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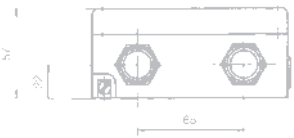
KROHNE

Handbook

IFC 110 F V2.0
IFC 110 F-EEx V2.0

Signal converters for electromagnetic flowmeters



Applicable to Software Versions

- Display & control unit No. **3.19937.02.00**
- A/D converter No. **8.13393.02.00**
- Outputs/inputs (I/O) No. **3.16230.01.00**

How to use these Instructions

Flowmeters are delivered ready for operation.

The flow sensor must be installed in the pipeline as described in the instructions for installation inside the packing of the flow sensor.

Power the flowmeter. THAT'S ALL. The system is operative.

Operator control of the IFC 110 F signal converter is described in Sect. 4 and 5.

Contents

Signal converter versions

The operating data are factory-set to your ordered specifications.

IFC 110 F / D (Standard)	**Standard version,** with local display and control elements
IFC 110 F / D / MP (Option)	**Same as display version,** additional with magnetic sensors (MP)
IFC 110 F / D / MP / EEx (Option)	**Same as display version (D + MP),** for operation with flow sensors installed in hazardous areas
IFC 110 F / RS 485	**Same as standard version,** but additionally with different interfaces

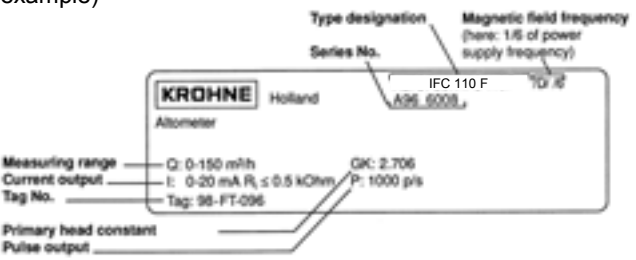
Items included with supply

- **Signal converter** in the version as ordered, see above.
- **Signal cable** in the version and length as ordered (standard: signal cable A, length 10 m / 30 ft)
- **Condensed installation and operating manual** in the ordered language for installation, electrical connection, start-up and operator control of the signal converter.
- **Service Manual** in english language.

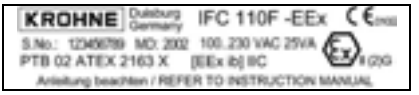
Please note!
In the **Installation and Operating Manual** there are hints with Sect. Numbers which you can find in the **Handbook / Service Manual** only!

Instrument nameplates

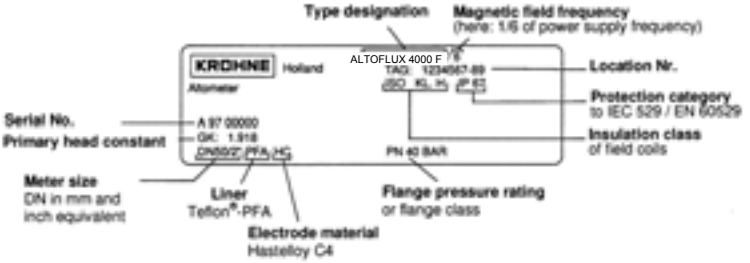
Signal converter (example)



Signal converter IFC 110F-EEx (example)



Flow sensor (example)



System description

Electromagnetic flowmeters are precision instruments designed for linear flow measurement of liquid products

The process liquids must be electrically conductive:, ≥ 5 µS/cm
(for cold demineralized water ≥ 20 µS/cm).

The full-scale range $Q_{100\%}$ can be set as a function of the meter size: flow velocity of 0.3 - 12 m/s or 1 - 40 ft/s (s. Section 10.4.).

Product liability and warranty

The electromagnetic flowmeters are designed solely for measuring the volumetric flowrate of electrically conductive, liquid process products.

These flowmeters are available for use in hazardous areas.
Special regulations apply in this case, which are given in the special EEx directions.

Responsibility as to suitability and intended use of these electromagnetic flowmeters rests solelywith the operator.

Improper installation and operation of the flowmeters (systems) may lead to loss of warranty.

In addition, the “General conditions of sale” forming the basis of the purchase contract are applicable.

If flowmeters need to be returned to KROHNE, please note the information given on the last-but-one page of these Instructions. KROHNE regrets that it cannot repair or check your flowmeter(s) unless accompanied by the completed form sheet.

CE / EMC / Standards / Approvals

The here described Electromagnetic flowmeters meet the NAMUR Directive NE21, the protection requirements of **Directive 89/336/EEC** in conjunction with **EN 61326-1** (1997) and **A1** (1998), as well as **Directives 73/23/EEC** and **93/68/EEC** in conjunction with **EN 61010-1**, and bear the **CE marking**.

CE

Software history

Display & control unit		Amplifier (ADC)		Inputs and outputs (I/O)	
Software	Status	Software	Status	Software	Status
3.19937.02.00	current	**8.13393.02.00**	current	**3.16230.01.00**	current

IMPORTANT!

In respect of EEx versions, pay regard to all directions marked with the Ex symbol, and also the information given in Sect. 6.1 and 13.
Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!

1 Electrical connection: power supply

1.1 Location and important installation notes ……. PLEASE NOTE !

- **Electrical connection in accordance with VDE 0100** ”Regulations for the erection of power installations with nominal voltages up to 1000 V” or **equivalent national regulations.**
- Do not cross or loop **cables inside the terminal compartment.**
- Use **separate wiring** (PG screwed cable entries) for power supply, field current lines, signal lines, outputs and inputs.
- **Hazardous areas** are subject to special regulations, see Section 6.1 and special installation instructions for hazardous-duty versions.
- Do not expose signal converter and switchgear cabinets with built-in converters to direct **sunlight.** Install a sunshade if necessary.
- **Signal converters installed in switchgear cabinets** require adequate cooling (e.g. by fans or heat exchangers).
- Do not expose signal converters to intense **vibration.**
- Keep the **distance between the flow sensor and signal converter** as small as possible, for empty pipe detection (EPD) ≤ 20 m / ≤ 66 ft. Observe maximum lengths of signal and field current lines (see Section 1.3.4).
- Use **KROHNE signal line A** (type DS, standard) **or signal line B** (type BTS, bootstrap, optional), standard length 10 m (33 ft).
- Generally use bootstrap signal lines B (type BTS) for **PROFIFLUX 5000 F and VARIFLUX 6000 F flow sensors** sized at DN 2.5-15 and 1/10’’-1/2’’ and for contaminated liquids which tend to form electrically insulating deposits.
- Always **calibrate** flow sensor and signal converter **together**. During installation particular care should therefore be given to **identical settings of flow sensor constant GK** (see instrument nameplate of flow sensor). In case GK constants are not identical, the signal converter must be adjusted to the flow sensor GK (see Sections 4 and 8.5).
- **Dimensions of signal converter** see Section 10.3.

IMPORTANT!

For EEx versions, also pay regard to all directions included in Sect. 6.1 and 13. **Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!**

1.2 Power supply - connection

PLEASE NOTE !

- Type of enclosure IP 65 to IEC 529 / EN 60529 equivalent to NEMA 4/4X.

- Dimensioning: the flowmeter housing protecting the electronic equipment against dust and moisture must always be kept closed. The selected clearances and creeping distances comply with VDE 0110 and/or IEC 664 regulations for contamination grade 2. Supply circuits and output circuits are designed to meet standards of overvoltage classes III and II, respectively.

- Fuse protection, disconnecting device: fuse protection for the feeding power circuit, and also a disconnecting device (switch, circuit breaker) for isolating the signal converters must be provided (see also Sect. 1.3.5 and 1.3.6).

100-230 V AC (tolerance range 85-255 V AC)

- **Observe information on the instrument nameplate,** power supply voltage and frequency.

- The **protective conductor PE** of the power supply **must be connected** to the separate U-clamp terminal inside the terminal compartment of the signal converter.

- **CAUTION:** do not remove the internal connection (line) inside the terminal compartment of the signal converter **(yellow/green wire)** between the U-clamp terminal and terminal 10 - **protective conductor (protection class I instrument).**

- Connec**tion diagrams I - IV** for the power supply and for the electrical connection between flow sensor and signal converter, see Sections 1.3.5 (Standard) and 1.3.6 (EEx).

24 V AC / DC (tolerance ranges: **AC** 20.4 - 26.4 V / **DC** 18 - 31.2 V)

- **Observe information on the instrument nameplate,** power supply voltage and frequency.

- For technical reasons concerning the measuring process, a **functional grounding conductor FE** has to be connected to the separate U-clamp terminal inside the terminal compartment of the signal converter.

- A facility providing a **reliable electrical separation (PELV)** has to be provided for connections to functional extra-low voltages (24 V AC / DC) - (VDE 0100 / VDE 0106 and/or IEC 364 / IEC 536 or equivalent national regulations).

- **Connection diagrams I - IV** for the power supply and for the electrical connection between flow sensor and signal converter, see Sections 1.3.5 (Standard) and 1.3.6 (EEx).

IMPORTANT!
For EEx versions, also pay regard to all directions included in Sect. 6.1 and 13.
Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!

Warning: Instrument must be properly grounded to avoid personnel shock hazard.

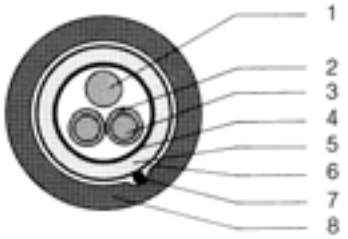
1.3 Electrical connection of flow sensors

1.3.1 General remarks on signal lines A and B and field current line C

Proper operation of the equipment is ensured when KROHNE signal lines A and B are used with foil screen and magnetic shield.

- Signal lines must be firmly installed.
- Shields are connected via stranded drain wires.
- Underwater or underground routing is possible.
- Insulating material flame-retardant to IEC 332.1 / VDE 0742.
- Low-halogen, unplasticized signal lines which remain flexible at low temperatures.

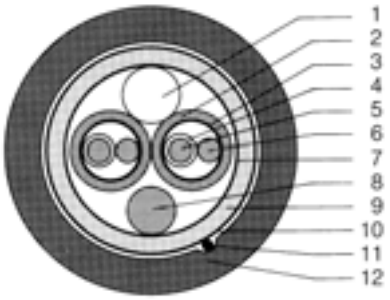
Signal line A (type DS) with double shielding



1 Stranded drain wire, 1st shield, 1.5 mm² or AWG 14
2 Insulation
3 Stranded wire 0.5 mm² or AWG 20 (3.1 red/3.2 white)
4 Special foil, 1st shield
5 Insulation
6 Mu-metal foil, 2nd shield
7 Stranded drain wire, 2nd shield, 0.5 mm² or AWG 20
8 Outer sheath

Signal line B (type BTS) with triple shielding (bootstrap line)
The bootstrap technology always controls the individual shields (3) of the signal converter exactly to the voltage which is supplied to the signal conductors (5). As this prevents voltage differences between the individual shields (3) and signal conductors (5), no current flows via the line capacitances between 3 and 5. The line capacitance seems to become ”zero”.

This allows greater cable lengths in case the electric conductivity of the liquid to be measured is low.



1 Dummy glider wire
2 Insulation (2.1 red/2.2 white)
3 Special foil, 1st shield (3.1/3.2)
4 Insulation (4.1/4.2)
5 Stranded wire 0.5 mm² or AWG 20 (5.1 red/5.2 white)
6 Stranded drain wire, 1st shield, 0.5 mm² or AWG 20 (6.1/6.2)
7 Special foil, 2nd shield
8 Stranded drain wire, 2nd shield, 1.5 mm² or AWG 14
9 Insulation
10 Mu-metal foil, 3rd shield
11 Stranded drain wire, 3rd shield, 0.5 mm² or AWG 20
12 Outer sheath

Field current line C1
Line 2 x 0.75 mm² (18 AWG) Cu or 2 x (4 x) 1.5 mm² (14 AWG) Cu (Cu = copper cross section)
The cross section depends on the required cable length.
For max. permissible cable lengths please refer to Section 1.3.4

IMPORTANT!
For EEx versions, also pay regard to all directions included in Sect. 6.1 and 13.
Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!

1.3.2 Stripping (preparation) of signal cables

Please note: The numbers in the drawings designate the stranded drain wires of signalling cables A and B, see sectional drawings in Sect. 1.3.1.

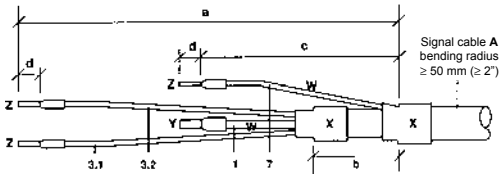
Flow sensor

Length	flow sensor	
	mm	inch
a	90	3.60
b	8	0.30
c	25	1.00
d	8	0.30
e	70	2.80

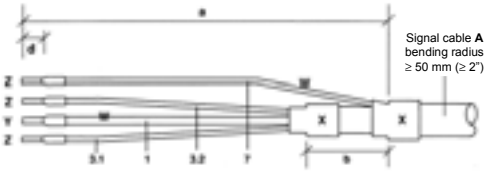
Converter

Length	Converter	
	mm	inch
a	50	2.00
b	8	0.40
d	8	0.40
e	20	0.80

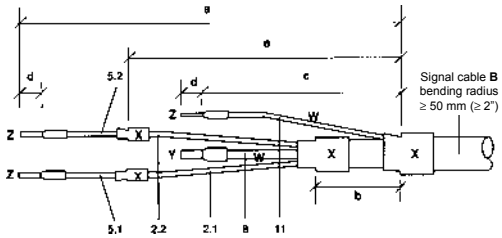
Signal cable A (type DS),
double shielding
for flow sensor



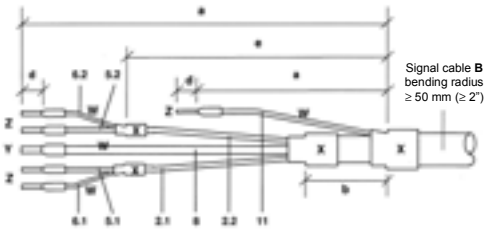
Signal cable A (type DS),
double shielding
for IFC 110 F Converter



Signal cable B (type BTS),
with triple shielding (bootstrap)
for flow sensor



Signal cable B (type BTS),
with triple shielding (bootstrap)
for IFC 110 F Converter



Customer-supplied materials	
W	Insulation tubing (PVC), Ø 2.0-2.5 mm (Ø 1")
X	Heat-shrinkable tubing or cable sleeve
Y	Wire end sleeve to DIN 41 228: E 1.5-8
Z	Wire end sleeve to DIN 41 228: E 0.5-8

1.3.3 Grounding of flow sensor

- The flow sensor must be correctly connected to ground.
- The grounding cable may not transfer interference voltages.
- Do not use the grounding cable to connect more than one device to ground.
- In hazardous areas the grounding line is also used for potential equalizing purposes. Special grounding instructions are contained in the installation instructions for hazardous-duty instruments (only supplied together with such instruments).
- The flow sensor is connected to ground by means of a **functional grounding conductor FE.**
- Special grounding instructions for the connection of several flow sensors are contained in the separate **installation instructions of the flow sensors.**
- These instructions also contain detailed descriptions on how to use grounding rings and how to install flow sensors in metal or plastic pipes or in pipes which are coated on the inside.

Warning: Instrument must be properly grounded to avoid personnel shock hazard.

IMPORTANT!

For EEx versions, also pay regard to all directions included in Sect. 6.1 and 13.
Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!

1.3.4 Cable lengths (max. distance between signal converter and flow sensor)

Abbreviations and explanations

The abbreviations used in the following tables, diagrams and connection diagrams stand for:

A Signal line A (type DS) with double shielding, max. length see diagram
B Signal line B (type BTS) with triple shielding, max. length see diagram
C Field current line, minimum cross section (A_F) and max. length see table
D High-temperature silicone line, 3x1.5 mm² (14 AWG) Cu, with single shield, max. length 5 m (16 ft)
E High-temperature silicone line, 2 x 1.5 mm² (14 AWG) Cu, max. length 5 m (16 ft)
A_F Cross section of field current line C in Cu, see table
L Cable length in **m** or **ft**
K Electrical conductivity of the process liquid
ZD Intermediate connection box required in connection with lines D and E for flow sensors ALTOFLUX 4000 F, PROFIFLUX 5000 F and VARIFLUX 6000 F for process temperatures exceeding 150°C (302°F).

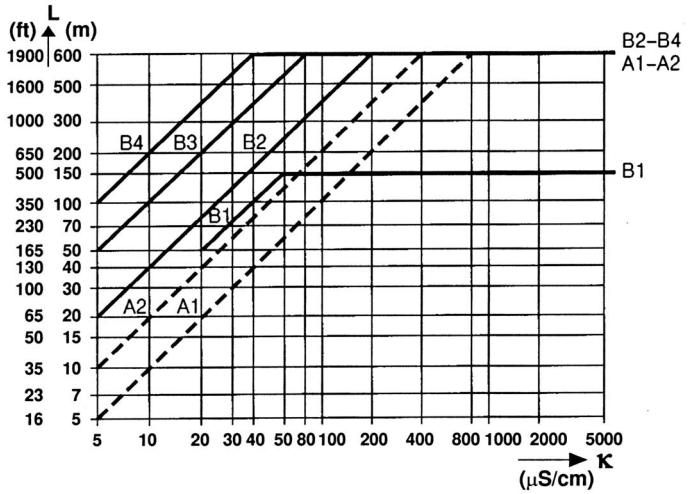
Recommended length of signal line

for magnetic field frequencies ≤ 1/6 x power frequency

Flow sensor	Meter size DN mm	Meter size Inch	Signal line
VARIFLUX 6000 F	2.5 - 15	1/10 - 1/2	B1
	25 - 80	1 - 3	A1 / B3
PROFIFLUX 5000 F	2.5 -	1/10 -	B1
	4 - 15	1/6 - 1/2	B2
	25 - 100	1 - 4	A1 / B3
ALTOFLUX 4000 F	10 - 150	3/8 - 6	A1 / B3
	200 - 1200	8 - 48	A2 / B4
ALTOFLUX 2000 F	150 - 250	6 - 10	A2 / B4
ECOFLUX 1000 F	10 - 150	3/8 - 6	A1 / B3
M900	10 - 300	3/8 - 12	A2 / B4

Please note!

For application with empty pipe detection (EPD) max. length < 20 m / 66 ft.



Max. length and minimum cross section of field current line

Length L		Cross section AF (Cu), minimum	
0 to 150 m	5 to 500 ft	2 x 0.75 mm² Cu	2 x 18 AWG
150 to 300 m	500 to 1000 ft	2 x 1.50 mm² Cu	2 x 14 AWG
300 to 600 m	1000 to 1900 ft	4 x 1.50 mm² Cu	4 x 14 AWG

1.3.5 Connection diagrams for power supply and flow sensors

Important remarks for circuit diagrams PLEASE NOTE !

- The figures in brackets indicate the stranded drain wires of the shields (see cross-sectional drawings of signal lines in Section 1.3.1).
- **Electrical connection to VDE 0100** "Regulations for the erection of power installations with nominal voltages up to 1000 V"
- **Power supply 24 V AC / DC:** protective extra-low voltages (PELV) acc. to VDE 0100/ VDE 0106 and/or IEC 364/IEC 365, or corresponding national regulations.
- **Systems to be used in hazardous areas** are subject to special regulations applying to electrical connections (see Section 1.3.6) for hazardous-duty instruments.
- **PE** = protective conductor **FE** = functional ground conductor

IMPORTANT!

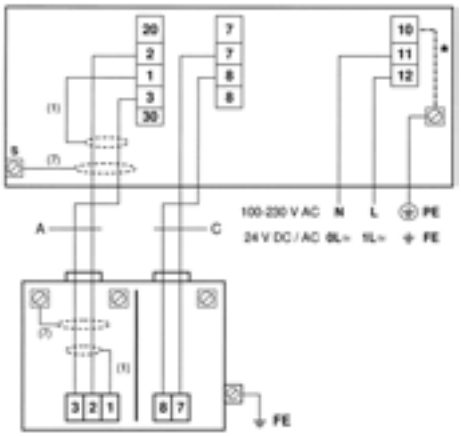
Electrical connection of EEx flow sensors and EEx signal converters to be carried out as described in Sect. 1.3.6.

*	Do not remove the internal connection (cable) inside the terminal compartment of the signal converter **(yellow/green wire)** between the U-clamp terminal and terminal 10 **(protective conductor for protection class I instruments).**

Process temperature below 150°C (302°F)

I Signal cable A (type DS)

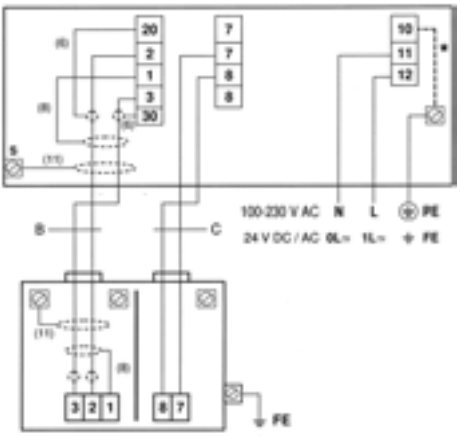
IFC 110 F V 2.0



Flow sensor

II Signal cable B (type BTS)

IFC 110 F V 2.0

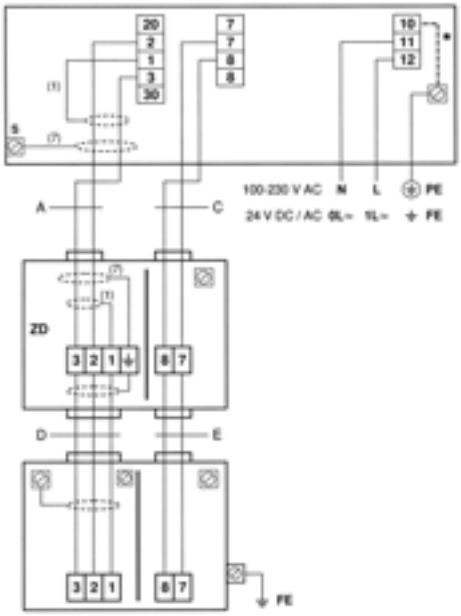


Flow sensor

Process temperature above 150°C (302°F)

III Signal cable A (type DS)

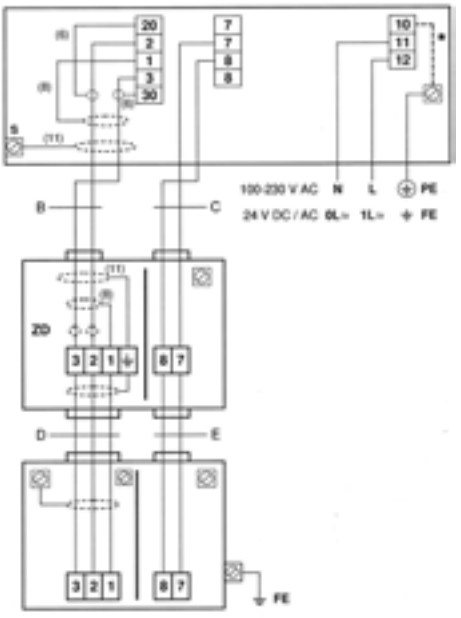
IFC 110 F V 2.0



Flow sensor

IV Signal cable B (type BTS)

IFC 110 F V 2.0



Flow sensor

1.3.6 EEx-Connection diagrams for power supply and flow sensors

PLEASE NOTE!

- The figures in brackets indicate the stranded drain wires for the shields (see cross-sectional drawing of signal cable in Section 1.3.1).
- The connections for the **intrinsically safe electrode circuit including the shield terminals** are safety-separated up to a peak value of 375 V from the terminals for thepower supply, for the inputs/outputs and for the field circuit. They are galvanically isolated from the housing (PE/PA).
- For connection of the **intrinsically safe electrode circuit including shield terminals** to the primary head, please refer to Item 12 in EN 60079-14.
  The non-intrinsically safe field circuit to be connected to the primary head in keeping with the requirements of Item 9 in EN 60079-14 .
- The **non-intrinsically safe input and output circuits** may only be routed into the hazardous area in compliance with appropriate measures as specified in EN 60079-14.
- **Supply power (terminals 11,12)**
  In conformity with current regulations for electrical installations, an isolating facility is required to be provided for the signal converter. The housing of the IFC 110 F – EEx signal converter must be incorporated in the equipotential bonding system (via external PA connection).

Note!	A PE safety conductor is not connected if a functional extra-low voltage with safety separation (PELV) is used. Grounding is then carried out by way of the equipotential bonding conductor.

- **Electrode circuit (terminals 1, 20, 2, 3, 30 and shield terminal S)**
  In conformity with the requirements for separation of intrinsically safe circuits, Category ib to EN 50 020, the cable for the intrinsically safe electrode circuit must, up to the terminals, be separated from all non-intrinsically safe circuits.
  Terminals 20 and 30 are optionally provided for connecting cables with single shielding. The terminal for the outer shield (S) is capacitance grounded in the signal converter. The outer overall shield to be connected by the shortest possible wire to the shield terminal. Shields to be carefully insulated from ground and from each other.
- **Field circuit FSV (terminals 7, 8)**
  The field circuit is all-pole protected on the FSV circuit board with an **internal fusible link 160mA / 250V.**
- **Input/output circuits**
  The connection is made to functional extra-low voltage circuits with safety separation (PELV). The I/O functions and technical data are described in the Standard Installation and Operating Instructions.

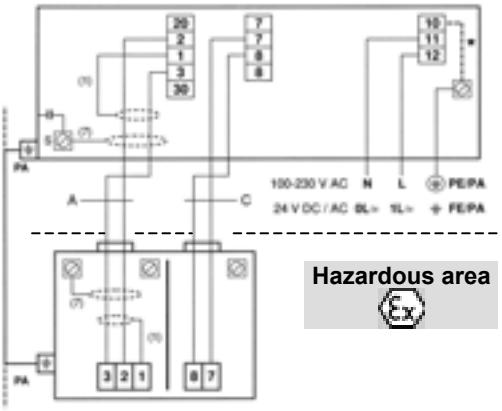
IMPORTANT!
For EEx versions, also pay regard to all directions included in Sect. 6.1 and 13.
Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!

*	Do not remove the internal connection (cable) inside the terminal compartment of the signal converter **(yellow/green wire)** between the U-clamp terminal and terminal 10 **(protective conductor for protection class I instruments).**

Process temperature below 150°C (302°F)

I Signal cable A (type DS)

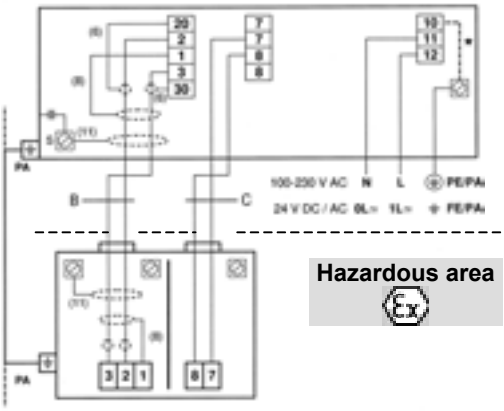
IFC 110 F V 2.0



Flow sensor

II Signal cable B (type BTS)

IFC 110 F V 2.0

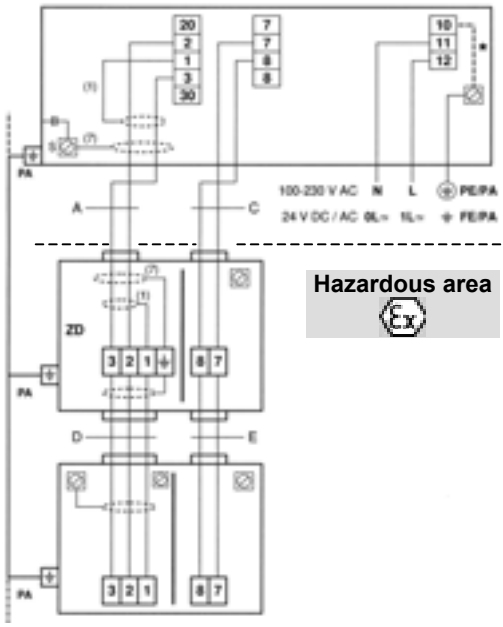


Flow sensor

Process temperature above 150°C (302°F)

III Signal cable A (type DS)

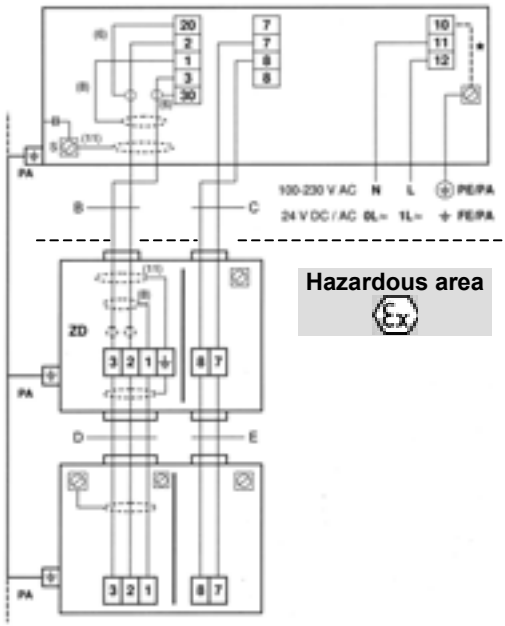
IFC 110 F V 2.0



Flow sensor

IV Signal cable B (type BTS)

IFC 110 F V 2.0



Flow sensor

2 Electrical connection: outputs and inputs

IMPORTANT!

