TEMPOSONICS® R-Series
The magnetostrictive Position Sensors

Instruction Manual

Smart, Linear Position Sensors
Model Types Temposonics-RP & RH
Interface: Profibus-DP

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MTS Sensor Technologie, Lüdenscheid, Germany

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IMPORTANT NOTES:
All references to the D52 connection in this document are preliminary. Consult factory for current availability.

ISO 9001

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Safety Instructions

Preface
The general safety instructions given below are intended to ensure the personnel safety and to avoid damage. TEMPOSONICS are state-of-the-art position measurement systems built in accordance with the standard safety regulations. Nevertheless, hazards to the life and health of the user or other persons, or impairments of the sensor or other objects may arise in conjunction with the use of TEMPOSONICS Sensors.

Application
1. The position measurement systems of all series TEMPOSONICS may be used only for the purposes for which they were designed, i.e. they may be used exclusively for measurement tasks in industrial, commercial and laboratory applications. E.g. positions, displacements and speeds can be measured (more detailed information is given in the relevant product documentation).

The position sensors are accessories of an installation and must be connected to a suitable evaluating unit as included in a PLC, IPC, indicator or other electronic control unit. Correct use for the intended purpose implies that all instructions given in the product documentation are followed. Using sensor Temposonics beyond these limits is incorrect. MTS Sensor Technologie refuse any liability for damage resulting from incorrect use.

2. The displacement sensors may be used only in safe condition. In order to maintain this condition and to ensure safe operation, installation, connection and service work may be done only by trained and qualified personnel *), whereby the relevant instructions for accident prevention and safety as well as the information given in the product documentation must be followed.

Functional trouble
Hazards to the safety of persons or risk of damage to operating facilities due to sensor failure or malfunction must be avoided by additional safety measures such as plausibility checks, limit switches, emergency off systems, protective devices, etc. In case of trouble, the sensor must be shut down and protected against accidental operation.

Repair
Repair of the sensor may be done only by MTS or an explicitly authorized organization.

Installation and operation
To ensure perfect functioning, following the information given below is indispensable:
1. Protect the sensors against mechanical damage during installation and operation.
2. Do not open or dismantle the sensors.
3. Connect the sensors with utmost care related to polarity of connections, supply voltage as well as type and duration of control pulses.
4. Use only approved power supplies.
5. Meeting the permissible sensor limit values e.g. for supply voltage, environmental conditions etc. specified in the product documentation is indispensable.
6. Check the correct function of the position sensors at regular intervals and provide test documentation.
7. Before switching on the installation, ensure that the starting machine does not threaten the safety and health of persons.

*) Trained personnel means persons who
• related to projecting, are familiar with the safety concepts of automation,
• are informed of the electromagnetic compatibility,
• have received a special training for commissioning and servicing,
• are familiar with the operation of the unit and informed of the specifications for correct operation given in the product documentation.
1. General Informations

Manufacturer: MTS Sensor Technologie, Auf dem Schüffel 9, D-58513 Lüdenscheid, Germany

Product name: Position Sensor TEMPOSONICS, Series R

Following description is valid for all R-Series TEMPOSONICS sensors, model types
TEMPOSONICS-RP (Profile style) and
TEMPOSONICS-RH (Rod style) with the
Interface Profibus-DP and
Measuring range: 25 - 7600 Millimeters

The exact sensor description is given on the sensor type label containing the ordering information shown in section 10, page 18, which is coded as follows:

Example Sensor label

KH-S-0850M-D50-1-P101
Grd: 2775.40 m/s
FNr: 0020 0376

2. Industrial application

The position sensors are used for displacement measurement and conversion in mechanical and plant engineering applications.

3. Operating principle and system construction

TEMPOSONICS are absolute position sensors for measuring linear movements. The sensor associates various magnetomechanical effects in a magnetostictive measurement principle, which uses the defined propagation speed of an ultrasonic wave (torsion pulse in a sensor element) for displacement measurement. This contactless measurement principle features a permanent magnet without separate power supply, which marks the position point through the sensor housing wall. The torsion pulse travel time can be converted into a high-accuracy output signal strictly proportional to the measured displacement.

The modular sensor comprises a sensing element (waveguide) for transmission of the measurement pulse, which is fitted in a pressure-proof housing (sensing rod), and an integrated electronic interface (sensor head) with active signal conditioning. The interface output is dependent of electronics module*. Dependent of version, connection of the position sensor is via connector or integrated cable.

