IFC 400 Technical Datasheet

Signal converter for electromagnetic flowmeters

- High measuring accuracy and long-term stability
- Smart diagnostics according to NAMUR NE 107
- Developed according to IEC 61508, SIL 2/3 certified

Ex HART COMMUNICATION PROTOCOL SIL 2/3 Safety Integrity Level

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

KROHNE

CONTENTS

1.1 The versatile solution

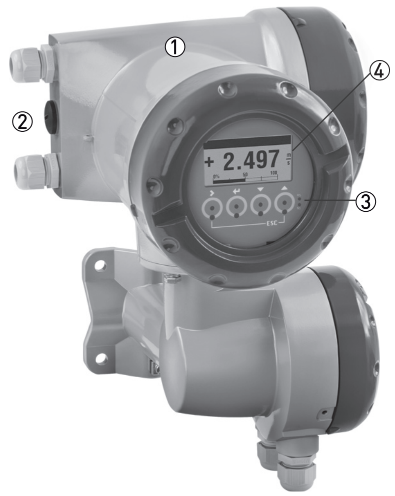
The **IFC 400** is a very complete signal converter, featuring a wide range of variants and options to match almost any application requirements in process industries. The robust and reliable signal converter is compatible with the OPTIFLUX 4000 flow sensor. Its measurement performance is excellent even in more difficult applications like mediums with low conductivity or mediums with high solid content or entrained air, corrosive and or abrasive mediums.

The IFC 400 is designed according to the unified General Device Concept (GDC) that is used for the volume flow, mass flow and analysis converters. The design concept offers an uniform user interface and menu structure and also an uniform electronics suitable for various housings, uniform device and process diagnostics functions and uniform communication interfaces.
This offers great time and cost benefits with regard to procurement, engineering, operation and servicing.

It is developed according to IEC 61508 and depending on the I/O and flow sensor variant suited for use in safety applications SIL 2/3.

Conforming to the NAMUR standard NE 107 for status and error handling, the IFC 400 features enhanced flowmeter diagnostics. This provides extensive self-checking of internal circuits and information regarding the health of the flow sensor, but just as importantly, vital information about the process and process conditions.

The IFC 400 signal converter provides a large variety of flowmeter and process diagnostic functions guaranteeing reliable measurements. Detection of deposits or coating on the electrodes, temperature and conductivity changes in the medium, gas bubbles or solids, and an empty pipe are good examples of process diagnostics functions. The flow velocity and volume can be read from the display or in analogue form via the current output (4...20 mA) as well as by frequency or pulse outputs. Measuring values and diagnostic information can be transmitted via HART® communication.



(signal converter in field housing)

① Supply voltage: 100...230 VAC (standard) and 24 VDC (optional)
② Communication with any third party system possible via HART®
③ 4 optical keys (standard display) or 4 push buttons (advanced display) for operator control without opening the housing
④ Intuitive navigation and a wide variety of languages integrated as standard for ease of operation

Highlights

- For flow sensors over a diameter range of DN2.5...3000 / 1/10...120"
- Developed according to IEC 61508, SIL 2/3 certified
- Safe configuration via local display or HART®
- Partial proof test capable
- Smart diagnostics, covering entire devices in less than a minute
- NE 107 status indicated by display background light
- Continuous measurement of volume flow and flow velocity
  Integrated conductivity measurement, mass flow (at constant density) and coil temperature
- High measuring accuracy and long-term stability: ± 0.2% of measured value ± 1 mm/s
- Optical and mechanical keys for ease of use
- Redundant data storage in signal converter housing
- Real time clock for logging events
- Overall, flexible lock concept
- HART® 7
- Power supply via 100...230 VAC (standard) or 24 VAC/DC (optional)
- Available inputs and outputs: current output (including HART®), pulse/frequency output, status output and control input

Industries

- Chemicals
- Water & Wastewater
- Pulp & Paper
- Minerals & Mining
- Pharmaceuticals
- Oil production & Refineries
- Iron, Steel & Metals

Applications

- Volume flow measurements, process control and monitoring, blending, batching
- Mediums with low conductivity, high solid content or entrained air
- Sudden change in pH value
- Pulsating or turbulent flows
- Abrasive sludge and slurries, pastes
- Wide range of corrosive chemicals
- (Sea)Water flow measurements in a wide range of industries
- Well water injection

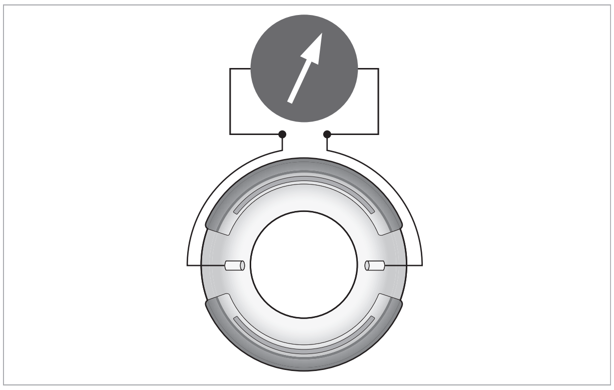
1.2 Options and variants

(signal converter in compact housing)

Compact or remote housing variants
The IFC 400 signal converter is available in different variants and offers superior performance in any conceivable application.

The compact and field housing versions of the signal converter is suitable for hazardous areas with approvals for ATEX and IECEx.

The IFC 400 in combination with the OPTIFLUX 4000 flow sensor is SIL 2/3 certified.
This makes it suitable for flow measurement in safety-related applications.


(Resistance measurement between electrodes)

Extensive diagnostics of the device and application
The primary focus of a user for a flowmeter is that it delivers reliable and robust measurements.
To achieve this all electromagnetic flowmeters are calibrated before leaving the factory.

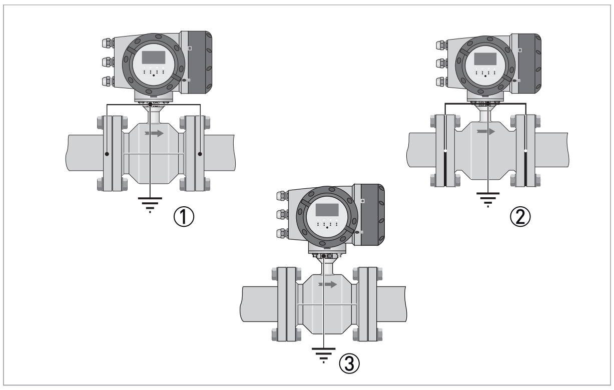
In addition, KROHNE was one of the first to introduce extensive diagnostic features.

The IFC 400 provides a wide range diagnostic functions on the flow sensor, signal converter and process integrated in the signal converter.

The IFC 400 automatically performs an online cyclical verification to determine whether the measuring device is still within its specifications regarding accuracy and linearity.

The IFC 400 diagnostics features can detect potential problems in the process such as:
gas bubbles, solids, electrode corrosion, deposits on the electrodes, conductivity changes, empty pipe, partial filling of the flow sensor, disrupted flow profiles and external magnetic fields.

Diagnostic information are available via local display, status outputs and Pactware.



① Metal pipes
② Non metal pipes
③ Virtual reference option

Virtual reference option simplifies installation
Based on a special method, developed by KROHNE, called virtual reference or grounding, electromagnetic flowmeters can be installed in any type of pipeline, without grounding rings or electrodes.

The virtual reference option on the IFC 400 provides complete isolation of the signal converters input amplifier and coil power circuits.

It is ideal for applications in the water and wastewater industry where large diameters are common or in case of abrasive or corrosive application that require rings of expensive materials. In these case the costs for grounding rings can be substantial.

Virtual reference also increases safety as it decreases the number of potential leakage points.