For EEx versions, also pay regard to all directions included in Sect. 6.1 and 13.
Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!

2.1 Important information for outputs and inputs ……. PLEASE NOTE !

- The signal converter has the following **outputs and inputs:**

Output and input group	Symbol	Terminals	Remarks
Power output	I	I_S / I	active / passive selectable
Current output	P	P / P	for electronic totalizers
Pulse output	A1* (P2)	A1* / A⊥	for electromechanical totalizers
Status outputs	A1* and A2	A1* / A⊥ / A2	A⊥ common centre grounding contact
Status outputs	D1 and D2	D1 / D⊥ / D2	D⊥ common centre grounding contact
Control inputs	C1 and C2	C1 / C⊥ / C2	C⊥ common centre grounding contact
Internal power supply	E	E+ / E-	for active mode of outputs and inputs

***** Output A1 can be used as a 2nd pulse output P2 for electromechanical totalizers or as a 4th status output, see Section 4.4, Fct. 3.07 HARDWARE.

- The output and input groups are electrically isolated from each other and from all other input and output circuits.

- **Please note:** **A⊥** common centre grounding contact for outputs **A1** and **A2**
  D⊥ common centre grounding contact for outputs **D1** and **D2**
  C⊥ common centre grounding contact for control inputs **C1** and **C2**

- **Active mode:** the signal converter supplies the power for the operation (selection) of receiver instruments, observe max. operating data (terminals **E+** and **E-**).

- **Passive mode:** the operation (selection) of receiver instruments requires an external power supply **(U_{ext})**, observe max. operating data.

- **Connection diagrams** of outputs and inputs are shown in **Section 2.6.**

- For **operating data** of outputs and inputs please refer to **Sections 2.6 and 10.1.**

2.2 Current output I

- The **current output is electrically isolated** from all other circuits.
- **Setting data and functions can note down in the Table in Sect. 3.**
  Please also refer to Section 2.7 ”Standard factory settings”.
- **All operating data and functions are adjustable** (see Sections 4.4 and 5.6, Fct. 1.05).
- **Max. load :** active operation 15-500 Ω
  passive operation ≤ 800 Ω
- **Selfcheck :** - interrupting the mA loop, and
  - short-circuit of mA loop via test function, see Fct. 2.03
    or when power supply is switched on in Fct. 3.07

  Error message on display (see Fct. 1.04, Section 5.4) and/or
  status output (see Fct. 1.07-1.10, Section 5.8).
- **Current value for error identification** is adjustable, see Fct. 1.05 and Section 5.6.
- **Range change-over**, automatically or externally by control input,
  see Sections 4.4 and 5.19, Fct. 1.07-1.10 and 1.11-12.

  Setting range from 5-80% of $Q_{100\%}$
  (corresponding low to high range ratio from 1:20 to 1:1.25).

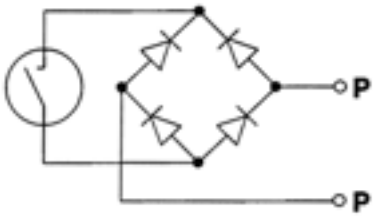
  Change-over from high to low range at approx. 85% of low range and vice versa at approx. 98% of low range.

  The active range is signalled via one of the four status outputs.
- **Forward/reverse flow measurement** (F/R mode) is possible (see Section 5.15).
- **Connection diagrams see Section 2.6.**

2.3 Pulse outputs P and A1

2.3.1 Pulse output P for electronic totalizers (EC)

- **Pulse output P is electrically isolated** from all other circuits.
- **Setting data and functions can note down in the Table in Sect. 3.**
  Please also refer to Section 2.7 "Standard factory settings".
- **All operating data and functions are adjustable,** see Sections 4.4 and 5.7, Fct. 1.05.
- **Active mode:** uses the internal power supply, terminals E+/E-
  Passive mode: requires external power supply, $U_{ext} \leq 32V$ DC/24V AC, $I \leq 30mA$
- **Max. adjustable frequency 10 kHz**
- **Scaling** in pulses per unit time (e.g. 1000 pulses/s at $Q_{100\%}$ flow) or
  in pulses per unit volume (e.g. 100 pulses/m³ or US Gal).
- **Pulse width** symmetric, pulse duty factor 1:1, independent of output frequency,
  automatic, with optimum pulse width,
  pulse duty factor approx. 1:1 at $Q_{100\%}$, or
  pulse width range from 0.01 to 1 s adjustable as required for correspondingly lower output frequency.
- **Forward/reverse flow measurement** (F/R mode) is possible, see Section 5.15.
- **Connection diagrams see Section 2.6**
- **Schematic wiring diagram for pulse output P** for electronic totalizers **EC**
  Similar to a relay contact, this pulse output switches direct and alternating voltages.



2.3.2 Pulse output A1 for electromechanical totalizers (EMC)

PLEASE NOTE:

The output terminal A1 can be used as status output A1 or as a 2nd pulse output A1 for electromechanical totalizers.
Setting is as described in Fct. 3.07 HARDWARE, see Sections 4.4 and 5.18.

- Pulse output A1 is electrically connected to status output A2 (common centre grounding contact A⊥) but electrically isolated from all other circuits.

- **Setting data and functions can note down in the Table in Sect. 3.**
  Please also refer to Section 2.7 ”Standard factory settings”.

- **All operating data and functions are adjustable**, see Sections 4.4 and 5.7, Fct. 1.07.

- **Active mode:** uses the internal power supply, terminals E+/E-
- **Passive mode:** requires external power supply, $U_{ext} \leq 32V$ DC/24V AC, $I \leq 100mA$ ($I \leq 200mA$ for polarized DC operation, see Section 6.3)

- **Max. adjustable frequency 50 kHz**

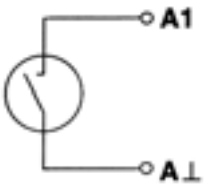
- **Scaling** in pulses per unit of time (e.g. 10 pulses/s at $Q_{100\%}$ flow) or in pulses per unit of volume (e.g. 10 pulses/m³ or US Gal).

- **Pulse width** symmetric, pulse duty factor 1:1, independent of output frequency, automatic, with optimum pulse width, pulse duty factor approx. 1:1 at $Q_{100\%}$, or pulse width range from 0.01 to 1 s adjustable as required for correspondingly lower output frequency.

- **Forward/reverse flow measurement** (F/R mode) is possible, see Section 5.15.

- **Connection diagrams see Section 2.6**

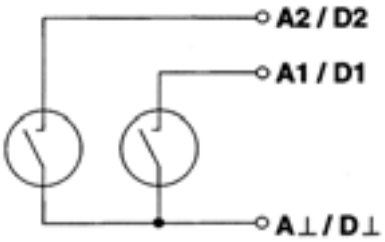
- **Schematic wiring diagram for pulse output A1** for electromechanical totalizers **EMC**. This pulse output has a MOSFET switch as output which switches direct and alternating voltages similar to a relay contact.



2.4 Status outputs A1 / A2 / D1 / D2

PLEASE NOTE:
The **output terminal A1 can be used as status output A1 or as a 2nd pulse output A1** for electromechanical totalizers.
Setting is as described in Fct. 3.07 HARDWARE, see Sections 4.4 and 5.18.

- **Status outputs A1/A2 and D1/D2** with the common centre grounding contacts A⊥ and B⊥ are **electrically isolated from each other and from all other circuits.**
- **Setting data and functions can note down in the Table in Sect. 3.**
  Please also refer to Section 2.7 ”Standard factory settings”.
- **All operating data and functions are adjustable,** see Sections 4.4 and 5.8, Fct. 1.07-1.10.
- **Active mode:** uses the internal power supply, terminals E+/E-
  Passive mode: requires external power supply, $U_{ext} \leq 32V$ DC/24V AC, $I \leq 100mA$
  ($I \leq 200mA$ for A1 in case of polarized DC operation, see Section 6.3)
- The **following operating conditions can be** signalled using the status outputs:
  - flow direction (F/R mode)
  - limits
  - error messages
  - active range in case of range change-over
  - inverse operation of A1 and A2 or D1 and D2,
    i.e. used as change-over switch with common centre grounding contact A⊥ or D⊥.
- **Connection diagrams see Section 2.6**
- **Schematic wiring diagram for status outputs** A1/A2 and D1/D2.
  This status outputs have MOSFET switches as outputs which switch direct and alternating voltages similar to relay contacts.



2.5 Control inputs C1 and C2

- **Control inputs C1 and C2 are electrically connected** (common centre grounding contact C⊥) but **electrically isolated from all other circuits.**
- **Setting data and functions can note down in the Table in Sect. 3.**
  Please also refer to Section 2.7 ”Standard factory settings”.
- **All operating data and functions are adjustable,** see Sections 4.4 and 5.9, Fct. 1.11-1.12.
- **Active mode:** uses the internal power supply, terminals E+/E-
  Passive mode: requires external power supply, $U_{ext} \leq 32V$ DC/24V AC, $I \leq 10mA$
- The **following operating conditions can be initiated** using the control inputs:
  - external range change
  - holding of output values
  - zeroing the outputs
  - resetting the internal totalizer
  - resetting (deleting) the error messages
- **Connection diagrams see Section 2.6**

2.6 Connection diagrams of outputs and inputs

IMPORTANT!
For EEx versions, also pay regard to all directions included in Sect. 6.1 and 13.
Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!

I	Current output (included HART®)
P, A1*	Pulse output
A1*, A2, D1, D2	Status outputs
C1, C2	Control inputs

Totalizer
-electromechanical (EMC)
- electronic (EC)

milliampmeter
0-20 mA or 4-20 mA and other

Key, N/O contact

External voltage source (U_{ext}), DC or AC voltage, connection polarity arbitrary

DC voltage,
external power source (U_{ext}), note connection polarity

Please note ! Unwired contacts or terminals may not have any conductive connection with other electrically conducting parts.

Interface operation with HART® or RS 485 (Option) see Sect. 6.4.

***** selectable as status output A1 or pulse output A1

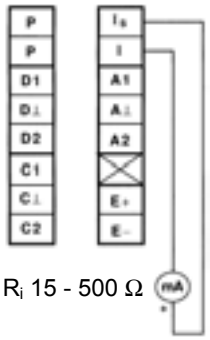
Active mode: the IFC 110 F supplies the power required for operating (driving) the receiver instruments. Observe the max. operating data (terminals **E+** and **E-**).

Passive mode: an external power supply source (Uext) is required for operating (driving) the receiver instruments.

Groups A / C / D / E / I / P are electrically isolated from each other and from all other input and output circuits.

Please note: common reference potential
A⊥ for A1 and A2
C⊥ for C1 and C2
D⊥ for D1 and D2

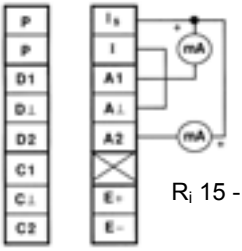
① Current output I_{active}



R_i 15 - 500 Ω

② Current output I_{active} with automatic range change BA

without external change-over relay



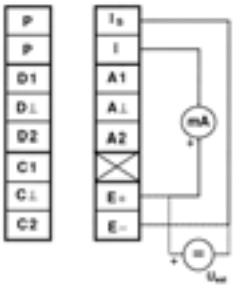
low range

high range

R_i 15 - 500 Ω

③ Current output $I_{passive}$

(see Sect. 6.8 passive/active operation



selectable with internal power supply **E** or external power supply $U_{ext.}$

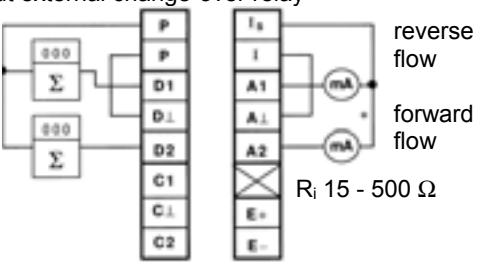
$U_{ext.}$	15 - 22 V DC	22 - 32 V DC
R_i	0 - 500 Ω	0 - 800 Ω

④ Forward/reverse flow meausrement (F/R mode)

for pulse and current outputs (P and I_{active}) without external change-over relay

reverse flow

forward flow



reverse flow

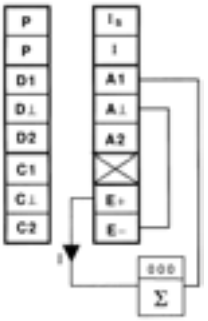
forward flow

R_i 15 - 500 Ω

Electronic totalizers must be connected as shown in the connection diagrams for pulse output P on the following page.

⑤ Pulse output A1 active

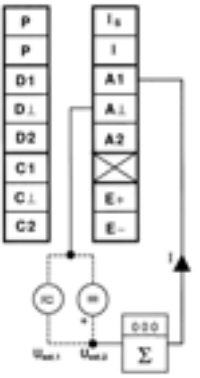
for electromechanical totalizers (EMC)



$R_i \geq 160$ Ω
$I \leq 100$ mA

⑥ Pulse output A1 passive

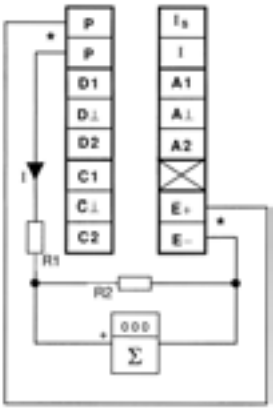
for electromechanical totalizers (EMC)



$U_{ext.} \leq 32$ V DC / ≤ 24 V AC $I \leq 10$ mA
oder umschaltbar auf
$U_{ext.2} \leq 32$ V DC $I \leq 200$ mA

⑦ Pulse output P_{active}

for electronic totalizers (EC)
<u>for frequencies ≤ 1 kHz</u>

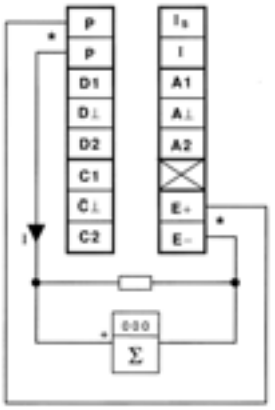


R1 = 1 kΩ/0.5 W I ≤ 20 mA $R_{i\ EC}$ > 100 kΩ

R2 / 0.2 W	10 kΩ	1 kΩ	270 Ω
$U_{EC\ max}$	22 V	12 V	5 V

⑧ Pulse output P_{active}

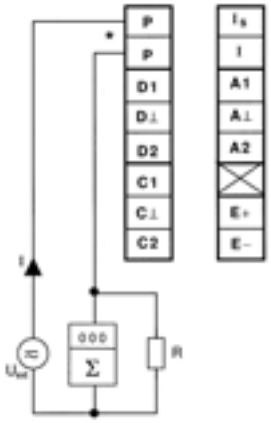
for electronic totalizers (EC)
<u>for frequencies > 1 kHz</u>



R = 1 kΩ/0.35 W I ≤ 30 mA

⑨ Pulse output $P_{passive}$

for electronic totalizers (EC)



<u>for frequencies ≤ **1 kHz**</u>

U_{ext} ≤ ≤ 32 V DC / ≤ 24 V AC
I ≤ ≤ 30 mA
R = 1 - 10 kΩ

$$P_R \geq \frac{U_{ext}^2}{R}$$

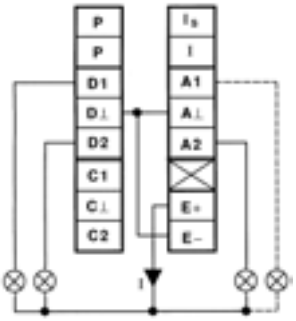
<u>for frequences > **1 kHz**</u>

U_{ext} = ≤ 24 V DC / AC
$R_{i\ EC}$ ≥ 100 kΩ

I	**~ 30 mA**	**~ 18 mA**
R	560 Ω	1 kΩ
P_R	0.5 W	0.35 W
U_{EC}	16 V	18 V

*** Shielded cables**
must be used to prevent radio interference at pulse output frequencies > 100 Hz

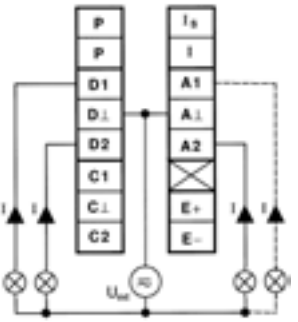
⑩ Status outputs D1 / D2 / A1 / A2 active



I ≤ 100 mA

⊗ e.g. message display

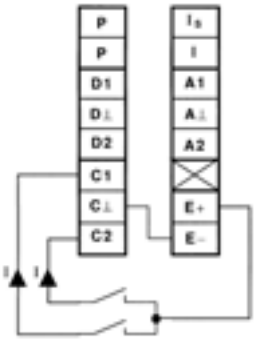
⑪ Status outputs D1 / D2 / A1 / A2 passive



$U_{ext.}$ ≤ 32 V DC / ≤ 24 V AC
I ≤ 100 mA

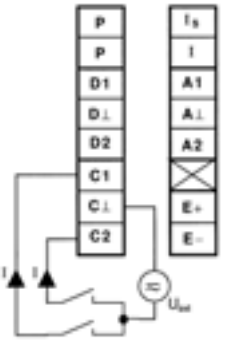
⊗ e.g. message display

⑫ Control inputs C1 / C2 active



Contacts 24 V, 10 mA
I ≤ 7 mA

⑬ Control inputs C1 / C2 passive



$U_{ext.}$ ≤ 32 V DC / ≤ 24 V AC
I ≤ 10 mA

2.7 Standard factory settings

- All operating data are set at the factory in accordance with the specifications contained in the order.
- If no specifications are made in the order, instruments will be delivered with the standard parameters and functions indicated in the table below.
- To facilitate the start-up of the instrument, current and pulse outputs are set to handle measurements in ”two flow directions” so that the current flow rates and volumes are displayed and/or counted independent of the direction of flow. The figures displayed may have a preceding sign.
- Such factory setting of current and pulse outputs may lead to measuring errors, particularly when volumes are metered and totalized.
- If e.g. pumps are switched off and ”backflows” occur which are not within the low-flow cutoff (SMU) range, or if separate displays and counts are required for both flow directions.
- To avoid faulty measurements, it may therefore be necessary to change the setting of the following functions:
  - SMU low-flow cutoff Fct. 1.03, Section 5.3
  - display Fct. 1.04, Section 5.5
  - current output I Fct. 1.05, Section 5.6
  - pulse output P Fct. 1.06, Section 5.7
- For special applications, such as pulsating flows, see Sections 6.5 to 6.10

Standard factory settings

Fct. No.	Function	Setting
1.01	Full-scale range	See instr. nameplate of flow sensor
1.02	Time constant	3 Sec. for display, pulse, current and status ouputs
1.03	Low-flow cutoff	ON: 1% OFF: 2%
1.04	Display flow rate totalizer	 m³/h m³
1.05	Current output function range error detection	 I_{active} 2 directions 4-20 mA 22 mA
1.06	Pulse output P function pulse value pulse width	 2 directions 1000 pulses/Sec. symmetric
1.07	Pulse output 2, A1 function pulse value pulse width	 2 directions 1 pulse/s 50 ms

Fct. No.	Function	Setting
1.08	Status output A2	ON
1.09	Status output D1	All error
1.10	Status output D2	Indication F/R
1.11	Control input C1	Totalizer reset
1.12	Control input C2	OFF
3.01	Language	German
3.02	Flow sensor meter size direction of flow	 See instr. nameplate + direction, see arrow on flow sensor
3.04	Entry code	NO
3.05	User unit	Liter/h
3.06	Application flow empty pipe ADC gain special filter	 steady NO automatic OFF
3.07	Hardware terminal A1 selfcheck	 pulse output A1 NO

3 Start-up

- Before connecting to power, check that the instrument is correctly installed as described in Sections 1 and 2.

- The flowmeter, flow sensor and signal converter are delivered ready for operation. All operating data are set at the factory in accordance with your specifications.
  Please also refer to Section 2.7 ”Standard factory settings”.

- Switch on the power supply. The flowmeter immediately begins to measure the flow.

- When the power supply is switched on, the display successively shows **START UP** and **READY**. Then the current flow rate and/or the current totalizer count are displayed. Displays are either steady or cyclic depending on the setting described for Fct. 1.04.

- **2 light-emitting diodes (LED)** in the ”diagnostics” field on the front panel of the signal converter indicate the status of measurement.

LED displays	Status of measurement
Green ”normal” LED is flashing	Everything O.K.
Green ”normal” LED and red ”error” LED are flashing alternately	Momentary overload of outputs and/or A/D converter. Detailed error messages by setting Fct. 1.04 DISPLAY, subfunction ”MESSAGES” to ”YES”, see Sections 4.4 and 5.5.
Red ”error” LED is flashing	Fatal Error, see Sections 7.3 and 7.4

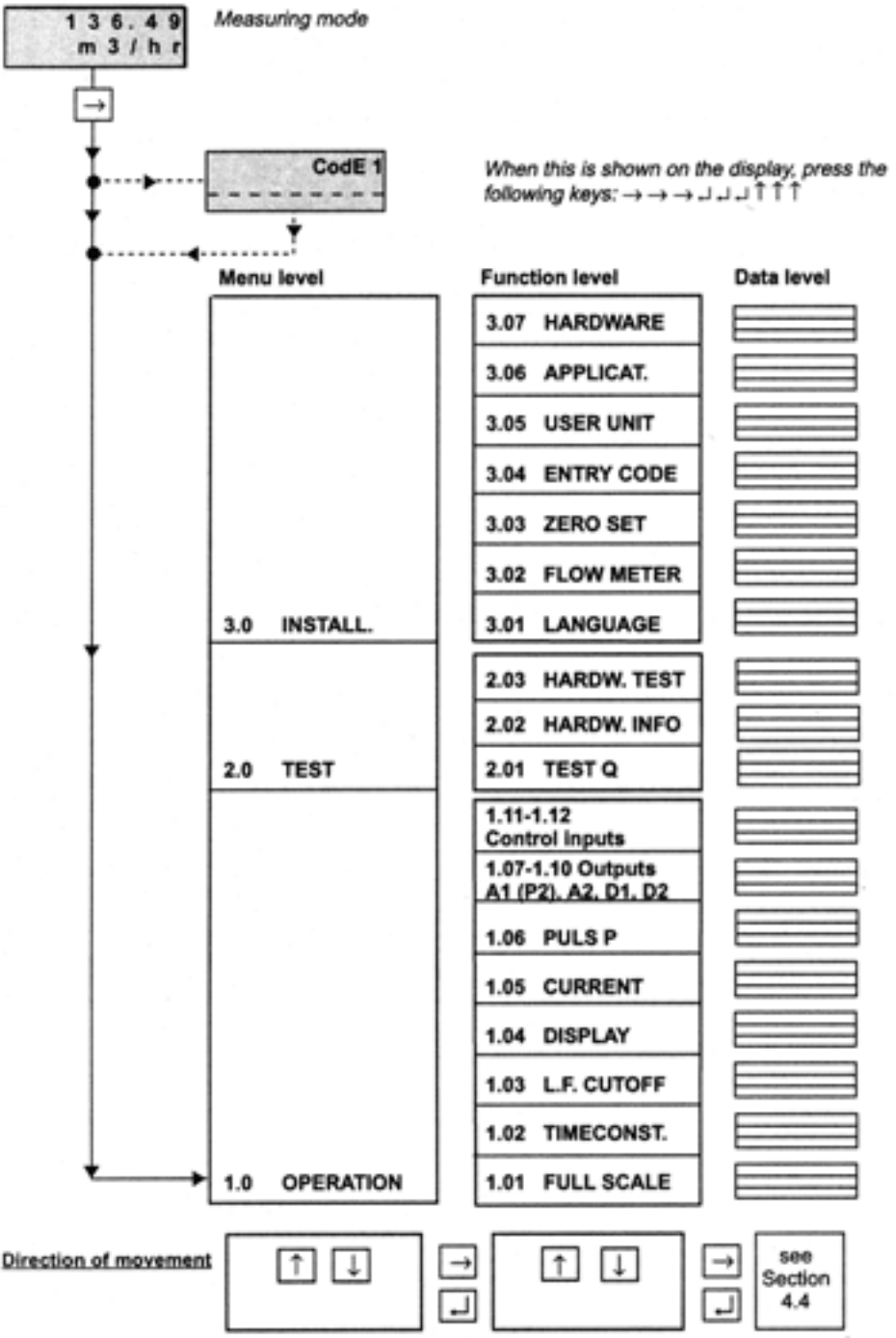
IMPORTANT!
For EEx versions, also pay regard to all directions included in Sect. 6.1 and 13.
Only the EEx flow sensor may be installed in the hazardous area. The EEx certified signal converter must be installed outside the hazardous area!

Setting data: Here you can note down the settings of the signal converter !

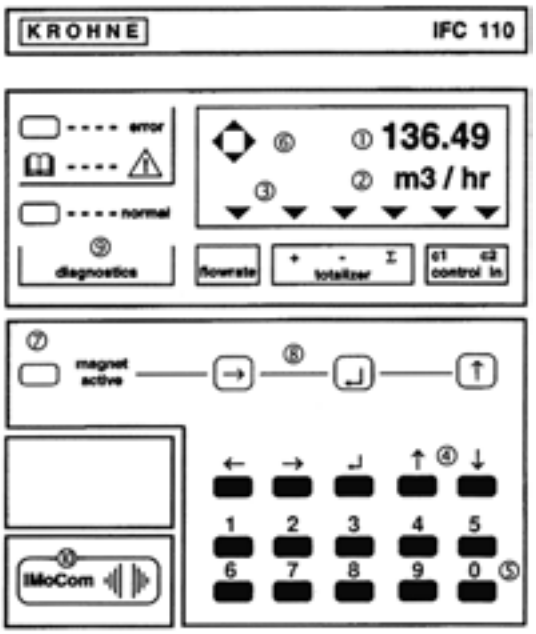
Fct. No.	Function	Settings
1.01	**Full-scale range**	
1.02	**Time constant**	
1.03	**Low-flow cut-off**	ON: OFF:
1.04	**Display**	Flow
		Totalizer
		Messages
		Trend
1.05	**Current output I**	Function
		Reverse range
		Range I
		Error
1.06	**Pulse output P**	Function
		Pulswidth
		Pulse value
1.07	**Pulse output A1 or**	
	Status output A1	
	(for setting see below, Fct. 3.07, terminal A1)	
1.08	**Status output A2**	
1.09	**Status output A3**	
1.10	**Status output A4**	
1.11	**Control input C1**	
1.12	**Control input C2**	
3.01	**Language**	
3.02	**Flow sensor**	Meter size
		GK value
		Field frequency
		Power frequency
		Flow direction
3.04	**Entry code required ?**	☐ no ☐ yes
		→ → → ↵ ↵ ↵ ↑ ↑ ↑
3.05	**User-defined unit**	
3.06	**Application**	Flow is ☐ steady ☐ pulsating
		Empty Pipe Detection (EPD) ☐ no ☐ yes
3.07	**Hardware-settings**	Terminal **A1** is ☐ Pulse output **or** ☐ Status output
3.08	**Measuring point**	
3.09	**Communication**	☐ of
		☐ HART **or** ☐ KROHNE RS 485
		Address:
		Baud rate:

4 Operating of the signal converter

4.1 KROHNE operating concept



4.2 Operating and control elements



The instrument can be operated by means of ....

… **the 15 keys ④ and ⑤** accessible after removal of the glass cover,

… **the 3 magnetic sensors ⑧ and the bar magnet** without opening the housing (optional).