*shown: Profibus-DP, version 04-2001-04-23
4. Technical Specifications

| Input | Measured variable: Displacement  
| Measuring range: Profile 25 - 5000 mm / Rod 25 - 7600 mm |

| Output | Output signal: PROFIBUS-DP System according ISO 74998  
| Data format: PROFIBUS-DP (EN 50 170)  
| Data transmission rate: Max. 12 Mbit/s |

| Accuracy | Resolution: 5 μm  
| Linearity, uncorrected: < ± 0.01 % F.S. (Minimum ± 50 μm)  
| Repeatability: < ± 0.001 % F.S. (Minimum ± 2.5 μm)  
| Cycle time: 0.5 ms at 500 mm / 1.0 ms at 2000 mm / 2.0 ms at 4500 mm / 3.2 ms at 7600 mm stroke length (Adjusted for single magnet measurement, for every additional magnet +0.05 ms)  
| Temperature coefficient: <15 ppm/° C  
| Hysteresis: < 4 μm |

| Operating Conditions | Sensor mounting position: Any orientation  
| Magnet speed: Any  
| Operating temperature: -40° C ... +75° C  
| Dew point, humidity: 90% rel. humidity, no condensation  
| Pressure rating (rod version): 350 bar (530 bar peak pressure)  
| Ingress protection*: Profile style IP65 / Rod style IP67  
| Shock rating: 100 g (Single hit) / IEC-Standard 68-2-27  
| Vibration rating: 5 g / 10 - 150 Hz / IEC-Standard 68-2-6  
| EMC test: DIN IEC 801-4 / Type 4  
| CE qualified |

| Construction, Material | Profile Model  
| Sensor head: Aluminum diecasting housing  
| Sensor housing style: Aluminum profile  
| Magnet type: Captive sliding magnet or open ringmagnet |

| Rod Model | Sensor head: Aluminum diecasting housing  
| Sensor rod with flange: Stainless steel 1.4301 / AISI 304  
| Magnet type: GF plastic with permanent magnets (Ringmagnet) |

| Installation | Profile model: Adjustable mounting feet or T-slot nut M5 in base channel  
| Rod model: Threaded flange M18 x 1.5 or 3/4"-16 UNF-3A |

| Electrical Connection | Sensor connectors: 2 pcs. 6 pin connectors or 1 pc. 4 pin male receptacle M8 x 1 and 1 pc. 5 pin female receptacle M12 x 1 (PNO), order dependent  
| Input voltage: 24 Vdc (+20 % / -15 %)  
| Current drain: 90 mA typical  
| Ripple: <1 % peak to peak  
| Electric strength: 500 V (DC ground to machine ground) |

* In the case of sensors with receptacle connection type, the IP rating is valid only if the mating cable connector is correctly fitted.
5. Mechanical Construction / Dimensions

5.1 Profile Model

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sensor head with electronics</td>
<td>1 Sensor head with electronics</td>
<td>7 Measuring range / Order length</td>
</tr>
<tr>
<td>2 Male receptacle, metal shell</td>
<td>2 Threaded flange, MI 8 x 1.5 or 3/4&quot;-16 UNF-3A</td>
<td>8 Mounting zone</td>
</tr>
<tr>
<td>2.1 Connection type D63</td>
<td>3 Sensor housing with built-in sensing element</td>
<td>9 Damping zone</td>
</tr>
<tr>
<td>2.2 Connection type D52</td>
<td>4 Mounting foot</td>
<td>10 Captive sliding magnet style V</td>
</tr>
<tr>
<td>3 Sensor housing with built-in sensing element</td>
<td>5 Captive sliding magnet style S</td>
<td>11 Ball jointed arm (M5 thread), rotation 18°</td>
</tr>
<tr>
<td>6 Ball jointed arm (M5 thread), vertical 18°, horizontal 360°</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

5.2 Rod Model

<table>
<thead>
<tr>
<th>Temposonics-RH</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sensor head with electronics</td>
<td>5 Male receptacle, metal shell (Connection types D63, D52)</td>
</tr>
<tr>
<td>2 Threaded flange, M16 x 1.5 or 3/4&quot;-16 UNF-3A</td>
<td>6 Measuring range / Order length</td>
</tr>
<tr>
<td>3 Position magnet</td>
<td>7 Mounting zone</td>
</tr>
<tr>
<td>4 Sensor rod with built-in sensing element, Ø 10</td>
<td>8 Damping zone</td>
</tr>
</tbody>
</table>

5.3 Connection Types for Profil and Rod Models

<table>
<thead>
<tr>
<th>Type D52</th>
<th>Type D63</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>9,5</td>
</tr>
</tbody>
</table>
5.3 Accessories

### Position Magnets for Profile Model

**Rotations:**
- Vertical 18°
- Horizontal 360°

**Dimensions:**
- Part No. 251 416, 6 mm
- Part No. 201 542, 10 mm

### Position Magnets for Rod Model

**Dimensions:**
- Part No. 033, 3 mm

<table>
<thead>
<tr>
<th>No. 1</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Open ring magnet Ø33</td>
<td>Part No. 251 416</td>
<td>124 416</td>
</tr>
<tr>
<td>2 Position magnet Ø33</td>
<td>Part No. 201 542</td>
<td>100 533</td>
</tr>
<tr>
<td>3 Position magnet Ø25,4 mm</td>
<td>Part No. 400 533</td>
<td>400 533</td>
</tr>
</tbody>
</table>

### Joint Rod for Sliding Magnet

**Dimensions:**
- Part No. 252 182, 12 mm
- Part No. 252 184, 12 mm

<table>
<thead>
<tr>
<th>No. 1</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Captive sliding magnet type »S«</td>
<td>Part No. 252 182</td>
<td>122 182</td>
</tr>
<tr>
<td>2 Captive sliding magnet type »V«</td>
<td>Part No. 252 184</td>
<td>122 184</td>
</tr>
<tr>
<td>3 Open ring magnet type »M«</td>
<td>Part No. 251 416</td>
<td>124 416</td>
</tr>
</tbody>
</table>

