Pull-out
Condensed Instructions

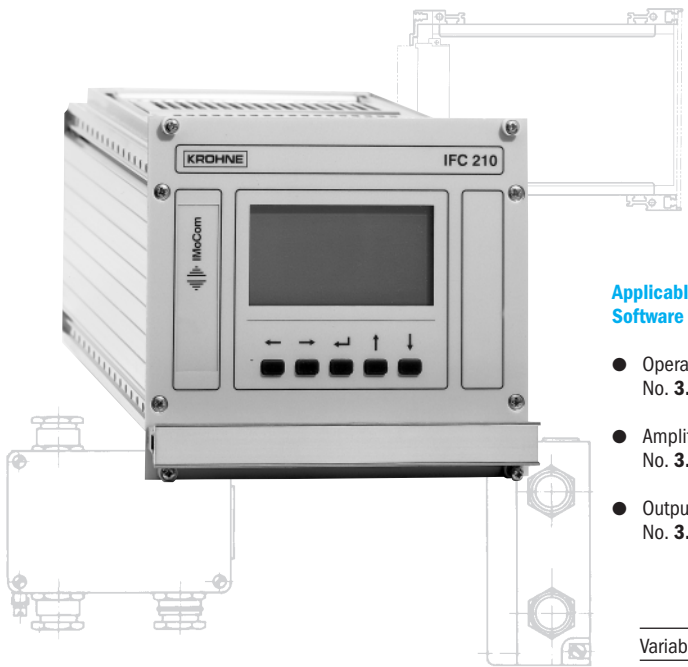
KROHNE

DIN A4: 7.10006.31.00
US size: 7.10006.71.00

Installation and operating instructions

IFC 210 E
IFC 210 E-EEx

Signal converters for electromagnetic flowmeters



Applicable to Software Versions

- Operating and check elements No. **3.18393.01**
- Amplifier (ADC) No. **3.17116.01**
- Outputs/inputs (I/O) No. **3.19005.01**

How to use these Instructions

The flowmeters are supplied ready for operation.

The primary head must be installed in the pipeline as described in the installation instructions inside the packing of the primary head.

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

Contents

Signal converter versions

All signal converter versions include local display and control elements.
The operating data are factory-set to your ordered specifications.

IFC 210 E (Standard)	**Standard version,** with large graphic display and integrated HART® interface
IFC 210 E / RS 485 (Option)	**same as standard version,** but additionally with RS 485 interface
IFC 210 E / _ / EEx (Option)	**Same as standard version,** for operation with primary heads installed in hazardous areas

Items included with supply

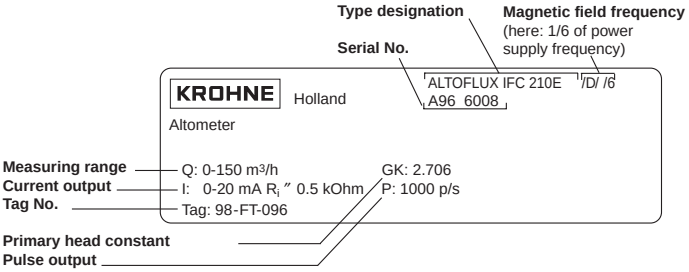
Signal converter in the version as ordered, see above.

These installation and operating instructions for the signal converter,
including pull-out condensed instructions for installation, electrical connection,
start-up and operator control of the signal converter.

signal cable in the version and length as ordered (standard: signal cable A, length 10 m / 30 ft)

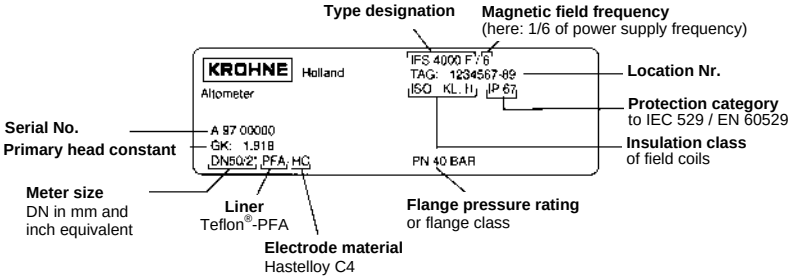
Instrument nameplates

signal converter (example)



signal converter IFC 210E-EEx (example)

primary head (example)



Materials for liner and electrodes see Installation Instructions for primary heads

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 10.1.).

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 solely with 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
3.18393.01	current	**3.17116.01**	current	**3.19005.01**	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 primary head may be installed in the hazardous area.
The signal converter must be installed outside the hazardous area!

1 Electrical connection: power supply

1.1 Location and important installation notes

- **Electrical connection in accordance with VDE 0100** "Regulations governing heavy-current installations with line voltages up to 1000 V" or **equivalent others national regulations**.
- Do not cross or loop **cables**.
- Use **separate cable** entries (see below) for power supply, field current cables, signal cables, outputs and inputs.
- Protect flowmeters or switchgear cabinets with built-in devices from direct **sunlight**. Fit a sunshade if necessary.
- When **installed in switchgear cabinets**, signal converters must be adequately cooled, e.g. use fans or heat exchangers. (dust-free air and no aggressive gases)
- Do not expose signal converters to intense **vibration**.
- Keep **distance between primary head and signal converter** as short as possible. Refer to Sect. 1.3.4 for maximum permissible length of signal and field current cables.
- Use the supplied KROHNE **signal cable A** (Type DS), standard length 10 m (33 ft), or optional **signal cable B** (Type BTS).
- Always **calibrate** primary head and signal converter **together**. Therefore, when installing, ensure **primary constant GK is identical**; refer to instrument nameplate for the primary head.
  If the GK is not identical, set the signal converter to the GK of the primary head.
  Refer also to Section 4.
- **Dimensions of signal converter,** refer to Section 10.4.

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

1.2 Power supply - Electrical connection

PLEASE NOTE !

- Rated values: The flowmeter housings meets the requirements of IP 20 in conformity with EN 60529.
  No protection against water and moisture. If necessary, take appropriate protective measures.
  The selected creepage distances and clearances have been dimensioned in conformity with VDE 0110 and IEC 664 for contamination category 2. Supply circuits and output circuits are designed to meet the standards of overvoltage class II.

- 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).

Power supply 100-230 V AC (Tolerance zone: 85-255 V AC)

- **Note information on instrument nameplate**: supply voltage and frequency

- **Connection diagrams** for electrical connection between primary head and signal converter: refer to Section 1.3.5.

