Electromagnetic flow converter

The documentation is only complete when used in combination with the relevant documentation for the flow sensor.
SAFETY INSTRUCTIONS

AFC 030

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 INSTALLATION

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.

The electromagnetic flowmeter is designed exclusively to measure the flow of electrically conductive, liquid media.

WARNING!
If the device is not used according to the operating conditions, the intended protection could be affected.

2.2 Scope of delivery

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.

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

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.

Figure 2-1: Scope of delivery
1. Ordered signal converter
2. Product documentation
3. Calibration report
4. Cable for remote connection
2.3 Storage

- Store the device in a dry, dust-free location.
- Avoid continuous direct sunlight.
- Store the device in its original packing.
- Storage temperature: \(-50\ldots+70^\circ\text{C} / -58\ldots+158^\circ\text{F}\)

2.4 Transport

**Signal converter**
- No special requirements.

**Compact version**
- Do not lift the device by the signal converter housing.
- Do not use lifting chains.
- To transport flange devices, use lifting straps. Wrap these around both process connections.

2.5 Installation specifications

**INFORMATION!**
The following precautions must be taken to ensure reliable installation.
- Make sure that there is adequate space to the sides.
- Protect the signal converter from direct sunlight and install a sun shade if necessary.
- Signal converters installed in control cabinets require adequate cooling, e.g. by fan or heat exchanger.
- Do not expose the signal converter to intense vibrations. The measuring devices are tested for a vibration level in accordance with IEC 68-2-64.
2.6 Mounting the wall-housing, remote version

**INFORMATION!**
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

### 2.6.1 Pipe mounting

1. Fasten the mounting plate to the pipe with standard U-bolts, washers and fastening nuts.
2. Screw the signal converter to the mounting plate with the nuts and washers.

![Figure 2-2: Pipe mounting of the wall-mounted housing](image)

- ① Fasten the mounting plate to the pipe with standard U-bolts, washers and fastening nuts.
- ② Screw the signal converter to the mounting plate with the nuts and washers.

### 2.6.2 Wall mounting

1. Prepare the holes with the aid of the mounting plate. For further information refer to Mounting plate of wall-mounted housing on page 7.
2. Fasten the mounting plate securely to the wall.
3. Screw the signal converter to the mounting plate with the nuts and washers.

![Figure 2-3: Wall mounting of the wall-mounted housing](image)
2.6.3 Mounting plate of wall-mounted housing

Dimensions in mm and inch

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</table>
2.6.4 Wall-mounted housing

Figure 2-4: Construction of wall-mounted housing

1. Cover for terminal compartments
2. Terminal compartment for measuring sensor
3. Terminal compartment for outputs
4. Terminal compartment for power supply with safety cover (shock-hazard protection)
5. Cable entry for electrode cable
6. Cable entry for field current cable
7. Cable entry for output
8. Cable entry with blanking plug
9. Cable entry for power supply

WARNING!
Be aware that the cable, type L45551 has a minimal bending radius of 140 mm / 5.5".
For more details see refer to Cable specifications on page 11.
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!

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 Important notes on electrical connection

DANGER!
Electrical connection is carried out in conformity with the VDE 0100 directive “Regulations for electrical power installations with line voltages up to 1000 V” or equivalent national regulations.

CAUTION!
• Use suitable cable entries for the various electrical cables.
• The measuring sensor and signal converter have been configured together at the factory. For this reason, please connect the devices in pairs. Ensure that the measuring sensor constant GK (see nameplates) are identically set.
• If delivered separately or when installing devices that were not configured together, set the signal converter to the DN size and GK of the measuring sensor.

3.3 Electrical cables for remote device versions

3.3.1 Notes on signal and field current cables

Observe the following notes:
• Place the signal cable with fastening elements.
• It is permissible to lay the signal cable in water or in the ground.
• Cable specifications have to comply to CST 74C068 standard
• The connection of the inner shield is carried out via the stranded drain wire.

Requirements for signal cables provided by the customer

INFORMATION!
If the signal cable was not ordered, it is to be provided by the customer. The following requirements regarding the electrical values of the signal cable must be observed:
3 ELECTRICAL CONNECTIONS

Electrical safety
• To IEC EN 60811-1-1, Common test methods for insulating and sheathing materials of electric cables and optical cables (or equivalent national regulations).