① Display, 1st line — Displaying numerical data

② Display, 2nd line — Displaying units and texts

③ Display, 3rd line — 6 arrows to mark the current display

flow rate		current flow rate
totalizer	**+**	totalizer
	-	totalizer
	Σ	sum totalizer (+ and -)
control in	**1/2**	control input 1 or 2 active

④ 5 keys for operating the signal converter ← → ↵ ↑ ↓

⑤ 10 keys for direct numerical setting of function values (not function numbers)

⑥ Compass field showing that a key is pressed

⑦ **magnet active** — LED green/red, magnetic sensors active

green = built-in magnetic sensors (optional), see ⑧
red = operation of one of the 3 magnetic sensors

⑧ 3 magnetic sensors (optional), operated by bar magnet without opening the housing, function of the sensors as described for the three keys → ↵ ↑, see ④.

⑨ **diagnostics** — 2 LEDs signalling the status of measurement

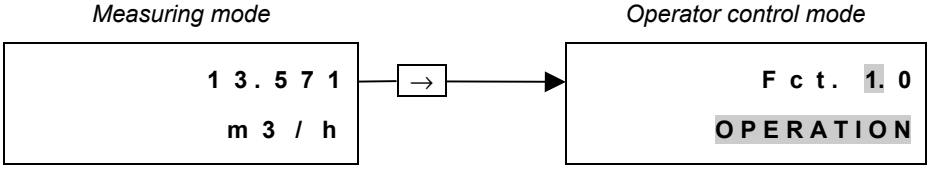
normal	green LED	= correct measurement, everything O.K.
error	red LED	= error, parameter or hardware error

⑩ **IMoCom** — IMoCom bus, multipoint connector for connecting external supplementary equipment, see Section 6.4, slide window to the left

4.3 Key functions

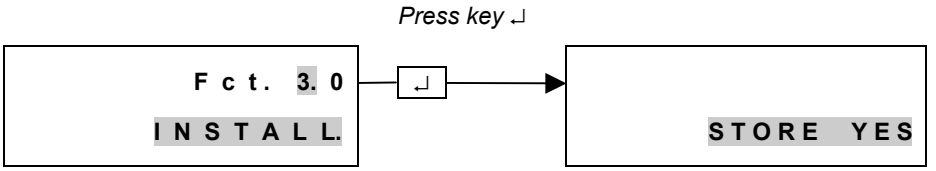
In the following, the cursor or flashing part of the display is shown against a grey background.

To start operator control



PLEASE NOTE: if **"YES"** is selected in **Fct. 3.04 ENTRY CODE, "CodE 1 - - - - - - - - -"** appears in the display after pressing the → key.
Enter the password for the entry code which is a sequence of 9 keys: → → → ↵ ↵ ↵ ↑ ↑ ↑ (each keystroke confirmed by " * ").

To terminate operator control
Press key ↵ any number of times until one of the following menus
Fct. 1.0 OPERATION, Fct. 2.0 TEST or **Fct. 3.0 INSTALL** is displayed.



Store new parameters: *acknowledge by pressing key ↵. Measuring mode is continued with new parameters.*

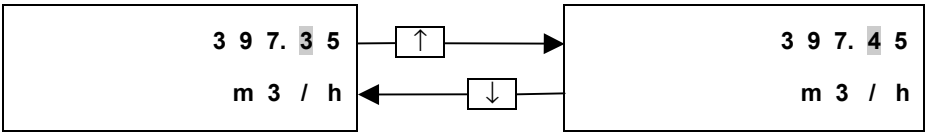
New parameters not to be stored:
press key ↑ to display
"STORE NO".
Measuring mode is continued with the "old" parameters after pressing key ↵.

Keyboard with 10 keys
The keyboard with the 10 keys **(0-9)** is used for **setting all flashing numbers (cursor).**

Exception: the digits of the function numbers, such as **Fct. 1.03**, can only be changed with keys ↑ or ↓.

To change numbers

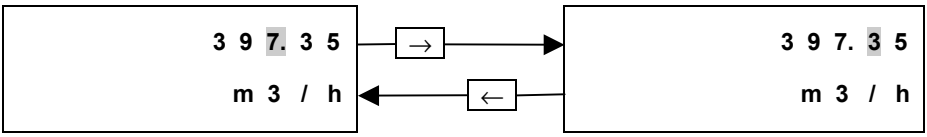
increase number



decrease number

To shift cursor (flashing position)

shift to right

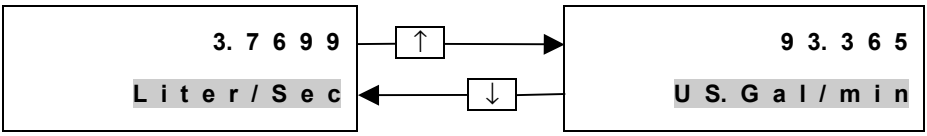


shift to left

To alter texts (units)

In case of units, the numerical value is converted automatically.

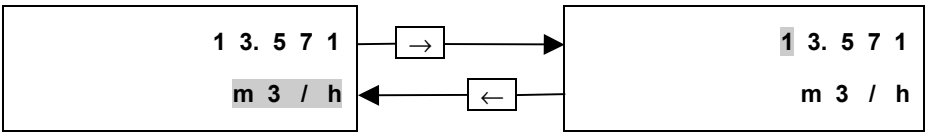
select next text



select preceding text

To change from text (unit) **to numerical setting**

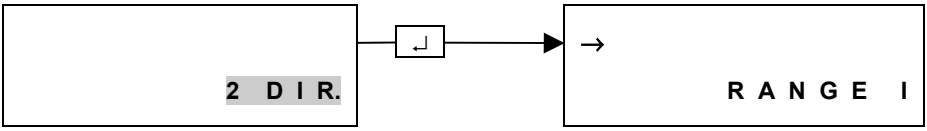
change to numerical setting



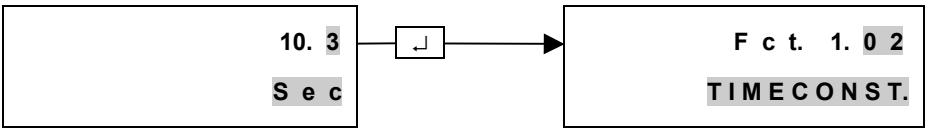
return to text setting

To change to subfunction

Subfunctions have no “Fct. No.” and are identified by a “→”



To revert to function display



4.4 Table of settable functions

Abbreviations used:

A1, A2 Status outputs (A1 can also be 2nd pulse output A1)
C1, C2 Control inputs
D1, D2 Status outputs
DN Meter size, nominal size
F_{max} = ½ x pulse width (s) for ≤ 50 Hz
≤ 10 kHz if "AUTO" or "SYM." are selected in subfunction "PULSWIDTH"
F_{min} = 10 pulses/h
F_M Conversion factor volume for any unit, see Fct. 3.05 "FACT. VOL."
F_T Conversion factor time for any unit, see Fct. 3.05 "FACT. TIME"
GK Flow sensor constant
I Current output
$I_{0\%}$ Current at 0% flow rate
$I_{100\%}$ Current at 100% flow rate
P (P2) Pulse output (2nd pulse output A1)
P_{max} = $F_{max}/Q_{100\%}$
P_{min} = $F_{min}/Q_{100\%}$
Q Current flow rate
$Q_{100\%}$ 100% flow rate = full-scale range
Q_{max} = $\frac{\pi}{4}$/4 DN² x v_{max} (= max. full-scale range $Q_{100\%}$ at v_{max} = 12 m/s or 40 ft/s)
Q_{min} = $\frac{\pi}{4}$/4 DN² x v_{min} (= min. full-scale range $Q_{100\%}$ at v_{min} = 0.3 m/s or 1 ft/s)
SMU Low-flow cutoff for I and P
v Flow velocity
v_{max} Maximum flow velocity (12 m/s or 40 ft/s) at $Q_{100\%}$
v_{min} Minimum flow velocity (0.3 m/s or 1 ft/s) at $Q_{100\%}$
F/R Forward/reverse flow in F/R measuring mode

Fct.	Text	Description and setting
1.0	**OPERATION**	**Operating menu**
	FULL SCALE	**Full-scale range for flow rate $Q_{100\%}$** Selection of unit • m³/h • Liter/Sec • US.Gal/min • user unit, factory setting "Liter/h" or "US MGal/day" (see Fct. 3.05) *Press → key to change to numerical setting* Setting ranges The range depends on the nominal width (DN) and the flow velocity (v): $Q_{min} = \frac{\pi}{4}$ DN² x v_{min} $Q_{max} = \frac{\pi}{4}$ DN² x v_{max} Nominal width/meter size: v_{min} = 0.3 m/s (1 ft/s) – v_{max} = 12 m/s (40 ft/s) • DN 2.5–1200 / 1/10"–48": 0.0053 – 48 860 m³/h 0.0237 – 218 560 US.Gal/min • DN 1300–3000 / 52"–120" (see Section 8.6): 1435 – 305 360 m³/h 6415 – 1 366 000 US.Gal/min *Press ↵ key to return to* Fct. 1.01 FULL SCALE
	→ **VALUE P** *and/or* → **VALUE P2**	**Pulse value for pulse output P** (Fct. 1.06 *"VALUE P"*) and/or **for the 2nd pulse output A1** (Fct. 1.07 *"VALUE P2"*) **has been changed.** With the "old" pulse values the output frequency (F) would have been exceeded or would not have been reached. **P_{min}** = F_{min} / $Q_{100\%}$ **P_{max}** = F_{max} / $Q_{100\%}$ **Check new values!**
1.02	**TIMECONST.**	**Time constant** Selection: • ALL (applies to display and all outputs) • ONLY I (only display, current and status outputs) *Press ↵ key to change to numerical setting.* Range: • 0.2 – 99.9 Sec *Press ↵ key to return to* Fct. 1.02 TIMECONST.
1.03	**L.F. CUTOFF**	**Low-flow cutoff** (L.F. CUTOFF) • OFF (fixed tripping points: ON = 0.1% / OFF = 0.2%) • PERCENT (variable tripping points) ON 1 – 19% OFF 2 – 20% *Press → key to change to numerical setting.* Note: the cutoff "OFF" value must be greater than the cutoff "ON" value. *Press ↵ key to return to* Fct. 1.03 L.F. CUTOFF.

Fct.	Text	Description and setting
1.04	**DISPLAY**	**Display functions**
	→ **DISP.FLOW**	**Selection of flow display** ● NO DISP. ● User unit, factory setting "Liter/h" or "US MGal/day" (s. Sect. 3.05) ● m³/h ● PERCENT ● Liter/Sec ● BARGRAPH (value and bar graph display in %) ● US.Gal/min *Press ↵ key to change to subfunction* "DISP. TOTAL."
	→ **DISP.TOTAL.**	**Selection of totalizer display** ● NO DISP. (totalizer is ON but no display) ● OFF (totalizer is OFF) ● + TOTAL. ● - TOTAL. ● +/- TOTAL. ● SUM (Σ) ● ALL (display single counts or all) *Press ↵ key to change to setting of display unit.* ● m³ ● Liter ● US.Gal ● User unit, factory setting "Liter" (s. Sect. 3.05) *Press → key to transfer to format setting.* Format setting ● **Auto** (exponent notation) ● # . ####### ● ##### . ### ● ## . ###### ● ###### . ## ● ### . ##### ● ####### . # ● #### . #### ● ######## *Press ↵ key to change to subfunction* "DISP. MSG."
	→ **DISP.MSG.**	**Additional messages desired during measuring mode?** ● NO ● YES (cyclic change with display of measured values) *Press ↵ key to return to* Fct. 1.04 DISPLAY.
1.05	**CURRENT I**	**Current output I**
	→ **FUNCT. I**	**Selecting the current output I function** ● OFF (switched off) ● + DIR. ● - DIR. (measurement in one flow direction only) ● 2 DIR. (forward/reverse flow, F/R mode) *Press ↵ key to change to subfunction* "RANGE I"; *if* "2 DIR." *is selected press this key to change to subfunction* "REV. RANGE".
	→ **REV.RANGE**	**Setting the full-scale range for reverse flow of $Q_{100\%}$** (only displayed when "2 DIR." is selected) ● 100 PCT. (same as forward flow $Q_{100\%}$, see Sect. 1.01) ● PERCENT setting range: 005 - 150 % of $Q_{100\%}$ (different value for reverse flow) *Press → key to change to numerical setting.* *Press ↵ key to change to subfunction* "RANGE I"
	→ **RANGE I**	**Selecting the measuring range** ● 0 - 20 mA ● 4 - 20 mA (fixed ranges) ● mA (user-defined range) $I_{0\%}$ (0 - 16 mA) - $I_{100\%}$ (4 - 20 mA) (Value $I_{0\%} < I_{100\%}$!) *Press → key to change to numerical setting!* *Press ↵ key to change to subfunction* "I ERROR".
	→ **I ERROR**	**Selecting the error value** ● 22 mA ● 0.0 to $I_{0\%}$ mA (variable when $I_{0\%} \geq 1$ mA, see above) *Press → key to change to numerical setting.* *Press ↵ key to return to* Fct. 1.05 "CURRENT OUTPUT I".
1.06	**PULS P**	**Pulse output P** Description of function of pulse output P on the next page.
1.07	**STATUS A1** *or* **PULS2 A1**	**Status output A1** **2nd pulse output A1** } **A1** = terminal connected as status or pulse output (P2) s. Fct. 3.07 HARDWARE, "Terminal A1" Description of function of status output A1 or 2nd pulse output A1 on the next page.

Fct.	Text	Description and setting
1.08 **1.09** **1.10**	**STATUS A2** **STATUS D1** **STATUS D2**	**Status outputs A2, D1 and D2** Description of function of status outputs A2, D1 and D2 on the next page but one.
1.11 **1.12**	**CONTROL C1** **CONTROL C2**	**Countrol inputs C1 and C2** Description of function of control inputs on the next page but one.
1.06	**PULS P**	**Pulse output P** for electronic totalizers up to 10,000 pulses/s
1.07	**PULS2 A1**	**2nd pulse output A1** for electromechanical totalizers up to max. 50 Hz. Connection of terminal A1 as a 2nd pulse output A1 or as status output A1, see Fct. 3.07 HARDWARE, "Terminal A1".
Fct. 1.06 and 1.07 have identical menus and are configured in accordance with the same setting mode.	→ **FUNCT. P** → **FUNCT. P2**	**Selecting the function for pulse outputs P and P2** ● OFF ● + DIR. ● - DIR. (measuring in one flow direction only) ● 2 DIR. (forward/reverse flow, F/R mode) *Press ↵ key to change to subfunction* "SELECT P **or** P2".
	→ **SELECT P** → **SELECT P2**	**Selecting the type of pulse** ● PULSE/VOL. (pulses per unit volume, flow rate) ● PULSE/TIME (pulses per unit time for 100% flow rate) *Press ↵ key to change to subfunction* "PULSWIDTH".
	→ **PULSWIDTH** → **PULSWIDTH**	**Selecting the pulse width** ● 0.01 - 1.00 s (only for F_{max} < 50 pulses/s) ● AUTO (automatic = 50% of cycle duration of 100% output frequency) ● SYM (symmetric = pulse duty factor approx. 1:1 across the entire range) *Press ↵ key to change to subfunction* "VALUE P **or** P2".
	→ **VALUE P** → **VALUE P2**	**Setting the pulse value per unit volume** (only displayed when "PULSE/VOL." is selected in "SELECT P **or** P2" above). ● xxxx PulS/m³ ● xxxx PulS/Liter ● xxxx PulS/US.Gal ● xxxx PulS/user unit, factory setting "Liter" or "US MGal" (s. Fct. 3.05) Setting range "xxxx" depends on pulse width and full-scale range: **P_{min}** = F_{min} / $Q_{100\%}$, **P_{max}** = F_{max} / $Q_{100\%}$ *Press ↵ key to return to* Fct. 1.06 PULS P **or** Fct. 1.07 PULS2 A1.
	→ **VALUE P** → **VALUE P2**	**Setting the pulse value per unit time** (only displayed when "PULSE/TIME" is selected in "SELECT P **or** P2" above). ● xxxx PulSe/Sec (=Hz) ● xxxx PulSe/min ● xxxx PulSe/h ● xxxx PulSe/user unit, factory setting "h" (s. Fct. 3.05) Setting range "xxxx" depends on pulse width (see above). *Press ↵ key to return to* Fct. 1.06 PULS P **or** Fct. 1.07 PULS2 A1.

Fct.	Text	Description and setting
1.07	**STATUS A1**	**Status output A1** (terminal A1 connected as status output A1 or as a 2nd pulse output A1, see Fct. 3.07 HARDWARE, "terminal A1")
1.08	**STATUS A2**	**Status output A2**
1.09	**STATUS D1**	**Status output D1**
1.10	**STATUS D2**	**Status output D2**
	→ Fct. 1.07 to 1.10 are configured in accordance with the same setting mode. Functions set for one of the status outputs are no longer available for the other status outputs.	• OFF • ON • ALL ERROR • FATAL.ERROR • INVERS D1 (inverse mode of D1 and D2) • INVERS A1 (inverse mode of A1 and A2 possible only if A1 is operated as status output, see Fct. 3.07 HARDWARE, "terminal A1") • SIGN I, P or P2 (F/R mode) • OVERFL. I, P or P2 (overloading the outputs) } **dynamic behaviour** of outputs see Fct. 1.02 TIMECONST.: I = ONLY I, **P** or **P2** = ALL • EMPTY PIPE ("tube empty" signal only with built-in option) • TRIP. POINT *Press → key to change to character.* Selection: • + DIR. • - DIR. • 2 DIR. *Press ↵ key to change to numerical setting.* Setting range: 000 - 150 PERCENT • AUTO. RNG. Setting range: 05-80 PERCENT (= lower to upper range ratio 1:20 to 1:1.25, value must be higher than that of Fct. 1.03 L.F. CUTOFF) *Press ↵ key to change to numerical setting.* *Press ↵ key to return to* Fct. 1.06, 1.07, 1.08 or 1.09.

Fct.	Text	Description and setting
1.11	**CONTROL C1**	**Control input C1 and C2**
1.12	**CONTROL C2**	• OFF • EXT. RNG. (external range change) Setting range: 05-80 PERCENT (= lower to upper range ratio 1:20 to 1:1.25, value must be higher than that of Fct. 1.03 L.F. CUTOFF) *Press ↵ key to change to numerical setting.* • OUTP. HOLD (hold output values) • OUTP. ZERO (set outputs to "min. values") • TOTAL.RESET (reset the totalizer) • ERROR.RESET (delete error messages) *Press ↵ key to return to* Fct. 1.11 or 1.12 CONTROL C1 or C2
	→	

Fct.	Text	Description and setting
2.0	**TEST**	**Test menu**
	TEST Q	**Test measuring range Q** Precautionary query • SURE NO *Press ↵ key to return to* Fct. 2.01 "TEST Q". • SURE YES *Press ↵ key, then use ↑ key to select value:* -110 / -100 / -50 / -10 / 0 / +10 / +50 / +100 / +110 PCT. of set full-scale range $Q_{100\%}$. Displayed value is available at outputs I and P. *Press ↵ key to return to* Fct. 2.01 "TEST Q".
2.02	**HARDW. INFO**	**Hardware information and error status** Before consulting factory, please note down all 6 codes.
	→ **MODUL ADC**	X . X X X X X . X X Y Y Y Y Y Y Y Y Y Y *Press ↵ key to transfer to* "MODUL IO".
	→ **MODUL IO**	X . X X X X X . X X Y Y Y Y Y Y Y Y Y Y *Press ↵ key to transfer to* "MODUL DISP.".
	→ **MODUL DISP.**	X . X X X X X . X X Y Y Y Y Y Y Y Y Y Y *Press ↵ key to return to* Fct. 2.02 "HARDW. INFO".
2.03	**HARDW. TEST**	**Hardware test** (Precautionary query) - SURE NO *Press ↵ key to return to* Fct. 2.03 "HARDW. TEST". - SURE YES *Press ↵ key to start test, duration approx. 60 s* If errors are found, the first one is displayed. Press ↓ key to display next error. List of errors see Section 4.5. *Press ↵ key to return to* Fct. 2.03 "HARDW. TEST".

Fct.	Text	Description and setting
3.0	**INSTALL.**	**Installation menu**
3.01	**LANGUAGE**	**Select language for display texts** ● GB / USA (English) ● S (Swedish) ● D (German) ● other languages on request ● F (French) *Press ↵ key to return to* Fct. 3.01 "LANGUAGE".
3.02	**FLOWMETER**	**Set data for flow sensor**
	→ **DIAMETER**	**Select size from meter size table** ● DN 2.5 - 1200 mm equivalent to 1/10 - 48 inch ● DN 1300 - 3000 mm equivalent to 52 - 120 inch (see Sect. 8.6) *Select with ↑ key.* *Press ↵ key to change to* subfunction "FULL SCALE".
	→ **FULL SCALE**	**Full-scale range for flow $Q_{100\%}$** To set, refer to Fct. 1.01 "FULL SCALE". *Press ↵ key to change to* subfunction "GK VALUE".
	→ **VALUE P** *and/or* → **VALUE P**	**Pulse value for pulse output P** (Fct. 1.06 *"VALUE P"*) *and/or* **for the 2nd pulse output A1** (Fct. 1.07 *"VALUE P2"*) **has been changed.** With the "old" pulse values the output frequency (F) would have been exceeded or would not have been reached. **P_{min} = F_{min} / $Q_{100\%}$ P_{max} = F_{max} / $Q_{100\%}$ Check new value.**
	→ **GK VALUE**	**Set primary constant GK** See instrument nameplate of flow sensor. Range: ● 1.0000 - 15.000 *Press ↵ key to change to* subfunction "FIELD. FREQ.".
	→ **FIELD FREQ.**	**Magnetic field frequency** Values: 1/2, 1/6, 1/18 and 1/36 of power frequency, see instr. nameplate. *Press ↵ key to change to* subfunction "FLOW DIR."; on DC instruments change to subfunction "LINE FREQ.".
	→ **LINE FREQ.**	**Power frequency customary in the country where the instrument is used** Please note: this function is limited to instruments with DC supply unit (24 V DC) to suppress line frequency interferences. Values: *50 Hz* and *60 Hz* *Press ↵ key change to* subfunction "FLOW DIR.".
	→ **FLOW DIR.**	**Define flow direction** (in F/R mode: forward flow). Set according to direction of arrow on flow sensor: ● + DIR. ● – DIR. *Select using ↑ key.* *Press ↵ key to return to* Fct. 3.02 "FLOWMETER".
3.03	**ZERO SET**	**Zero calibration** Note: carry out only at "0" flow and with completely filled measuring tube! Precautionary query ● CALIB. NO *Press ↵ key to return to* Fct. 3.3 "ZERO SET". ● CALIB. YES *Press ↵ key to start calibration.* Duration approx. 15-90 s (depending on magnetic field frequency), current flow rate displayed in the selected unit (s. Fct. 1.04 "DISP. FLOW"). *A "WARNING" sign appears when flow rate ">0";* *acknowledge by pressing ↵ key.* ● STORE NO (do **not** store new zero value) ● STORE YES (store new zero value) *Press ↵ key to return to* Fct. 3.03 "ZERO SET".
3.04	**ENTRY CODE**	**Entry code required to enter setting mode?** ● NO (= entry with → only) ● YES (= entry with → and Code 1: → → → ↵ ↵ ↵ ↑ ↑ ↑) *Press ↵ to return to* Fct. 3.04 "ENTRY CODE".

Fct.	Text	Description and setting
3.05	**USER UNIT**	**Set any required unit for flowrate and counting**
	→ **TEXT VOL.**	**Set text for required flowrate unit** (max. 5 characters) Factory setting = Liter or US MGal Characters which can be assigned to each place: ● A-Z, a-z, 0-9, or " – " (= blank character). *Press ↵ key to transfer to subfunction* "FACT. VOL."
	→ **FACT. VOL.**	**Set conversion factor (F_M) for volume** Factory setting "1.00000 E+3" for "Liter" or "2.64172E-4" for "US MGal" (exponent notation, here 10^3 or 2.64172 x 10^{-4}) Factor F_M = volume per 1m³. Setting range ● 1.00000 E-9 to 9.99999 E+9 (= 10^{-9} to 10^{+9}) *Press ↵ key to transfer to subfunction* "TEXT TIME".
	→ **TEXT TIME**	**Set text for any time** (max. 3 characters) Factory setting = "h" (hours) Characters which can be assigned to each space: ● A-Z, a-z, 0-9, or " – " (= blank character). *Press ↵ key to transfer to subfunction* "FACT. TIME"
	→ **FACT. TIME**	**Set conversion factor (F_T) for time** Factory setting "3.60000 E+3" for "h" (exponent notation, here 3.3 x 103). Set factor F_T in seconds. Setting range ● 1.00000 E-9 to 9.99999 E+9 (= 10^{-9} to 10^{+9}) *Press ↵ key to return to* Fct. 3.05 "USER UNIT".
3.06	**APPLICAT.** → **FLOW**	**Set modulation range of A/D converter** ● STEADY (150% of $Q_{100\%}$) ● PULSATING (1000% of $Q_{100\%}$) *Press ↵ key to change to subfunction* "EMPTY PIPE".
	EMPTY PIPE	**Empty pipe detection EPD** (see Sect. 6.9) ● NO (*Press ↵ key to change to subfunction* "ADC Gain") ● YES (*Press ↵ key to change to* "VAL. FULL") ● VAL. FULL (*Press ↵ key, precautinory query*) ● CALIB. NO (*Press ↵ key to change to* "VAL. EMPTY") ● CALIB. YES (*Press ↵ key, calibration will start with flashing display* "WAIT", *duration approx. 20 seconds*) Make sure that measuring tube is completely filled! ● STORE NO (*Press ↵ key to change to* "VAL. EMPTY") ● STORE YES (*Press ↵ key to change to* "VAL. EMPTY") ● VAL. EMPTY (*Press ↵ key, precautinory query*) ● CALIB. NO (*Press ↵ key to change to* "VAL. EMPTY") ● CALIB. YES (*Press ↵ key, calibration will start with flashing display* "WAIT", *duration approx. 20 seconds*) Make sure that measuring tube is completely empty! ● STORE NO (*Press ↵ key to change to* subfunction " ADC GAIN") ● STORE YES (*Press ↵ key to change to* subfunction "ADC GAIN") **Please Note:** The values of the measured impedances must be in range 0 - 150. The difference of the value VAL. EMPTY must be 10 greater than the value of VAL. FULL!
	→ **ADC GAIN**	**Set gain of A/D converter** ● AUTO ● 10 ● 30 ● 100 Select with key ↑ or ↓ *Press ↵ key to change to subfunction* "SPEC. FILT.".
	→ **SPEC. FILT.**	**Activate special filter for noise/interference suppression?** PLEASE NOTE information and examples given in Sect. 6.6. ● NO (*Press ↵ key to change to* Fct. 3.06 "APPLICAT.") ● YES (*Press ↵ key to change to subfunction* "LIMIT VAL.").

Fct.	Text	Description and setting
	→ **LIMIT VAL.**	**Set limit value for noise/interference suppression** (appears only when "YES" is selected under "SPEC. FILT.", see above) Setting range: 01-90 PERCENT of full-scale range $Q_{100\%}$ see Fct. 3.02, subfunction "FULL SCALE" *Press ↵ key to change to subfunction* "LIMIT CNT.".
	→ **LIMIT CNT.**	**Totalizer active when exceeding limit value** (see "LIMIT VAL." above) (appears only when "YES" is selected under "SPEC. FILT.") Setting range: 001-250 *Press ↵ key to return to* Fct. 3.06 "APPLICAT.".
3.07	**HARDWARE**	**Determine HARDWARE functions**
	→ **TERM.A1**	**Terminal A1** ● PULSOUTP. ● STATUSOUTP. *Select with key* ↑. *Press key ↵ to transfer to subfunction* "SELFCHECK".
	→ **SELFCHECK**	**Carry out self check?** See Section 5.18. ● YES ● NO (testing different parameters) *Press key ↵ to transfer to subfunction* "FIELD CURRENT".
	→ **FIELDCUR.**	Determine field current ● INTERNAL ● EXTERNAL (only with power driver, see Sect. 8.6) *Press ↵ key to return to* Fct. 3.07 "HARDWARE".

4.5 Error messages in measuring mode

The following list contains all errors which may occur during flow measurment. Errors are displayed when "YES" is selected in Fct. 1.04 DISPLAY, subfunction "DISP. MSG.".

