**Operating Instructions**

**Analog Measurement System**

**Temposonics** are linear position sensors. Measurement values are absolute and available without error immediately without reference measurement even after power recovery. Position measurement is contactless via a position magnet which does not need to be energized. The wear-free sensor function combines high operating safety and a long service life.

This **Temposonics** sensor with built-in analog output is connected to the controller without an additional evaluating unit. Position and velocity can be measured. Operations with one or two magnets are possible.

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Preface
The general safety instructions given below are intended to ensure the personnel safety and to avoid damage. Tempsonics 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 Tempsonics Sensors.

Application
1. The position measurement systems of all series Tempsonics 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 Tempsonics beyond these limits is incorrect. MTS Sensor Technologie GmbH & Co. KG 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 risks 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.
The following description is valid for all R-Series Tempsonics position sensors with ANALOG Interfaces (Profile or Rod style) with measuring ranges of 25 - 7600 mm. Their model number is shown on each sensor type label with following ordering code (see right).

### Position Sensor Tempsonics

#### Sensor Model
- **RP** = Profile housing
- **RH** = Hydraulic Rod with threaded flange

#### Style
1. **Tempsonics-RP (Profile)**
   - **S** = Captive sliding magnet, joint at top
   - **V** = Captive sliding magnet, joint at front
   - **M** = Floating magnet, Ø 33 mm (open ring)

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

#### Measuring Range/Order Length
- 0050 - 5000 mm (Profile model)
- 0050 - 7600 mm (Rod model)

#### Connection Type
- **D60** = 6 pin DIN male receptacle
- **R02** = 2 m pigtailed PVC cable w/o connector (Option: 01 - 10 m)

#### Input Voltage
- 1 = +24 Vdc

### Output

#### 1-Magnet Sensor
1. **Position**
   - V01 = 0 - 10 V
   - V11 = 10 - 0 V
   - A01 = 4 - 20 mA
   - A11 = 20 - 4 mA
   - A21 = 0 - 20 mA
   - A31 = 20 - 0 mA

<table>
<thead>
<tr>
<th>Position</th>
<th>V01 XXX,X = 0 - 10 V</th>
<th>V11 XXX,X = 10 - 0 V</th>
<th>A01 XXX,X = 4 - 20 mA</th>
<th>A11 XXX,X = 20 - 4 mA</th>
<th>A21 XXX,X = 0 - 20 mA</th>
<th>A31 XXX,X = 20 - 0 mA</th>
</tr>
</thead>
</table>

   **Velocity (Vmax):** 000,1 - 010,0 m/s
   - Sample: (5.5 → 0 → 5.5 m/s = 10 → 0 → 10 V) = V01 0055
   - (1.0 → 0 → 1.0 m/s = 4 → 12 → 20 mA) = A41 0010
   - Velocity output for V01 - A71 (see above)

   Measuring direction: Revers - Null - Forward
   - V01 = 10 → 0 → 10 V
   - V11 = 10 → 0 → 10 V
   - A01 = 20 → 4 → 20 mA
   - A11 = 20 → 20 mA
   - A21 = 20 → 20 mA
   - A31 = 20 → 20 mA

#### 2-Magnet Sensor
Position 1 + 2
- V02 = 0 - 10 V
- V12 = 10 - 0 V
- A02 = 4 - 20 mA
- A12 = 20 - 4 mA
- A22 = 0 - 20 mA
- A32 = 20 - 0 mA

<table>
<thead>
<tr>
<th>Position</th>
<th>V01 XXX,X = 0 - 10 V</th>
<th>V11 XXX,X = 10 - 0 V</th>
<th>A01 XXX,X = 4 - 20 mA</th>
<th>A11 XXX,X = 20 - 4 mA</th>
<th>A21 XXX,X = 0 - 20 mA</th>
<th>A31 XXX,X = 20 - 0 mA</th>
</tr>
</thead>
</table>

Sample type label
- **RH-S-0850M-D60-1-V01**
- **Output signal**
- **0-10 V**
- **FNr:** 0020 0376
- **Production code #.**
Temposonics-RP / Measuring Range: 50 - 5000 mm

1. Temposonics RP-S...

2. Temposonics RP-V...

3. Temposonics RP-M...

Temposonics-RH / Measuring Range: 50 - 7600 mm

CAUTION!
With all sensors described in these operating instructions, the areas left and right of the stroke length are inactive (mounting area, damping) and should not be used for measurement. Nevertheless, the stroke length can be overtravelled.
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 contactless.