Power supply 24 Volt AC / DC (Tolerance zone: **AC** 20.4 - 26.4 V / **DC** 18 - 31.2 V)

- **Note information on instrument nameplate**: supply voltage and frequency

- For measurement reasons, connect an **FE functional ground conductor**.

- If connected to a functional extra-low voltage source (24 V AC / DC, 48 V AC), provide for **protective separation (PELV)** in conformity with e.g. VDE 0100 / VDE 0106 or IEC 364 / IEC 536, or equivalent national regulations.

- **Connection diagrams** for power supply and electrical connection between primary head and signal converter: refer to Section 1.3.5.

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

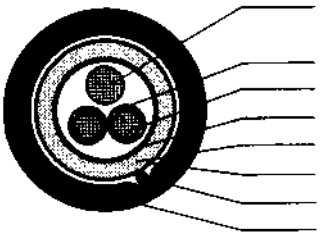
1.3 Electrical connection of separate primary heads

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

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

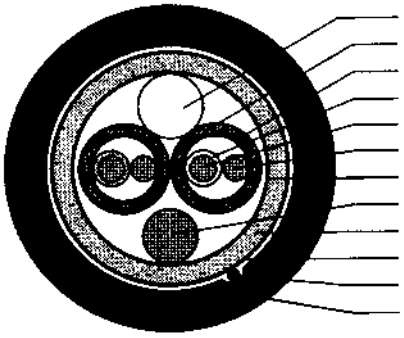
- Signal cables must be firmly installed.
- Shields are connected via stranded drain wires.
- Underwater or underground routing is possible.
- Insulating material flame-retardant to IEC 332.1 / VDE 0742.
- Low-halogen, unplasticized signal cables which remain flexible at low temperatures.

Signal cable A (type DS) with double shielding



1 Stranded drain wire, 1st shield, 1.5 mm^2
2 Insulation
3 Stranded wire 0.5 mm^2 (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 mm^2
8 Outer sheath

Signal cable B (type BTS) with triple shielding (bootstrap line)



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 mm^2 (5.1 red/5.2 white)
6 Stranded drain wire, 1st shield, 0.5 mm^2 (6.1 / 6.2)
7 Special foil, 2nd shield
8 Stranded drain wire, 2nd shield, 1,5 mm^2
9 Insulation
10 Mu-metal foil, 3rd shield
11 Stranded drain wire, 3rd shield,, 0,5 mm^2
12 Outer sheath

Field current line C
Line 2 × 0,75 mm^2, 2 × 1,5 mm^2 or 4 × 1,5 mm^{2}Cu, single shielding
(Cu = copper cross section)
The cross section depends on the required cable length, see table in Section 1.3.4.

IMPORTANT!
For EEx versions, also pay regard to all special directions included in Sect. 6.1 and 13.
Only the EEx primary head may be installed in the hazardous area.
The 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.

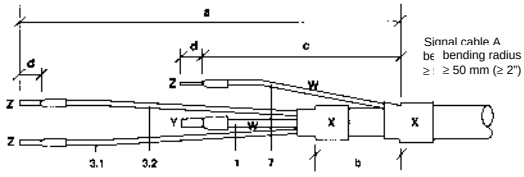
primary head

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

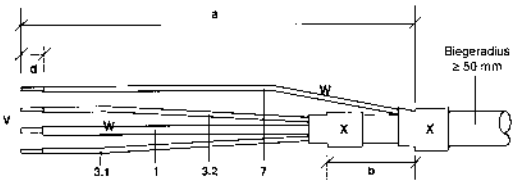
Converter

Length	Converter	
	mm	inch
a	40	2.80
b	10	0.30
d	5	0.30
e	20	2.00

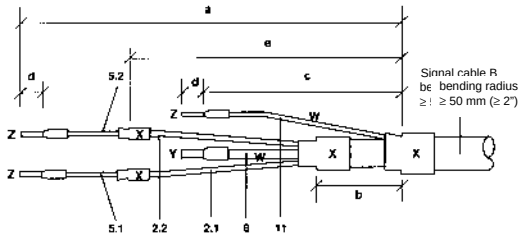
Signal cable A (type DS),
double shielding
for primary head



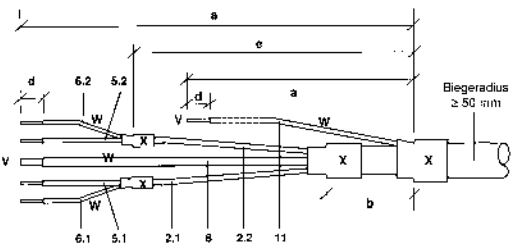
Signal cable A (type DS),
double shielding
for IFC 210 E Converter



Signal cable B (type BTS),
with triple shielding (bootstrap)
for primary head



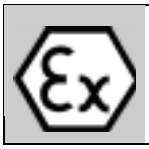
Signal cable B (type BTS),
with triple shielding (bootstrap)
for IFC 210 E Converter



Customer-supplied materials	
V	Tin-coat all stranded drain wire ends!
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 primary head

- All flowmeters must be grounded.
- The grounding conductor should not transmit any interference voltages.
- Do not ground any other electrical device together with this conductor.
- The primary head is connected to ground by means of an **FE functional ground conductor**.
- Special information on grounding various primary heads is contained in the separate **installation instructions for primary heads**.
- These instructions also contain detailed descriptions on how to use grounding rings and how to install primary heads in metal or plastic pipes or internally coated pipelines.



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

1.3.4 Cable lengths (max. distance between signal converter and primary head)

Abbreviations and explanatory notes
used in the following tables, diagrams and connection diagrams

A Signal cable A (type DS), with double shielding, see diagram A for max. length

B Signal cable B (type BTS) with triple shielding, max. length see diagram B

C Field current cable min. cross-section (AF) and max. length, see Table

D High-temperature silicone cable, 3 × 1.5 mm^2 (14 AWG) Cu, (with single shielding, max. length 5 m (16 ft)

E High-temperature silicone cable, 2 × 1.5 mm^2 (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

κ Electrical conductivity of the process liquid

ZD Intermediate connection box required in connection with cables D and E for primary heads ALTOFLUX IFS 4000 F, PROFIFLUX IFS 5000 F and VARIFLUX IFS 6000 F in cases where process temperatures exceed 150 °C (302 °F)

Recommended length of signal cable A (Type DS) **and B** (Type BTS)

