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# **Ω OMEGA™** **User's Guide**



*PRTXI model*

*PRTXS model*

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## **PRTXI and PRTXS Series RTD Temperature Transmitter with IO-Link/Switch and 4 to 20 mA**



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The information contained in this document is believed to be correct, but OMEGA accepts no liability for any errors it contains and reserves the right to alter specifications without notice.

## Table of Contents

|  |           |
|--|-----------|
| Table of Contents .....                                      | 3         |
| <b>1 Notes, Cautions, and Warnings .....</b>                 | <b>4</b>  |
| 1.1 Requirements for Personnel .....                         | 4         |
| 1.2 Designated Use .....                                     | 4         |
| 1.3 Operational Safety .....                                 | 4         |
| 1.4 Product Safety .....                                     | 4         |
| <b>2 Specifications .....</b>                                | <b>5</b>  |
| <b>3 PRTX Hardware Overview .....</b>                        | <b>9</b>  |
| 3.1 Installation Instructions .....                          | 10        |
| 3.1.1 Orientation .....                                      | 11        |
| 3.1.2 Device Temperature Ranges .....                        | 11        |
| 3.1.3 Cylindrical Threads .....                              | 11        |
| 3.1.4 Tapered Threads .....                                  | 12        |
| <b>4 Electrical Connection .....</b>                         | <b>13</b> |
| 4.1 IO-Link Operating Mode .....                             | 13        |
| 4.2 4 to 20 mA Operating Mode .....                          | 14        |
| <b>5 System Integration .....</b>                            | <b>15</b> |
| 5.1 Device and Vendor Identification .....                   | 15        |
| 5.2 Process Data .....                                       | 15        |
| 5.3 Reading and Writing Device Data .....                    | 16        |
| 5.3.1 Specific Device Data .....                             | 16        |
| 5.3.2 IO-Link Specific Device Data .....                     | 19        |
| 5.3.3 System Commands .....                                  | 19        |
| <b>6 Diagnostics and Troubleshooting .....</b>               | <b>20</b> |
| 6.1 Diagnostic Information via Communication Interface ..... | 20        |
| 6.2 Diagnostic Overview .....                                | 21        |
| 6.2.1 Device Behavior During an Event Fault .....            | 22        |
| 6.3 Diagnostic List .....                                    | 23        |
| 6.4 Event Logbook .....                                      | 23        |
| <b>7 Maintenance and Cleaning .....</b>                      | <b>23</b> |
| 7.1 Services .....   | 23        |
| <b>8 Certifications and Approvals .....</b>                  | <b>24</b> |

## 1 Notes, Cautions, and Warnings

If the equipment is used in a manner not specified in this manual, protection of the equipment may be impaired.

Do not operate the equipment in flammable or explosive environments.

It is important to read and follow all precautions and instructions in this manual before operating or commissioning this device as it contains important information relating to safety and EMC. Failure to follow all the safety precautions may result in injury and/or damage to the equipment.

The following labels identify information that is especially important to note:



**Note:** Provides information that is important to successfully set up and use the PRTXI/PRTXS.



**Caution or Warning:** Informs about the risk of electrical shock.



**Caution, Warning, or Important:** Informs of circumstances that can affect the functionality of the instruments and must refer to accompanying documents.

### 1.1 Requirements for Personnel

Installation, commissioning, diagnostics, and maintenance must abide by the following requirements:

- Trained, qualified specialists must have relevant qualifications.
- Personnel must be authorized by the plant owner/operator.
- Personnel must be familiar with federal/national regulations.
- Before starting work, read and understand the instructions in the manual.
- Follow instructions and comply with basic conditions.

### 1.2 Designated Use

The device is a compact RTD temperature sensor for industrial temperature measurement. The manufacturer is not liable for damage caused by improper or non-designated use.

### 1.3 Operational Safety

**Modifications to the device:** Unauthorized modifications to the device are not permitted and can lead to dangers to personnel and/or the device.



**Caution: Risk of injury!**

- Operate the device only if it is in proper technical condition, free from errors and faults.

### 1.4 Product Safety

This measuring device is designed in accordance with safety requirements, has been tested, and shipped in a condition in which it is safe to operate. It meets general safety standards and legal requirements. It also complies with the EC directives listed in the EC Declaration of Conformity. The manufacturer confirms this by affixing the CE mark to the device.

## 2 Specifications

**Measurement Range:** -50 to 200°C (-58 to 392°F)

**Output Signal**

**4 to 20 mA (Analog):** 4 to 20 mA; measuring range -50 to 200°C (-58 to 392°F)

**IO-Link (Digital):** C/Q (IO-Link or switch output)

**Note** For additional information regarding the IO-Link and 4 to 20 mA wiring, refer to Section 4 **Electrical Connection**.

### Failure Information

Failure information is generated if the measuring information is missing or not valid. The device displays the three diagnostic messages with the highest priority.

In the **IO-Link mode**, the device transmits all failure information digitally.

In the **4 to 20 mA mode**, the device transmits the failure information according to NAMUR NE43:

| Fault                      | Description  |
|----------------------------|--|
| Underranging               | Linear drop from 4.0 to 3.8 mA.  |
| Overranging                | Linear increase from 20.0 to 20.5 mA.  |
| Failure (Sensor Defective) | ≤ 3.6 mA (low) or ≥ 21 mA (high) can be selected. The high alarm setting can be set between 21.5 mA and 23 mA; providing the flexibility needed to meet the requirements of various control systems. |

**Linearization/Transmission Behavior:** Temperature – linear

### Power Supply

**Supply Voltage (IO-Link/4 to 20 mA):**  $U_b = 10$  to 30 V DC, protected against reverse polarity. IO-Link communication is guaranteed only if the supply voltage is at least 15 V. If the supply voltage is less than 15 V, the device displays a diagnostic message and deactivates the switch output.

**Power Supply Failure:** To meet electrical safety according to CAN/CSA-C22.2 No. 61010-1 or UL 61010-1, the device may only be powered by a power supply unit with a limited energy electric circuit in accordance with UL/EN/IEC 61010-1 chapter 9.4 or Class 2 according to UL 1310, "SELV or Class 2 circuit".

**Behavior in the event of overvoltage (> 30 V):** The device works continuously up to 35 V DC without any damage. If the supply voltage is exceeded, the provided specifications can no longer be guaranteed.

**Behavior in the event of undervoltage:**

If the supply voltage falls below the minimum value ~ 7 V, the device will switch off as if not supplied with power.

**Maximum Current Consumption:** ≤ 23 mA for 4 to 20 mA

**Power-On Delay:** 2 seconds

**Overvoltage Protection:** To protect against overvoltage in the power supply and signal/communication cables for the RTD temperature sensor electronics, the use of a suitable surge arrester is recommended.

