7.7.1 Disassembly of aluminum or stainless steel field housing

- Remove all the covers (②, ③, ⑤) on housing and console by unscrewing. Non standard versions can have interlocking headscrews which then have to be unscrewed first with Allen key 4.
- Disconnect all electric cables from connection terminals (if still attached).
- Remove all the cable glands, stopping plug and plastic insert of the housing ①.
- Remove the electronics insert and display ⑥.
- Unscrew the cable terminal in the console ④ and remove the terminal and cable.
- Unscrew the backplane PCB ⑦ inside of the housing, together with the terminal block (T20) and disconnect all the wiring from the terminal block.
- Remove both the plastic cable covers and backplane and push the cabling (feedthrough) inside the housing and remove it then completely.
- By unscrewing of the four M10 bolts, the housing and console can also be separated.

➲ All main parts are now disassembled and can be shipped separate for re-usage and/or recycling.

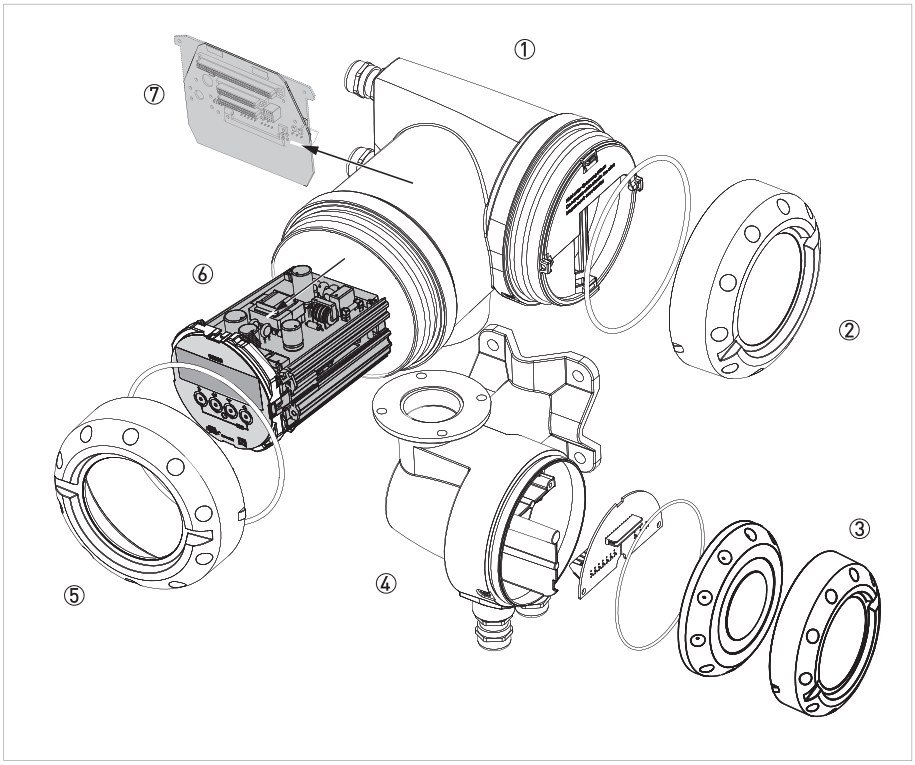

Figure 7-1: Exploded view of field housing

① Field housing
② Cover of electric and I/O connections compartment
③ Cover of sensor connections compartment
④ Console sensor connection part
⑤ Cover of electronic insert / display compartment (glass window)
⑥ Electronic insert with display unit
⑦ Backplane PCB for connection inside the housing (varies per version ordered)

7.7.2 Disassembly of aluminum or stainless steel compact housing

- Remove all the covers (②, ③) on housing and console by unscrewing. Non standard versions can have interlocking headscrews which then have to be unscrewed first with Allen key 4.
- Disconnect all electric cables from connection terminals (if still attached).
- Remove all the cable glands, stopping plug and plastic insert of the housing ①.
- Remove the electronics insert and display ④.
- Unscrew the backplane PCB ⑤ inside of the housing, together with the terminal block (T20) and disconnect all the wiring from the terminal block.
- Remove both the plastic cable covers and backplane and push the cabling (feedthrough) inside the housing and remove it then completely.
- By unscrewing of the four M10 bolts, the housing and console can also be separated.

➲ All main parts are now disassembled and can be shipped separate for re-usage and/or recycling.

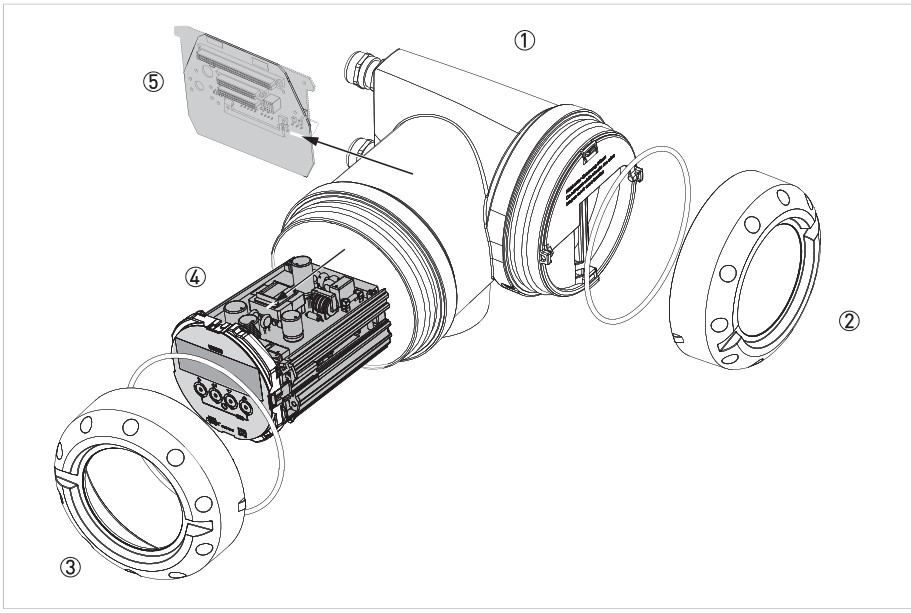

Figure 7-2: Exploded view of compact housing

① Field housing
② Cover of electric and I/O connections compartment
③ Cover of electronic insert / display compartment (glass window)
④ Electronic insert with display unit
⑤ Backplane PCB for connection inside the housing (varies per version ordered)

7.7.3 Location of battery

The battery is located on the PCB as shown in the following figure.

- Remove the battery ⑤ by taking out of the holder.
- Lead it to the re-usage and/or recycling process.