Primary head	Meter size						Signal cable	
	DN mm			inch			A	B
AQUAFLUX F	10	-	1600	3/8	-	64	A1	B1
ECOFLUX IFS 1000 F	10	-	15	3/8	-	½	A4	B3
	25	-	150	1	-	6	A3	B2
ALTOFLUX IFS 2000 F	150	-	250	6	-	10	A1	B1
ALTOFLUX IFS 4000 F	10	-	150	3/8	-	6	A2	B2
	200	-	1600	8	-	64	A1	B1
PROFIFLUX IFS 5000 F	2.5	-	15	1/10	-	½	A4	B3
	25	-	100	1	-	4	A2	B2
VARIFLUX IFS 6000 F	2.5	-	15	1/10	-	½	A4	B3
	25	-	80	1	-	3	A2	B2
ALTOFLUX M 900	10	-	300	3/8	-	12	A1	B1

Diagram A

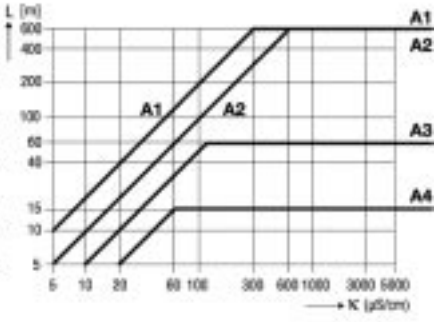
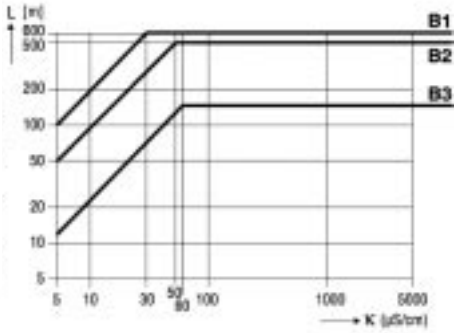


Diagram B



Field current cable C

Length L		Cross section A_F (Cu), minimum	
0 – 150 m	5 – 500 ft	2 x 0.75 mm²	/ 2 × 18 AWG
150 – 300 m	500 – 1000 ft	2 x 1.50 mm²	/ 2 × 14 AWG
300 – 600 m	1000 – 1900 ft	4 x 1.50 mm²	/ 2 × 12 AWG

1.3.5 Connection diagrams for power supply and primary head

PLEASE NOTE: Undocumented contacts/terminals to remain unwired.

The figures in brackets indicate the stranded drain wires for the shields
(see cross-sectional drawing of signal cable in Section 1.3.1).

- Electrical connection to VDE 0100 "Regulations governing heavy-current installations with line voltages up to 1000 V" or equivalent national regulations.

- 24 V AC / DC power supply: Functional extra-low voltage with protective separation in conformity with VDE 0100, Part 410 or equivalent national regulations (IFC 020 E: 24 V DC in preparation).

- Fuse protection of the feed line circuit with $I_{RAT} \leq 16$ A is required. Also, a disconnecting device (switch/circuit breaker) must be provided in the vicinity of the solidly connected signal converters or device groups, refer to EN 61 010. This disconnecting device must be easy to reach and also identifiable as such.

***** Contacts **2d, 2z, 4d, 4z** of **XA** must be electrically connected.

****** Connection to **8d** and/or **8z** of **XA.**

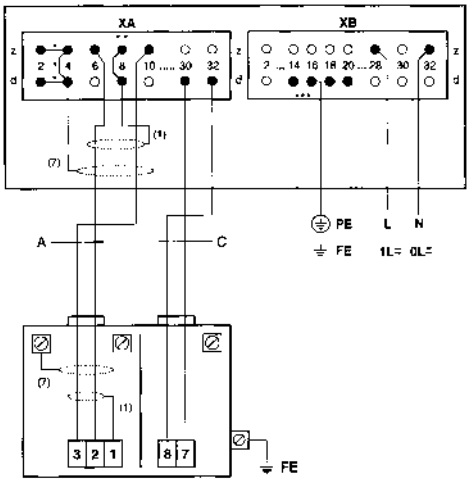
******* Contacts **d2 to d32** of **XB** are of leading type, for connection of **PE** (safety conductor) or **FE** (functional ground). **At least 4 contacts** with adequate cross-section to be electrically connected.

Important:
Electrical connection of EEx primary heads and EEx signal converters
To be carried out as described in Sect. 1.3.6.

Process temperature < 150°C (302°F)

I Signal cable A (type DS)

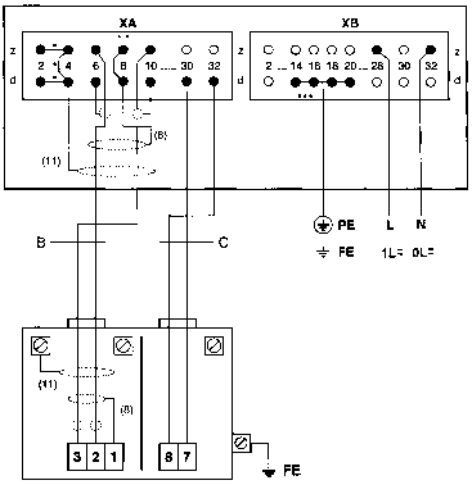
IFC 210 E



Primary head

II Signal cable B (type BTS)

IFC 210 E

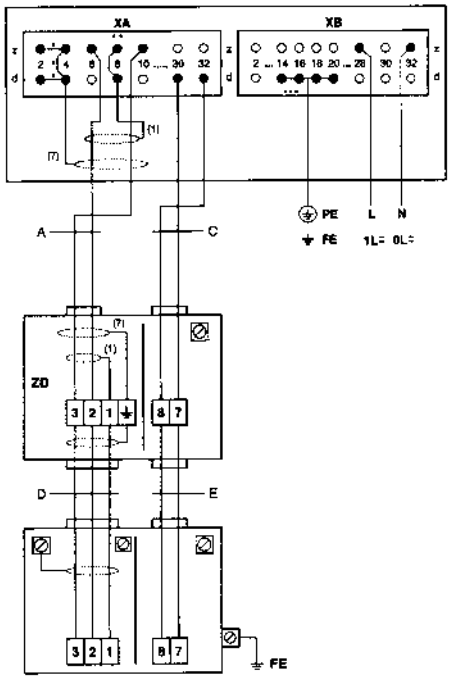


Primary head

Process temperature > 150°C (302°F)

III Signal cable A (type DS)

