

Foxboro® Model IMT31A Magnetic Flow Signal Converter



The IMT31A magnetic flow signal converter can be used with 8400A, 8500A, 9500A, 9600A and 9700A magnetic flow sensors.

- ▶ Extended accuracy option
- ▶ Diagnostics of device and application
- ▶ Certified for use in hazardous areas

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1.1 The comprehensive solution

The **IMT31A** electromagnetic signal converter combines an attractive price with a wide range of features and benefits including an excellent measuring accuracy.

The signal converter is compatible with the 8400A, 8500A, 9500A, 9600A and 9700A flow sensors.

The signal converter supplies the current required by two field coils to generate a magnetic field. It converts the flow proportional signal voltage into digital values and filters out electrical noise and interference signals. From the filtered signal, the flow velocity, the volume flow and the mass flow are calculated.

The **IMT31A** 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, pulse and status outputs. Measuring values and diagnostic information can be transmitted via interfaces including HART[®], RS485 Modbus, Foundation Fieldbus and Profibus.



[signal converter in wall-mounted housing]

- ① Large backlit graphic display with 4 push buttons to operate the signal converter without having to open the housing
- ② Supply voltage: 100...230 VAC (standard) and 24 VDC or 24 VAC/DC (optional)
- ③ Communication with any third party system possible via HART[®], RS485 Modbus, Foundation Fieldbus or Profibus

Highlights

- For operation with the 8400A, 8500A, 9500A, 9600A and 9700A flow sensors
- For flow sensors over a diameter range from DN2.5 up to DN1200
- Housing in aluminium with a polyester topcoat or in stainless steel (option)
- Tropicalized electronics to protect it from humidity (option)
- Available outputs: 4...20 mA current output, pulse/frequency output, status output/limit switch and Ex i I/O (option)
- HART® as standard
- Communication to third party systems via HART®, Foundation Fieldbus, Profibus PA/DP or Modbus
- Control input option
- Power supply via 100...230 VAC (standard) or 24 VDC or 24 VAC/DC (optional)
- Clearly readable values due to angle of the signal converter housing which prevents dirt and dust on the display
- Extended calibration option for higher measuring accuracy down to 0.2% of the measuring value
- Excellent price/performance ratio

Industries

- Machinery
- Water & Wastewater
- HVAC, energy management
- Chemical
- Food and Beverages
- Metals and Mining

Applications

- Flow in electrically conductive mediums with a minimum conductivity of 5 $\mu\text{S}/\text{cm}$
- Water flow measurements in a wide range of industries
- Water based chemicals
- Sludge and slurries
- Sanitary applications (CIP, SIP) for food & beverage

1.2 Options and variants

Compact or remote wall-mounted housing



(signal converter in wall-mounted aluminium housing)

For an optimal reading of the display, the compact variant comes in a 0° and a 45° version.

The signal converter can be rotated in 90° increments to suit different installation positions.

The compact 0° version is designed for flowmeters in vertical pipelines, the compact 45° version for horizontal installations.

The wall mounted signal converter can be installed remotely for locations where the sensor is difficult to access, or ambient temperature conditions or vibrations prevent a compact variant.

Variant for use in hazardous areas



(Compact version as 0° version)

The IMT31A signal converter is available in a variant suitable for hazardous areas with approvals to ATEX, IECEx, FM, CSA and NEPSI.

Stainless steel housing (option)



(signal converter in wall-mounted stainless steel housing)

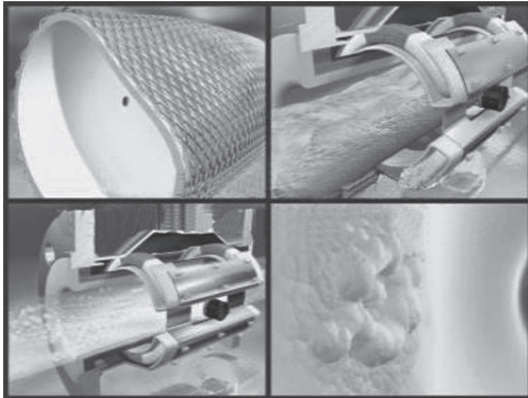
Whereas the standard housing material is aluminium with a polyester topcoat, the **IMT31A** can optionally be ordered in a stainless steel housing.

The robust housing is suitable for many applications in the food and beverage industry. It is designed for environments where extreme chemicals or aggressive cleaning are used.

The housing is dual rated to IP67/69 protection category to resist wash down cleaning and no glass is used for the display window.

The mounting angle for the compact housing and the rounded edges in the wall-mount position prevent dirt and water from building up on the surface.

Diagnostics of device and application



The primary focus of a user for a flowmeter is that it delivers reliable measurements. To achieve this all our electromagnetic flowmeters are calibrated before leaving the factory.

In addition, the **IMT31A** provides a range diagnostic functions on the flow sensor, signal converter and process, integrated in the signal converter.

Potential problems including gas bubbles, solids, electrode corrosion, deposits on electrodes, conductivity changes, empty pipe can be detected by the diagnostics features.

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.

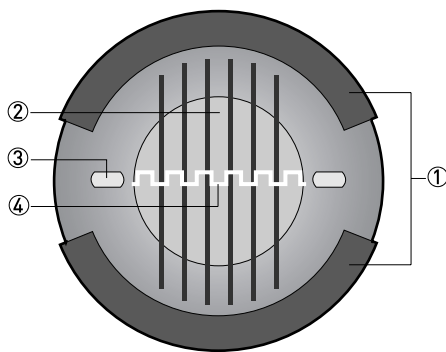


Figure 1-1: Measuring principle

- 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.*

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 construction	The measuring system consists of a flow sensor and a signal converter.
Flow sensor	
8400A	DN10...150 / 3/8...6"
8500A	DN2.5...100 / 1/10...4"
9500A	DN25...1200 / 1...48"
9600A	DN2.5...150 / 1/10...6"
9700A	DN2.5...1200 / 1/10...48"
	With the exception of the 8400A all flow sensors are also available in an Ex version.
Signal converter	
Compact (integral) version (C)	IMT31A-4 (0°) & IMT31A-6 (45°)
Wall-mounted remote version (W)	IMT31A-N
	All signal converters are also available in an Ex version.
Options	
Outputs	Current output (incl. HART®), pulse output, frequency output, status output and/or limit switch
Counter	2 internal counters with a max. of 10 counter places (e.g. for counting volume and/or mass units)
Verification	Integrated verification, diagnostic functions: measuring device, empty pipe detection, stabilisation
Communication interfaces	HART® as standard
	Foundation Fieldbus, Profibus PA/DP or Modbus (check www.BuyAutomation.com for availability)