## Reference Operating Conditions

**Adjustment Temperature (Ice Bath):** 0°C (32°F) for sensor

**Ambient Temperature:** (25°C ± 3°C (77°F ± 5°F) for electronics

**Supply Voltage:** 24 V DC ± 10%

**Relative Humidity:** <95%

**Maximum Measured Error:** When in accordance with the reference operating conditions listed above, the measured error data corresponds to ±2 σ (Gaussian distribution). The data include non-linearities and repeatability.

Measured error (according to IEC 60751) in °C = 0.15 + 0.002 |T|

**Note:** |T| = Numerical value of the temperature in °C without regard to algebraic sign.

## RTD Temperature Sensor with Electronics

| Standard  | Designation | Measuring Range                 | Measured Error (±)    |   |                   |
|-----------|-------------|---------------------------------|-----------------------|---|-------------------|
|           |             |                                 | Maximum               | Based on measured value                               | D/A <sup>2)</sup> |
| IEC 60751 | Pt100 Cl. A | -50 to +200 °C (-58 to +392 °F) | ≤0.55 °C<br>(0.99 °F) | ME = ± (0.215 °C (0.387 °F) +<br>0.134% * (MV - LRV)) | 0.05 % (8 μA)     |

1) Measured Value transmitted via IO-Link.

2) Percentages based on the configured span of the analog output signal.

MV = Measured value

LRV = Lower range value of relevant sensor

Total measured error of transmitter at current output =  $\sqrt{(\text{Measured error digital})^2 + \text{Measured error D/A}^2}$

**Operating Influences:** The measured error data corresponds to  $\pm 2 \sigma$  (Gaussian distribution).

| Standard  | Designation | Ambient Temperature Influence (+-) per 1 °C (1.8 °F) Change |  |                   | Supply Voltage Influence (+-) per 1 V Change |  |                   |
|-----------|-------------|---|--|-------------------|--|--|-------------------|
|           |             | Digital <sup>1)</sup>                                       |  | D/A <sup>2)</sup> | Digital <sup>1)</sup>                        |  | D/A <sup>2)</sup> |
|           |             | Maximum <sup>3)</sup>                                       | Based on measured value <sup>4)</sup>              |                   | Maximum <sup>3)</sup>                        | Based on measured value <sup>4)</sup>              |                   |
| IEC 60751 | Pt100 Cl. A | 0.010 °C (0.018 °F)   | 0.004 % * (MV - LRV), min.<br>0.008 °C (0.0144 °F) | 0.003 % (0.48 µA) | 0.010 °C (0.018 °F)                          | 0.004 % * (MV - LRV), min.<br>0.008 °C (0.0144 °F) | 0.003 % (0.48 µA) |

- 1) Measured value transmitted via IO-Link.
- 2) Percentages based on the configured span of the analog output signal.
- 3) Maximum measured error for the specified measuring range.
- 4) Deviations from maximum measured error possible due to rounding.

MV = Measured value

LRV = Lower range value of relevant sensor

Total measured error of transmitter at current output =  $\sqrt{(\text{Measured error digital})^2 + \text{Measured error D/A}^2}$

The following is a table of sample calculations with Pt100, measuring range -50 to +200 °C (-58 to +392°F), ambient temperature +35 °C (+95 °F), and supply voltage 30 V:

| Sample Calculations                          |  |                   |
|--|--|-------------------|
| Measured Error Digital                       | $0.215 \text{ °C (0.387 °F)} + 0.134\% \times [200 \text{ °C (392 °F)} - (-50 \text{ °C (-58 °F)})]$   | 0.55 °C (0.99 °F) |
| Measured Error D/A                           | $0.05\% \times 200 \text{ °C (392 °F)}$  | 0.10 °C (0.18 °F) |
| Influence of Ambient Temperature (Digital)   | $(35 - 25) \times (0.004\% \times 200 \text{ °C (392 °F)})$ , min. 0.008 °C (0.014 °F)   | 0.08 °C (0.14 °F) |
| Influence of Ambient Temperature (D/A)       | $(35 - 25) \times (0.003\% \times 200 \text{ °C (392 °F)})$  | 0.06 °C (0.11 °F) |
| Influence of Supply Voltage (Digital)        | $(30 - 24) \times (0.004\% \times 200 \text{ °C (392 °F)})$ , min. 0.008 °C (0.014 °F)   | 0.05 °C (0.09 °F) |
| Influence of Supply Voltage (D/A)            | $(30 - 24) \times (0.003\% \times 200 \text{ °C (392 °F)})$  | 0.04 °C (0.07 °F) |
| Measured Error Digital Value (IO-Link)       | $\sqrt{(\text{Measured error digital})^2 + \text{Influence of ambient temperature (digital)}^2 + \text{Influence of supply voltage (digital)}^2}$  | 0.56 °C (1.01 °F) |
| Measured Error Analog Value (Current Output) | $\sqrt{(\text{Measured error digital})^2 + \text{Measured error D/A}^2 + \text{Influence of ambient temperature (digital)}^2 + \text{Influence of ambient temperature (D/A)}^2 + \text{Influence of supply voltage (digital)}^2 + \text{Influence of supply voltage (D/A)}^2}$ | 0.57 °C (1.03 °F) |

#### Long-Term Drift:

|                        | 1 Month  | 3 Months | 6 Months | 1 Year   | 3 Years  | 5 Years  |
|------------------------|----------|----------|----------|----------|----------|----------|
| Digital output IO-Link | ± 9 mK   | ± 15 mK  | ± 19 mK  | ± 23 mK  | ± 28 mK  | ± 31 mK  |
| Current output 4-20 mA | ± 2.5 µA | ± 4.3 µA | ± 5.4 µA | ± 6.4 µA | ± 8.0 µA | ± 8.8 µA |

**Response Time  $T_{90}$ :** Test in water at 0.4 m/s (1.3 ft/s) according to IEC 60751; temperature changes in increments of 10 K.

| Design               | $t_{90}$ |
|----------------------|----------|
| 1/8" diameter probe  | 2 s      |
| 3/16" diameter probe | 2 s      |
| 1/4" diameter probe  | 4 s      |

#### Environment

**Ambient Temperature Range:** -40 to 85°C (-40 to 185°F)

**Storage Temperature:** -40 to 85°C (-40 to 185°F)

**Operating Altitude:** Up to 2000 m (6600 ft) above sea level

**Climate Class:** As per IEC/EN 60654-1, Class Dx

**Degree of Protection:** As per IEC/EN 60529 IP69

**Shock and Vibration Resistance:** The RTD temperature sensor meets the requirements of IEC 60751, which specifies shock and vibration resistance of 5 g in the 10 to 2000 Hz range.

**Electromagnetic Compatibility (EMC):** EMC in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21). For details, refer to the Declaration of Conformity.