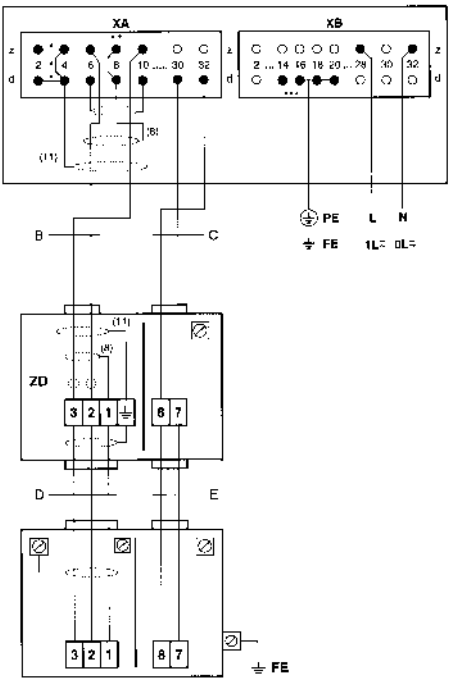
IFC 210 E



Primary head

IV Signal cable B (type BTS)

IFC 210 E



Primary head

1.3.6 EEx-Connection diagrams for power supply and primary head

Connection diagrams

PLEASE NOTE: Undocumented contacts/terminals to remain unwired.

The figures in brackets indicate the stranded drain wires for the shields
(see cross-sectional drawing of signal cable in Section 1.3.1).

- Electrical connection to VDE 0100 "Regulations governing heavy-current installations with line voltages up to 1000 V" or equivalent national regulations.

- 24 V AC / DC power supply: Functional extra-low voltage with protective separation in conformity with VDE 0100, Part 410 or equivalent national regulations (IFC 020 E: 24 V DC in preparation).

- Fuse protection of the feed line circuit with $I_{RAT} \leq 16$ A is required. Also, a disconnecting device (switch/circuit breaker) must be provided in the vicinity of the solidly connected signal converters or device groups, refer to EN 61 010. This disconnecting device must be easy to reach and also identifiable as such.

***** Contacts **2d, 2z, 4d, 4z** of **XA** must be electrically connected.

****** Connection to **8d** and/or **8z** of **XA.**

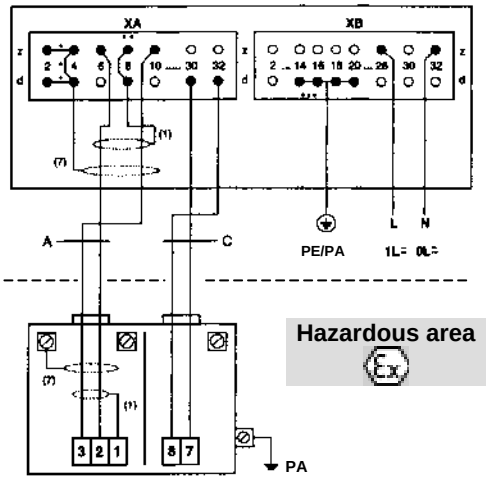
******* Contacts **d2 to d32** of **XB** are of leading type, for connection of **PE** (safety conductor) or **FE** (functional ground).
At least 4 contacts with adequate cross-section to be electrically connected.

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 primary head may be installed in the hazardous area.
The signal converter must be installed outside the hazardous area!

Process temperature < 150°C (302°F)

I Signal cable A (type DS)

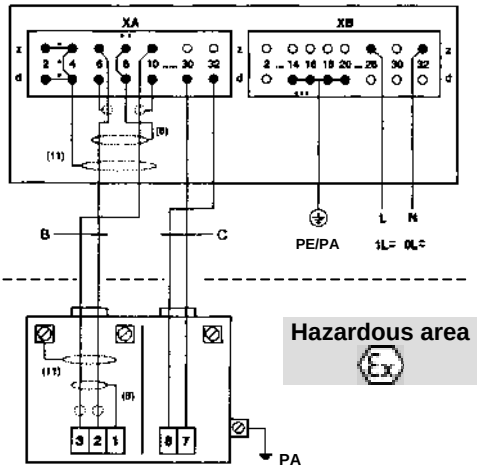
IFC 210 E-EEx



Primary head

II Signal cable B (type BTS)

IFC 210 E-EEx

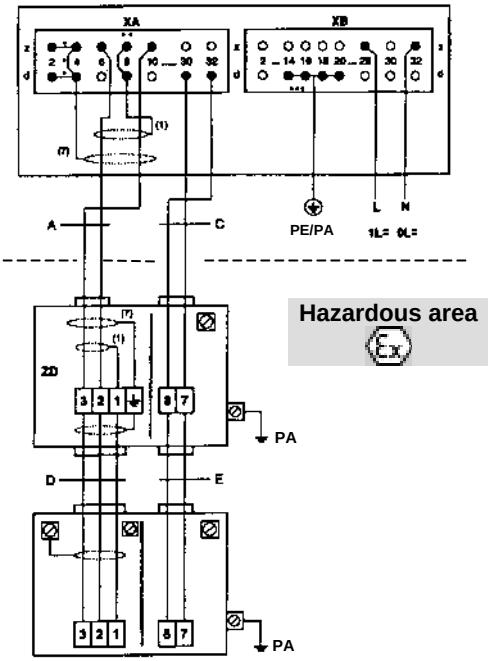


Primary head

Process temperature > 150°C (302°F)

III Signal cable A (type DS)

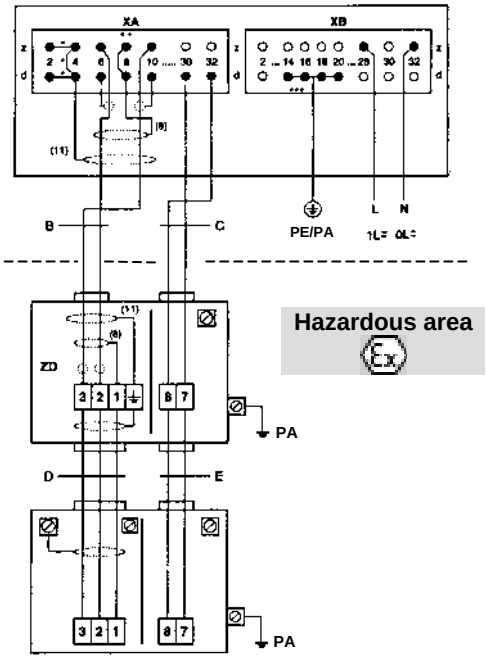
IFC 210 E-EEx



Primary head

IV Signal cable B (type BTS)

IFC 210 E-EEx



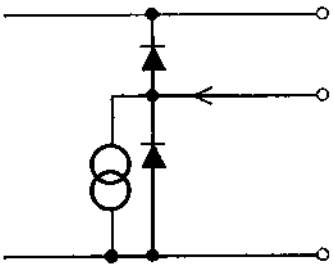
Primary head

2 Electrical connection of outputs and inputs

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 primary head may be installed in the hazardous area.
The signal converter must be installed outside the hazardous area!