### Cable Connectors for Type D63 (Pls. order separately)

<table>
<thead>
<tr>
<th>No. 1</th>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 6 pin DIN female connector</td>
<td>Part No. ST C0 9131D06 PG9</td>
<td>126 9131D06</td>
</tr>
<tr>
<td>2 6 pin DIN male connector</td>
<td>Part No. ST C0 9131H06 PG9</td>
<td>126 9131H06</td>
</tr>
<tr>
<td>3 6 pin DIN male connector</td>
<td>Part No. ST A0 9131H06</td>
<td>126 9131H06</td>
</tr>
</tbody>
</table>

### Bus-Endplug with bus termination

- Housing material: Brass
- Termination: Solder
- Contact insert: Female, male (silver plating)
- Cable clamp: Pg 9
- Cable Ø max.: 6 mm

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- 5 -
Cable Connectors for Type D52 (Pls. order separately)

1. Bus T-connector
   - Housing material: PU
   - Insert: Silver plated
   - Coupling ring: Metal

2. Bus male cable connector
   - Housing material: Brass
   - Termination: Screw clamp
   - Insert: Silver plated
   - Cable Ø max.: 6-8 mm

3. Bus female cable connector
   - Housing material: Brass
   - Termination: Screw clamp
   - Insert: Silver plated
   - Cable Ø max.: 6-8 mm

4. Bus male endplug
   - Housing material: Brass
   - Insert: Silver plated
   - Nominal voltage: 50 Vdc
   - Internal resistor: 2 x 390 ohms, 1/4 W
   - 220 ohms, 1/4 W

5. Male cable connector for input voltage
   - Housing material: Brass
   - Termination: Solder
   - Insert: Silver plated
   - Cable Ø max.: 5 mm

1. 5 pin T-connector M12 x 1 for Profibus up to 12 MBd, Part No. 560887
2. 5 pin cable connector M12 x 1, male, Profibus B coded, Part No. 560884
3. 5 pin cable connector M12 x 1, female, Profibus B coded, Part No. 560885
4. 5 pin bus endplug M12 x 1, male, Profibus B coded, Part No. 560888
5. 4 pin 90° cable connector M8 x 1, female (input voltage), Part No. 660886
6. Installation Guide

Attention. Ensure the sensor mounting is kept away from strong magnetic and electrical noise-fields.

The sensor may be operated in any position. Normally, the sensor is firmly installed, whilst the magnet head is mounted at the mobile machine part and taken over the tube contactlessly.

Note!
To avoid damaging of slider, magnet and sensor housing be aware of a careful parallel mounting of the transducer.

6.1 Profile Style Sensor
The sensor requires at least two mounting feet which simply slide on to the transducer and are held in place with screws M5 x 20 (DIN 6912) or M5 screws in base channel. Mount the floating style magnet using non-magnetic material and screws.

6.2 Open Ringmagnet type M, removable

6.3 Rod Style Sensor
The sensor can be mounted in any position. Note the minimum clearance (right). Use non-magnetic screws, supports etc. Sensors above 1000 mm measuring stroke may require mechanical supports (below).

Example: Sensor Supports

1 Magnet
2 Non-magnetic mounting plate and screws
6.4 Cylinder Installation

The basic sensor unit comprising electronic head and sensing element is mounted in the high pressure sensor housing (flange with rod) with only 2 screws and fits into the piston rod. The magnet on the bottom of the piston floats contactless over the sensor rod and marks the measuring point through the rod wall. Due to this construction, the sensor tube is part of the cylinder and the hydraulic system has not to be opened in case of maintenance.

When installing the sensor in hydrocylinders, note
• Magnet must not slide along the sensor tube
• The bore in the piston rod and type of sealing are determined by cylinder manufacturers as these depend on hydraulic pressure and piston velocity. We recommend 13 mm bore hole diameter at minimum and O-rings or copper gaskets for sealing
• Do not exceed peak pressure of 530 bar
• Protect sensor rod from wear

ATTENTION
After changeament of sensor cartridge, the screws must be fastened with e.g. Loctite 243.

6.5 Measuring Range

The technical data of each TEMPOSONICS sensor are checked and recorded at the final inspection. At the same time the active measuring range (see page 4) is adjusted. In order to guarantee the total electrical stroke is available, the position magnets must be fixed as follows

1 Sensor Hydraulic Housing
(Flange with tube), becomes a permanent component of the cylinder

2 Sensor Cartridge
(Electronic head + Sensing element): Easy to replace in the field with 2 screws Torx 20

3 Position magnet
7. Electrical Connection

**IMPORTANT**
Temposonics sensors are active electronic systems. When installing the unit it is essential that correct sensor connections are ensured. Before turn-on, please check if the sensor was connected correctly, in order to prevent destruction of the sensor electronics by voltage peaks or faulty connection.

**CAUTION:** During wiring, disconnection from all voltage sources must be ensured.

To prevent interference affecting the electronic measuring equipment, the connecting cables must be installed with utmost care. Therefore...
- Keep cables away from motor cables, frequency inverters, valves, piping, relays, etc.
- Avoid ground loops.
- Use only stabilized power supplies.
- Take care that the specified connection values are not exceeded.
- Use only low impedance, twisted pair and screened cables.

