Guided Radar (TDR) Level Meter for 2-wire control systems

for distance, level, volume and mass measurement of liquids, liquid interface, pastes and solids
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Warnings and symbols used

DANGER!
This information refers to the immediate danger when working with electricity.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator’s plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator’s plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator’s plant.

INFORMATION!
These instructions contain important information for the handling of the device.

HANDLING
• This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

RESULT
This symbol refers to all important consequences of the previous actions.

Safety instructions for the operator

CAUTION!
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

LEGAL NOTICE!
The responsibility as to the suitability and intended use of this device rests solely with the user. The supplier assumes no responsibility in the event of improper use by the customer. Improper installation and operation may lead to loss of warranty. In addition, the “Terms and Conditions of Sale” apply which form the basis of the purchase contract.

INFORMATION!
• Further information can be found on the supplied CD-ROM in the manual, on the data sheet, in special manuals, certificates and on the manufacturer’s website.
• If you need to return the device to the manufacturer or supplier, please fill out the form contained on the CD-ROM and send it with the device. Unfortunately, the manufacturer cannot repair or inspect the device without the completed form.
2.1 Intended use

**CAUTION!**
Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

**INFORMATION!**
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

It can be installed on tanks, silos and open pits.

2.2 Scope of delivery

**INFORMATION!**
Do a check of the packing list to make sure that you have all the elements given in the order.

![Figure 2-1: Scope of delivery for compact version](image)

2. Probe segments. For the assembly procedure of the single rod probe, refer to the instructions that are supplied with the device. If a single rod or coaxial probe is attached and you ordered the "segmented probe" option, only part of the probe is attached to the device. For the assembly procedure of the segmented single rod probe, refer to the instructions that are supplied with the device. For the assembly procedure of the segmented coaxial probe, refer to the instructions that are supplied with the device.
   - The assembly instructions and small parts are in a bag attached to the signal converter.
3. Quick Start
4. CD-ROM. This contains the Handbook, the Quick Start, the Technical Datasheet and related software.
Figure 2-2: Scope of delivery for the remote version

1. Signal converter and probe
2. Probe segments. For the assembly procedure of the single rod probe, refer to the instructions that are supplied with the device. If a single rod or coaxial probe is attached and you ordered the “segmented probe” option, only part of the probe is attached to the device. For the assembly procedure of the segmented single rod, refer to the instructions that are supplied with the device. For the assembly procedure of the segmented coaxial probe, refer to the instructions that are supplied with the device.

   The assembly instructions and small parts are in a bag attached to the signal converter.
3. Quick Start
4. CD-ROM. This contains the Handbook, the Quick Start, the Technical Datasheet and related software.
5. Flexible conduit. For the assembly procedure, refer to How to assemble the remote version on page 32.
6. Wall bracket (also for installation on pipes)

**INFORMATION!**

No special tools, no training required!
2.3 Visual Check

**INFORMATION!**
Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

![Figure 2-3: Visual check](image)

1. Device nameplate (for more data, refer to the handbook)
2. Process connection data (size and pressure rating, material reference and heat number)
3. Gasket material data - refer to the illustration that follows

![Figure 2-4: Symbols for the supplied gasket material](image)

1. EPDM
2. Kalrez® 6375

If the device is supplied with an FKM/FPM gasket, there is no symbol on the side of the process connection.

**INFORMATION!**
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

**WARNING!**
- If the display screen glass is broken, do not touch.
- If the device has to measure the level of dangerous products (ammonia etc.), we recommend that the device has the Metaglas® option.
- If the device has to measure the level of products where there is a risk of electrostatic discharge, we recommend that the device has the ESD (electrostatic discharge) protection option.
2.4 Storage

**WARNING!**
*Do not keep the device in a vertical position. This will damage the probe and the device will not measure correctly.*

![Figure 2-5: Storage conditions](image)

- Do not bend rod and coaxial probes – support here
- Storage temperature range: -50 to 85°C / -60 to 185°F (min. -40°C / -40°F for devices with the integrated LCD display option)

- Store the device in a dry and dust-free location.
- Store the device in its original packing.
2.5 Transport

Figure 2-6: How to hold the device

Remove the converter before you lift the device with a hoist.

Wind cable probes greater than 400 mm / 16" in diameter.

Do not hold the probe when you lift the device.

Do not wind the flexible conduit less than 330 mm / 13" in diameter.

WARNING!
If you do not lift the device carefully, you can cause damage to the probe.
2.6 Pre-installation requirements

INFORMATION!
Obey the precautions that follow to make sure that the device is correctly installed.

- Make sure that there is sufficient space on all sides.
- Protect the signal converter from direct sunlight. If necessary, install the weather protection accessory.
- Do not subject the signal converter to heavy vibrations. The devices are tested for vibration and agree with EN 50178 and IEC 60068-2-6.

2.7 How to prepare the tank before you install the device

CAUTION!
To avoid measuring errors and device malfunction, obey these precautions.

2.7.1 Pressure and temperature ranges

Figure 2-8: Pressure and temperature ranges

1. Process connection temperature
   - The process connection temperature must stay in the temperature range of the gasket material unless the device is a High-Temperature version. Refer to the table “Temperature ranges for gaskets” that follows and to “Technical data” on page 42.
   - Ex devices: see supplementary operating instructions

2. Ambient temperature for operation of the display
   - -20...+60°C / -5...+140°F
   - If the ambient temperature is not between these limits, the display screen switches off automatically.

3. Ambient temperature
   - Non-Ex devices: -40...+80°C / -40...+176°F
   - Ex devices: see supplementary operating instructions

4. Process pressure
   - Refer to the table “Process pressure limits” that follows and “Pressure/temperature table for probe selection” in the handbook.