Furthermore it is no longer necessary to select the right grounding ring (material) and reduces the risk of wrong installation of grounding rings and gaskets.

1.3 Measuring principle

An electrically conductive fluid flows inside an electrically insulated pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils. Inside of the fluid, a voltage U is generated:
U = v * k * B * D

in which:
v = mean flow velocity
k = factor correcting for geometry
B = magnetic field strength
D = inner diameter of flowmeter

The signal voltage U is picked off by electrodes and is proportional to the mean flow velocity v and thus the flow rate Q. A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalizing, recording and output processing.

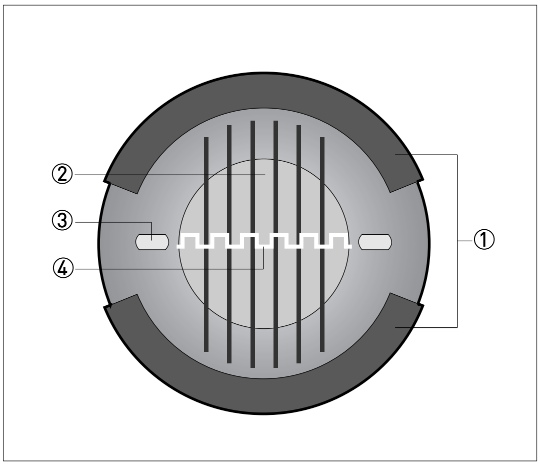


Figure 1-1: Measuring principle

① Field coils
② Magnetic field
③ Electrodes
④ Induced voltage (proportional to flow velocity)

2.1 Technical data

- *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 (Downloadcenter).*

Measuring system

Measuring principle	Faraday's law of induction
Application range	Continuous measurement of current volume flow, flow velocity, conductivity, mass flow (at constant density), coil temperature of the flow sensor

Design

Modular design	The measuring system consists of a flow sensor and a signal converter.
Flow sensor	
OPTIFLUX 4000	DN2.5...3000 / 1/10...120"
	The flow sensors are also available as Ex versions.
Signal converter	
Compact version (C)	OPTIFLUX 4400 C
Field housing (F) - remote version	IFC 400 F
	Compact and field housing versions are also available as Ex versions.
Options	
Outputs / inputs	Current output (including HART®), pulse output, frequency output and/or status output, limit switch and/or control input (depending on the I/O version)
Totaliser	2 (optional 3) internal totalisers with a max. of 8 counter places (e.g. for counting volume and/or mass units)
Verification	Integrated verification, diagnostic functions: measuring device, process, measured value, empty pipe detection, stabilisation
Communication interface	HART® as standard
Display and user interface	
Standard display	LC display, backlit white.
	Size: 128 x 64 pixels, corresponds to 59 x 31 mm = 2.32" x 1.22"
	Display module can be positioned/rotated in 90° increments.
	4 optical keys for operator control of the signal converter without opening the housing.
	Ambient temperatures below -25°C / -13°F, may affect the readability of the display.
Advanced display	LC display, backlit white, red, orange, yellow or blue depending on the device status according to NE 107:2017
	Size: 256 x 128 pixels, corresponds to 59 x 31 mm = 2.32" x 1.22"
	Display module can be positioned/rotated in 90° increments.
	4 push buttons and 4 optical keys for operator control of the signal converter without opening the housing.
	Ambient temperatures below -25°C / -13°F, may affect the readability of the display.

Remote operation	PACTware^{TM} (including Device Type Manager (DTM))
	HART® Handheld Communicator from Emerson Process
	AMS® from Emerson Process
	PDM® from Siemens
	All DTMs and drivers are available free of charge from the manufacturer's website.
Display functions	
Operating menu	Setting the parameters using 2 measured value pages, status page, graphics page (measured values and graphics are freely adjustable)
Language display texts	Available languages: English, German, French, Danish, Spanish, Italian, Dutch, Polish, Portuguese, Swedish, Turkish, Norwegian, Russian, Chinese
Measurement functions	**Units:** Metric, British and US units selectable as desired from lists for volume/mass flow and counting, velocity, temperature, pressure
	Measured values: Volume flow, flow velocity, conductivity, mass flow (at constant density), coil temperature, flow direction (not a displayed unit – but available via outputs)
Diagnostic functions	**Standards:** VDI / NAMUR / WIB 2650 and NE 107 / IEC 61508
	Status messages: Output of status messages optional via display, current and/or status output, HART® or bus interface
	Sensor and sensor electronics diagnosis: Redundant sensor signal monitoring, sensor and process diagnostics (empty-pipe detection, full-pipe detection, noise detection, sensor linearity check, asymmetry detection), sensor cable monitoring, monitoring of internal signals, CPU diagnostics, internal data integrity checks, internal communication monitoring
	Signal converter and inputs/outputs: Data bus monitoring, current output connections, current readback with redundant calibration, factory calibration integrity, electronics temperature monitoring, CPU diagnostics, supply voltage monitoring

Measuring accuracy

Flow measurement	
Reference conditions	Medium: water
	Temperature: +5...+35°C / +41...+95°F
	Pressure: 0.1...5 bar / 1.5...72.5 psi
Maximum measuring error	±0.2% of the measured value ±1 mm/s, depending on the flow sensor. For further information refer to the technical data of the respective flow sensor.
	Current output electronics: ±5 μA
Repeatability	±0.06%
Conductivity measurement	
Conductivity range	DN2.5...6 / 1/10...1/4": 20...2000 μS/cm
	DN10...125 / 3/8...5": 20...10000 μS/cm
	DN150...600 / 6...24": 20...50000 μS/cm
Maximum measuring error	±10% of the measured value
Repeatability	±5%
Cable length (in field housing)	≤ 30 m / 98 ft

Operating conditions

Temperature	
Process temperature	Refer to the technical data of the flow sensor.
Humidity	Annual average ≤ 90% RH (no condensation)
Ambient temperature	Depending on the version and combination of outputs.
	It is advised to protect the signal converter from external heat sources such as direct sunlight as higher temperatures reduce the life cycle of electronic components.
	Standard version: Without second I/O module:-40...+60°C / -40...+140°F With second I/O module:-40...+50°C / -40...+122°F
	Version with extended temperature: Without second I/O module: -40...+65°C / -40...+149°F With second I/O module:-40...+60°C / -40...+140°F
	Ambient temperatures below -25°C / -13°F, may affect the readability of the display.
Storage temperature	-40...+70°C / -40...+158°F
Pressure	
Medium	Refer to the technical data of the flow sensor.
Ambient pressure	Atmosphere: altitude up to 2000 m / 6561.7 ft above sea level
Chemical properties	
Electrical conductivity	All media except for water: ≥ 1 μS/cm (also refer to the technical data of the flow sensor)
	Water: ≥ 20 μS/cm
Type of measurement	Electrically conductive liquids
Solid content (volume)	Up to 70%
	The greater the solid content, the less accurate the measurements!
Gas content (volume)	Up to 5%
	The greater the gas content, the less accurate the measurements!
Flow rate	For detailed information, refer to chapter "Flow tables".
Other conditions	
Ingress protection	IP66/67, NEMA4/4X/6

Installation conditions

Installation	For detailed information, refer to chapter "Installation".
Inlet / outlet sections	Refer to the technical data of the flow sensor.
Dimensions and weight	For detailed information refer to chapter "Dimensions and weight".

Materials

Signal converter housing	Die-cast aluminium powder coated (Epoxy primer and Polyester topcoat)
Flow sensor	For housing materials, process connections, liners, grounding electrodes and gaskets, refer to the technical data of the flow sensor.

