MTS SENSORS

Temposonics®

The *magnetostrictive* Position Sensors

Temposonics, R-Series

Profile style RP / Rod style RH

Profibus-DP Interface

Operation Manual

Part 2 - Wiring, Programming

Profibus-Ourtput versions

P101 (Multi-Magnet measurement: max. 15 positions simultaneous)
P102 (1-Magnet measurement: 1 position)
P103 (Multi-Magnet measurement: max. 5 positios and speed simultaneous)

...the measurable difference

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1 General

Note

The operating manual of Temposonics R-Series sensors normally consists of two separate parts.

Part 1 contains the general safety hints for operation of this sensor and the mechanical mounting instructions.

The present Part 2 of the manual describes the output dependent sensor interface, the wiring and adjustment possibilities.

Validity

Temposonics linear absolute position sensors are used for measurement and conversion of the displacement variable in automated industrial systems and machinery.

This manual describes the steps for commissioning of the R-series sensors with Profibus DP interface, starting 09/2005. Detailed sensor version information is given on the type label shown as an example.

Profibus ourtput versions:

P101 (Multi-Magnet measurement: max. 15 positions simultaneous)
P102 (1-Magnet measurement: 1 position)
P103 (Multi-Magnet measurement: max. 5 positios and speed simultaneous)

Model # --	RP-M-0850M-D63-1-P103	Output version Connection type Measuring length in mm (here 850)
Number of position magnets --	Z03	
Gradient: Speed of sensing pulse --	Grd: 2785.85 m/s	
Production code --	FNr: 0551 2876	

2 At a Glance

All MTS Temposonics Profibus-DP position sensors are factory-checked for compliance with the specified values and factory-set to **slave address 125**.

[1] Addressing

The sensors are not fitted with an internal switch for adjusting the slave address. For sensor addressing, we recommend using a class 2 Profibus master or one of the service tools (see behind).

[2] Including the GSD file into the hardware catalog (only during initial startup)

The GSD (basic device data) for the Profibus sensors are stored on the CD supplied with the sensor:
- Electronic data sheet MTS R04C3.GSD for outputs P101 / P102
- Electronic data sheet MTS 079D.GSD for output P103

[3] Selecting a sensor in the hardware catalog

The GSD files are accessible in **Profibus-DP / Additional Field Devices / General** in the catalog. Drag folder **P10x R-DP** from the catalog and attach it to the Profibus hardware configurator.
Open folder **P10xR-DP** in the catalog, select the required sensor function (e.g. one magnet without Preset) and store it in **slot 0**.

[4] Sensor parameters setting

The parameters can be edited in the sensor object features.
Caution: For sensors with output P10x, only asynchronous operation is possible!

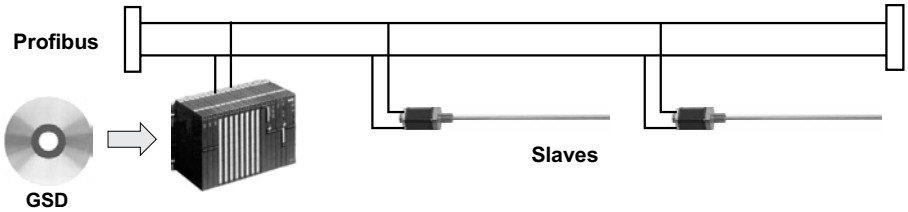
[5] Connecting the sensor to the bus

Take care that screening, cabling and bus connection are correct. After switch-on, the green diagnostic LED in the sensor connecting lid flashes. After successful sensor parameter setting by the PLC, the **green LED is lit permanently**, when a position magnet was detected.

For commissioning, please follow the detailed instructions given below!

3 Profibus-DP Interface

Profibus-DP (IEC 61158 and IEC 61784), an open fieldbus standard for machine level provides a serial, bit-synchronous data communication between central controller (Master) and distributed, smart field devices (Slaves).



Master: PLC with Profibus-DP Interface

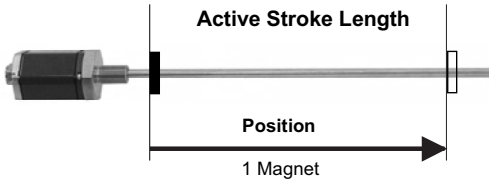
The sensor is a PROFIBUS-DP Slave of EN 50170 and certified by the PNO (Profibus user organization). Using the magnetostrictive principle, the sensor measures position and speed via his permanent magnet head. For operation, the sensor can directly connected to the bus and needs for identifica-tion a unique slave address. Sensor integrated signal processing converts measurements into bus oriented formats for a direct data transfer into the controller.

Its interface is realized using Siemens bus controller SPC3. Apart from data transmission, the sensor-integrated software to class 2 DP slave supports extensive monitoring and diagnostic functions.

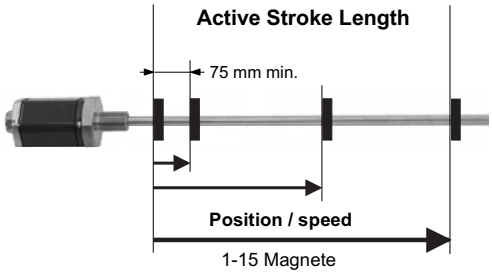
Temposonics Profibus sensors featuring:
Sensor outputs:
Position and speed measurement, sensor status, error detection (e.g. magnet status).
Selectable parameters:
Null position shifting, offset/preset for each magnet, measuring direction: forward/reverse, resolution, different data formats.

Order dependent the sensor is available with optional outputs (operation modes):

Output P102: 1-Magnet position measurement (Standard).



Output P101: Multi-Magnet measurement (Positions of max.15 magnets simultaneously)
Output P103: Multi-Magnet measurement (Position + speed of max. 5 magnets simultaneously).



Data exchange: With Multi-magnets measurement, 1 status byte and 3 position data bytes are transmit-ted. The status byte contains e.g. the error bit and the position number of the following measurement value.

