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RADARCONT® RP4
Electronic Radar Sensor
with a free-space 122
GHz FMCW signal
for distance, level, and
volume measurements



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1 Notes on the Document

1.1 Document function

This manual describes the product's design, functions, and use, and helps ensure that the product is operated as intended.

Read the manual carefully before using the product. This will help you avoid potential injury, property damage, and damage to the device.

The operating manual is an integral part of the device and must be kept accessible at all times in the immediate vicinity of the operating site.

The information in this document reflects the knowledge available at the time of printing. Subject to change without notice.

1.2 Terms

NOTE

Information on how to prevent malfunctions, operational failures, and damage to the device or system.



WARNING

Failure to follow these instructions may result in serious or fatal injury.

[04-5]

Reference to a variant >> Product Code section

1.3 Additional documentation

In addition to this document, you can find additional documentation online.

2 Safety instructions

2.1 Authorized Personnel

Installation, electrical connection, commissioning, operation, maintenance, disassembly, and disposal of the device must be performed by a qualified and authorized specialist in accordance with the instructions in the operating manual and applicable standards.

This specialist must have read and understood the operating instructions, particularly the safety instructions. The required personal protective equipment must always be worn when working on or with the device.

2.2 Intended use

The device is an electronic radar sensor for measuring distances, levels, and volumes in liquid media.

The device is safe to operate only when used as intended. Improper or unintended use of this product may result in application-specific hazards, such as a container overflow due to incorrect installation or adjustment. This can result in property damage, personal injury, or environmental damage. Furthermore, this may impair the device's performance.

Improper use, failure to follow the operating instructions and technical regulations, the use of inadequately qualified personnel, unauthorized modifications, and damage to the device exclude the manufacturer's liability for any resulting damages. The manufacturer's warranty is void.

2.3 Operational safety

The device is designed and tested in accordance with the state of the art to ensure operational safety. It may only be operated when it is in technically sound and safe operating condition. The operator is responsible for ensuring the trouble-free operation of the device. The device may only be used within the permissible operating limits. Any use outside these intended limits may result in significant hazards.

The materials must be checked for compatibility with the application requirements prior to use. An unsuitable material can lead to damage, malfunction, or destruction of the device and the resulting hazards.

The device must not be used as the sole means of preventing hazardous conditions on machines and systems.

For safety and warranty reasons, any modifications beyond the described operating procedures may only be performed by personnel authorized by the manufacturer. Unauthorized modifications or alterations are expressly prohibited. For safety reasons, only accessories specified by the manufacturer may be used.

The maximum transmitted power of the sensor does not exceed the permitted limits specified in ETSI EN 305550-2.

This device complies with Article 4(3) of EU Directive 2014/68/EU (Pressure Equipment Directive) and is designed and manufactured in accordance with good engineering practice.

The device meets the requirements of all relevant EU directives. This is confirmed by the CE marking affixed to the device. The corresponding EU Declaration of Conformity can be requested or downloaded from the website.

3 Product description

3.1 Function

The device is an electronic radar sensor for measuring distances, fill levels, and volumes in liquid media.

The device operates using a pulsed FMCW (Frequency Modulated Continuous Wave) radar and measures the distance to stationary objects without contact.

The sensor periodically transmits a radar signal with a linearly rising and falling frequency. The rate of change of the frequency over time remains constant. Objects within the detection range reflect the transmitted signal. The distance to the object is determined based on the time-of-flight shift and the frequency shift in the reflected signal.

The device is suitable for applications in virtually all industrial sectors and is ideal for use in tanks up to 10 m.

The narrow beam angle minimizes interference from foreign objects or internal components. It is recommended for applications in which optical or ultrasonic sensors are unsuitable due to interfering factors such as temperature, the formation of gas or vapor layers, overpressure, underpressure, or vacuum, dust, wind, or incident light.

Depending on the type of application, radar technology enables:

- Measurement of liquids, even in the presence of gas stratification (e.g., ammonia) or foam formation
- Measurement of bulk solids
- Measurement through the container wall, e.g., IPC containers, or through protective windows, e.g., PTFE or PP

3.2 Design

3.2.1 Standard version – suspension cable – [01-S]

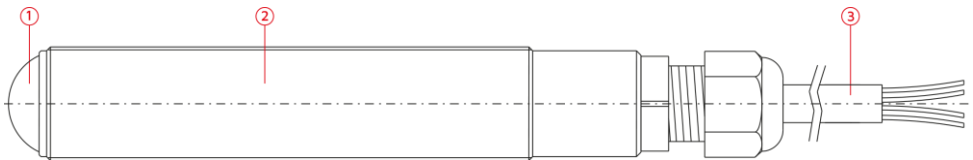


Figure 3.1: grf00021_cmp_rp4sr

- (1) Sensor lens
- (2) Process connection / connection housing
- (3) Support cable with steel core
- (4) The device is installed in the respective system via the process connection (2).

The radar signal is emitted and received via the sensor lens (1).

The signal is detected by the electronics integrated into the connection housing (2), processed according to the settings, and output via the connections on the connection cable (3).

The integrated evaluation electronics are configured via Bluetooth® using the SmartConnect app (Android/iOS) or via the wired interface.

Length-stable support cable (3) with steel core and shielding braid.

Laser-etched labeling on the nameplate ensures the device can be identified throughout its entire service life.

3.2.2 Industrial version – M12 connector – [01-I]



Figure 3.2: grf00022_cmp_rp4ir

- (1) Sensor lens
- (2) Process connection / connection housing
- (3) Connector

The device is installed in the respective system via the process connection (2).

The radar signal is transmitted and received via the sensor lens (1). The signal is detected by the electronics integrated into the connection housing (2), processed according to the settings, and output via the connectors (3).

The integrated evaluation electronics are configured via Bluetooth® using the SmartConnect app (Android / iOS) or via the wired interface.

Laser engraving on the nameplate ensures the device can be identified throughout its entire service life.

3.3 Nameplate

The nameplate contains the most important information for identifying and using the device.

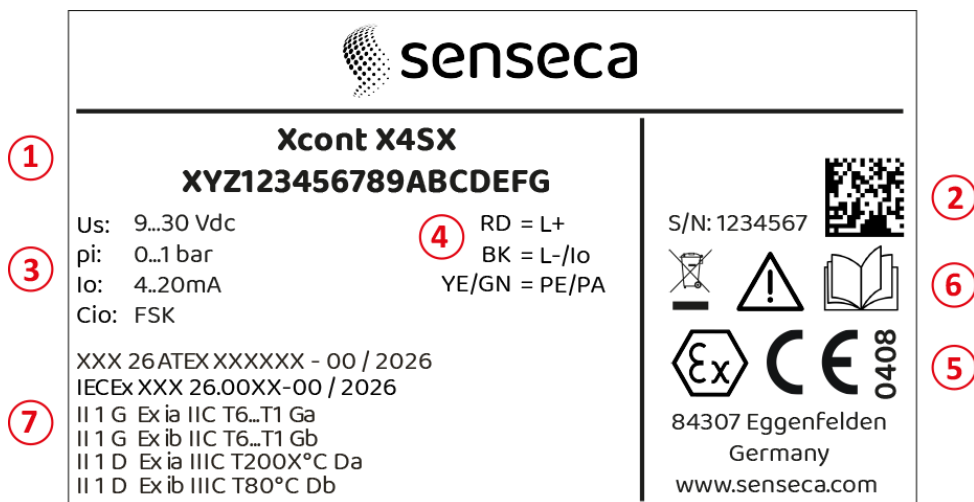


Figure 3.3: grf00002_lab001

- (1) Product code
- (2) Serial number
- (3) Technical Specifications
- (4) Electrical Connection
- (5) Approvals
- (6) Safety Instructions
- (7) Type of Ignition Protection