WARNING!
The process connection temperature range must agree with the temperature limits of the gasket material. The operating pressure range is subject to the process connection used and the flange temperature.
### Temperature ranges for gaskets

<table>
<thead>
<tr>
<th>Gasket material</th>
<th>Process connection temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Standard version</td>
</tr>
<tr>
<td></td>
<td>[°C]</td>
</tr>
<tr>
<td>FKM/FPM</td>
<td>-40...+200</td>
</tr>
<tr>
<td>Kalrez® 6375</td>
<td>-20...+200</td>
</tr>
<tr>
<td>EPDM</td>
<td>-50...+150</td>
</tr>
</tbody>
</table>

**INFORMATION!**

**Ø4 mm / 0.16” single cable probe with FEP coating option only:** The process connection temperature range is -20...+150°C / -4...+302°F

**INFORMATION!**

**Single rod probes with protective sheath option only:** The process connection temperature range depends on the protective sheath material selected.
- PP: -40...+90°C / -40...+194°F
- PVDF: -40...+150°C / -40...+302°F
- PVC: -15...+80°C / +5...+176°F

### Process pressure limits

<table>
<thead>
<tr>
<th>Device version</th>
<th>Maximum process pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[barg]</td>
</tr>
<tr>
<td>Ø8 mm / 0.32” single cable</td>
<td>40 (1)</td>
</tr>
<tr>
<td>High-Pressure (HP) version</td>
<td>300 (1)</td>
</tr>
<tr>
<td>All other probe types and device versions</td>
<td>100 (1)</td>
</tr>
</tbody>
</table>

(1) Refer also to “Pressure / temperature table for probe selection” in the handbook
2.7.2 General information for nozzles

**CAUTION!**
*Follow these recommendations to make sure that the device measures correctly.*

![Figure 2-9: Recommended nozzle dimensions for single rod and single cable probes](image)

1. Recommended conditions: \( h \leq d \), where \( h \) is the height of the tank nozzle and \( d \) is the diameter of the tank nozzle.
2. The end of the nozzle must not have an extension into the tank. Do not install the device on a high nozzle.

**CAUTION!**
*If the device is installed on a high nozzle, make sure that the probe does not touch the side of the nozzle (attach the probe end, ...). We recommend that you use a coaxial probe (this solution is applicable only to liquids).*

**INFORMATION!**
*It is possible to measure in these conditions with a minimum top dead zone. Use the snapshot function to filter the parasite signals from long nozzles. For more data, refer to the Handbook.*

![Figure 2-10: Sockets for threaded process connections](image)

1. Recommended installation
2. The end of the socket must not have an extension into the tank
CAUTION!
Do not put the process connection near to the product inlet. If the product that enters the tank touches the probe, the device will measure incorrectly.

Figure 2-11: Do not put the device near to a product inlet

① The device is in the correct position.
② The device is too near to the product inlet.
③ If it is not possible to put the device in the recommended position, install a deflector pipe.
2.7.3 Installation requirements for concrete roofs

If product particles are likely to collect in holes, a nozzle is not recommended.
Attach the flange directly to the tank.
Use a threaded connection to attach the device directly to the tank.

**INFORMATION!**
If your device has a coaxial probe, you can ignore these installation recommendations.

**CAUTION!**
Install coaxial probes in clean liquids that are not too viscous.

The diameter, $d$, of the hole must be greater than the thickness, $t$, of the concrete.
If the thickness, $t$, of the concrete is greater than the diameter, $d$, of the hole, install the device in a recess.
2.8 Installation recommendations for liquids

2.8.1 General requirements

**Figure 2-14: Installation recommendations for liquids**

1. The electromagnetic (EM) field generated by the device. It has a radius of $R_{\text{min}}$. Make sure that the EM field is clear of objects and product flow. Refer to the table that follows.
2. If there are too many objects in the tank, install a bypass chamber or stilling well.
3. Keep the probe straight. If the probe is too long, shorten the probe length. Make sure that the device is configured with the new probe length. For more data on the procedure, refer to the handbook.
4. Empty space. Refer to the table that follows.

**INFORMATION!**
*If the device has to measure the level of dangerous products (ammonia etc.), we recommend that you use a device with the Metaglas® option.*

**Clearance between the probe and other objects in the tank**

<table>
<thead>
<tr>
<th>Probe type</th>
<th>Empty space $(R_{\text{min}})$, around the probe</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[mm]</td>
</tr>
<tr>
<td>Coaxial</td>
<td>0</td>
</tr>
<tr>
<td>Double rod / cable</td>
<td>100</td>
</tr>
<tr>
<td>Single rod / cable</td>
<td>300</td>
</tr>
</tbody>
</table>
2.8.2 How to attach probes to the bottom of the tank

If the liquid is agitated or turbulent, you can attach the probe to the bottom of the tank. The procedure to attach the probe depends on the type of probe used.

For more data, refer to the Handbook.

2.8.3 Standpipes

Use a standpipe if:

- There is highly conductive foam in the tank.
- The liquid is very turbulent or agitated.
- There are too many other objects in the tank.
- The device is measuring a liquid (petro-chemicals) in a tank with a floating roof.

For more data, refer to the Handbook.

Figure 2-15: Basic installation recommendations for standpipes (stilling wells and bypass chambers)

1. Stilling well
2. Bypass chamber
3. Air circulation hole
4. Level of the liquid

INFORMATION!
Standpipes are not necessary for devices with coaxial probes. But if there is a sudden change in diameter in the standpipe, we recommend that you install a device with a coaxial probe.

2.9 Installation recommendations for solids

2.9.1 Nozzles on conical silos

We recommend that you prepare the installation when the silo is empty.
**DANGER!**
Risk of electrostatic discharge (ESD): The device is resistant to electrostatic discharges of up to 15 kV (30 kV with the ESD protection option – recommended for solid applications), but it is the responsibility of the fitter and the user to prevent ESD.