4 Technical Data

Input	
Measured variables	Position, Speed, Multi-magnet measurement: max. 15 positions or max. 5 positions + 5 velocities simultaneously
Measuring range	Profile: 25 - 5000 mm / Rod: 25 - 7600 mm
Output	
Output signal	RS 485 isolated
Data format	Profibus-DP-V0 acc. IEC 61158 and EN 50 170
Data transfer rate	Max. 12 Mbit/s, auto. recognition
Accuracy	
Resolution	
- Position	5 µm Standard / 2...1000 µm selectable via GSD file
- Speed (mm/s) at stroke length	**5 µm** position resolution: 0,64 up to 500 mm / 0,43 up to 2000 mm / 0,21 up to 4500 mm and 0,14 up to 7600 mm stroke length **2 µm** position resolution: 2.5-fold minor values
Linearity	< ± 0,01 % F.S. (Minimum ± 50 µm)
Repeatability	< ± 0,001 % F.S. (Minimum ± 2,5 µm)
Cycle time (1 magnet at stroke length)	0,5 ms at 500mm; 1 ms at 2000mm; 2 ms at 4500mm; 3,1 ms at 7600mm stroke length each additional magnet: + 0,05 ms For speed measurement: ca. + 0,03 ms
Temperature coefficient	< 15 ppm/°C
Hysteresis	< 4 µm
Operating Conditions	
Magnet speed	Any
Magnet difference	Min. 75 mm gap between each magnet at Multi-Magnet measurement
Operating temperature	-40 °C ... +75 °C
Dew point, humidity	90% rel. humidity, no condensation
Protection	Profile: IP65; Rod: IP67 if mating connector is correctly fitted
Shock test	100 g single hit (IEC-Standard 68-2-27)
Vibration test	15g / 10 - 2000 Hz (ach IEC-Standard 68-2-6)
Standards, ECV test	Electromagnetic emission EN 50081-1 Electromagnetic immunity EN 50082-2 EN 61000-4-2/3/4/6, Level 3/4, Criteria A, CE-qualified
Form factor, Material	
Profile model:	
Sensor head	Aluminum
Sensor stroke	Aluminum
Position magnet	Magnet slider or removable U-Magnet
Rod model:	
Sensor head	Aluminum
Rod with flange	Stainless steel 1.4301 / AISI 304
- Pressure rating	350 bar, 700 bar peak
Position magnet	Ringmagnet or U-Magnet
Installation	
Mounting position	Any orientation
Profile model	Adjustable mounting feet or T-slot nut M5 in base channel
U-Magnet	Mounting plate and screws from antimagnetical material
Stab model	Threaded flange M18 x 1,5 or 3/4" -16 UNF-3A, Hex nut M18
Position magnet	Mounting plate and screws from antimagnetical material
Electrical Connection	
Connection type	2 x 5 pin connector M12 and 1 x 4 pin connector M8 / Option: 2 x 6 pin connector M16
Power supply	24 VDC (-15/+20 %)
- Polarity protection	up to -30 VDC
- Overvoltage protection	up to 36 VDC
Current drain	90 mA typical
Ripple	< 1 % S-S
Electric strength	500 V (DC ground to machine ground)
Diagnostic display	LEDs beside connector

5 Electrical Connections

The sensor has to be directly connected - according to wiring diagram - via the bus with the control unit. As an active electronic system, it must be wired very carefully to avoid damage to its electronics due to voltage peaks or faulty connections - regardless of protection against wrong polarity. Do not make connections under voltage!

CE marking
The sensors meet European guideline 89/336/EEC (91/386/EECand 93/44/EEC) EMC and comply with the standards: Electromagnetic Emission EN 50081-1 and Electromagnetic Immunitity EN 50082-2.

To prevent interference from being induced onto the measurement circuitry and for compliance with the certified electromagnetic compatibility EMC, the following rules for connection should be taken into account:

Use only bus cables, according to regulations of the Profibus User Organistation.

Bus cables must be installed according Profibus-DP guideline.

The bus wiring must terminated at both ends (see EN 50170).

Control and signal leads should be kept separate from power cables and sufficiently far away from motor cables, frequency inverters, valve lines, relays, etc.

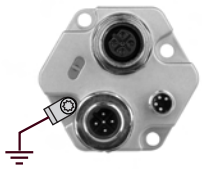
Use only metal connectors and connect the screening to the connector housing.

The connecting surface at both screening ends should be as large as possible.

Keep all non-screened leads as short as possible.

The earth connection should be as short as possible with a large cross section and avoid ground loops.

With potential differences between machine and electronics earth connections, no compensating currents are allowed to flow across the cable screening.
Our recommendation:
Install potential compensating lead with large cross section, or use cables with separate double screening, and connect only one end of screen.



Use only stabilized power supplies in compliance with the specified connecting values.

Due to its anodized housing, the profile sensor does not have a ground connection to the machine via the mounting clamps. For this reason, earthing via the flat-pin connector at the sensor head is indispensable (see fig.).

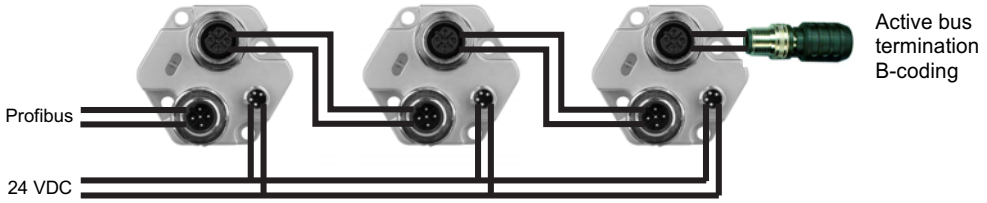
Diagnostics display

LEDs (red/green) in the cover of sensor electronics head inform on the actual sensor condition and are used also for sensor parameter setting.

Green	Red	Function
on	off	Normal function (Operation mode)
on	on	Magnet out of measuring range, wrong magnet quantity
flashing	off	Waiting for master parameters
flashing	on	Programming mode

5 Electrical Connection, Connector type D53

Bus wiring



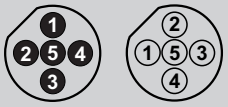
Connections: 5 pin male connector M12, 5 pin female connector M12, 4 pin male connector M8.
Separate wiring of Bus In/Out and input voltage via profibus standard connectors. Bus endplug with active terminating resistor. (Bus termination active only, if sensor is supplied with 24 VDC). Option: 1 T-connector.