- Maximum measured error under EMC tests: < 1 % of the span
- Interference immunity according to IEC/EN 61326 series, requirements for industrial fields.
- Interference emission according to IEC/EN 61326 series, Class B equipment

#### IO-Link

- Only the requirements of IEC/EN 61131-9 are met in IO-Link mode.
- The connection between the IO-Link master and RTD temperature sensor is established using an unshielded 3-wire cable, maximum 20 m (65.6 ft) in length.

#### 4 to 20 mA

- Electromagnetic compatibility in accordance with all the relevant requirements of the IEC/EN 61326 series and NAMUR Recommendation EMC (NE21).
- With a connection cable length of 30 m (98.4 ft): always use a shielded cable.
- The use of twisted pair shielded connection cables is generally recommended.

**Electrical Safety:** Protection class III, Overvoltage category II, Pollution level 2



### 3 PRTX Hardware Overview

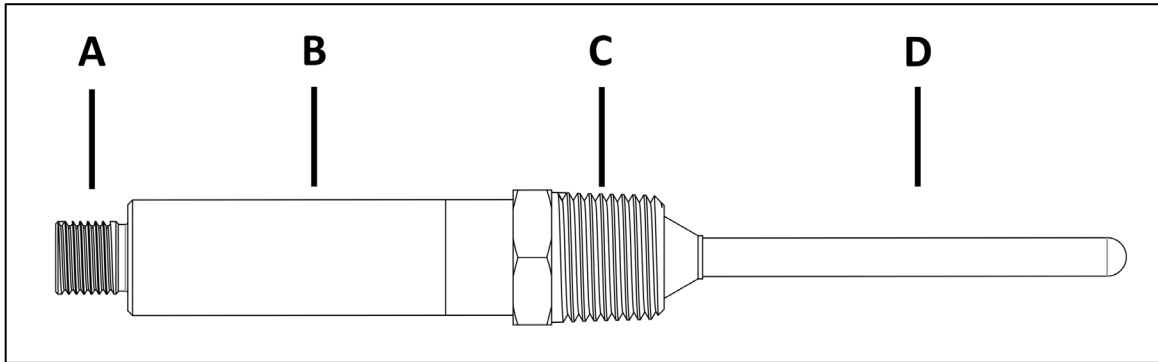


Figure 1: PRTX probe diagram

| Key | Description            |
|-----|------------------------|
| A   | M12 threaded connector |
| B   | Transmitter housing    |
| C   | Process connection     |
| D   | Sensor Probe           |

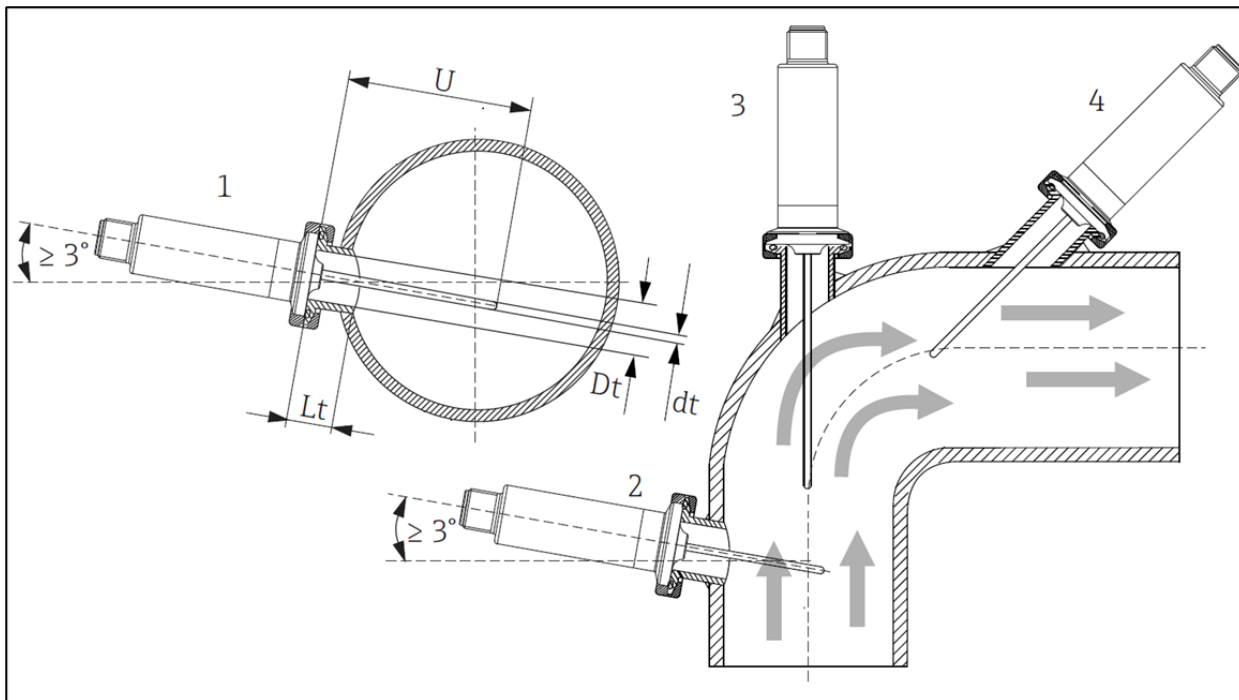


Figure 2: Installation visual diagram guide

| Key | Description   |
|-----|---|
| 1   | Perpendicular to flow direction, installed at a minimum angle of 3° to ensure self-draining |
| 2   | Perpendicular to flow direction, installed at a minimum angle of 3° to ensure self-draining |
| 3   | On elbows   |
| 4   | Inclined installation in pipes with a small nominal diameter                                |
| U   | Immersion length  |

### 3.1 Installation Instructions

The immersion length of the RTD temperature sensor can considerably influence the accuracy of the device. If the immersion length is too short, measurement errors can occur. When installing the device in a pipe, the immersion length should penetrate halfway into the pipe diameter and ideally also be at least 15 times the diameter of the probe. Installation examples include:

- Pipes
- Tanks
- Other plant components

Proceed as follows to install the device:

**Step 1:** The permitted tightening torque of the process connections can be found in the specifications.

**Step 2:** The process connection and compression fitting must comply with the maximum specified process pressure.

**Step 3:** Make sure that the device is installed and secured before applying the process pressure.

**Step 4:** Adjust the tightening torque of the thermowell to the process conditions.

**Step 5:** It may be necessary to calculate the static and dynamic tightening torque.

In the case of pipes with a small nominal diameter, the tip of the RTD temperature sensor should be inserted deep enough into the process so that it extends past the pipe axis; Installation at an angle (4) may be another solution. When determining the immersion length or installation depth, parameters of the RTD temperature sensor and of the medium to be measured, such as flow velocity and process pressure, must be considered.