3.4 Product code

RP4 [01][02][03][04][05][06][07][94][95][98]

	Device	RP4	Radar sensor
01	Application Type	S	Standard
01		I	Industrial
02	Sensor	R	FMCW Radar
03	Certification	S	Standard
04	Process Connection	U	Thread DIN 13 – M30x1.5
05	Electronics – Output	V	RS485 Modbus-RTU, 4-wire
05		L	IO-Link, current 0/4...20 mA / 1x/2x switch PP, 3-/4-wire
06	Electronics – Function	0	without
06		3	Temperature -20...+70 °C (-4...+158 °F)
07	Electrical connection	S	M12-A-4P connector
07		O	PE cable, unassembled, assembly kit
07		K	PE Cable, Strands Assembled
07		H	PE Cable, Assembled Strands Hydrolog HLF4
80	Length L1	/#####	mm (≤ 300,000 mm)
94	Additional option	+SF	LABS-free, silicone-free / Paint-compatible version
95	Additional option	+ML	Measurement point designation / TAG - laser marking
98	Additional option	+KF	Configuration / Default Setting

Variants are generally identified by the letter Y in the product code.

3.5 Dimensions

Dimensions in mm

The parameter d_i indicates the distance measurement value relative to the respective measurement reference point.

[07-K/H/L] = Specifications for pre-assembled cables

3.5.1 Standard version – suspension cable – [01-S]

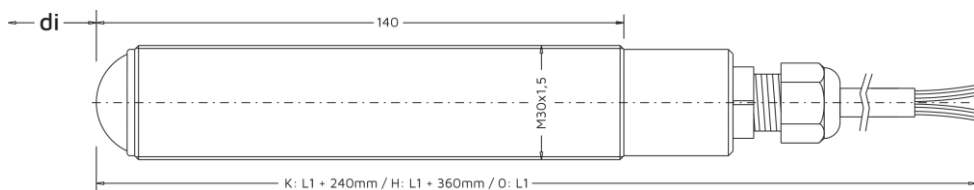


Figure 3.4: grf00023_dim_rp4sr

3.5.2 Industrial Version – M12 Connector – [01-I]

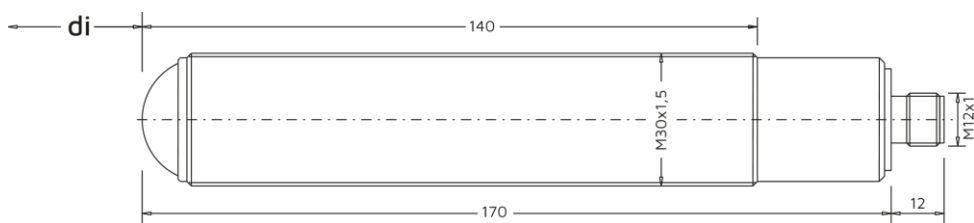


Figure 3.5: grf00024_dim_rp4ir

3.6 Packaging, Transport, Storage

The device is protected by packaging designed to withstand normal transport stresses. Transport must be carried out in accordance with the instructions on the shipping packaging. Failure to do so may result in damage to the device.

Upon receipt, the shipment must be inspected immediately for correctness, completeness, and any transport damage. Any transport damage or hidden defects found must be handled accordingly.

The packages must be kept sealed until installation and, unless otherwise specified, stored only under the following conditions:

- Do not store outdoors
- Store in a dry, dust-free area
- Do not expose to corrosive substances
- Protect from direct sunlight
- Avoid mechanical shocks
- Storage and transport temperature: -20...+85 °C
- Relative humidity 20...85 %

3.7 Accessories

A comprehensive range of accessories, optimally tailored to the device, is available for installation and electrical connection.

4 Installation

4.1 Ambient and process conditions

Correct operation of the device within the specified technical data can only be guaranteed if the permissible ambient and process conditions at the installation site (see the Technical Data section) are not exceeded. Therefore, before installation, ensure that all parts of the device in contact with the process (e.g., sensor lens, process connection, process seal, cable) are suitable for the prevailing process conditions (e.g., process pressure, process temperature, chemical properties of the media, abrasion, mechanical stresses).

The quality of the measurement result depends significantly on the properties of the medium being measured:

- Liquids with a refractive index (DK) of ≥ 4 can be measured.
- Filling, agitators, or other processes in the tank can cause very dense foams to form on the surface of the process medium, which may significantly attenuate the transmitted signal.
- Reduction of the maximum possible measurement range due to media with poor reflective properties, buildup, heavy condensation, foaming, or icing of the sensor.

4.2 Installation location

The distance measurement value refers to the measurement reference point (see the “Product Description – Dimensions” section).

No object detection occurs within the blind zone (for the minimum measuring range, see the Technical Data section).

The sensor may be mounted in any orientation.

Short connection pipes should be used so that the signal can propagate undisturbed in the near field.

Plastics are generally transparent to radar waves. Therefore, in plastic containers—such as IPC containers—the sensor can be mounted on the outside without damaging the container wall. Measurement through a protective barrier—e.g., made of PTFE or PP—is also possible in the presence of high temperatures or aggressive media. Certain materials, such as glass or, as well as mixtures containing glass or carbon fibers or graphite, can make measurement difficult or even impossible.

If the outer wall of the container is made of a non-conductive material (e.g., plastic, fiberglass-reinforced plastic), microwaves may also be reflected by external interference sources (e.g., metal pipes, ladders, gratings, etc.). Therefore, no such interference sources should be present within the beam cone outside the container.

Multiple radar sensors can be mounted side by side without the devices interfering with one another.

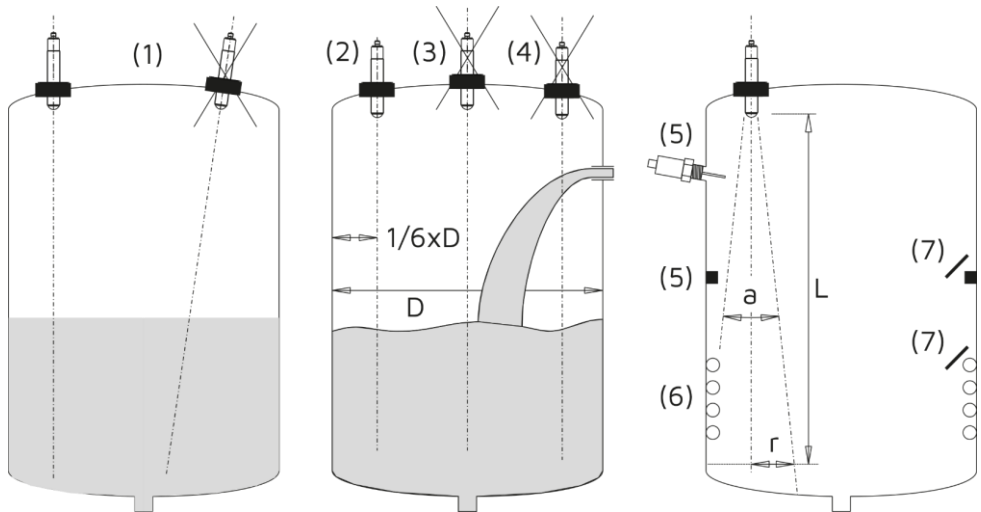


Figure 4.1: grf00025_ins_rp4ir_1

- (1) The sensor must be mounted perpendicular to the surface of the material.
- (2) The recommended mounting distance from the tank wall is $1/6$ of the tank diameter.
- (3) The sensor should not be mounted in the center of the tank.
- (4) Avoid measuring through the filling flow.
- (5) Avoid installing components such as limit switches or temperature sensors within the detection range.
- (6) Symmetrical components such as heating coils or flow breakers can significantly interfere with the measurement.
- (7) Interference reflections from internal components can be scattered or reduced by using metal screens mounted at an angle.
- (8) The radius r of the detection area at a distance L and an opening angle a (see "Technical Data" section) can be determined using the following equation: $r = \tan(a / 2) * L$

The cable end must terminate in a dry room or in a suitable junction box.