Cable
Use a PROFIBUS cable (EN 50170) for fixed installation: 1 twisted pair
e.g. MTS cable part no. K58.

Wiring

View:
front of sensor connector
back of mating connector

BUS IN / OUT



IN male — OUT female

Pin	Cable K58	Signal
1	---	VP +5 V (Bus termination)*
2	green	RxD/TxD-N (Bus)
3	---	Data GND (Bus termination)*
4	red	RxD/TxD-P (Bus)
5	may be connected to shield	
	* only female insert, male insert n.c.	

Power supply

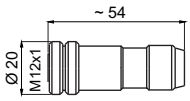
Pin	MTS cable	Input voltage
1	brown	+ 24 VDC (-15/+20 %)
2	white	n.c.
3	blue	0 V (GND)
4	black	n.c.

Pls. use shielded power line cable to prevent noise on the leads.

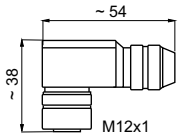
Mating connectors (shieldable, B-coding)

- Housing: Zinc, nickel plated / Screw termination / Strain relief: PG 9 / Cable-Ø: 6,5...8,5 mm / Cable type: e.g. MTS No. K58

Bus IN

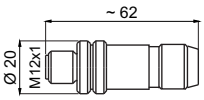


5 pin female connector M12
Part No. 560 885

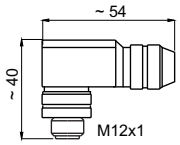


5 pin female angled connector
Part No. 370 514

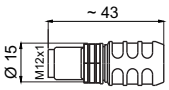
Bus OUT



5 pin male connector M12
Part No. 560 884



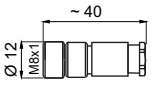
5 pin male angled connector M12
Part No. 370 515



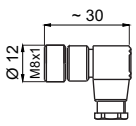
5 pin bus endplug M12 with terminating resistor
Part No. 560 888

Power supply (shieldable)

- Solder termination / Cable-Ø: max. 5 mm

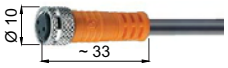


4 pin female connector M8
Part No. 370 504



4 pin female angled connector M8
Part No. 560 886

Recommendation:

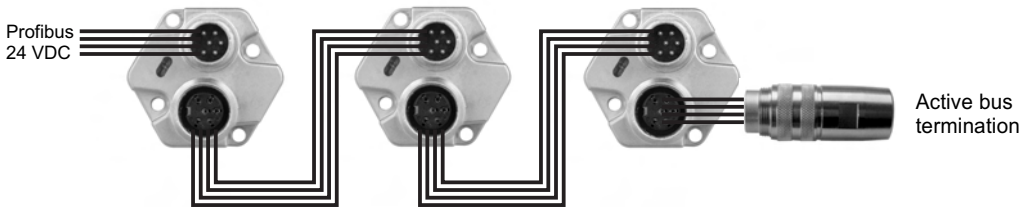


5 m PUR cable 4 x 0,25 mm²
with 4 pin female connector M8,
pigtailed, Part No. 530 066

See also mounting description on connector packing!

5 Electrical Connection, Connector type D63

Bus wiring

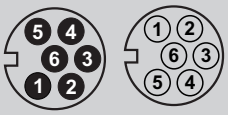


Connections: 6 pin male connector M16, 6 pin female connector M16.
Common wiring of Bus and input voltage via DIN standard connectors. Bus endplug with active terminating resistor. (Bus termination is active only, if the sensor is supplied with 24 VDC).

Cable
Use a Profibus hybrid cable for fixed and flexible installation: 1 twisted pair, 3 wires
e.g. MTS cable, part no. K53.

Wiring

BUS / Power supply



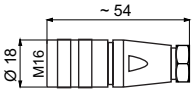
IN male — OUT female

View:
front of sensor connector
back of mating connector

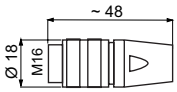
Pin	Cable K53	Signal
1	green	RxD/TxD-N (Bus)
2	red	RxD/TxD-P (Bus)
3	----	Data GND (Bus termination)*
4	----	VP +5 V (Bus termination)*
		Input voltage
5	black	+ 24 VDC (-15/+20 %)
6	blue	0 V (GND)
	yellow/green	Shielding, machine ground (normally n.c.)

* only female insert, male insert n.c.

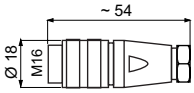
Mating connectors



6 pin female connector M16
Part No. ST C0 9131 D06 PG9



6 pin bus endplug M16
with terminating resistor
Part No. ST A0 9131 H06



6 pin male connector M16
Part No. ST C0 9131 H06 PG9

Housing: Zinc, nickel plated, shieldable
Solder termination
Strain relief: PG 9
Cable-Ø: 6-8 mm
Cable type: e.g. MTS No. K53

See also mounting description on connector packing!

6 Configuration Example

Commissioning of the Temposonics sensor is explained at the example of Siemens S7 PLC and programming software SIMATIC Manager STEP 7. For other projecting tools, the relevant manufacturer specifications are applicable.

Inclusion of position sensor into a bus system is via an electronic data sheet (GSD file) and manufacturer-specific PLC projecting software. Normally, following steps are required for this purpose:

1. Defining the sensor address
2. Installing the basic sensor data (GSD files)
3. Selection of sensor functions
4. Entry of the sensor parameters

Factory settings

The sensors is preset at factory on the order-dependent basic adjustments, e.g. measuring range, resolution and output version and is set to its **slave address 125**.

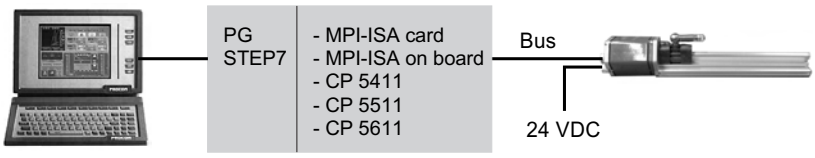
As every address in a Profibus system must be unique, we recommend adjusting the slave address before integration of the sensor into the bus.