Error message	Description of error	Elimination of error
LINE INT.	Power failure Note: no counting during power failure	Cancel error in RESET/QUIT. menu Reset totalizer if necessary.
OVERFLOW I *or* OVERFL. I2	Current output overranged. (flow rate > measuring range)	Check instrument parameters and correct if necessary. After elimination of the cause, the error message is cancelled automatically. See Sections 6.4 and 6.7.
OVERFLOW P *or* OVERFL. P2	Pulse output P *or* Pulse output range P2 exceeded (flow rate > modulation range)	Check instrument parameters and correct if necessary. After elimination of the cause, the error message is cancelled automatically. See Sections 6.4 and 6.7.
I SHORT *or* * I2 SHORT	Current output I or I2 externally shorted or load < 15 Ω	Check mA loop and increase load using additional resistor if necessary.
I OPEN *or* * I2 OPEN	mA loop interrupted by current output I or I2 or load > 500 Ω	Check mA loop and reduce load to 500 Ω if necessary.
TOTALIZER	Overflow of internal totalizer	Delete error message in RESET/QUIT menu, see Sect. 4.6
ADC	Analog/digital converter range exceeded	Set Fct. 3.06, subfunction ADC GAIN to "10". See Sections 6.4 and 6.7. If error message does not disappear, consult factory.
ADC-PARAM.	Check sum error	Replace ADC printed circuit board
ADC-HARDW.	Hardware error A/D converter	Replace ADC printed circuit board
ADC GAIN	Hardware error A/D converter	Replace ADC printed circuit board
FC-HARDW.	Hardware error on field current PCB	Replace field current PCB
FATAL.ERROR	Fatal error, measurement interrupted	Replace electronic unit or consult factory.
EP PARAM.	Parameters of "Empty Pipe" are wrong	Error shut off automatically EPD function. Please check calibration values! Value Empty Pipe – Value Full pipe ≥ 10 Values must be in range of 0 – 150.

* only for active operation

4.6 Resetting the totalizer and deleting error messages, RESET/QUIT menu

Delete error messages in RESET/QUIT menu

Key		Display	Description
	- - - - - - -	- - - - - / - - -	Measuring mode
↵	**CodE 2**	- -	Key-in entry code 2 for RESET/QUIT menu: ↑ →
↑ →		**ERROR QUIT.**	Menu for error acknowledgement
→		**QUIT. NO**	**Do not** delete error messages, press ↵ twice to return to measuring mode.
↑		**QUIT. YES**	Delete error messages
↵		**ERROR QUIT.**	Error messages deleted.
↵	- - - - - - -	- - - - - / - - -	Return to measuring mode

Reset totalizer in RESET/QUIT menu

Key		Display	Description
	- - - - - - -	- - - - - / - - -	Measuring mode
	CodE 2	- -	Key-in entry code 2 for RESET/QUIT menu: ↑ →
↑ →		**ERROR QUIT.**	Menu for error acknowledgement
↑		**TOTAL.RESET**	Menu for resetting totalizer
→		**RESET NO**	**Do not** reset totalizer, press ↵ twice to return to measuring mode
↑		**RESET YES**	Reset totalizer
↵		**TOTAL.RESET**	Totalizer is reset
↵	- - - - - - -	- - - - - / - - -	Return to measuring mode

4.7 Examples of signal converter settings

In the following example the cursor or flashing part of the display is shown in **bold** characters.

- **Change measuring range of current output and value for error messages** (Fct. 1.05):
- Change measuring range from 04-20 mA to **00-20 mA**
- Change value for error messages from 0 mA to **22 mA**

Key	Display		Description
→			If "YES" is selected in Fct. 3.04 ENTRY CODE, enter the 9-digit entry CODE 1: → → → ↑ ↑ ↑ ↵ ↵ ↵
	Fct. 1.00	**OPERATION**	
→	Fct. 1.**01**	**FULL SCALE**	
4x ↑	Fct. 1.**05**	**CURRENT I**	
→		FUNCT. I	
→ ↵		RANGE I	
→	**04-20**	mA	old current range
2x ↑	**00-20**	mA	new current range
↵		I ERROR	
→	**0**	mA	old value for error messages
↑	**22**	mA	new value for error messages
↵	Fct. 1.**05**	**CURRENT I**	
↵	Fct. 1.00	**OPERATION**	
↵		**STORE YES**	
↵	- - - - - - -	- - - - - / - - -	Measuring mode with new current output data

5 Description of functions

5.1 Full-scale range $Q_{100\%}$

Fct. 1.01 FULL SCALE
Press → key

Select unit for full-scale range $Q_{100\%}$
- **m³/h** (cubic metres per hour)
- **Liter/Sec** (litres per second)
- **US.Gal/min** (US gallons per minute)
- User-defined unit, factory setting = **"Liter/h"** (litres per hour) or **"US MGal/day",** see Section 5.14

Select with ↑ and ↓ keys.
Use → key to change to numerical setting, 1st number (cursor) flashes.

Set full-scale range $Q_{100\%}$
The setting range depends on the meter size (DN) and the flow velocity (v):

$\mathbf{Q_{min}} = \frac{\pi}{4}$ DN² x v_{min} $\mathbf{Q_{max}} = \frac{\pi}{4}$ DN² x v_{max} (refer to flow table in Section 10.2)

Nom. diameter/meter size
- DN 2.5 – 1200 / $^1/_{10}$" – 48": 0.0053 – 48 860 m³/h
  0.0237 – 218 560 US.Gal/min
- DN 1300 – 3000 / 52" – 120": 1435 – 305 360 m³/h
  (refer to Section 8.6) 6415 – 1 366 000 US.Gal/min

Change flashing number (cursor) with ↑ and ↓ keys.
Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to return to Fct. 1.1 FULL SCALE

Please note that if "VALUE P" or "VALUE P2" is displayed after pressing ↵ key:
PULSE/VOL. is set in Fct. 1.06 PULS P and/or in Fct. 1.07 PULS 2 A1, subfunction "SELECT P" and/or "SELECT P2". Due to the changed full-scale range $Q_{100\%}$, the output frequency (F) of the pulse outputs is either exceeded or not reached:

$\mathbf{P_{min}} = F_{min} / Q_{100\%}$ $\mathbf{P_{max}} = F_{max} / Q_{100\%}$

Change pulse value accordingly, see Section 5.07 Pulse output P, Fct. 1.06 and/or 2nd pulse output A1, Fct. 1.07.

5.2 Time constant

Fct. 1.02 TIMECONST.
Press → key

Select
- **ALL** (applies to display and all outputs)
- **ONLY I** (applies only to display, current and status outputs)

Select with keys ↑ and ↓.
Press ↵ key to change to numerical setting, 1st number (cursor) flashes.

Set numerical value
- **0.2 - 99.9 s** (seconds)

Change flashing number (cursor) with keys ↑ and ↓.
Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to return to Fct. 1.02 TIMECONST.

5.3 Low-flow cutoff SMU

Fct. 1.03 L.F. CUTOFF
Press → key

Select
- **OFF** (fixed tripping points: ON = 0.1 % / OFF = 0.2 %)
- **PERCENT** (variable tripping points: ON = 1 - 19 % / OFF = 2 - 20 %)

Select with keys ↑ and ↓ (only if PERCENT is selected).
1st number (cursor) flashes.

Setting the numerical value when "PERCENT" is selected
- **01** to **19** (cutoff "ON" value, left of hyphen)
- **02** to **20** (cutoff "OFF" value, right of hyphen)

Change flashing number (cursor) with keys ↑ and ↓ .
Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to return to Fct. 1.03 L.F. CUTOFF.

Note: the cutoff "OFF" value must be greater than the cutoff "ON" value.

5.4 Display

Fct. 1.04 DISPLAY
Press → key

→ **DISP. FLOW = select unit for display of flow rate,** *press → key*
- **NO DISP** (no display)
- **m³/h** (cubic metres per hour)
- **Liter/Sec** (litres per second)
- **US.Gal/min** (US gallons per minute)
- User-defined unit, factory setting = **"Liter/h"** (litres per hour) or **"US MGal/day"**, see Section 5.14
- **PERCENT** (percentage display)
- **BARGRAPH** (numerical value and bar graph display in %)

Select with ↑ and ↓ keys.
Press ↵ key to change to subfunction "DISP. TOTAL.".

→ **DISP. TOTAL. = select unit for totalizer display,** *press → key*
- **NO DISP.** (no display)
- **OFF** (internal totalizer switched off)
- **+ TOTAL.** • **– TOTAL.** • **+/– TOTAL.** • **SUM. (Σ)** • **ALL (sequential)**

Select with ↑ and ↓ keys.
Press ↵ key to change to display unit setting.

- **m³** (cubic metres)
- **Liter** (litres)
- **US.Gal** (US gallons)
- User-defined unit, factory setting = **"Liter"** (litres) or **"US MGal/day",** see Section 5.14

Select with ↑ and ↓ keys.
Use → key to change to totalizer format setting.

Setting of totalizer format

- Auto (exponent notation)
- **# . #######**
- **## . ######**
- **### . #####**
- **#### . ####**
- **##### . ###**
- **###### . ##**
- **####### . #**
- **########**

Select with ↑ and ↓ keys.
Press ↵ key to change to subfunction "DISP. MSG.".

→ **DISP. MSG. = additional messages desired in measuring mode,** *press → key*

- **NO** (no additional messages)
- **YES** (display additional messages, e.g. errors, in sequence with measured values)

Select with ↑ and ↓ keys.
Press ↵ key to return to Fct. 1.04 DISPLAY

Note: "BUSY" is displayed in measuring mode when all displays are set to *"NO DISP."* or *"NO".* Sequencing of displays is automatic. In measuring mode, however, keys - and ¯ can be used for manual sequencing. Return to automatic sequencing after approx. 3 minutes.

Please refer to Section 2.7 "Factory settings"

5.5 Internal electronic totalizer

The internal electronic totalizer counts in m³ regardless of the unit set in Fct. 1.04, subfunction "DISP. FLOW".
The counting range depends on the meter size and has been selected such that the totalizer will count for at least 1 year without overflow.

Meter size		**Counting range**	
DN mm	Inch	in m³	US Gal equivalent
2.5 - 50	$^1/_{10}$ - 2	999 999.99999999	0 - 264 172 052.35800
65 - 200	$2^1/_2$ - 8	9 999 999.9999999	0 - 2 641 720 523.5800
250 - 600	10 - 24	99 999 999.999999	0 - 26 417 205 235.800
700 -1000	28 - 40	999 999 999.99999	0 - 264 172 052 358.00

Only part of the totalizer count is shown in the display as it is not possible to display a 14-digit number. Unit and format of the display are freely selectable. Refer to Fct. 1.04, subfunction "DISP. TOTAL." and Section 5.4 to determine which part of the count is to be displayed. Display overflow and totalizer overflow are independent of one another.

Example

Internal count	0000123 . 7654321	m³
Format, display unit	XXXX . XXXX	liter
Internal count in unit	0123765 . 4321000	liter
Displayed	3765 . 4321	liter

5.6 Internal power supply (E+/E-) for connected loads

Passive loads connected to the outputs and inputs can be fed by means of the internal power supply (terminals E+/E-).

U = 24 V DC (observe polarity)
Ri = approx. 15 Ω
I ≤ 100 mA

Connection diagrams, see Section 2.6.

5.7 Current output I

Fct. 1.05 CUR. OUTP. I
Press → key

→ FUNCT. I = select function for current output, *press → key*
- **OFF** (switched off, no function)
- **+ DIR.** } (measurement in one direction, refer to selection of main flow direction in
- **– DIR.** } Fct. 3.02 FLOW METER, subfunction "FLOW DIR.")
- **2 DIR.** (2 flow directions, F/R mode, forward/reverse)

Select with ↑ and ↓ keys.
Press ↵ key to change to subfunction "RANGE I".
Exception: *when "OFF" is selected, return to Fct. 1.05 CUR. OUTP. I.*
When "2 DIR." is selected, change to subfunction "REV. RANGE".

→ REV. RANGE = select full-scale range for reverse flow
(only displayed when "2 DIR." is selected in "FUNCT. I" above)
Press → key
- **100 PCT.** (same full-scale range $Q_{100\%}$ as forward flow, see Fct. 1.01)
- **PERCENT** (adjustable range) Setting range 005 - 150 % of $Q_{100\%}$ (see Fct. 1.01)

Select with ↑ and ↓ keys.
Press → key to change to numerical setting.
Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to change to subfunction "RANGE I".

→ RANGE I = select the measuring range, *press → key*
- **0 - 20 mA** } fixed ranges
- **4 - 20 mA** }
- **mA** (any value) (value $I_{0\%} < I_{100\%}$!)

$I_{0\%}$ – $I_{100\%}$
0-16 mA 4-20 mA

Press → key to change to numerical setting.
Select with ↑ and ↓ keys.
Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to change to subfunction "I ERROR"

→ **I ERROR = set the error value,** *press → key*

- **22 mA** (fixed value)
- **0.0 - $I_{0\%}$ mA** (variable value, only variable when $I_{0\%} \geq 1$ mA, see "RANGE I" above)

Select with ↑ and ↓ keys.
Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to return to Fct. 1.05 CUR. OUTP. I

Please refer to Section 2.7 "Factory settings"

Refer to Section 2.6 for connection diagrams and to Section 5.16 for characteristics.

5.8 Pulse outputs P and A1

	Pulse output P	**2nd pulse output A1**
for ...	electronic totalizer	electromagnetic or electronic totalizers
Terminals	P and P	A1 and A ⊥
F_{max} at full-scale range $Q_{100\%}$	10,000 pulses/s	50 pulses/s
F_{min} at full-scale range $Q_{100\%}$	10 pulses/h	10 pulses/h
Max. switching current	30 mA / AC or DC	100 mA / AC or DC 200 mA / DC polarized (see Section 6.3)
Remark	–	"PULSOUTP." must be selected in Fct. 3.07 HARDWARE, subfunction "Terminal A1"

PLEASE NOTE: check that output terminal **"A1"** is defined as pulse output in Fct. 3.07 "HARDWARE", see Sections 2.2 and 5.17.

Fct. 1.06 PULS P *Press → key* ***and / or*** **Fct. 1.07 PULS2 A1** *Press → key*

→ **FUNCT. P = select function for pulse output,** *press → key*

- **OFF** (switched off, no function)
- **+ DIR.** } (measurement in one direction, refer to selection of main flow direction in
- **– DIR.** } Fct. 3.02 FLOW METER, subfunction "FLOW DIR.")
- **2 DIR.** (2 flow directions, F/R mode, forward/reverse)

Select with ↑ and ↓ keys.
Press ↵ key to change to subfunction "SELECT P".
Exception: *when "OFF" is selected, return to Fct. 1.06 PULS P or Fct. 1.07 PULS2 A1.*

→ **SELECT P = select pulse type,** *press → key*

- **PULSE/VOL.** (pulses per unit volume, flow)
- **PULSE/TIME** (pulses per unit time for 100 % flow)

Select with ↑ and ↓ keys.
Press ↵ key to change to subfunction "PULSWIDTH".

→ **PULSWIDTH = select pulse width,** *press → key*

- **AUTO** (automatic = 50 % of cycle duration of 100 % output frequency)
- **SYM.** (symmetric = pulse duty factor 1:1 across entire range)
- **SEC.** (variable) setting range 0.01 - 1.00 SEC

Select with ↑ and ↓ keys.
Press → key to change to numerical setting.
Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.

Press ↵ key to change to subfunction "VALUE P" and/or "VALUE P2".

→ **VALUE P = set pulse value per unit volume**
only appears when "PULSE/VOL." is selected in "SELECT P", *press → key*

- **XXXX PulS/m³**
- **XXXX PulS/litre**
- **XXXX PulS/US.Gal**
- **XXXX PulS**/user-defined unit, factory setting = **"Liter"** or **"US MGal/day",** see Section 5.14

Select with ↑ and ↓ keys.
Press → key to change to numerical setting, 1st number (cursor) flashes.

Set numerical value

- **XXXX** (setting range depends on pulse width and full-scale range:
  $\mathbf{P_{min}} = F_{min} / Q_{100\%}$ $\mathbf{P_{max}} = F_{max} / Q_{100\%}$)

Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to return to Fct. 1.06 PULS P or to Fct. 1.07 PULS2 A1.

or

→ **VALUE P = set pulse value per unit time**
only appears when "PULSE/TIME" is selected in "SELECT P", *press → key*

- **XXXX PulSe/Sec**
- **XXXX PulSe/min**
- **XXXX PulSe/h**
- **XXXX PulSe**/user-defined unit, factory setting = **"h"** or **"day"**, see Section 5.14

Select with ↑ and ↓ keys.
Press → key to change to numerical setting, 1st number (cursor) flashes.

Set numerical value

- **XXXX** (setting range depends on pulse width)

Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to return to Fct. 1.06 PULS P or to Fct. 1.07 PULS2 A1.

Please refer to Section 2.7 "Factory settings".

Refer to Section 2.6 for connection diagrams and to Section 5.16 for characteristics.

5.9 Status outputs A1 / A2 and D1 / D2

PLEASE NOTE:
Connection diagrams see Section 2.6.

Status outputs	A1	A2	D1	D2
Select **Fct** _ . _ _ then press → key	1.07	1.08	1.09	1.10
Terminals	A1 / A⊥	A2 / A⊥	D1 / D⊥	D2 / D⊥
Max. switching current	• 100 mA/AC or DC • 200 mA/DC polarized see Section 6.3	100 mA/AC	100 mA/AC	100 mA/AC
Remark	”STATUSOUTP.” must be selected in Fct. 3.07 HARDWARE, subfunction ”TERMINALS”.	–	–	–

PLEASE NOTE:
Select function for status outputs, *press → key*

- **ALL ERROR** (indicate all errors)
- **FATAL.ERROR** (only indicate fatal errors)
- **OFF** (switched off, no function)
- **ON** (signals the operation of the flowmeter)
- **SIGN I** } F/R mode
- **SIGN P/P2** }
- **OVERFL. I** } exceeding output ranges
- **OVERFL. P/P2** }

} dynamic behaviour of outputs see Fct. 1.02, Sect. 5.2 ”Time constant”
I = ONLY I
P/P2 = ALL

- **INVERS. A1** (switches output A2 inverse to A1. A1 and A2 then operate as change-over elements with common centre grounding contact A⊥. Only available when status output is selected in Fct. 3.07 ”TERM. A1”.)
- **INVERS. D1** (switches output D2 inverse to D1. D1 and D2 then operate as change-over elements with common centre grounding contact D⊥).
- **EMPTY PIPE** (signals that measuring tube is empty, only with option ”empty tube detection”)
- **AUTO. RNG.** (automatic range change) Setting range 5 - 80 PERCENT
  (= high to low range ratio, 1:20 to 1:1.25, value must be higher than that of Fct. 1.03 L.F. CUTOFF), see Section 5.20.
- **FULL SCALE,** see Section 5.19.
  Select flow direction (characteristic) for full-scale range
  • + DIR. • – DIR. • 2 DIR. *Select with ↑ and ↓ keys.*
  Define full-scale range

XXX –	YYY
0 – 150%	0 – 150%

normally open contact: XXX > YYY
normally closed contact: XXX < YYY
hysteresis: difference between XXX and YYY.

Press ↵ key to change to numerical setting, 1st number (cursor) flashes.
Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to return to Fct. 1.07, 1.08, 1.09 or 1.10 for status outputs A1, A2, D1 or D2.

Characteristic of status outputs	Switch open	Switch closed
OFF (switched off)	no function	
ON (e.g. operation indicator)	power supply OFF	power supply ON
SIGN I (F/R mode)	**f**orward flow	**r**everse flow
SIGN P/P2 (F/R mode)	**f**orward flow	**r**everse flow
FULL SCALE (full-scale indicator)	inactive	active
AUTO. RNG. (autom. range change)	high range	low range
OVERFL. I (I range exceeded)	current output O.K.	cur. output range exceeded
OVERFL. P/P2 (P range exceeded)	pulse output O.K.	pulse output range exceeded
ALL ERROR (all errors)	error	no error
FATAL.ERROR (only fatal errors)	error	no error
INVERS A1: status output A2 . . .	when A1 is closed	when A1 is open
INVERS D1: status output D2 . . .	when D1 is closed	when D1 is open
EM**PTY PIPE** (empty tube identification option)	when measuring tube is empty	when measuring tube is full

For factory settings please refer to Section 2.7.

5.10 Control inputs C1 and C2

Fct. 1.11 CONTROL C1 *and/or* **Fct. 1.12 CONTROL C2**
Press → key *Press → key*

Select function for the control inputs, *press ↑ or ↓ key*

- **OFF** (switched off, no function)
- **OUTP. HOLD** (hold output values) } Functions also act on
- **OUTP. ZERO** (set outputs to ”min. values”) } display and totalizer
- **TOTAL. RESET** (reset totalizer)
- **ERROR. RESET** (acknowledge/delete error messages)
- **EXT. RNG.** (external range change for automatic range change, see Sect. 5.20.
  Setting range 5 - 80 PERCENT = low to high range ratio
  1:20 to 1:1.25, value must be greater than that of Fct. 1.03 L.F. CUTOFF)

Press ↵ key to change to numerical setting, 1st number (cursor) flashes.
Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.

Press ↵ key to return to Fct. 1.11 CONTROL C1 or to Fct. 1.12 CONTROL C2.

Please refer to Section 2.7 for factory settings.

Connection diagram see Section 2.6.

5.11 Language

Fct. 3.01 LANGUAGE
Press → key

Select language for texts in display

- **D** (German)
- **GB/USA** (English)
- **F** (French)
- Other languages on request
- **S** (Swedish)

Select with ↑ and ↓ keys.
Press ↵ key to return to Fct. 3.01 LANGUAGE.

5.12 Entry code

Fct. 3.04 ENTRY CODE
Press → key

Select

- **NO** (no code, enter setting mode by pressing → key)
- **YES** (enter setting mode by pressing → key and Code 1: → → → ↵ ↵ ↵ ↑ ↑ ↑)

Select with ↑ and ↓ keys.
Press ↵ key to return to Fct. 3.04 ENTRY CODE.

5.13 Flow sensor

Fct. 3.02 FLOW METER
Press → key

→ **DIAMETER = set meter size (see instrument nameplate),** *press → key*
Select size from table of meter sizes:
- **DN 2.5 – 1200** equivalent to **$^{1}/_{10}$ - 48 inch**
- **DN 1300 – 3000** equivalent to **52 - 120 inch,** see Section 8.6.

Select with ↑ and ↓ keys.
Press ↵ key to change to subfunction "FULL SCALE".

→ **FULL SCALE = set full-scale range,** *press → key*
Set as described in Section 5.1.

Press ↵ key to change to subfunction "GK VALUE".

Please note that if "VALUE P" or "VALUE P2" is displayed after pressing ↵ key:
PULSE/VOL. is set in Fct. 1.06 PULS P and/or in Fct. 1.07 PULS 2 A1, subfunction "SELECT P" and/or "SELECT P2". Due to the changed full-scale range $Q_{100\%}$, the output frequency (F) of the pulse outputs is either exceeded or not reached:

$\mathbf{P_{min}} = F_{min} / Q_{100\%}$ $\mathbf{P_{max}} = F_{max} / Q_{100\%}$

Change pulse value accordingly, see Section 5.08 Pulse output P, Fct. 1.06 and/or 2nd pulse output A1, Fct. 1.07.

→ **GK VALUE = set flow sensor constant GK,** *press → key*
- **1.0000 - 9.9999** (note information on instrument nameplate, do not change setting)

Change flashing number (cursor) with keys ↑ and ↓ .
Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.
Press ↵ key to change to subfunction "FIELD FREQ."

→ **FIELD FREQ. = set magnetic field frequency,** *press → key*
- **1/2** • **1/6** (1/2, 1/6, 1/18 or 1/36 of power frequency, see instrument nameplate,
- **1/18** • **1/36** do **not** change setting, exceptions see Sections 6.4-6.10)

Select with ↑ and ↓ keys.
Press ↵ key to change to subfunction "FLOW DIR."
(for DC instruments change to subfunction "LINE FREQ.").

→ **LINE FREQ. = set power frequency customary in country where instrument is used,** *press → key*
(Please note: only applies to instruments with DC power unit)
- **50 Hz** *Select with ↑ and ↓ keys.*
- **60 Hz** *Press ↵ key to change to subfunction "FLOW DIR.".*

→ **FLOW DIR. = set flow direction,** *press → key*
- **+ DIR.** (for identification of flow direction see "+" arrow on flow sensor;
- **- DIR.** F/R mode: identification of "positive" flow direction)

Select with ↑ and ↓ keys.
Press ↵ key to return to Fct. 3.02 FLOW METER.

Zero check, see Fct. 3.03 and Section 7.1.

Please refer to Section 2.7 "Factory settings".

5.14 User-defined units

Fct. 3.05 USER UNIT

Press → key

→ TEXT VOL. = set text for user-defined flow unit, *press → key*

- **Liter** (max. 5 characters, factory setting = "Liter" or "US MGal")
  Characters which can be assigned to each place: **A-Z, a-z, 0-9** or "–" (= blank character).

Change flashing number (cursor) with keys ↑ and ↓.
Use → and ← keys to shift cursor 1 place to right or left.
Press ↵ key to change to subfunction "FACT. VOL.".

→ FACT. VOL. = set factor FM for volume, *press → key*

- **1.00000 E+3** (factory setting "1000" / Factor $\mathbf{F_M}$ = volume per 1 m³)
  Setting range: 1.00000 E-9 to 9.99999 E+9 (= 10^{-9} bis 10^{+9})

Change flashing number (cursor) with keys ↑ and ↓.
Use → and ← keys to shift cursor 1 place to right or left.
Press ↵ key to change to subfunction "TEXT TIME".

→ TEXT TIME = set text for required time, *press → key*

- **h** (max. 3 places, factory setting = "h"/hours or "day")
  Characters which can be assigned to each place:
  A-Z, a-z, 0-9 or "–" (= blank character).

Change flashing number (cursor) with keys ↑ and ↓.
Use → and ← keys to shift cursor 1 place to right or left.
Press ↵ key to change to subfunction "FACT. TIME".

→ FACT. TIME = set factor F_T for time, *press → key*

- **3.60000 E+3** (factory setting "3600" / set factor FT in seconds)
  Setting range: 1.00000 E-9 to 9.99999 E+9 (= 10^{-9} bis 10^{+9})

Change flashing number (cursor) with keys ↑ and ↓.
Use → and ← keys to shift cursor 1 place to right or left.
Press ↵ key to return to Fct. 3.05 USER UNIT
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.

Factors for volume F_M (factor F_M = volume per 1 m³)

Volumetric unit	Text example	Factor F_M	Setting
Cubic metres	**m³**	1.0	**1.00000 E+0**
Liter	**Liter**	1 000	**1.00000 E+3**
Hectolitres	**h Lit**	10	**1.00000 E+1**
Decilitres	**d Lit**	10 000	**1.00000 E+4**
Centilitres	**c Lit**	100 000	**1.00000 E+5**
Millilitres	**m Lit**	1 000 000	**1.00000 E+6**
US gallons	**USGal**	264.172	**2.64172 E+2**
Millions US gallons	**USMG**	0.000264172	**2.64172 E-4**
Imperial gallons	**GBGal**	219.969	**2.19969 E+2**
Mega imperial gallons	**GBMG**	0.000219969	**2.19969 E-4**
Cubic feet	**Feet3**	35.3146	**3.53146 E+1**
Cubic inches	**inch3**	61 024.0	**6.10240 E+4**
US barrels liquid	**US BaL**	6.28982	**6.28982 E+0**
US barrels ounces	**US BaO**	33 813.5	**3.38135 E+4**

Factors for time FT (factor F_T in seconds)

Time unit	Text example	Factor FT (seconds)	Setting
Seconds	**sec**	1	**1.00000 E+0**
Minutes	**min**	60	**6.00000 E+1**
Hours	**h**	3 600	**3.60000 E+3**
Day	**DAY**	86 400	**8.64000 E+4**
Year (=365 days)	**YR**	31 536 000	**3.15360 E+7**

5.15 F/R mode, forward/reverse flow measurement

- **Refer to Section 2.6 for electrical connection of outputs.**
- **Define direction of forward flow,** see Fct. 3.02, subfunction ”FLOW DIR.”:
  in conjunction with F/R operation, this is where to set the direction of the forward flow.
  ”+” means the same direction as shown by the arrow on the flow sensor.
  ”-” means the opposite direction.
- Set one of the **status outputs** to ”SIGN I”, ”SIGN P” or ”SIGN P2”, see Fct. 1.08-1.10 (1.07).
  Dynamic behaviour of outputs in case of ”SIGN I, P or P2” see Section 5.8.
- **Current and/or pulse outputs** must be set to ”2 DIR.”, see Fct. 1.05, 1.06 and 1.07, subfunctions ”FUNCT. I”, ”FUNCT. P” and ”FUNCT. P2”.