Display and user interface	
Graphic display	LC display, backlit white.
	Size: 128 x 64 pixels, corresponds to 59 x 31 mm = 2.32" x 1.22"
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Operating elements	4 push buttons for operator control of the signal converter without opening the housing.
Remote control	PACTware™ (including Device Type Manager (DTM))
	HART® Communicator
	AMS®
	All DTMs and drivers are available free of charge from the manufacturer's website.
Display functions	
Operating menu	Setting the parameters using 2 measuring pages, 1 status page, 1 graphic page (measured values and graphics are freely adjustable)
Language display texts (as language package)	Standard: English, French, German, Dutch, Portuguese, Swedish, Spanish, Italian
	Eastern Europe: English, Slovenian, Czech, Hungarian
	Northern Europe: English, Danish, Polish, Finnish, Norwegian
	China: English, German, Chinese (check www.BuyAutomation.com for availability)
	Russia: English, German, Russian
Units	Metric, British and US units selectable as required from lists for volume / mass flow and counting, flow velocity, electrical conductivity, temperature

Measuring accuracy

Max. measuring accuracy	Standard: ±0.3% of the measured value ± 1 mm/s; depending on the flow sensor
	Option (optimised accuracy with extended calibration): ±0.2% of the measured value ± 1.5 mm/s; depending on the flow sensor
	For detailed information and accuracy curves refer to <i>Measuring accuracy</i> on page 26.
	Special calibrations are available on request.
	Current output electronics: ±10 µA; ±100 ppm/°C (typically: ±30 ppm/°C)
Repeatability	±0.1%

Operating conditions

Temperature	
Process temperature	Refer to technical data for the flow sensor.
Ambient temperature	Depending on the version and combination of outputs.
	It is a good idea to protect the signal converter from external heat sources such as direct sunlight as higher temperatures reduce the life cycle of all electronic components.
	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 technical data for the flow sensor.
Ambient pressure	Atmospheric
Chemical properties	
Electrical conductivity	All media except for water: $\geq 5 \mu\text{S}/\text{cm}$ (also refer to the technical data for the flow sensor)
	Water: $\geq 20 \mu\text{S}/\text{cm}$
State of aggregation	Conductive, liquid media
Solid content (volume)	$\leq 10\%$
Gas content (volume)	$\leq 3\%$
Flow rate	For detailed information, refer to chapter "Flow tables".
Other conditions	
Ingress protection acc. to IEC 529 / EN 60529	Standard version with aluminium housing: IP66/67 (acc. to NEMA 4/4X)
	Optional version with stainless steel housing: IP69

Installation conditions

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

Materials

Signal converter housing	Standard: Aluminum with a polyester topcoat Option: Stainless steel 1.4404 / AISI 316L
Flow sensor	For housing materials, process connections, liners, grounding electrodes and gaskets, refer to technical data for 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; non-Ex: standard; Ex: optional 240 VAC + 5% is included in the tolerance range.
	24 VDC (-55% / +30%); only available as non-Ex version 12 VDC - 10% is included in the tolerance range.
	24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%); non-Ex: standard; Ex: optional 12 V is not included in the tolerance range.
Power consumption	AC: 7 VA
	DC: 4 W
Signal cable	Only necessary for remote versions.
	DS 300 (type A) Max. length: 600 m / 1968 ft (depending on electrical conductivity and flow sensor version)
Cable entries	Standard: M20 x 1.5 (8...12 mm)
	Option: 1/2 NPT, PF 1/2

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 abbreviations	U_{ext} = external voltage; R_L = load + resistance; U_0 = terminal voltage; I_{nom} = nominal current

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...21.5 mA	
	Error identification: 20...22 mA	
	With HART®	
	Q = 0%: 4...20 mA; Q = 100%: 10...21.5 mA	
	Error identification: 3...22 mA	
Operating data	Basic I/Os	Ex i I/Os
Active	U _{int, nom} = 20 VDC I ≤ 22 mA R _L ≤ 750 Ω	-
	HART® at terminals A	
Passive	U _{ext} ≤ 32 VDC I ≤ 22 mA U ₀ ≥ 2 V at I = 22 mA R _L ≤ (U _{ext} - U ₀) / I _{max}	U _{ext} ≤ 32 VDC I ≤ 22 mA U ₀ ≥ 4 V R _L ≤ (U _{ext} - U ₀) / I _{max}
		U _i = 30 V I _i = 130 mA P _i = 1 W C _i = 10 nF L _i ~ 0 mH
	HART® at terminals A	HART® at terminals C
HART®		
Description	HART® protocol via active and passive current output	
	HART® version: V5	
	Universal Common Practice HART® parameter: completely supported	
Load	≥ 250 Ω at HART® test point; Note maximum load for current output!	
Multi-drop mode	Yes, current output = 4 mA	
	Multi-drop address adjustable in operation menu 1...15	
Device drivers	Available for HART® Communicator, AMS®, FDT/DTM	
Registration (HART Communication Foundation)	Yes	

Pulse output / 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	0.25...10000 Hz	
	For Modbus I/O: 0.25...1000 Hz	
Settings	Pulses per volume or mass unit or max. frequency for 100% flow	
	Pulse width: adjustable as automatic, symmetric or fixed (0.05...2000 ms)	
Operating data	Basic I/Os	Ex i I/Os
Passive	$U_{ext} \leq 32 \text{ VDC}$ f_{max} in operating menu set to $f_{max} \leq 100 \text{ Hz}$: $I \leq 100 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$ closed: $U_{0, max} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, max} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$	-
	f_{max} in operating menu set to $100 \text{ Hz} < f_{max} \leq 10 \text{ kHz}$: $I \leq 20 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$ closed: $U_{0, max} = 1.5 \text{ V}$ at $I \leq 1 \text{ mA}$ $U_{0, max} = 2.5 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, max} = 5.0 \text{ V}$ at $I \leq 20 \text{ mA}$	-
NAMUR	-	Passive to EN 60947-5-6 open: $I_{nom} = 0.77 \text{ mA}$ closed: $I_{nom} = 4.7 \text{ mA}$
		$U_i = 30 \text{ V}$ $I_i = 130 \text{ mA}$ $P_i = 1 \text{ W}$ $C_i = 10 \text{ nF}$ $L_i = 0 \text{ mH}$

Operating data	Modbus
Passive	$U_{\text{ext}} \leq 32 \text{ VDC}$
	f_{max} in the operating menu set to $f_{\text{max}} \leq 1 \text{ kHz}$: $I \leq 100 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $U_{\text{ext}} = 32 \text{ VDC}$ closed: $U_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$
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) or 0...±9.999 m/s (pulse output)
Hysteresis	Set in increments of 0.1%.
	0...5% (current output, frequency output) or 0...5 m/s (pulse output)
Time constant	
Function	The time constant corresponds to the elapsed time until 67% 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	Basic I/Os + Modbus	Ex i I/Os
Passive	$U_{ext} \leq 32 \text{ VDC}$ $I \leq 100 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$ closed: $U_{0, max} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $U_{0, max} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$	-
NAMUR	-	Passive to EN 60947-5-6 open: $I_{nom} = 0.77 \text{ mA}$ closed: $I_{nom} = 4.7 \text{ mA}$ <hr/> $U_i = 30 \text{ V}$ $I_i = 130 \text{ mA}$ $P_i = 1 \text{ W}$ $C_i = 10 \text{ nF}$ $L_i = 0 \text{ mH}$
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	Basic I/Os	Ex i I/Os + Modbus
Passive	$U_{ext} \leq 32 \text{ VDC}$ $I_{nom} = 6.5 \text{ mA}$ at $U_{ext} = 24 \text{ VDC}$ $I_{nom} = 8.2 \text{ mA}$ at $U_{ext} = 32 \text{ VDC}$ Contact closed (on): $U_0 \geq 8 \text{ V}$ at $I_{nom} = 2.8 \text{ mA}$ Contact open (off): $U_0 \leq 2.5 \text{ V}$ at $I_{nom} = 0.4 \text{ mA}$	-

