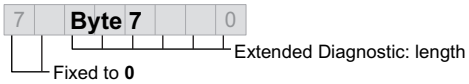
The sensor supports the following extended device-specific diagnostic functions



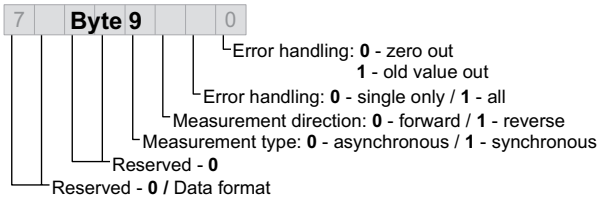


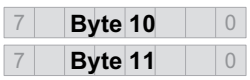




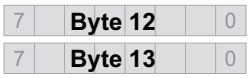


Reserved

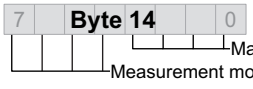


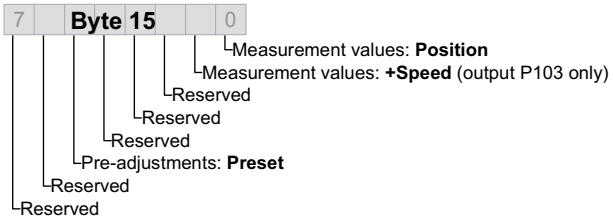


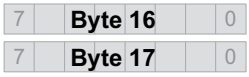
Resolution (µm): High/Low Byte,
16 Bit, unsigned



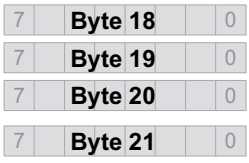
Cycle time (µs) synchronous: High/Low Byte,
16 Bit, unsigned



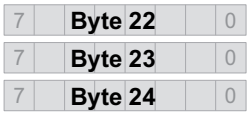




Measuring Range (mm)
High Byte / Low Byte,
16 Bit unsigned

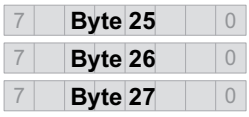


Production #
H/L Byte
32 Bit, unsigned

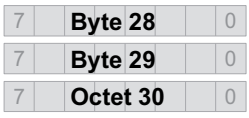


Sensing-pulse speed
Grd: .....m/s (on sensor label)
L/M/H Byte
24 Bit unsigned

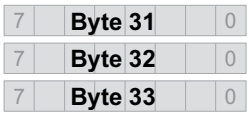
For preset calculation the additionally saved factors are shown in Preset-mode:



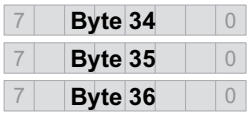
Preset Value Magnet 1
L/M/H Byte
24 Bit, unsigned



Preset Value Magnet 2
L/M/H Byte
24 Bit, unsigned

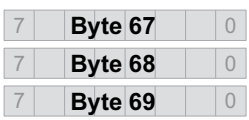


Preset Value Magnet 3
L/M/H Byte
24 Bit, unsigned



Preset Value Magnet 4
L/M/H Byte
24 Bit, unsigned

etc.



Preset Value Magnet 15
L/M/H Byte
24 Bit, unsigned

More informations see website Profibus User Organization: www.profibus.com

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1. Parameterization in hex coding

B8 02 03 0B 04 C3 00 00 00 00 C2 01 F4 07 D0 53 21

Byte 1 - 7 describe the PROFIBUS parameters:

B8 One Master; Sync. freeze possible; Watchdog on
02 03 Watchdog time
0B TSDR (station delay responder time)
04 C3 Identification # of sensor (Output version P101 and P102)
00 Group_Ident

Following byte describe sensor functions:

00 No alarm function
00 00 Datatransfer
C2 32 Motorola format, error handling: all values 0
01 F4 Resolution 500 µm
07 D0 Cicle time sychronous mode
53 3 magnets
21 Preset without speed

2. Error handling with 3 magnets

Byte 11, 40hex, Status/H/M/L; at error handling the single position turns to zero
Magnet missing: *10 00 01 23 *20 00 02 47 38 00 00 00
Magnet too much: 18 00 00 00 28 00 00 00 38 00 00 00

Byte 11, 01hex, Status/L/M/H; at error handling the single position turns to old value
Magnet missing: *10 32 01 00 *20 47 02 00 38 68 03 00
Magnet too much: *18 32 01 00 *28 47 02 00 *38 68 03 00

Byte 11, C2hex, HH/H/L/LL; at error handling all positions turns to zero
Magnet failure: 00 00 00 00 00 00 00 00 00 00 00 000

3. Resolution in hex coding

Resolution setting is via byte 12 + 13 for H / L-byte:

10 µm = 00 0A
50 µm = 00 32
200 µm = 00 C8
1000 µm = 03 E8

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4. Preset

Preset enables an independent offset of Null position for each single magnet. This, however, requires the selection of **Preset** function at hardware configuration via GSD file.

If the sensor is in data exchange with the master, then the PLC constantly transfers the Control-byte and the 3 byte of Preset default value to the sensor.