**CAUTION!**
Install the device at the correct location to measure level correctly and prevent too much bending and traction. If necessary, attach the probe to the bottom of the tank.

**Figure 2-16: Installation recommendations for solids**

1. We recommend installation without a nozzle. If not, h ≤ 50 mm / 2”.
2. The end of the probe must be more than 300 mm / 12” above the tank bottom.
3. Empty space [radius, $R_{min}$] around the probe.
4. The electromagnetic (EM) field generated by the device. It is also the measurement zone of the probe. Make sure that the EM field is clear of objects and product flow.
5. Ground the tank, the product and the probe (if attached).
6. If possible, put the process fitting ≥ 300 mm / 12” from the tank wall

**Clearance between the probe and other objects in the tank**

<table>
<thead>
<tr>
<th>Probe type</th>
<th>Empty space [radius, $R_{min}$] around the probe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single cable Ø4 mm / 0.16” ④</td>
<td>300 [mm] 12 [inches]</td>
</tr>
<tr>
<td>Single cable Ø8 mm / 0.32” ④</td>
<td>300 [mm] 12 [inches]</td>
</tr>
</tbody>
</table>

**INFORMATION!**
If the probe is longer than 10 m / 33 ft, we recommend that you do not attach the end of the probe.
2.9.2 Traction loads on the probe

Traction load depends on:
- The height and shape of the tank.
- The particle size and density.
- The rate at which the tank is emptied.

**CAUTION!**
Risk of damage to the cable probe. High loads can break the cable.
If the load on the Ø8 mm / 0.32’ single cable probe is more than 3500 kg / 7700 lb, contact your supplier.

**CAUTION!**
Make sure that the tank roof is resistant to deformation at high loads.

### Estimated traction load on the probe in kg

<table>
<thead>
<tr>
<th>Material</th>
<th>Probe length, 10 m</th>
<th>Probe length, 20 m</th>
<th>Probe length, 30 m</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[kg]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td>1000</td>
<td>2000</td>
<td>3000</td>
</tr>
<tr>
<td>Fly ash</td>
<td>500</td>
<td>1000</td>
<td>1500</td>
</tr>
<tr>
<td>Wheat</td>
<td>300</td>
<td>500</td>
<td>1200</td>
</tr>
</tbody>
</table>

### Estimated traction load on the probe in lb

<table>
<thead>
<tr>
<th>Material</th>
<th>Probe length, 33 ft</th>
<th>Probe length, 65 ft</th>
<th>Probe length, 98 ft</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>[lb]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cement</td>
<td>2200</td>
<td>4410</td>
<td>6520</td>
</tr>
<tr>
<td>Fly ash</td>
<td>1100</td>
<td>2200</td>
<td>3300</td>
</tr>
<tr>
<td>Wheat</td>
<td>660</td>
<td>1100</td>
<td>2650</td>
</tr>
</tbody>
</table>
2.10 How to install the device on the tank

2.10.1 How to assemble the single rod probe (single-piece probe)

**INFORMATION!**
This procedure is for devices with single rod probes that are not segmented (single-piece probes).

Figure 2-17: Equipment needed to assemble the device

1. Union nut
2. 2 locking nuts
3. Housing assembly
4. Single rod probe
5. Tools: two 8 mm open-ended wrenches (not supplied)
6. Tools: one 7 mm open-ended wrench (not supplied)
- Make sure that the housing assembly and the single rod have the same ID numbers.
- Remove the sticker from the probe.
• Attach a locking nut to the housing assembly.
• Make sure that the nut is fully engaged on the thread.
• Attach the union nut to the housing assembly.
• Tighten these nuts with the two 8 mm open-ended wrenches.
• Continue the assembly procedure on the page that follows.
• Attach a locking nut to the single rod.
• Make sure that the locking nut is engaged ¾ along the length of the thread.
• Attach the single rod to the union nut. Make sure the probe touches the housing assembly.
• Tighten the single probe with a 7 mm open-ended wrench [step 9].
• Tighten the locking nut against the union nut with two 8 mm open-ended wrenches [step 10].

CAUTION!
Support the probe.
2.10.2 How to assemble the single rod probe (segmented probe)

**INFORMATION!**

This procedure is for devices with single rod probes that are segmented.

![Equipment needed to assemble the single rod probe (segmented)](image)

- ① Converter and process connection
- ② Bottom (quantity: 1) segment of the rod probe
- ③ Top and middle (if more than one) segments of the rod probe
- ④ Tools: two 8 mm open-end wrenches (not supplied)
- ⑤ Lock nuts (2 lock nuts per segment)
- ⑥ Union nut (1 union nut per segment)
• Attach a lock nut to the threaded rod below the process connection. Turn the nut until it is \( \frac{3}{4} \) along the length of the rod.
• Attach a union nut to the threaded rod below the process connection.
• Use two 8 mm open-end wrenches to tighten the union nut against the lock nut.
- Attach a lock nut to each end of the rod probe segments.
- Attach a union nut to the bottom end of each rod probe segment, but not to the bottom segment. Use two 8 mm open-end wrenches to tighten the union nut against the lock nut.
- Attach the top segment of the rod probe to the union nut below the process connection. Use two 8 mm open-end wrenches to tighten the union nut against the lock nut on the rod probe.
- Attach the middle segment of the rod probe to the union nut on the top segment (if there are middle segments). Use two 8 mm open-end wrenches to tighten the union nut against the lock nut. Repeat this step for the other segments.
- Attach the bottom segment of the rod probe to the union nut on the top segment. Use two 8 mm open-end wrenches to tighten the union nut against the lock nut.