PROFIBUS DP	
Description	Galvanically isolated acc. to IEC 61158-2
	PA profile version: class B, V3.02
	Automatic data transmission rate recognition (max. 1.5 MBaud)
	Bus address adjustable via local display at the measuring device
Function blocks	5 x analogue input, 3 x totaliser
Output data	Volume flow, mass flow, volume counter 1 + 2, mass counter, velocity, coil temperature, conductivity
PROFIBUS PA	
Description	Galvanically isolated acc. to IEC 61158-2
	PA profile version: class B, V3.02
	Current consumption: 10.5 mA
	Permissible bus voltage: 9...32 VDC; in Ex application: 9...24 VDC
	Bus interface with integrated reverse polarity protection
	Typical error current FDE (Fault Disconnection Electronic): 6 mA
	Bus address adjustable via local display at the measuring device
Function blocks	5 x analogue input, 3 x totaliser
Output data	Volume flow, mass flow, volume counter 1 + 2, mass counter, velocity, coil temperature, conductivity
FOUNDATION Fieldbus	
Description	Galvanically isolated acc. to IEC 61158-2
	Current consumption: 10.5 mA
	Permissible bus voltage: 9...32 VDC; in Ex application: 9...24 VDC
	Bus interface with integrated reverse polarity protection
	Link Master function (LM) supported
	Tested with Interoperable Test Kit (ITK) version 5.2
Function blocks	3 x analogue input, 2 x integrator, 1 x PID
Output data	Volume flow, mass flow, velocity, coil temperature, conductivity, electronics temperature
Modbus	
Description	Modbus RTU, Master / Slave, RS485
Address range	1...247
Broadcast	Supported with function code 16
Supported Baud rate	1200, 2400, 3600, 4800, 9600, 19200, 38400, 57600, 115200 Baud

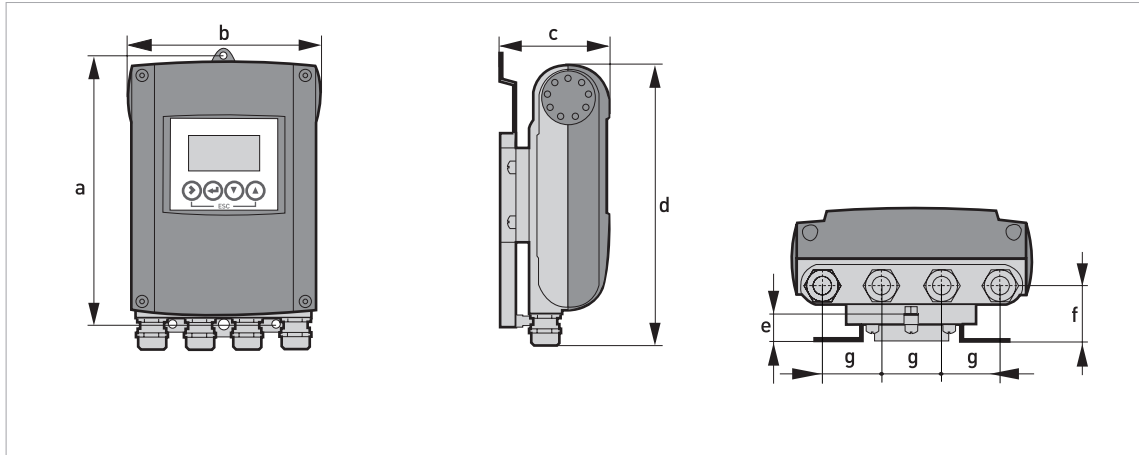
Approvals and certificates

CE	This device fulfils the statutory requirements of the relevant EU directives. The manufacturer certifies successful testing of the product by applying the CE mark.
	For full information of the EU directives & standards and the approved certifications, please refer to the EU declaration or the manufacturer website.
Non-Ex	Standard
Hazardous areas	
ATEX	Option (only 9500A & 9700A)
	II 2 G Ex e [ia] mb IIC T4 (DN10...20; DN200...300; DN350...3000)
	II 2 G Ex d e [ia] mb IIC T4 (DN25...150)
	II 2 G Ex e [ia] mb q T4/T3 (DN25...150; DN200...300)
	II 2 D Ex tD A21 IP64 T120°C (all nominal sizes)
	Option (Wall-mounted version only)
	II 2 G Ex e [ia] mb IIC T4
	II 2 D Ex tD A21 IP64 T135°C
IECEX	Option (only 9500A & 9700A)
	Ex e [ia] mb IIC T4 (DN10...20; DN200...300; DN350...3000)
	Ex d e [ia] mb IIC T4 (DN25...150)
	Ex tD A21 IP64 T120°C (all nominal sizes)
	Option (Wall-mounted version only)
	Ex e [ia] mb IIC T4
	Ex tD A21 IP64 T135°C
	FM/CSA
Class I, Div 2, Group A, B, C and D	
Option (Wall-mounted version only)	
Class I, Div 2, Group A, B, C and D	
Ordinary location	
Other standards and approvals	
Electromagnetic compatibility (EMC)	2004/108/EU in conjunction with EN 61326-1 (A1, A2)
Shock and vibration resistance	IEC 68-2-27, IEC 68-2-64
NAMUR	NE 21, NE 43, NE 53