2.1 Current output I

- The current output is galvanically isolated from all input and output circuits.
- Setting data and functions can note down in Section 3.3.
  Please also refer to Sect. 3.2 Factory settings.
- Typical current output



I+ approx. 22-25 V DC positive voltage of current output

I current sink

I⊥ chassis ground, current output

- All operating data and functions can be set, see Sect. 4 and 5.6, Fct. 1.05 for operator control
- The current output can also be used as an internal voltage source for the binary outputs and inputs.
- U_{int} = 22-25 V DC I = 23 mA when operated **without** receiver instruments at the current output
  I = 3 mA when operated **with** receiver instruments at the current output
- **Connection diagrams**, see Sect. 2.5: diagrams ① ② ③ ⑤ ⑦ ⑨ ⑩

2.2 Pulse output P

- The pulse output is galvanically isolated from the current output and all input circuits.
- Setting data and functions can note down in Section 3.3.
  Please also refer to Sect. 3.2 Factory settings.
- Typical pulse output P

P pulse output

P pulse output

- All operating data and functions can be set, see Sect. 4 and 5.7, Fct. 1.06 for operator control
- The pulse output can be operated in the active or passive mode.
- Active mode: The current output is the internal voltage source, connection of electronic totalizers (EC)
- Passive mode: External DC or AC voltage source required, connection of electronic (EC) or electromechanical (EMC) totalizers

Please note:
A fixed pulse width (0.01 – 1s) must be set for **operation with EMC totalizer**. Only then is an optocoupler active for higher output currents.

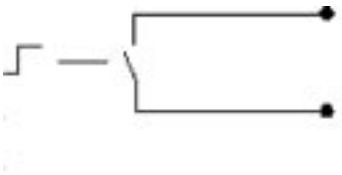
- Digital pulse division, interpulse period is non-uniform. Therefore, if frequency meters or
- cycle counters are connected, allow for minimum counting interval:

- gate time, counter $\leq \frac{1000}{P_{100\%}\ [Hz]}$

- **Connection diagrams,** see Sect. 2.5: diagrams ③ ④ ⑨ ⑩

2.3 Status outputs B1 and B2

- The status outputs are galvanically isolated from the current output and all input circuits.
- Setting data and functions can note down in Section 3.3.
  Please also refer to Sect. 3.2 Factory settings.
- Typical status outputs B1 and/or B2



B1/B2 status outputs B1/B2

B⊥ chassis ground, binary outputs and inputs

- All operating data and functions can be set,
  see Sect. 4 and 5.9, Fct 1.07 and/or 1.08 for operator control

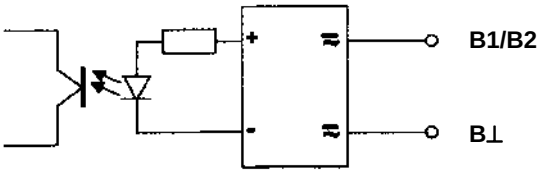
The status outputs can be operated in the active or passive mode.
Active mode: The current output is the internal voltage source.
Passive mode: External DC or AC voltage source required.

Characteristics of the 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 (F/R mode)	**F**orward flow	**R**everse flow
TRIP POINT (limit switch)	inactive	active
AUTO RANGE (automatic range change)	high range	low range
OVERFLOW I (I overranged)	current output OK	current output overranged
OVERFLOW. P (P overranged)	pulse output OK	pulse output overranged
SMU I (low-flow cutoff active)	Inactive	active
SMU P (low-flow cutoff active)	Inactive	active
Inverse B1 (switches B2 inversely to B1)	B2 open, B1 closed	B2 closed, B1 open
ALL. ERROR (all errors)	errors	no error
FATAL.ERROR (fatal errors only)	errors	no error
EMPTY PIPE (option)	when measuring tube is empty	when measuring tube is full

- **Connection diagrams,** see Sect. 2.5: diagrams ⑤ ⑥ ⑨ ⑩

2.4 Control inputs B1 and B2

- The control inputs are galvanically isolated from the current output and all input circuits.
- Setting data and functions can note down in Section 3.3.
  Please also refer to Sect. 3.2 Factory settings.
- Typical current inputs B1 and B2



- All operating data and functions can be set,
  see Sect. 4 and 5.10, Fct 1.07 and/or 1.08 for operator control
- The control inputs must be operated in the passive mode.

Function of the control inputs	**inactive** no voltage	**active** voltage present
Off	No functions	
External range	High range	Low range
Hold measured values	Measured values follow the measurement	Hold measured values
Measured values at zero	Measured values follow the measurement	Measured values set to "zero"
Reset totalizer	inactive	Reset totalizer
Delete errors	inactive	Delete error messages

Connection diagram, see Sect. 2.5: diagram ⑦ ⑧

2.5 Connection diagrams for outputs and inputs

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 primary head may be installed in the hazardous area.
The signal converter must be installed outside the hazardous area!

I Current output (included HART®)

P Pulse output

B1, B2 Status output (**S**) and / or Control input (**C**)

Totalizer
- electromechanical (EMC)
- electronic (EC)

milliammeter
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 may not have any conductive connection with other electrically conducting parts.

Electrical connection to socket connector XC
Wiring diagrams ① to ⑩ of outputs and inputs.

Interface operation with HART® or RS 485 (Option) see Sect. 6.2.1 and 6.2.2.

Active mode

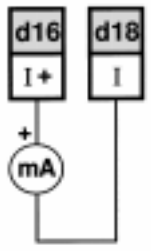
Power for operation (activation) of outputs and inputs supplied by the current output.

Passive mode

External power source required for operation (activation) of outputs and inputs.