5.16 Output characteristics

I current output
$I_{0\%}$ 0 or 4 mA
$I_{100\%}$ 20 mA

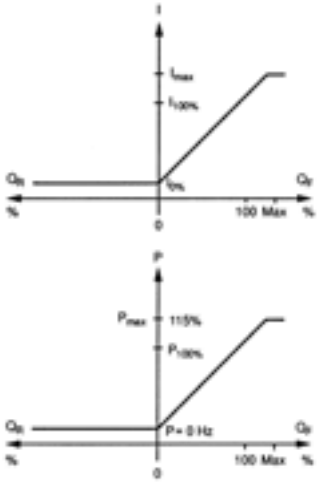
P pulse outputs P and A1 (P2)
$P_{100\%}$ pulses at $Q_{100\%}$, full-scale range

Q_F 1 flow direction, forward flow in F/R mode
Q_R reverse flow in F/R mode
$Q_{100\%}$ full-scale range

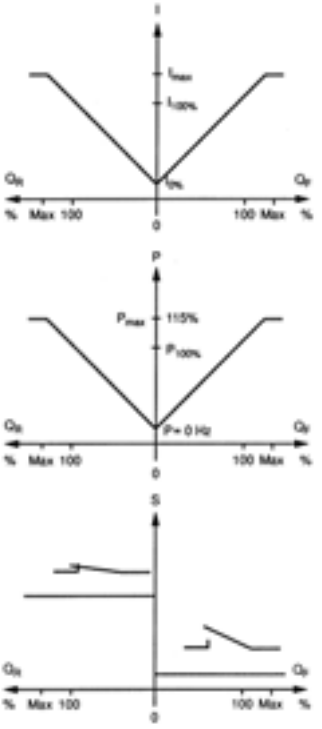
S status outputs A1, A2, D1 and D2

switch open
switch closed

1 flow direction



2 flow directions



5.17 Applications

Fct. 3.06 APPLICAT.
Press → key twice

Set flow characteristics, *select with ↑ or ↓ keys*
- **STEADY** (steady flow)
- **PULSATING** (pulsating flow, e,g, caused by reciprocating pumps, refer to Sections 6.5 to 6.10 ”Special applications”)

Press ↵ key to change to subfunction ”ADC GAIN”.

Set ADC GAIN, *select with ↑ or ↓ keys*
- **AUTO** (for homogeneous process liquids, low pulsation)
- **10** (for high solids contents or extremely pulsating flows)
- **30** (for solids contents or pulsating flows)
- **100** (high resolution even at low flows)

Press ↵ key three times to return to Fct. APPLICAT.

Do not change the settings of subfunctions ”SPEC. FILT.”, ”LIMIT VAL.” and ”LIMIT CNT.” as these functions are needed to obtain steady signals for display and outputs for special applications, see Section 6.6.

5.18 Hardware settings

Fct. 3.07 HARDWARE
Press → key

Define function of terminal A1, *press → key*
- **PULSOUTP.** (= pulse output)
- **STATUSOUTP.** (= status output)

} *Select with ↑ or ↓ keys, press ↵ key to change to ”Selfcheck”*

Carry out selfcheck during measurement? *Press → key*
- **NO** • **YES** *Select with ↑ or ↓ keys, press ↵ key to change to ”Field current”.*

What is checked? ADC gain and other parameters are continuously checked for their permissible values and deviations.

Errors are only displayed when ”YES” is selected in Fct. 1.04 DISPLAY, subfunction ”DISP. MSG.”. After acknowledging/deleting the errors in the ERROR/QUIT menu (see Section 4.6), the tests described in a) and b) above are re-started. Test duration 4 to 20 minutes.

Select field current supply, *press → key*
- **INTERNAL** (DN 2.5–1600 / 1/10”–64”)
- **EXTERNAL** (see Section 8.6)

} Select with ↑ or ↓ keys,

Press ↵ key to return to Fct, 3.07 HARDWARE.

5.19 Limit switches

Fct. 1.07 - 1.10 Status outputs A1, A2, D1 or D2
(Define operating mode of output terminals A1, see Section 5.18)
Press → key
Press ↑ key as often as required to set one of the status outputs to "TRIP. POINT"

Press → key to change to "Characteristic" (flow direction).

Select:
- **+ DIR.**
- **– DIR.**
- **2 DIR.**

} Select with ↑ or ↓ keys

Press ↵ key to change to numerical setting, 1st number (cursor) flashes.
Change *flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.*

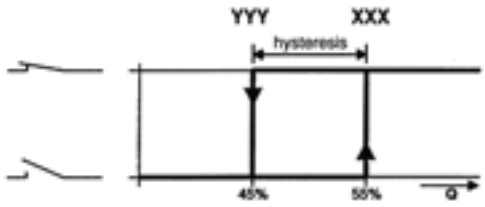
- **Display: XXX – YYY**

- **Setting ranges:** **XXX** value = 0 – 150% of $Q_{100\%}$
  YYY value = 0 – 150% of $Q_{100\%}$
  hysteresis ≥ 1% (= difference between XXX and YYY values)

- **Switching behaviour** (NO/NC contact) and hysteresis are adjustable.

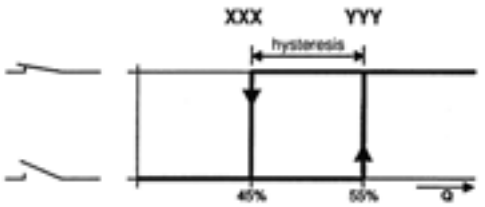
NC contact XXX value > YYY value
Switch **closes** when flow **exceeds** XXX value

Example: XXX = 55%
YYY = 45%
hysteresis = 10%



NC contact XXX value < YYY value
Switch **opens** when flow **exceeds** YYY value

Example: XXX = 45%
YYY = 55%
hysteresis = 10%



Please note: if two status outputs (e.g. D1 and D2) are activated
it is possible to have e.g. **min. and max. values** signalled.

5.20 Range change

Automatic range change by status output

Fct. 1.07 - 1.10 Status outputs A1, A2, D1 or D2
(Define operating mode of output terminal A1, see Section 5.18)

Press → key

Press ↑ key as often as required to set one of the status outputs to automatic range change "AUTO. RNG."

Press ↵ key to change to numerical setting, 1st number (cursor) flashes.
Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.

Setting range: 5 – 80 PERCENT of $Q_{100\%}$ (= low to high range ratio 1:20 to 1:1.25)

Press ↵ key to return to Fct. 1.07 - 1.10, status outputs A1, A2, D1 or D2.

External range change by control input

Fct. 1.11 or 1.12 Control inputs C1 or C2

Press → key

Press ↑ key as often as required to set one of the control inputs C1 or C2 to range change "EXT. RNG."

Press ↵ key to change to numerical setting, 1st number (cursor) flashes.
Change flashing number (cursor) with keys ↑ and ↓. Use → and ← keys to shift cursor 1 place to right or left.
Flashing numbers (cursor) can also be directly set with the 10-key keyboard.

Setting range: 5 – 80 PERCENT of $Q_{100\%}$ (= low to high range ratio 1:20 to 1:1.25)

Press ↵ key to return to Fct. 1.11 or 1.12, control inputs C1 or C2.

6 Special Applications, Functional Checks, Service and Order Numbers

6.1 Use in hazardous areas

6.1.1 General

Signal converters of type IFC 110 F - EEx are type tested as associated electrical apparatus in compliance with European Directive 94/9/EG (ATEX 100a) in conformity with European Standards EN 50 014 / EN 50 020.

The EC type examination certificate has been issued by the Physikalisch-Technische Bundesanstalt (PTB) under: **PTB 02 ATEX 2163 X**

Important, please note!

- Observe the directions, regulations and electrical data specified in the EC type examination certificate, see Section 13.
- In addition to the regulations for power installations (VDE 0100), pay particular attention to the regulations specified in EN 60079-14 “Electrical installations in hazardous areas".
- Assembly, installation, commissioning and maintenance may only be carried out by ”personnel trained in explosion protection“!

6.1.2 Main safety features

Both generation of the intrinsically safe electrode circuit and also protection of the non-intrinsically safe field circuit by fusible links form integral parts of the IFC 110 F - EEx signal converter.

- **Category / Zone**

IFC 110 F - EEx signal converters are associated electrical apparatus required to be installed outside the hazardous area.
The **intrinsically safe electrode circuit** is designed in **Category 2** for use in Zone 1.

- **Types of protection**

The **electrode circuit** is designed in Intrinsic Safety **EEx ib IIC** type of protection.
The **non-intrinsically safe field circuit** must be installed inside the hazardous area using a type of protection conforming to European Standard (e.g. Increased Safety "e").
Power supply and **signal inputs / outputs** are non-intrinsically safe.

- **Field current fuse protection**

The field circuit is fuse-protected in the signal converter IFC 110F – EEx by two fusible links on the FSV circuit board (TR5, 160 mA F).

- **Safety-relevant type code**

The following code is used for type designation:

IFC	**110**	**F**	**/ …**	**- E**	**Ex**
1	2	3	4	5	6

1 Electromagnetic signal converter
2 Type series
3 Field housing for “remote” measuring systems
4 Marking – no effect on explosion protection
  S Special version for -40 °C
  … others as required
5 Approval to European standard
6 Explosion-protected equipment

6.1.3 Installation and electrical connection

Type IFC 110 F - EEx signal converters are type tested as **associated electrical apparatus**.
They are installed outside the hazardous area.
The PE/PA connection (housing) must have protective bonding with the potential of the hazardous area (PA).

Insulation ratings
The insulation of signal converters Type IFC 110 F - EEx is rated in conformity with VDE 0110-1, equivalent to IEC 664-1, and the following rated values have been taken into consideration:

- overvoltage category for the line circuit: III
- overvoltage category for the signal and measuring circuits: II
- insulation pollution degree: 2

Important, please note without fail!

- The buffer barrier for the intrinsically safe electrode circuit is an integral part of the IFC 110 F - EEx signal converter and is safety galvanically isolated.
- The cable entry for the interconnecting cable of the intrinsically safe electrode circuit is marked in light blue.
- The terminals of the intrinsically safe electrode circuit may only be connected to intrinsically safe circuits, even if the device is operated in the non-hazardous area.
- Electrical connection between front panel and potential to ground to be made by way of the fastening screws on the front panel. These must therefore always be properly tightened down (torque approx. 1.3 Nm).

Start-up
Check the following points before starting up:

- that the line voltage (power supply) agrees with the details given on the nameplate.
- that the nominal value of the fuse for field current protection agrees with the maximum permissible nominal value specified for the flow sensor.

Evidence shall be furnished of the intrinsic safety for the electrode circuit together with the safety-relevant data of the interconnecting cable and of the flow sensor.

Operation
Operator control of the signal converter is permitted during operation. For this purpose, remove the cover of the electronic compartment. Definitely avoid ingress of dirt and moisture when the housing cover is open.

Preventive maintenance
The signal converter does not require any maintenance when used for the intended purpose. Within the scope of checks required to be carried out in hazardous areas to maintain systems in proper working order, visual inspection of the housing, cable entries and interconnecting cables for signs of damage should be carried out at regular intervals.

Maintenance
Maintenance work of a safety-relevant nature within the meaning of explosion protection may only be carried out by the manufacturer, his authorized representative or under the supervision of authorized inspectors.

Please note !
Safety data see Sect. 10.1 !

6.2 Magnetic sensors MP (optional)

- The MP magnetic sensors allow the signal converter to be operated with a bar magnet without opening the housing.
- This optional equipment can also be retrofitted (see Section 8.2). A green LED in the ”magnet active” field on the front panel indicates that magnetic sensors are installed.
- The function of the three magnetic sensors is identical to the function of the corresponding keys.
- Take hold of the plastic cap of the bar magnet and touch the glass pane on top of the magnetic sensors with the blue end of the bar magnet (north pole).
- Sensor tripping is acknowledged by corresponding symbols appearing on the display and by a change of colour of the green LED referred to above.

6.3 Changing the load capacity of the output A1 for polarized DC operation

In case of polarized DC operation of output A1 (status or pulse output), the load capacity can be increased to I ≤ 200 mA (factory setting: I ≤ 100 mA).

Switch off the power supply before opening the housing!

1) Remove the cover from the terminal compartment (remove 2 screws).
2) Pull all plug-in terminals out of the sockets inside the terminal compartment.
3) Remove the glass cover from the control compartment (remove 4 screws).
4) Remove 4 screws from the front panel, take hold of the handle on the upper end of the front panel and carefully pull the complete electronic unit out of the signal converter housing.
5) Put down the electronic unit with the front panel facing down.
6) Unscrew the SLP screw from the I/O printed circuit board (inputs/outputs) and carefully pull the PCB out of the plug base (see illustration in Section 8.3).
7) Remove the two X4 jumpers from the I/O printed circuit board, turn them by 90° and plug them back into the PCB in ”DC position” (see illustration of PCB I/O in Section 8.7).
8) Re-assemble in reverse order (items 6 to 1).

6.4 Interfaces

Important, please note!

- Observe the directions and regulations and the electrical data specified in the **EC type test certificate**.
- In addition to the regulations for heavy-current installations (VDE 0100), pay particular attention to the requirements specified in **EN 60079-14 “Electrical equipment in hazardous areas”**.
- Assembly, installation, commissioning and maintenance work may only be carried out by **“personnel trained in explosion protection”!**

6.4.1 RS 232 adapter incl. IMoCom software (optional)

An RS 232 adapter including IMoCom software is available as an optional extra for operation of the signal converter with an MS-DOS PC. Detailed instructions are included in the package.

The RS 232 adapter connecting the signal converter to the PC or laptop is plugged into the IMoCom bus multipoint connector on the front panel of the signal converter (underneath the sliding window, see Section 4.2).

6.4.2 HART®- interface

The HART® interface is a smart interface, in other words a communication signal superimposed on the current output. All functions and parameters can be accessed via this interface.

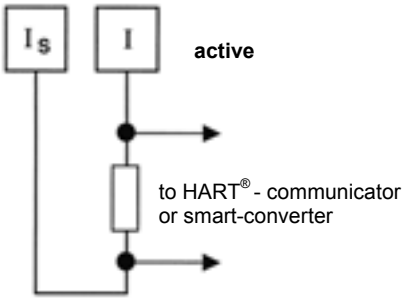
The following HART® features are supported:

- point-to-point connection
- multidrop (up to 15 HART devices)

The burst mode is not normally used.
Further information about HART is available from the HART® Communication Foundation, of which KROHNE is a member.

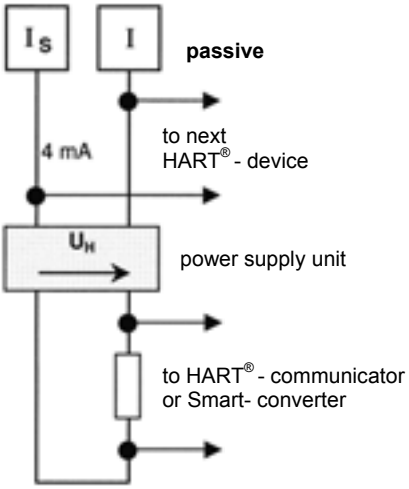
Electrical connection

HART® - active
not with multidrop operation



Bürde ≥ 230 Ω

HART® - passive
only with multidrop operation



Power supply unit (and section switch amplifier) must be set up accordingly if in use for HART® operation. For setting active/passive operation see Sect. 6.8.

Settings and operation

Fct.	Parameter	Point-to-point mode	Multidrop mode
1.05	**Function**	1 CORRECT. **or** 2 CORRECT.	OFF
	Range I	4-20 mA or $I_{0\%} \geq 4$ mA	$I_{0\%} \geq 4$ mA
3.09	**Communication**	HART	HART
	Address	0	01, 02, 03 ..... 15 (use one address at one time only)
Operation Current output		active or passive	passive only

For further information on setting the signal converter refer to chapters 4 and 5.

HART® operating tools / Device Description (DD)

The signal converter can be operated either via its local operator interface or by means of the HART® communicator, which is available from KROHNE.

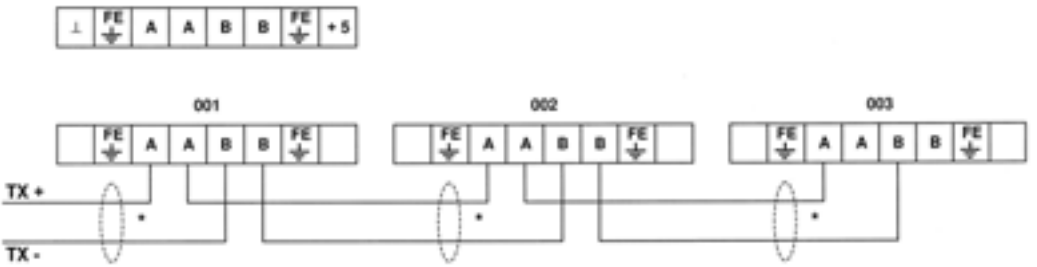
Operator control by means of the HART® communicator requires a device description (DD) which we can load for you into the communicator. We can, of course, also load the DDs of all manufacturers who have filed their DDs with the HART® Communication Foundation.

If you wish to use the signal converter in your operating tool, for example, please ask for the description of the HART® command used so that you can address the complete signal converter functionality via HART®.

6.4.3 KROHNE RS 485 Interface (Option)

Electrical connection

RS 485 Interface (Option, connection at plug-in terminal **RS**)



***** The shields can be grounded as follows:
1) directly at both ends
or where there is risk of circulating currents,
2) directly at one end (static shielding) **or**
3) directly at one end and capacitive at the other end.

In the case of 2) and 3), a decrease in EMC is to be expected.

It is essential to blank off the final signal converter's electrical bus. To do this, solder up the semicircular circuits of solder points S3 and S4 on the RS485 - PCB. For further information refer to section 8.7.

The RS 485 protocol is available. Please contact your local KROHNE supplier / company.

Settings for use in interface operation

Fct.	Parameter	KROHNE RS 485 Interface
3.09	Communication	KROHNE
	Address	000-239
	Baud rate	• 1200 • 9600 • 2400 • 19200 • 4800

For further information on setting the signal converter refer to chapters 4 and 5.

6.5 Pulsating flow

Application
Downstream of positive displacement pumps (reciprocating or diaphragm pumps) without pulsation damper.

Resetting the signal converter, see Sections 4 and 5.

Changing the settings

- Fct. 3.02 FIELD FREQ. (change the magnetic field frequency)
  - Stroke frequency **less than 80 strokes/min.** (at max. pump lift), do **not** change setting.
  - Stroke frequency **80-200 strokes/min.** (at max. pump lift), change setting to **1/2**, only recommended for PROFIFLUX 5000 F (DN 2.5-100 and $^1/_{10}$"-4") and ALTOFLUX 4000 F (DN 10, 15, 50-100 and $^1/_{10}$", $^1/_2$", 2"-4"), for other types and sizes please consult factory.
  - Please note: at stroke frequencies near the limit of 80 strokes/min. additional measurement deviations of ± 0.5 % of the measuring value may occur occasionally.

- Fct. 3.06 APPLICAT. (adapt modulation limit of A/D converter to the application)
  Change setting of subfunction "FLOW" to "PULSATING".

- Fct. 1.04 DISP. FLOW (change display of flow)
  Change setting to "BARGRAPH" in order to be able to evaluate the display ripple.

- Fct. 1.02 TIMECONST. (change time constant)
  - Change setting to "ALL" and set time (**t**) to seconds.
  - Recommendation: $t\,[s] = \dfrac{1000}{\text{min. number of strokes/min.}}$
  - Example: min. number of strokes during operation = 50 strokes/min.

    $t\,[s] = \dfrac{1000}{50/\text{min.}} = 20\ s$

    With this setting, the residual ripple of the display is approx. ± 2 % of the measuring value. Doubling the time constant reduces the residual ripple of the display by a factor of 2.

6.6 Unstable display and outputs

Unstable displays and outputs may occur:
- with high amounts of solids,
- with inhomogeneities,
- with badly blended mixtures,
- after constant chemical reactions in the process liquid or
- in ALTOFLUX 4000 F flow sensors when the wrong electrode material is selected for the process liquid, e.g. Hastelloy B2 for hydrochloric acid.

If the flow is pulsating because of the use of diaphragm or reciprocating pumps please refer to Section 6.5.

Resetting the signal converter, see Sections 4 and 5.

When changing the signal converter settings, the green LED (normal) and the red LED (error) on the front panel of the signal converter start to flash rapidly and frequently. This indicates that the A/D converter range is frequently exceeded and that not all measured values are evaluated.

Change the following settings to allow the display ripple to be properly evaluated:

Select ”BARGRAPH” in Fct. 1.04 DISPLAY, subfunction ”DISP. FLOW” and select ”YES” in submenu ”DISP. MSG.”.

Press ↵ key 4 times to return to measuring mode.

The following displays are possible in measuring mode:

ADC = A/D converter range exceeded

and

OVERFL. I, P and/or **P2** = one or several output ranges exceeded

Change procedure A

PLEASE NOTE:
After each of the following changes check if the display and outputs are unsteady in measuring mode. Do not proceed to the next step unless the display and outputs continue to be unsteady.

- Fct. 1.02 TIMECONST. (change time constant)
  - Set to ”ONLY I”; set to ”ALL” when pulse output is also unsteady.
  - Set time constant to approx. ”20 seconds”, check if display remains unsteady and correct if necessary.

- Fct. 3.06 APPLICAT. (adapt modulation limit of A/D converter to the application)
  Change setting of subfunction ”FLOW” to ”PULSATING” on a trial basis.

  When the green LED and red LED continue to flash,
  change the setting of subfunction ”ADC GAIN” to 30.
  Should the green LED and red LED continue to flash frequently, set value to 10.

- Fct. 3.02 FIELD FREQ. (change magnetic field frequency)
  Change the setting to 1/2 on a trial basis.
  If this has no significant effect, restore the last setting (usually 1/6).

  Only recommended for PROFIFLUX 5000 F (DN 2.5-100 and $^1/_{10}$-4 inch)
  and ALTOFLUX 4000 F (DN 10, 15, 50-100 and $^1/_{10}$, $^1/_2$, 2-4 inch),
  for other types and sizes please consult factory.

If display and outputs continue to be unsteady or if the set time constant proves too high for your specific application (Fct. 1.02) please proceed as described in **change procedure B.**

Change procedure B

PLEASE NOTE:
Do not proceed according to **change procedure B** unless the steps of **change procedure A proved unsuccessful.**

Change procedure B must not be adopted for pulsating flows downstream of positive displacement pumps.

The following settings result in a **modified dynamic behaviour** of the system which is no longer defined by the setting of the time constant in Fct. 1.02.

- Fct. 1.02 TIMECONST.
  Change setting to 3 seconds.
- Fct. 3.06 APPLICAT.
  – Select "YES" in subfunction **"SPEC. FILT."** to activate a special noise filter.
  – Subfunction "**LIMIT VAL."** defines a window with a width (somewhere around the mean flow) equivalent to the value in PERCENT of the full-scale range $Q_{100\%}$ set here (Fct. 3.02, subfunction "FULL SCALE").

  This value must always be a lot smaller than the amplitude of the display ripple (peak-to-peak).

  Example: full-scale range $Q_{100\%}$ 500 m³/h
  ripple mean value ± 25 m³/h = ± 5% of full-scale range $Q_{100\%}$
  set amplitude to e.g. ± 2%

  Signals outside the **± LIMIT VALUE** window are cut off (clipping). When e.g. interferences cause the measuring value to leave this window for a short time, the rate of change of the display and outputs is limited to...

$$\frac{\Delta Q_{max}}{\Delta T}\left[\frac{\%}{s}\right] = \frac{\text{LIMIT VAL.}}{\text{TIMECONST. (Fct. 1.02)}}$$

Formula applying to the above example

$$\frac{\Delta Q_{max}}{\Delta T} = \frac{2\%}{3\ s} = 0.66\ \frac{\%}{s}$$

The delay required for passing on major changes of flow to the display and outputs is defined in subfunction **"LIMIT CNT.".**

Set subfunction **"LIMIT CNT."** to **10** on a trial basis.

Should the measuring value leave the above window in one direction more than 10 times, this window is temporarily rendered inactive.

Display and outputs follow major changes of flow with the appropriate speed.

This setting provides an additional dead time for display and outputs:

Dead time = LIMIT CNT. x duration of measuring cycle
Duration of measuring cycle = **approx. 60 ms** (for magnetic field frequency = 1/6 ´ line frequency, see Section 3.02, subfunction "FIELD FREQ.").

A "10" set in subfunction "LIMIT CNT." results in a dead time of approx. 600 milliseconds.

By changing the subfunctions **"LIMIT VAL.", "LIMIT CNT."** and **"TIMECONST."** (Fct. 1.02) on a trial basis, a setting can normally be found which ensures that the display and outputs are sufficiently stable.

Each of the steps described above must be followed by a check of the ripple of display and outputs in measuring mode.

6.7 Quickly changing flows

Application
For filling processes, high-speed control circuits, etc.

Resetting the signal converter, see Sections 4 and 5.

Changing the settings

- Fct. 1.02 TIMECONST. (change the time constant)
  – Change the setting to "ONLY I" and set time to 0.2 seconds.

- Dynamic behaviour for sizes DN 2.5-300 and $^1/_{10}$ -12 inch
  Dead time: approx. 0.06 at 50 Hz line frequency
  approx. 0.05 at 60 Hz line frequency
  Time constant: as set above, current output (mA) then is 0.1 seconds

- Reduction of dead time by factor 3 (possible by changing the magnetic field frequency)
  Change Fct. 3.02 FLOW METER, subfunction "FIELD FREQ." to "1/2",
  only recommended for PROFIFLUX 5000 F (DN 2.5-100 and $^1/_{10}$ -4 inch)
  and ALTOFLUX 4000 F (DN 10, 15, 50-100 and $^1/_{10}$, $^1/_2$, 2-4 inch),
  for other types and sizes please consult factory.

6.8 Changeover of current output, active / passive mode

Standard factory setting: active mode

The current output can be changed over to the passive mode. This requires a power source, either an external one or via the isolated internal one (24 V DC), power terminals E+ / E-.
See Sect. 2.6 for connection diagrams.

Proceed as follows to change over from active to passive mode, or vice versa.

Changes on the I/O circuit board (inputs/outputs), see diagram in Sect. 8.7

Switch off power source before opening the housing!

1) Remove glass cover from control compartment (detach 4 screws).
2) Remove cover from terminal compartment (detach 2 screws).
3) In terminal compartment, pull off all plug-in terminals.
4) Detach 4 screws from the front panel **F** and carefully pull complete electronic unit out of the converter housing using the grip at the top of the front panel.
5) Place electronic unit down on front panel **F**.
6) Detach the two fastening screws SLP from the **I/O board** (inputs/outputs) and carefully pull the board out of the pin base, see figures in Sect. 8.7.
7) On the printed side of the I/O board, transpose the two jumpers **X3** and **X6**, in the same direction, to Position **A** (= active mode) or Position **P** (= passive mode).
8) Reassemble in reverse order, Points 6) - 1).
9) **Please note:**
In the passive mode, load impedance monitoring under **Fct. 1.04 DISPLAY** and **DISP. MESSAGES - yes** is not possible.

6.9 Empty pipe detection EPD

The signal converter is equipped as standard with an EPD (Empty Pipe Detection) which only needs to be activated as and when required.

To ensure proper functioning, **the following requirements need to be met:**

Type of signal cable	Electrical conductivity of process liquid	Nominal size of flow sensor	Max. length of signal cable
A = Type DS	> 200 µS/cm	≥ DN 25 / ≥ 1“	< 20 m / 65 ft
B = Type BTS	> 50 µS/cm	≥ DN 25 / ≥ 1“	< 20 m / 65 ft

Settings for empty pipe detection (EPD)

- Fct. 3.06 APPLICATION • EMPTY PIPE • YES (switched on) • NO (switched off)

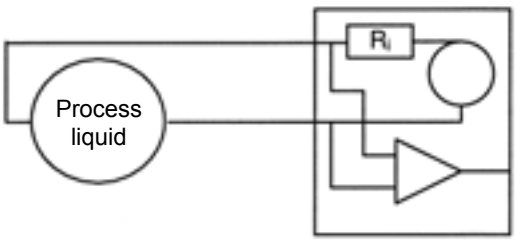
The calibration mode must be run through during initial start-up!

- If“YES“ selected, the impedances for EMPTY and FULL PIPE need to be determined.
- Select subfunction **VALUE FULL** and **CALIB. YES** (determine impedance for “full pipe“) **WAIT** (approx. 20 s)
- Select subfunction **VALUE EMPTY** and **CALIB. YES** (determine impedance for “empty pipe“) **WAIT** (approx. 20 s)
- Store values after completion of calibration for “Full” and “Empty” values; quit operator control after the second calibration.