2.2 Dimensions and weight

2.2.1 Housing

Wall-mounted version, aluminium housing



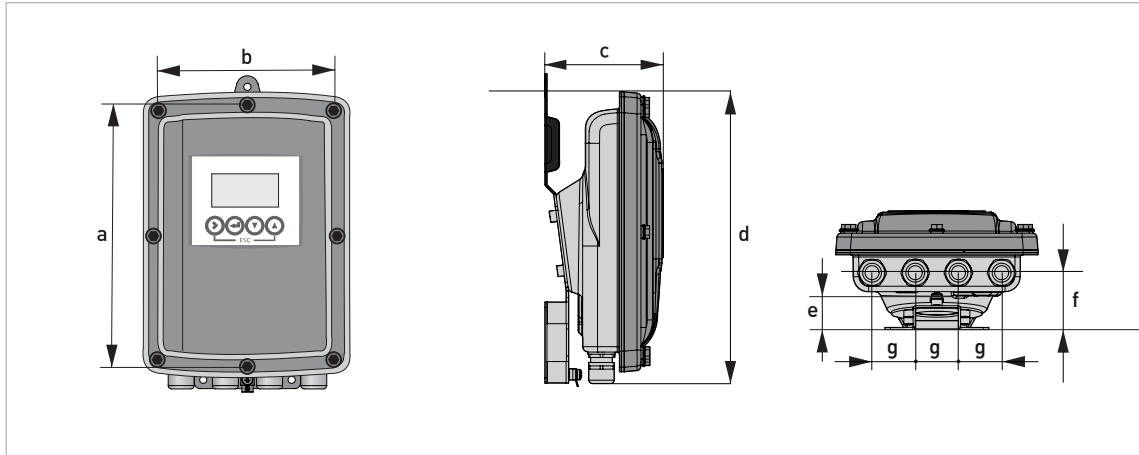
Dimensions and weights in mm and kg

	Dimensions [mm]							Weight [kg]
	a	b	c	d	e	f	g	
Wall-mounted version	241	161	95.2	257	19.3	39.7	40	1.9

Dimensions and weights in inch and lb

	Dimensions [inch]							Weight [lb]
	a	b	c	d	e	f	g	
Wall-mounted version	9.50	6.34	3.75	10.12	0.76	1.56	1.57	4.2

Wall-mounted and compact 10° version, stainless steel housing



Dimensions and weights in mm and kg

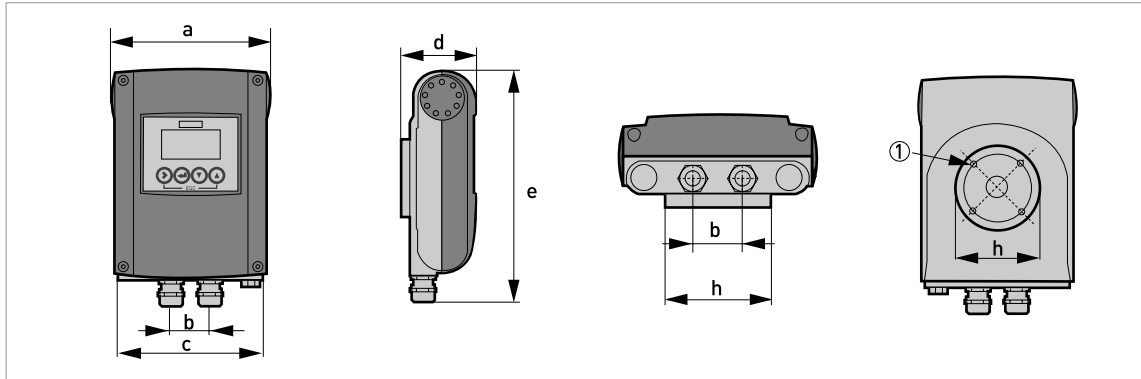
	Dimensions [mm]							Weight [kg]
	a	b	c	d	e	f	g	
Wall-mounted version	268	187	110	276	29	53	40	Approx. 3.5

Dimensions and weights in inch and lb

	Dimensions [inch]							Weight [lb]
	a	b	c	d	e	f	g	
Wall-mounted version	10.55	7.36	4.33	10.87	1.14	2.09	1.57	Approx. 7.2

The compact 10° version is without mounting plate.

Compact 0° version, aluminium housing



① 4 x M 6

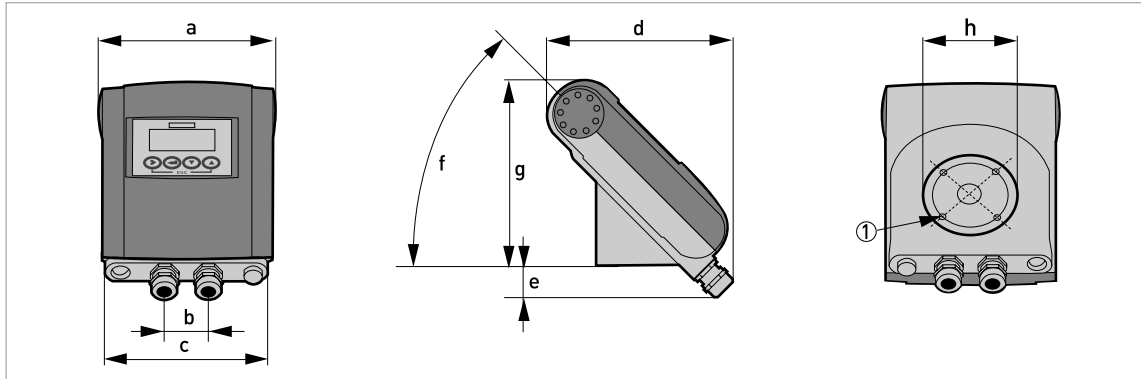
Dimensions and weights in mm and kg

	Dimensions [mm]								Weight [kg]
	a	b	c	d	e	f	g	h	
0° version	161	40	155	81.5	257	-	-	Ø72	Std: 1.9 Ex: 2.4

Dimensions and weights in inch and lb

	Dimensions [inch]								Weight [lb]
	a	b	c	d	e	f	g	h	
0° version	6.34	1.57	6.1	3.21	10.12	-	-	Ø2.83	Std: 4.2 Ex: 5.3

Compact 45° version, aluminium housing



① 4 x M 6

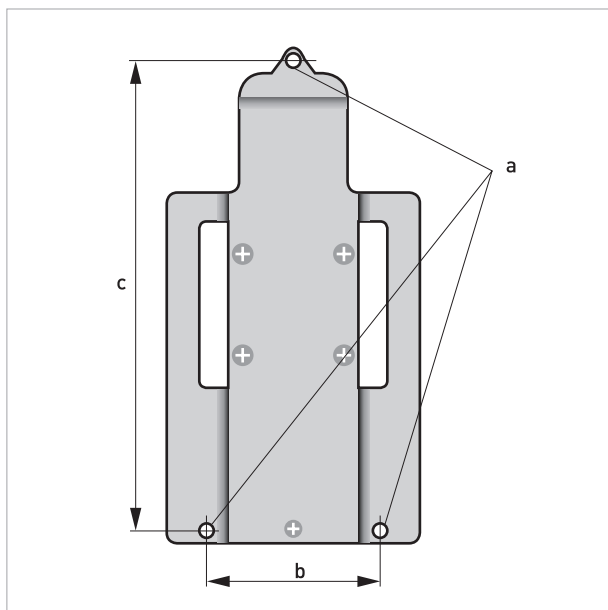
Dimensions and weights in mm and kg

	Dimensions [mm]								Weight [kg]
	a	b	c	d	e	f	g	h	
45° version	161	40	155	184	27.4	45°	186	Ø72	Std: 2.1 Ex: 2.6