Electrical connection

General	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 specifications.
Power supply	100...230 VAC (-15% / +10%), 50/60 Hz
	24 VAC/DC (AC: -15% / +10%, 50/60 Hz; DC: -55% / +30%)
Power consumption	AC: 22 VA
	DC: 12 W
Signal cable	Only for remote versions.
	DS 300 (type A): Max. length: 600 m / 1968 ft (depending on electrical conductivity and flow sensor version) **Note:** The DS 300 signal cable cannot be used for SIL devices.
	BTS 300 (type B): Max. length: 600 m / 1968 ft (depending on electrical conductivity and flow sensor version) **Note:** For cable lengths > 50 m / 164 ft used with SIL devices refer to the "OPTIFLUX x400 Safety manual".
Field current cable	**SIL devices:** A shielded 3-wire copper cable is required! The shield **MUST** be connected in the housing of the signal converter.
	Non-SIL devices: A shielded cable is not required.
Cable entries	Standard: M20 x 1.5 (8...12 mm)
	Option: 1/2 NPT, PF 1/2

Inputs and outputs

General	All outputs are electrically isolated from each other and from all other circuits.	
	All operating data and output values can be adjusted.	
Description of used abbreviations	V_{ext} = external voltage; R_L = load + resistance; V_0 = terminal voltage; I_{nom} = nominal current Safety limit values (Ex i): V_i = max. input voltage; I_i = max. input current; P_i = max. input power rating; C_i = max. input capacity; L_i = max. input inductivity	
Current output		
Output data	Volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity	
Settings	Without HART®: Q = 0%: 0...20 mA; Q = 100%: 10...20 mA Alarm signal: selectable 0...22 mA	
	With HART®: Q = 0%: 4...20 mA; Q = 100%: 10...20 mA Alarm signal: selectable 3...22 mA	
Operating data	**Modular I/Os**	**Ex i I/Os**
Active	V_{int} = 24 VDC I ≤ 22 mA Terminals A and B: R_L ≤ 1 kΩ Terminals C: R_L ≤ 250 Ω	V_{int} = 21 VDC I ≤ 22 mA R_L ≤ 400 Ω
		V_0 = 21 V I_0 = 90 mA P_0 = 0.5 W C_0 = 90 nF / L_0 = 2 mH C_0 = 110 nF / L_0 = 0.5 mH Linear characteristics
	Observe connection polarity.	
Passive	V_{ext} ≤ 30 VDC I ≤ 22 mA V_0 ≥ 2.3 V Terminals C: R_L ≤ 250 Ω $R_{L, max} = (V_{ext} - V_0) / I_{max}$	V_{ext} ≤ 30 VDC I ≤ 22 mA V_0 ≥ 4 V $R_{L, max} = (V_{ext} - V_0) / I_{max}$
		V_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i ~ 0 mH
	Observe connection polarity.	Any connection polarity.

HART®		
Description	HART® protocol via active and passive current output	
	HART® version: 7	
	Universal HART® parameter: completely integrated	
Load	≥ 230 Ω at HART® test point; Note maximum load for current output!	
Multi-Drop operation	Disabled loop current mode, output current = 0%, e.g. 4 mA	
	Multi-Drop address adjustable in operation menu 0...63	
Device drivers	Available for FC 375/475, AMS, PDM, FDT/DTM	
Registration	At HART Communication Foundation	
	Yes	
Pulse output or frequency output		
Output data	Pulse output: volume flow, mass flow	
	Frequency output: volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity	
Function	Can be set as a pulse output or frequency output	
Pulse rate/frequency	Up to 10000 pulses/s or Hz (5000 pulses/s or Hz for the phase-shifted or NAMUR output)	
Settings	Either mass or volume per pulse or max. frequency for 100% flow	
	Pulse width: adjustable as automatic, symmetric or fixed (0.05...2000 ms)	
Operating data	**Modular I/Os**	**Ex i I/Os**
Active	V_{nom} = 24 VDC	-
	f_{max} in operating menu set to $f_{max} \leq 100$ Hz: $I \leq 20$ mA open: $I \leq 0.05$ mA closed: $V_{0, nom}$ = 24 V at I = 20 mA	
	f_{max} in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz: $I \leq 20$ mA open: $I \leq 0.05$ mA closed: $V_{0, nom}$ = 22.5 V at I = 1 mA $V_{0, nom}$ = 21.5 V at I = 10 mA $V_{0, nom}$ = 19 V at I = 20 mA	
	Any connection polarity.	

Operating data	**Modular I/Os**	**Ex i I/Os**
Passive	$V_{ext} \leq 32$ VDC	-
	f_{max} in operating menu set to $f_{max} \leq 100$ Hz: $I \leq 100$ mA $R_{L, max} = 47$ kΩ $R_{L, min} = (V_{ext} - V_0) / I_{max}$ open: $I \leq 0.05$ mA at $V_{ext} = 32$ VDC closed: $V_{0, max} = 0.2$ V at $I \leq 10$ mA $V_{0, max} = 2$ V at $I \leq 100$ mA	
	f_{max} in operating menu set to 100 Hz < f_{max} ≤10 kHz: $I \leq 20$ mA $R_{L, max} = 47$ kΩ $R_{L, min} = (V_{ext} - V_0) / I_{max}$ open: $I \leq 0.05$ mA at $V_{ext} = 32$ VDC closed: $V_{0, max} = 1.5$ V at $I \leq 1$ mA $V_{0, max} = 2.5$ V at $I \leq 10$ mA $V_{0, max} = 5.0$ V at $I \leq 20$ mA	
	Any connection polarity.	
NAMUR	Passive to IEC 60947-5-6 $V_{ext} = 8.2$ V ± 0.1 VDC R = 1 kΩ ± 10 Ω Nominal current for open: I = 0.6 mA closed: I = 3.8 mA	Passive to IEC 60947-5-6 $V_{ext} = 8.2$ V ± 0.1 VDC R = 1 kΩ ± 10 Ω Nominal current for open: I = 0.43 mA closed: I = 4.5 mA
		$V_i = 30$ V $I_i = 100$ mA $P_i = 1$ W $C_i = 10$ nF $L_i \sim 0$ mH
	Any connection polarity.	
Low flow cut-off		
Function	Switching point and hysteresis separately adjustable for each output, counter and the display	
Switching point	Set in increments of 0.1%.	
	0...20% (current output, frequency output)	
Hysteresis	Set in increments of 0.1%.	
	0...20% (current output, frequency output)	
Time constant		
Function	The time constant corresponds to the elapsed time until 63% of the end value has been reached according to a step function.	
Settings	Set in increments of 0.1 seconds.	
	0...100 seconds	

Status output / limit switch		
Function and settings	Adjustable as automatic measuring range conversion, display of flow direction, counter overflow, error, switching point or empty pipe detection	
	Valve control with activated dosing function	
	Status and/or control: ON or OFF	
Operating data	**Modular I/Os**	**Ex i I/Os**
Active	V_{int} = 24 VDC I ≤ 20 mA open: I ≤ 0.05 mA closed: $V_{0, nom}$ = 24 V at I = 20 mA	-
	Observe connection polarity.	
Passive	V_{ext} = 32 VDC I ≤ 100 mA $R_{L, max}$ = 47 kΩ $R_{L, min} = (V_{ext} - V_0) / I_{max}$ open: I ≤ 0.05 mA at V_{ext} = 32 VDC closed: $V_{0, max}$ = 0.2 V at I ≤ 10 mA $V_{0, max}$ = 2 V at I ≤ 100 mA	-
	Any connection polarity.	
NAMUR	Passive to IEC 60947-5-6 V_{ext} = 8.2 V ± 0.1 VDC R = 1 kΩ ± 10 Ω Nominal current for open: I = 0.6 mA closed: I = 3.8 mA	Passive to IEC 60947-5-6 V_{ext} = 8.2 V ± 0.1 VDC R = 1 kΩ ± 10 Ω Nominal current for open: I = 0.43 mA closed: I = 4.5 mA
		V_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i = 0 mH
	Any connection polarity.	