**ATTENTION:** (For Profile Sensors only).
The profile sensor is equipped with mounting feet for isolation from machine ground. It is necessary that you apply ground to the sensor housing. Connection is made with the flat pin connector on the sensor head.

**CE-Labeling.**
The devices agree with the European Guideline 89/336/EEC (changed through 91/386/EEC and 93/44/EEC), "Electromagnetics Compatibility". The following European special basic standards will be fulfilled:
- **Electromagnetic Emission:** EN 50081-1 and **Electromagnetic Susceptibility:** EN 50082-2

**Mounting Instructions!**
To fulfill the above mentioned basic standards require a prescribed standard cable. Ensure that the sensor has a flawless machine grounding. The cable shield must be fixed to the cable connector and has to be connected to machine ground on the controller electronic side.

7.1 Bus Wiring

**Connection type D63**
- Advantages
  - Stub-line length is minimized
  - No external T-Connectors are required
  - Bus and input voltage common in 1 shielded hybrid cable

**Connection type D52**
- Advantages
  - Standardized bus connector M12 x 1
  - Separate input voltage
  - No bus breakdown at sensor disconnection
7.2 Connection Type D63

Position Sensor TEMPOSONICS Profile Model RP & Rod Model RH with PROFIBUS-DP Interface

In this system, the supply voltage is integrated in the bus cable. Therefore, a suitable Profinbus cable (e.g. type K53) is required. A mains filter (e.g. Siemens 6ES5 762-2CS11) should be used. The supply voltage is taken via the instrument and made available at the output. At the bus end, the output connector can be terminated directly by means of a bus terminating connector STA 09131 H05.

### Input Connector for Bus-Cable Wiring

<table>
<thead>
<tr>
<th>Sensor Pin Layout</th>
<th>Cable</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 pin male receptacle</td>
<td>Pin</td>
<td>Wire Colour</td>
</tr>
<tr>
<td>1</td>
<td>green</td>
<td>RxD/TxD-N (Bus)</td>
</tr>
<tr>
<td>2</td>
<td>red</td>
<td>RxD/TxD-P (Bus)</td>
</tr>
<tr>
<td>3</td>
<td>-----</td>
<td>Do not connect</td>
</tr>
<tr>
<td>4</td>
<td>-----</td>
<td>Do not connect</td>
</tr>
<tr>
<td>5</td>
<td>black</td>
<td>+24V dc (+20% / -15%)</td>
</tr>
<tr>
<td>6</td>
<td>blue</td>
<td>DC Ground (0V)</td>
</tr>
<tr>
<td>--</td>
<td>yellow/green</td>
<td>Normally do not connect</td>
</tr>
</tbody>
</table>

### Output Connector for Bus-Cable or Bus-endplug

<table>
<thead>
<tr>
<th>Sensor Pin Layout</th>
<th>Cable</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 pin female receptacle</td>
<td>Pin</td>
<td>Wire Colour</td>
</tr>
<tr>
<td>1</td>
<td>green</td>
<td>RxD/TxD-N (Bus)</td>
</tr>
<tr>
<td>2</td>
<td>red</td>
<td>RxD/TxD-P (Bus)</td>
</tr>
<tr>
<td>3</td>
<td>-----</td>
<td>DGND</td>
</tr>
<tr>
<td>4</td>
<td>-----</td>
<td>VP</td>
</tr>
<tr>
<td>5</td>
<td>black</td>
<td>+24V dc (+20% / -15%)</td>
</tr>
<tr>
<td>6</td>
<td>blue</td>
<td>DC Ground (0V)</td>
</tr>
<tr>
<td>--</td>
<td>yellow/green</td>
<td>Normally do not connect</td>
</tr>
</tbody>
</table>

**Mounting hint!**

A type-A PROFIBUS cable to EN 50170 must be used for connection. Ensure correct sensor grounding. The cable shield must be connected via a large, conducting surface to the connector metal housing and grounded at the control electronics via a large screening collar.
7.3 Connection Type D52

Position Sensor TEMPOSONICS Profile Model RP & Rod Model RH with PROFIBUS-DP Interface

In this system, the bus is taken via a standard PROFIBUS connector M12 x 1. Therefore, only 2-wire Profibus cable (e.g. type K50) is required. Supply voltage connection is individual for each instrument via a standard M8 x 1. For bus branching at each sensor, a special T-piece for Profibus (art. no. 560887) is required. At the bus end, a terminating connector (art. no. 560888) at the T-piece must be used.