Dimensions and weights in inch and lb

	Dimensions [inch]								Weight [lb]
	a	b	c	d	e	f	g	h	
45° version	6.34	1.57	6.10	7.24	1.08	45°	7.32	Ø2.83	Std: 4.6 Ex: 5.7

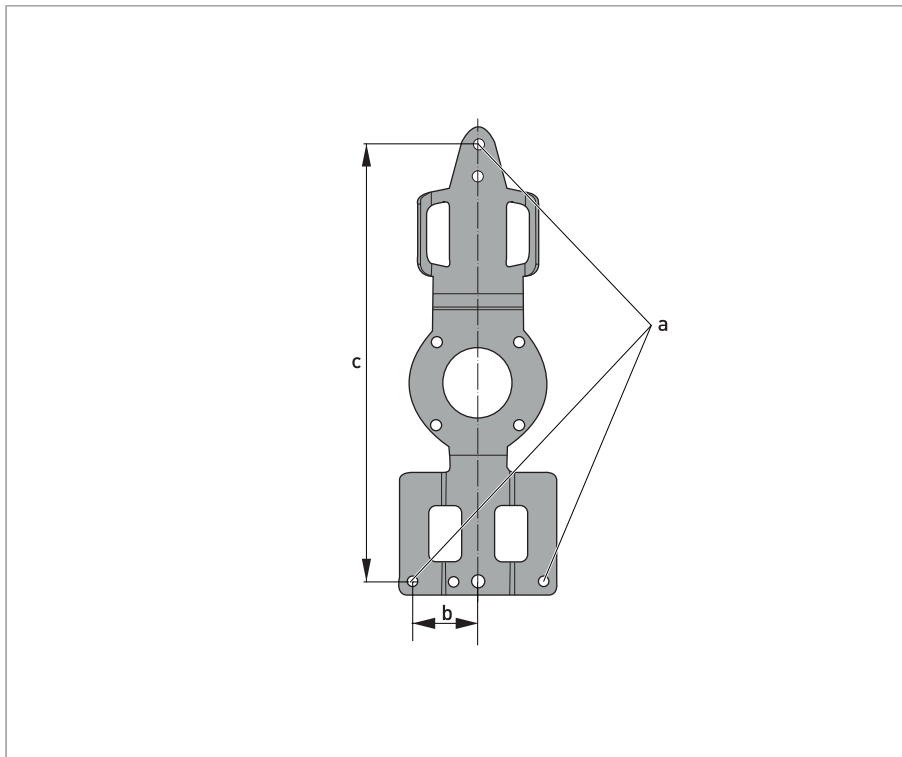
2.2.2 Mounting plate of wall-mounted version, aluminium housing



Dimensions in mm and inch

	[mm]	[inch]
a	Ø6.5	Ø0.26
b	87.2	3.4
c	241	9.5

2.2.3 Mounting plate of wall-mounted version, stainless steel housing



	[mm]	[inch]
a	Ø6.5	Ø0.26
b	40	1.6
c	267.9	10.55

2.3 Flow tables

Flow rate in m/s and m³/h

v [m/s]	Q _{100 %} in m ³ /h			
	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

Flow rate in ft/s and US gallons/min

	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
1/8	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

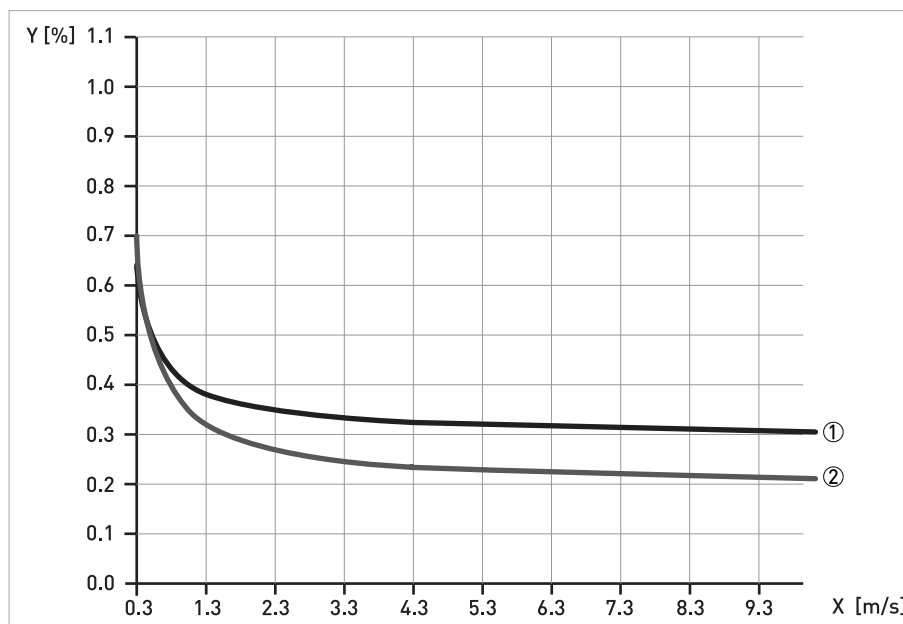
2.4 Measuring accuracy

Every electromagnetic flowmeter is calibrated by direct volume comparison. The wet calibration validates the performance of the flowmeter under reference conditions against accuracy limits.

The accuracy limits of electromagnetic flowmeters are typically the result of the combined effect of linearity, zero point stability and calibration uncertainty.

Reference conditions

- Medium: water
- Temperature: +5...+35°C / +41...+95°F
- Operating pressure: 0.1...5 barg / 1.5...72.5 psig
- Inlet section: ≥ 5 DN
- Outlet section: ≥ 2 DN



X [m/s]: flow velocity

Y [%]: deviation from the actual measured value (mv)

	DN [mm]	DN [inch]	Standard accuracy ①	Optimised accuracy ②
8400A	10...150	3/8...6	±0.4% of mv ± 1 mm/s; as ① + 0.1%	-
8500A / 9600A / 9700A	2.5...6	1/10...1/4		
8500A / 9500A / 9600A / 9700A	10...1200	3/8...48	±0.3% of mv ± 1 mm/s	only 9500A / 9700A: ±0.2% of mv ± 1.5 mm/s Extended calibration at 2 points

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 CISPR11:2009. 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 a 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. sun shade) 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 measuring 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 wall-mounted housing, remote version