Control input		
Function	Hold value of the outputs (e.g. for cleaning work), set value of the outputs to "zero", counter and error reset, range change.	
	Start of dosing when dosing function is activated.	
Operating data	**Modular I/Os**	**Ex i I/Os**
Active	V_{int} = 24 VDC Ext. contact open: $V_{0,\ nom}$ = 22 V Ext. contact closed: I_{nom} = 4 mA Switching point for identifying "contact open or closed": Contact closed (on): $V_0 \leq 10$ V at I_{nom} = 1.9 mA Contact open (off): $V_0 \geq 12$ V at I_{nom} = 1.9 mA	-
	Observe connection polarity.	
Passive	$3\ V \leq V_{ext} \leq 32$ VDC I_{max} = 9.5 mA at $V_{ext} \leq 24$ V I_{max} = 9.5 mA at $V_{ext} \leq 32$ V Switching point for identifying "contact open or closed": Contact open (off): $V_0 \leq 2.5$ V at I_{nom} = 1.9 mA Contact closed (on): $V_0 \geq 3$ V at I_{nom} = 1.9 mA	$5.5\ V \leq V_{ext} \leq 30$ VDC I_{max} = 6 mA at $V_{ext} \leq 24$ V I_{max} = 6.5 mA at $V_{ext} \leq 30$ V Switching point for identifying "contact open or closed": Contact open (off): $V_0 \leq 3.5$ V at $I \leq 0.5$ mA Contact closed (on): $V_0 \geq 5.5$ V at $I \geq 4$ mA
		V_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i = 0 mH
	Observe connection polarity.	Any connection polarity.
NAMUR	Active to IEC 60947-5-6 Switching point for identifying "contact open or closed": Contact open (off): $V_{0,\ nom}$ = 6.3 V at I_{nom} < 1.9 mA Contact closed (on): $V_{0,\ nom}$ = 6.3 V at I_{nom} > 1.9 mA Detection of cable break: $V_0 \geq 8.1$ V at $I \leq 0.1$ mA Detection of cable short circuit: $V_0 \leq 1.2$ V at $I \geq 6.7$ mA	-
	Observe connection polarity.	

Approvals and certificates

Declaration of conformity	This device fulfils the statutory requirements of the relevant directives. The manufacturer certifies successful testing of the product by applying the conformity mark on the device.
	For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer's website.
Standard version	Non-Ex
Functional safety according to IEC 61508	Depends on I/O variant and flow sensor. For detailed information refer to the "OPTIFLUX x400 Safety manual".
Hazardous areas	
Compact flowmeter version	
ATEX	II 2(1)G Ex db eb [ia Ga] mb IIC T6...T3 Gb (DN2.5...15)
	II 2(1)G Ex db eb [ia Ga] mb IIC T6...T3 Gb (DN10...20)
	II 2(1)G Ex db eb [ia Ga] IIC T6...T3 Gb (DN25...150)
	II 2(1)G Ex db eb [ia Ga] q IIC T5...T3 Gb (DN25...150 special)
	II 2(1)G Ex db eb [ia Ga] q IIC T6...T3 Gb (DN200...300)
	II 2(1)G Ex db eb [ia Ga] IIC T6...T3 Gb (DN350...3000)
	II 2D Ex tb IIIC T85...T150°C Db (DN2.5...3000)
IECEx	Ex db eb [ia Ga] mb IIC T6...T3 Gb (DN2.5...15)
	Ex db eb [ia Ga] mb IIC T6...T3 Gb (DN10...20)
	Ex db eb [ia Ga] IIC T6...T3 Gb (DN25...150)
	Ex db eb [ia Ga] q IIC T5...T3 Gb (DN25...150 special)
	Ex db eb [ia Ga] q IIC T6...T3 Gb (DN200...300)
	Ex db eb [ia Ga] IIC T6...T3 Gb (DN350...3000)
	Ex tb IIIC T85...T150°C Db (DN2.5...3000)
Field version of signal converter	
ATEX	II 2G Ex db eb [ia Ga] IIC T6 Gb
	II 2D Ex tb IIIC T85°C Db
IECEx	Ex db eb [ia Ga] IIC T6 Gb
	Ex tb IIIC T85°C Db
Other standards and approvals	
Vibration resistance	**IEC 60068-2-64, Vibration (broadband random)** 5...200 Hz, ASD 0.01 g^2/Hz, 3 directions, each 120 minutes
	IEC 60068-2-27, Shock (IEC 60721-3-4, Class 4M12) Half sine wave, 2 g, pulse duration 6 ms, 3 directions, positive and negative sense, each 100 times
NAMUR	NE 21, NE 43, NE 53, NE 107, NE 131

Table 2-1: Technical data

2.2 Dimensions and weight

2.2.1 Housing

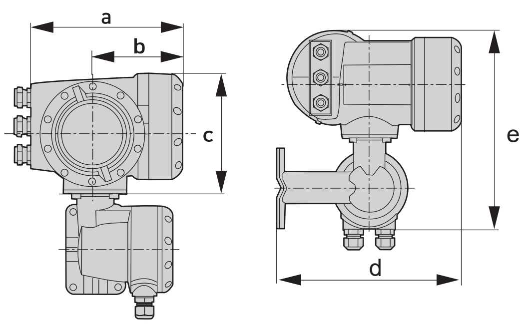


Figure 2-1: Dimensions of field housing (F) - remote version

Dimensions [mm / inch]					Weight [kg / lb]
a	b	c	d	e	
215 / 8.46	120 / 4.75	155 / 6.10	277 / 10.90	300 / 11.81	6.1 / 13.5

Table 2-2: Dimensions and weight

The total dimensions and weight of the compact device are depending on the nominal diameter and the material of the flow sensor.
For detailed information please refer to the relevant flow sensor documentation.

2.2.2 Mounting plate of field housing

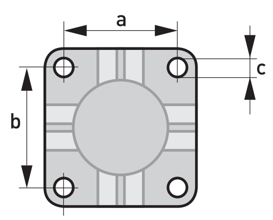


Figure 2-2: Dimensions for mounting plate of field housing

	[mm]	[inch]
a	72	2.8
b	72	2.8
c	Ø9	Ø0.4

Table 2-3: Dimensions in mm and inch

2.3 Flow tables

	$Q_{100\,\%}$ in m³/h			
v [m/s]	0.3	1	3	12
DN [mm]	Minimum flow	Nominal flow		Maximum flow
2.5	0.005	0.02	0.05	0.21
4	0.01	0.05	0.14	0.54
6	0.03	0.10	0.31	1.22
10	0.08	0.28	0.85	3.39
15	0.19	0.64	1.91	7.63
20	0.34	1.13	3.39	13.57
25	0.53	1.77	5.30	21.21
32	0.87	2.90	8.69	34.74
40	1.36	4.52	13.57	54.29
50	2.12	7.07	21.21	84.82
65	3.58	11.95	35.84	143.35
80	5.43	18.10	54.29	217.15
100	8.48	28.27	84.82	339.29
125	13.25	44.18	132.54	530.15
150	19.09	63.62	190.85	763.40
200	33.93	113.10	339.30	1357.20
250	53.01	176.71	530.13	2120.52
300	76.34	254.47	763.41	3053.64
350	103.91	346.36	1039.08	4156.32
400	135.72	452.39	1357.17	5428.68
450	171.77	572.51	1717.65	6870.60
500	212.06	706.86	2120.58	8482.32
600	305.37	1017.90	3053.70	12214.80
700	415.62	1385.40	4156.20	16624.80
800	542.88	1809.60	5428.80	21715.20
900	687.06	2290.20	6870.60	27482.40
1000	848.22	2827.40	8482.20	33928.80
1200	1221.45	3421.20	12214.50	48858.00
1400	1433.52	4778.40	14335.20	57340.80
1600	2171.46	7238.20	21714.60	86858.40
1800	2748.27	9160.9	27482.70	109930.80
2000	3393.00	11310.00	33930.00	135720.00
2200	4105.50	13685.00	41055.00	164220.00
2400	4885.80	16286.00	48858.00	195432.00
2600	5733.90	19113.00	57339.00	229356.00
2800	6650.10	22167.00	66501.00	266004.00
3000	7634.10	25447.00	76341.00	305364.00