① Current output I_{aktiv}

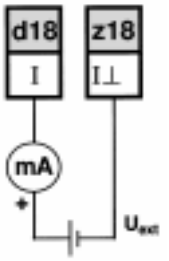
U = 0/4-20 mA
R_L < 800 Ω



② Current output I_{passiv}

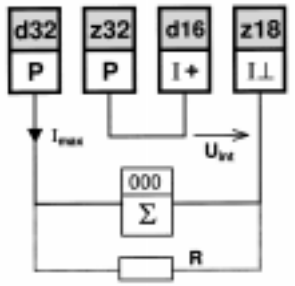
U_{ext}	15-22 V DC	22-32 V DC
R_L	0-500 Ω	0-800 Ω

I = 0/4-20 mA



③ Pulsoutput P_{activ}
for electronic totalizer (**EC**)

U_{int} = 22-25 V DC from current output
$I_{max} \leq$ 3 mA operation **with** current output **I**
$I_{max} \leq$ 23 mA operation **without** current output **I**



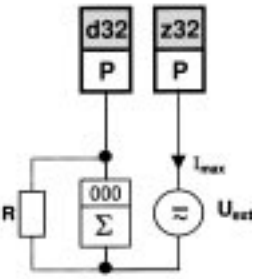
R = 10 kΩ, prevents incorrect counts when pulse output in open circuit

Where frequencies are > 100 Hz, use shielded cables (RFD)

④ Pulsoutput P_{passiv}
for electronic totalizer (**EC**) or electromechanical totalizer (**EMC**)

EMC: $U_{ext} \leq$ 32 V DC / ≤ 24 V AC
$I_{max} \leq$ 150 mA **f** ≤ 50 Hz
EC: $U_{ext} \leq$ 32 V DC $I_{max} \leq$ 20 mA

Pulses	≤ 1 kHz	< 10 kHz
R (load)	1-10 kΩ	1-3 kΩ

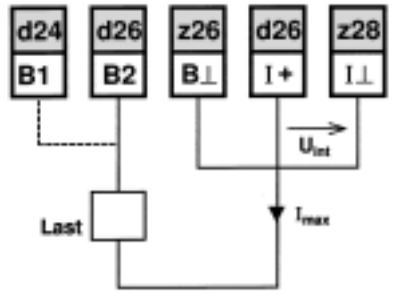


R = load impedance with EC totalizer operation; for value refer to table above

Where frequencies are > 100 Hz, use shielded cables (RFD)

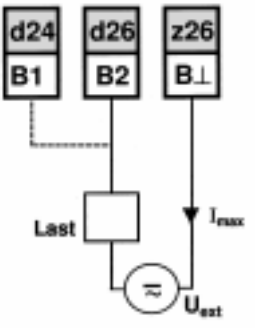
⑤ Statusoutput S_{activ}
(connection to B2 and/or B1)

U_{int} = 22-25 V DC from current output
$I_{max} \leq$ 3 mA operation **with** current output **I**
$I_{max} \leq$ 23 mA operation **without** current output **I**



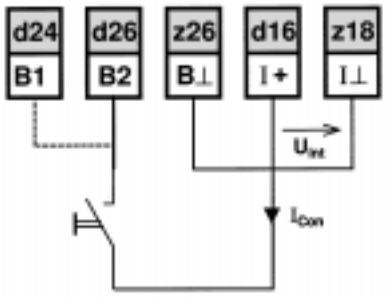
⑥ Statusoutput S_{passiv}
(connection to B2 and/or B1)

U_{ext} ≤ 32 V DC / ≤ 24 V DC
I_{max} ≤ 150 mA



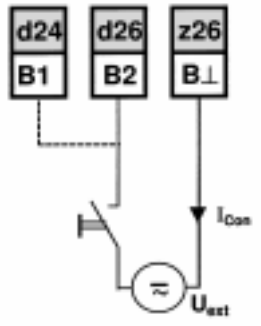
⑦ Control input C_{active}
(connection to B2 and/or B1)

U_{int} = 22-25 V DC from current output
$I_{con} \leq$ 4 mA (max. contact rating)



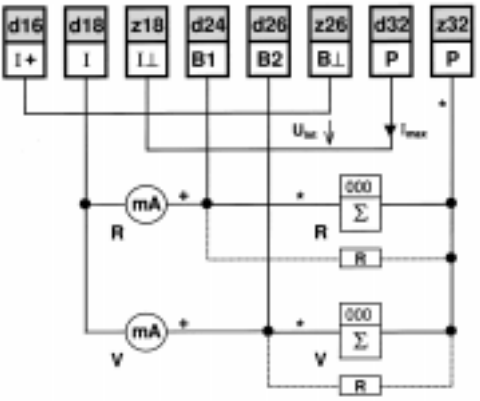
⑧ Control input $C_{passive}$
(connection to B2 and/or B1)

U_{ext} ≤ 32 V DC / ≤ 24 V AC
I_{con} ≤ 6 mA (max. contact rating)



⑨ F/R measurement (**F**=forward) (**R**=reverse)
Current output I_{active} **a**nd/or
pulse output P_{aktive} (for **EC**)
without external changeover relay

U_{int} = 22-25 V DC from current output
$I_{max} \leq$ 3 mA operation **with** current output **I**
$I_{max} \leq$ 23 mA operation **without** current output **I**



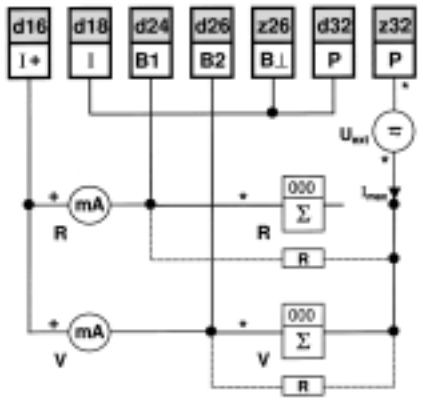
R = 10 kΩ, prevents incorrect counts when pulse output in open circuit

* Where frequencies are > 100 Hz, use shielded cables (RFD)

⑩ F/R measurement (**F**=forward) (**R**=reverse)
Current output $I_{passive}$ **a**nd/or
pulse output $P_{passive}$ (for **EC** or **EMC**)
without external changeover relay

EMC: $U_{ext} \leq$ 32 V DC / ≤ 24 V AC
$I_{max} \leq$ 150 mA **f** ≤ 50 Hz
EC: $U_{ext} \leq$ 32 V DC $I_{max} \leq$ 20 mA

Pulses	≤ 1 kHz	< 10 kHz
R (load)	1-10 kΩ	1-3 kΩ



R = load impedance with EC totalizer operation; for value refer to table above

* Where frequencies are > 100 Hz, use shielded cables (RFD)

3 Start-up

3.1 Power-on and measurement

- Before powering the system, please check that it has been correctly installed according to Sect. 1 and 2.
- The flowmeter is delivered ready for operational use. All operating data have been factory set in accordance with your specifications.
  Please refer to Sect. 3.2 "factory settings".
- Power the unit, and the flowmeter will immediately start process flow measurement.
- Refer to Sect. 4 and 5 for operator control.