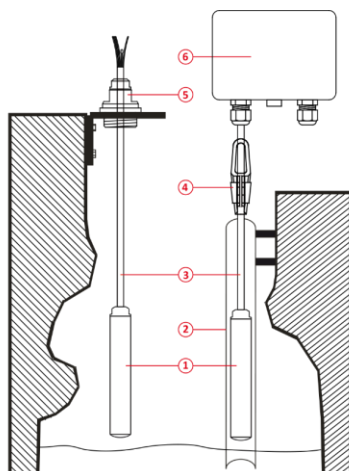


Figure 4.2: grf00027_ins_rp4sr

- (1) Level Sensor
- (2) Guide tube
- (3) Support cable (bending radius > 80 mm)
- (4) Tension clamp – see accessories
- (5) Mounting screw – see accessories
- (6) Panel enclosure – see accessories

4.3 Stand pipe

Using a standpipe can significantly improve signal quality.

This is recommended for in-tank installations or in cases of highly uneven tank walls, foaming, moving surfaces, and low DK values.

The standpipe should be made of metal or plastic with graphite or carbon fiber added.

In media prone to heavy buildup, measurement in the standpipe is not advisable; if necessary, the pipe must be cleaned regularly.

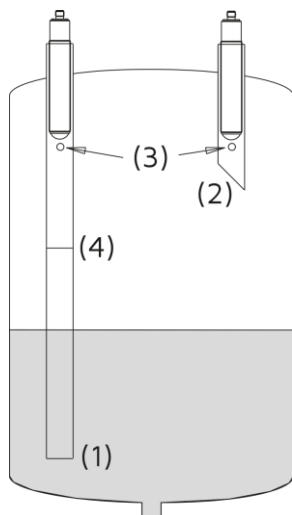


Figure 4.3: grf00026_ins_rp4ir_2

- (1) Standpipes should extend deeper than the minimum fill level.
- (2) For shorter tubes, the end of the tube on the medium side must be angled (45°).
- (3) A vent opening (Ø 5–10 mm) must be provided in the dead zone, above the maximum fill level.
- (4) Large gaps and thick weld seams inside the pipe when joining pipes must be avoided.

4.4 Installation instructions



WARNING

- Allow the system to cool sufficiently before installation. There is a risk from escaping, hazardous, and hot measured media.

Do not remove the packaging until immediately before installation, and inspect the device for any damage.

The protective cap attached to the process connection or the sensor lens must not be removed until immediately before installation. The sensor lens must not be damaged.

The mounting nuts must be tightened only on the hexagon using a suitable wrench, applying no more than the maximum permissible tightening torque (see the “Product Description – Dimensions” section).

5 Electrical connection

5.1 Electronic output – RS485 Modbus-RTU – [05-V]

5.1.1 Function

The Modbus protocol is a communication protocol based on a master/slave architecture. All devices are connected via two data lines (A+ / B-) and a COMMON line (C/L-).

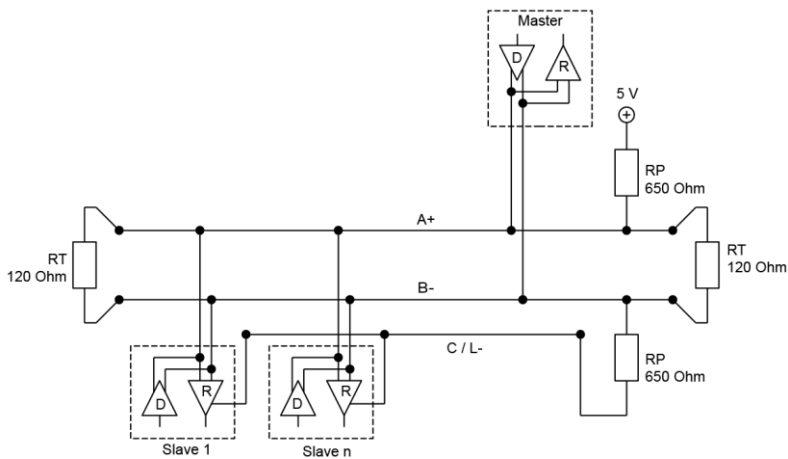


Figure 5.1: grf00011_eac_modbus_line_termination

A standard RS485 allows for the connection of 32 slaves in a single segment. The device has a load of only 1/8 of the standard load ($R_{in} \geq 96 \text{ kOhm}$), so that theoretically up to 256 of these devices can be operated in a single network segment. However, the number is limited to 247 by the Modbus address space.

The two terminating resistors RT prevent reflections on the data lines. The optimal resistance value depends on the characteristic impedance of the cable used; however, a value of 120 ohms is a common choice.

The polarization network is required to ensure appropriate potentials when none of the devices are transmitting and the A+ and B- lines are therefore undefined (high-impedance). The value of RP depends, for example, on the bus load or the terminating resistors. Recommended values range from 450 to 650 ohms.

The use of a polarization network is recommended to ensure a stable network. Typically, the polarization resistors are built into the master device or can be enabled as needed.

Arrange the devices in a bus topology (line). Avoid branch lines.

5.1.2 Pin assignment

Electrical Connection – Carrier Cable – [07-0/K/H]

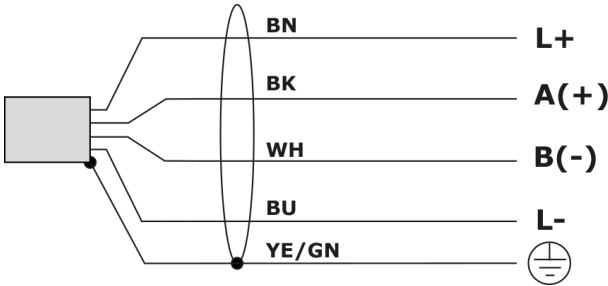


Figure 5.2: grf00028_eac_cab_4p_4w_rs485_rp4

Cable colors: BN = brown / WH = white / BK = black / BU = blue / YE/GN = yellow/green

Electrical Connection – M12 Connector – [07-S]

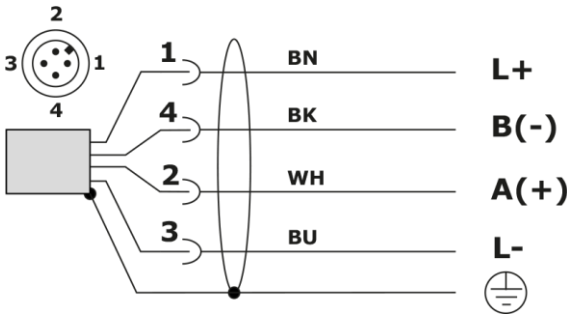


Figure 5.3: grf00029_eac_m12_4p_4w_rs485

Cable: M12 – A-coded, 1-BN = brown / 2-WH = white / 3-BU = blue / 4-BK = black

5.1.3 Connection cable

Use a 4-wire cable in accordance with the EIA485 recommendation:

Impedance	135...165 ohms @ 3...20 MHz
Cable capacitance	< 30 pF/m
Cable diameter	> 0.64 mm
Cable cross-section	0.34 mm² / AWG 22
Loop resistance	< 110 ohms/km
Shielding	Braided shield / shielding foil
Cable length	38,400 baud ≤ 1,200 m

5.1.4 Connection instructions

 WARNING

- ▶ Install the device only when it is de-energized.