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

**Profile-Style**
The sensor requires at least 2 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.

**Rod-Style**
The sensor can be mounted in any position. Note the minimum clearances (right). Use non-magnetic screws, supports etc. Sensors above 1000 mm measuring stroke may require mechanical supports at horizontal mounting.

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**Open Ringmagnet, removable**

1. Magnet
2. Non-magnetic mounting plate and screws

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**Example: Sensor Supports**

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

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**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 service.

When installing the sensor in the cylinder notice following:
1. Magnet must not slide along the sensor tube.
2. 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.
3. Do not exceed peak pressure of 530 bar.
4. Protect the sensor rod from wear.

**ATTENTION**
After change of sensor cartridge, the screws must be fastened with e.g. Loctite 243.
Profile and Rod-Models

WARNING!
Tempsonics sensors are active electronic systems. When installing the transducer 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.

Dependent on version, the sensor must be connected via the 6 pin connector or via the in-tegated cable. Connection is dependent on application:

- Position measurement (1 magnet sensor)
- Position measurements 1 + 2 (2 magnets sensor)
- Velocity measurement (1 magnet sensor)

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 mor- tor cables,

Attention!
Note supplement to CE labeling!
Be care for a flawless sensor machine grounding. The cable shield must be connected to the cable connector and has to be connected to machine ground on the controller electronic side. Typical ground connections are shown in the examples right.

<table>
<thead>
<tr>
<th>Pin</th>
<th>Cable</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>gray</td>
<td>Output No. 1: Position</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 - 10 V / 10 - 0 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 - 20 mA / 20 - 4 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 - 20 mA / 20 - 0 mA</td>
</tr>
<tr>
<td>2</td>
<td>pink</td>
<td>DC Ground / Return</td>
</tr>
<tr>
<td>3</td>
<td>yellow</td>
<td>Output No. 2: Position or Velocity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 - 10 V / 10 - 0 V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4 - 20 mA / 20 - 4 mA</td>
</tr>
<tr>
<td></td>
<td></td>
<td>0 - 20 mA / 20 - 0 mA</td>
</tr>
<tr>
<td>4</td>
<td>green</td>
<td>DC Ground / Return</td>
</tr>
<tr>
<td>5</td>
<td>brown</td>
<td>+24 Vdc (+15%/-20%)</td>
</tr>
<tr>
<td>6</td>
<td>white</td>
<td>DC Ground (0 V)</td>
</tr>
</tbody>
</table>

IMPORTANT!
If using Output # 1 only, the cable wires yellow and green of Output # 2 must be isolated absolutely.
ATTENTION: SHORT CIRCUIT

Typical grounding profile style

Typical grounding rod style
All Tempsonics sensors are factory calibrated and should not require calibration. However, if your application requires that the Zero and Span settings or velocity output be modified, use the appropriate procedure below.

Sensor programming means the location of setpoints SP1 and SP2 (Fig. 3) and adjustment of the outputs (V or mA) at these points. Use the two pushbuttons (right) in the sensor head for new setpoints and the choice of operation modes.

For programming, remove the two protective screws above pushbuttons PB1 and PB2 and press the switches by means of the programming tool delivered with the sensor.

Attention
Do not use peaked or sharp-edged tools for actuating pushbuttons. They can destroy the switches.

Measuring Range

ATTENTION!
Independent on measuring direction, location of setpoints is always:
• SP1 at Sensor head
• SP2 at Rod end

When programming sensors, make sure that setpoints are within the active stroke length of the sensor.

NOTE
Sensors will be adjusted at factory according to the order specifications and delivered with
- one current output or
- one voltage output or
- two current outputs or
- two voltage outputs
Operation Modes

The sensor will support three available operation modes. Determined output values of a connected multimeter confirm setting of the desired mode (below).