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 Wall mounting

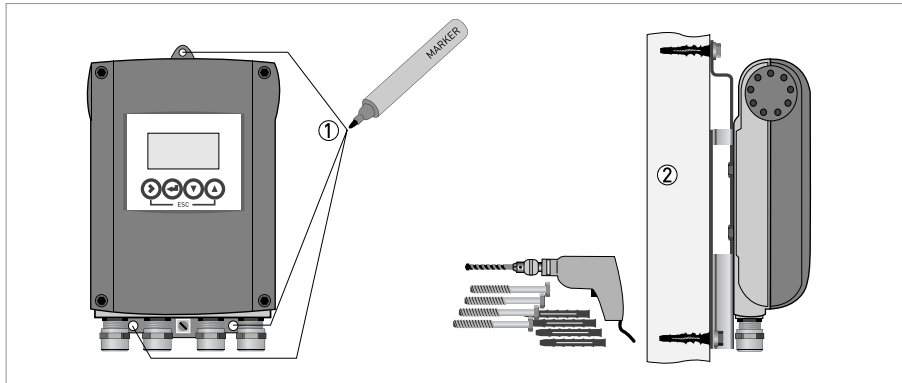
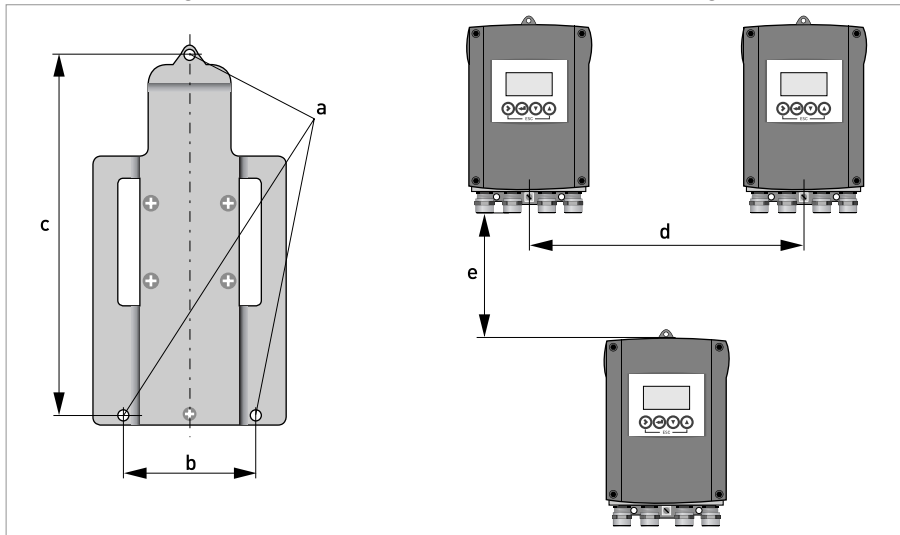


Figure 3-1: Mounting the wall-mounted housing

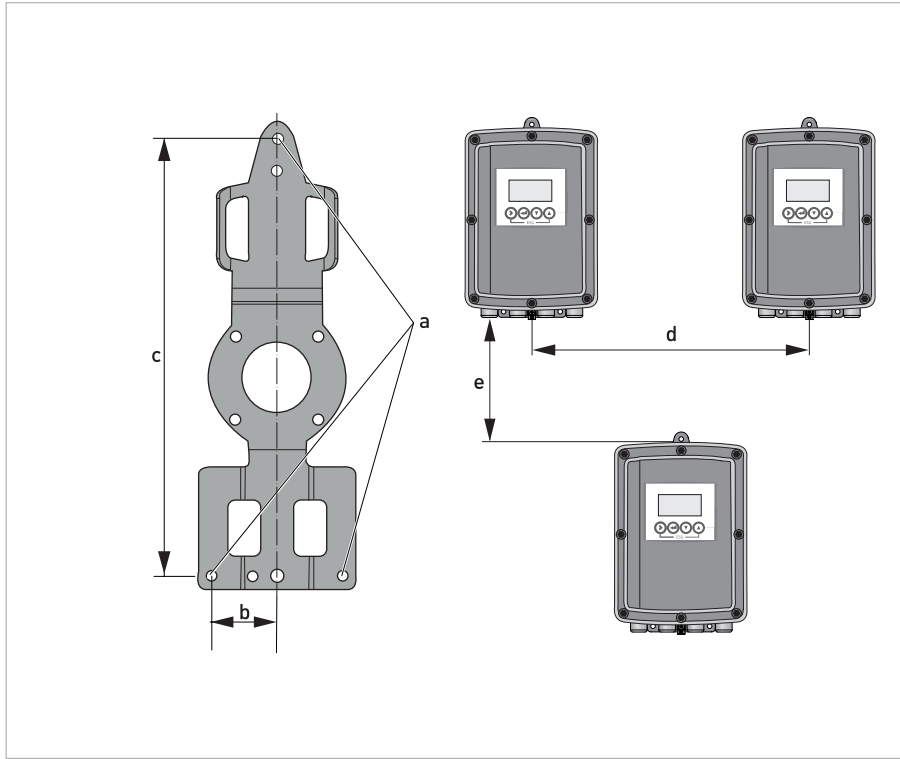
- ① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate of wall-mounted version, aluminium housing* on page 22.
- ② Fasten the device securely to the wall with the mounting plate.

Wall mounting of multiple devices (aluminium housing)



	[mm]	[inch]
a	Ø6.5	Ø0.26
b	87.2	3.4
c	241	9.5
d	310	12.2
e	257	10.1

Wall mounting of multiple devices (stainless steel housing)



	[mm]	[inch]
a	Ø6.5	Ø0.26
b	268	10.5
c	40	1.6
d	336	13.2
e	257	10.1

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.

- 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.
- If delivered separately or when installing devices that were not configured together, set the signal converter to the DN size and GK/GKL of the flow sensor.

4.2 Preparing the signal and field current cables

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.

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: $\geq 50 \text{ mm} / 2''$

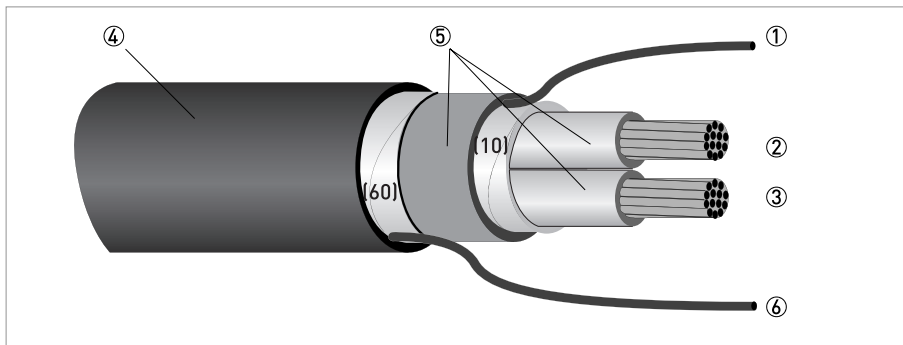


Figure 4-1: Construction of signal cable A

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

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 diameter		Min. electrical conductivity [µS/cm]	Curve for signal cable A
	DN [mm]	[inch]		
8400A	10...150	3/8...6	5	A1
8500A	2.5...100	1/10...4	5	A1
	150...250	6...10	5	A2
9500A	25...150	1...6	20	A1
	200...1200	8...48	20	A2
9600A	2.5...150	1/10...6	5	A1
9700A	2.5...150	1/10...6	5	A1
	200...1200	8...48	5	A2