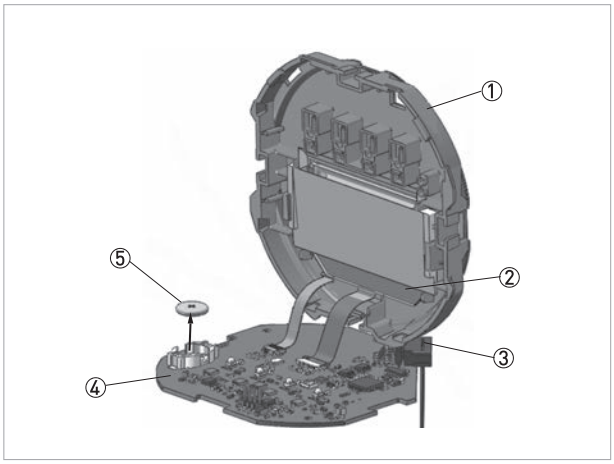

Figure 7-3: Location of battery on display unit

① Front panel
② LCD display
③ Pre-assembled cable
④ PCB
⑤ Battery

7.7.4 Overview of the materials and components

The items mentioned in the listing below are the main parts of the device.

The device can be ordered in different versions. The next tables show the data of the normal (standard) versions with compact and field housing. Please contact our Support Service for details of special versions with additional features.

Materials/components, which must be removed and treated separately

Material (or material code)	Weight		Additional information
	[kg]	[lb]	
Printed circuit boards	0.555	1.224	Tot. average size is approx. 600 cm² (± 5%).
Electrolyte capacitor	①	①	① Electronic insert (unit) PCB contains approx. 20 cm³ of electrolytic capacitors.
Battery	-		For further information about the battery refer to *Location of battery* on page 117.
LCD display	0.087	0.192	Cover contains approx. 70 g / 0.15 lb glass screen.
Noble/precious metal	-	-	-

Table 7-8: Compact and field version

Material/components, which can disturb recycling processes

Material (or material code)	Weight		Additional information
	[kg]	[lb]	
Mixture ABS / steel	-	-	-
Metal mixture	0.0188	0.0414	Bolts, washers, screws, cable clamp
Plastics mixture	-	-	-
Silicon / rubber	0.030	0.067	-
PVC & connector parts	0.012	0.026	E.g. on cables, display foil
Copper, Brass, other	0.024	0.053	Gold-plated connectors, copper wire

Table 7-9: Compact and field version

Beneficial material/components, useful for recycling

Material (or material code)	Weight		Additional information
	[kg]	[lb]	
Stainless steel ①	12	26.5	① Only applicable for stainless steel version (housing).
Aluminum ②	5	11	② Aluminum housing version, covers
Polyamide	0.360	0.793	Compartment inserts, lids
PCB	0.555	1.224	Complete electronic insert, PB holders
Cabling	-	-	All cables are detachable from the device.
Copper content	negligible		-

Table 7-10: Compact and field version

8.1 Measuring principle

The signal converter has been designed to work with all the measuring tube designs used in the mass flowmeters. For information regarding the measuring principle for a specific measuring tube design, please refer to the technical documentation of the relevant flow sensor.

8.2 Technical data

INFORMATION!

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

Measuring system

Measuring principle	Coriolis principle
Application range	Measurement of mass flow, density, temperature, volume flow, flow velocity, concentration

Design

Modular construction	The measuring system consists of a flow sensor and a signal converter.
Flow sensor	
OPTIMASS 1000	DN15...50 / 1/2...2"
OPTIMASS 2000	DN100...400 / 4...16"
OPTIMASS 3000	DN01...04 / 1/25...4/25"
OPTIMASS 6000	DN08...250 / 3/8...10"
OPTIMASS 7000	DN06...80 / 1/4...3"
	All flow sensors are also available in an Ex version.
Signal converter	
Compact version (C)	OPTIMASS x400 C (x = 1, 2, 3, 6 or 7)
Field housing (F) - remote version	MFC 400 F
	Compact and field housing versions are also available in an Ex version.
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, stabilisation
Concentration measurement	Universal concentration measurement, °Brix, °Baume, °Plato, alcohol concentration, NaOH and API density
Communication interfaces	HART®, Foundation Fieldbus, Profibus PA and DP, PROFINET IO, Modbus, Bluetooth®

Display and user interface	
Graphic display	LC display, backlit white.
	Size: 256 x 128 pixels, corresponds to 59 x 31 mm = 2.32" x 1.22"
	Display turnable in 90° steps.
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Operating elements	4 push buttons/optical keys for operator control of the signal converter without opening the housing.
	Infrared interface for reading and writing all parameters with IR interface (option) without opening the housing.
Remote operation	PACTware™ (including Device Type Manager (DTM))
	HART® Hand Held 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.
	OPTICHECK Flow Mobile app via wireless Bluetooth® interface
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	Available languages: English, German, French, Danish, Spanish, Italian, Dutch, Polish, Portuguese, Swedish, Turkish, Norwegian
Measurement functions	**Units:** Metric, British and US units selectable as desired from lists for volume/mass flow and counting, velocity, temperature, pressure
	Measured values: Mass flow, total mass, temperature, density, volume flow, total volume, velocity, flow direction (not displayed unit – but available via outputs), Brix, Baume, NaOH, Plato, API, mass concentration, volume concentration
Diagnostic functions	**Standards:** VDI / NAMUR / WIB 2650 and NE 107
	Status messages: Output of status messages optional via display, current and/or status output, HART® or bus interface
	Sensor and sensor electronics diagnosis: Sensor signal integrity, sensor and drive coils diagnostics, measurement channels check, comparison of internal signals with references, drive circuit integrity, process temperature, CPU diagnostics, process temperature circuit monitoring, internal data integrity check, redundant calibration
	Signal converter and inputs/outputs: Data bus monitoring, current output connections, current readback with redundant calibration, factory calibration integrity, electronics temperature, CPU diagnostics, voltage monitoring

Measuring accuracy

Reference conditions	Medium: water
	Temperature: +20°C / +68°F
	Pressure: 1 bar / 14.5 psi
Maximum measuring error	Refer to technical data for the flow sensor.

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.
	Die-cast aluminum housing: SIL device: -40…+55°C / -40…+131°F Non-SIL device: -40...+65°C / -40...+149°F
	Stainless steel housing: SIL device: -40…+55°C / -40…+131°F Non-SIL device: -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 technical data for the flow sensor.
Ambient pressure	Atmospheric
Chemical properties	
State of aggregation	Liquids, gases and slurries
Flow rate	Refer to technical data for the flow sensor.
Other conditions	
Ingress protection according to IEC 60529	IP66/67 (according to NEMA 4/4X)

Installation conditions

Installation	For detailed information, refer to chapter "Installation".
Dimensions and weight	For detailed information refer to chapter "Dimensions and weight".