All settings described below can be realized only *OFFLINE* rather than during operation of the bus network!

6.1 Sensor adressing

Opening the Temposonics sensor is **not** necessary for address definition. This ensures its protection type and increases its reliability. Setting the sensor address is done via external operating tools before starting operation, e.g. with

Profibus programming unit (PG) Class 2 master



Programming unit (PG)

Address setting (see figures 1, 2)

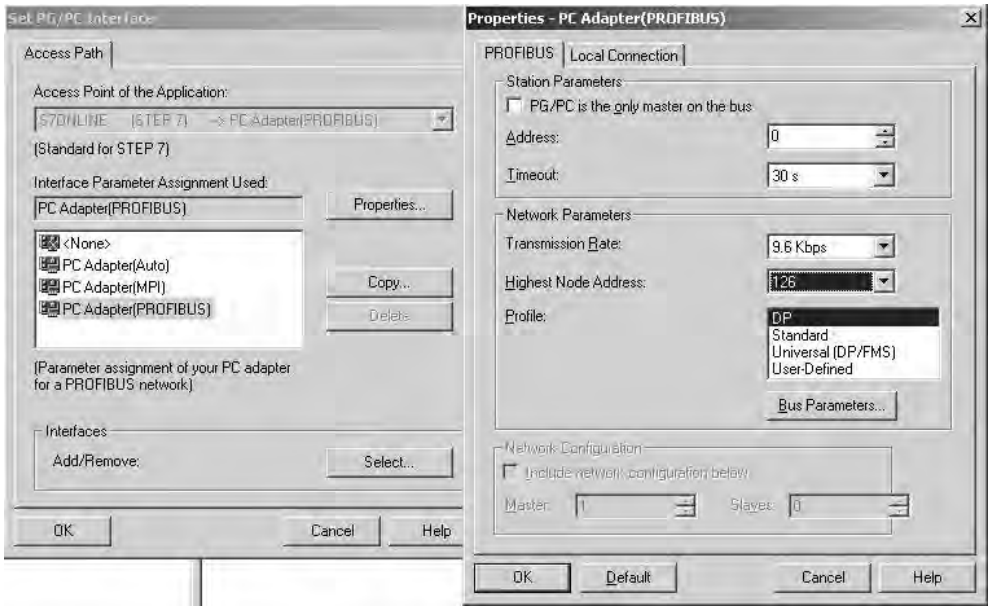
[1] Connect the sensors individually to the bus interface of the programming unit.
Caution: The PC/TS adaptor is not suitable for this purpose.
[2] Switch the programming unit to Profibus interface operation, i.e. select **Profibus** in **Options** and set **PG/PC Interface**.
[3] Select **Properties** and adjust the Highest Node Address on the **MPI Profibus** tab control.
[4] Connect the 24 VDC supply to the sensor.
[5] Select **PLC** in the main menu and **Assign Profibus Address** (Details see Siemens documentation).
[6] Set the required new address (e.g. 25), which remains stored in the sensor.

6 Configuration Example *Continuation*

6.1 Sensor addressing, *continuation*

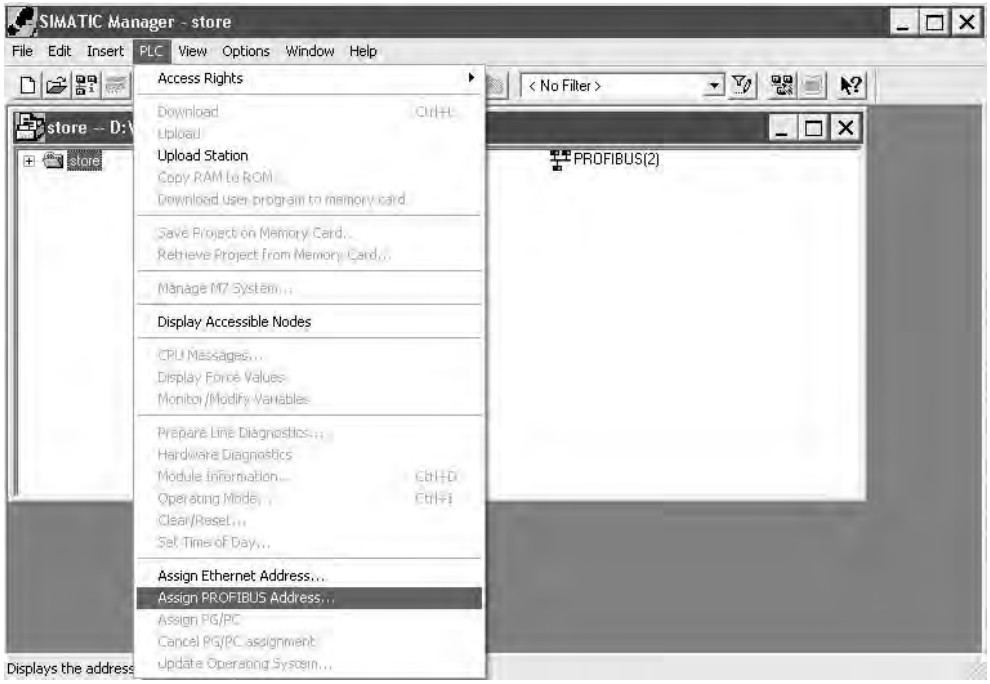
Set Interface and Highest Node Address

Fig. 1



Assign Profibus Address

Fig. 2



See behind for additional addressing tools.

6 Configuration Example *Continuation*

6.2 Installing GSD files

The function of the entire bus system is determined by a database. The database is provided by using all GSD files and the desired parameters.

All functions of the Temposonics sensor are stored in its GSD file on the CD-ROM delivered with the sensor.