**Operation Mode 1: Position Output (Single magnet) ........ Display: appx. 5.5 V or 11.0 mA**

**Operation Mode 2: Position Output 1+2 (Dual magnet) ...... Display: appx. 3.0 V or 6.8 mA**

Attention: Operation mode 2-magnets needs two magnets. One magnet only does not work.

**Operation Mode 3: Position + Velocity Output (Single magnet) ... Display: appx. 8.0 V or 15.5 mA**

<table>
<thead>
<tr>
<th>OPERATION MODE 1: Displacement Measurement (Single Magnet)</th>
<th>Display Output</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measuring direction: FORWARD ACTING</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output: 0-10 V / 4-20 mA / 0-20 mA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Action</th>
<th>Display Output</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1)</td>
<td>Remove screws to access push-buttons PB1 and PB2</td>
<td></td>
</tr>
<tr>
<td>2)</td>
<td>Connect a multimeter (V/A) across Output 1 (see page 6)</td>
<td></td>
</tr>
<tr>
<td>3)</td>
<td>Turn the power ON</td>
<td>Attention! Switch on sensor approx. 5 minutes before programming.</td>
</tr>
<tr>
<td>4)</td>
<td>Move the magnet to desired set point SP2 (towards rod end)</td>
<td>Important! Do not move the magnet anymore.</td>
</tr>
<tr>
<td>5)</td>
<td>Press and release PB1</td>
<td>jumps to appx. 5.5 V (11.0 mA)</td>
</tr>
<tr>
<td>6)</td>
<td>Press and release PB2</td>
<td>jumps to appx. 10.5 V (20.0 mA)</td>
</tr>
<tr>
<td>7)</td>
<td>Press and release PB2</td>
<td>remains at appx. 10.5 V (20.0 mA)</td>
</tr>
</tbody>
</table>

**Operation Mode Selection Display: 5.5 V / 11.0 mA**

<table>
<thead>
<tr>
<th>Setpoint SP2 Adjustment</th>
<th>8) Press PB1 (increase) or PB2 (decrease) for setting</th>
<th>10.000 V (20.000 mA) or the desired Output Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alternative: Press PB1 + PB2 together</td>
<td>Velocity of setting values increase after approx. 10 seconds.</td>
</tr>
<tr>
<td></td>
<td>9) Move the magnet to desired set point SP1 (towards sensor head)</td>
<td>jumps to appx. 1.000 V (2.000 mA)</td>
</tr>
<tr>
<td></td>
<td>Alternative: Press PB1 + PB2 together</td>
<td>Attention! Needs a minimum magnet speed of approx. 3.5 mm/sec.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Setpoint SP1 Adjustment</th>
<th>10) Press PB1 (increase) or PB2 (decrease) for setting</th>
<th>0.050 V. 4.000 mA. 0.050 mA or the desired Output Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Alternative: Press PB1 + PB2 together</td>
<td>Velocity of displayed values increase after approx. 10 seconds.</td>
</tr>
<tr>
<td></td>
<td>11) Move the magnet towards SP2 (rod end)</td>
<td>10.000 V (20.000 mA) or adjusted Output Value</td>
</tr>
<tr>
<td></td>
<td>Alternative: Press PB1 + PB2 together</td>
<td>Attention! Needs a minimum magnet speed of appx. 3.5 mm/sec.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Moving the magnet automatically exits programming and puts the sensor in operating mode.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Checkup</th>
<th>12) Move the magnet towards SP (sensor head)</th>
<th>0.050 V. 4.000 mA. 0.050 mA or adjusted Output Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13) Place the magnet at the middle of the measuring range</td>
<td>5.025 V. 12.000 mA or 10.025 mA</td>
</tr>
<tr>
<td></td>
<td>14) Move the magnet inside the active stroke</td>
<td>Output values must be displayed continuously.</td>
</tr>
<tr>
<td></td>
<td>15) Screw in the protective screws with Loctite 243</td>
<td></td>
</tr>
</tbody>
</table>

Note:
Tempmosonic sensors are supplied with either Vdc or mA output from the factory and cannot be reprogrammed in the field. When programming Tempmosonic sensors, make sure that the setpoints are within the active stroke length of sensor.
## OPERATING MODE 1: Displacement Measurement (Single Magnet)