NOTE

Switch off all connected control devices before commissioning.

Observe the maximum permissible supply voltage U_s at the L+/L- terminals:

- $U_s = 6...35\text{ Vdc}$

Ground the device, preferably via the metallic process connection, or alternatively via the cable shield.

Route the cable separately from power-carrying lines; ground the cable shield.

5.2 Electronic output [05-L] – IO-Link

5.2.1 Function

IO-Link is a globally standardized I/O technology for communicating with sensors. It is a serial, bidirectional point-to-point connection.

IO-Link communication requires an IO-Link master.

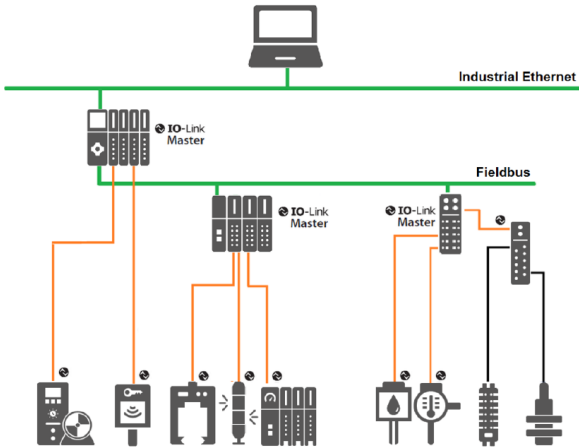


Figure 5.4: grf00030_eac_io_link

5.2.2 Pin Assignment

Electrical Connection – Cable – [07-0/K/H]



Figure 5.5: grf00032_eac_cab_4p_4w_io

Cable colors: BN = brown / WH = white / BK = black / BU = blue / YE/GN = yellow/green

Electrical Connection – M12 Connector – [07-S]

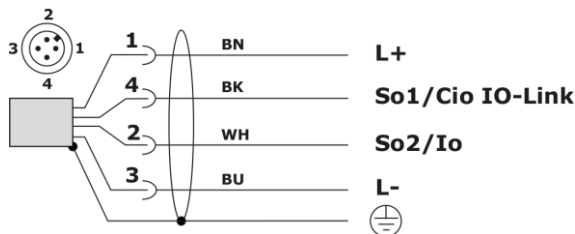


Figure 5.6: grf00031_eac_m12_4p_4w_io

Cable: M12 – A-coded, 1-BN = brown / 2-WH = white / 3-BU = blue / 4-BK = black

5.2.3 Connection cable

Cable: M12 – A-coded, 1-BN = brown / 2-WH = white / 3-BU = blue / 4-BK = black

Use a cable that is max. 20 m long, 3-wire or 4-wire, unshielded.

When using the analog output, a shielded cable must be used.

5.2.4 Connection Instructions



WARNING

- ▶ Install the device only when it is de-energized.

NOTE

Switch off all connected control devices before commissioning.

NOTE

Operate inductive loads (auxiliary contactors, solenoid valves) at the Switching outputs only with a free-wheeling diode or an RC circuit.

Observe the maximum permissible supply voltage U_s at the L+/L- terminals:

- $U_s = 9...35 \text{ Vdc}$
- $U_s = 18...30 \text{ Vdc}$, IO-Link

Observe the maximum permissible load resistance R_L of the analog output:

- $R_L \leq (U_s - 8 \text{ V}) / 22 \text{ mA}$

Ground the device, preferably via the metallic process connection, or alternatively via the cable shield.

Route the cable separately from power-carrying lines; ground the cable shield.

Out1 – IO-Link / Out2 – Current 0/4...20 mA

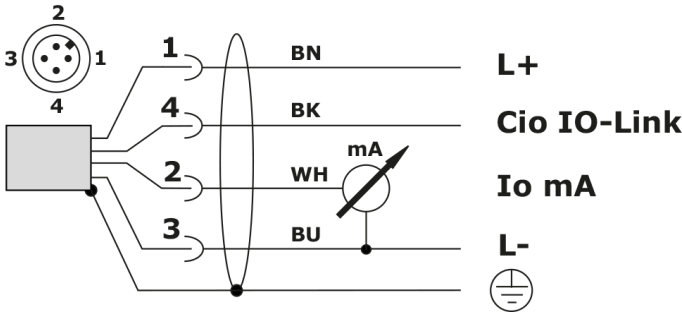


Figure 5.7: grf00033_eac_m12_4p_4w_io_ma

Out1 – IO-Link / Out2 – p-contact switch

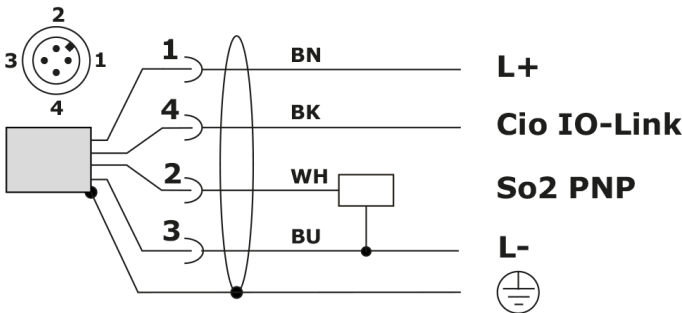


Figure 5.8: grf00034_eac_m12_4p_4w_io_snp

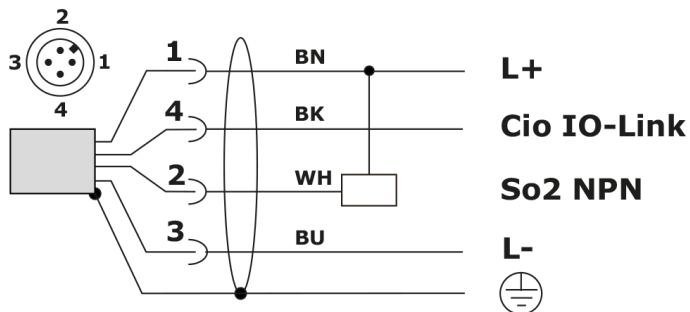
Out1 - IO-Link / Out2 - Normally Open Switch

Figure 5.9: grf00035_eac_m12_4p_4w_io_snnpn

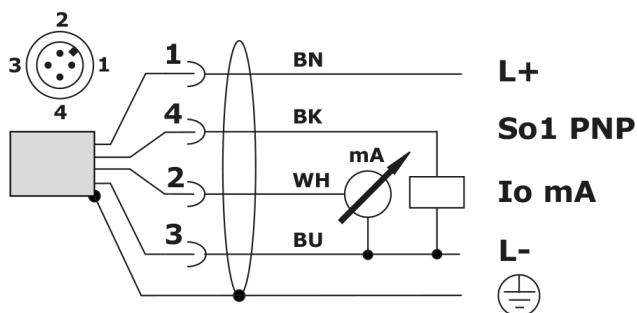
Out1 - Current 0/4...20 mA / Out2 - Normally Open Switch

Figure 5.10: grf00036_eac_m12_4p_4w_ma_snpn

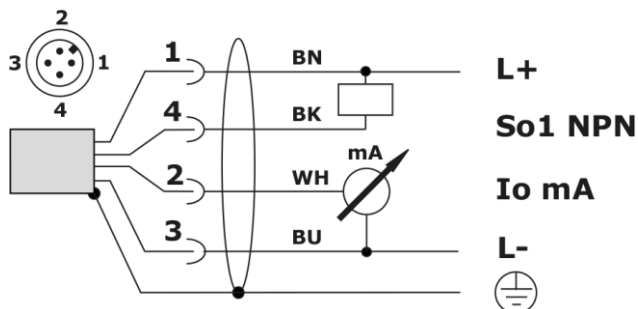
Out1 - Current 0/4...20 mA / Out2 - n-contact switch