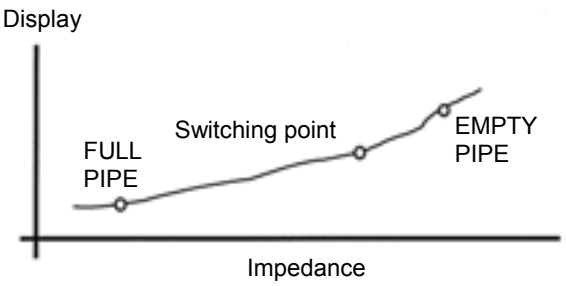
When the electrodes are not wetted (= empty pipe), typically a response time of approx. 20 seconds is required before “empty pipe“ is indicated. In this time undefined display values and output signals are possible.

Functional description

A high-resistance AC voltage is applied to the electrodes. The process liquid in the measuring tube forms a voltage divider together with the internal resistance of the circuit. The voltage ratio is measured and weighted (see figure on right). Impedance and length of electrode cable will also affect the result.



The result is a numerical value proportional to the impedance at the input. The switching point of the Empty Pipe Detector is defined when the system is calibrated for “full pipe“ and “empty pipe“(at approx. 2/3 of the range between the two calibration points). In order to function properly there must be a difference of at least “10“ between the two calibration points. In operation, the display indicates in the range between 0 and 150 (non-dimensional). The value for “FULL PIPE“ must be lower than that for “EMPTY PIPE“.



6.10 Stable signal outputs with empty measuring tube

Important, please note!

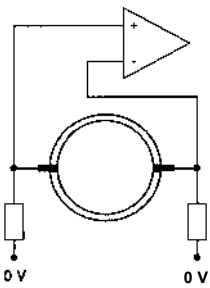
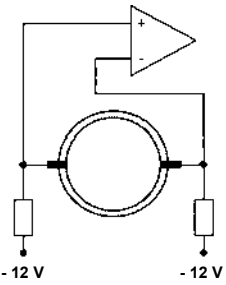
- Observe the directions and regulations and the electrical data specified in the **EC type test certificate**.
- In addition to the regulations for heavy-current installations (VDE 0100), pay particular attention to the requirements specified in **EN 60079-14 "Electrical equipment in hazardous areas"**.
- Assembly, installation, commissioning and maintenance work may only be carried out by **"personnel trained in explosion protection"!**

Output signals can be stabilized to values as for "zero" flow to prevent undefined output signals when the measuring tube is empty.

– Display	0
– Current output	0 or 4 mA, see setting in Fct. 1.05
– Pulse output P	no pulses (= 0 Hz), see setting in Fct. 1.06
– 2nd pulse output A1	no pulses (= 0 Hz), see setting in Fct. 1.07

Prerequisite:

- electrical conductivity of process liquid ≥ 200 mS/cm, ≥ 500 mS/cm for sizes DN 2.5 - 15 and $^1/_{10}$" - $^1/_2$".
- Signal cable length ≤ 20 / ≤ 65 ft and vibration free with signal converter.

LA / S2 Empty Tube stabilization steady display at "0" flow	**LA / S4 electrode cleaning** **and Empty Tube stabilization**
LA / S2 should be used when problems are encountered with EPD or the limits of the application are exceeded. At "0" flow, the electrodes are connected to 0 V (chassis) via high-resistance resistors.	LA / S4 prevents any deposits of high-resistance layers on the electrodes (e.g. fat from very creamy milk) and effects stabilization similar to the LA / S2. For this purpose, the electrodes are connected to –12 V via high-resistance resistors.
	
To join the "semicircles" of the three **soldering points S1, S2** and **S4**, see under "Point 8".	To join the "semicircles" of the three **soldering points S1, S3** and **S4**, see under "Point 8".
Possibly reset low-flow cutoff (SMU), see under Point 11	Possibly reset low-flow cutoff (SMU), see under Point 11

Please note!
Only use the two functions, if **Empty Pipe Detection (EPD)** is switched off, see Sect. 6.9 and in Fct. 3.06 Application → EMPTY PIPE.

Changes on A/D converter PCB, see illustration in Section 8.7

Switch off the power supply before opening the housing !

1) Remove the glass cover from the control compartment (remove 4 screws).

2) Remove the cover from the terminal compartment (remove 2 screws).

3) Pull all plug-in terminals out of the sockets inside the terminal compartment.

4) Remove 4 screws from the front panel, take hold of the handle on the upper end of the front panel and carefully pull the complete electronic unit out of the signal converter housing.

5) Put down the electronic unit with the front panel **F** facing down.

6) Unscrew the two $\mathbf{S}_{LP}$ screws from the printed circuit boards **FSV** (field current supply) and **ADC** (analog/digital converter) and carefully pull both PCBs out of their plug bases (see illustration in Section 8.7).

7) Loosen the common plug-and-socket connection.

8) The circuit side of the **ADC** circuit board has 4 soldering points S1-S4 (two semicircles, each - see illustration in Section 8.7).
Carefully scratch the protective lacquer off the soldering points which are used. Do not remove the protective lacquer from soldering point **S3**. Do not damage the conductive tracks.

9) Connect the semicircles of soldering points which are used with tin solder.

10) Re-assemble in reverse order (items 7 to 2).

11) For LA / S2 (empty tube stabilization) and LA / S4 (electrode cleaning and empty tube stabilization), check the setting of the low-flow cutoff SMU, Fct. 1.03, and reset if necessary:

L.F.Cutoff switched on, range:

Full scale range $Q_{100\%}$		**Cutoff ..... values**	
		... OFF ...	**... ON ...**
> 3 m/s	> 10 ft/s	> 2 %	1 %
1 – 3 m/s	3 -10 ft/s	> 6 %	4 %
< 1 m/s	< 3 ft/s	> 10 %	8 %

7 Functional checks

7.1 Checking the zero with IFC 110 F signal converter, Fct. 3.03

- Set **"zero" flow** in the pipeline. Make sure that the **measuring tube** is **completely filled** with liquid.
- Switch on the system and wait 15 minutes.
- Press the following keys for zero measurement:

Key	Display		Description
→			If "YES" is selected in Fct. 3.04 ENTRY CODE, key in 9-stroke CODE 1 now: → → → ↵ ↵ ↵ ↑ ↑ ↑
	Fct. 1.00	OPERATION	
2x ↑	Fct. 3.00	INSTALL.	
→	Fct. 3.01	LANGUAGE	
2x ↑	Fct. 3.03	ZERO SET	
→		CALIB. NO	
↑		CALIB. YES	
↵	0.00	- - - - - / - - -	Flow rate displayed in set unit, see Fct. 1.04 DISPLAY, subfunction "DISP. FLOW". Zero is measured, duration approx. 15-90 s. "WARNING" is displayed when flow is ">0", acknowledge by pressing ↵ key.
		STORE NO	If new value is not to be stored, press ↵ key (3 times) 4 times = return to measuring mode
↑		STORE YES	
↵	Fct. 3.03	ZERO SET	Store new zero value
(2x) 3x ↵	- - - - - - -	- - - - - / - - -	Measuring mode with new zero

7.2 Checking the measuring range Q, Fct. 2.01

- For this test a measuring value can be simulated in the range of -110 to +110 percent of $Q_{100\%}$ (set full-scale range, see Fct. 1.01 FULL SCALE).
- Switch on the system.
- Press the following keys for checking the measuring range:

Key	Display		Description
→			If "YES" is selected in Fct. 3.04 ENTRY CODE, key in 9-stroke CODE 1 now: → → → ↵ ↵ ↵ ↑ ↑ ↑
	Fct. 1.00	OPERATION	
↑	Fct. 2.00	TEST	
→	Fct. 2.01	TEST Q	
→		SURE NO	
↑		SURE YES	
↵	0	PCT.	Current, pulse and status outputs indicate corresponding values.
	± 10	PCT.	
↑	± 50	PCT.	Select with ↑ key
	± 100	PCT.	
	± 110	PCT.	
↵	Fct. 2.01	TEST Q	End of test, actual measured values again available at outputs
(2x) 3x ↵	- - - - - - -	- - - - - / - - -	Measuring mode

7.3 Hardware information and error status, Fct. 2.02

- Before consulting the factory about errors or flow measurement problems, please invoke Fct. 2.02 HARDW. INFO (hardware information).
- An 8-character and a 10-character status code are stored under this function in each of 3 ”windows”. These 6 status codes allow your compact flowmeter to be subjected to a simple and rapid diagnosis.
- Switch on the system.
- Press the following keys for a display of the status codes:

Key	Display		Description	
→			If ”YES” is selected in Fct. 3.04 ENTRY CODE, key in 9-stroke CODE 1 now: → → → ↵ ↵ ↵ ↑ ↑ ↑	
	Fct. 1.00	OPERATION		
↑	Fct. 2.00	TEST		
→	Fct. 2.01	TEST Q		
↑	Fct. 2.02	HARDW. INFO		
→	→ MODUL ADC	-.- - - - -.- - - - - - - - -	**1st window**	Example for status code **3.25105.02** (8-character code, 1st line) **3A47F01DB1** (10-character code, 2nd line)
↵	→ MODUL I/O	-.- - - - -.- - - - - - - - -	**2nd window**	
↵	→ MODUL DISP.	-.- - - - -.- - - - - - - - -	**3rd window**	
PLEASE NOTE DOWN ALL 6 STATUS CODES !				
↵	Fct. 2.02	HARDW. INFO	Terminate hardware information	
(2x) 3x ↵	- - - - - - - -	- - - - - / - - -	Measuring mode	

7.4 Hardware test, Fct. 2.03

Please note:
Before beginning the test, deactivate any alarms and controllers as the current output will be tested with three values 4, 4.7 and 23 mA for a short period.

Key	Display		Description
→			If ”YES” is selected in Fct. 3.04 ENTRY CODE, key in 9-stroke CODE 1 now: → → → ↑ ↑ ↑ ↵ ↵ ↵
	Fct. 1.00	OPERATION	
↑	Fct. 2.00	TEST	
→	Fct. 2.01	TEST Q	
2 x ↑	Fct. 2.03	HARDW. TEST	Hardware test
→		SURE NO	
↑		SURE YES	
↵		WAIT	Hardware test in progress, duration approx. 60 seconds
		- - - - - - - -	1st error } List of errors see Sect. 4.5. Errors are always displayed independent of setting in Fct. 1.04. If no error is detected, refer to next line.
↑		- - - - - - - -	2nd error
↑		- - - - - - - -	3rd error
↵	Fct. 2.03	HARDW. TEST	Terminate hardware test
(2x) 3x ↵	- - - - - - - -	- - - - - / - - -	Measuring mode

If you need to return your flowmeter to KROHNE, please refer to the last-but-one page of these instructions.

7.5 Faults and symptoms during start-up and flow measurement

- Most faults and symptoms occurring with the flowmeters can be eliminated by following the instructions indicated in the following tables.
- For greater clarity, faults and symptoms in the tables are divided into different groups.
- **LED** light-emitting diodes on the front panel (status messages)
  D display
  I current output I
  P pulse outputs P and A1
  S status outputs D1, D2, A1 and A2
  C control inputs C1 and C2

Before contacting the KROHNE Service Department, please read the instructions in the table. THANK YOU.

Group LED	Display	Cause	Remedial action
LED 1	Both LEDs flash	A/D converter range exceeded	Reduce flow rate; if unsuccessful, test as described in Section 7.6
		Measuring tube drained,- A/D conv. range exceeded	Fill measuring tube
LED 2	Red LED flashes	Fatal error, hardware and/or software fault	Replace signal converter, see Section 8.3
LED 3	Cyclic flashing of red LED, approx. 1 sec.	Hardware fault, watchdog trips	Replace signal converter, see Section 8.3
LED 4	Red LED on continuously	Hardware fault	Replace signal converter, see Section 8.3

Group D	Display	Cause	Remedial action
D 1	LINE INT.	Power failure Note: no counting during power failure	Delete error message in RESET/QUIT. menu, reset totalizer if necessary.
D 2	OVERFL. I	Current output range exceeded	Check instrument parameters and correct if necessary. Error message is deleted automatically after cause has been eliminated.
D 3	OVERFL. P	Pulse output range exceeded Note: totalizer deviation is possible	Check instrument parameters and correct if necessary. Reset totalizer. Error message is deleted automatically after cause has been eliminated.
D 4	ADW	A/D converter range exceeded	Error message is deleted automatically after cause has been eliminated.
D 5	FATAL.ERROR	Fatal Error, all outputs are set to ”min” values	Replace signal converter, see Sect. 8.3 or consult KROHNE Service, having first noted down hardware information and error status, see Sect. 7.3, Fct. 2.02.
D 6	TOTALIZER	Counts lost (overflow, data error)	Delete error message in RESET/QUIT. menu.
D 7	I SHORT	Short circuit at current output	Check electrical connection acc. to Sect. 2.2 and correct if necessary. Load ≥ 15 Ω !
D 8	I OPEN	Open current output	Provide load ≤ 500 Ω !
D 9	ADC PARAM.	Fault detected on the ADC printed circuit	Check measuring accuracy. Replace ADC printed circuit board (see Sect. 8.4) or consult KROHNE Service, having first noted down hardware information and error status, see Sect.. 7.3, Fct. 2.02
D 10	ADC HARDW.		
D 11	ADC GAIN		
D 12	STARTUP, cyclic flashing	Hardware fault, watchdog trips	Replace signal converter (see Sect. 8.3) or consult KROHNE Service, having first noted down hardware information and error status, see Sect. 7.3, Fct. 2.02.
D 13	BUSY	Displays for flow, totalizers and messages disabled	Change setting in Fct. 1.4
D 14	Unsteady display	Low electrical conductivity, high solids content, pulsating flow	Increase time constant in Fct. 1.2, refer to Sect. 6.5 and 6.7.
D 15	No display	Power supply OFF	Switch on power supply.
		Check power supply fuse F5 (F6 for DC versions) in terminal compartment	Replace if blown,

Group I	Faults / Symptoms		Cause	Remedial action
I 1	Receiver instrument indicates ”0” **Invoke test function 2.03 for analysis see Sect.7.4.** (this check is only usefully, if current output is operating in active mode, see Sect. 6.8!)		**Display shows...**	
			I SHORT Current output shorted, Load is < 15 Ω	Eliminate short circuit, Load must be ≥ 15 Ω !
			I OPEN Load resistance > 500 Ω	Find interruption and eliminate.
			No information displayed after test	
			as described for faults **I 2** and **I 9**	
I 2	Receiver instrument indicates “0“.		Wrong connection/polarity	Connect properly, see Sect. 2.2 and 2.6.
		active mode	Circuit and/or receiver instruments defective	Check circuit and receiver instrument at **I_S / I** and replace if necessary. Check position of jumper X3 + X6 for active mode, see Sect. 6.8 and check fuse F9 on I/O PCB and replace if necessary, see Sect. 8.4 and 8.7.
		passive mode	Receiver instruments and/or exernal voltage source defective	Check connections, receiver instruments and external voltage source and replace if necessary.
			Internal power supply (E+E-) is voltage source, shorted or defective current output	Check connections and cables, see Sect. 2.3 and 2.6. Voltage between E+and E- approx. 24 V. If voltage is a lot smaller, switch off the instrument, eliminate the short circuit, check position of jumper X3 + X6 for passive mode, (see Sect. 6.8) and replace fuses F1 and F8 on the I/O PCB if necessary. Switch the instrument back on. If it still does not operate, current output is defective. Replace I/O PCB or complete electronic unit, see Sect. 8.3 and/or 8.4.
			Defective current output	Replace I/O PCB (see Sect. 8.4) or consult KROHNE Service, having first noted down hardware information and error status, see Sect. 7.3, Fct. 2.02.
			Wrong flow direction setting	Set properly in Fct. 3.1.
			Current output switched off	Switch on in Fct. 1.5.

Group I	Faults / Symptoms	Cause	Remedial action
I 3	22 mA are available at current output (fault current)	Range of current output I is exceeded	Check instrument parameters and correct if necessary (see Sect. 2.2 and 5.7) or consult KROHNE Service, having first noted down hardware information and error status, see Sect. 7.3, Fct. 2.02.
I 4	22 mA are available at current output (fault current) and red LED flashes	Fatal Error	Replace signal converter or consult KROHNE Service, having first noted down hardware information and error status, see Sect. 7.3, Fct. 2.02
I 5	Unsteady display	Electric conductivity of process liquid too low	Increase time constant (see Sect. 5.2, Fct. 1.2). Also refer to Sect. 6.7.
I 6	Receiver instruments indicate ”constant value”	Control input C1 or C2 is set to ”Hold outputs” and is activated	Change setting (see Sect. 5.10, Fct. 1.11 and 1.12), or deactivate control input.
I 7	Jumping current values	Current output is set to automatic range change	Change hysteresis or tripping ranges, see Sect. 5.20.
I 8	F/R-Mode: different displays for identical flow volumes in both directions	Different ranges set for ”forward flow” and ”reverse flow”	Change setting, see Sect. 5.15, Fct. 1.05 ”Rev. range”.
I 9	Receiver instruments indicate ”min. values”	Control input C1 or C2 is set to ”Zero outputs” or ”Hold outputs” and is activated	Change setting (see Sect. 5.10, Fct. 1.11 and 1.12) or deactivate control input.

Group P	Faults / Symptoms	Cause	Remedial action
P 1	Totalizer connected but does not count pulses	Wrong connection/polarity	Connect properly, see Sect. 2.3 and 2.6, note recommended resistances !
		Totalizer or exernal voltage source defective	Check connections, totalizer and external voltage source and replace if necessary.
		Internal power supply (E+E-) is voltage source, shorted or defective pulse output	Check connections and cables, see Sect. 2.3 and 2.6. Voltage between E+and E- approx. 24 V. If voltage is a lot smaller, switch off the instrument, eliminate the short circuit and replace fuses F1 and F8 on the I/O PCB if necessary. Switch the instrument back on. If it still does not operate, pulse output is defective. Replace I/O PCB or complete electronic unit, see Sect. 8.3 and/or 8.4.
		Pulse output switched off or wrong flow direction setting	Switch on pulse output and change flow, see Sect. 5.8 and 5.13, Fct. 1.06 (P), 1.07 (A1) and 3.02.
		Fatal Error, red LED is on	Replace signal converter or consult KROHNE Service, having first noted down hardware information and error status, see Sect. 7.3, Fct. 2.02.
		Control input C1 or C2 is set to ”Zero outputs” and is activated	Change settings, see Sect. 5.10, Fct. 1.11 and 1.12 or deactivate control input.
	These causes only apply to the 2nd pulse output P2, terminal A1 !	Terminals A1 and A^ are not defined as a 2nd pulse output	Switch on in Fct. 3.07 and set in Fct. 1.07.
		Resistance of totalizer too low for DC operation, I > 100 mA	Re-position jumper X4 on I/O PCB to suit DC operation, see Sect. 6.3.
P 2	Constant output of totalizer pulses	Control input C1 or C2 is set to ”Hold outputs” and is activated	Change setting, see Sect. 5.10, Fct. 1.11 and 1.12 or deactivate control input.
P 3	Unsteady pulse rate	Electrical conductivity of process liquid is too low	Increase time constant (see Sect. 6.5-6.8) or consult KROHNE Service.
P 4	Pulse rate too high or too low	Incorrect pulse output settings	Correct settings in Fct. 1.06 (P) or 1.07 (A1).

Group S	Faults / Symptoms	Cause	Remedial action
S 1 **(A1, A2, D1, D2)**	No reaction from connected signalling instrument(s)	Defective signalling instrument(s) or external voltage source	Check signalling instrument(s) or external voltage source and replace if necessary.
		Internal power supply (E+/E-) is voltage source: shorted, one or several pulse outputs defective	Check connections and cables, change if necessary (see Sect. 2.6). Voltage between E+ and E- approx. 24 V. Check fuse F8 on the I/O PCB and replace if necessary (see Sect. 8.7). If instrument still does not operate, check fuses **F**.. on the I/O PCB for the status outputs and replace if necessary: **F2** for terminals A1 and A⊥ **F3** for terminals A2 and A⊥ **F4** for terminals D1 and D⊥ **F5** for terminals D2 and D⊥. If it still does not operate, one or several pulse outputs are defective. Replace I/O PCB, see Sect. 8.4.
		Control inputs C1 and C2 are set to ”Hold outputs” or to ”0”	Change setting, see Sect. 4.4 and 5.10, Fct. 1.11 and 1.12
		In addition to this, the red LED flashes = Fatal Error	Replace signal converter, see Sect. 8.3.
S 2 **(A1, A2, D1, D2)**	Signalling instrument(s) is(are) constantly tripped	”All Error” or ”Fatal Error” settings	Check settings in Fct. 1.07-1.10 and change if necessary, see Sect. 4.4 and 5.9.
S 3 **(only for A1)**	No reaction of connected signalling instrument	Terminal ”A1” not defined as status output	Adjust in Fct. 3.07.
		Wrong connection/polarity	Observe polarity for driver capacity **0.1 < I ≤ 0.2 A** see Sect. 6.3. **A1** = ”+” and **A**⊥ = ”–”
S 4 **(only for A1)**	Cyclic tripping of signalling instrument	Terminal ”A1” not defined as status output	Adjust in Fct. 3.07.

Group C	Faults / Symptoms	Cause	Remedial action
C 1	No function of control inputs	Wrong connection	Connect properly, see Sect. 2.5 and 2.6.
		Defective control input C or voltage source (internal or external)	Check connections and cables and change or replace if necessary. Check voltage source. Check fuses F6 and F7 on I/O PCB and replace if necessary.
		Wrong setting of control inputs	Change, see Sect. 4.4 and 5.10.

7.6 Checking the flow sensor

Always switch off the power supply before opening the housing.

Required measuring instruments and tools

- Ohmmeter with at least 6 V measuring voltage range
- or AC voltage/resistance bridge
- **Note:** accurate measurements in the electrode area can only be obtained with an AC voltage/resistance bridge. The measured resistance also heavily depends on the electrical conductivity of the process liquid.

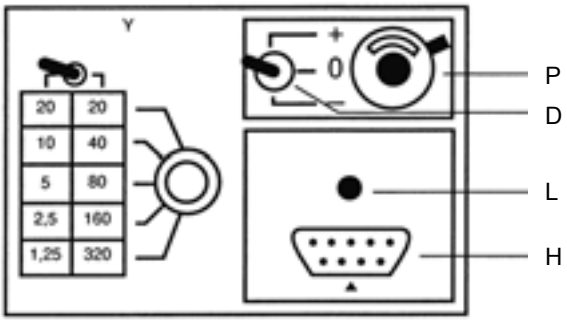
Preparations

- Switch off the power supply.
- Remove the cover from the terminal compartment (remove 2 screws).
- Pull out the two plug-in terminals SC (5-pin, signal line) and FP (4-pin, field current supply line), see illustration in Section 8.1.
- Fill the measuring tube of the flowmeter completely with process liquid.
- **Please note:** the following measurements must only be carried out for plug-in terminals which are occupied (used).

Action Resistance measurements at plug-in terminals **SC** (5-pin, signal line) and **FP** (4-pin, field current supply line)		**Typical result**	**Incorrect result for** **1–3 =** defective flow sensor, return to factory for repair, refer to last-but-one page !
1	Measure resistance between wires **7** and **8**	30 – 170 Ω	If lower, interwinding fault.
			If higher, wire break.
2	Measure resistance between wires **1** and **7** or between wires **1** and **8**	> 20 MΩ	If lower, interwinding fault to PE or FE.
3	Measure resistance between wires **1** and **2** and between **1** and **3** (same measuring conductor always on wire 1 !)	1 kΩ – 1 MΩ (see **"Note"** above) Both values should be approx. equal	If lower, drain measuring tube and repeat measurement; if still too low, short-circuit in electrode wires.
			If higher, break in electrode wires or electrodes contaminated.
			If values differ considerably, break in electrode wires or electrodes contaminated.
4	When signal line B (type BTS/ bootstrap) is used: measure resistance between the following lines: 1 and 20 / 1 and 30 / 20 and 30 2 and 20 / 3 and 30	> 20 MΩ	If lower, line fault. Check connection cables, replace signal line if necessary.

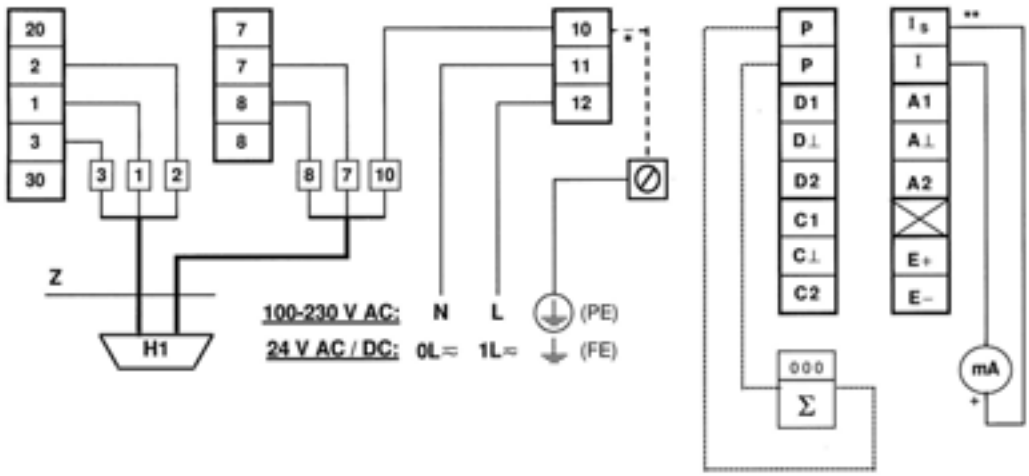
7.7 Checking the signal converter using a GS 8 A simulator (optional)

GS 8 A operating elements and accessories



D switch, flow direction
H socket for plug **H1** of cable **Z**
H1 plug of cable **Z**
L power supply ON
P potentiometer "zero"
Y switch, measuring ranges
Z cable between GS 8 A and signal converter
*** *** active operation

Connection of GS 8 A to signal converter



Switch off the power supply before starting work.

1) Remove the cover from the terminal compartment of the signal converter.
2) Disconnect all flow sensor cables from terminals **1, 2, 3, 7, 8, 20** and **30**, having first noted down which cable is connected to which terminal.
3) Connect the GS 8 A to the signal converter as shown above.
4) Slip plug **H1** of cable **Z** into socket **H** on the front panel of the GS 8 A.
5) Connect the **mA meter** to terminals $\mathbf{I_S/I}$: accuracy class 0.1
Ri = 15-500 W
range 0 / 4 - 20 mA
6) Connect the **electronic totalizer** to terminals **P / P**: range 0 - 10 kHz
time basis at least 1 s
For **further details** on the totalizer and its connection for active or passive modes of operation please refer to the connection diagrams **in Section 2.6.**
7) Test as described on the following two pages.
8) When the test is completed, disconnect the GS 8 A and re-connect the flow sensor and receiver instruments (items 4 to 1 above).

PLEASE NOTE
that an adapter is needed to connect the GS 8 simulator to the signal converter
(adapter Order No. 210764.00)

Checking the setpoint reading

1) Switch on the power supply and allow at least 15 minutes for "warming up".
2) Turn switch **D** (GS 8 A front panel) to "0".
3) Adjust zero to 0 or 4 mA with the 10-turn potentiometer **P** (GS 8 A front panel), depending on the setting in Fct. 1.05, deviation <± 10 µA.
4) Calculate the position of switch **Y** and displayed setpoints **"I"** and **"f"**.

4.1) $X = \frac{Q_{100\%} \times K}{GK \times DN^2}$

$Q_{100\%}$ full-scale range (100%) in unit volume **V** per unit time **t**
GK flow sensor constant, see instrument nameplate
DN meter size DN in mm, not inches, see instrument nameplate
t time in seconds **(sec.)**, minutes **(min.)** or hours **(h)**
V unit volume
K constant according to the following table

t / **V**	Sec	min	h
liters	25 464	424.4	7.074
m³	25 464 800	424 413	7 074
US Gallons	96 396	1 607	26.78

4.2) Determine position of switch **Y**: use table (GS 8 A front panel) to determine value **Y** which comes closest to factor **X** and meets condition **Y** ≤ **X**.

4.3) Calculate setpoint reading "I" for current output: $I = I_{0\%} + \frac{Y}{X} (I_{100\%} - I_{0\%})$ in mA

$I_{0\%}$ current (0/4mA) at 0% flow rate
$I_{100\%}$ current (20mA) at 100% flow rate

4.4) Calculate setpoint reading **"f"** for pulse output: $f = \frac{Y}{X} \times P_{100\%}$ in Hz

$P_{100\%}$ pulses per second (Hz) at 100% flow rate

5) Turn switch **D** (GS 8 A front panel) to "+" or "-" (**f**orward/**r**everse flow).
6) Set switch **Y** (GS 8 A front panel) to the value determined as described above.
7) Check setpoint readings **I** and **f**, see items 4.3 and 4.4 above.
8) Deviation < 1.5 % of setpoint. If higher, replace signal converter, see Section 8.7.
9) Linearity test: set lower Y values, readings will drop in proportion to the calculated values for Y.
10) **Switch off power supply** after completing the test.
11) Disconnect the GS 8 A.
12) Re-assemble in reverse order (items 2 to 1 "in connection of GS 8A"). See also illustration in Section 8.1 and 8.7.
13) The system is ready for operation after the power supply is switched on again.