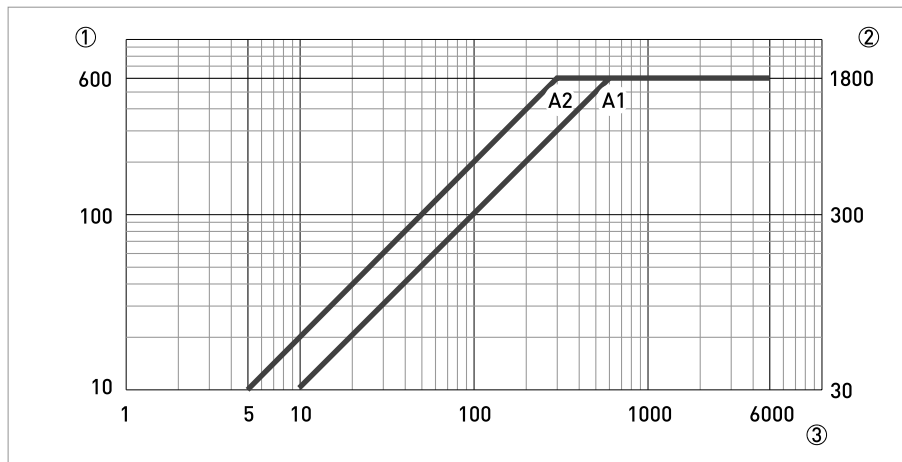


Figure 4-2: Maximum length of signal cable A

- 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 Connection diagram for signal and field current cable

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

- A shielded 2-wire copper cable is used as the field current cable. The shielding **MUST** be connected in the housing of the flow sensor and signal converter.
- The outer shield (60) is connected in the terminal compartment of the flow sensor directly via the shield and a clip.
- Bending radius of signal and field current cable: $\geq 50 \text{ mm} / 2''$
- The following illustration is schematic. The positions of the electrical connection terminals may vary depending on the housing version.

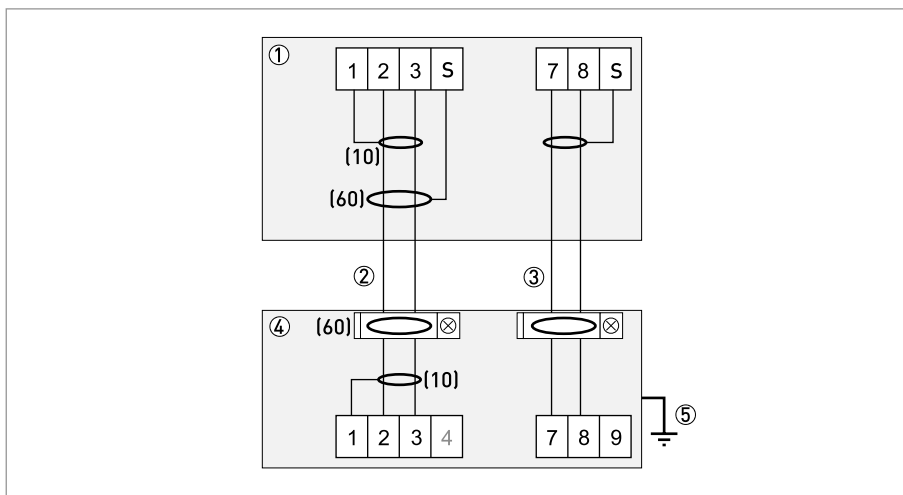


Figure 4-3: Connection diagram for signal and field current cable

- ① Electrical terminal compartment in the signal converter
- ② Signal cable A
- ③ Field current cable C
- ④ Electrical terminal compartment in the flow sensor
- ⑤ Functional ground FE

4.3 Connecting the power supply

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

- 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 ($I_N \leq 16\text{ A}$) for the infeed power circuit, and also a separator (switch, circuit breaker) to isolate the signal converter must be provided.

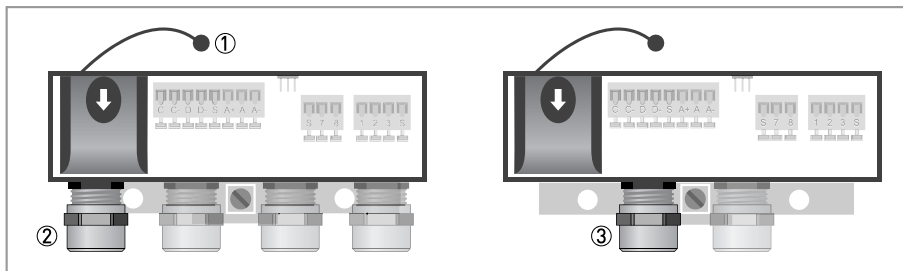


Figure 4-4: Terminal compartment for power supply

- ① Retaining band of the cover
- ② Cable entry for power supply, remote version
- ③ Cable entry for power supply, compact version

Version overview

Version	Non-Ex	Ex
100...230 VAC	Standard	Optional
24 VDC	Standard	-
24 VAC/DC	Standard	Optional

- Open the cover of the electrical terminal compartment by pressing down and pulling forwards at the same time.

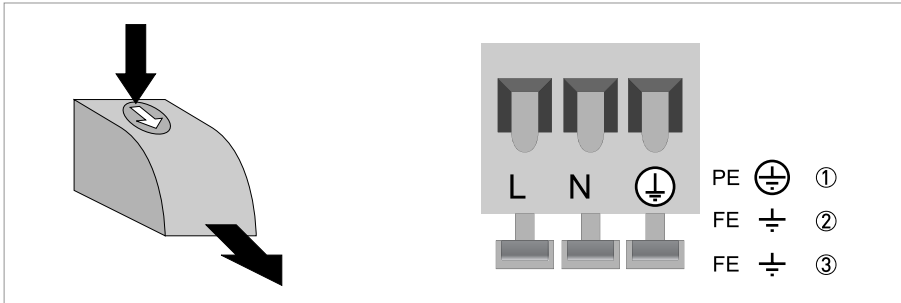


Figure 4-5: Power supply connection

- ① 100...230 VAC (-15% / +10%), 8 VA
- ② 24 VDC (-55% / +30%), 4 W
- ③ 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%), 7 VA or 4 W

- Close the cover after the power has been connected.

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

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.

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

24 VDC (tolerance range: -55% / +30%)

- Note the data on the nameplate!
- When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (acc. to VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or relevant national regulations).

12 VDC - 10% is included in the tolerance range.

24 VAC/DC (tolerance range: AC: -15% / +10%; DC: -25% / +30%)

- AC: Note the power supply voltage and frequency (50...60 Hz) on the nameplate.
- AC/DC: When connecting to functional extra-low voltages, provide a facility for protective separation (PELV) (acc. to VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or relevant national regulations).