Materials

Signal converter housing	Standard: die-cast aluminum (polyurethane coated)
	Option: stainless steel 316 / 1.4408
Flow sensor	For housing material, process connections, measuring tubes, accessories 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	Standard: 100...230 VAC (-15% / +10%), 50/60 Hz
	Option: 24 VDC (-55% / +30%)
Power consumption	AC: 22 VA
	DC: 12 W
Signal cable	Only for remote versions.
	10 core shielded cable. Detailed specifications are available on request.
	Length: max. 20 m / 65.6 ft
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 abbreviations	U_{ext} = external voltage; R_L = load + resistance; U_0 = terminal voltage; I_{nom} = nominal current Safety limit values (Ex i): U_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, temperature, density, flow velocity, diagnostic values, 2-phase signal	
	Concentration and concentration flow are also possible with available concentration measurement (optional).	
Resolution	<1 µA	
Uncertainty	±5 µA	
Temperature coefficient	Typically ±30 ppm/K	
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**
Active	$U_{int, nom}$ = 24 VDC I ≤ 22 mA R_L ≤ 1 kΩ	$U_{int, nom}$ = 21 VDC I ≤ 22 mA R_L ≤ 400 Ω
		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
Passive	U_{ext} ≤ 30 VDC I ≤ 22 mA U_0 ≥ 1.8 V R_L ≤ (U_{ext} - U_0) / I_{max}	U_{ext} ≤ 30 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®		
Description	HART® protocol via active and passive current output	
	HART® version: V7	
	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 (HART Communication Foundation)	Yes	
Pulse output or frequency output		
Output data	Pulse output: volume flow, mass flow, mass or volume of dissolved substance during activated concentration measurement	
	Frequency output: flow velocity, mass flow, temperature, density, diagnostic value Optional: concentration, flow of the dissolved substance	
Function	Can be set as a pulse output or frequency output	
Pulse rate/frequency	0.01...10000 pulses/s or Hz (5000 Hz for phase-shifted outputs)	
Settings	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**	**Fixed I/Os**
Active	U_{nom} = 24 VDC	-
	f_{max} in operating menu set to $f_{max} \leq 100$ Hz: I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0, nom}$ = 24 V at I = 20 mA	
	f_{max} in operating menu set to 100 Hz < $f_{max} \leq 10$ kHz: I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0, nom}$ = 22.5 V at I = 1 mA $U_{0, nom}$ = 21.5 V at I = 10 mA $U_{0, nom}$ = 19 V at I = 20 mA	

Passive	$U_{ext} \leq 32$ VDC	-
	f_{max} in operating menu set to $f_{max} \leq 100$ Hz: $I \leq 100$ mA open: $I \leq 0.05$ mA at $U_{ext} = 32$ VDC closed: $U_{0, max} = 0.2$ V at $I \leq 10$ mA $U_{0, max} = 2$ V at $I \leq 100$ 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 at $U_{ext} = 32$ VDC closed: $U_{0, max} = 1.5$ V at $I \leq 1$ mA $U_{0, max} = 2.5$ V at $I \leq 10$ mA $U_{0, max} = 5.0$ V at $I \leq 20$ mA	
NAMUR	Passive to EN 60947-5-6 $U_{ext} = 8.2$ V ± 0.1 VDC R = 1 kΩ ± 10 Ω open: $I_{nom} = 0.6$ mA closed: $I_{nom} = 3.8$ mA	Passive to EN 60947-5-6 open: $I_{nom} = 0.43$ mA closed: $I_{nom} = 4.5$ mA
		$U_i = 30$ V $I_i = 100$ mA $P_i = 1$ W $C_i = 10$ nF $L_i \sim 0$ mH
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)	
Damping		
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, overflow, error or switching point.	
	Valve control with activated dosing function	
	Status and/or control: ON or OFF	
Operating data	**Modular I/Os**	**Fixed I/Os**
Active	U_{int} = 24 VDC I ≤ 20 mA open: I ≤ 0.05 mA closed: $U_{0, nom}$ = 24 V at I = 20 mA	-
Passive	U_{ext} ≤ 32 VDC I ≤ 100 mA $R_{L, max}$ = 47 kΩ $R_{L, min} = (U_{ext} - U_0) / I_{max}$ open: I ≤ 0.05 mA at U_{ext} = 32 VDC closed: $U_{0, max}$ = 0.2 V at I ≤ 10 mA $U_{0, max}$ = 2 V at I ≤ 100 mA	-
NAMUR	Passive to EN 60947-5-6 U_{ext} = 8.2 V ± 0.1 VDC R = 1 kΩ ± 10 Ω open: I_{nom} = 0.6 mA closed: I_{nom} = 3.8 mA	Passive to EN 60947-5-6 open: I_{nom} = 0.43 mA closed: I_{nom} = 4.5 mA
		U_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i = 0 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, stop counter, range conversion, zero calibration	
	Start of dosing when dosing function is activated.	
Operating data	**Modular I/Os**	**Fixed I/Os**
Active	U_{int} = 24 VDC External contact open: $U_{0, nom}$ = 22 V External contact closed: I_{nom} = 4 mA Contact open (off): $U_0 \geq 12$ V with I_{nom} = 1.9 mA Contact closed (on): $U_0 \leq 10$ V with I_{nom} = 1.9 mA	-
Passive	3 V ≤ U_{ext} ≤ 32 VDC I_{max} = 9.5 mA at $U_{ext} \leq 24$ V I_{max} = 9.5 mA at $U_{ext} \leq 32$ V Contact closed (on): $U_0 \geq 3$ V with I_{nom} = 1.9 mA Contact open (off): $U_0 \leq 2.5$ V with I_{nom} = 1.9 mA	$U_{ext} \leq 32$ VDC I ≤ 6 mA at U_{ext} = 24 V I ≤ 6.5 mA at U_{ext} = 32 V On: $U_0 \geq 5.5$ V with I ≥ 4 mA Off: $U_0 \leq 3.5$ V with I ≤ 0.5 mA
		U_i = 30 V I_i = 100 mA P_i = 1 W C_i = 10 nF L_i = 0 mH
NAMUR	Active to EN 60947-5-6 Terminals open: $U_{0, nom}$ = 8.7 V Contact closed (on): $U_{0, nom}$ = 6.3 V with I_{nom} > 1.9 mA Contact open (off): $U_{0, nom}$ = 6.3 V with I_{nom} < 1.9 mA Detection of cable break: $U_0 \geq 8.1$ V with I ≤ 0.1 mA Detection of cable short circuit: $U_0 \leq 1.2$ V with I ≥ 6.7 mA	-