Allocation of data base to each bus-device takes place via its corresponding Identification-Numbers. These are for Temposonics sensors with output versions

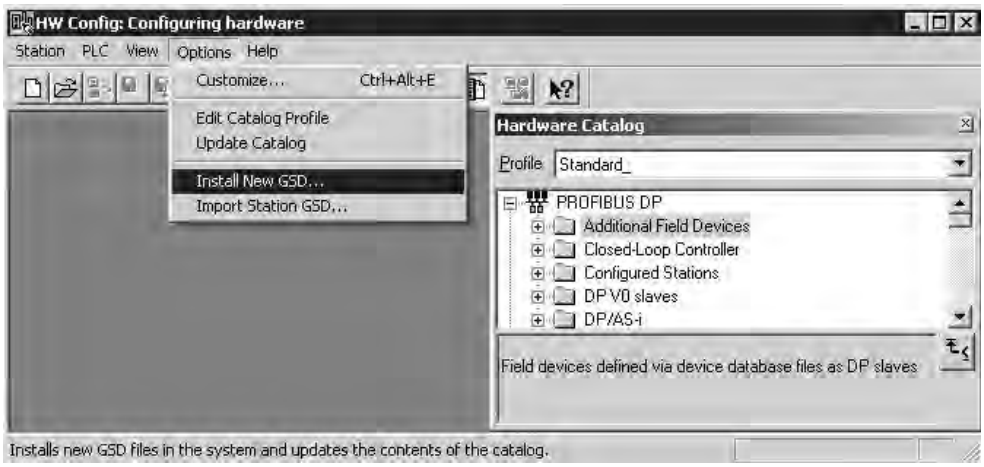
- P101/P102: MTSR04C3.GSD
- P103: MTS079D.GSD

Over the programming software SIMATIC Manager Step7 these GSD files are merged into the bus-system and the sensor is taken up in the hardware catalog step 7.

Installing the GSD file (only applicable for startup, otherwise, continue)

[1] When using the sensor for the first time, its GSD file must be included into the hardware catalog.
Call up the hardware configurator of the programming software (close any open configuration window).
[2] Enter the source of the sensor GSD file in menu **Options / Install New GSD**.
[3] After read-in, update the GSD catalog via the same menu.

Fig. 3



6 Configuration Example *Continuation*

6.3 Selecting sensor type

For programming the PLC, all connected bus participants must be configured in the Profibus system of the master.

Therefore select at first the MTS sensor in the hardware catalog Step 7 via opening **Insert/Hardware Components** in **Profibus-DP**/ **Additional Field Devies** / **General**. Click the desired sensors **P101/2 R-Serie DP** or **P103 R-Serie DP**.

Drag the complete folder from the catalog and drop it to the Profibus graphic.
Now, a window is opened.
Enter the previously adjusted sensor address on the tab control **Parameters**.

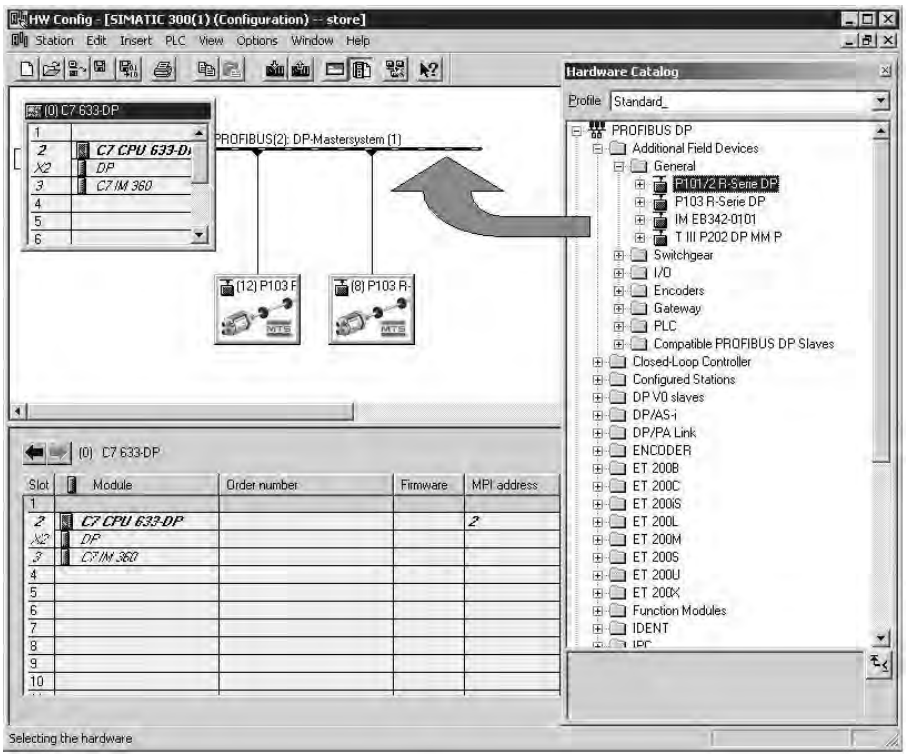


Fig. 4

Subsequently open folder in the hardware catalog and select the required sensor configuration, e.g.

Magnet:
Numbers of position magnets
Note: for sensor type P102 the operation later on is restricted onto one magnet.

Preset:
Allows offset of Null position.

Speed (Output P103 only)**:**
The sensor send per magnet a 4 byte speed output value after the position output.

Drag the configuation from the catalog and drop it to **Slot 0** of the table.