### Input Connector for Power Supply

<table>
<thead>
<tr>
<th>Sensor Pin Layout</th>
<th>Cable</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 pin male connector M8 x 1</td>
<td>Pin</td>
<td>Wire color</td>
</tr>
<tr>
<td>1</td>
<td>brown</td>
<td>+24 V DC (+20% / -15%)</td>
</tr>
<tr>
<td>2</td>
<td>white</td>
<td>NC</td>
</tr>
<tr>
<td>3</td>
<td>blue</td>
<td>0 V (GND)</td>
</tr>
<tr>
<td>4</td>
<td>black</td>
<td>NC</td>
</tr>
</tbody>
</table>

### Input Connector for Profibus-DP

<table>
<thead>
<tr>
<th>Sensor Pin Layout</th>
<th>Cable</th>
<th>Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 pin female bus connector M12 x 1</td>
<td>Pin</td>
<td>Wire color</td>
</tr>
<tr>
<td>1</td>
<td>-----</td>
<td>Do not connect</td>
</tr>
<tr>
<td>2</td>
<td>green</td>
<td>RXD/TXD-N (BUS)</td>
</tr>
<tr>
<td>3</td>
<td>-----</td>
<td>NC</td>
</tr>
<tr>
<td>4</td>
<td>red</td>
<td>RXD/TXD-P (BUS)</td>
</tr>
<tr>
<td>5</td>
<td>shield</td>
<td>shield</td>
</tr>
</tbody>
</table>

**Mounting hint!**

Use a type-A PROFIBUS cable to EN 50170 for connection. Ensure correct sensor grounding. The cable screening must be connected via a large, conducting surface to the connector metal housing and grounded at the control electronics via a large screening collar.
8. Profibus-DP Interface

PROFIBUS is an open fieldbus, based on international standard EN 50 170. Protocol architecture is oriented to OSI model (ISO 7498). PROFIBUS-DP (Decentralized Periphery) is designed for machine level and provides functions for diagnostics and monitoring, which are loaded into the bus via a configuration tool.

TEMPOSONICS sensor with Profibus-DP interface is a DP slave implementation for direct connection to the bus. The sensor realizes the absolute position measuring up to 15 positions with direct transmission of digitized data in RS 485 standard to control units. Profibus interface is built up with Siemens Asic SPC3 and contains a galvanic isolation between power supply and bus signals. That allows baudrates from 9600 baud to 12 Mbaud with an automatic search of transfer rate and a very fast system response time.

Electronic data sheet for open sensor configuration
To achieve a plug and play Profibus configuration, all characteristic features are specified in an electronic data sheet (Device Data Base File or GSD file). The GSD files provide a clear and comprehensive description of the sensor characteristics in a precisely defined format.

Using the configuration tool (3.5" disk) based on GSD files, integration of TEMPOSONICS sensors in the bus system is very simple.

The GSD files for TEMPOSONICS sensors are
1. General specifications with vendor and device name, hardware and software release states etc.
2. DP-Slave features with all specifications related to the displacement sensor, e.g. resolution, number of magnets, diagnostics etc.

TEMPOSONICS sensors allows following customized parameter configuration
- Absolute position of 15 magnets
- Sensor status and error detection
- Magnet status (error/non-error)
- Options: 2 setpoints for 1 magnet, velocity for 1 magnet, Maximum/Minimum position with reset.
- Offset for each magnet
- Measuring direction: forward and reverse acting
- Resolution/Error handling: selectable up to 20 µm / 5µm
- Measuring cycle: Non-synchronized or synchronized (optional)
- Multiple magnet measurement: Position of 1 - 15 selectable magnets on 1 sensor are detected.

Operation mode
TEMPOSONICS sensors with Profibus output will support one or multiple position magnets.
- **1-Magnet System**: Provides one displacement output over the entire active range of the sensor’s stroke length.
- **Multiple Magnet System**: Provides up to 15 magnet positions on 1 sensor only along the sensor length.

*Note: A gap of at least 95 mm must be maintained between the magnets.*
9. System Configuration

For operation, the sensor has to be connected to the bus and needs a unique slave address. The assigning of the slave address is done during the configuration of Profibus system with a class 2 master, and is free choosable within the Profibus guidelines. The assignment is done by the Profibus service SetSlaveAddress by software.

If this service is not available, the display and placing of the address can also be handled with the MTS Profibus Hand-hold Programmer (MTS Part No. 252 173). Contrary to the adjustment by integrated switches, this solution guarantees the preservation of the ingress protection code of housing. The default setup of the address is 125.

Before running the bus, a database must be created by using a software projecting tool, which is an electronic rebuilt of the plant. Therefore a hardware description is necessary, which as well offers the parameter-selection called the GSD file.

By transferring the database to the PLC, the master can handle the slaves. After starting the bus the master transmits the parameters to the connected slaves, controls the functions and asks for their position data.

Following description of the “state machine” (below) for Profibus-DP sensor is identically the description for the DP-slave in the standard EN 50170.
9.1 Parameter Adjustment

The parameterization of the Temposonics Profibus-DP sensor follows the Profibus standard EN 50170 (DIN 19245-3). The first 7 Bytes are defined by the Profibus standard. Byte 8 contains the specific information for the Profibus controller SPC3 and also the information for the DP extensions for the acyclic data exchange (DPV 1). These extensions are not supported by the MTS Sensor. The parameter adjustments start at Byte 11 (Byte 9 and 10 are reserved by the Profibus-DP extension). The adjustments are preset by the Device Data Base Files (*.GSD) as User_PrM_Data, but they are changeable during the configuration. Using the configuration tool based on GSD files makes integration of sensors into the bus simple and user-friendly. In some cases a manual parameter input is necessary as shown in the following description.