Profibus DP	
Description	Galvanically isolated according to IEC 61158, test voltage 500 VAC RMS
	Profile version: 3.02
	Automatic data transmission rate recognition (max. 12 MBaud)
	Bus address adjustable via local display at the measuring device
Function blocks	8 x analogue input (AI), 3 x totaliser
Output data	Mass flow, volume flow, mass counter 1 + 2, volume counter, product temperature, several concentration measurements and diagnostic data
Profibus PA	
Description	Galvanically isolated according to IEC 61158, test voltage 600 VAC RMS for Ex i I/O, 500 VAC RMS for other I/O
	Profile version: 3.02
	Current consumption: 10.5 mA
	Permissible bus voltage: 9…32 V; in Ex application: 9...24 V
	Bus interface with integrated reverse polarity protection
	Typical error current FDE (Fault Disconnection Electronic): 4.3 mA
	Bus address adjustable via local display at the measuring device
Function blocks	8 x analogue input (AI), 3 x totaliser
Output data	Mass flow, volume flow, mass counter 1 + 2, volume counter, product temperature, several concentration measurements and diagnostic data
Foundation Fieldbus	
Description	Galvanically isolated according to IEC 61158, test voltage 600 VAC RMS for Ex i I/O, 500 VAC RMS for other I/O
	Current consumption: 10.5 mA
	Permissible bus voltage: 9…32 V; in Ex application: 9...24 V
	Bus interface with integrated reverse polarity protection
	Link Master function (LM) supported
	Tested with Interoperable Test Kit (ITK) version 6.01
Function blocks	6 x analogue input (AI), 2 x integrator, 1 x PID
Output data	Mass flow, volume flow, density, temperature of tube, several concentration measurements and diagnostic data
Modbus	
Description	Galvanically isolated, test voltage 500 VAC RMS
	Modbus RTU over RS-485
	Receiver input tolerance (baud rate deviation): 3%
	RS-485 receiver input resistance: 96 kΩ = 1/8 unit load
	RS-485 driver short-circuit output current: 200 mA
	Optionally switchable bus termination: 136 Ω, 0.5 W
	Optionally switchable bus polarisation: 2 x 562 Ω, 0.2 W
	Modbus device DTM is available which allows easy and comfortable communication with the signal converter.
Address range	1…255
Supported function codes	01, 02, 03, 04, 05, 06, 08, 15, 16, 23, 43
Baud rates	1200...115200

PROFINET IO	
Description	PROFINET IO is an Ethernet based communications protocol.
	The device features two Ethernet ports with an integrated industrial Ethernet switch.
	The Ethernet standard 100BASE-TX is supported.
	Additionally, the PHYs support the following features: - Auto negotiation - Auto crossover - Auto polarity
Output data	Mass flow, volume flow, flow speed, density, mass or volume counter 1 + 2, product temperature, several concentration measurements and diagnostic data
Bluetooth® interface	
Description	The interface offers wireless connectivity to the device via Bluetooth® Low Energy 5.0.
	The used frequency range of Bluetooth® Low Energy is 2400...2480 MHz. The maximum output power of the device is 10 mW.
	OPTICHECK Flow Mobile app is available for Google Android™ and Apple® iOS mobile devices.
	Supported mobile devices must have at least the following features: - Bluetooth® Low Energy 4.0 interface or higher For the minimal supported versions of Google Android™ or Apple® iOS refer to the latest version of the OPTICHECK Flow Mobile app available in "Google Play™ store" or "Apple App Store".
Functionality	Display status, measurement & diagnostic data
	Device parametrization and guided configuration wizards
	Advanced diagnostic methods
	Full device backup and restore

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 CE declaration or the manufacturer website.
Non-Ex	Standard
Functional safety according to EN 61508	Depends on I/O variant and flow sensor. For detailed information refer to the "Safety manual".
Hazardous areas	
Option (C version only)	
ATEX	II 1/2 (1) G - Ex d ia [ia Ga] IIC T6 Ga/Gb
	II 1/2 (1) G - Ex de ia [ia Ga] IIC T6...T1 Ga/Gb
	II 2 (1) G - Ex d ia [ia Ga] IIC T6...T1 Gb
	II 2 (1) G - Ex de ia [ia Ga] IIC T6...T1 Gb
	II 2 (1) D - Ex t [ia Da] IIIC Txxx Db
	II 1/2 G - Ex d ia IIC T6...T1 Ga/Gb; II 1/2 G - Ex de ia IIC T6...T1 Ga/Gb
	II 2 G - Ex d ia IIC T6...T1 Gb; II 2 G - Ex de ia IIC T6...T1 Gb
	II 2 D - Ex t IIIC Txxx°C Db

Option (F version only)	
ATEX	II 2 (1) G - Ex db [ia Ga] IIC T6 Gb
	II 2 (1) G - Ex db eb [ia Ga] IIC T6 Gb
	II 2 (1) D - Ex tb [ia Da] IIIC T75°C Db
	II 2 G - Ex db eb [ia] IIC T6 Gb
	II 2 D - Ex tb IIIC T75°C Db
NEPSI	Ex d ia [ia Ga] IIC T6...T1 Ga/Gb; Ex de ia [ia Ga] IIC T6...T1 Ga/Gb
Option	
FM / CSA	FM: Class I, Div 1 groups A, B, C, D CSA: Class I, Div 1 groups C, D
	Class II, Div 1 groups E, F, G
	Class III, Div 1 hazardous areas
	FM: Class I, Div 2 groups A, B, C, D CSA: Class I, Div 2 groups C, D
	Class II, Div 2 groups E, F, G
	Class III, Div 2 hazardous areas
IECEx	Ex zone 1 + 2
Custody transfer	
Standard	Without
Option (in preparation)	Liquids other than water MID MI005 / OIML R117
	Gases MID MI002 / OIML R137
	Compliance with API and AGA
Other standards and approvals	
Vibration resistance	IEC 60068-2-6 10 cycles 10-150-10 Hz with: 0.15 mm for 10-60 Hz and 20 m/s² for 60-150 Hz
NAMUR	NE 21, NE 43, NE 53, NE 107

8.3 Dimensions and weight

8.3.1 Housing

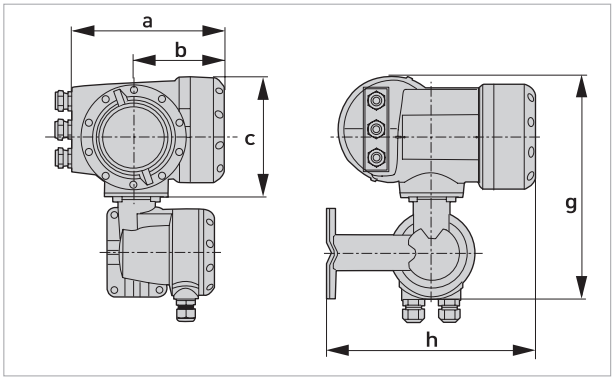

Figure 8-1: Dimensions for field housing (F) - remote version

Dimensions [mm / inch]					Weight [kg / lb]	
a	b	c	g	h	Aluminum housing	Stainless steel housing
202 / 7.95	120 / 4.72	155 / 6.10	296 / 11.65	277 / 10.90	6 / 13.2	13 / 28.7

Table 8-1: Dimensions and weight of field housing

INFORMATION!
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.