Capacitance of the insulated conductors
• Insulated conductor / insulated conductor < 50 pF/m
• Insulated conductor / shield < 150 pF/m

Insulation resistance
• $R_{\text{iso}} > 100 \, \text{G\Omega x km}$

Test voltages
• Insulated conductor / inner shield 500 V
• Insulated conductor / insulated conductor 1000 V
• Insulated conductor / outer shield 1000 V

Twisting of the insulated conductors
• At least 10 twists per meter.

DANGER!
A non-shielded 2-wire copper cable is sufficient for the field current cable. If you nevertheless use shielded cables, the shield must NOT be connected in the housing of the signal converter.

INFORMATION!
The field current cable is not part of the scope of delivery.
3.3.2 Preparing the signal and field current cables

**INFORMATION!**
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

The electrical connection of the outer shield is different for the various housing variants.
Please observe the corresponding instructions.

3.3.3 Cable specifications

The following cables are supplied with the ordered signal converter / flowmeter:

- Field current cable, PEEK - H1619 STQ 3
- Signal cable, PEEK - H1619 STQ 3
- Signal cable, type L45551.....

The cabling for connection to mains supply and grounding are not supplied. See refer to Power supply connection on page 17

![Figure 3-1: PEEK Cable H1619 STQ3](image)

- **1**: PEEK outer jacket
- **2**: Silver plated annealed copper braided shield
- **3**: Three single twisted wires (polyamide insulated)
Both cables are suitable for zone 3 and 4 controlled area with the following specifications:

|  |  |  |  |  |  |  |  |  |
|---|---|---|---|---|---|---|---|
| 1 | 5.2 | 69 | 3 | 16 | 1.5 | 1.35 | 200 | 600 | 10 | 55 |
| 2 | 13.9 | 254 | 5 | 20 | 2.1 | 3.5 | 90 | 300 | 0.75 | 140 |

specification standards:
2. Type L45551 cable: EN 13602, EN 50295, flame retardant acc. NF C32-070 C1 and IEC 60332-3-23
3.4 Connecting the signal and the field current cables

3.4.1 Cable type - L45551

- The outer shield of the signal cable is connected via an AWG22 cable (140 mm)
- If a shielded field current cable is used, the shield must NOT be connected in the housing of the signal converter.
- The Krohne supplied cable has a bending radius: \( \geq 70 \text{ mm} / 2.8" \) (one time bending)
  For repeated bending; bending radius \( \geq 140 \text{ mm} / 5.6" \)

1. Open the housing cover.
2. Pass the prepared signal cable through the cable entry and connect the corresponding stranded drain wires and conductors.
3. Connect the drain wire of the outer shield.
4. Pass the prepared field current cable through the cable entry and connect the corresponding conductor.
   Any shield that is present must NOT be connected.
5. Tighten the screw connections of the cable entry and close the housing cover.

**INFORMATION!**
Ensure that the housing gasket is properly fitted, clean and undamaged.
3.4.2 PEEK cable H1619 STQ3

- The outer shield of the signal cable is connected via an AWG22 cable (140 mm)
- If a shielded field current cable is used, the shield must **NOT** be connected in the housing of the signal converter.
- The Krohne supplied cable has a bending radius: \[ \geq 25 \text{ mm} / 1'' \text{ (one time bending)} \]
  - For repeated bending; bending radius \[ \geq 50 \text{ mm} / 2'' \]

1. Open the housing cover.
2. Pass the prepared signal cable through the cable entry and connect the corresponding stranded drain wires and conductors.
3. Connect the drain wire of the outer shield.
4. Pass the prepared field current cable through the cable entry and connect the corresponding conductor.
5. Any shield that is present must **NOT** be connected.
6. Tighten the screw connections of the cable entry and close the housing cover.