9.1.1 Parameters (DP-Protocol)

Octet 1

Octet 2

Octet 3

Octet 4

Octet 5

Octet 6

Octet 7

Octet 8

Octet 9

Octet 10

9.1.2 Parameter (MTS Profile)

Octet 11

Octet 12

Octet 13

Octet 14

Octet 15

Octet 16

Octet 17

Note: This parameter is only relevant for the usage of the asynchronous measurement function.

All Bits will be set as:
1 = Functional selection / 0 = Reserved
After having checked the parameters from the Master, the sensor with Profibus DP interface changes into the state `Wait_Cfg`. Here it waits for the transmission of the configuration data. If the parameters are not allowed, it sends a diagnostic message to the master and stays in the state `Wait_Prm` until it gets the right parameters.

### 9.2 Configuration

After the successful parameterization, the sensor needs the configuration data. The configuration describes mainly the length of the input and output data, that are transferred during the data exchange mode. A minimum of two bytes are sent to the sensor. One byte for the input data length (data to the controller) and one byte for the output data length (data from the controller).

#### Construction of Configuration Byte

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

- **Data Length**
  - 0000 = 1 Byte
  - 0015 = 10 Bytes
- **Input / Output Data**
  - 0 = Special Format
  - 01 = Input only
  - 10 = Output only
  - 11 = Input and Output
- **Format**
  - 0 = Byte / 1 = Word
- **Consistency**
  - 0 = No / 1 = Yes

#### Input Data

The configuration of MTS Profibus profile has a modular structure. During the configuration one configuration byte has to be added for each magnet in the configuration data. The data length for the input data in the data exchange mode is for the position 4 byte, 1 byte (status information) and 3 byte for the position data.

- **Output Data**

For the output data there are following restrictions: 1 byte is always necessary for the output data during the data exchange mode. This byte controls the synchronized measurement, if it has been parameterized. If the preset mode is selected, 3 additional bytes are transmitted. They contain the value of the selected preset. The data length for the output data in the data exchange mode is

- **No Preset**: 1 Byte
- **Preset**: 4 Byte (1 Byte Control data / 3 Byte Preset)

#### Example

- **Configuration Data**: 0 x 15,0 x A0
  - 1 Position Module (4 Byte Input Data)
  - 1 Control-Byte (1 Byte Output Data)
- **Configuration Data**: 0 x 93,0 x 93,0 x A3
  - 3 Position Modules (8 Byte Input Data)
  - 1 Control-Byte with Preset Function (4 Byte Output Data)

After the sensor has checked the configuration data, it enters the data exchange mode `Data_Exch` and transmits the parameterized data. If the configuration is not valid, it sends a diagnostic message to the master and waits in the configuration state `Wait_Cfg`, until it receives the right configuration data.

### 9.3 Data Exchange

For the MTS profile, 1 status byte (input data) and 1 control byte (output data) are transmitted during data exchange mode. If more than one magnet was selected, each position contains an own status byte. The status byte with magnet number and a failure bit which shows if during the last measurement an error occurs. If the sensor produces valid measurements the failure bit is resetted.

#### Input Data (Sensor -> Controller)

**Status Byte**

<p>| | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
<td>3</td>
</tr>
</tbody>
</table>

- **Synchronous Bit**
  - 0 = Free-running measurement
  - 1 = Synchronous measurement
- **Failure Bit**
  - 0 = No Error / 1 = Error
- **Magnet #**
  - (1 - 15)

The synchronous bit shows the status of the synchronous special function. If an error occurs during the measurement the failure Bit is set. The encoded magnet-number allows an individual analysis for the failure treatment in the controller. Reasons for failures may be the leaving of the measurement range or differences between projected and real number of magnets.

- **Position**
  - Low Byte
  - Medium Byte
  - High Byte

Input data can be transferred to controllers in 4 formats. Parameters selection is done by Octet 11.

1) 0 0 = Status/LM/L (24 bit Intel format w. status)
2) 0 1 = Status/ML (24 bit Motorola format w. status)
3) 1 0 = L/ML/Status (Inverse Motorola format w. status)
4) 1 1 = L/ML/L (32 bit Motorola format)

Although there is no status transfer in format 4, an error polling is possible by setting up Error handling (see Octet 11). Thereby in a fault case the measured value shows 00000000. A normal measuring operation with Preset does not reach 00000000. Therefore this value definitively shows Fault status.

#### Output Data (Controller -> Sensor)

**Control Byte**

<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>6</td>
<td>5</td>
<td>4</td>
</tr>
</tbody>
</table>

- **Synchronous Bit**
  - 0 = Free-running measurement
  - 1 = Synchronous measurement
- **Preset value**
  - *New/ Preset value*
  - (Low to High edge)
- **Reserved** (fill UD with 01)
- **Magnet #**
  - (1 - 15)

The lowest bit is necessary for the synchronous special function. Otherwise it is registered with 0. The Preset mode allows to define the measurement position for any sensor individually. Therefore it is possible to define an individual zero point for any magnet or to calibrate the scale to the mechanics. The magnet number for which a preset shall be transmitted is indicated in the control Byte and the value of the preset is defined.
With the change of the 2nd Bit from Low (0) to High (1) this value is transmitted to the sensor. Herewith the new magnet position is redefined for the value of the preset. This redefinition of the scale is saved internally. The sensor figures out a correction factor for the calculation of the measured position. This correction factor is also visible in the diagnosis data.