8.3.2 Mounting plate of field housing

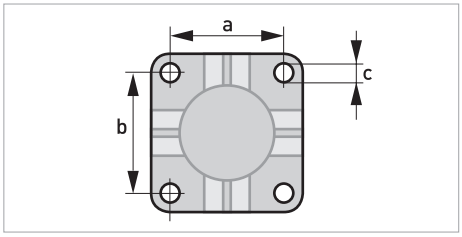

Figure 8-2: Dimensions for mounting plate of field housing

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

Table 8-2: Dimensions in mm and inch

9.1 General description

The open HART® protocol, which can be used freely, is integrated into the signal converter for communication.

Devices which support the HART® protocol are classified as either operating devices or field devices. When it comes to operating devices (Master), both manual control units (Secondary Master) and PC-supported workstations (Primary Master) are used in, for example, a control centre.

HART® field devices include flow sensors, signal converters and actuators. The field devices range from 2-wire to 4-wire to intrinsically safe versions for use in hazardous areas.

The HART® data are superimposed over the analogue 4...20 mA signal via FSK modem.
This way, all of the connected devices can communicate digitally with one another via the HART® protocol while simultaneously transmitting the analogue signals.

When it comes to the field devices and secondary masters, the FSK or HART ® modem is integrated, whereas with a PC communication takes place via an external modem which must be connected to the serial interface. There are, however, other connection variants which can be seen in the following connection diagrams.

9.2 Software history

INFORMATION!
In the table below, "_" is a placeholder for possible multi-digit alphanumeric combinations, depending on the available version.

Release date	Electronic revision (ER)	HART®	
		Device revision	DD revision
2020-10-23	ER2.1.1_	1	2

Table 9-1: Software history for HART® interface

Manufacturer ID:	69 (0x45)
Extended Device Type:	0x45BB
Device revision:	1
DD revision:	2
HART® Universal Revision:	7
FC 375/475 system SW.Rev.:	≥ 3.3
AMS version:	≥ 12.0
PDM version:	≥ 9.0
FDT version:	≥ 1.2

Table 9-2: HART® identification codes and revision numbers

9.3 Connection variants

The signal converter is a 4-wire device with 4...20 mA current output and HART® interface. Depending on the version, the settings and the wiring, the current output can operate as passive or active output.

- **Multi-drop mode is supported**
  In a multi-drop communication system, more than 2 devices are connected to a common transmission cable.
- **Burst mode is not supported**
  In the Burst mode a slave device transfers cyclic pre-defined response telegrams, to get a higher rate of data transfer.

INFORMATION!

For detailed information about the electrical connection of the signal converter for HART®, refer to the section "Electrical connection".

There are two ways of using the HART® communication:

- as Point-to-Point connection and
- as multi-drop connection, with 2-wire connection or
  as multi-drop connection, with 3-wire connection.

9.3.1 Point-to-Point connection - analogue / digital mode

Point-to-Point connection between the signal converter and the HART® Master.

The current output of the device may be active or passive.

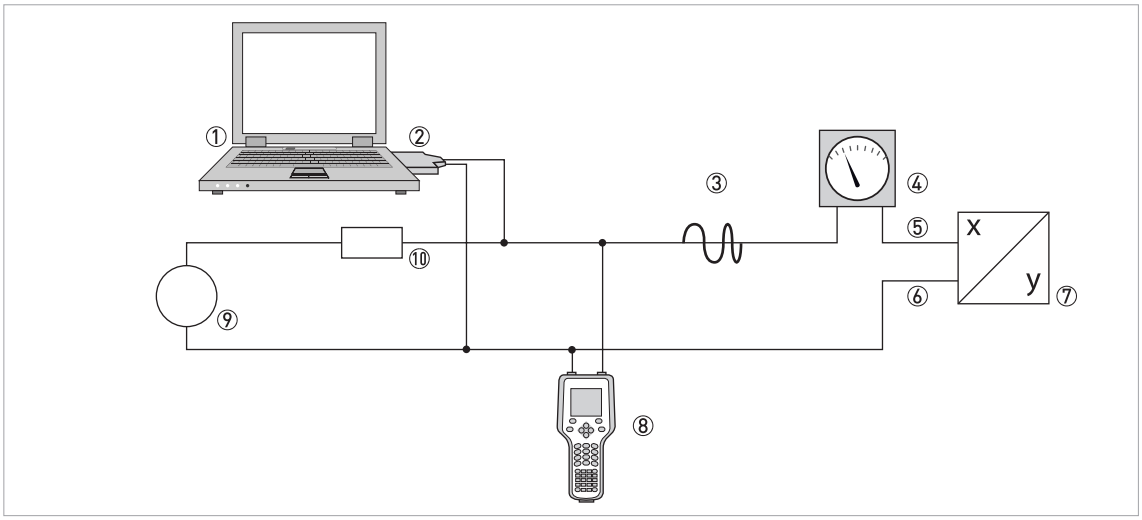

Figure 9-1: Point-to-Point connection

① Primary master
② FSK modem or HART® modem
③ HART® signal
④ Analogue indication
⑤ Signal converter terminals C
⑥ Signal converter terminals C-
⑦ Signal converter with address = 0 and passive or active current output
⑧ Secondary Master
⑨ Power supply for devices (slaves) with passive current output
⑩ Load ≥ 230 Ω

9.3.2 Multi-Drop connection (2-wire connection)

In the case of a multi-drop connection, up to 15 devices may be installed in parallel (this signal converter and other HART® devices).

The current outputs of the devices must be passive!

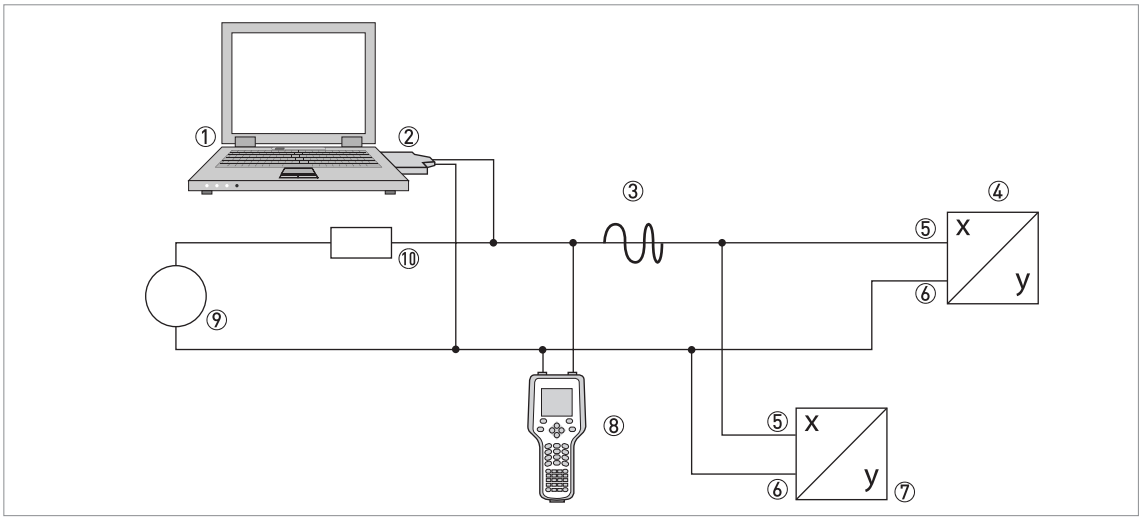

Figure 9-2: Multi-Drop connection (2-wire connection)