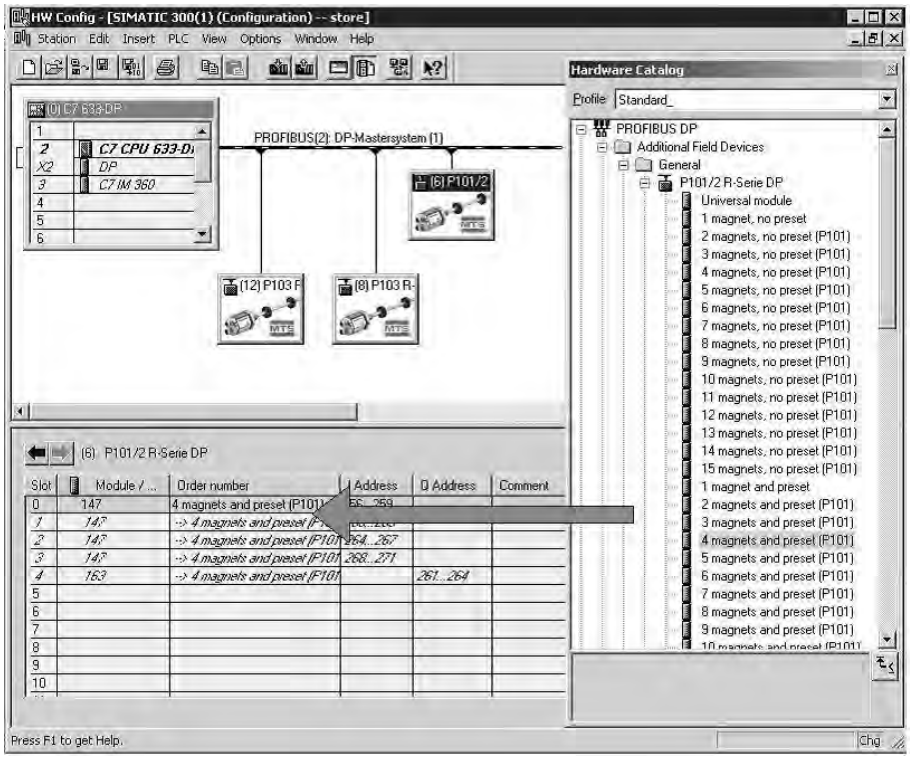


Fig. 5

6 Configuration Example *Continuation*

6.4 Sensor parameterizing

Click on **Object Properties** in the main menu **Edit** to open a window with the device-specific sensor properties.
We recommend activating the **Watchdog** function first.
Thus the sensor can be parameterized immediately, if the line is interrupted or the master is stopped.

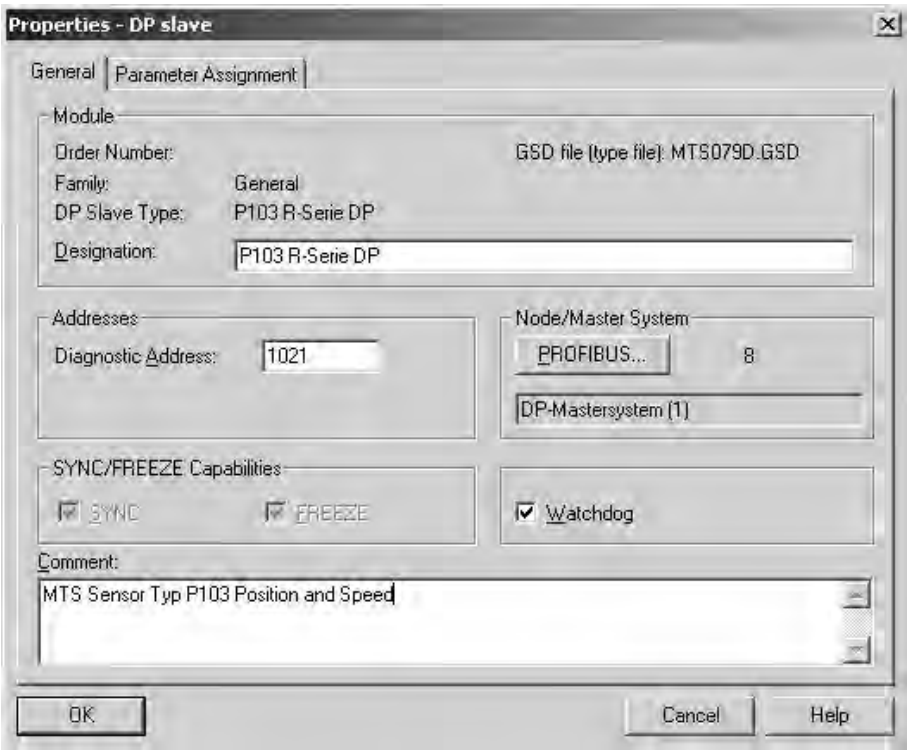


Fig. 6

Sensor parameters

On **Parameter Assignment**, the sensor parameters are displayed and adjustable as plain text and/or as hexadecimal characters.

Examples of parameter settings will be shown in a separate annex.

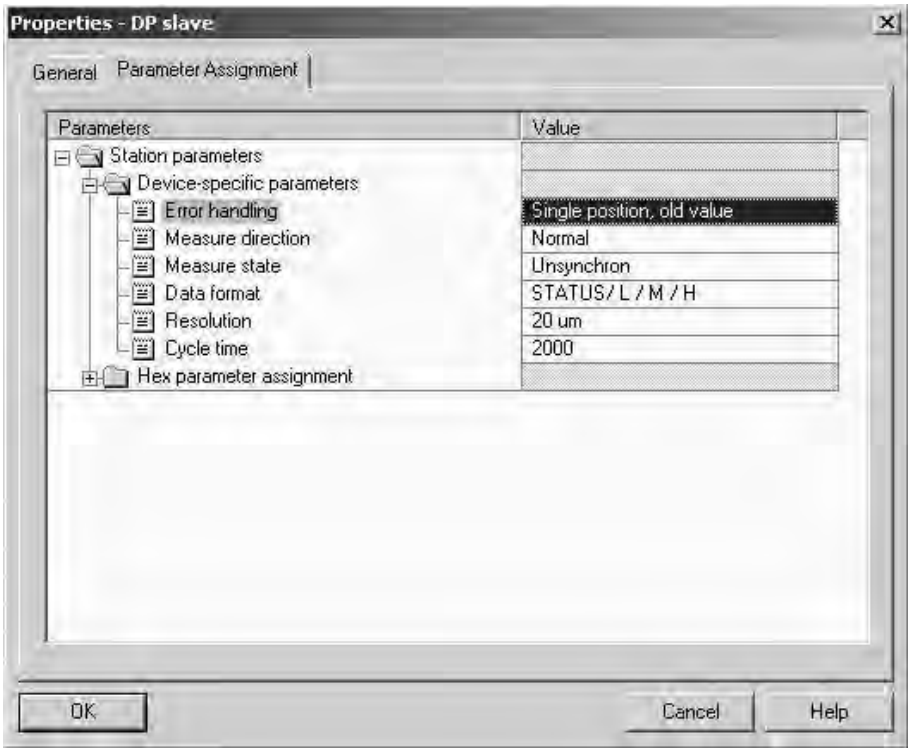


Fig. 7

6 Configuration Example *Continuation*

Sensor parameters, *continuation*

Error handling
In case of measuring fault (e.g. if a magnet is missing), the sensor can output the old, i.e. the previous value for one or all magnet positions. Zero as a position value should be preferred in connection with the data format without status.
- All positions, zero output
- All positions, previous value
- Single position, zero output
- Single position, previous value