*12 V is **not** included in the tolerance range.*

4.4 Inputs and outputs, overview

4.4.1 Description of the CG number

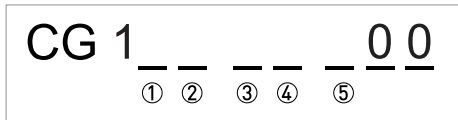


Figure 4-6: Marking (CG number) of the electronics module and output variants

- ① ID number: 0
- ② ID number: 0 = standard; 9 = special
- ③ Power supply
- ④ Display (language versions)
- ⑤ Output version

4.4.2 Fixed, non-alterable output versions

This signal converter is available with various output combinations.

- The grey boxes in the tables denote unassigned or unused connection terminals.
- In the table, only the final digits of the CG no. are depicted.
- Connection terminal A+ is only operable in the basic output version.

Basic outputs (I/O) (Standard)

CG no.	Connection terminals							
	C	C-	D	D-	S	A+	A	A-
1 0 0	S _p / C _p passive ①		P _p / S _p passive ①		②		I _p + HART® passive ③	
						I _a + HART® active ③		

① Function change by software

② Shielding

③ Function changed by reconnecting

Description of the used abbreviations

I _a	I _p	Current output active or passive
P _p		Pulse/frequency output passive
S _p		Status output / limit switch passive
C _p		Control input passive

Ex i, Profibus PA + DP, Foundation Fieldbus and Modbus (I/O) (Option)

CG no.	Connection terminals						
	D	D-	S	C	C-	B	B-

Ex i (Option)

3 0 0	P _p / S _p passive ①	②	I _p + HART® passive	
-------	---	---	--------------------------------	--

PROFIBUS PA (Option)

D 0 0	PA+ (1)	PA+ (2)	②	PA- (1)	PA- (2)	
-------	---------	---------	---	---------	---------	--

FOUNDATION Fieldbus (Option)

E 0 0	V/D+ (1)	V/D+ (2)	②	V/D- (1)	V/D- (2)	
-------	----------	----------	---	----------	----------	--

PROFIBUS DP (Option)

F 0 0	RxD/TxD+ / P / +B (1)	RxD/TxD- / N / -A (1)	②	Termination N / -T	Termination P / +T	RxD/TxD+ / P / +B (2)	RxD/TxD- / N / -A (2)
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Modbus (Option)

G 0 0	P _p / S _p passive	②	+3.3 V; 560 Ω	Common	Sign. A (D0-)	Sign. B (D1+)
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① Function change by software

② Shielding

Supplementary instructions related to the communication busses Foundation Fieldbus, Profibus PA/DP and Modbus are available on the website.

4.5 Laying electrical cables correctly

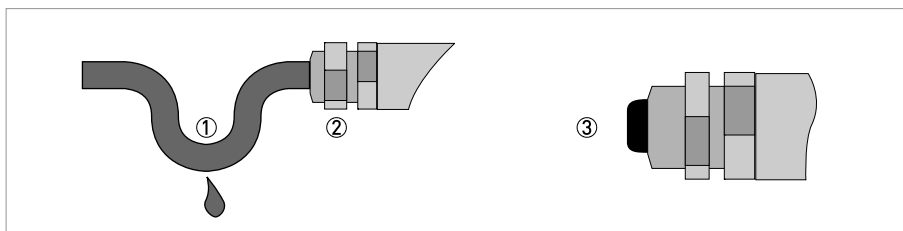


Figure 4-7: Protect housing from dust and water

- ① For compact versions with nearly horizontally-oriented cable entries, lay the necessary electric cables with a drip loop as shown in the illustration.
- ② Tighten the screw connection of the cable entry securely.
- ③ Seal cable entries that are not needed with a plug.

Model	Description
IMT31A	Foxboro® Model IMT31A Magnetic Flow Signal Converter
-4 -6 -N	Type IMT31A compact (0°) IMT31A compact (45°) IMT31A wall-mounted
1 4 A	Power supply 12-24 VDC 24 VDC/AC (9-31 V) 100-230 VAC (85-253 VAC, 50/60 Hz)
0 2 5 A C G T U V W X Y	Ex version Without - non Ex Ex zone 1 (terminal compartment "e" - compact & wall) (9500A & 9700A) cFMus Class 1 DIV 2 (US) cCSAus 0L cFMus Class 1 DIV 2 (Canada) IECEx zone 1 (terminal compartment "e" - compact & wall) (9500A & 9700A tubes only) Check www.BuyAutomation.com for availability of the following items: BE-Ex EAC (Belarus "e" - compact & wall) (9500A & 9700A tubes only) RU-Ex EAC (Russia "e" - compact & wall) (9500A & 9700A tubes only) KA-Ex EAC (Kazakhstan "e" - compact & wall) (9500A & 9700A tubes only) RU EAC (Russia) KA EAC (Kazakhstan) BE EAC (Belarus)
4 5 6	Cable connection 1/2 NPT PF 1/2 M20 x 1.5
5 6 7 8 A B H K L M R X	Operating manual (see "Manuals" section of the Model Code below) / operating language Without / German Without / English GB Without / French Without / Spanish Without / eastern Europe group (GB, CZ, HU, SI, SL, AL, BG & RO) Without / northern Europe group (GB, DK, FI, LT, NO, PL, EE & LV) Without / Italian Without / Portuguese Without / Dutch Without / Swedish Without / Chinese (check www.BuyAutomation.com for availability) Without / Russian
0	Custody transfer Without
0 C	Process diagnostics Standard Tropicalized electronics for non Ex (not for 12-24 VDC)
1* 2	Signal converter housing Aluminum with a polyester topcoat Stainless steel
1 3 D E F G	Communication Basic IO (4-20 mA / HART + pulse / frequency + status output) Ex i IO: CO pas. + PO pas. (Cur. Out. passive+ Pulse Out. passive) Fieldbus IO: Profibus PA (not for 12-24 VDC) Fieldbus IO: Foundation Fieldbus (not for 12-24 VDC) Fieldbus IO: Profibus DP (not for 12-24 VDC) IO RS485 Modbus (not for 12-24 VDC)
0	1st IO module Without, no module possible

Model	Description
0	2nd IO module Without, no module possible
0	Reference method Standard
0 2 3	Tag plate (field & wall only) Standard 316/1.4401 tag plate (120 x 46 mm) 316/1.4401 tag plate (67 x 25 mm)
1 3* 4	Manuals German English French

*: Standard

ORDERING INSTRUCTIONS

1. Model Number.
2. Flow Data:
 - a. Maximum, minimum, and normal flow rate.
 - b. Fluid composition and viscosity at operating temperatures.
 - c. Fluid density or relative density (specific gravity).
 - d. Maximum, minimum and normal operating temperatures.
 - e. Maximum, minimum and normal operating pressures.
 - f. Mating pipe schedule.
 - g. Type and location (distance) of upstream disturbance.
3. Calibration Information (analog output only); maximum flow rate 20 mA output.
4. Electric Classification.
5. Optional Selections and Accessories.
6. Customer Tag Data.

FLOWEXPERTPRO SIZING APPLICATION

Mobile application FlowExpertPro.com



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