① Primary Master
② HART® modem
③ HART® signal
④ Other HART® devices or this signal converter (refer also to ⑦)
⑤ Signal converter terminals C
⑥ Signal converter terminals C-
⑦ Signal converter with address > 0 and passive current output, connection of max. 15 devices (slaves) with 4...20 mA
⑧ Secondary Master
⑨ Power supply
①⓪ Load ≥ 230 Ω

9.3.3 Multi-Drop connection (3-wire connection)

Connection of 2-wire and 4-wire devices in the same network. In order that the current output of the signal converter is working continuously active, an additional third wire must be connected to the devices in the same network. These devices must be powered via a 2-wire loop.

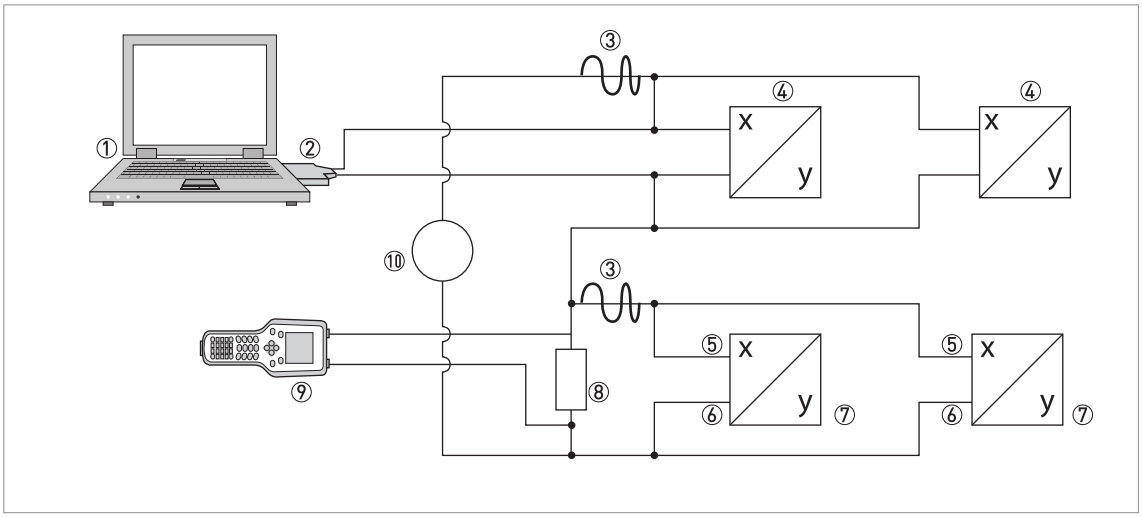

Figure 9-3: Multi-Drop connection (3-wire connection)

① Primary Master
② HART® modem
③ HART® signal
④ 2-wire external devices (slaves) with 4...20 mA, addresses > 0, powered by current loop
⑤ Signal converter terminals C
⑥ Signal converter terminals C-
⑦ Connection of active or passive 4-wire devices (slaves) with 4...20 mA, addresses > 0
⑧ Load ≥ 230 Ω
⑨ Secondary Master
①⓪ Power supply

9.4 Inputs/outputs and HART dynamic variables and device variables

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

The connection of the terminals A...D to the HART® dynamic variables PV, SV, TV and 4V depends on the device version.

PV = Primary Variable; SV = Secondary Variable; TV = Tertiary Variable; 4V = Fourth Variable

Signal converter version	HART® dynamic variable			
	PV	SV	TV	4V
Modular I/O and Ex i I/O, connection terminals	C	D	A	B

Table 9-3: Connection of the terminals to the HART® dynamic variables

The signal converter can provide up to 24 measurement-related values. The measured values are accessible as so-called HART® device variables and can be connected to the HART® dynamic variables. The availability of these variables depends on the device versions and the settings.

Code = device variable code

HART® device variable	Code	Type	Explanations
Flow Velocity	0	linear	
Volume Flow	1	linear	
Mass Flow	2	linear	
Temperature	3	linear	
Density	4	linear	
Sensor Average	5	linear	Diagnostic value, optional, available when one of the diagnostic channels (1 or 2) is set to "Sensor Average".
Sensor Deviation	6	linear	Diagnostic value, optional, available when one of the diagnostic channels (1 or 2) is set to "Sensor Deviation".
Drive Level	7	linear	Diagnostic value, optional, available when one of the diagnostic channels (1 or 2) is set to "Drive Level".
Tube Frequency	8	linear	Diagnostic value, optional, available when one of the diagnostic channels (1 or 2) is set to "Tube Frequency".
	9	linear	
	10	linear	
2 Phase Signal	11	linear	Diagnostic value, optional, available when one of the diagnostic channels (1 or 2) is set to "2 Phase Signal".
Concentration 1	12	linear	Available when concentration measurement is switched on.
Concentration 2	13	linear	Available when concentration measurement is switched on and Concentration 2 is not switched off.
Concentration Flow 1 Mass	14	linear	Available when concentration measurement is switched on and concentration mode 1 does not measure % volume or % alcohol per volume.

HART® device variable	Code	Type	Explanations
Concentration Flow 1 Volume	15	linear	Available when concentration measurement is switched on and Concentration mode 1 measures % volume or % alcohol per volume.
Concentration Flow 2 Mass	16	linear	Available when concentration measurement is switched on and Concentration 2 is not switched off and Concentration mode 1 does not measure % volume or % alcohol per volume.
Concentration Flow 2 Volume	17	linear	Available when concentration measurement is switched on and Concentration 2 is not switched off and Concentration mode 2 measures % volume or % alcohol per volume.
Totaliser 1 Mass	18	Totaliser	
Totaliser 1 Volume	19	Totaliser	
Totaliser 2 Mass	20	Totaliser	
Totaliser 2 Volume	21	Totaliser	
Totaliser 3 Mass	22	Totaliser	Depends on hardware configuration
Totaliser 3 Volume	23	Totaliser	Depends on hardware configuration

Table 9-4: Description of the HART® device variables

For the dynamic variables connected to the linear analogue outputs for current and/or frequency, the assignment of the device variables takes place by selecting the linear measurement for these outputs under the appropriate function of the signal converter. It follows that the dynamic variables connected to current or frequency outputs can only be assigned to the linear HART® device variables.