Figure 5.11: grf00037_eac_m12_4p_4w_ma_snpn

Out1 - P-contact switch / Out2 - P-contact switch

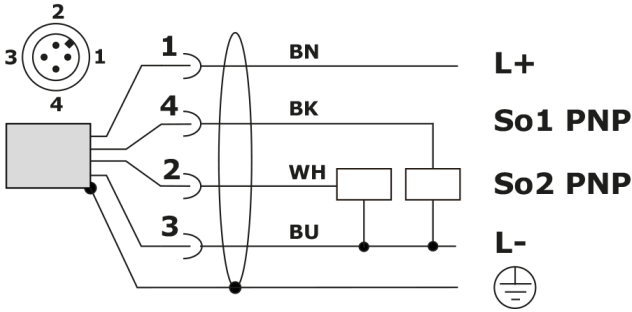


Figure 5.12: grf00038_eac_m12_4p_4w_2snpn

Out1 - normally open switch / Out2 - normally open switch

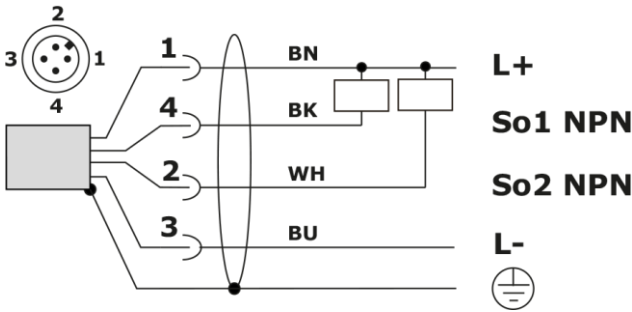


Figure 5.13: grf00039_eac_m12_4p_4w_2snpn

6 Operation

Operation is performed via the SmartConnect app (Android / iOS) or via the wired interface.

6.1 Measured variable

6.1.1 Distance

The distance from a detectable object to the sensor. This corresponds to the base measurement value.

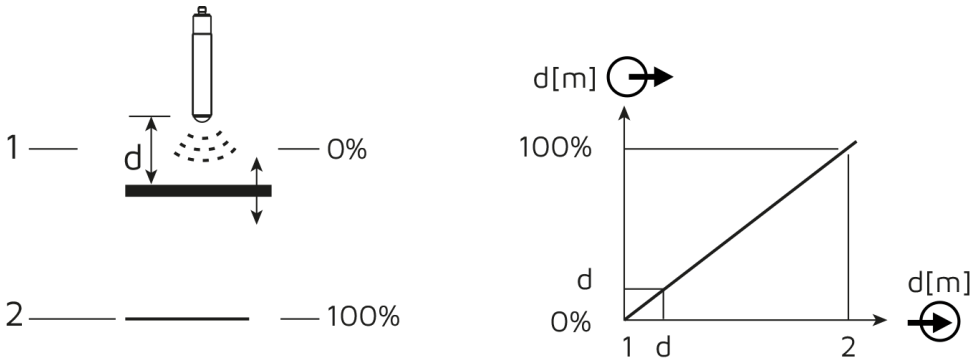


Figure 6.1: grf00040_ope_rp4ir_distance_lin

6.1.2 Level / Volume

The distance from a detectable liquid surface to the sensor can be converted into a level measurement value or a volume and, if necessary, linearized.

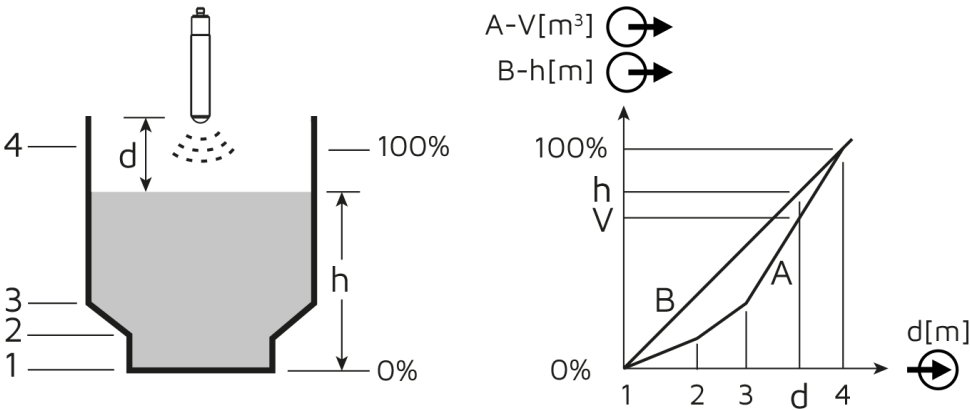


Figure 6.2: grf00044_ope_rp4ir_volume_lin

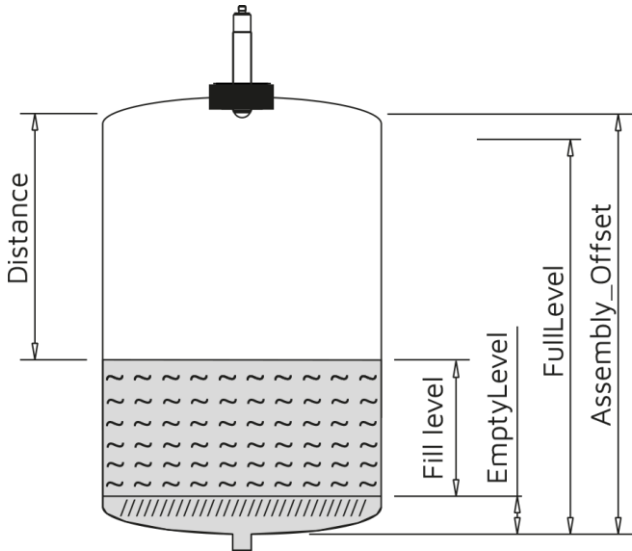


Figure 6.3: grf00041_ope_rp4ir_level

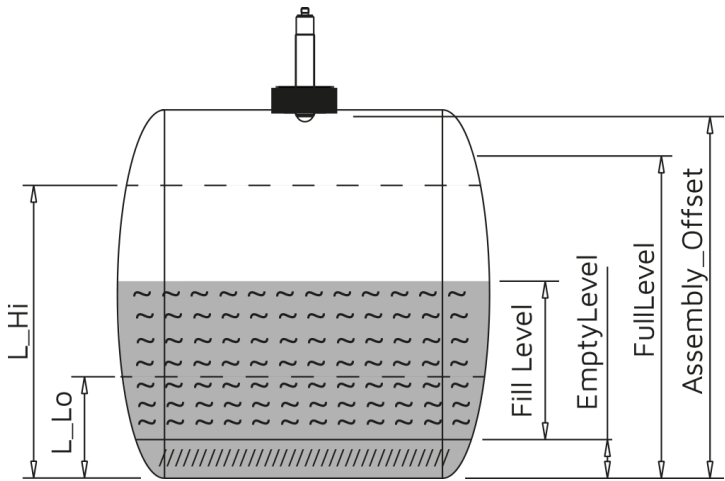


Figure 6.4: grf00042_ope_rp4ir_level_active

6.1.3 Echo signal curve

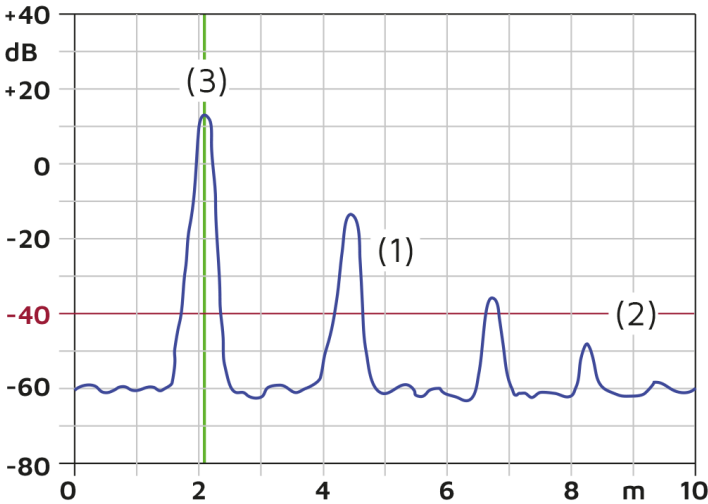


Figure 6.5: grf00045_ope_echo_curve_radar

- (1) Echo signal curve
- (2) Evaluation Threshold
- (3) Process value

6.1.4 Signal filter

The signal filter allows you to define a correct measurement signal:

Parameter	Default	Option	Description
Filter	Slow	Jumpy	Jumpy: the first signal evaluated as valid - Figure 6.6
		Fast	Fast 0.5 m/s: Suppression of very rapid signal jumps
		Slow	slow 1 m/s: Suppression of fast signal jumps
		Max. Peak	Maximum value: strongest/highest signal – Figure 6.7

Signal filter: abrupt >> first valid value:

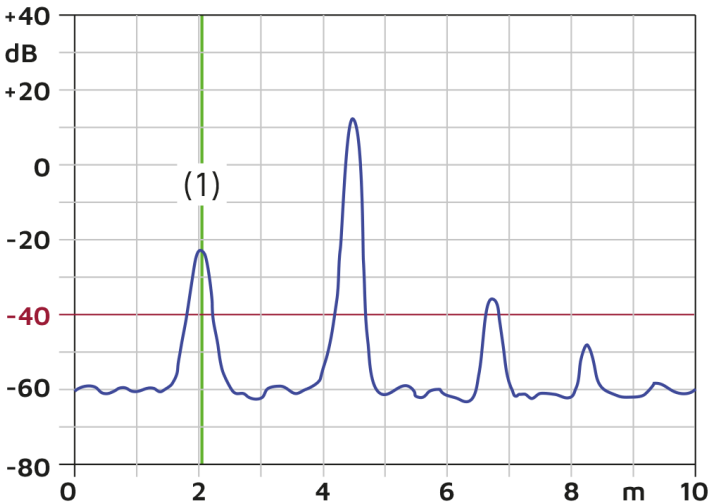


Figure 6.6: grf00046_ope_echo_curve_radar_j

Signal filter maximum value >> strongest, highest signal:

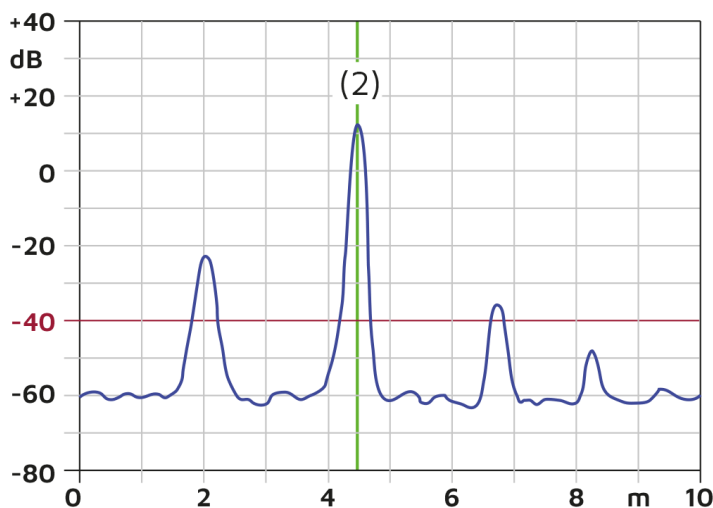


Figure 6.7: grf00047_ope_echo_curve_radar_m

6.2 Electronic output – RS485 Modbus-RTU – [05-V]

Information regarding installation and use of the interface and operating software is not included in this manual.

6.2.1 Parameters

The parameter file and description can be downloaded from the manufacturer's website. Setting ranges and default values are specified for all parameters.

6.3 Electronic output [05-L] – IO-Link

Information regarding installation and use of the interface and operating software is not included in this manual.

6.3.1 Parameters

The parameter file and description can be downloaded from the manufacturer's website. Setting ranges and default values are specified for all parameters.

6.3.2 Switching output So

Operating Functions - Operation Mode

Depending on the function [O1_Conf/O2_Conf+Operation Mode], the output is switched differently:

- PP (Push-Pull) Auxiliary power supply +L <--> Auxiliary power supply -L
- NPN Auxiliary power supply -L <--> Off - high impedance
- PNP Auxiliary power supply +L <--> off - high impedance
- Analog Out Current output Io 0/4...20 mA

For the Switching output So1, only the PP operating mode can be selected.

Switching Functions - Switch Mode

Various switching functions [O1_Conf/O2_Conf+Switch Mode] can be set for the Switching outputs:

Deactivated

The Switching output is deactivated and therefore high-impedance.

Single-Point Mode

The Switching output is activated when the measured value exceeds the switching point [O1_SP/O2_SP] and the turn-on delay time [O1_dS/O2_dS] has elapsed.

The Switching output is deactivated when the measured value falls below the switching point [O1_SP/O2_SP] and the deactivation delay time [O1_dR/O2_dR] has elapsed.

For polarity [O1_Conf/O2_Conf+Polarity+NO], the reset point is [O1_HY/O2_HY] less than the set switching point [O1_SP/O2_SP]

For polarity [O1_Conf/O2_Conf+Polarity+NC], the actual switching point is greater than the set switching point [O1_SP/O2_SP] by the hysteresis [O1_HY/O2_HY]

Operating Mode - Polarity: NO / Normally Open

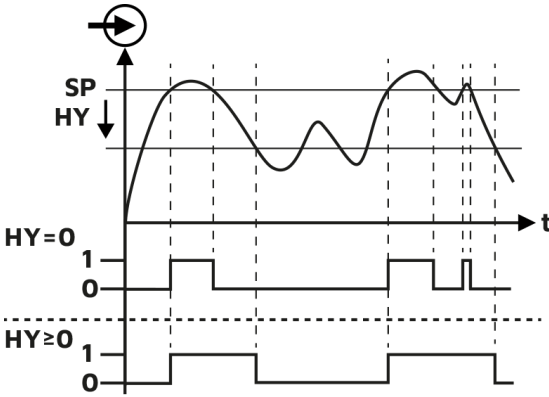


Figure 6.8: grf00048_fun_sw_sp_no

Operating Mode - Polarity: NC / Normally Open

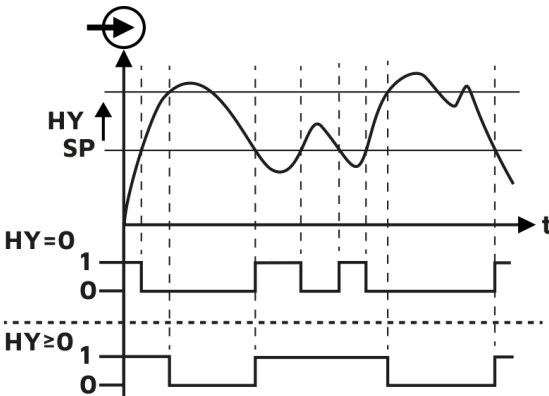


Figure 6.9: grf00049_fun_sw_sp_nc

Window Function - Window Mode

The switching range is defined by specifying the switching point [O1_SP/O2_SP] and the reset point [O1_RP/O2_RP].