**Note**

**Note:** The requirements of the EHEDG and the 3-A Sanitary Standard must be adhered to.

- Installation instructions EHEDG/cleanability:  $Lt \leq (Dt-dt)$
- Installation instructions 3-A/cleanability:  $Lt \leq 2(Dt-dt)$
- EHEDG certified installation requires the use of special gaskets as described in the EHEDG position paper "Easy cleanable pipe couplings and process connections" Version 5, June 2019

The following actions must be taken if a sealing ring (O-ring) or seal fails:

**Step 1:** The RTD temperature sensor must be removed.

**Step 2:** The thread and the O-ring joint/sealing surface must be cleaned.

**Step 3:** The sealing ring or seal must be replaced.

**Step 4:** Proper cleaning of the device must be performed after installation.

In the case of weld-in connections, exercise the necessary degree of care when performing the welding work on the process side:

**Step 1:** Use suitable welding material.

**Step 2:** Flush-weld or weld with welding radius  $\geq 3.2$  mm (0.13 in).

**Step 3:** Avoid crevices, folds or gaps.

**Step 4:** Ensure the surface is honed and polished,  $Ra \leq 0.76$   $\mu\text{m}$  (30  $\mu\text{in}$ ).

The installed sensor is suitable for cleaning in place. Cleaning is performed together with the pipe or tank. In the case of internal tank fixtures using process connection nozzles, it is important to ensure that the cleaning assembly directly sprays this area so that it is cleaned properly.

### 3.1.1 Orientation

No restrictions. However, the process must be able to self-drain. If there is an opening to detect leaks at the process connection, the opening must be at the lowest possible point.


### 3.1.2 Device Temperature Ranges

The device generates a diagnostic message **S825** if unfavorable device conditions are reached, such as high process temperature, high ambient temperature, or electronics too close to the process. The device generates diagnostic message **F001** or **Failure Current** if the device temperature exceeds the recommended temperature.

**Ambient Temperature Range:** -40 to 85°C (-40 to 185°F) The RTD temperature sensor electronics must be protected against temperatures over 85°C (185°F)

**Process Temperature Range:** -50 to 200°C (-58 to 392°F)

### 3.1.3 Cylindrical Threads

**Note**  **Note:** Seals must be used for cylindrical G threads.

| Process Connection | Tightening Torque [Nm] |
|--------------------|------------------------|
| G ¼"               | 61 Nm (45 ft/lbs)      |
| G ⅜"               | 75 Nm (55 ft/lbs)      |
| G ½"               | 81 Nm (60 ft/lbs)      |

If new sealing washers are required, they can be purchased from Omega Engineering in the following sizes:

| Process Connection | Omega Part Number |
|--------------------|-------------------|
| G ¼"               | CSW-1/4           |
| G ⅜"               | CSW-3/8           |
| G ½"               | CSW-1/2           |

### 3.1.4 Tapered Threads

The operator must verify if additional sealing is necessary in the case of NPT threads or other tapered threads.

| Process Connection | Tightening Torque [Nm]             |
|--------------------|------------------------------------|
| ¼" NPT             | Hand-tighten, then, 2-3 full turns |
| ⅜" NPT             | Hand-tighten, then, 2-3 full turns |
| ½" NPT             | Hand-tighten, then, 2-3 full turns |

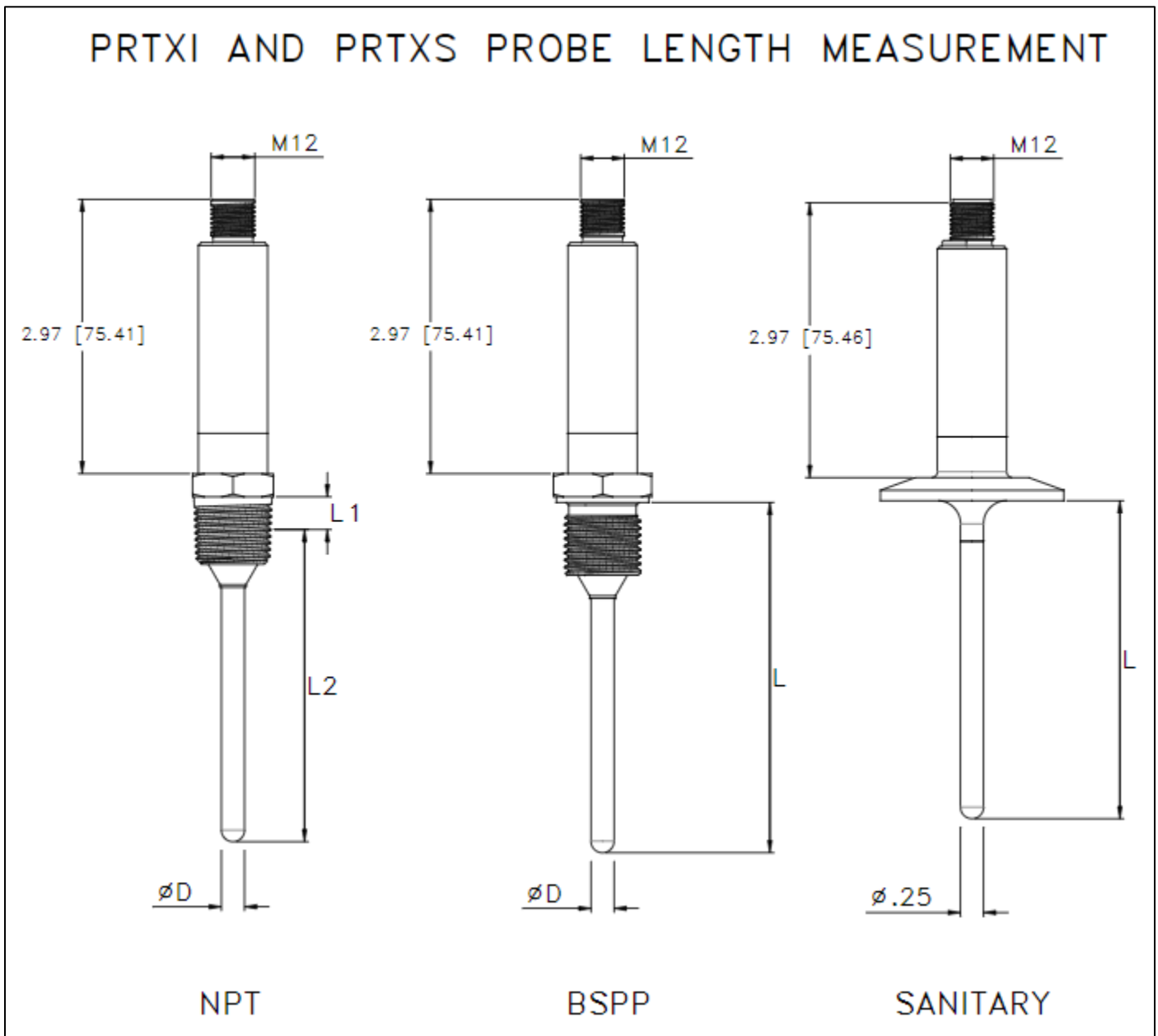



Figure 3: Tapered thread measurement guide

## 4 Electrical Connection

The Omega PRTX offers two operating modes. Refer to the wiring diagrams below outlining the two different options.