The HART® dynamic variable PV is always connected to the HART® current output.

A totaliser device variable can thus not be assigned to the dynamic variable PV because the PV is always connected to the HART® current output.

Such correlations do not exist for dynamic variables not connected to linear analogue outputs. Both linear and totaliser device variables can be assigned.

The totaliser device variables can only be assigned to the dynamic variables SV, TV and 4V if the connected output is not a current or frequency output.

The signal converter is optionally equipped with a Bluetooth® interface.
This interface provides wireless access to the signal converter for convenient parametrisation and service diagnosis via standard mobile devices, such as smartphones or tablet computers.

The interface is accessed by the KROHNE OPTICHECK Flow Mobile app, which is available for Google Android™ and Apple® iOS operation systems.

10.1 Introduction

10.1.1 Functionality

The OPTICHECK Flow Mobile app offers the following functionality:

- Display device status (NE107 status, error messages and counter measures)
- Display and visualise measurement values
- Device parametrisation
- Guided configuration wizards (e.g. for EGM™ (Entrained Gas Management), NE107 status mapping, zero calibration, density calibration and configuration of the current outputs)
- Advanced diagnostic methods (device snapshot)
- Full device backup and restore
- Available for Google Android™ and Apple® iOS

10.1.2 Quick start guide

- Prepare the field device for a Bluetooth® connection (for details refer to *Field device setup* on page 142).
- Install the OPTICHECK Flow Mobile app on your mobile device (for details refer to *Installation of the OPTICHECK Flow Mobile app* on page 146).
- Open the OPTICHECK Flow Mobile app.
  - A list of available devices is displayed.
  - Select the appropriate device and establish a connection by entering the device-specific Bluetooth® password (for details refer to *Password for the Bluetooth interface (C8.2.0 Password)* on page 144).
- Use the app to access the functionality of the device via a wireless connection.

10.2 Security considerations

Remote access to the signal converter via Bluetooth® requires additional security mechanisms. The existing perimeter security (i.e. limited physical access) is no longer sufficient, because wireless connections do not require physical access to the signal converter.

10.2.1 Wireless security concept

The converter is equipped with a multi-layered wireless security concept. It offers a high level of protection and can be adapted to the needs of the application. It consists of the following mechanisms:

- **Bluetooth® access level:**
  Disable the Bluetooth® interface or limit it to read-only mode (for details refer to *Bluetooth access level* on page 142).
- **Password-based authentication:**
  A password must be entered before a wireless connection is established (for details refer to *Password for the Bluetooth interface (C8.2.0 Password)* on page 144).
- **Security lockout:**
  Entering a wrong password will temporarily disable the Bluetooth® interface (for details refer to *Reset Bluetooth lockout (A2.7.0, C8.4.0)* on page 145).
- **Firewall:**
  Prevents denial-of-service attacks and ensures the SIL operation cannot be manipulated via the wireless interface (for details refer to *Bluetooth interface and SIL mode* on page 141).
- **Encryption:**
  Data exchanged via the wireless link is protected against interception and manipulation using strong encryption.
- **Update mechanism:**
  The firmware of the Bluetooth® interface can be updated wirelessly via the OPTICHECK Flow Mobile app. This permits security updates without interrupting the operation of the signal converter.

10.2.2 Bluetooth interface and SIL mode

The Bluetooth® interface has no impact on the SIL mode of the device. Bluetooth® can be enabled even if the device is in SIL mode. For detailed information refer to the "Safety manual".

Note the following restrictions:

- Activation or deactivation of the SIL mode is not possible via the Bluetooth® interface.
- SIL-relevant parameters cannot be changed once the device is in SIL mode.

10.3 Field device setup

The Bluetooth® interface is an optional feature and must be purchased before it can be used. Please contact your sales representative on information how to order and activate the Bluetooth® feature, if it is not yet available.

For security reasons, the Bluetooth® interface must be parametrised and enabled locally at the field device before a connection is possible. Once enabled successfully, the Bluetooth® interface state is indicated in the header line of the local display (for details refer to *Display and operating elements* on page 54).

The following steps are necessary for the initial setup of the Bluetooth® interface:

1. Set the maximum access level via the mechanical switch (for details refer to *Bluetooth access level setting via mechanical switch* on page 143).
2. Further limit the access level via a software setting (for details refer to *Bluetooth access level setting via software (C8.1.0 Access Level)* on page 144).
3. Look up or modify the password for the Bluetooth® interface (for details refer to *Password for the Bluetooth interface (C8.2.0 Password)* on page 144).

10.3.1 Bluetooth access level

The Bluetooth® access level is used to limit the remote access to the field device via the Bluetooth® interface. The following access levels can be selected:

Access level	Description
No access	The Bluetooth® interface is disabled. No connection is possible.
Read only	The Bluetooth® interface is enabled. Parameters of the field device can be read. Parameter changes are not possible.
Read + Write	The Bluetooth® interface is enabled. Reading and modification of field device parameters are possible.

Table 10-1: Access levels for the Bluetooth® interface

The access level is set by two mechanisms: A mechanical switch and a software setting.

The mechanical switch is located at the backside of the display and can be operated only when the housing of the signal converter is opened. The setting of the mechanical switch takes precedence over the software setting and provides high security for use cases, in which access via the Bluetooth® interface must be limited.

Mechanical switch (switch position)	Software setting	Resulting access level
No access (OFF)	No access	No access ①
Read only (R/-)	No access	No access
	Read only	Read only
Read + Write (R/W)	No access	No access
	Read only	Read only
	Read + Write	Read + Write

Table 10-2: Access level selection via mechanical switch and software settings

① If the mechanical switch is in the OFF position, the Bluetooth® interface is disabled by a hardware mechanism. No activation via software is possible.

It is recommended to set the mechanical switch to the most permissive level which is acceptable for the application. Further limitations can be performed via software settings without opening the field device housing.

Note that application specific locks (for details refer to *Locking of configuration* on page 100) have a higher priority than the access level of the Bluetooth® interface and will prevent any modification of locked parameters, even though the access level "Read + Write" is selected.

10.3.2 Bluetooth access level setting via mechanical switch

The mechanical switch is the primary method to define the access level. It is located at the back of the display. To change the position of the mechanical switch, the housing of the signal converter must be opened, and the display must be detached (for details refer to *Turning the display of the field housing version* on page 21).