**Measuring direction:** REVERSE ACTING

**Output:** 0-10 V / 4-20 mA / 0-20 mA

<table>
<thead>
<tr>
<th>Action</th>
<th>Display Output</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Remove screws to access push-buttons PB1 and PB2</td>
<td>• Connector Pin: 1 and 2 • Cable Color: gray and pink</td>
<td></td>
</tr>
<tr>
<td>2) Connect a multimeter (V/A) across Output 1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3) Turn the power ON</td>
<td></td>
<td>Attention! Switch on sensor approx. 5 minutes before programming.</td>
</tr>
</tbody>
</table>

### Operation Mode Selection

**Display:** 5.5 V / 11.0 mA

<table>
<thead>
<tr>
<th>Action</th>
<th>Display Output</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>4) Move the magnet to desired set point SP2 (towards rod end)</td>
<td>jumps to approx. 5.5 V (11.0 mA)</td>
<td>Important! Do not move the magnet anymore.</td>
</tr>
</tbody>
</table>

### Setpoint SP2 Adjustment

<table>
<thead>
<tr>
<th>Action</th>
<th>Display Output</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>5) Press and release PB1</td>
<td>0.050 V, 4.000 mA, 0.050 mA or the desired Output Value</td>
<td>Velocity of setting values increase after approx. 10 seconds</td>
</tr>
<tr>
<td>6) Press and release PB2</td>
<td>jumps to approx. 10.0 V (20.0 mA)</td>
<td>Shows displacement measurement «revers acting» mode is selected.</td>
</tr>
<tr>
<td>7) Press and release PB1</td>
<td>jumps to approx. 0.5 V (1.5 mA)</td>
<td></td>
</tr>
<tr>
<td>8) Press and release PB2</td>
<td>remains at approx. 0.5 V (1.5 mA)</td>
<td>Confirms selected operating mode</td>
</tr>
</tbody>
</table>

### Setpoint SP1 Adjustment

<table>
<thead>
<tr>
<th>Action</th>
<th>Display Output</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>9) Press PB1 (decrease) or PB2 (increase) for setting</td>
<td>10.000 V (4.000 mA) or the desired Output Value</td>
<td>Velocity of displayed values increase after approx. 10 seconds.</td>
</tr>
<tr>
<td>10) Move the magnet to desired set point SP1 (towards sensor head)</td>
<td>jumps to approx. 10.0 V (20.0 mA)</td>
<td>Attention! Needs a minimum magnet speed of approx. 3.5 mm/sec.</td>
</tr>
<tr>
<td>Alternative:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press PB1 + PB2 together</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Checkup

<table>
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<tr>
<th>Action</th>
<th>Display Output</th>
<th>Note</th>
</tr>
</thead>
<tbody>
<tr>
<td>11) Press PB1 (decrease) or PB2 (increase) for setting</td>
<td>10.000 V (4.000 mA) or the desired Output Value</td>
<td></td>
</tr>
<tr>
<td>12) Move the magnet towards SP2 (rod end)</td>
<td>0.050 V, 4.000 mA, 0.050 mA or adjusted Output Value</td>
<td>Attention! Needs a minimum magnet speed of approx. 3.5 mm/sec. Moving the magnet automatically exits pro- gramming and puts the sensor in operating mode.</td>
</tr>
<tr>
<td>Alternative:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Press PB1 + PB2 together</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Programming of «reverse acting» is complete

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<tr>
<th>Action</th>
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<tr>
<td>13) Move the magnet towards SP1 (sensor head)</td>
<td>10.000 V (20.000 mA) or adjusted Output Value</td>
<td></td>
</tr>
<tr>
<td>14) Place the magnet at the middle of the measuring range</td>
<td>5.025 V, 12.000 mA or 10.025 mA</td>
<td>Valid only for standard adjustment.</td>
</tr>
<tr>
<td>15) Move the magnet inside the active stroke</td>
<td></td>
<td>Output values must be displayed continuously.</td>
</tr>
</tbody>
</table>

**Note!**

Tempsonics sensors are supplied with either Vdc or mA output from the factory and cannot be reprogrammed in the field. When programming Tempsonics sensors, make sure that the setpoints are within the active stroke length of sensor.

**Recommendation!**

At present reprogramming of Operation Modes 2 and 3 should be done at MTS factory.