Table 2-4: Flow rate in m/s and m³/h

	$Q_{100\ \%}$ in US gallons/min			
v [ft/s]	1	3.3	10	40
DN [inch]	Minimum flow	Nominal flow		Maximum flow
1/10	0.02	0.09	0.23	0.93
1/6	0.06	0.22	0.60	2.39
1/4	0.13	0.44	1.34	5.38
3/8	0.37	1.23	3.73	14.94
1/2	0.84	2.82	8.40	33.61
3/4	1.49	4.98	14.94	59.76
1	2.33	7.79	23.34	93.36
1.25	3.82	12.77	38.24	152.97
1.5	5.98	19.90	59.75	239.02
2	9.34	31.13	93.37	373.47
2.5	15.78	52.61	159.79	631.16
3	23.90	79.69	239.02	956.09
4	37.35	124.47	373.46	1493.84
5	58.35	194.48	583.24	2334.17
6	84.03	279.97	840.29	3361.17
8	149.39	497.92	1493.29	5975.57
10	233.41	777.96	2334.09	9336.37
12	336.12	1120.29	3361.19	13444.77
14	457.59	1525.15	4574.93	18299.73
16	597.54	1991.60	5975.44	23901.76
18	756.26	2520.61	7562.58	30250.34
20	933.86	3112.56	9336.63	37346.53
24	1344.50	4481.22	13445.04	53780.15
28	1829.92	6099.12	18299.20	73196.79
32	2390.23	7966.64	23902.29	95609.15
36	3025.03	10082.42	30250.34	121001.37
40	3734.50	12447.09	37346.00	149384.01
48	5377.88	17924.47	53778.83	215115.30
56	6311.60	21038.46	63115.99	252463.94
64	9560.65	31868.51	95606.51	382426.03
72	12100.27	40333.83	121002.69	484010.75
80	14938.92	49795.90	149389.29	597557.18
88	18075.97	60252.63	180759.73	723038.90
96	21511.53	71704.38	215115.30	860461.20
104	25245.60	84151.16	252456.02	1009824.08
112	29279.51	97597.39	292795.09	1171180.37
120	33611.93	112038.64	336119.31	1344477.23

Table 2-5: Flow rate in ft/s and US gallons/min

3.1 Intended use

The electromagnetic flowmeters are designed exclusively to measure the flow and conductivity of electrically conductive, liquid media.

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

If the device is not used according to the operating conditions (refer to chapter "Technical data"), the intended protection could be affected.

This device is a Group 1, Class A device as specified within CISPR11. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

3.2 Installation specifications

The following precautions must be taken to ensure reliable installation.
- *Make sure that there is adequate space to the sides.*
- *The device must not be heated by radiated heat (e.g. exposure to the sun) to an electronics housing surface temperature above the maximum permissible ambient temperature. If it is necessary to prevent damage from heat sources, a heat protection (e.g. sunshade) has to be installed.*
- *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 devices are tested for a vibration level as described in the chapter "Technical data".*

3.3 Mounting of the compact version

Turning the housing of the compact version is not permitted.

The signal converter is mounted directly on the flow sensor.
For installation of the flowmeter, please observe the instructions in the supplied product documentation for the flow sensor.

3.4 Mounting the field housing, remote version

Remarks for sanitary applications

- *To prevent contamination and dirt deposits behind the mounting plate, a cover plug must be installed between the wall and the mounting plate.*
- *Pipe mounting is not suitable for sanitary applications!*

Remarks concerning vibration on process line

Due to excessive vibration impact, the mounting of the signal converter on the process pipe is not allowed.

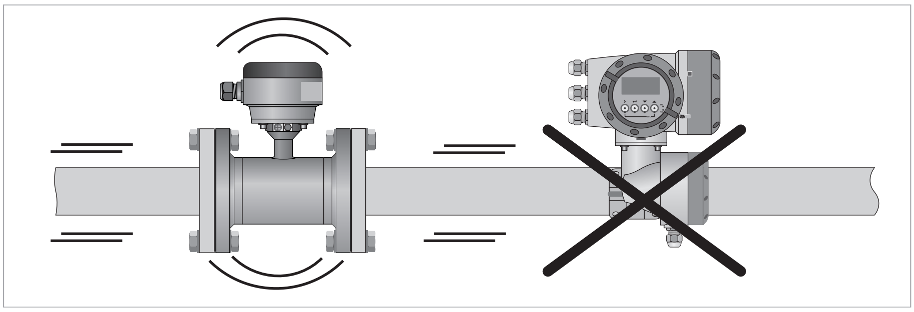


Figure 3-1: Not allowed mounting of the remote signal converter on the process pipe

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.

3.4.1 Pipe mounting

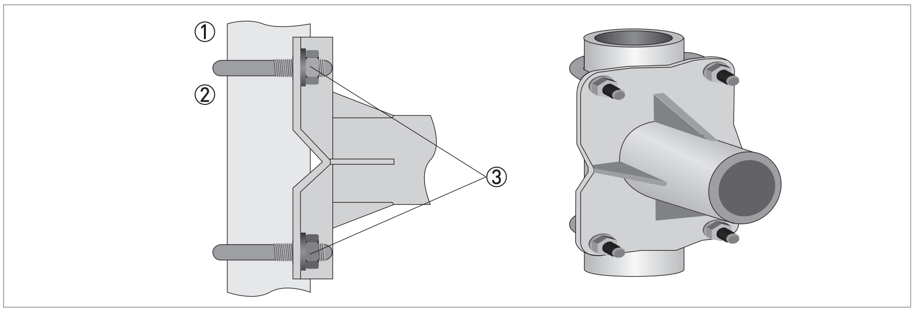


Figure 3-2: Pipe mounting of the field housing

① Fix the mounting bracket of the signal converter to the pipe.
② Fasten the mounting bracket of the signal converter using standard U-bolts and washers.
③ Tighten the nuts.

3.4.2 Wall mounting

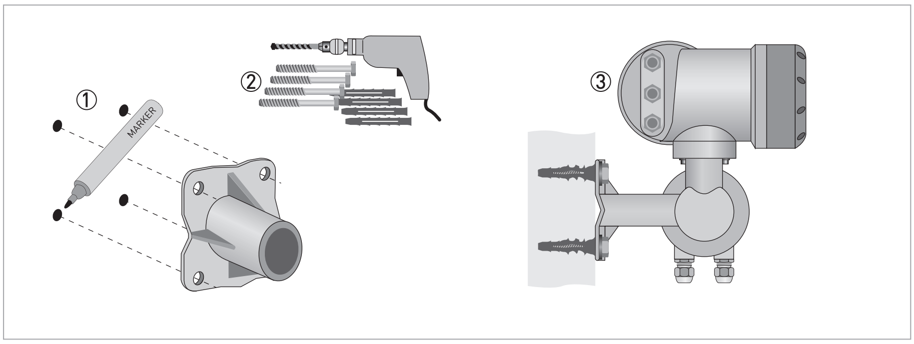


Figure 3-3: Wall mounting of the field housing

① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate of field housing* on page 18.
② Fasten the mounting plate securely to the wall.
③ Screw the mounting bracket of the signal converter to the mounting plate with the nuts and washers.