![Figure 3-4: Electrical connection of the signal and the field current cables](image)

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**INFORMATION!**

Ensure that the housing gasket is properly fitted, clean and undamaged.
3.5 Connection diagrams

**DANGER!**
The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

**Connection diagram, PEEK cable**

![Diagram](image)

1. Electrical terminal compartment in housing of the signal converter.
2. Connection box of measuring sensor
3. Signal cable
4. Field current cable
5. Terminal 4 is connected to shield of cable
6. Functional ground FE

**Connection diagram, cable L45551**

![Diagram](image)

1. Electrical terminal compartment in housing of the signal converter.
2. Wire on terminal 4 (cable lug connection in signal converter)
3. Signal cable
4. Field current cable
5. Connection box of measuring sensor
6. Functional ground FE
3.6 Grounding

**DANGER!**
The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

3.6.1 Classical method

**CAUTION!**
There should be no difference in potential between the flow sensor and the housing or protective earth of the signal converter!

- The flow sensor must be properly grounded.
- The grounding cable should not transmit any interference voltages.
- Do not use the grounding cable to connect any other electrical devices to ground at the same time.
- In hazardous areas, grounding is used at the same time for equipotential bonding. Additional grounding instructions are provided in the supplementary “Ex documentation”, which are only supplied together with hazardous area equipment.
- The flow sensors are connected to ground by means of a functional grounding conductor FE.
- Special grounding instructions for the various flow sensors are provided in the separate documentation for the flow sensor.
- The documentation for the flow sensor also contain descriptions on how to use grounding rings and how to install the flow sensor in metal or plastic pipes or in pipes which are coated on the inside.
3.7 Power supply connection

**DANGER!**
The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

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

- The protection category depends on the housing versions (IP65...67 to IEC 529 / EN 60529 or NEMA4/4X/6).
- The housings of the devices, which are designed to protect the electronic equipment from dust and moisture, should be kept well closed at all times. Creepage distances and clearances are dimensioned to VDE 0110 and IEC 664 for pollution severity 2. Supply circuits are designed for overvoltage category III and the output circuits for overvoltage category II.
- Fuse protection (IN ≤ 16 A) for the infeed power circuit, as well as a separator (switch, circuit breaker) to isolate the signal converter must be provided close to the device. The separator must conform to IEC 60947-1 and IEC 60947-3 and must be marked as the separator for this device.

100...230 VAC (tolerance range: -15% / +10%)

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.
- The protective ground terminal PE of the power supply must be connected to the separate U-clamp terminal in the terminal compartment of the signal converter.

**INFORMATION!**
240 VAC + 5% is included in the tolerance range.

**CAUTION!**
The protective conductor contacts must not be used to loop through the PE connection.
3.8 Laying electrical cables correctly

1. Lay the cable in a loop just before the housing.
2. Tighten the screw connection of the cable entry securely.
3. Never mount the housing with the cable entries facing upwards.
4. Seal cable entries that are not needed with a plug.

Figure 3-7: Protect housing from dust and water
3.9 Wall-mounted housing, electrical connection of the inputs and outputs

**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!

- The shield must be electrically connected using 6.3 mm / 0.25” push-on connector (insulation to DIN 46245) in the I/O terminal compartment.
- Terminal A+ is only operable in the basic version.

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![Electrical Connections Diagram]

**INFORMATION!**
Ensure that the housing gasket is properly fitted, clean and undamaged.
Only the output connections [4–20mA] A, A-, A+ and ground are connected in the AFC 030 signal converter. The connection diagrams below shows the possible output connections to use. Connections B, B+, C, C+, D, and D+ are not connected.

4-20mA, passive mode (external supply)

4-20mA, passive mode, grounded (external supply)

4-20mA, active mode (internal supply)
4.1 Adjustment procedure

This chapter contains relevant information to adjust the AFC 030 before or after installation. When making any adjustments make sure to work ESD protected.

The converter is to some extent sensitive to ESD (Electro Static Discharge). To prevent failing or even damage:

**CAUTION!**
*Do not touch any electrical contact directly*

4.2 Equipment needed for adjustment

The following equipment is needed:

1. Resistance meter with 10k - 100k range and accuracy < +/- 0.07%
2. Voltmeter with < 500 mV DC range with averaging function and accuracy < 0.1 mV
3. ESD wrist strap with lead to connect to PE (or other earth connection)

**Figure 4-1: Open housing AFC 030**

*Detailed area for adjustments*

* see next page for illustration and details of the adjustment area
4.2.1 AFC 030 adjustment locations

The figure below is in detail the area to find the different jumpers and potentiometers, necessary for adjustment and settings after installation.