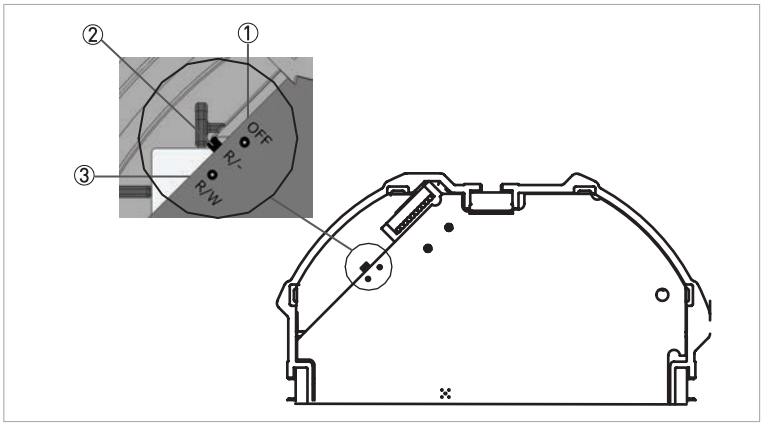

Figure 10-1: Position of mechanical switch

① "OFF" position: No access
② "R/-" position: Read only
③ "R/W" position: Read + Write

10.3.3 Bluetooth access level setting via software (C8.1.0 Access Level)

The access level can be further limited by a software setting in menu C8.1.0. The available options depend on the position of the mechanical switch. For details refer to previous section.

INFORMATION!
The software setting may change when the mechanical switch is operated. Therefore, the position of the mechanical switch must be selected before the access is further limited via the software setting.

10.3.4 Password for the Bluetooth interface (C8.2.0 Password)

The password for the Bluetooth® interface is used for authentication of the wireless connection and must be entered in the mobile device to establish a connection to the field device.
The password must be kept secret and must only be known by authorised personnel.

Each device is shipped with a unique and randomly generated password. The initial password can be looked up by navigating to the menu C8.2.0 (Password). If necessary, the initial password can be changed by entering a new password in menu C8.2.0.

The password must comply to the following rules:

- Alphanumeric characters (a…z, A…Z, 0…9) in addition to the letters '.', '/', '-', '_', '²' and '³'
- Minimum length: 4 characters
- Maximum length: 16 characters
- Trailing whitespaces are ignored (i.e. spaces after the last character are not part of the password)

Note that the write access authentication level "Operator" (for details refer to *Locking of configuration* on page 100) is required to view or modify the Bluetooth® password via the local display. Enabling the write access authentication therefore protects the password against unauthorised lookup or modification locally at the device.

For security reasons, it is strongly recommended:

- Select a unique password for each device.
- Set a sufficiently strong password according to your company security guidelines (e.g. at least 8 characters, combination of letter and numbers).
- Do not use passwords which can be guessed easily, or which can be found in a dictionary.
- Only grant knowledge of the password to authorised personnel.
- Change the password immediately if there is reason to suspect that unauthorised personnel have gained knowledge of the password.

10.3.5 LED Signalling (C8.3.0)

The connection status of the Bluetooth® interface can be signalled via the MS (S1) LED on the local display (for details refer to *Display and operating elements* on page 54). The functionality can be turned on and off by menu C8.3.0.

The LED signalling for the Bluetooth® interface may not be available for all signal converter configurations.

If the LED signalling is enabled, the Bluetooth® connection status is indicated via the MS (S1) LED:

MS (S1) LED	Blink pattern	Description
Off	-	Bluetooth® interface turned off
Blue	Constant on	Bluetooth® interface enabled, ready for connection
Blue	Fast blinking (1 Hz)	Bluetooth® interface connected, read & write mode
Blue	Slow blinking (0.5 Hz)	Bluetooth® interface connected, read-only mode

Table 10-3: Status indication

10.3.6 Reset Bluetooth lockout (A2.7.0, C8.4.0)

The Bluetooth® connectivity is temporarily disabled in case of a failed authentication. This can happen if a wrong password was entered and prevents brute-force attacks by iterating over all possible passwords.

The duration of the lockout increases with the number of consecutively failed authentications (range: 1 s…1 h). After 10 authentications have failed in a row, the Bluetooth® interface is disabled permanently and must be unlocked at the signal converter.

If the device is in a temporary or permanent lockout phase, the lockout can be removed immediately by one of the following actions:

- "Reset BT Lockout" via menu (A2.7.0, C8.4.0).
- "Reset all Errors" (A2.1.0, C6.2.0). Note that this may also reset other errors in the device.
- Power cycling the signal converter.

10.3.7 Check Bluetooth connection status (B1.7.1)

The status of the Bluetooth® interface is displayed in detail in menu B1.7.1:

Connection status	Description
Off	Bluetooth® interface turned off.
Advertising	Bluetooth® interface is enabled and ready for connection.
Connected	Bluetooth® interface connected.
Lockout	Bluetooth® is temporarily or permanently disabled due to failed authentications (for details refer to *Reset Bluetooth lockout (A2.7.0, C8.4.0)* on page 145).

Table 10-4: Status of the Bluetooth® interface

10.3.8 Login history (B1.7.2, B1.7.3)

The date and time of the last successful and the last failed authentication attempts are displayed via menu B1.7.2 (last successful authentication) and B1.7.3 (last failed authentication). If there was no authentication attempt, a "Value invalid" message is displayed.

The information can be useful to check if there have been unexpected login attempts via Bluetooth®. Note that the login history is reset when a power cycle of the device is performed.

10.4 Installation of the OPTICHECK Flow Mobile app

The OPTICHECK Flow Mobile app is available for supported devices via "Google Play™ store" and "Apple App Store".

Perform the following steps for installation:

- Ensure your mobile device is connected to the internet.
- Open the app store (e.g. "Google Play™ store" on Android™ devices or "App Store" on Apple® devices)
- Type "KROHNE OPTICHECK Flow Mobile" in the search field.
- Follow the instructions to install and start the app.

For advanced users and special use-cases a package (.apk) for manual installation on Android™ can be obtained via the download area on the manufacturer homepage. However, the automatic installation via the app store is strongly recommended.

10.5 FCC and ISED statements

FCC statements

RF Exposure
The equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. The equipment should be operated with minimum distance of 20 cm between the device and user's body. End users must follow the operation instructions for satisfying RF exposure compliance.

§15.19(3)
This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

§15.21
Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

§15.105(a)
NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Contact for FCC queries:
fcc-approval@krohne.com

ISED statements, CAN ICES-3 (A)/NMB-3(A)

This device complies with Industry Canada licence-exempt RSS standard(s).
Operation is subject to the following two conditions:
(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
(1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

RF Exposure

The equipment complies with ISED RSS-102 radiation exposure limits set forth for an uncontrolled environment.
The equipment should be operated with minimum distance of 20 cm between the device and user's body. End users must follow the operation instructions for satisfying RF exposure compliance.

Contact for ISED queries:

ised-approval@krohne.com

KROHNE – Products, Solutions and Services

- Process instrumentation for flow, level, temperature, pressure measurement and process analytics
- Flow metering, monitoring, wireless and remote metering solutions
- Engineering, commissioning, calibration, maintenance and training services

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