 **Important:** Do not overtighten the M12 plug, as this may damage the device. The maximum torque of the M12 knurl is **0.4 Nm**. The indicated degree of protection is ensured if the M12x1 cable connector meets the required degree of tightness.

### 4.1 IO-Link Operating Mode

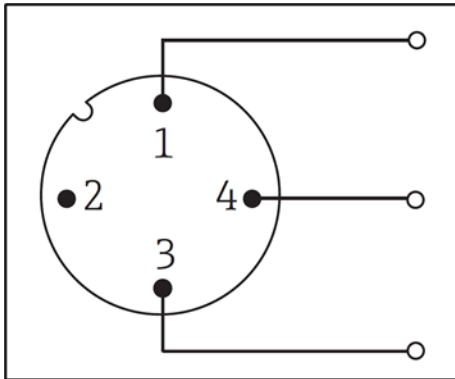


Figure 3: IO-Link wiring diagram

| Pin | Description                    |
|-----|--------------------------------|
| 1   | + Power supply 15 to 30 V DC   |
| 2   | Not used                       |
| 3   | - Power supply 0 V DC          |
| 4   | C/Q (IO-Link or switch output) |

#### Switching Capacity

- 1x PNP switch output
- Switch state ON  $I_a \leq 200 \text{ mA}$ ; switch state OFF  $I_a \leq 10 \mu\text{A}$
- Switch cycles  $> 10,000,000$
- Voltage drop PNP  $\leq 2 \text{ V}$
- Overload protection
  - Automatic load testing of switching current
  - If a current of over 220 mA flows in the ON switch state, the device switches to a safe state
  - Diagnostic message **Overload at switch output**
- Switch functions
  - Hysteresis or window function
  - NC contact or NO contact
- No pull-down resistor is integrated in the device for the switch output

## 4.2 4 to 20 mA Operating Mode

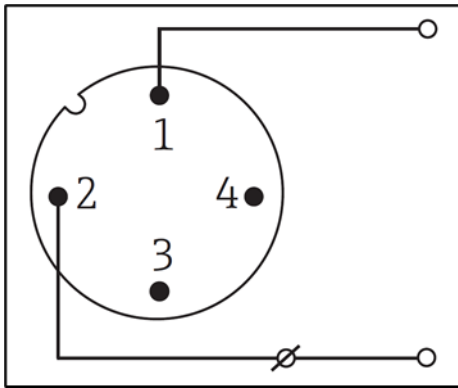


Figure 4: 4 to 20 mA wiring diagram

| Pin | Description                  |
|-----|------------------------------|
| 1   | + Power supply 10 to 30 V DC |
| 2   | - Power supply 0 V DC        |
| 3   | Not used                     |
| 4   | Not used                     |

**Load:**  $R_{b \max} = (U_{b \max} - 10 \text{ V}) / 0.023 \text{ A}$  (current output)

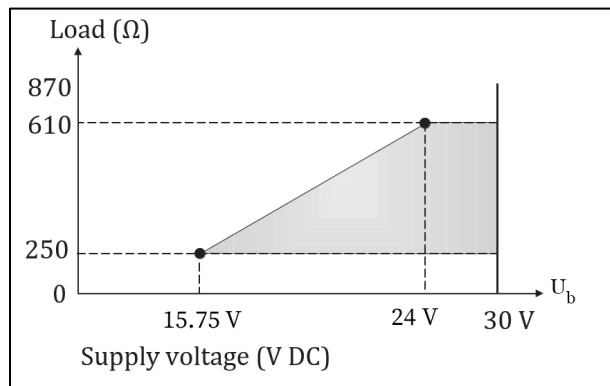


Figure 5: Maximum allowable load resistance

**Linearization/Transmission Behavior:** Temperature – Linear

**Damping:**

|                                   |            |
|-----------------------------------|------------|
| Configurable Sensor Input Damping | 0 to 120 s |
| Factory Default Setting           | 0 s        |

## 5 System Integration

### 5.1 Device and Vendor Identification

|           |         |
|-----------|---------|
| Device ID | 8585472 |
| Vendor ID | 1590    |

### 5.2 Process Data

When the PRTX is in **Digital Mode**, the state of the switch output and the temperature value are transmitted in the form of process data via IO-Link. The signal is initially transmitted in the **SIO-Mode** (Standard IO-Mode). Digital IO-Link communication starts as soon as the IO-Link master sends the **Wake-Up** command.

- In SIO mode, the switch output is switched at pin 4 of the M12 connector. In the IO-Link communication mode, this pin is reserved for communication.
- The measuring device's process data are transmitted cyclically in 32-bit batches.

| Byte 1                               |    |    |    |    |    |    |    | Byte 2 |    |    |    |    |    |    |    |
|--------------------------------------|----|----|----|----|----|----|----|--------|----|----|----|----|----|----|----|
| 31                                   | 30 | 29 | 28 | 27 | 26 | 25 | 24 | 23     | 22 | 21 | 20 | 19 | 18 | 17 | 16 |
| sint16                               |    |    |    |    |    |    |    |        |    |    |    |    |    |    |    |
| Temperature (with one decimal place) |    |    |    |    |    |    |    |        |    |    |    |    |    |    |    |

| Byte 3     |    |    |    |    |    |   |   | Byte 4 |   |   |                       |   |   |   |              |  |
|------------|----|----|----|----|----|---|---|--------|---|---|-----------------------|---|---|---|--------------|--|
| 15         | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7      | 6 | 5 | 4                     | 3 | 2 | 1 | 0            |  |
| sint8      |    |    |    |    |    |   |   |        |   |   | Enum4                 |   |   |   | Bool         |  |
| Scale (-1) |    |    |    |    |    |   |   |        |   |   | Measured value status |   |   |   | Switch state |  |

| Process Value | Values                      | Meaning  |
|---------------|-----------------------------|--|
| Temperature   | -32000 to +32000            | Temperature value with one decimal place<br>Example: a transmitted value of 123 corresponds to a measured temperature value of 12.3 °C |
|               | 32764 = No measurement data | Process value if no valid measured value is available  |
|               | - 32760 = Out of range (-)  | Process value if the measured value is below the lower limit value   |
|               | 32760 = Out of range (+)    | Process value if the measured value is above the upper limit value   |
| Scale         | -1                          | The transmitted measured value must be multiplied by 10 exp (Scale) (times 10 <sup>-1</sup> or 0.1)                                    |

| Process value                     | Values           | Meaning   |
|-----------------------------------|------------------|---|
| Measured value status [bit 4 - 3] | 0 = Bad          | Measured value cannot be used   |
|                                   | 1 = Uncertain    | Measured value can only be used to a limited extent, e.g.: device temperature is outside the permitted range (S825) |
|                                   | 2 = Manual/Fixed | Measured value can only be used to a limited extent, e.g.: simulation of the measured variable is active (C485)     |
|                                   | 3 = Good         | Measured value is good  |
| Measured value status [bit 2- 1]  | 0 = Not limited  | Measured value without limit value violation  |
|                                   | 1 = Low limited  | Limit value violation at lower end  |
|                                   | 2 = High limited | Limit value violation at upper end  |
|                                   | 3 = Constant     | Measured value is set to a constant value   |
| Switch output [bit 0]             | 0 = Off          | Switch output opened  |
|                                   | 1 = On           | Switch output closed  |