The software engineer can force the offset via the magnet number and the positive edge of bit 2^1 of Control-byte. That is automatically done in the sensor by subtracting the transmitted default value from the actual magnet position. The calculated Preset value remains stored in the sensor permanently and will be displayed at sensor's online diagnostics.

The default Preset value can either be positive or negative in a well defined format:

32hex **0011 0010**bi Control-Byte Magnet 3, Preset edge
FFhex **1111 1111**bi L-Byte Preset default
02hex **0000 0010**b M-Byte Preset default
00hex **0000 0000**b H-Byte Preset default

That works in both measurement directions! Negative Preset default values are set by the two's complement, i.e. the most significant bit marks the unsigned value.

Preset range:
7F FF FFhex = **8.388.607**dec
80 00 00hex = **- 8.388.608**dec (two's complement)

The diagnostics data are extended by 3 bytes with every additional magnet, containing the stored Preset value.

Often Preset is adjusted to the machine null-position (mechanical stop or dead centre) of customer's machine.

⚠ Attention

Changing of sensor resolution requires a new Preset procedure. Preset can not be changed at magnet failure. Preset value is lost by replacing the sensor by a spare.

Example 1: The actual position of magnet # 1 is set to +0,237 m.

Determine the Preset default value: 0,237 m at 20 µm actual resolution = **11850**dec = **00 2E 4A**hex.

Set new Preset value (Bit 2) for magnet # 1 means: the Control-byte becomes **12**hex

4 Byte	Status		L-Byte		M-Byte		H-Byte	
hex	1	2	4	A	2	E	0	0
binary	0001	0010	0100	1010	0010	1110	0000	0000
decimal	306851328							

Siemens S7 AWL: L L#306851328 //Load new Preset **2E4A**hex for magnet 1
T PQD 260 //transfer 4 byte to the sensor

Cancel magnet # 1 Preset bit means: the Control-byte becomes **10**hex again
10 00 00 00hex = **268435456**dez

Siemens S7 AWL: L L#268435456 //Load Preset Magnet 1 finished
T PQD 260 //transfer 4 byte to the sensor

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Example 2: The actual position of magnet # 1 is set to -0,237 m.

Determine the Preset default value: 0,237 m at 20 µm actual resolution = **11850**dec
Since Preset default value is a number without signs, a negative Preset is build by the two's complement with binary arithmetic, i.e. **+ 11850**dec = **00 2E 4A**hex
- 11850dec = **FF D1 B6**hex, over two's complement with scientific pocket calculator

Set new Preset value (Bit 2) for magnet # 1 means: the Control-byte becomes **12**hex

4 Byte	Status		L-Byte		M-Byte		H-Byte	
hex	1	2	B	6	D	1	F	F
binary	0001	0010	1011	0110	1101	0001	1111	1111
decimal	313971199							

Siemens S7 AWL: L L#313971199 //Load new Preset **FFD1B6**hex for magnet 1
T PQD 260 //transfer 4 byte to the sensor

Cancel magnet # 1 Preset bit means: the Control-byte becomes **10**hex again
10 00 00 00hex = **268435456**dec

Siemens S7 AWL: L L#268435456 //Load Preset Magnet 1 finished
T PQD 260 //transfer 4 byte to the sensor

5 Measurement cycle time

The time of position measurement depends on the measuring length and the numbers of position values.

Measuring length (mm)	Cycle time (ms) 1 position	Cycle time (ms) 5 positions + speed
500	0,5	0,8
2000	1,0	1,2
4500	2,0	2,4
7600	3,1	3,6

For each additional magnet + 0,05 ms

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6. Velocity

Sensor' output version P103 supplies for each magnet a 4-byte velocity output in addition to the position measurement. The sequence follows the selected data format of Motorola or Intel .

Example: position Status / L / M / H leads to **velocity LL / L / H / HH**

Forward measuring direction to tip of rod/profile, the speed has a positive sign and a negative sign for reverse magnet movement. The output value is unsigned and will be provided as a two's complement if necessary.
General: Velocity = Displacement / Time
- Displacement is sum of resolution steps
- Time is a fixed internal cycle time, which may not be to large due to the contouring error

Example: Real positive velocity is 500 mm/s in HH / H / L / LL format for 10 µm resolution:

Data: HH-Byte 00000000 00
H-Byte 00000000 00
L-Byte 11000011 C3
LL-Byte 00000000 00, that is **C300**hex = **49920**dec

V [mm/s] = (W / 1000) x R [µm] (V = Velocity / W = Output counts / R = Resolution)
V [mm/s] = 499,2 = 49920 / 1000 x 10

The speed value is directly dependent on resolution, the time value is constant.

Resolution	Velocity (1 count corresponds)
0,005 mm	0,005 mm/s
0,010 mm	0,010 mm/s
0,050 mm	0,050 mm/s

Long sensors have a greater cycle time and can recognize slow-going movements.

Measuring length	Resolution (Velocity)	
	0,005 mm	0,01 mm
500 mm	0,64 mm/s	1,28 mm/s
2000 mm	0,43 mm/s	0,86 mm/s
4500 mm	0,21 mm/s	0,42 mm/s
7600 mm	0,14 mm/s	0,28 mm/s

Practical Note

To detect fast movement, resolution of 5 µm or 10 µm is recommended.

Document Part Number: 100306 (EN)

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