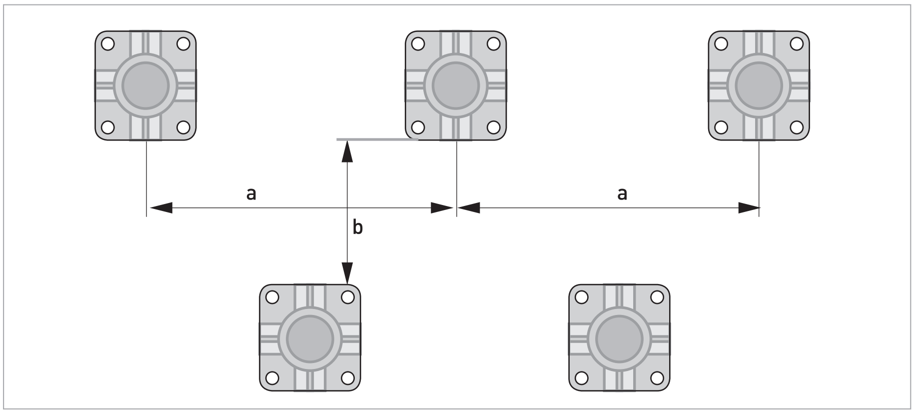


Figure 3-4: Mounting multiple devices next to each other

a ≥ 600 mm / 23.6"
b ≥ 250 mm / 9.8"

4.1 Important notes on electrical connection

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.

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

- *Use suitable cable entries for the various electrical cables.*
- *The flow sensor and signal converter have been configured together at the factory. For this reason, please connect the devices in pairs. Ensure that the flow sensor serial number (refer to nameplates) is identical.*

4.2 Preparing the signal and field current cables

SIL devices:
The DS 300 signal cable cannot be used for SIL devices.

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.

4.2.1 Signal cable A (type DS 300), construction

- Signal cable A is a double-shielded cable for signal transmission between the flow sensor and signal converter.
- Bending radius: ≥ 50 mm / 2"

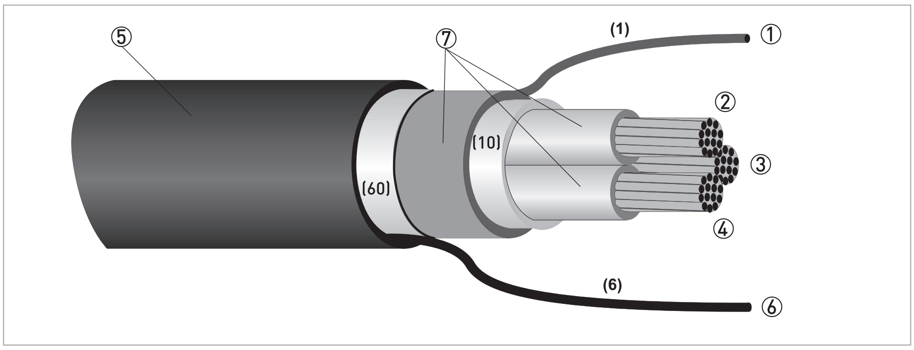


Figure 4-1: Construction of signal cable A

① Stranded drain wire (1) for the inner shield (10), 1.0 mm^2 Cu / AWG 17 (not insulated, bare)
② Insulated wire, 0.5 mm^2 Cu / AWG 20
③ Insulated wire, 0.5 mm^2 Cu / AWG 20
④ Insulated wire, 0.5 mm^2 Cu / AWG 20
⑤ Outer sheath
⑥ Stranded drain wire (6) for the outer shield (60)
⑦ Insulation layers

4.2.2 Length of signal cable A

For temperatures of the medium above 150°C / 300°F, a special signal cable and a ZD intermediate socket are necessary. These are available including the changed electrical connection diagrams.

Flow sensor	Nominal size		Min. electrical conductivity [μS/cm]	Curve for signal cable A
	DN [mm]	[inch]		
OPTIFLUX 4000 F	2.5...150	1/10...6	1	A1
	200...2000	8...80	1	A2

Table 4-1: Length of signal cable A

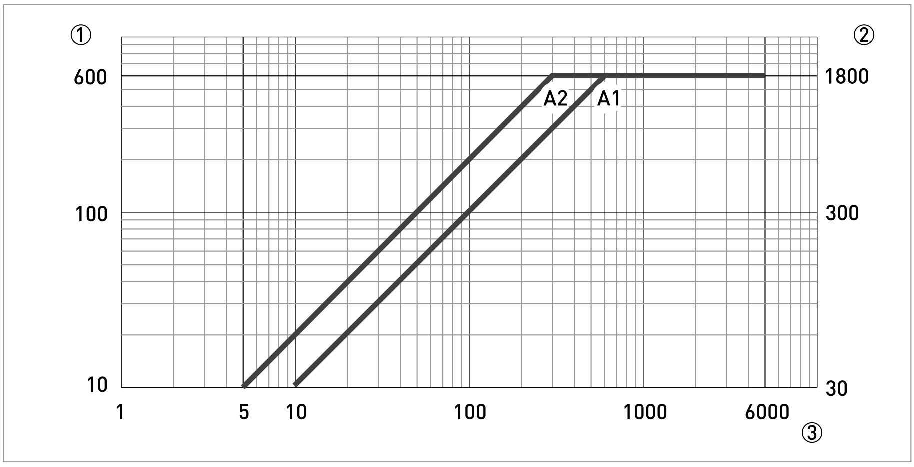


Figure 4-2: Maximum length of signal cable A

① Maximum length of signal cable A between the flow sensor and signal converter [m]
② Maximum length of signal cable A between the flow sensor and signal converter [ft]
③ Electrical conductivity of the medium being measured [μS/cm]

4.2.3 Signal cable B (type BTS 300), construction

SIL devices:
For cable lengths > 50 m / 164 ft used with SIL devices refer to the "OPTIFLUX x400 Safety manual".

- Signal cable B is a triple-shielded cable for signal transmission between the flow sensor and signal converter.
- Bending radius: ≥ 50 mm / 2"

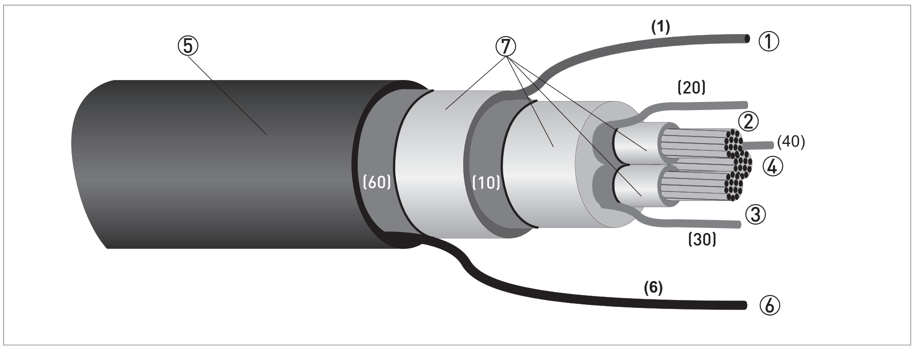


Figure 4-3: Construction of signal cable B

① Stranded drain wire (1) for the inner shield (10), 1.0 mm^2 Cu / AWG 17 (not insulated, bare)
② Insulated wire (2), 0.5 mm^2 Cu / AWG 20 with stranded drain wire (20) of shield
③ Insulated wire (3), 0.5 mm^2 Cu / AWG 20 with stranded drain wire (30) of shield
④ Insulated wire (4), 0.5 mm^2 Cu / AWG 20 with stranded drain wire (40) of shield
⑤ Outer sheath
⑥ Stranded drain wire (6) for the outer shield (60), 0.5 mm^2 Cu / AWG 20 (not insulated, bare)
⑦ Insulation layers

4.2.4 Length of signal cable B

SIL devices:
For cable lengths > 50 m / 164 ft used with SIL devices refer to the "OPTIFLUX x400 Safety manual".