WARNING!
Put a support below the probe to prevent deformation.

CAUTION!
Make sure that the nuts are tight and the rod probe cannot loosen.
CAUTION!
Make sure that the length of the probe is correct. If the probe is too long, refer to “How to decrease the length of probes” in the handbook.

2.10.3 How to assemble the segmented coaxial probe

![Figure 2-24: Equipment needed to assemble the coaxial probe](image)

1. Converter and process connection
2. HC M4×20 screws (1 screw per probe segment)
3. Lock washers (1 pair of washers per probe segment)
4. Top (quantity: 1), middle (quantity: 1 or more) and bottom (quantity: 1) segments of the signal rod
5. PTFE spacer (1 spacer per probe segment)
6. Middle (quantity: 1 or more) and bottom (quantity: 1) segments of the coaxial tube
7. Union nut with 2 socket set screws M5×5 (1 union nut per segment of the coaxial tube)
8. Tools: two 7 mm open-end wrenches (not supplied)
9. Tools: two pipe (Stillson) wrenches (not supplied)
10. Tools: one 2.5 mm Allen wrench and one 2 mm Allen wrench (not supplied)
• Use a 2 mm Allen wrench to attach and tighten a HC M4×20 screw at the top of each rod segment (intermediary and end rod segments).
• Attach a PTFE spacer to the end of each rod segment that has a groove.
• Attach a pair of lock washers at the top of each rod segment (intermediary and end rod segments).
• Assemble one of the middle rod segments (with a pair of lock washers on the attached screw) and the signal rod below. Use two 7 mm open-ended wrenches to tighten the assembled parts to a torque of 2...3 Nm.

Figure 2-25: How to assemble the segmented coaxial probe: part 1

CAUTION!
Do not attach the screw to the end of the rod segment that has a groove for the attachment of a PTFE spacer.
• Attach a union nut to each coaxial tube (middle and end tubes)
• Attach a middle tube segment to the coaxial probe stem. Do not use tools to tighten the assembled parts.
• Assemble the next middle rod segment (with a pair of lock washers on the attached screw) and the top rod segment. Use two 7 mm open-ended wrenches to tighten the assembled parts to a torque of 2...3 Nm.
• Assemble the next coaxial tube segment and the top coaxial tube segment. Do not use tools to tighten the assembled parts. Do steps [9] thru [10] again until the end rod segment and end coaxial tube are attached.
• Use the 2 pipe wrenches to tighten the coaxial tubes in the lock nuts.
• Use a 2.5 mm Allen wrench to attach and tighten the two HC M5×5 screws (lock screws) to the union nut.

**WARNING!**
Be careful when you use the pipe wrenches. Make sure that the measuring tubes have no deformation.

**CAUTION!**
- Make sure that the screws are tight and the measuring tube cannot loosen.
- Make sure that the fitting for the lock screw is not aligned with a hole in the coaxial tube.
2.10.4 How to install a device with a flange connection

Equipment needed:

- Device
- Gasket (not supplied)
- Wrench (not supplied)

Make sure that the flange on the nozzle is level.

Make sure that you use the applicable gasket for the flange and the process.

Align the gasket correctly on the flange facing of the nozzle.

Lower the probe carefully into the tank.

*For more data on cable probes, refer to How to install a cable probe in the tank on page 30.*

- Tighten the flange bolts.

*Refer to local rules and regulations for the correct torque to apply to the bolts.*

Figure 2-27: Flange connection
2.10.5 How to install a device with a threaded connection

Equipment needed:

- Device
- Gasket (not supplied)
- 50 mm / 2” wrench (not supplied)

Make sure the tank connection is level.

Make sure that you use the applicable gasket for the connection and the process.

Align the gasket correctly.

If the device is installed on a tank made of plastic or other non-conductive material, refer to Recommendations for pits and tanks made of non-conductive materials on page 31.

Lower the probe carefully into the tank.

For more data on cable probes, refer to How to install a cable probe in the tank on page 30.

Use 50 mm / 2” wrench to attach the process connection to the tank.

Tighten the nut.

Refer to local rules and regulations for the correct torque to apply to the connection.

INFORMATION!

If there is not sufficient clearance to install the device, remove the housing. Install the probe and then put the housing back on the process connection. For more data, refer to How to turn or remove the signal converter on page 35.
2.10.6 How to install a cable probe in the tank

• Use two persons to lift the housing and the probe above the process connection.
• Hold the device 1 m / 3½ ft above the tank.
• Unwind the probe carefully into the tank.

**WARNING!**
If you bend the probe too much, you will damage the device and it will not measure accurately.

---

**Figure 2-29: Wind cable probes carefully**

1. Do not wind cable probes less than 400 mm / 16” in diameter.

---

**Figure 2-30: Installation of devices with cable probes**

1. >1 m / 3½ ft
2.10.7 Recommendations for pits and tanks made of non-conductive materials

If you have a device with a single rod or a single cable probe and a thread connection, obey these instructions:

- Put a metal sheet between the device and the process connection.
- It must have a diameter greater than 200 mm / 8”.
- Make sure that the metal sheet is in contact with the thread stop on the device.

We recommend that you use DN≥200 / ≥8” for flange connections.

If you have a device with a double rod, double cable or coaxial probe, you can ignore these instructions.

Figure 2-31: Installation in a non-metallic tank or pit with a thread connection

1. Non-metallic (plastic...) tank or pit
2. Metal sheet, Ø≥200 mm / 8”

CAUTION!
When the device is installed, make sure that the tank roof has no deformation.
2.10.8 How to assemble the remote version

- Attach the wall bracket ① to the flexible conduit.
- Tighten the locking nut ② with a 24 mm wrench.
- Attach the wall bracket to a wall or pipe (DN50...100 / 2"...4") ③.
- Loosen the housing locking screw ④ with a 5 mm Allen wrench.
- Remove the housing ⑤.