Measure direction
- Forward: upscale from sensor head to sensor tip
- Inverse: downscale

Measure status
- Non-synchronous: Measurement is time independent of the bus as frequently as possible
- Synchronous: status presently not supported

Data format
To ensure easy cooperation with different PLCs, various data formats can be selected. For this, the sequence of low, medium and high bytes can be defined.
- Intel format with status (Standard): **Status / L / M / H**
- Motorola format with status (Siemens): **Status / H / M / L**
- Inverse Motorola format with status (Allen-Bradley): **L / M / H / Status**
- 32-Bit Motorola format w/o Status (Siemens S7): **HH / H / M / L**

Resolution
is the displacement required to change the numeric value output by the sensor. When multiplying the value by the resolution, the result is the position with unit meters.

Cycle time (only in synchronous mode, presently not supported)
determines the time between a position measurement and data reading during synchronous mode.

Velocity (only at Multi-magnet measurement P103)

Programming instructions

For safe operation, STEP7 needs the following objects:

OB 1	Main program
OB 82	Diagnostic alarm processing
OB 86	Communication error processing
OB 100	Behaviour in case of re-start
OB 122	Behaviour in case of errors in peripheral units

With sensors working with **Preset**, **OB 82** must also be used, because the diagnostic data change with Preset (for detailed explanations, see the information given in the annex).

For further information, see: **S7 Help > index > OB 82; OB 86; OB 100 and OB122**

Unless e.g. the **OB 86** was programmed, the CPU changes into status STOP, if a rack failure was detected.
Programming a sequence in objects is not indispensable.

Marking not only the sensor in the hardware configurator but the corresponding **Slot 0**, then parameterizing of the module is gettable in the same procedure.

7 Starting Operation

1. Check the bus structure for maximum number of bus sharing devices per segment, bus termination and topology.
2. Before switching on for the first time, check carefully for correct connection.
3. Ensure that uncontrolled displacement of the sensor control system is prevented when switching on.
4. Switch on the bus system.

When the sensor is ready for operation and in the application data mode after switching on, the green LED is lit continuously when a position magnet was detected.

Diagnostics

The sensor status, selected in the hardware configurator can be displayed via menu **PLC** only during **on-line operation**. **Module Information** provides status informations about error cause in the PLC.

More sensor information can be provided as follows.

Under **View** in the main menu switch to **Online**. Go to **Hardware diagnostics** in the PLC drop-down menue and select the slave.
The tab **DP-Slave diagnostics** shows the informations.
Button **Hex. Format** opens a window with diagnostics data (see below) of the MTS sensor.

This hexadecimal display corresponds to the sensor operating status, parameter setting and characteristic data.

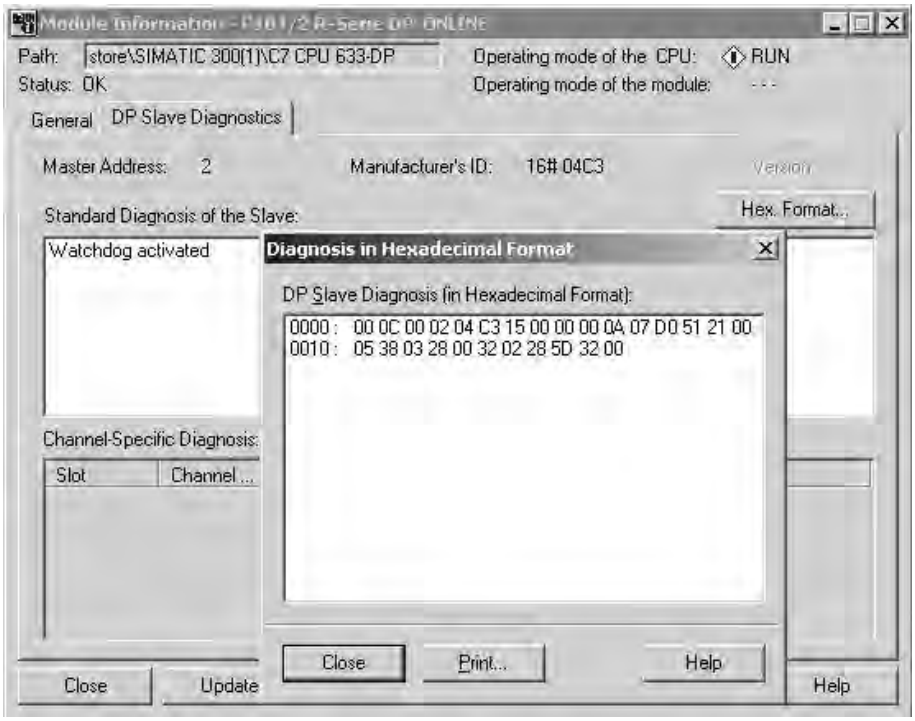


Fig. 8

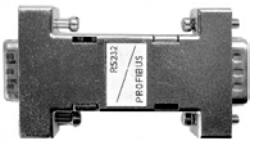
Diagnostics data
(see window above)