For temperatures of the medium above 150°C / 300°F, a special signal cable and a ZD intermediate socket are necessary. These are available including the changed electrical connection diagrams.

Flow sensor	Nominal size		Min. electrical conductivity [μS/cm]	Curve for signal cable B
	DN [mm]	[inch]		
OPTIFLUX 4000 F	2.5...6	1/10...1/6	10	B1
	10...150	3/8...6	1	B3
	200...2000	8...80	1	B4

Table 4-2: Length of signal cable B

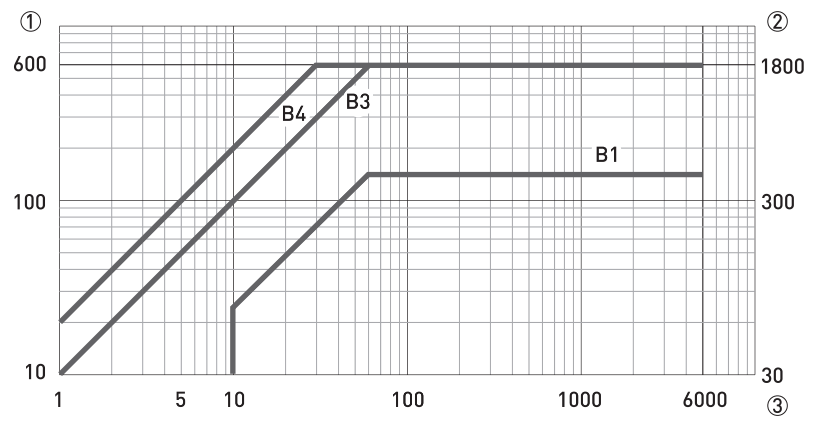


Figure 4-4: Maximum length of signal cable B

① Maximum length of signal cable B between the flow sensor and signal converter [m]
② Maximum length of signal cable B between the flow sensor and signal converter [ft]
③ Electrical conductivity of the medium being measured [μS/cm]

4.3 Connecting the signal and field current cables

Cables may only be connected when the power is switched off.

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

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

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.

4.3.1 Connecting the signal and field current cables, field housing

- The outer shield of signal cable A and/or B is connected electrically with the housing via the clip of the strain relief.
- SIL devices: The shielded field current cable MUST be connected in the housing of the signal converter.
  Non-SIL devices: if a shielded field current cable is used, the shield must NOT be connected in the housing of the signal converter.
- Bending radius: ≥ 50 mm / 2"

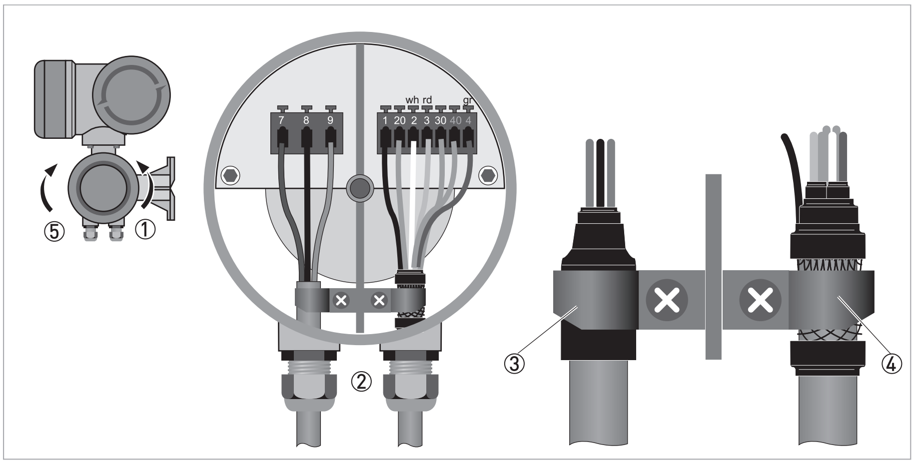


Figure 4-5: Electrical connection of the signal and field current cables, field housing

Wire coding: wh = white; rd = red; gr = green

① Unscrew the terminal compartment cover.
② Pass the prepared signal and field current cables through the cable entries and connect the corresponding stranded drain wires and conductors.
③ Secure the field current cable using the clip.
For SIL devices the shield MUST be connected.
④ Secure the signal cable using the clip. This also connects the outer shield to the housing.
⑤ Re-fit the cover and tighten it by hand.

Each time a housing cover is opened, the thread should be cleaned and greased.
Use only resin-free and acid-free grease.
Ensure that the housing gasket is properly fitted, clean and undamaged.

4.3.2 Connection diagram for flow sensor, field housing

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

- **SIL devices:**
  A shielded 3-wire copper cable is required for the field current cable.
  The shield **MUST** be connected in the housing of the signal converter.
- **Non-SIL devices:**
  A shielded field current cable is **not** required.
- The outer shield of signal cable A or B in the signal converter housing is connected via the strain relief terminal.
- Bending radius of signal and field current cable: ≥ 50 mm / 2"
- The following illustration is schematic. The positions of the electrical connection terminals may vary depending on the device variant.

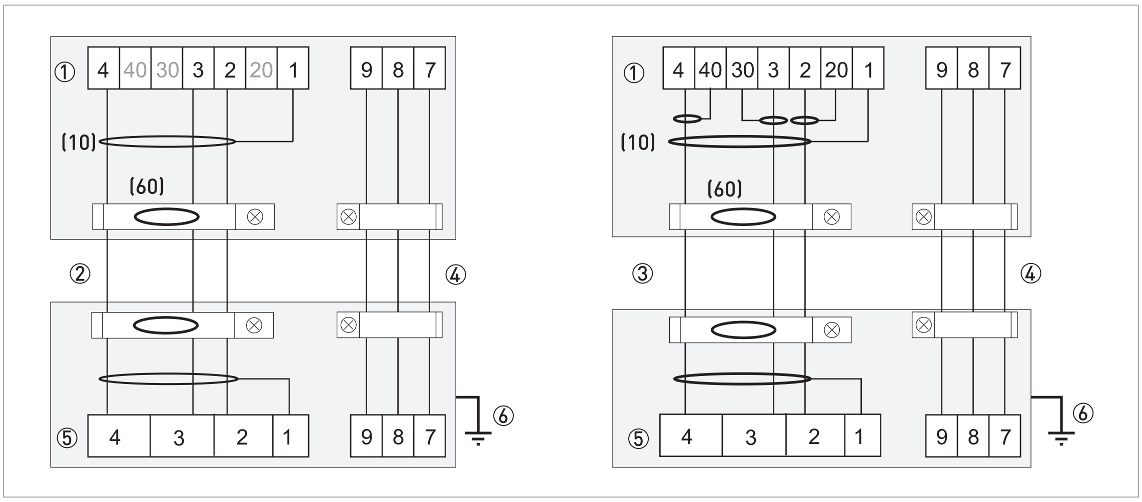


Figure 4-6: Connection diagram for flow sensor in combination with field housing

① Electrical terminal compartment in housing of the signal converter for signal and field current cable
② Signal cable A (type DS 300)
③ Signal cable B (type BTS 300)
④ Field current cable C
⑤ Connection box of flow sensor
⑥ Functional ground FE
(10) inner cable shield
(60) outer cable shield