3.2 Factory setting

All operating data are factory set according to your order specifications.

If you have not made any particular specifications at the time of ordering, the instruments will be delivered with the standard parameters and functions listed in the Table below.

To facilitate easy and rapid initial start-up, current output and pulse output are set to process flow measurement in "2 flow directions", so that the current flowrate is displayed and the volumetric flow counted independent of the flow direction. The measured values may possibly be shown with a " – " sign.

This factory setting for the current and pulse outputs may possibly lead to measuring errors, particularly in the case of volume flow counting:

For example, if pumps are switched off and a "backflow" occurs which is not within the range of the low-flow cutoff (SMU), or if separate displays and counts are required for both flow directions.

To avoid faulty measurements, therefore, it may be necessary to change the factory setting of some or all of the following functions:
– low-flow cutoff SMU, Fct. 1.03, Sect. 5.3
– display, Fct. 1.04, Sect. 5.4
– current output I, Fct. 1.05, Sect. 5.6
– pulse output P, Fct. 1.06, Sect. 5.7

Operation see **Section 4 and 5**.

Standard factory settings

Function		Setting
1.01	Full-scale range $Q_{100\%}$	
1.02	Time constant	3 s, for I, B1, B2 and display
1.03	Low-flow cutoff SMU	ON: 1% OFF: 2%
1.04	Display flow rate totalizer(s) Messages Trend Updating Scaling	 m^3/hr or US Gal/min m^3 or US Gal no Mittelwert 1 sec. auto
1.05	Current output I function Range I I Max I Error	 2 directions 4-20 mA 22 mA 22 mA
1.06	Pulse output P function pulse width pulse value	 2 directions 50 ms 1 pulse/s

Function		Setting
1.07	Status output B1	flow directions
1.08	Control input B2	off
3.01	Language for display only	English
3.02	Flowmeter diameter flow direction (see arrow on primary head)	 see nameplate } + direction
3.04	Entry code	no
3.05	User unit	Liter/hr or USMGal/day
3.06	Application: Flow	steady
3.07	Hardware: Terminal B1 Terminal B2	Statusoutput Control input
3.08	Location	ALTOMETER
3.09	Communication	off

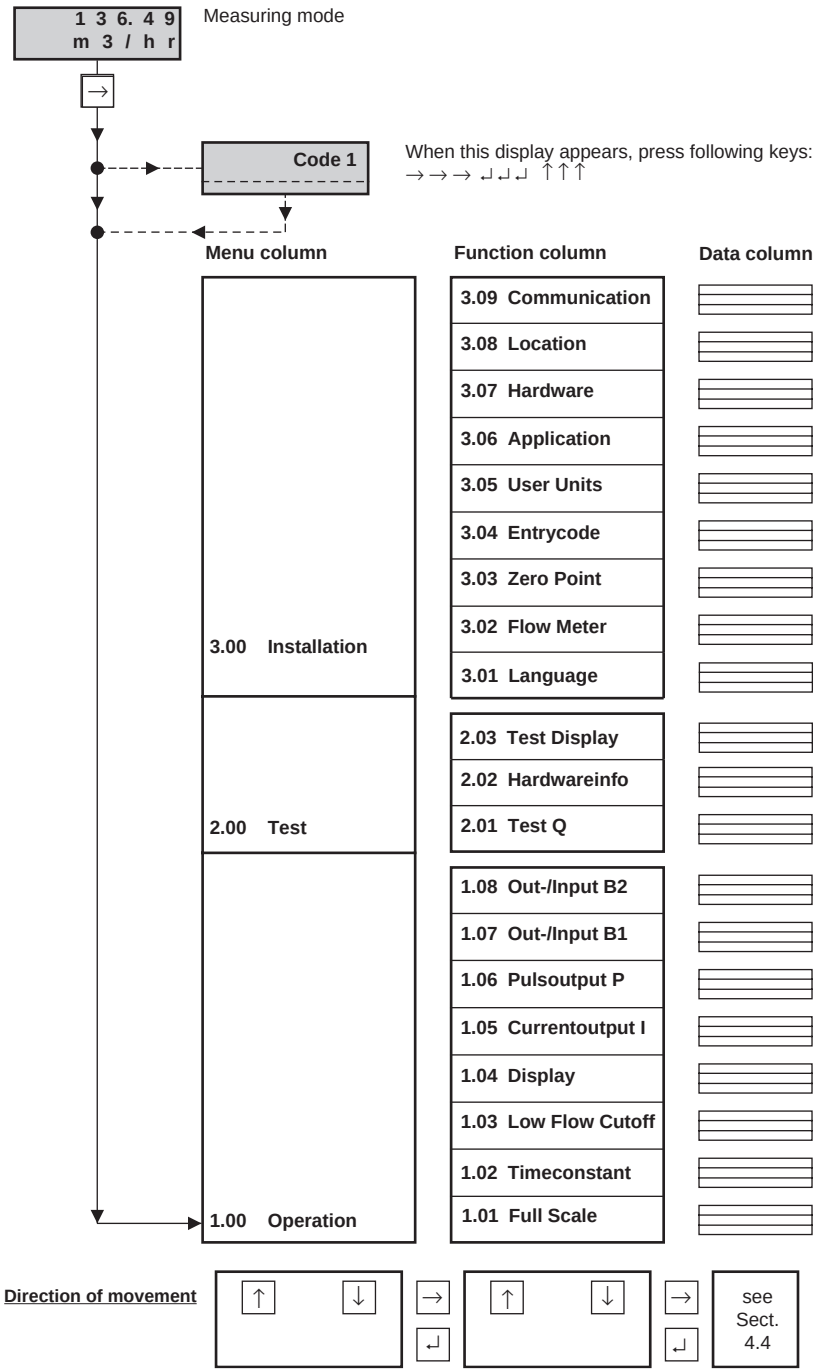
3.3 Setting data

Here you can note down the settings of the signal converter !