![Location of jumpers and potentiometers](image)

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**Figure 4-2: Location of jumpers and potentiometers**

1. TP1
2. GE
3. GK interval
4. Range
5. TP2
6. P3: GK adjustment
7. P2: Offset adjustment
8. TP3
9. TP4

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4.2.2 AFC 030; set flow range

The flow range can be set before or after field installation, with or without mains power applied. Set the three “Range” jumpers according to the desired full scale range. Settings are 2, 4, 6, 8, 10, 12, 14. Range 0 is invalid, and ranges 2 m/s and 14 m/s are outside the accuracy specifications of AFC 030.

<table>
<thead>
<tr>
<th>Full scale range (m/s)</th>
<th>Jumper settings</th>
<th>Time constant</th>
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</table>

**Table 4-1: Jumper setting for flow range**
4.2.3 AFC 030; Span adjustment and time constant selection

This procedure is required to adjust the AFC 030 for a specific sensor constant GK. The procedure can be performed after installation in the field or as preparation before installation. The procedure can be performed with or without applied mains power.

See for the corresponding jumpers and potentiometers the previous picture.

Actions to follow

- Open both upper and lower doors of the AFC 030 housing
- Set jumper “GE” to position “0”
- Calculate the required resistance between TP1 and TP2 from the formula:

\[ R = \frac{100 \text{k}\Omega}{\text{GK} \times (\frac{1}{10} \div \frac{1}{2})} \quad [7.8 < R < 104.3] \]

Target range [m/s] = full scale flow arranging 20 mA output.

\[ 1 = \text{Range set [m/s]} \quad \text{refer to AFC 030 adjustment locations on page 22} \]
\[ 2 = \text{Target range [m/s]} \]

- Set the jumpers “GK-interval” to the adjustment range of R conform the interval table on next page.
- Connect the multimeter to measure the actual resistance between TP1 and TP2
- Adjust P3 (GK-adjust) to the calculated resistance within +/-0.05% of the calculated value
- Disconnect the multimeter from TP1 and TP2
- Set jumper “GE” to position “1” for normal operation
- For changed cabling or sensor, adjust the zero offset according the "Zero adjustment procedure" on next page
- Close both the upper and lower doors of the AFC 030 housing
Example: determination of full scale Range setting

The data on flowmeter nameplate: DN50 / 2" and GK = 3.123
Target range (full scale) = 20 m³/h; this value have to be used to calculate the Range jumper settings as described, refer to AFC 030; set flow range on page 22

- Converting the [m³/h] to [m/s] is done by transposing to seconds and meters (using \(0.25\pi(\theta/1000)^2\) = the cross section of the pipe [m²])
  Note that the DN bore size diameter \(\theta\) is always in mm

- Target range calculation: \(20\ [m^3/h]/(3600\ [s] \times 0.25 \times \pi \times (50/1000)^2) = 2.829\ [m/s]\)

- The calculated Target range 2.829 [m/s] can now be used in the formula to calculate the settings of R [kOhm].

The possible ranges to select:

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Depending on the selected Range as described, refer to AFC 030; set flow range on page 22, the corresponding time constant (TC) is selected.
### Jumper settings 50K-interval

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<td>56.3</td>
</tr>
</tbody>
</table>

Rmin - Rmax in [kOhm]
4.2.4 AFC 030; Zero adjustment

The zero adjustment procedure is required to adjust the zero flow measured by the AFC 030. The procedure must be performed after installation in the field, to compensate for offset, caused by magnetic field crosstalk into the installed cables.

The AFC 030 is preset at factory and assuming no cable crosstalk. The zero adjustment procedure must be carried out with applied mains power.

Actions to follow performing zero adjustment

- Open both upper and lower doors of the AFC 030 housing
- Set the flow to zero and assure that there is absolutely no flow and/or leakage present. Check by closing valves in the pipeline and that the pipe line is filled with fluid
- Connect the multimeter to TP4 (-) and TP3 (+) and set to mV range
- Stabilize the measuring system by applying the mains power for at least 15 minutes.
- Adjust P2 (offset) to < 0 (±0.5 mV average)

The multimeter must be used with averaging on, because the noise level is approximately 1mVpp. After every adjustment, reset the average function of the multimeter.