### 5.3 Reading and Writing Device Data

Device data are always exchanged acyclically and at the request of the IO-Link master via the ISDU communication channel. The IO-Link master can read the following parameter values or device conditions:

#### 5.3.1 Specific Device Data

The default values apply to parameters which are not ordered with customer-specific settings.

| Identifier               | Index (dec) | Index (hex) | Size (byte) | Data Type  | Access | Default Value                     | Value Range  | Data Storage |
|--------------------------|-------------|-------------|-------------|------------|--------|-----------------------------------|--|--------------|
| Application Specific Tag | 24          | 0x0018      | 32          | String     | r/w    | –                                 | –  | Yes          |
| Order Code               | 1054        | 0x041E      | 20          | String     | r/-    | –                                 | –  | –            |
| Extended Order Code      | 259         | 0x0103      | 60          | String     | r/-    | –                                 | –  | –            |
| Unit                     | 5121        | 0x1401      | 1           | UInteger8  | r/w    | 32                                | 32 = °C<br>33 = °F<br>35 = K   | Yes          |
| Damping                  | 7271        | 0x1C67      | 1           | UInteger8  | r/w    | 0 s                               | 0 to 120 s   | Yes          |
| Sensor Offset            | 3082        | 0x0C0A      | 4           | Float      | r/w    | 0 °C (32 °F)                      | –10 to +10 °C<br>(–18 to +18 °F)   | Yes          |
| Operating Mode Switch    | 2050        | 0x0802      | 2           | UInteger16 | r/w    | Hysteresis normally open (0x0C9C) | Window normally open (0x0CFF)<br>Window normally closed (0x0C96)<br>Hysteresis normally open (0x0C9C)<br>Hysteresis normally closed (0x0C99)<br>Off (0x80EC) | Yes          |



| Identifier             | Index (dec) | Index (hex) | Size (byte) | Data Type   | Access | Default Value   | Value Range  | Data Storage |
|------------------------|-------------|-------------|-------------|-------------|--------|-----------------|--|--------------|
| Switch Point Value     | 2051        | 0x0803      | 4           | Float       | r/w    | 100 °C (212 °F) | -1E+20 to 1E+20  | Yes          |
| Switchback Point Value | 2052        | 0x0804      | 4           | Float       | r/w    | 90 °C (194 °F)  | -1E+20 to 1E+20  | Yes          |
| Switch Delay           | 2053        | 0x0805      | 1           | UInteger8   | r/w    | 0 s             | 0 to 99 s  | Yes          |
| Switchback Delay       | 2054        | 0x0806      | 1           | UInteger8   | r/w    | 0 s             | 0 to 99 s  | Yes          |
| 4 mA Value             | 8218        | 0x201A      | 4           | Float       | r/w    | -50 °C (-58 °F) | -50000 to +50000 °C  | Yes          |
| 20 mA Value            | 8219        | 0x201B      | 4           | Float       | r/w    | 200 °C (392 °F) | -50000 to +50000 °C  | Yes          |
| Current Trimming 4 mA  | 8213        | 0x2015      | 4           | Float       | r/w    | 4.00 mA         | 3.85 to 4.15 mA  | Yes          |
| Current Trimming 20 mA | 8212        | 0x2014      | 4           | Float       | r/w    | 20.00 mA        | 19.85 to 20.15 mA  | Yes          |
| Failure Mode           | 8234        | 0x202A      | 1           | UInteger8   | r/w    | 0 = Low alarm   | 0 = Low alarm<br>2 = High alarm  | Yes          |
| Failure Current        | 8232        | 0x2028      | 4           | Float       | r/w    | 22.5 mA         | 21.5 to 23 mA  | Yes          |
| Operating Time         | 6148        | 0x1804      | 4           | UInteger32  | r/-    | -               | -  | Yes          |
| Alarm Delay            | 6147        | 0x1803      | 1           | UInteger8   | r/w    | 2 s             | 1 to 5 s   | Yes          |
| Device Status          | 36          | 0x0024      | 1           | UInteger8   | r/-    | -               | 0: Device is OK<br>1: Maintenance required<br>2: Out of specification<br>3: Functional check<br>4: Failure | -            |
| Detailed Device Status | 37          | 0x0025      | 36          | OctetString | r/-    | -               | In accordance with IO-Link specification   | -            |
| Actual Diagnostic 1    | 6184        | 0x1828      | 2           | UInteger16  | r/-    | -               | -  | -            |
| Actual Diagnostic 2    | 6186        | 0x182A      | 2           | UInteger16  | r/-    | -               | -  | -            |
| Actual Diagnostic 3    | 6188        | 0x182C      | 2           | UInteger16  | r/-    | -               | -  | -            |
| Previous Diagnostics 1 | 6214        | 0x1846      | 2           | UInteger16  | r/-    | -               | -  | -            |
| Timestamp 1            | 6204        | 0x183C      | 4           | UInteger32  | r/-    | -               | -  | -            |
| Previous Diagnostics 2 | 6216        | 0x1848      | 2           | UInteger16  | r/-    | -               | -  | -            |
| Timestamp 2            | 6205        | 0x183D      | 4           | UInteger32  | r/-    | -               | -  | -            |
| Previous Diagnostics 3 | 6218        | 0x184A      | 2           | UInteger16  | r/-    | -               | -  | -            |
| Timestamp 3            | 6206        | 0x183E      | 4           | UInteger32  | r/-    | -               | -  | -            |