The Switching output is activated when the measured value lies within the range defined by the switching point [O1_SP/O2_SP] and the reset point [O1_RP/O2_RP] and the turn-on delay time [O1_dS/O2_dS] has elapsed.

The Switching output is deactivated when the measured value is outside the range defined by the switching point [O1_SP/O2_SP] and the reset point [O1_RP/O2_RP], and the reset delay time [O1_dR/O2_dR] has elapsed.

The hysteresis [O1_HY/O2_HY] creates a switching offset symmetrical about the switching point [O1_SP/O2_SP] and the reset point [O1_RP/O2_RP].

Operating Mode - Polarity: NO / Normally Open

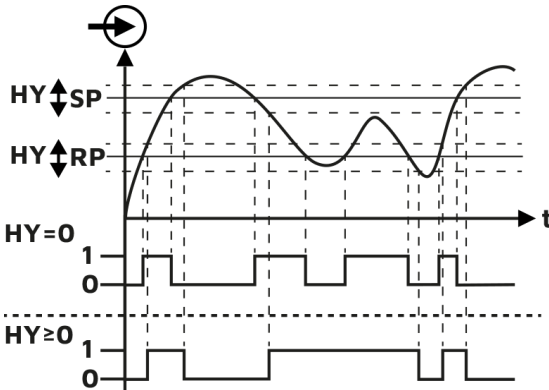


Figure 6.10: grf00050_fun_sw_win_no

Operating Mode - Polarity: NC / Normally Open

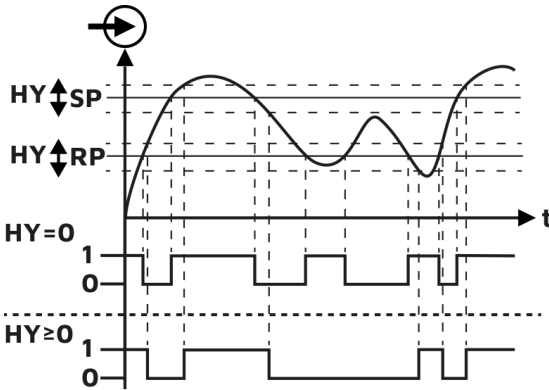


Figure 6.11: grf00051_fun_sw_win_nc

Two-Point Mode

The switching range is defined by specifying the switching point [O1_SP/O2_SP] and the reset point [O1_RP/O2_RP].

The Switching output is activated when the measured value exceeds the switching point [O1_SP/O2_SP] and the turn-on delay time [O1_dS/O2_dS] has elapsed.

The Switching output is deactivated when the measured value falls below the switching point [O1_SP/O2_SP] and the reset delay time [O1_dR/O2_dR] has elapsed.

Operating Mode - Polarity: NO / Normally Open

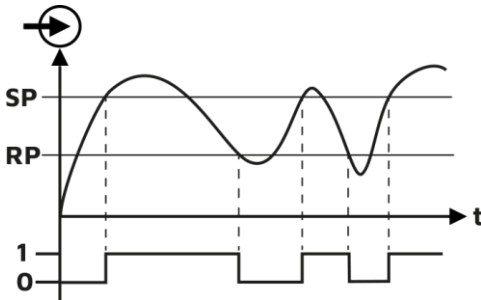


Figure 6.12: grf00052_fun_sw_tp_no

Operating Mode - Polarity: NC / Normally Closed

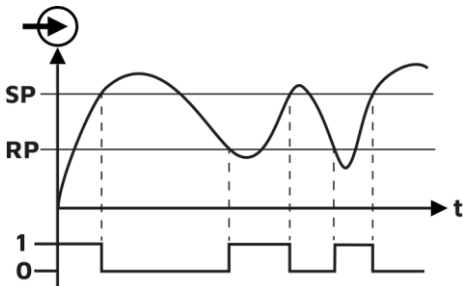


Figure 6.13: grf00053_fun_sw_tp_nc

Fault Reporting Function

The Switching output signals a detected functional error (see the section on Fault Diagnosis and Troubleshooting)

6.3.3 Analog output I_o

An analog current signal is output, which is assigned to the device's nominal measurement range:

- 0–20 mA Output signal range 0...20.5 mA
- 4–20 mA Output signal range 3.8...20.5 mA
- 20–0 mA Output signal range 20.5...0 mA
- 20–4 mA Output signal range 20.5... 3.8 mA

Free assignment to measurement input values within the nominal measurement range is possible.

Behavior of the output current value when the output signal range is exceeded, in accordance with NAMUR NE43:

- (1) Output value held at 0 / 3.8 mA / 20.5 mA
- (2) Step change ≤ 3.6 mA
- (3) Step ≥ 21 mA (22 mA)

Output signal 4–20 mA

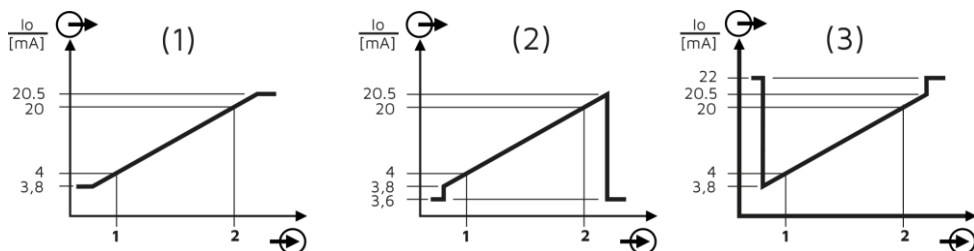


Figure 6.14: grf00054_fun_iout_4_20_h_36_22

Output signal 0–20 mA

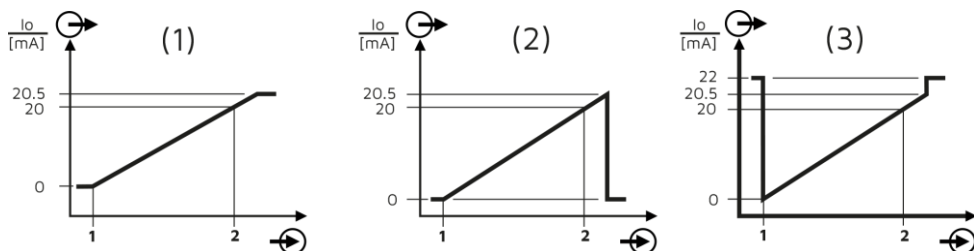


Figure 6.15: grf00055_fun_iout_0_20_h_0_22

7 Diagnostics and troubleshooting

The plant operator is responsible for taking appropriate measures to resolve any malfunctions that occur.

Error Messages for electronic output – IO-Link – [03-L]:

IO-Link Code	Description	Resolution
20480 (0x5000)	Device hardware error	Replace or return the device
35856 (0x8C10)	Measurement range exceeded	Check measurement range calibration
35888 (0x8C30)	Measurement range undershoot	Check measurement range calibration
36346 (0x8DFA)	Analog output error 3.6 mA	Check current output calibration
36347 (0x8DFB)	Analog Output Error 22 mA	Check the calibration of the current output

In the event of a fault, check:

Component / Area	Test	Remedy
Housing	Damage	Replace or return the device
Sensor lens	Contamination	Clean the device or send it in
	Damage	Replace or return the device
Process seals	Damage	Replace the process seal
		Use a different sealing material if necessary
Supply voltage	Operating voltage present	Turn on the operating voltage
		Check or repair the connection terminals
	Operating voltage polarity reversed	Reverse the polarity of the operating voltage

	Operating voltage too low	Adjust or repair
	Operating voltage too high	Send the device in for repair
	Load resistance too high	Increase operating voltage
	Connection cable is damaged	Send the unit in for repair

If the malfunction cannot be resolved, please contact the manufacturer.