Example: see next page.

Example

Full-scale range		$Q_{100\%}$	= 200 m³/h (Fct. 1.01)
Meter size		**DN**	= 80 mm = 3 inch (Fct. 3.02)
Current at	$Q_{0\%}$	$I_{0\%}$	= 4 mA } (Fct. 1.05)
	$Q_{100\%}$	$I_{100\%}$	= 20 mA }
Pulses at	$Q_{100\%}$	$P_{100\%}$	= 200 pulses/h (Fct. 1.06)
Flow sensor constant		**GK**	= 3.571 (see instrument nameplate)
Constant	(**V** in **m³**)		
	(**t** in **h**)	**K**	= 7074 (see table)
	(**DN** in **mm**)		

Calculation of **"X"** and setting of **"Y"**

$$X = \frac{Q_{100\%} \times K}{GK \times DN^2} = \frac{200 \times 7074}{3.571 \times 80 \times 80} = 61.905$$

Y = 80, setting of switch Y, see GS 8 A front panel
(comes closest to the value of X and is smaller than X).

Calculation of setpoint readings **I** and **f**

$$I = I_{0\%} + \frac{Y}{X}(I_{100\%} - I_{0\%}) = 4\ mA + \frac{40}{61.905}(20mA - 4mA) = 14.3mA$$

Deviations are permissible between 14.1 and 14.6 mA (equivalent to ± 1.5 %).

$$f = \frac{Y}{X} \times P_{100\%} = \frac{40}{61.905} \times pulses / h = 180.9\ pulses/h$$

Deviations are permissible between 178.2 and 183.6 pulses/h (equivalent to ± 1.5 %).

If you need to return your flowmeter to KROHNE,
please refer to the last-but-one page of these instructions.

8 Service

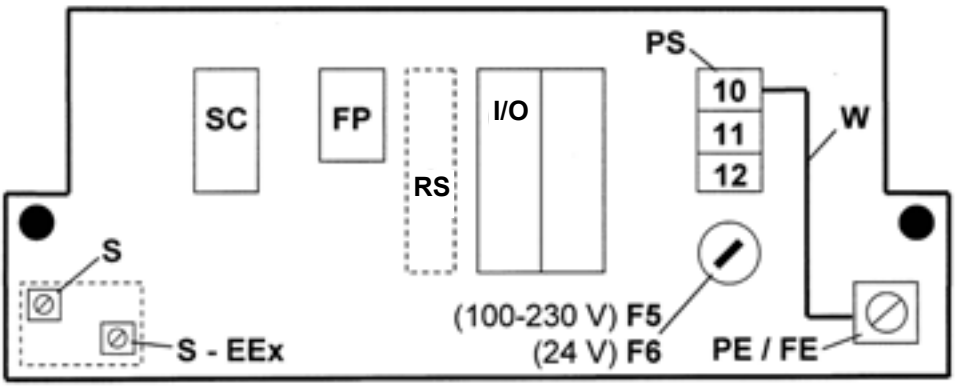
8.1 Replacing the power supply fuse

Switch off the power supply before opening the housing.

1) Remove the cover from the terminal compartment (remove 2 screws).
2) Unscrew the cap of the power supply fuse **F**.
3) Replace fuse F5 or F6, type 5 x 20 G (Order No. see Sect. 9).

F5: value for 100-230 V AC	**0.8 A T**, breaking capacity 1500 A
F6: value for 24 V AC / DC	**1.6 A T**, breaking capacity 150 A

F5/F6	power supply fuses, values are indicated above
FP	plug-in terminal for field current supply line, 4-pin
I/O	plug-in terminal for outputs and inputs, 2x8-pin
PE/FE	U-clamp terminal for connecting protective conductor **PE** or functional grounding conductor **FE**
PS	plug-in terminal for power supply line, 3-pin
RS	plug-in terminal for interface(s)
S	U-clamp terminal for connecting the signal line shielding: signal line A: 2nd shield (7) signal line B: 3rd shield (11)
SC	plug-in terminal for electrode signal line, 5-pin
S-EEx	Same as **"S"**, only available for hazardous duty version
W	internal connection, may not be removed.



8.2 Retrofitting of magnetic sensors MP (optional)

Switch off the power supply before opening the housing.

1) Remove the cover from the terminal compartment (remove 2 screws).

2) Pull all cables out of the plug-in terminals.

3) Remove the glass cover from the control compartment (remove 4 screws).

4) Remove 4 screws from the front panel F, take hold of the handle on the upper end of the front panel and carefully pull the complete electronic unit out of the signal converter housing.

5) Put down the electronic unit with the front panel F facing down (see illustration on the next but one page).

6) Position the 2 mm (0.08") thick insulating strip (Order No. 3 15940.01) loosely on top of the **MP** printed circuit board (PCB). The magnetic sensors and chip capacitor slip into the 4 holes in the insulating strip. Slip the **MP** PCB and insulating strip from right to left between the front panel and **BDE** PCB, taking care that the **MP** PCB and insulating strip are slipped through the three retaining clips H at the back of front panel **F**. Slip the socket connector of the **MP** PCB onto the (5-pin) plug connector $\mathbf{PL_{MP}}$.

7) Fix the **MP** PCB with special steel tooth lock washer and nut $\mathbf{S_{MP}}$ to establish contact between the back of the PCB and the back of the front panel. When correctly fitted, the **MP** PCB must be slightly bent between the final retaining clip H and the plug connector $\mathbf{PL_{MP}}$.

8) Re-assemble in reverse order (items 4 to 1 above).

9) Switch on the power supply. The **"magnet active"** LED on the front panel is green. The function of the corresponding keys is tripped by touching the glass pane above the 3 white fields "→, ↵ and ↑" with the bar magnet. The LED lights up red, see Section 4.2, items ⑦ and ⑧.

8.3 Replacing the complete electronic unit of the IFC 110 F signal converter

Switch off the power supply before opening the housing.

1) Remove the cover from the terminal compartment (remove 2 screws).

2) Pull all cables out of the plug-in terminals.

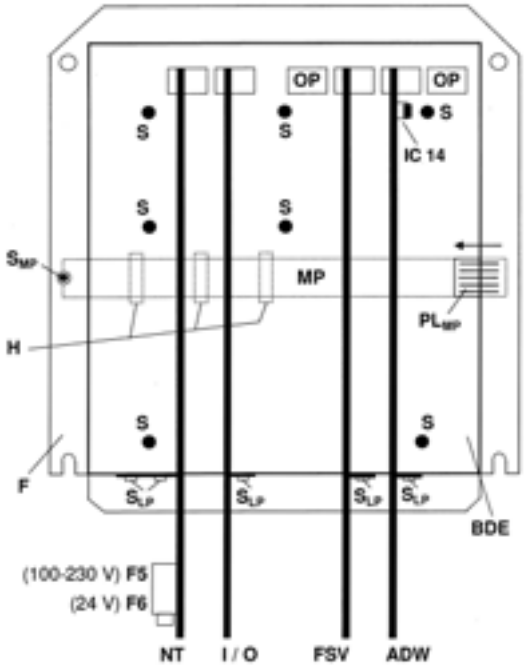
3) Remove the glass cover from the control compartment (remove 4 screws).

4) Remove 4 screws from the front panel F, take hold of the handle on the upper end of the front panel and carefully pull the complete electronic unit out of the signal converter housing.

5) Carefully remove the **data EEPROM IC 14** (on ADC printed circuit board) from the old electronic unit and move it to the new electronic unit. Observe the direction of the IC when plugging the data EEPROM. After changing the EEPROM from the old to the new electronic unit, no further adjustments or settings are required. Refer to the drawing on the next page and to the illustrations of the printed circuit boards in Section 8.7.

6) Re-assemble in reverse order (items 4 - 1 above).

ADC printed circuit board of A/D converter (ADC)
BDE motherboard
F front panel
F5 power supply fuse for 100 – 230 V AC, see Sect. 8.1 and 9
F6 power supply fuse for 24 DC/AC, see Sect. 8.1 and 9
FSV printed circuit board for field current supply
H 3 retaining clips at the back of the front panel
IC 14 data EEPROM (8-pin)
I/O printed circuit board for outputs and inputs
MP printed circuit board for magnetic sensors (optional), see Sect. 6.2 and 8.2
NT printed circuit board for power unit
OP connection plug for additional modules
PL_{MP} 5-pin plug connector for connection of the printed circuit board MP for the magnetic sensors
S 7 nuts for fastening the electronic unit to front panel F
S_{LP} screws for fastening the PCBs
S_{MP} nut and special steel tooth lock washer for fixing the MP PCB for the magnetic sensors



8.4 Replacing single printed circuit boards (PCBs)

Switch off the power supply before opening the housing.

1) Remove the cover from the terminal compartment (remove 2 screws).

2) Pull all cables out of the plug-in terminals.

3) Remove the glass cover from the control compartment (remove 4 screws).

4) Remove 4 screws from the front panel **F**, take hold of the handle on the upper end of the front panel and carefully pull the complete electronic unit out of the signal converter housing.

5) Put down the electronic unit with the front panel **F** facing down.

6) Remove screw(s) $\mathbf{S_{LP}}$ from the PCB(s) to be replaced and carefully pull the PCB(s) out of the plug base(s). Fit new PCB(s), refer to the illustration in Sect. 8.3 (preceding page).

- When **replacing** the PCBs **FSV and/or ADC**, always remove both PCBs together as they have a common plug-and-socket connector.
- When **replacing** the **ADC** PCB, carefully move the data EEPROM **IC 14** from the old to the new PCB and observe the direction of the IC during plugging. After changing the EEPROM from the old to the new electronic unit, no further adjustments or settings are required. Refer to the illustration in Section 8.7.

7) Re-assemble in reverse order (items 6 - 1 above).

8.5 Replacing the flow sensor

Switch off the power supply before beginning work.

1) Before removing the ”old” flow sensor please note down which cable is connected to which terminal.

2) Install the new flow sensor as described in the installation instructions supplied with the instrument.

3) Electrically connect the flow sensor to the signal converter as described in these installation and operating instructions, see Sections 1.3.5 and 1.3.6.

4) During factory calibration, specific calibration data are determined for each flow sensor which are indicated on the instrument nameplate. These data include the primary constant GK and the magnetic field frequency which must be reset in Fct. 3.02 FLOW METER, subfunctions ”GK VALUE” and ”FIELD FREQ.”, see Sections 4.4 and 5.13.

5) If the meter size of the flow sensor has changed, also reset the full-scale range $Q_{100\%}$ and the meter size in Fct. 3.02 FLOW METER, subfunctions ”DIAMETER” and ”FULL SCALE”, see Sections 4.4 and 5.13.

6) Perform zero test as described in Section 7.1 after the signal converter is reset.

7) Reset the internal electronic totalizer of the signal converter as described in Sect. 4.6 if necessary.

8.6 IFC 110 F replacements for old KROHNE signal converters

The IFC 110 F can replace all older KROHNE signal converter versions:

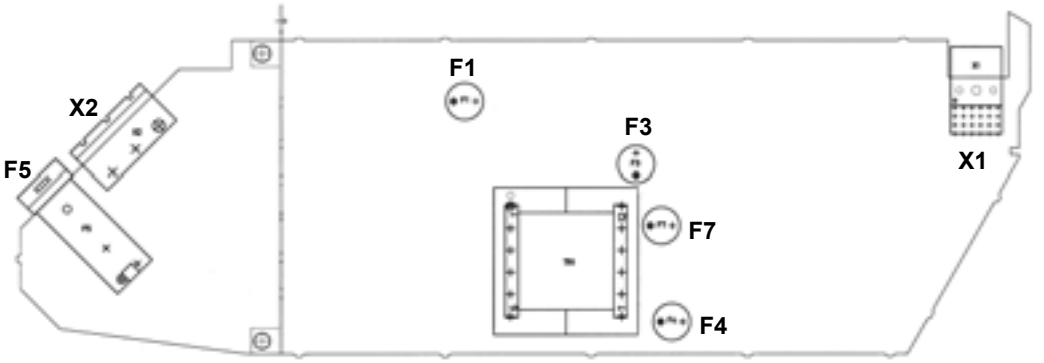
TIV 60 F / T 900 F / SC 100 A/F / SC 100 AS/F

This also applies to systems up to the size of DN 3000 / 120” that are operated with a power driver. Such replacements are delivered together with any new wiring diagrams and additional instructions for installation and setting of the IFC 110 F. You are kindly requested to comply with these instructions.

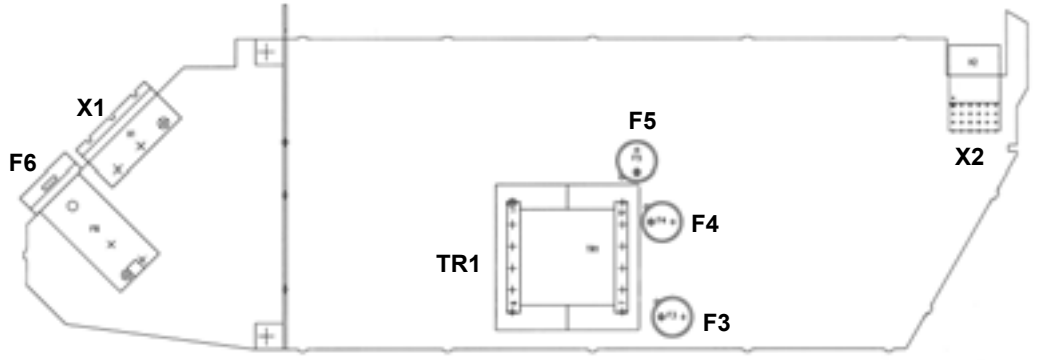
8.7 Illustration printed circuit boards (PCBs)

110 - 230 AC	24 V DC / AC	Description
X2	**X1**	Plug-in terminal inside terminal compartment
X1	**X2**	Internal connection to mother board
F5	**F6**	Power supply fuse (typ, value and order No. see Sect. 9)
		Small fuses TR5 (values and order No. see Sect. 9)
F3	**F5**	5 V voltage
F4	**F3**	Field current supply
F7	**F4**	Current output and power for passive operation of outputs
F1	**-**	Coupling element

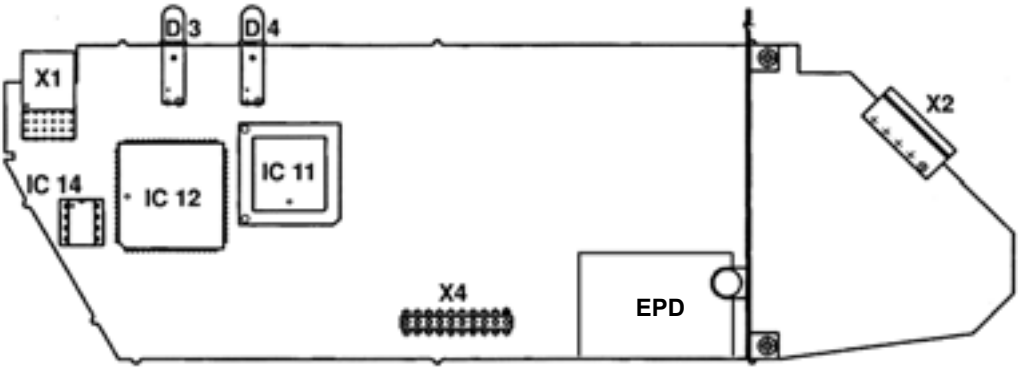
PCB 110 - 230 V AC



PCB 24 V DC / AC

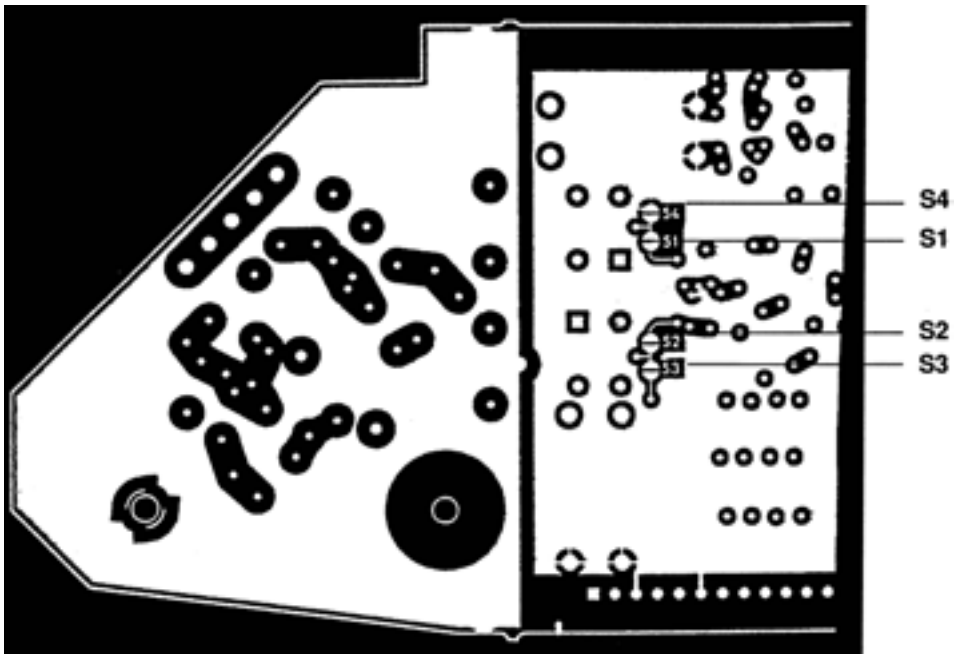


Analog/digital converter PCB, (ADC)



X1	internal connection to motherboard	**IC 12**	microprocessor
X2	plug-in terminals in terminal compartment	**IC 14**	data EEPROM
X4	multipoint connector	**D3**	green LED on front panel
IC 11	peripheral IC incl. control program	**D4**	red LED on front panel
		EPD	empty pipe detection

Analog/digital converter PCB, rear side (detail)



S1, **S2**, **S4** } solder bridges for steady output signals when measuring tube is empty, see Sect. 6.8

Inputs/outputs PCB, I/O

Jumper X3 + X6

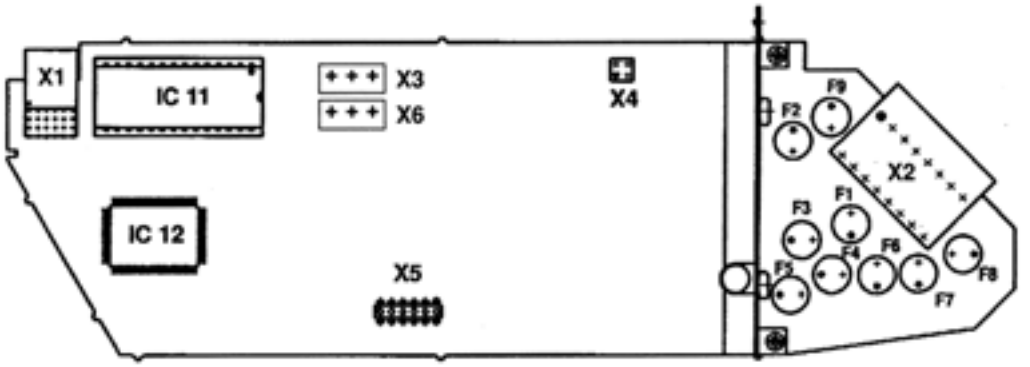
X3 +
X6 + active operation

\+ **X3**
\+ **X6** passive operation

Jumper X4

DC operation ≤ 0.2 A

AC operation ≤ 0.1 A (factory setting)



X1	plug-in terminals inside terminal compartment
X2	internal connection to motherboard
X4	jumper, change-over of AC/DC operation of output A1, see Sect. 6.3
X5	multipoint connector
IC 11	control program EPROM
IC 12	microprocessor
X3/X6	jumper for active or passive operation of current output

Small fuses TR 5, values and Order No. see Section 9

F1	P	terminals
F2	A1	
F3	A2	
F4	D1	
F5	A2	
F6	C1	
F7	C2	
F8	E+	
F9	E–	

HART® / RS 485 PCB

X1	internal connection to mother board
X2	plug-in terminal inside terminal compartment

F1, F2, F3	small fuses TR5
IC _ _	integrated circuit
S3, S4	solder bridges

9 Order numbers

Spare parts				Order No.
Electronic unit with display	**100-230 V AC** without magnetic sensors			2135520100
	100-230 V AC with HART / RS 485			2135520300
	24 V AC / DC without magnetic sensors			2135520700
Power supply fuses:				
(5 × 20 G fuse, breaking capacity 1500 A)		**F5:** 100-230 V AC	**0.8 A T**	5080850000
(5 × 20 G fuse, breaking capacity 150 A)		**F6:** 24 V AC/DC	**1.6 A T**	5119230100
Various small fuses TR5				
• **I/O PCB** (inputs/outputs)		**F2, F8**	T 250 mA	5075640000
		F1, F3-F7, F9	T 160 mA	5075900000
• **NT PCB**	**100 – 230 V AC**	**24 V AC/DC**		
(power unit)	F3, F4	F3, F5	T 630 mA	5080190000
	F7	F4	T 500 mA	5075860000
	F1	–	T 50 mA	5075780000
plug-in terminals	**3**-pin power supply			3161180100
(printed and coded)	**8**-pin outputs **D** and **P**, inputs **C**			3160220100
	8-pin outputs **A** and **I**, internal power supply **E**			3160230200
	4-pin field current supply			3160200100
	5-pin signal line			3160210100
RS 232 adapter incl. CONFIG operator software				
(from version V 3.1 onwards)			**German**	V 035100131
for operator control of signal converter by MS-DOS PC or laptop			**English**	V 035100132
Conversion kit MP for magnetic sensors (complete retrofitting kit)				V 150100004
Bar magnet for operating the magnetic sensors				2070530000
Flow sensor simulator GS 8 A				2070680200
Adapter to make older versions of GS 8 simulators suitable for use with IFC 110 F				2107640000
Glass cover for housing				2106730000
Sealing material for housing cover, by the metre				3137030000
ADC PCB (A/D converter)				VX 2134250100
I/O PCB (inputs/outputs)				VX 2115140100
FSV PCB (field current supply)				VX 2135520200
NT PCB (power unit) 100-230 V AC				2127970100
NT PCB (power unit) 24 V AC / DC				2133330100
HART / RS 485 PCB				2134310100

10 Technical data

10.1 Signal converter

Mode of operation and system structure		
Measurement principle		Faraday's law of induction
Modularity		Measuring system consisting of signal converter and flow sensor
Measured variable		Volumetric flowrate (electrode voltage from flow sensor)
Electrical conductivity of product		≥ 5 µS/cm ≥ 20 µS/cm for demineralized cold water
Versions		
IFC 110 F / **D** (standard)		Display version, **with** local display / control elements (15 keys)
IFC 110 F / D / **MP** (option)		same as display version, additionally with magnetic sensors (MP) to control the signal converter using bar magnet without opening the housing
IFC 110 F / D / MP / _ EEx (option)		ATEX-EEx version for hazardous areas, PTB 02 ATEX 2163 X
Interfaces		– HART® } add-on module – RS 485 / PROFIBUS } add-on module
Add-on equipment		– CONFIG software and adapter for operator control via MS-DOS-PC, connection to internal IMoCom interface (equipment bus)
Full-scale range		
Flowrate for Q = 100%		6 Liter/h to 86 860 m³/h **or** 0.03 to 401 080 US Gal/min, corresponding to flow velocity v = 0.3 – 12 m/s **or** v = 1 to 40 ft/s
Units		m³/h, liter/s, US Gal/min or user-defined unit, e. g. liter/day or US Gal/day
Input / output circuits		
Nominal voltages		≤ 25 V AC / ≤ 50 V DC (safety value Um = 253 V)
Active / passive/ mode		connection to protective extra-low voltage (**PELV**)
Current output		
Function		– all operating data configurable – galvanically isolated from all input and output circuits
Current:	fixed ranges	0 – 20 mA and 4 – 20 mA
	variable ranges	for Q = 0% $I_{0\%}$ = 0 – 16 mA for Q = 100% $I_{100\%}$ = 4 – 20 mA } adjustable in 1mA increments for Q > 100% I > 20 – 22 mA (maximum)
Load	– active operation	min. 15 Ω
	– passive operation	22 V DC ≤ U ≤ 32 V DC: R_L ≤ 800 Ω 15 V DC ≤ U ≤ 22 V DC: R_L ≤ 500 Ω
Error identification		0 / 22 mA and variable
Forward/reverse flow measurement		direction identified via status output

Pulse outputs (passive)	**P**	**A1** (can also be operated as status output)
Function	– for electronic totalizers – all operating data settable	– for electromechanical totalizers – all operating data configurable
Terminals	P / P	A1 / A ⊥
Pulse rate	0 – 10 000 pulses **per** s [= Hz], min, h, m³, liter, etc., any scaling	0 – 50 pulses **per** s [= Hz], min, h, m³, liter, etc., any scaling
Electrical data	galvanically isolated U ≤ 32 V DC / ≤ 24 V AC I ≤ 30 mA, any polarity	galvanically isolated, but not from **A2** U ≤ 32 V DC / ≤ 24 V AC I ≤ 100 mA, any polarity **or** U ≤ 32 V DC, I ≤ 200 mA note polarity
Pulse width	automatic: pulse duty cycle 1:1, max. 10 000 pulses/s = 10 kHz variable: 10 ms – 1 s, $P_{100\%}$ [pulses/s] = f_{max} [Hz] = $\frac{1}{2 \times \text{pulse width}}$ digital pulse division, interpulse period non-uniform, therefore if frequency and cycle meters connected allow for minimum counting interval: gate time, totalizer ≥ $\frac{1000}{P_{100\%}\text{ [Hz]}}$	
Forward/reverse flow measurement	direction identified via status output	

Status outputs (passive)	**D1 / D2 / A2**	**A1** (can also be operated as pulse output)	
Function, set for	trip point flow direction automatic range change error identification overdriving empty pipeline	trip point flow direction automatic range change error identification overdriving empty pipeline	
Terminals	D1 / D2 / D ⊥ / A2 / A ⊥	A1 / A ⊥	
	Please note: D ⊥ common reference potential for D1 and D2 A ⊥ common reference potential for A1 and A2		
Electrical data	galvanically isolated U ≤ 32 V DC / ≤ 24 V AC I ≤ 100 mA, any polarity	galvanically isolated, but not from A2 U ≤ 32 V DC / ≤ 24 V AC I ≤ 100 mA, any polarity **or** U ≤ 32 V DC, I ≤ 200 mA, note polarity	
Control inputs C1 and **C2** (passive)			
Function, set for	automatic range change, totalizer reset, error reset, start self-test, set outputs to min. values or hold last measured values of outputs		
Terminals	C1 / C ⊥ and C2 / C ⊥, galvanically isolated **Please note:** C ⊥ common reference potential for C1 and C2 U = 8 – 32 V DC, I ≤ 10 mA, any polarity		
Internal power supply	for passive outputs and inputs and external receiver instruments		
Terminals	E + and E –, please note polarity, galvanically isolated		
Electrical data	U = 24 V DC / R_i = approx. 15 Ohm / I ≤ 100 mA		
Time constant	0.2 – 99.9 s, adjustable in increments of 0.1 second		
Low-flow cutoff	cutoff "on" value: 1 – 19 % cutoff "off" value: 2 – 20 % } of $Q_{100\%}$, adjustable in 1% increments		
Local display and operation	3-line back-lit LCD		
Display function	actual flowrate, forward, reverse, sum totalizers (7 digits) or 25-character bar graph with percent display and status messages		
Units: actual flowrate	m³/h, liter/s., US gallons/min or user-defined unit, e. g. hecto liter/h		
totalizer	m³, liter, or US gallons or user-defined unit (adjustable counting time till overflow)		
Language of plain texts	English, German, French, Swedish, others on request		
Display: 1st line	8-character, 7-segment, numerical and sign display, and symbols for key acknowledgement		
2nd line	10-character, 14-segment, text display		
3rd line	6 markers to identify display in measuring mode		
Operation elements	15 keys or as option with 3 additionally magnetic sensors for operation without opening the housing		
Electrode circuit			
Type of protection	intrinsic safety [EEx ib IIC]		
Max. values (cumulative)	U_0 = 18 V / I_0 = 40 mA / P_0 = 80 mW		
Kinked characteristic	capacitance C_0 ≤ 225 nF / inductance L_0 ≤ 5 mH		
Field power supply			
Type	pulsed bipolar DC field for all KROHNE primary heads, galvanically isolated from all input and output circuits		
Terminals	2 x 7 and 8		
Current / voltage	± 0.125 A (± 5%) / U_N ≤ 40 V DC (frequency controlled)		
Clock frequency	$^1/_{36}$ to ½ of power frequency, configurable to the calibration data of the primary head		
Internal fuse protection	I_N ≤ 160 mA		
Power supply	**AC version** standard	**AC / DC version** (switch-selectable) option, in preparation	
Voltage range (without change over)	100 – 230 V AC	24 V AC	24 V DC
Tolerance band	85 – 255 VAC	20.4 – 26.4 V AC	18 – 31.2 V DC
Safety value	U_m = 253 V	U_m = 253 V	U_m = 253 V
Frequency	48 – 63 Hz	48 – 63 Hz	–
Power consumption (incl. primary head)	18 VA, typical (max. 25 VA)	18 VA, typical (max. 25 VA)	18 W, typical (max. 18 W)
	When connected to a functional extra-low voltage, **24 V AC / DC**, protective separation (PELV) must be ensured (VDE 0100 / VDE 0106 and IEC 364 / IEC 536 or equivalent national standards).		
Approvals and housing			
Material of field housing	die-cast aluminium with polyurethane finish		
Ambient temperature • operation	standard -25 to +60 °C / -13 to +140 °F EEx -20 to +55 °C / - 4 to +131 °F EEx, special "S" -40 to +55 °C / -40 to +131 °F		
• storage	all versions -40 to +60 °C / -40 to +140 °F		
Protection category (IEC 529 / EN 60 529)	IP 65, equivalent to NEMA 4 / 4X		
EU_EMC Directives	to EN 61326-1 (1977) and A1 (1998) directives and NAMUR Standard NE 21		
Certificates and approvals	II (2) G [EEx ib] IIC PTB 02 ATEX 2136 X		

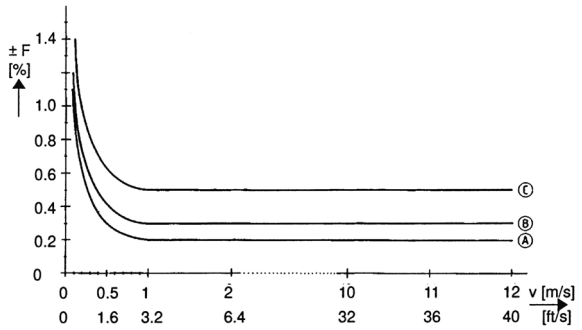
10.2 Error limits

Display, digital values, pulse output
F maximum error in % of measured value (MV), **not** typical values
v Flow velocity in m/s and ft/s

Reference conditions similar to EN 29 104

Product	water at 10 – 30°C/ 50 – 86°F
Electrical conductivity	> 300 µS/cm
Power supply (rated voltage)	U_N (± 2%)
Ambient temperature	20 – 22°C / 68-71.6 °F
Warm-up time	60 min
Max. calibration equipment error	10 × smaller than F
Inlet / outlet runs	10 × DN / 2 × DN (DN = meter size)
Flow sensor	properly grounded and centered

Calibrated on EN 17025 accredit to calibration equipment in direct volumetric comparsion.