Figure 2-32: Part 1 of assembly procedure
• Attach the housing to the flexible conduit 6.
• Tighten the housing locking screw 7.
• Attach the flexible conduit to the probe 8.
• Tighten the flexible conduit locking screw 9.

Figure 2-33: Part 2 of the assembly procedure
You can attach the wall bracket of the remote housing to a wall or pipe (DN50...100 / 2"...4"). These are the dimensions:

![Diagram of wall bracket dimensions](image)

**Figure 2-34: Dimensions of the wall bracket**

### Dimensions in mm

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall bracket</td>
<td>120</td>
<td>60</td>
<td>20</td>
<td>11</td>
<td>90</td>
<td>150</td>
<td>6</td>
<td>67.4</td>
<td>126.4</td>
<td>150.4</td>
</tr>
</tbody>
</table>

### Dimensions in inches

<table>
<thead>
<tr>
<th></th>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall bracket</td>
<td>4.7</td>
<td>2.4</td>
<td>0.8</td>
<td>0.4</td>
<td>3.5</td>
<td>5.9</td>
<td>0.2</td>
<td>2.65</td>
<td>4.98</td>
<td>5.92</td>
</tr>
</tbody>
</table>
2.10.9 How to turn or remove the signal converter

The converter turns 360°. The converter can be removed from the process connection assembly under process conditions.

Figure 2-35: How to turn or remove the signal converter

1. **Tool:** 5 mm Allen wrench (not supplied) for the lock screw on the signal converter
2. **Cover for the coaxial hole on top of the process connection assembly (not supplied)**

**CAUTION!**

*If you remove the housing, put a cover on the coaxial hole on top of the process connection assembly.*

*When the housing is attached to the process connection assembly, tighten the lock screw with the 5 mm Allen wrench 1.*
2.10.10 How to attach the weather protection to the device

Equipment needed:
- Device
- Weather protection (option)
- 10 mm wrench (not supplied)

Refer to “Technical data: Dimensions and weight”, for the overall dimensions of the weather protection.

- Loosen the bracket nuts on the weather protection. Remove the bracket.
- Lower the weather protection onto the device. Turn the weather protection so that the keyhole points forward.
- Attach the bracket.
- Lift the weather protection to the top of the housing support pillar. Hold the weather protection in the correct position and tighten the bracket nuts.
2.10.11 How to open the weather protection

Equipment needed:
- Weather protection attached to the device.
- Large slotted tip screwdriver (not supplied).

![Diagram of weather protection]

Figure 2-37: How to open the weather protection

1. Weather protection in its closed position
2. Weather protection in its open position. Minimum clearance in front of the device: 300 mm / 12”.

- Put a large slotted tip screwdriver into the keyhole at the front of the weather protection. Turn the screwdriver counterclockwise.
- Pull the top of weather protection up and forward.
- This will open the weather protection.
2.11 Electromagnetic compatibility

The device design agrees with European Standard EN 61326-1 when installed in metallic tanks.

You can install the device on open-air tanks and tanks that are not made of metal. Refer also to the note that follows.

**CAUTION!**
If you install a device with a rod or cable probe in a non-metallic tank or open-air pit, a strong electromagnetic field near to the device can have an unwanted effect on the accuracy. Use a device with a coaxial probe for this type of installation.

**INFORMATION!**
Device operation agrees with residential-class (class B) emissions and industrial-class for immunity requirements if:
- the device has a single or double probe (rod or cable probe) and is used in a closed tank made of metal or
- the device has a coaxial probe.
3.1 Safety instructions

**DANGER!**
All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

**DANGER!**
Observe the national regulations for electrical installations!

**DANGER!**
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

**WARNING!**
Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

**INFORMATION!**
Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Electrical installation: outputs 1 and 2

![Electrical Installation Diagram]

Output 1 energizes the device and is used for HART® communication. If the device has the second current output option, use a separate power supply to energize output 2.
Procedure:
• Remove the housing terminal compartment cover ①.
• Connect the wires to the device. Obey the national electrical codes.
• Make sure that the polarity of the wires is correct.
• Attach the ground to ④ or ⑦. Both terminals are technically equivalent.

**INFORMATION!**
If the polarity is not correct, this will not cause damage to the device. But the device will not operate and the output will be 0 mA.

3.3 Electrical connection for current output

3.3.1 Non-Ex devices

Figure 3-2: Electrical connections for non-Ex devices

1. Power supply
2. Resistor for HART® communication
3. Output 1: 14...30 VDC for an output of 22 mA at the terminal
4. Output 2: 10...30 VDC for an output of 22 mA at the terminal

3.3.2 Devices for hazardous locations

**DANGER!**
For electrical data for device operation in hazardous locations, refer to the related certificates of compliance and supplementary instructions (ATEX, IECEx, FM, CSA, ...). This documentation can be downloaded from our website.
3.4 Protection category

**INFORMATION!**
The device fulfils all requirements per protection category IP 66/67. It also fulfils all requirements per NEMA type 4X (housing) and type 6P (probe).

**DANGER!**
Make sure that the cable gland is watertight.

Figure 3-3: How to make the installation agree with protection category IP 67

- Make sure that the gaskets are not damaged.
- Make sure that the electrical cables are not damaged.
- Make sure that the electrical cables agree with the national electrical code.
- The cables are in a loop in front of the device ① so water does not go into the housing.
- Tighten the cable feedthroughs ②.
- Close unused cable feedthroughs with dummy plugs ③.
4.1 Technical data

**INFORMATION!**

- The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.
- Additional information (certificates, special tools, software, ...) and complete product documentation can be downloaded free of charge from the website.