| Identifier                      | Index (dec) | Index (hex) | Size (byte) | Data Type  | Access | Default Value | Value Range                               | Data Storage |
|---------------------------------|-------------|-------------|-------------|------------|--------|---------------|---|--------------|
| Previous Diagnostics 4          | 6220        | 0x184C      | 2           | UInteger16 | r/-    | -             | -   | -            |
| Timestamp 4                     | 6207        | 0x183F      | 4           | UInteger32 | r/-    | -             | -   | -            |
| Previous Diagnostics 5          | 6222        | 0x184E      | 2           | UInteger16 | r/-    | -             | -   | -            |
| Timestamp 5                     | 6208        | 0x1840      | 4           | UInteger32 | r/-    | -             | -   | -            |
| Current Output Simulation       | 8210        | 0x2012      | 2           | UInteger16 | r/w    | 33004 = Off   | 33004 = Off<br>33005 = On                 | -            |
| Current Output Simulation Value | 8211        | 0x2013      | 4           | Float      | r/w    | 3.58 mA       | 3.58 to 23 mA                             | -            |
| Sensor Simulation               | 3109        | 0x0C25      | 1           | UInteger8  | r/w    | 0 = Off       | 0 = Off<br>1 = On                         | -            |
| Sensor Simulation Value         | 3104        | 0x0C20      | 4           | Float      | r/w    | 0 °C (32 °F)  | -1E+20 to 1E+20 °C                        | -            |
| Switch Output Simulation        | 2056        | 0x0808      | 2           | UInteger16 | r/w    | 0 = Disabled  | 0 = Disabled<br>33004 = Off<br>33006 = On | -            |
| Sensor Min Value                | 3081        | 0x0C09      | 4           | Float      | r/-    | -             | -   | -            |
| Sensor Max Value                | 3080        | 0x0C08      | 4           | Float      | r/-    | -             | -   | -            |
| Device Temperature              | 4096        | 0x1000      | 4           | Float      | r/-    | -             | -   | -            |
| Device Temperature Min          | 4107        | 0x100B      | 4           | Float      | r/-    | -             | -   | -            |
| Device Temp Max                 | 4106        | 0x100A      | 4           | Float      | r/-    | -             | -   | -            |
| MDC Descriptor                  | 16512       | 0x4080      | 11          | Record     | r/-    | -             | -   | -            |

### 5.3.2 IO-Link Specific Device Data

| Identifier          | Index (dec) | Index (hex) | Size (byte) | Data Type | Access | Default Value               |
|---------------------|-------------|-------------|-------------|-----------|--------|-----------------------------|
| Serial Number       | 21          | 0x0015      | 16          | String    | r/-    | –                           |
| Product ID          | 19          | 0x0013      | 32          | String    | r/-    | PRTXI-PRTXS                 |
| Product Name        | 18          | 0x0012      | 32          | String    | r/-    | PRTX RTD Temperature Sensor |
| Product Text        | 20          | 0x0014      | 32          | String    | r/-    | PRTXI-PRTXS                 |
| Vendor Name         | 16          | 0x0010      | 32          | String    | r/-    | Omega Engineering           |
| Vendor Text         | 17          | 0x0011      | 32          | String    | r/-    | Sensing Incredible Things   |
| Hardware Version    | 22          | 0x0016      | 8           | String    | r/-    | –                           |
| Firmware version    | 23          | 0x0017      | 8           | String    | r/-    | –                           |
| Device Access Locks | 12          | 0x000C      | 2           | Record    | r/w    | –                           |

#### 5.3.2.1 IO-Link Configuration

IO-Link functions and device-specific parameters are configured through the device's IO-Link communication. IO-Link devices are typically configured using the automation system. The PRTX supports IO-Link Data Storage.

### 5.3.3 System Commands

| Identifier                              | Value (dec) | Value (hex) |
|---|-------------|-------------|
| Reset factory settings                  | 130         | 0x82        |
| Activate parametrization lock           | 160         | 0xA0        |
| Deactivate parametrization lock         | 161         | 0xA1        |
| Reset sensor min/max values             | 162         | 0xA2        |
| Reset device temperature min/max values | 163         | 0xA3        |
| IO-Link 1.1 system test command 240     | 240         | 0xF0        |
| IO-Link 1.1 system test command 241     | 241         | 0xF1        |
| IO-Link 1.1 system test command 242     | 242         | 0xF2        |
| IO-Link 1.1 system test command 243     | 243         | 0xF3        |

## 6 Diagnostics and Troubleshooting

Follow these instructions to resolve general troubleshooting issues.

| Error                           | Possible Cause   | Solution   |
|---------------------------------|--|--|
| Device is not responding.       | Supply voltage does not match the value indicated in the specifications. | Apply correct voltage.                                   |
|                                 | The polarity of the supply voltage is wrong.                             | Correct the polarity of the supply voltage.              |
| Device measures incorrectly.    | The device has been incorrectly configured.                              | Check and correct the parameter configuration.           |
|                                 | The device has been incorrectly connected.                               | Check the pin assignment.                                |
|                                 | Incorrect device orientation.  | Install the device correctly.                            |
|                                 | Heat dissipation over the measuring point.                               | Observe the installed length of the sensor.              |
| No communication                | Communication cable is not connected.                                    | Check wiring and cables.                                 |
|                                 | Communication cable is incorrectly attached to the IO-Link master.       |  |
| No transmission of process data | There is an error in the device.   | Correct errors that are displayed as a diagnostic event. |

### 6.1 Diagnostic Information via Communication Interface

The **Device Status** parameter shows the event category of the active diagnostic message with the highest priority.

The status signals provide information on the state of the device by categorizing the cause of the diagnostic information. The status signals are categorized according to NAMUR Recommendation NE 107:

F = Failure,  
 C = Function Check  
 S = Out of Specification  
 M = Maintenance Required

| Alphabetic Character | Event Category       | Meaning  |
|----------------------|----------------------|--|
| F                    | Operating error      | An operating error has occurred.   |
| C                    | Service mode         | The device is in service mode (e.g. during a simulation).  |
| S                    | Out of specification | The device is being operated outside its technical specifications (e.g. during warm-up or cleaning processes). |
| M                    | Maintenance required | Maintenance is required.   |