00	Slave is ready (02 = Slave is not ready)
0C	Diagnostics, no parameters are expected, slave reaction control
00	Reserved
02	Master's Node Address
04 C3	ID # of the GSD-file
15	Length of the diagnostic data (in bytes; hex coded)
00	Reserved
00	Error handling, Measuring direction forward, data in Intelformat (Status byte first)
00 0A	Resolution 10 µm
07 D0	Cycle time (used only at synchronous mode, not implemented yet)
51	Number of magnets (51 = 1 magnet, 5A = 10 magnets)
21	Preset (01 = without Preset)
00 05	Stroke length 05 00 mm
38 03 28 00	S/N (Fabrication #): 00 28 03 38
32 02 28	Speed of sensing pulse (Gradient): 28 02,32 m/s
1B 71 00	Preset value: 1 magnet (24 Bit, unsigned)

8 Service tools

1. Profibus-DP Mastersimulator (Part No. 401 727) with Cable (Part No. 401 726)

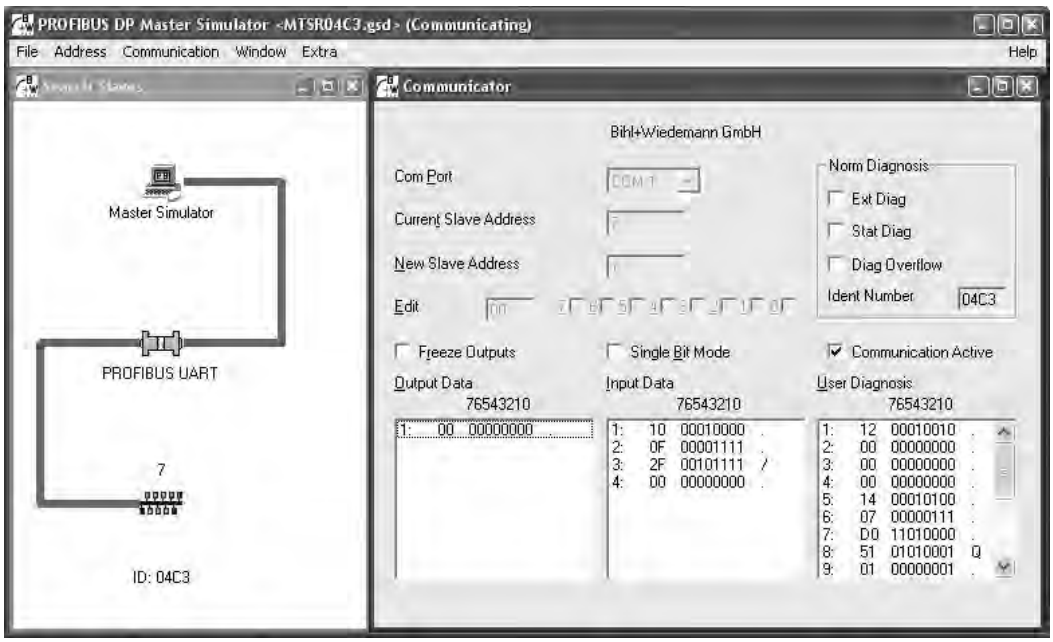
The Profibus-DP master simulator a normal commercially available service tool can be used for easy evaluation of bus sections and Profibus slaves. The simulator consists of an interface converter with the relevant operating software.
It converts the signals from the serial PC output (RS 232) to Profibus (RS 485), thus permitting easy data exchange with the Profibus slaves. It can be used also for adjusting the sensor slave address.



Setting the slave address

1. Connect the sensor with the PC via master simulator.
2. Call up the program.
3. Adjust the new sensor address in window Communicator (Fig.).
4. Re-disconnect all cables.

Fig. 9



Additional functions

- Position data display
- Speed display, if necessary
- Set Preset
- Diagnostic display
- Localize and display of address

8 Service tools *Continuation*

2. MTS Profibus address programmer (Part No. 280 640-3)

This unit is an address indicator with adaptable decode switch. The address is displayed as a hexadecimal value limited to permissible values **01 to 7E (1 to 126)**.

Note: When re-adjusting, any programmed **NoAddChange** is reset.

Dimensions:
80 x 55 x 10 mm

Setting sensor slave address

1. Disconnect the sensor from the bus and from the supply voltage.
2. Connect the sensor to the Profibus addressing box.
3. Connect the Profibus addressing box with the power supply.
4. After initialization, the actual address is displayed.
5. If required, select the new address and program it by pressing the push button.
6. The new address is displayed.
7. Disconnect all lines again.

Hex-Decimal table

Dc	Hx	Dc	Hx	Dc	Hx	Dc	Hx	Dc	Hx	Dc	Hx
1	01	22	16	43	2B	64	40	85	55	106	6A
2	02	23	17	44	2C	65	41	86	56	107	6B
3	03	24	18	45	2D	66	42	87	57	108	6C
4	04	25	19	46	2E	67	43	88	58	109	6D
5	05	26	1A	47	2F	68	44	89	59	110	6E
6	06	27	1B	48	30	69	45	90	5A	111	6F
7	07	28	1C	49	31	70	46	91	5B	112	70
8	08	29	1D	50	32	71	47	92	5C	113	71
9	09	30	1E	51	33	72	48	93	5D	114	72
10	0A	31	1F	52	34	73	49	94	5E	115	73
11	0B	32	20	53	35	74	4A	95	5F	116	74
12	0C	33	21	54	36	75	4B	96	60	117	75
13	0D	34	22	55	37	76	4C	97	61	118	76
14	0E	35	23	56	38	77	4D	98	62	119	77
15	0F	36	24	57	39	78	4E	99	63	120	78
16	10	37	25	58	3A	79	4F	100	64	121	79
17	11	38	26	59	3B	80	50	101	65	122	7A
18	12	39	27	60	3C	81	51	102	66	123	7B
19	13	40	28	61	3D	82	52	103	67	124	7C
20	14	41	29	62	3E	83	53	104	68	125	7D
21	15	42	2A	63	3F	84	54	105	69	126	7E

Note

The sensor parameter settings are stored as function modules in a configuration table via the projecting software. These modules permit special sensor configurations for customer-specific measurement tasks.

The parameters of these new configurations have to be entered or changed manually. That can provided only by specialized automation personnel or trained service technicians who are familiar with Temposonics PROFIBUS-Sensor projecting and handling.

For that a detailed handling manual is available after consulting MTS Sensors.

Document Part Number: T2 R-Profibus.170206 (EN)

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