- After establishing correct setting of the offset, remove the multimeter.
- Close both upper and lower doors of the AFC 030 housing

4.3 Troubleshooting

Figure of the display with LED

1. Red LED: Output error
2. Red LED: Sensor error
3. Red LED: Field current error
4. Yellow LED: Zero flow/under flow
5. Green LED Bar: Percentage of flow
6. Red LED: Over flow
The following table shows possible solutions for problems and/or errors occurring.

<table>
<thead>
<tr>
<th>Error</th>
<th>Cause</th>
<th>Solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>All leds are off</td>
<td>No mains supply</td>
<td>Measure mains supply voltage</td>
</tr>
<tr>
<td></td>
<td>At least te most left LED (zero flow/underflow) should light up</td>
<td>Inspect mains supply cable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inspect internal cabling AFC 030 (flat cable &amp; sensor cable)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If these are all OK, the AFC 030 has an internal defect and has to be returned for repair</td>
</tr>
<tr>
<td>AFC 030 measure zero flow only, while there is flow present</td>
<td>Flow sensor is mounted in wrong flow direction</td>
<td>Mount the sensor in the correct flow direction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indicate arrow on sensor must point in the positive flow direction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Correct/incorrect functioning can be checked (before re-mounting) by temporarily exchanging pins 7 and 8 of the field current cable</td>
</tr>
<tr>
<td></td>
<td>Field current connection has wrong polarity (pins 7 &amp; 8 are exchanged)</td>
<td>Inspect and if necessary correct the connections</td>
</tr>
<tr>
<td></td>
<td>Sensor connections has wrong polarity (pins 2 &amp; 3 are exchanged)</td>
<td>Inspect and if necessary correct the connections</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Check also the correct connection of cable screens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Connect shield of cables; pin 2 to pin 20 and pin 3 to pin 30</td>
</tr>
<tr>
<td></td>
<td>Jumper &quot;GE&quot; is not put back on pos. 1 after GN adjustment</td>
<td>Place jumper GE to position 1</td>
</tr>
<tr>
<td></td>
<td>Range is set to 0 m/s</td>
<td>Inspect jumpers</td>
</tr>
<tr>
<td></td>
<td>Bad jumper contact</td>
<td></td>
</tr>
<tr>
<td>LED &quot;Current loop error&quot; lights</td>
<td>4-20 mA I/O cable is disconnected</td>
<td>Inspect I/O cabling</td>
</tr>
<tr>
<td>LED &quot;Sensor error&quot; lights</td>
<td>Sensor cable is disconnected, or connection to pin 4 is not made</td>
<td>Inspect sensor cabling</td>
</tr>
<tr>
<td></td>
<td>Sensor is heavy polluted</td>
<td>Inspect sensor</td>
</tr>
<tr>
<td></td>
<td>Sensor electrode is defect</td>
<td>When error LED is off (after connecting pin 2 and 3 with pin 1 at sensor) the error is in the sensor itself and not in the cable</td>
</tr>
<tr>
<td>LED &quot;Field current error&quot; lights</td>
<td>Field current cable is not connected or short circuited</td>
<td>Inspect field current cable (at pin 7 and 8)</td>
</tr>
<tr>
<td>LED &quot;Overflow&quot; lights</td>
<td>The flow is to high to be measured</td>
<td>Check flow</td>
</tr>
<tr>
<td></td>
<td>The GK or range jumpers are not set correctly (wrt flow range)</td>
<td>Inspect jumpers and jumper settings</td>
</tr>
<tr>
<td></td>
<td>Jumpers have bad contact</td>
<td></td>
</tr>
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</table>
5.1 Dimensions and weights

Wall version housing

<table>
<thead>
<tr>
<th>a (mm)</th>
<th>b (mm)</th>
<th>c (mm)</th>
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</thead>
<tbody>
<tr>
<td>198</td>
<td>138</td>
<td>299</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>a (inch)</th>
<th>b (inch)</th>
<th>c (inch)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.8&quot;</td>
<td>5.4&quot;</td>
<td>11.8&quot;</td>
</tr>
</tbody>
</table>

weight approximately: 2.4 kg / 5.3 lb
KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process Analysis
- Services

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www.krohne.com