## 6.2 Diagnostic Overview

| Diagnostic Message | Diagnostic Behavior | IO-Link Event Qualifier | IO-Link Event Code | Event Text                         | Reason   | Corrective Measure  |
|--------------------|---------------------|-------------------------|--------------------|------------------------------------|--|---|
| F001               | Alarm               | IO-Link Error           | 0x1817             | Device failure                     | Device fault   | 1: Restart the device.<br>2: Replace device.  |
| F004               | Alarm               | IO-Link Error           | 0x1818             | Sensor defective                   | The sensor is defective (e.g.: sensor failure or sensor short-circuit)   | Replace device.   |
| S047               | Warning             | IO-Link Warning         | 0x1819             | Sensor limit reached               | Sensor limit has been reached  | 1: Check sensor.<br>2: Check process conditions.  |
| C401               | Warning             | IO-Link Notification    | 0x181F             | Factory reset active               | Factory reset is active  | Factory reset is active, please wait.   |
| C402               | -                   | -                       | -                  | Initialization active              | Initialization is active   | Initialization active, please wait.   |
| C485               | Warning             | IO-Link Warning         | 0x181A             | Process variable simulation active | Simulation of the process variable is active   | Deactivate simulation.  |
| C491               | Warning             | IO-Link Warning         | 0x181B             | Current output simulation active   | Simulation of the current output is active   | Deactivate simulation.  |
| C494               | Warning             | /IO-Link Warning        | 0x181C             | Switch output simulation active    | Simulation of the switch output is active  | Deactivate simulation.  |
| F537               | Alarm               | IO-Link Error           | 0x181D             | Configuration invalid              | Current range is invalid<br>The difference between the 4mA value and 20mA value must be greater than or equal to 10°C.<br>Switch points are invalid. The switch point must be greater than or equal to the switchback point. | 1: Check device configuration.<br>2: Upload and download new configuration.                 |
| S801               | Warning             | IO-Link Warning         | 0x181E             | Supply voltage too low             | Supply voltage too low   | Increase supply voltage.  |
| S804 <sup>1)</sup> | Alarm               | -                       | -                  | Overload at switch output          | Overload at the switch output  | 1: Increase load resistance at switch output.<br>2: Check the output.<br>3: Replace device. |
| S825               | Warning             | IO-Link Warning         | 0x1812             | Operating temperature              | Operating temperature of the electronics out of specification  | 1: Check ambient temperature.<br>2: Check process temperature.                              |

| Diagnostic Message | Diagnostic Behavior | IO-Link Event Qualifier | IO-Link Event Code | Event Text                         | Reason                                     | Corrective Measure   |
|--------------------|---------------------|-------------------------|--------------------|------------------------------------|--|--|
| S844 <sup>2)</sup> | Warning             | -                       | -                  | Process value out of specification | Process value is outside the specification | 1: Check process value.<br>2: Check application.<br>3: Check sensor. |

1) Diagnostic only possible in SIO mode

2) Diagnostic only possible in the 4 to 20 mA mode

## 6.2.1 Device Behavior During an Event Fault

The diagnostic behavior of the device differs depending on the selected operating mode. Regardless of the operating mode, all the diagnostic messages are saved in the event logbook, where they can be accessed as required.

### 6.2.1.1 IO-Link

The device displays warnings and faults via IO-Link. All the device warnings and faults are for information purposes only and do not have a safety function. The errors diagnosed by the device are displayed via IO-Link in accordance with NE107. A distinction must be made between the following types of diagnostic behavior:

#### Warning

The device continues measuring in the event of warning-type diagnostic behavior. The output signal is not affected (exception: simulation of the process variable is active).

#### Alarm

- The device does not continue measuring if this type of error occurs. The output signal adopts its fault state value in the event of an error.
- The PDValid Flag indicates that the process data are invalid.
- The fault state is displayed via IO-Link.

### 6.2.1.2 Switch output

#### Warning

The switch output remains in the state defined by the switch points.

#### Alarm

The switch output changes to the open state.

### 6.2.1.3 4 to 20 mA

#### Warning

The current output is not affected.

#### Alarm

The current output adopts the configured failure current.



**Note:** The behavior of the output in the event of a failure is regulated in accordance with NAMUR NE43.

- The failure current can be set.
- The selected failure current is used for all errors.

### 6.3 Diagnostic List


If three or more diagnostic events are pending simultaneously, only the 3 diagnostic messages with the highest priority are shown in the diagnostic list. The status signal dictates the priority in which the diagnostic messages are displayed. The following order of priority applies: F, C, S, M. If two or more diagnostic events with the same status signal are active simultaneously, the numerical order of the event number dictates the order of priority in which the events are displayed, e.g. F042 appears before F044 and before S044.

### 6.4 Event Logbook

The diagnostic messages are shown in chronological order in the event logbook. Additionally, a timestamp is saved with every diagnostic message. This timestamp is determined by the operating time counter.

## 7 Maintenance and Cleaning

The device must be cleaned whenever necessary. Cleaning can also be done when the device is installed. When cleaning the device, care must be taken to ensure that it is not damaged.

 **Important:** Avoid damage to the device and the system. Pay attention to the specific IP code when cleaning.

### 7.1 Services

| Service     | Description  |
|-------------|--|
| Calibration | RTD elements may drift depending on the application. Regular recalibration to verify accuracy is recommended. The calibration can be performed by Omega Engineering. |

**Calibration:** Factory calibration is available upon request. Customers may request Cal-3 for standard 3-point calibration, or Cal-4 for user-specified temperature points. All calibrations are NIST traceable.

| Probe Type | Probe Length Minimum | Standard Calibration Points for CAL-3<br>Probe Diameter |                       |                       |
|------------|----------------------|---|-----------------------|-----------------------|
|            |                      | 0.125 in<br>(3.18 mm)                                   | 0.188 in<br>(4.76 mm) | 0.250 in<br>(6.35 mm) |
| RTD        | < 178 mm (7")        | 0°C (32°F)<br>50°C (122°F)<br>100°C (212°F)             |                       |                       |
|            | ≥ 178 mm (7")        | 100°C (212°F)<br>150°C (302°F)<br>200°C (392°F)         |                       |                       |

## 8 Certifications and Approvals

**CE Mark:** The product meets the requirements of the harmonized European standards. As such, it complies with the legal specifications of the EC directives. The manufacturer confirms successful testing of the product by affixing the CE-mark.



**UKCA Mark:** The product meets the requirements of UK designated standards. As such, it complies with the specifications of relevant UK legislations. The manufacturer confirms successful testing of the product by affixing the UKCA mark.



**RoHS:** The measuring system complies with EU Directive 2011/65/EU (RoHS 2) and 2015/863 of the European Parliament on the restriction of use of certain hazardous substances in electrical and electronic equipment.

**MTBF:** For the transmitter: 327 years, according to Siemens Standard SN29500

### Hygienic Standard (Applies to Sanitary Models Only):

- 3-A Authorization No. 1519, 3-A Sanitary Standard 74-07. Sensors and Sensor Fittings and Connections.
- EHEDG Certified, Certificated No. EHEDG-C2200048

### Other Standards and Guidelines:

- Degree of protection provided by enclosures (IP code) according to IEC 60529
- Safety requirements for electrical equipment for measurement, control and laboratory use according to IEC 61010-1
- Industrial platinum resistance RTD temperature sensor in accordance with IEC 60751
- Electromagnetic compatibility (EMC requirements) IEC/EN 61326 series
- NAMUR International user association of automation technology in process industries ([www.namur.de](http://www.namur.de))
- NE21 - Electromagnetic Compatibility (EMC) of Industrial Process and Laboratory Control Equipment.
- NE43 - Standardization of the Signal Level for the Failure Information of Digital Transmitters.
- Electromagnetic compatibility (EMC) according to IO-Link Specification IEC 61131-09



## WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

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Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

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