### Measuring system

<table>
<thead>
<tr>
<th>Measuring principle</th>
<th>2-wire loop-powered level transmitter; Time Domain Reflectometry (TDR)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Application range</td>
<td>Level measurement of liquids, pastes, slurries, powders and granulates</td>
</tr>
<tr>
<td>Primary measured value</td>
<td>Time between the emitted and received signal</td>
</tr>
<tr>
<td>Secondary measured value</td>
<td>Distance, level, volume, mass and/or interface</td>
</tr>
</tbody>
</table>

### Design

<table>
<thead>
<tr>
<th>Construction</th>
<th>The measurement system consists of a measuring sensor (probe) and a signal converter which is available in a compact or remote version</th>
</tr>
</thead>
<tbody>
<tr>
<td>Options</td>
<td>Integrated LCD display with sun cover [-20...+60°C / -5...+140°F]; if the ambient temperature is not in these limits, the display switches off</td>
</tr>
<tr>
<td></td>
<td>2nd current output</td>
</tr>
<tr>
<td></td>
<td>ESD protection (max. 30 kV)</td>
</tr>
<tr>
<td></td>
<td>Metaglas® [dual process sealing system for dangerous products (ammonia, chlorine, ...)]</td>
</tr>
<tr>
<td></td>
<td>Remote housing connected to the probe via a flexible conduit</td>
</tr>
<tr>
<td></td>
<td>Standard lengths: 2 m / 6.6 ft, 4.5 m / 14.8 ft, 9.5 m / 31.2 ft and 14.5 m / 47.6 ft</td>
</tr>
<tr>
<td>Probe end types [not for rod and coaxial probes]</td>
<td></td>
</tr>
<tr>
<td>Standard</td>
<td>Counterweights [refer to counterweight dimensions in “Technical data: Dimensions and weights in the handbook]</td>
</tr>
<tr>
<td>Options</td>
<td>Turnbuckle, chuck, threaded end, crimped end, open end</td>
</tr>
</tbody>
</table>

### Accessories

| Weather protection         | Weather protection                                                                                              |
|                           | Double rod Ø8 mm / 0.32": 4 m / 13 ft                                                                         |
|                           | Single rod Ø8 mm / 0.32": 4 m / 13 ft                                                                          |
|                           | Single rod Ø8 mm / 0.32” (segmented): 6 m / 20 ft                                                               |
|                           | Coaxial Ø22 mm / 0.87": 6 m / 20 ft                                                                           |
|                           | Coaxial Ø22 mm / 0.87” (segmented): 6 m / 20 ft                                                                |
|                           | Double cable Ø4 mm / 0.16": 8 m / 26 ft                                                                       |
|                           | Single cable Ø2 mm / 0.08": 35 m / 115 ft (for liquids only)                                                   |
|                           | Single cable Ø4 mm / 0.16": 35 m / 115 ft (For liquids only. An angled probe is available on request for installations with very low ceilings or objects in the tank that prevent installation on top of the tank.) |
|                           | Single cable Ø8 mm / 0.32": 35 m / 115 ft (for solids only)                                                   |
| Tolerance, probe length   | ±0.5%                                                                                                          |
| Dead zone                 | This depends on the type of probe. For more data, refer to “Measurement limits” in the handbook.                 |
### TECHNICAL DATA

#### Display and User interface

<table>
<thead>
<tr>
<th>Display</th>
<th>LCD display</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>9 lines, 160×160 pixels in 8-step grayscale with 4-button keypad</td>
</tr>
<tr>
<td>Interface languages</td>
<td>English, German, French, Italian, Spanish, Portuguese, Japanese, Simplified Chinese and Russian</td>
</tr>
</tbody>
</table>

#### Accuracy

| Resolution | 1 mm / 0.04" |
| Repeatability | ±1 mm / ±0.04" |
| Accuracy (in direct mode) | Liquids: ±3 mm / ±0.12", when distance < 10 m / 33 ft; ±0.03% of measured distance, when distance > 10 m / 33 ft |
| Powders: | ±20 mm / ±0.8" |
| Interface: | ±10 mm / ±0.4" (εr constant) |
| Accuracy (in TBF mode) | ±20 mm / ±0.8" (εr constant) |
| Minimum layer (interface) | 50 mm / 2" |

#### Reference conditions acc. to EN 60770

| Temperature | +20°C ±5°C / +68°F ±10°F |
| Pressure | 1013 mbar ±20 mbar / 14.69 psia ±0.29 psi |
| Relative air humidity | 60% ±15% |

#### Operating conditions

| Temperature | Ambient temperature | -40...+80°C / -40...+176°F |
|             | Ex: see supplementary operating instructions or approval certificates |
| Storage temperature | -40...+85°C / -40...+185°F |
| Process connection temperature | Standard | -50...+200°C / -58...+392°F [according to the temperature limits of the gasket material. Refer to “Material” in this table.] |
|             | Ex: see supplementary operating instructions or approval certificates |
|             | High-Temperature (HT) and High-Temperature / High-Pressure (HT/HP) versions with FKM/FPM and Kalrez® 6375 gaskets | +300°C / +572°F [single cable Ø2 mm / 0.08“ probe only] |
|             | Ex: see supplementary operating instructions or approval certificates |
|             | HT and HT/HP versions with EPDM gaskets | +250°C / +482°F [single cable Ø2 mm / 0.08“ probe only] |
|             | Ex: see supplementary operating instructions or approval certificates |

| Pressure | Operating pressure | Single cable Ø8 mm / 0.32“ probe |
|          | -1...40 barg / -14.5...580 psig |
|          | subject to process connection temperature and probe type used |
|          | High-Pressure (HP) version | max. 300 barg / 4350 psig [single cable Ø2 mm / 0.08“ probe only] |
|          | subject to process connection temperature and probe type used |
|          | All other probe types | -1...100 barg / -14.5...1450 psig |
|          | subject to process connection temperature and probe type used |
**Other conditions**