8 Maintenance

The device is maintenance-free when used as intended.

Deposits adhering to the sensor lens can cause incorrect readings. In this case, clean the sensor lens regularly. Do not use sharp or hard tools, compressed air, or harsh chemicals.

9 Repair

The device is not intended for repair by the user. Repairs may only be performed by the manufacturer.

9.1 Disassembly

Wear appropriate protective clothing, such as safety goggles and gloves.



WARNING

- ▶ Allow the device and system to cool sufficiently before disassembly. There is a risk from hot surfaces as well as leaking, hazardous, and hot measured media.



WARNING

- ▶ Allow the device and system to cool sufficiently before disassembly. There is a risk from hot surfaces as well as leaking, hazardous, and hot measured media.



WARNING

- ▶ Disassemble the device only when it is de-energized.



WARNING

- ▶ Switch off all connected control units before disassembly.

After disassembly, fit the sensor lens, process connection, and, if applicable, the connector with a protective cap.

9.2 Returns

Returns can only be accepted if the device is accompanied by a decontamination declaration. The declaration is available for download on the website and must be fully completed and affixed to the outside of the packaging in a manner that protects it from the elements and during transport.

9.3 Disposal



Figure 9.1: sym00001_weee_can

In accordance with EU Directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), the product is marked with the symbol shown to minimize the disposal of WEEE as unsorted household waste. These products must not be disposed of as unsorted household waste and can be returned to the manufacturer for disposal. Returns are subject to the manufacturer's general terms and conditions or individually agreed terms.

10 Technical data

Reference Conditions	Ta = +15...+25 °C (+59...+77 °F) / Pa = 860...1060 kPa / r.F. = 45...75 %
	Us = 24 Vdc ±0.1 V / ton = 240 s / vertical, sensor at the bottom
	Reflector: Metal plate with an edge length of ≥ 20 cm
	No significant interfering reflections within the beam cone
	Filter = Jumpy / Measurement interval = 0.05 / Attenuation = 0.00
Measurement deviation	EN/IEC 60770-1: Characteristic curve deviation - Threshold point setting

10.1 Input distance

Sensor type	FMCW radar, pulsed
Frequency	122...123 GHz
EIRP	≤ 10 dBm
Beamwidth	10°
Pulse rate	≥ 10 Hz / ≤ 100 ms
Measurement range	0 ... 10 m (FSI)
Dead zone	≤ 30 cm
Resolution	≤ 1 mm
Characteristic curve deviation	$\leq \pm 0.1\%$ FSI (linearity + repeatability + hysteresis)
Linearity	$\leq \pm 0.1\%$ FSI
Repeatability	$\leq \pm 2$ mm
Hysteresis	negligible

Effect of auxiliary power	$\leq \pm 0.002\% \text{ FSI/V}$
Temperature effect	$\leq \pm 0.005\% \text{ FSI/K}$
Long-term drift	$\leq \pm 0.02\% \text{ FSI/year}$
Effect of Mounting Orientation	None

10.2 Outputs

10.2.1 Electronic output – RS485 Modbus-RTU – [05-V]

Interface - Cio	
Specifications	RS485, bidirectional / Modbus-RTU / 9600 baud (4800...38400 baud)
Input resistance	112 Ω
Time Response	Pressure/level signal: $t_{90} \leq 2 \text{ ms}$ ($t_d = 0 \text{ s}$)
	Temperature signal: $t_{90} \leq 60 \text{ s}$ ($t_d = 0 \text{ s}$)
Auxiliary power	
Supply voltage U_s	6...35 Vdc, reverse-polarity protected / residual ripple $\leq 2 \text{ Vpp}$
Input current I_s	$\leq 10 \text{ mA}$ (no load)
Turn-on delay time	$\leq 0.1 \text{ s}$ ($t_d = 0 \text{ s}$)

10.2.2 Electronic output [05-L] – IO-Link

Interface - Cio	
Specifications	IO-Link V1.1 / Port Class A / Com2 (38.4 kBaud), Com3 (230.4 kBaud)
Cycle time	$\geq 2.3 \text{ ms}$

Time response $t_{90-\min}$	$\leq 100 \text{ ms}$ ($t_d = 0 \text{ s}$)
Switching output - S_o	
Specification	2x PP (push-pull), switching to +L/-L
Output signal U_o	$\leq 0.2 \dots \geq (U_s - 2 \text{ V}) / I_o = 0 \dots 200 \text{ mA}$ (current-limited to $\leq 450 \text{ mA}$, short-circuit-proof)
Switching delay time	$\leq 30 \mu\text{s}$ ($R_L \leq 3 \text{ k}\Omega / I_o \geq 4.5 \text{ mA}$)
Switching cycles	$\geq 100,000,000$
Analog output - I_o	
Signal range	4...20 mA: Signal range 3.8...20.5 mA, error $\leq 3.6 \text{ mA} / \geq 21 \text{ mA}$ (22 mA)
	0...20 mA: Signal range 0...20.5 mA, error $\leq 0.05 \text{ mA} / \geq 21 \text{ mA}$ (22 mA)
Resolution	$\leq 1 \mu\text{A}$
Permissible load R_L	$\leq (U_s - 8 \text{ V}) / 22 \text{ mA}$
Effect of auxiliary power	$\leq \pm 0.5 \mu\text{A/V}$
Temperature effect T_a	$\leq \pm 0.5 \mu\text{A/K}$
Auxiliary power	
Supply Voltage U_s	IO-Link inactive: 9...35 Vdc, reverse-polarity protected / residual ripple $\leq 2 \text{ Vpp}$
	IO-Link active: 18...30 Vdc, reverse-polarity protected / residual ripple $\leq 2 \text{ Vpp}$
Input current I_s	$\leq 20 \text{ mA}$ ($C_{io} / S_o / I_o = 0 \text{ mA}$)
Turn-on delay time	$\leq 0.5 \text{ s}$ ($t_d = 0 \text{ s}$)

10.4 Interface - Bluetooth®

Standard	Bluetooth® 5.2
Specification	2 Mbit/s, Advertising Mode 2 s
Transmit Power	≤ 0.1 W
Range	Outdoors: max. 200 m / Indoors: max. 40 m
10.4	Environmental conditions
Process temperature T _p	-20...+70 °C (-4...+158 °F)
Process pressure	-0.2...+0.5 bar
Ambient temperature T _a	-20...+70 °C (-4... +158 °F)
Protection rating	IP65/IP67 (EN/IEC 60529)
Climate class	4K4H (EN/IEC 60721-3-4)
Shock resistance	50 g [1 ms] (EN/IEC 60068-2-27)
Vibration resistance	20 g [10...2000 Hz] (EN/IEC 60068-2-6)
EMC	Class B equipment / industrial environment (EN/IEC 61326)
Surge protection	Integrated surge protection (EN/IEC 61000-4-5)
	Insulation voltage ≥ 50 Vdc / Rated discharge current 10 kA (8/20 μs)
Protection class	III
Pollution degree	4
Operating altitude	2,000 m above sea level
MTTF	[05-V]: 213 years / [05-L]: 214 years
Weight	0.2 kg + (L1 × 0.068 kg/m)

10.6 Materials

Not in contact with the process	PE-HD, POM, PA, FKM/FPM, PE, PUR, epoxy
Support cable	Breaking strength of steel shield: $\geq 920\text{ N}$
	Bending radius: $\geq 100\text{ mm}$
	Cross-sectional area of strands: 0.22 mm^2
	Resistance: 90 ohms/km

11 Revision

Version	Changes
UMN07.26	Initial release

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