9.4 Diagnostic

The sensor supports also the extended diagnostic function. The first 6 bytes are defined as the Profibus DP standard.

Octet 1

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Diag.Station_Not_Existend</td>
</tr>
<tr>
<td>6</td>
<td>Diag.Station_Not_Ready</td>
</tr>
<tr>
<td>5</td>
<td>Diag.Cfg_Fault</td>
</tr>
<tr>
<td>4</td>
<td>Diag.Ext_diag</td>
</tr>
<tr>
<td>3</td>
<td>Diag.Not_supported</td>
</tr>
<tr>
<td>2</td>
<td>Diag.Invalid_Response</td>
</tr>
<tr>
<td>1</td>
<td>Diag.Prm_Fault</td>
</tr>
<tr>
<td>0</td>
<td>Diag.Masterr_Lock</td>
</tr>
</tbody>
</table>

Octet 2

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Diag.Prm_Req</td>
</tr>
<tr>
<td>6</td>
<td>Diag.Diag_Req</td>
</tr>
<tr>
<td>5</td>
<td>Diag.WD_On</td>
</tr>
<tr>
<td>4</td>
<td>Diag._Freeze_Mode</td>
</tr>
<tr>
<td>3</td>
<td>Diag.Synch_Mode</td>
</tr>
<tr>
<td>2</td>
<td>Reserved</td>
</tr>
<tr>
<td>1</td>
<td>Diag.Deactivated</td>
</tr>
<tr>
<td>0</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

Octet 3

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Reserved</td>
</tr>
<tr>
<td>6</td>
<td>Diag.Ext_Diag_Overflow</td>
</tr>
</tbody>
</table>

Octet 4

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Diag.Masterr_Add</td>
</tr>
</tbody>
</table>

Octet 5

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Identification # High</td>
</tr>
</tbody>
</table>

Octet 6

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Identification # Low</td>
</tr>
</tbody>
</table>

Octet 7

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Extended Diagnostic</td>
</tr>
</tbody>
</table>

Octet 8

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Reserved</td>
</tr>
</tbody>
</table>

Octet 9

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Error Handling</td>
</tr>
<tr>
<td>6</td>
<td>Measuring Mode</td>
</tr>
<tr>
<td>5</td>
<td>Magnet quantity</td>
</tr>
<tr>
<td>4</td>
<td>Measuring direction</td>
</tr>
<tr>
<td>3</td>
<td>Measurement State</td>
</tr>
<tr>
<td>2</td>
<td>reserved</td>
</tr>
<tr>
<td>1</td>
<td>reserved</td>
</tr>
<tr>
<td>0</td>
<td>reserved</td>
</tr>
</tbody>
</table>

Octet 10

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Resolution (Micron)</td>
</tr>
<tr>
<td>6</td>
<td>reserved</td>
</tr>
<tr>
<td>5</td>
<td>reserved</td>
</tr>
<tr>
<td>4</td>
<td>reserved</td>
</tr>
<tr>
<td>3</td>
<td>reserved</td>
</tr>
<tr>
<td>2</td>
<td>reserved</td>
</tr>
<tr>
<td>1</td>
<td>reserved</td>
</tr>
<tr>
<td>0</td>
<td>reserved</td>
</tr>
</tbody>
</table>

Octet 11

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>High/Low Byte</td>
</tr>
</tbody>
</table>

Octet 12

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>reserved</td>
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</tbody>
</table>

Octet 13

<table>
<thead>
<tr>
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<th>Description</th>
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<tbody>
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Octet 14

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Octet 15

<table>
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<tbody>
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</tr>
</tbody>
</table>

Octet 16

<table>
<thead>
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</thead>
<tbody>
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</tbody>
</table>

Octet 17

<table>
<thead>
<tr>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>reserved</td>
</tr>
</tbody>
</table>

Octet 18

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>Production #</td>
</tr>
</tbody>
</table>

Octet 19

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>reserved</td>
</tr>
</tbody>
</table>

Octet 20

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>reserved</td>
</tr>
</tbody>
</table>

Octet 21

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>reserved</td>
</tr>
</tbody>
</table>

Octet 22

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>reserved</td>
</tr>
</tbody>
</table>

Octet 23

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>reserved</td>
</tr>
</tbody>
</table>

Octet 24

<table>
<thead>
<tr>
<th>Bit</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7</td>
<td>reserved</td>
</tr>
</tbody>
</table>
For preset calculation the additionally saved factors are shown in Preset-mode:

Octet 25 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 1  
24 Bit unsigned
Octet 26 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 2  
24 Bit unsigned
Octet 27 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 3  
24 Bit unsigned
Octet 28 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 4  
24 Bit unsigned
Octet 29 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 5  
24 Bit unsigned
Octet 30 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 6  
24 Bit unsigned
Octet 31 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 7  
24 Bit unsigned
Octet 32 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 8  
24 Bit unsigned
Octet 33 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 9  
24 Bit unsigned
Octet 34 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 10  
24 Bit unsigned
Octet 35 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 11  
24 Bit unsigned
Octet 36 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 12  
24 Bit unsigned
Octet 37 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 13  
24 Bit unsigned
Octet 38 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 14  
24 Bit unsigned
Octet 39 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 15  
24 Bit unsigned

etc.