***** VARIFLUX 6000 F (DN 2.5 – 4 and 1/10'' – 1/6'') additional error ± 0,3% of MV

MV Measured Value

z = 1 mm/s = 0.04 inch/s

Flow sensor	Meter size DN mm	Meter size inch	Standard details v ≥ 1.0 m/s; v ≥ 3.3 ft/s	Standard details v < 1.0 m/s; v < 3.3 ft/s	Curve	Option (extra charge) v ≥ 1.0 m/s; v ≥ 3.3 ft/s	Option (extra charge) v < 1.0 m/s; v < 3.3 ft/s	Curve
VARIFLUX 6000 F	2.5- 6	1/10 - 1/4	± 0.5% of MV	± 0.4% of MV + z	**C**	–	–	–
	10 - 80	3/8 - 3	± 0.3% of MV	± 0.2% of MV + z	**B**	–	–	–
PROFIFLUX 5000 F	2.5- 6	1/10 - 1/4	± 0.5% of MV	± 0.4% of MV + z	**C**	–	–	–
	10 - 100	3/8 - 4	± 0.3% of MV	± 0.2% of MV + z	**B**	± 0.2% of MV	± 0.1% of MV + z	**A**
ALTOFLUX 4000 F	10. - 25	3/8 - 1	± 0.3% of MV	± 0.2% of MV + z	**B**	± 0.2% of MV	– ± 0.1% of MV + z	– **A**
	32 -1600	1 1/4 -64						
ALTOFLUX 2000 F	150 - 250	6 -10	± 0.3% of MV	± 0.2% of MV + z	**B**	± 0.2% of MV	± 0.1% of MV + z	**A**
ECOFLUX 1000 F	10 - 150	3/8 - 6	± 0.5% of MV	± 0.4% of MV + z	**B**	–	–	–
M 900	10. - 25	3/8 - 1	± 0.3% of MV	± 0.2% of MV + z	**B**	–	–	–
	32 - 300	1 1/4 -12				± 0.2% of MV	± 0.1% of MV + z	**A**

Current output	same error limits as above, additionally ± 10 µA		
Reproducibility and repeatability	0,1% of MV, minimum 1 mm/s / 0.04 inch/s at constant flow		
External influences	typical values	maximum values	
Ambient temperature			
Pulse output	0,003% of MV (1)	0,01 % of MV (1)	} per 1 K / 1.8° F
Current output	0,01 % of MV (1)	0,025% of MV (1)	} temperature variation
Power supply	< 0,02 % of MV	0,05 % of MV	at 10% variation
Load	< 0,01 % of MV	0,02 % of MV, at max. load, see Sect. 10.1	

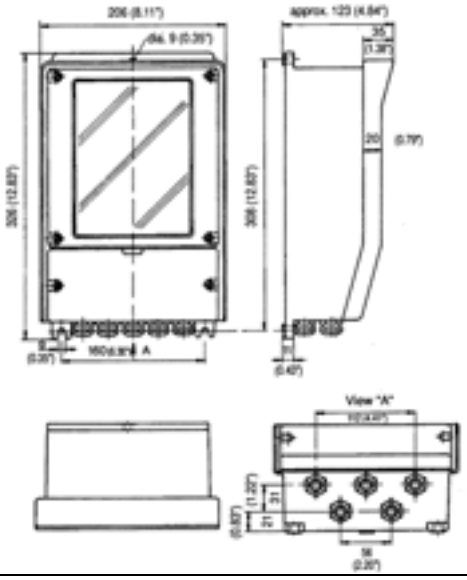
(1) All KROHNE signal converters undergo burn-in tests, duration minimum 20 hours at varying ambient temperatures – 20 to + 60°C/– 4 to + 140°F. The tests are controlled by computers.

10.3 Dimensions and weights IFC 110 F / IFC 110 F-EEx and ZD / ZD-EEx

Dimensions in mm and inch

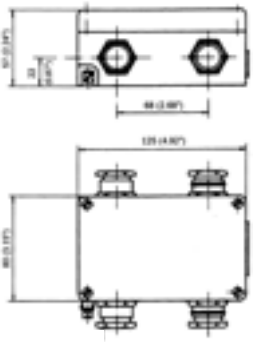
IFC 110 F Signal converters

Weight approx. 4.1 kg / 9.0 lbs



ZD Intermediate connection box

Weight approx. 0.5 kg / 1.1 lbs



10.4 Flow table

v = flow velocity in m/s and ft /s

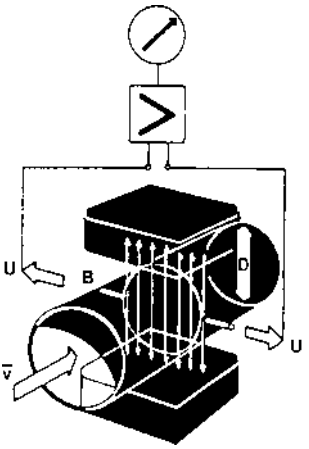
Meter size		Full-scale range $Q_{100\%}$ in m³/h		
DN		v = 0.3 m/s	v = 1 m/s	v = 12 m/s
mm	inch	(minimum)		(maximum)
2.5	1/10	0.0053	0.0177	0.2121
4	1/8	0.0136	0.4520	0.5429
6	1/4	0.0306	0.1018	1.222
10	3/8	0.0849	0.2827	3.392
15	1/2	0.1909	0.6362	7.634
20	3/4	0.3393	1.131	13.57
25	1	0.5302	1.767	21.20
32	-	0.8686	2.895	34.74
40	1 1/2	1.358	4.524	54.28
50	2	2.121	7.069	84.82
65	-	3.584	11.95	143.3
80	3	5.429	18.10	217.1
100	4	8.483	28.27	339.2
125	-	13.26	44.18	530.1
150	6	19.09	63.62	763.4
200	8	33.93	113.1	1357
250	10	53.02	176.7	2120
300	12	76.35	254.5	3053
400	16	135.8	452.4	5428
500	20	212.1	706.9	8482
600	24	305.4	1018	12215
700	28	415.6	1385	16625
800	32	542.9	1810	21714
900	36	662.8	2290	26510
1000	40	848.2	2827	33929
1200	48	1221	4072	48858
1400	56	1663	5542	66501
1600	64	2171	7238	86859

Meter size		$Q_{100\%}$ in US Gal/min	
DN		v = 1 ft/s	v = 40 ft/s
inch	mm	(minimum)	(maximum)
1/10	2.5	0.0245	0.979
1/8	4	0.0383	1.530
1/4	6	0.1530	6.120
3/8	10	0.3735	14.93
1/2	15	0.8405	33.61
3/4	20	1.494	59.75
1	25	2.334	93.34
-	32	3.824	153.0
1 1/2	40	5.979	239.0
2	50	9.339	373.5
-	65	15.78	630.9
3	80	23.90	955.6
4	100	37.35	1493
-	125	37.35	2334
6	150	84.05	3361
8	200	149.43	5975
10	250	233.4	9334
12	300	336.2	13442
16	400	597.9	23899
20	500	933.9	37345
24	600	1345	53781
28	700	1919	76760
32	800	2507	100272
36	900	3173	126904
40	1000	3917	156672
48	1200	5640	225608
56	1400	7677	307080
64	1600	10027	401080

11 Measuring principle

The flowmeter is designed for electrically conductive fluids.

Measurement is based on Faraday's law of induction, according to which a voltage is induced in an electrically conductive body which passes through a magnetic field. The following expression is applicable to the voltage:



$$U = K \times B \times \overline{v} \times D$$

K an instrument constant
B magnetic field strength
$\overline{v}$ mean velocity
D pipe diameter

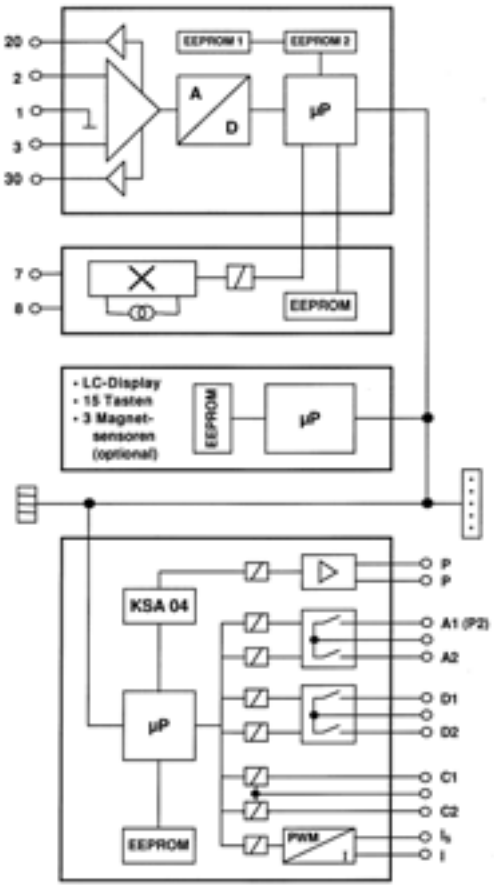
Inside the electromagnetic flowmeter, the fluid passes through a magnetic field applied perpendicular to the direction of flow. An electric voltage is induced by the movement of the fluid (which must have a minimum electrical conductivity). This is proportional to the mean flow velocity and thus to the volume of flow. The induced voltage signal is picked up by two electrodes which are in conductive contact with the fluid and is transmitted to a signal converter for a standardized output signal.

This method of measurement offers the following advantages:

1) No pressure loss through pipe constriction or protruding parts.
2) Since the magnetic field passes through the entire flow area, the signal represents a mean value over the pipe cross-section; therefore, only relatively short straight inlet pipes 5 x DN from the electrode axis are required upstream of the flow sensor.
3) Only the pipe liner and the electrodes are in contact with the fluid.
4) Already the original signal produced is an electrical voltage which is an exact linear function of the mean flow velocity.
5) Measurement is independent of the flow profile and other properties of the fluid.

The magnetic field of the flow sensor is generated by a square wave current fed from signal converter to the field coils. This field current alternates between positive and negative values. Alternate positive and negative flowrate-proportional signal voltages are generated at the same frequency by the effect of the magnetic field, which is proportional to the current. The positive and negative voltages at the flow sensor electrodes are subtracted from one another in the signal converter. Subtraction always takes place when the field current has reached its stationary value, so that constant interference voltages or external or fault voltages changing slowly in relation to the measuring cycle are suppressed. Power line interference voltages coupled in the flow sensor or in the connecting cables are similarly suppressed.

12 Block diagram



① **ADC printed circuit board, analog / digital converter** (terminals 1, 2, 3, 20 and 30)
- Signal processor protected against overload, for quick and precise processing of flow peaks up to and exceeding 20 m/s or 60 ft/s.
- Digital signal processor, sequential control and test routines.
- Patented high-resolution analog/digital converter, digitally controlled and monitored.
- Input amplifier allowing control of potential of signal line shielding (bootstrap).
- User parameter and internal calibration values are stored in separate EEPROMs (easily replaceable).

② **FSV printed circuit board, field current supply** (terminals 7 and 8)
- Large signal-to-noise ratio owing to low-loss field current supply with high frequencies and high currents.
- Pulsed direct current which is precisely controlled electronically, for the magnetic coils of the flow sensor.
- Operating and calibrating data are stored in an EEPROM so that the PCB can be easily replaced without the need for re-calibration.

③ **BDE printed circuit board, motherboard**
- Large illuminated LC display.
- 15 keys for operator control of signal converter
- Can be retrofitted with optional operator control by bar magnet.
- Distribution of general signals such as IMoCom bus, power supply.

④ **I/O printed circuit board, inputs and outputs**
- Groups, inputs and outputs are galvanically isolated from each other and from all other circuits.
- Power supply source for the inactive inputs and outputs.
- Specific KROHNE circuit KSA 04 for fine quantization of output pulses across a wide dynamic range.
- Active current output **I** (e.g. 0/4-20 mA) with load control.
- Pulse output **P** for electronic totalizers, max. 10 Hz.
- Pulse output **A1** for electromechanical totalizers, max. 50 Hz, can also be used as status output **A1**.
- Several status outputs **A1, A2, D1, D2**.
- Control inputs **C1** and **C2**.

⑤ **IMoCom bus plug**
Connecting external operating and testing devices, e.g. RS 232 adapter and CONFIG software for operator control of signal converter by MS-DOS PC or laptop.

⑥ **Slots for plug-in modules, for upgrading or converting the signal converter**
- HART / RS 485 ancillary board
- GTEX ancillary board for Ex-i operation of the signal converter outside hazardous areas.
- Other modules and ancillary boards in preparation.

13 Approvals

13.1 EC-type examination certificate

English translation

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

PTB

(1) **EC-TYPE-EXAMINATION CERTIFICATE**

(Translation)

(2) Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres - **Directive 94/9/EC**

(3) EC-type-examination Certificate Number:

PTB 02 ATEX 2163 X

(4) Equipment: Measuring transducer, type IFC 110 F/...-EEx

(5) Manufacturer: Krohne Messtechnik GmbH & Co. KG

(6) Address: Ludwig Krohne Straße 5, 47058 Duisburg, Germany

(7) This equipment and any acceptable variation thereto are specified in the schedule to this certificate and the documents therein referred to.

(8) The Physikalisch-Technische Bundesanstalt, notified body No. 0102 in accordance with Article 9 of the Council Directive 94/9/EC of 23 March 1994, certifies that this equipment has been found to comply with the Essential Health and Safety Requirements relating to the design and construction of equipment and protective systems intended for use in potentially explosive atmospheres, given in Annex II to the Directive.

The examination and test results are recorded in the confidential report PTB Ex 02-22121.

(9) Compliance with the Essential Health and Safety Requirements has been assured by compliance with:

EN 50 014:1997 +A1 +A2 **EN 50 020:1994**

(10) If the sign "X" is placed after the certificate number, it indicates that the equipment is subject to special conditions for safe use specified in the schedule to this certificate.

(11) This EC-type-examination Certificate relates only to the design, examination and tests of the specified equipment in accordance to the Directive 94/9/EC. Further requirements of the Directive apply to the manufacturing process and supply of this equipment. These are not covered by this certificate.

(12) The marking of the equipment shall include the following:

Ex **II (2) G [EEx ib] IIC**

Zertifizierungsstelle Explosionsschutz
By order:

Braunschweig, November 08, 2002

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

PHYSIKALISCH-TECHNISCHE BUNDESANSTALT 24

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EC-type-examination Certificates without signature and official stamp shall not be valid. The certificates may be circulated only without alteration. Extracts or alterations are subject to approval by the Physikalisch-Technische Bundesanstalt.
In case of dispute, the German text shall prevail.

Physikalisch-Technische Bundesanstalt • Bundesallee 100 • D-38116 Braunschweig

English translation

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

(13) **SCHEDULE**

(14) **EC-TYPE-EXAMINATION CERTIFICATE PTB 02 ATEX 2163 X**

(15) Description of equipment

The measuring transducer, type IFC 110 F/...-EEx is used for flow rate measurement of electroconductive liquids. The apparatus is installed outside the hazardous area.

The permissible range of the ambient temperature is: -20 °C bis 55 °C (standard version)
resp. -40 °C bis 55 °C (special version).

Electrical data

Auxiliary power dependent on variant (terminals 11 and 12)	24/100 ... 230 V AC +10% -15%, 25 VA U_m = 253 V 24 V DC +30% -25%, 15 W U_m = 253 V
Input/output circuits (aktive / passive)	for connection to functional extra low voltage with safe electrical isolation (PELV) $U_N \leq$ 25 V AC $U_N \leq$ 50 V DC U_m = 253 V
Field circuit (terminals 7, 8)	$U_N \leq \pm 40$ V (switched-mode direct voltage) $I_N \leq$ 160 mA (internal fuse)
Electrode circuit (terminals 1, 2, 3, 20, 30)	type of protection Intrinsic Safety EEx ib IIC Maximum values: U_o = 18 V (± 9 V against ground) I_o = 40 mA P_o = 80 mW kinked characteristic L_o = 5 mH C_o = 225 nF (C_i considered)

The electrode circuit is safely electrically isolated from all other circuits up to a peak value of the nominal voltage of 375 V.

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English translation

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

SCHEDULE TO EC-TYPE-EXAMINATION CERTIFICATE PTB 02 ATEX 2163 X

(16) Test report PTB Ex 02-22121

(17) Special conditions for safe use

1. Equipotential bonding has to be installed along the entire cable run of the intrinsically safe circuit.
2. The terminal for the equipotential bonding conductor has to be connected to equipotential bonding conductor of the hazardous area.

(18) Essential health and safety requirements

met by compliance with the standards mentioned above

Zertifizierungsstelle Explosionsschutz
By order:

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

Braunschweig, November 08, 2002

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13.2 EC-type examination certificate

German original

Physikalisch-Technische Bundesanstalt

PTB

Braunschweig und Berlin

(1) EG-Baumusterprüfbescheinigung

(2) Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen - **Richtlinie 94/9/EG**

(3) EG-Baumusterprüfbescheinigungsnummer

PTB 02 ATEX 2163 X

(4) Gerät: Messumformer Typ IFC 110 F/...-EEx

(5) Hersteller: Krohne Messtechnik GmbH & Co. KG

(6) Anschrift: Ludwig Krohne Straße 5, 47058 Duisburg, Deutschland

(7) Die Bauart dieses Gerätes sowie die verschiedenen zulässigen Ausführungen sind in der Anlage und den darin aufgeführten Unterlagen zu dieser Baumusterprüfbescheinigung festgelegt.

(8) Die Physikalisch-Technische Bundesanstalt bescheinigt als benannte Stelle Nr. 0102 nach Artikel 9 der Richtlinie des Rates der Europäischen Gemeinschaften vom 23. März 1994 (94/9/EG) die Erfüllung der grundlegenden Sicherheits- und Gesundheitsanforderungen für die Konzeption und den Bau von Geräten und Schutzsystemen zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen gemäß Anhang II der Richtlinie.

Die Ergebnisse der Prüfung sind in dem vertraulichen Prüfbericht PTB Ex 02-22121 festgehalten.

(9) Die grundlegenden Sicherheits- und Gesundheitsanforderungen werden erfüllt durch Übereinstimmung mit

EN 50 014:1997 +A1 +A2 **EN 50 020:1994**

(10) Falls das Zeichen „X" hinter der Bescheinigungsnummer steht, wird auf besondere Bedingungen für die sichere Anwendung des Gerätes in der Anlage zu dieser Bescheinigung hingewiesen.

(11) Diese EG-Baumusterprüfbescheinigung bezieht sich nur auf Konzeption und Prüfung des festgelegten Gerätes gemäß Richtlinie 94/9/EG. Weitere Anforderungen dieser Richtlinie gelten für die Herstellung und das Inverkehrbringen dieses Gerätes. Diese Anforderungen werden nicht durch diese Bescheinigung abgedeckt.

(12) Die Kennzeichnung des Gerätes muß die folgenden Angaben enthalten:

Ex II (2) G [EEx ib] IIC

Zertifizierungsstelle Explosionsschutz
Im Auftrag

Dr.-Ing. U. Johannsmeyer
Regierungsdirektor

Braunschweig, 08. November 2002

PHYSIKALISCH-TECHNISCHE BUNDESANSTALT 24

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German original

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

(13) **Anlage**

(14) **EG-Baumusterprüfbescheinigung PTB 02 ATEX 2163 X**

(15) Beschreibung des Gerätes

Der Messumformer Typ IFC 110 F/...-EEx dient zur Volumendurchflussmessung von elektrisch leitfähigen Flüssigkeiten. Das Gerät wird außerhalb des explosionsgefährdeten Bereiches errichtet.

Der zulässige Bereich der Umgebungstemperatur beträgt: -20 °C bis 55 °C (Standardausführung) bzw. -40 °C bis 55 °C (Sonderausführung).

Elektrische Daten:

Hilfsenergie je nach Ausführung (Klemmen 11 und 12)	24/100 ... 230 V AC +10% -15%, 25 VA U_m = 253 V 24 V DC +30% -25%, 15 W U_m = 253 V
Ein-/Ausgangsstromkreise (aktiv / passiv)	zum Anschluss an Funktionskleinspannung mit sicherer Trennung (PELV) $U_N \leq$ 25 V AC $U_N \leq$ 50 V DC U_m = 253 V
Feldstromkreis (Klemmen 7, 8)	$U_N \leq \pm 40$ V (getaktete Gleichspannung) $I_N \leq$ 160 mA (interne Absicherung)
Elektrodenstromkreis (Klemmen 1, 2, 3, 20, 30)	in Zündschutzart Eigensicherheit EEx ib IIC Höchstwerte: U_o = 18 V (± 9 V gegen Erde) I_o = 40 mA P_o = 80 mW geknickte Kennlinie L_o = 5 mH C_o = 225 nF (C_i berücksichtigt)

Der Elektrodenstromkreis ist von allen anderen Stromkreisen bis zu einem Scheitelwert der Nennspannung von 375 V sicher galvanisch getrennt.

German original

Physikalisch-Technische Bundesanstalt

Braunschweig und Berlin

Anlage zur EG-Baumusterprüfbescheinigung PTB 02 ATEX 2163 X

(16) Prüfbericht: PTB Ex 02-22121

(17) Besondere Bedingungen:

1. Im gesamten Verlauf des eigensicheren Stromkreises ist Potenzialausgleich zu errichten.

2. Der Anschluss für den Potenzialausgleichsleiter ist mit dem Potenzialausgleich des explosionsgefährdeten Bereiches zu verbinden.

(18) Grundlegende Sicherheits- und Gesundheitsanforderungen:

erfüllt durch Übereinstimmung mit den vorgenannten Normen

Zertifizierungsstelle Explosionsschutz
Im Auftrag

Dr.-Ing. U. Johannsmeier
Regierungsdirektor

Braunschweig, 08. November 2002

Seite 3/3

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Notice

If you need to return flowmeters for testing or repair to KROHNE

Your electromagnetic flowmeter

- has been carefully manufactured and tested by a company with ISO 9001 certification
- and volumetrically calibrated in one of the world's most accurate test rigs.

If installed and operated in accordance with these operating instructions, your flowmeter will rarely present any problems.

Should you nevertheless need to return a flowmeter for checkout or repair, please pay strict attention to the following points:

Due to statutory regulations concerning protection of the environment and the health and safety of our personnel, Krohne may only handle, test and repair returned flowmeters that have been in contact with liquids if it is possible to do so without risk to personnel and environment. This means that Krohne can only service your flowmeter if it is accompanied by a certificate in line with the following model confirming that the flowmeter is safe to handle.

If the flowmeter has been operated with toxic, caustic, flammable or water-endangering liquids, you are kindly requested

- to check and ensure, if necessary by rinsing or neutralizing, that all cavities in the flowmeter are free from suchdangerous substances.
  (Directions on how you can find out whether the flow sensor has to be opened and then flushed out or neutralized are obtainable from Krohne on request.)
- to enclose a certificate with the flowmeter confirming that the flowmeter is safe to handle and stating the liquid used.

KROHNE regret that they cannot service your flowmeter unless accompanied by such a certificate.

S P E C I M E N certificate

Company: …….. Address: ……

Department: …….. Name: ……

Tel. No.: ……

The enclosed electromagnetic flowmeter

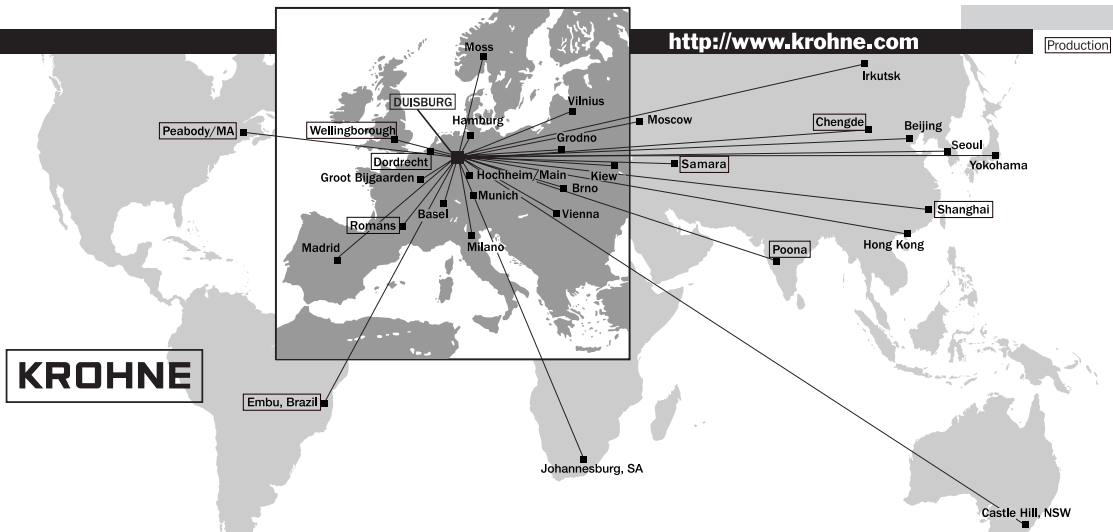
Type: …….. KROHNE Order No. or Series No ……

has been operated with the following liquid: ……..

Because this liquid is
water-endangering * / toxic * / caustic * / flammable *
we have
– checked that all cavities in the flowmeter are free from such substances *
– flushed out and neutralized all cavities in the flowmeter *
(* delete if not applicable)
We confirm that there is no risk to man or environment through any residual liquid contained in this flowmeter.

Date: …….. Signature: ……..

Company stamp:



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