- **Dielectric constant ($\varepsilon_r$)**
  - Level in direct mode: $\geq 1.4$ for coaxial probe; $\geq 1.6$ for single and double probes
  - Interface in direct mode: $\varepsilon_r(\text{interface}) \gg \varepsilon_r(\text{level})$
  - Level in TBF mode: $\geq 1.1$

- **Vibration resistance**: IEC 60068-2-6 and EN 50178 (10...57 Hz: 0.075 mm / 57...150 Hz: 1g)

- **Protection category**: IP 66/67 equivalent to NEMA 4X (housing) and 6P (probe)

---

**Installation conditions**

- **Process connection size**: Refer to “Installation: How to prepare the tank before you install the device” and “Technical data: Measurement limits”

- **Process connection position**: Make sure that there are not any obstructions directly below the process connection for the device.

- **Dimensions and weights**: Refer to “Technical data: Dimensions and weights” in the Handbook

---

**Material**

<table>
<thead>
<tr>
<th>Component</th>
<th>Standard</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Housing</td>
<td>Standard: Polyester-coated aluminium</td>
<td>Option: Stainless steel (1.4404 / 316L) 3</td>
</tr>
<tr>
<td>Single rod [single-piece]</td>
<td>Standard: Stainless steel (1.4404 / 316L)</td>
<td>Option: Stainless steel (1.4404 / 316L) in a PVDF protective sheath, Hastelloy® C-22 (2.4602) 4 On request: Stainless steel (1.4404 / 316L) in a PVC, PVDF or PP protective sheath On request: Monel; Tantalum; Titanium; Duplex</td>
</tr>
<tr>
<td>Single rod [segmented]</td>
<td>Standard: Stainless steel (1.4404 / 316L)</td>
<td></td>
</tr>
<tr>
<td>Double rod</td>
<td>Standard: Stainless steel (1.4404 / 316L)</td>
<td>Option: Hastelloy® C-22 (2.4602) On request: Monel; Tantalum; Titanium; Duplex</td>
</tr>
<tr>
<td>Coaxial [single-piece]</td>
<td>Standard: Stainless steel (1.4404 / 316L)</td>
<td>Option: Hastelloy® C-22 (2.4602)</td>
</tr>
<tr>
<td>Coaxial [segmented]</td>
<td>Standard: Stainless steel (1.4404 / 316L)</td>
<td></td>
</tr>
<tr>
<td>Single cable</td>
<td>Standard: Stainless steel (1.4401 / 316)</td>
<td>Option: Hastelloy® C-22 (2.4602) On request: FEP-coated stainless steel (-20...+150°C / -4...+302°F) – only for the Ø2 mm / 0.08&quot; single cable probe</td>
</tr>
<tr>
<td>Double cable</td>
<td>Stainless steel (1.4401 / 316)</td>
<td></td>
</tr>
<tr>
<td>Process fitting</td>
<td>Standard: Stainless steel (1.4404 / 316L)</td>
<td>Option: Hastelloy® C-22 (2.4602) On request: Monel; Tantalum; Titanium; Duplex</td>
</tr>
<tr>
<td>Gaskets</td>
<td>FKM/FPM (-40...+200°C / -40...+392°F); Kalrez® 6375 (-20...+200°C / -4...+392°F); EPDM (-50...+150°C / -58...+302°F) – all probes except single cable Ø8 mm / 0.32&quot; 5</td>
<td></td>
</tr>
<tr>
<td>Weather protection</td>
<td>Stainless steel (1.4301 / 304)</td>
<td></td>
</tr>
<tr>
<td>Protective sheath [On request for single rod only]</td>
<td>PP [-40...+90°C / -40...+194°F]; PVC [-15...+80°C / +5...+176°F]; PVDF [-40...+150°C / -40...+300°F]</td>
<td></td>
</tr>
<tr>
<td>Conduit for remote housing [Option]</td>
<td>Zinc-coated steel in a PVC sheath [-40...+105°C / -40...+221°F]</td>
<td></td>
</tr>
</tbody>
</table>
### Process connections

| **Thread** | **G ½ (ISO 228); ½ NPT (ASME B1.20.1); ½ NPTF (ASME B1.20.3 – for the HT/HP version)** |
| **Single cable Ø2 mm / 0.08** | | |
| **Double cable Ø4 mm / 0.16** | | |
| **Double rod Ø8 mm / 0.32** | | |
| **All other probes** | **G ¾...1½ (ISO 228); ¾...1½ NPT (ASME B1.20.1)** |

| **Flange versions for double rod and double cable probes** | **EN 1092-1** | **DN50...80 in PN40 (Form B1), DN100...200 in PN16 or PN40 (Form B1), DN50...150 in PN63 or PN100 (Form B1); others on request** |
| **Optional flange facing: Forms C, D, E and F** | **ASME B16.5** | **2"...8" in 150 lb, 2"...6" in 300 lb RF, 2"...4" in 600 lb RF, 3"...4" 900 lb RF, 2" in 900 lb or 1500 lb RJ; others on request** |
| **Optional flange facing: RJ (Ring Joint)** | **JIS B2220** | **50...100A in 10K; others on request** |

| **Flange versions for single cable Ø8 mm / 0.32** | **EN 1092-1** | **DN40...80 in PN40 (Form B1), DN100...200 in PN16 or PN40 (Form B1), DN40...150 in PN63 or PN100 (Form B1); others on request** |
| **Optional flange facing: Forms C, D, E and F** | **ASME B16.5** | **1½"...8" in 150 lb, 1½"...4" in 300 lb RF, 1½"...4" in 600 lb RF, 1½...2" in 900 lb or 1500 lb RJ; others on request** |
| **Optional flange facing: RJ (Ring Joint)** | **JIS B2220** | **40...100A in 10K; others on request** |