Octet 67 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 16  
24 Bit unsigned
Octet 68 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 17  
24 Bit unsigned
Octet 69 | 7 | 7 | 7 | 7 | 7 | Octet Value Magnet # 18  
24 Bit unsigned

For more informations see the website of Profibus User Organization www.profibus.com
10. Ordering Guide

Position Sensor TEMPOSONICS

Scope of Delivery

1. Profile Model
   Sensor with captive sliding magnet or floating magnet and two mounting feet up to 1250 mm measuring stroke. Additional 1 mounting foot per 500 mm longer strokes.

2. Rod Model
   Sensor only. Position magnets are not included with rod-style sensors. They must be ordered separately.

Installation guide + 3.5” GDS disc (Electronic Data Sheet with standardized Device Data Base File).

P1. Order accessories separately!

* Measuring Range

1. Profile Model
   Standard:
   - up to 1000 mm in 50 mm steps
   - up to 5000 mm in 250 mm steps
   Option: Other lengths upon request

2. Rod Model
   Standard:
   - up to 1000 mm in 50 mm steps
   - up to 7600 mm in 250 mm steps
   Option: Other lengths upon request

Sensor Model

RP = Profile housing
RH = Hydraulic rod, threaded flange

Style

1. TEMPOSONIC-RP (Profile)
   S = Captive sliding magnet, joint at top
   V = Captive sliding magnet, joint at front

2. TEMPOSONIC-RH (Rod)
   M = Flange, metric thread M18 x 1.5 (Standard)
   S = Flange, english thread 3/4" - 16 UNF - 3A

Measuring Range * Order Length

0025 / 50 - 2000 mm (Profile model)
0025 / 50 - 7600 mm (Rod model)

Connection Type

D63 = 1 x 6 pin DIN male receptacle, 1 x 6 pin DIN female receptacle
D52 = 1 x 4 pin male receptacle M9, 1 x 5 pin female receptacle M12 (PNO)

Input Voltage

1 = +24 Vdc

Output

P101 = Profibus-DP, Multi-Position measurement
P102 = Profibus-DP, Standard

Number of Magnets for Multi-Position Measurement P101:

Z02 - Z15 = 2 - 15 pieces

* Note: P1. specify magnet numbers for your sensing application and order separately

Accessories

<table>
<thead>
<tr>
<th>Description</th>
<th>Part No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captive Sliding Magnet Type »Se</td>
<td>252 182</td>
</tr>
<tr>
<td>Captive Sliding Magnet Type »Ve</td>
<td>252 184</td>
</tr>
<tr>
<td>Floating Magnet ø 33 mm (open ring)</td>
<td>251 416</td>
</tr>
<tr>
<td>Ringmagnet ø 33 mm, Standard</td>
<td>201 542</td>
</tr>
<tr>
<td>Ringmagnet ø 25,4 mm</td>
<td>400 533</td>
</tr>
<tr>
<td>Mounting Foot</td>
<td>400 747</td>
</tr>
<tr>
<td>T-slot Nut M5 for base channel</td>
<td>401 602</td>
</tr>
<tr>
<td>Sleeve</td>
<td>401 603</td>
</tr>
<tr>
<td>Ball Jointed Arm</td>
<td>401 913</td>
</tr>
<tr>
<td>Connector outlet D63</td>
<td></td>
</tr>
<tr>
<td>6 pin DIN female cable connector</td>
<td>ST C0 9131 D06 PG9</td>
</tr>
<tr>
<td>6 pin DIN male cable connector</td>
<td>ST C0 9131 H06 PG9</td>
</tr>
<tr>
<td>6 pin Bus endplug, male</td>
<td>ST A0 9131 H06</td>
</tr>
<tr>
<td>bus cable (2 wires/2x bus, 2x power supply)</td>
<td>K 53 (specify length)</td>
</tr>
<tr>
<td>Connector outlet D52</td>
<td></td>
</tr>
<tr>
<td>5 pin T-connector M12</td>
<td>560887</td>
</tr>
<tr>
<td>5 pin Cable connector M12, male</td>
<td>560884</td>
</tr>
<tr>
<td>5 pin Cable connector M12, female</td>
<td>560885</td>
</tr>
<tr>
<td>5 pin Bus-endplug M12, male</td>
<td>560888</td>
</tr>
<tr>
<td>4 pin 50&quot; Cable connector M6, female (power supply)</td>
<td>560886</td>
</tr>
<tr>
<td>Profibus cable, 2 wires</td>
<td></td>
</tr>
</tbody>
</table>

Servicetools

- Profibus Handheld-Programmer for simply address set-up for
  - Sensors with connector outlet D63 252 173 D63
  - Sensors with connector outlet D52 252 173-D52
- Profibus Mastersimulator 1131 for check-up sensor function 401 727
- Cable Mastersimulator - Sensors, connector outlet D63 401 720
- Cable Mastersimulator - Sensors, connector outlet D52 252 383

NOTIF

Projecting and parameterizing a Profibus system will be done with servicetool of Profibus mastersystem supplier.