4.4 Power supply connection

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

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

- The ingress protection depends on the available housing versions.
- 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 60664 for pollution severity 2. Supply circuits are designed for overvoltage category III and the output circuits for overvoltage category II.
- Fuse protection ($I_N \leq 16$ A) for the infeed power circuit, as well as a separator (switch, circuit breaker) to isolate the signal converter should be provided for the device in accordance with applicable regulations. The separator 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.
- Colour of connector: green

24 VAC/DC (tolerance range: AC: -15% / +10%; DC: -55% / +30%)

- AC: Note the power supply voltage and frequency (50...60 Hz) on the nameplate.
- DC: Note the power supply voltage on the nameplate.
- Colour of connector: red
- 24 VAC/DC OVCIII, test voltage 1400 VAC

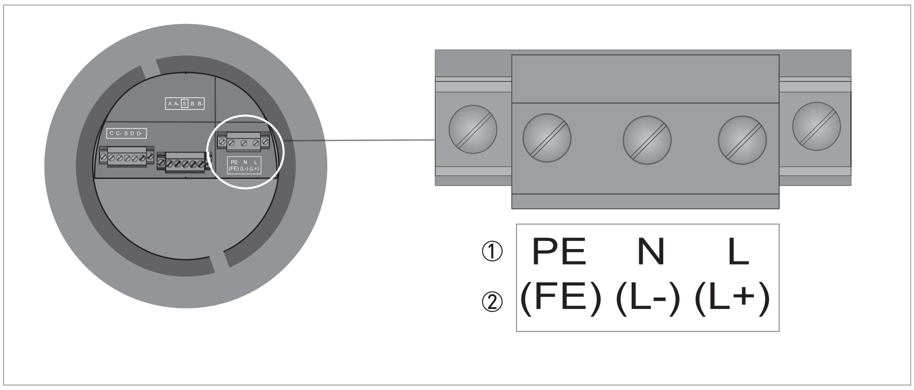


Figure 4-7: Power supply connection

① 100...230 VAC (-15% / +10%), 22 VA
② 24 VAC/DC (AC: -15% / +10%; DC: -55% / +30%), 22 VA or 12 W

4.5 Inputs and outputs, overview

4.5.1 Combinations of the inputs/outputs (I/Os)

This signal converter is available with various input/output combinations.

Ex i version

- Depending on the task, the device can be configured with various output modules.
- Current outputs can be active or passive.

Modular version

- Depending on the task, the device can be configured with various output modules.

Ex option

- For hazardous areas, all of the input/output variants for the housing designs C and F with terminal compartment in the Ex d (pressure-resistant casing) or Ex e (increased safety) versions can be delivered.
- Please refer to the separate instructions for connection and operation of the Ex devices.

4.5.2 Description of the CG number

CG 4 _ _ _ _ _ _ _
① ② ③ ④ ⑤ ⑥ ⑦

Figure 4-8: Marking (CG number) of the electronics module and input/output options

① ID number: 0
② ID number: 0 = standard; 9 = special
③ Power supply option / flow sensor option
④ Display option
⑤ Input/output option (I/O)
⑥ 1st optional module for connection terminal A
⑦ 2nd optional module for connection terminal B

The last 3 digits of the CG number (⑤, ⑥ and ⑦) indicate the assignment of the terminal connections. Please refer to the following examples.

CG 400 31 4AC	100...230 VAC & advanced HMI; modular I/O: I_a & P_a/S_a
CG 400 T1 320	24 VAC/DC & advanced HMI; I_p & P_N/S_N and Ex i option I_p & P_p/C_p

Table 4-3: Examples for CG number

Marking for ③	Power supply options
1...6	Standard: 100...230 VAC (-15% / +10%), 50/60 Hz
R...W	Option: 24 VAC/DC (AC: -15% / +10%, 50/60 Hz; DC: -55% / +30%)

Table 4-4: Power supply options

Marking for ④	Display options
G...L	Standard display
1...4	Advanced display with additional mechanical keys, Bluetooth® interface (optional), colour status backlight and real time clock for logging

Table 4-5: Display options

Abbreviation	Identifier for CG no.	Description
I_a	A	Active current output
I_p	B	Passive current output
P_a / S_a	C	Active pulse output, frequency output, status output or limit switch (changeable)
P_p / S_p	E	Passive pulse output, frequency output, status output or limit switch (changeable)
P_N / S_N	F	Passive pulse output, frequency output, status output or limit switch according to NAMUR (changeable)
C_a	G	Active control input
C_p	K	Passive control input
C_N	H	Active control input to NAMUR Signal converter monitors cable breaks and short circuits according to IEC 60947-5-6.
-	8	No additional module installed
-	0	No further module possible

Table 4-6: Description of abbreviations and CG identifier for possible optional modules on terminals A and B

4.5.3 Fixed, non-alterable input/output versions

This signal converter is available with various input/output combinations.

- The grey boxes in the tables denote unassigned or unused connection terminals.
- In the table, only the final digits of the CG number are depicted.

CG no.	Connection terminals							
	A	A-	B	B-	C	C-	D	D-
Ex i I/Os (option)								
2 0 0					I_a + HART® active		P_N / S_N NAMUR ①	
3 0 0					I_p + HART® passive		P_N / S_N NAMUR ①	
2 1 0	I_a active		P_N / S_N NAMUR C_p passive ①		I_a + HART® active		P_N / S_N NAMUR ①	
3 1 0	I_a active		P_N / S_N NAMUR C_p passive ①		I_p + HART® passive		P_N / S_N NAMUR ①	
2 2 0	I_p passive		P_N / S_N NAMUR C_p passive ①		I_a + HART® active		P_N / S_N NAMUR ①	
3 2 0	I_p passive		P_N / S_N NAMUR C_p passive ①		I_p + HART® passive		P_N / S_N NAMUR ①	

Table 4-7: Fixed, non-alterable input/output versions
① Menu configurable

4.5.4 Alterable input/output versions

This signal converter is available with various input/output combinations.

- In the table, only the final digits of the CG number are depicted.
- The signal converter is delivered preset with respect to active / passive / NAMUR according to the customer order.

CG no.	Connection terminals							
	A	A-	B	B-	C	C-	D	D-
Modular I/Os (option)								
4 _ _	max. 2 optional modules for terminal A + B				I + HART® active/passive ①		P/S active/passive/ NAMUR ①	

Table 4-8: Alterable input/output versions
① Software configurable

4.6 Laying electrical cables correctly

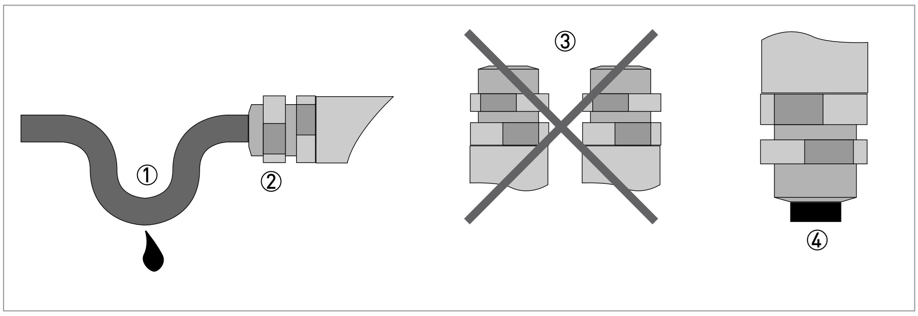


Figure 4-9: Protect housing from dust and water

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.

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