| **Flange versions for single cable Ø2 mm / 0.08** probe | **EN 1092-1** | **DN25...80 in PN40 (Form B1), DN100...200 in PN16 or PN40 (Form B1), DN25...150 in PN63 or PN100 (Form B1); others on request** |
| **Optional flange facing: Forms C, D, E and F** | **ASME B16.5** | **1"...8" in 150 lb RF, 1½"...6" in 300 lb RF, 1"...4" in 600 lb RF, 3"...4" in 900 lb RF, 1"...2" in 900 lb or 1500 lb RJ, 1" in 2500 lb RJ; others on request** |
| **Optional flange facing: RJ (Ring Joint)** | **JIS B2220** | **40...100A in 10K; others on request** |

| **Flange versions for other probes** | **EN 1092-1** | **DN25...80 in PN40 (Form B1), DN100...200 in PN16 or PN40 (Form B1), DN25...150 in PN63 or PN100 (Form B1); others on request** |
| **Optional flange facing: Forms C, D, E and F** | **ASME B16.5** | **1"...8" in 150 lb RF, 1½"...6" in 300 lb RF, 1"...4" in 600 lb RF, 3"...4" in 900 lb RF, 1"...2" in 900 lb or 1500 lb RJ; others on request** |
| **Optional flange facing: RJ (Ring Joint)** | **JIS B2220** | **40...100A in 10K; others on request** |

| **Other options for single and double rod probes** | **SMS** | Available on request |
| **Tri-clamp** | Available on request |
| **Others** | Others on request |
Electrical connections

<table>
<thead>
<tr>
<th>Power supply</th>
<th>Terminals output 1 – Non-Ex / Ex i: 14...30 VDC; min./max. value for an output of 22 mA at the terminal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Terminals output 1 – Ex d: 20...36 VDC; min./max. value for an output of 22 mA at the terminal</td>
</tr>
<tr>
<td></td>
<td>Terminals output 2 – Non-Ex / Ex i / Ex d: 10...30 VDC; min/max. value for an output of 22 mA at the terminal (additional power supply needed – output only)</td>
</tr>
<tr>
<td>Cable entry</td>
<td>M20×1.5; ½ NPT</td>
</tr>
<tr>
<td></td>
<td>G ½ (not for FM-approved devices. Not for stainless steel housings.)</td>
</tr>
<tr>
<td></td>
<td>M25×1.5 (for stainless steel housings only)</td>
</tr>
<tr>
<td>Cable gland</td>
<td>Standard: none</td>
</tr>
<tr>
<td></td>
<td>Options: M20×1.5 (for non-Ex and Ex-approved devices with M20×1.5 and M25×1.5 cable entries); others are available on request</td>
</tr>
<tr>
<td>Cable entry capacity (terminal)</td>
<td>0.5...1.5 mm²</td>
</tr>
</tbody>
</table>

Input and output

<table>
<thead>
<tr>
<th>Current output</th>
<th>Output signal [Output 1] 4...20 mA HART® or 3.8...20.5 mA acc. to NAMUR NE 43 (optional)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output signal</td>
<td>4...20 mA [no HART® signal] or 3.8...20.5 mA acc. to NAMUR NE 43 (optional)</td>
</tr>
<tr>
<td>Resolution</td>
<td>±3 µA</td>
</tr>
<tr>
<td>Temperature drift</td>
<td>Typically 50 ppm/K</td>
</tr>
<tr>
<td>Error signal</td>
<td>High: 22 mA; Low: 3.6 mA acc. to NAMUR NE 43</td>
</tr>
</tbody>
</table>

Approvals and certification

| CE | This device fulfils the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark. |
| Explosion protection | ATEX KEMA 07ATEX0069 X: II 1 G, 1/2 G, 2 G Ex ia IIC or Ex ia IIIB or Ex ia IIA T6...T2; II 1 D, 1/2 D, 2 D Ex iaD 20 or Ex iaD 20/21 or Ex iaD 21 IP6X T70°C...T95°C; II 1/2 G, 2 G Ex d[ia] IIC or Ex d[ia] IIIB or Ex d[ia] IIA T6...T2; II 1/2 D, 2 D Ex tD[iaD] A21/20 or Ex tD[iaD] A21 IP6X T70°C...T95°C; II 3 G Ex nA II T6...T2 X |
| IECEx IECEx KEM 10.0082X | Ga Ex ia IIC T6...T2; Ex iaD 20 IP 6X T70°C...T95°C; Ga/Gb Ex d[ia] IIC T6...T2; Ex tD[iaD] A21/20 IP 6X T70°C...T95°C |
| FM – Dual Seal-approved | NEC 500: XP-IS / Cl. I / Div. 1 / Gr. ABCD / T6-T1; DIP / Cl. II, III / Div. 1 / Gr. EFG / T6-T1; IS / Cl. I, II, III / Div. 1 / Gr. ABCDEFG / T6-T1; NI / Cl. I / Div. 2 / Gr. ABCD / T6-T1 |
|                | NEC 505: Cl. I / Zone 0 / AEx d[ia] / IIC / T6-T1; Cl. I / Zone 0 / AEx ia / IIC / T6-T1; Cl. I / Zone 2 / AEx nA[ia] / IIC / T6-T1 |
|                | Hazardous [Classified] Locations, indoor/outdoor Type 4X and 6P, IP66, Dual Seal |
### 4.2 Measurement limits

For more data, refer to “Measurement limits” in the handbook.
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