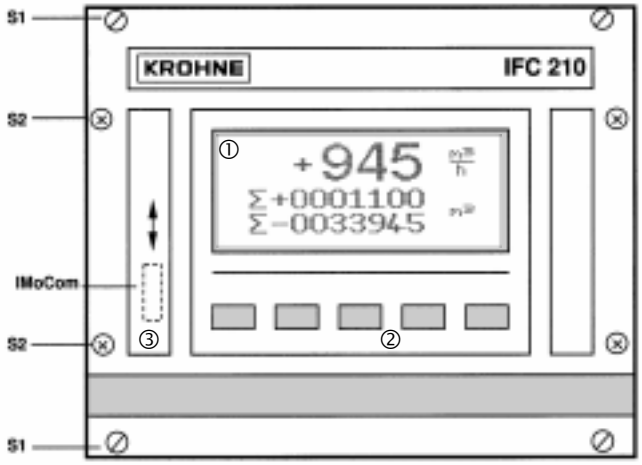
Fct. No.	Function	Settings	
1.01	**Full-scale range**		
1.02	**Time constant**		
1.03	**Low-flow cut-off**	ON:	OFF:
1.04	**Display**	Flow	
		Totalizer	
		Messages	
		Trend	
		Updating	
		Scaling	
1.05	**Current output I**	Function	
		Reverse Range	
		Range I	
		I Max	
		I Error	
1.06	**Pulse output P**	Function	
		Pulswidth	
		Pulsvalue	
1.07	**Status output B1 or Control input B1** (for setting see below, Fct. No. 3.07, terminal B1)		
1.08	**Status output B2 or Control input B2** (for setting see below, Fct. No. 3.07, terminal B2)		
3.01	**Language**		
3.02	**Primary head**	Diameter	
		GK Value	
		Field Frequency	
		Line Frequency	
		Flow Direction	
3.04	**Entry code required ?**	☐ no	☐ yes
		→ → → ↵ ↵ ↵ ↑ ↑ ↑	
3.05	**User-defined unit**		
3.06	**Application**	Flow is	☐ steady ☐ pulsating
		Empty Pipe	☐ no ☐ yes
3.07	**Hardware-setting**	Terminal **B1** is	☐ Status output ☐ Control input
		Terminal **B2** is	☐ Status output ☐ Control input
3.08	**Measuring point**		
3.09	**Communication**	☐ off	
		☐ HART **or** ☐ KROHNE RS 485	
		Address:	
		Baud rate:	

4 Operation of the signal converter

4.1 KROHNE operator control concept



4.2 Operating and check elements

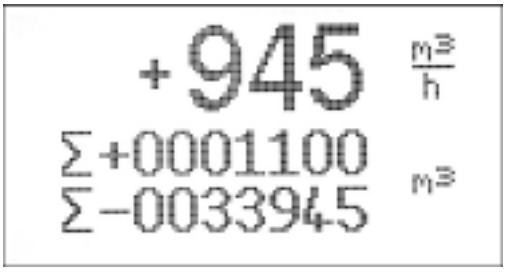


① Graphic LCD

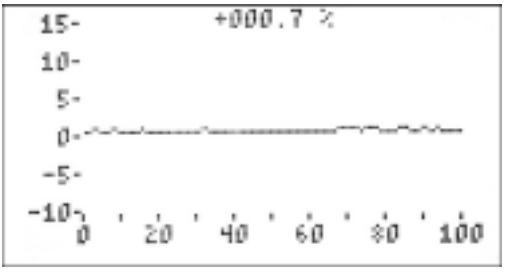
② 5 keys for operator control

③ ImoCom interface

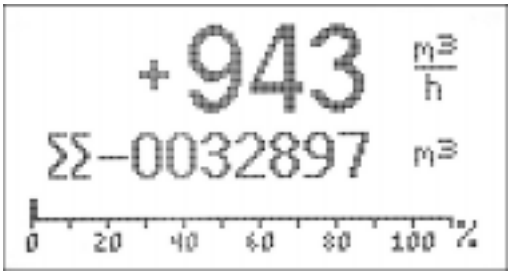
Flowrate in m^3/hr
+ and – totalizer in m^3



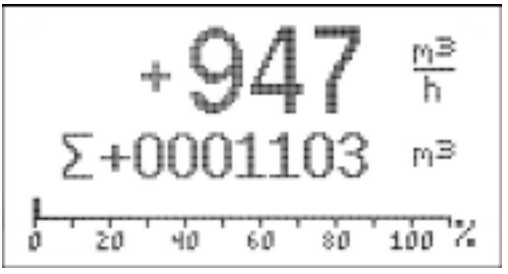
Graphic display (Trend)



Flowrate in m^3/hr
sum totalizer in m^3 (+ and – totalizer)



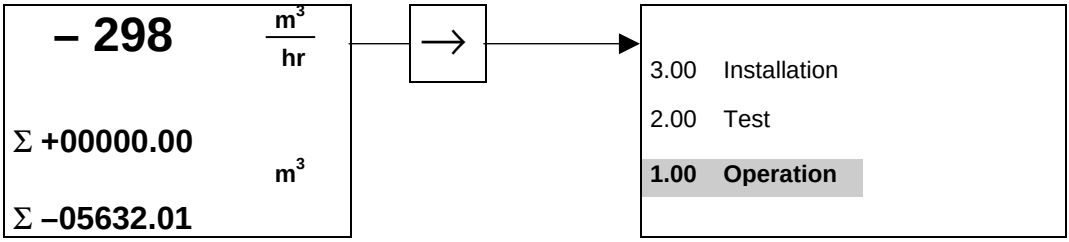
Flowrate in m^3/hr
+ totalizer in m^3



4.3 Function of keys

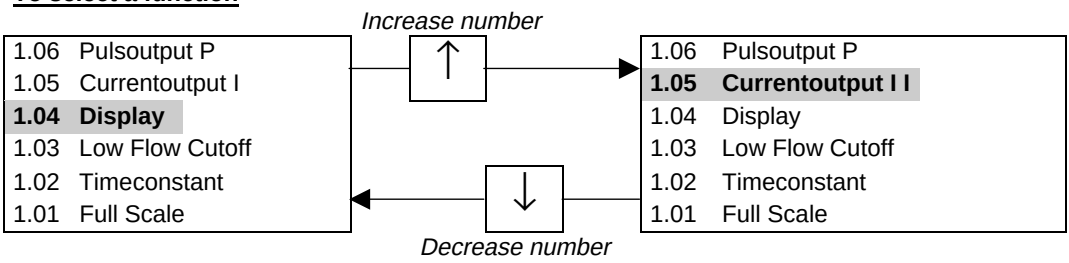
The **cursor** has a **grey** background in the following descriptions.

To start operator control

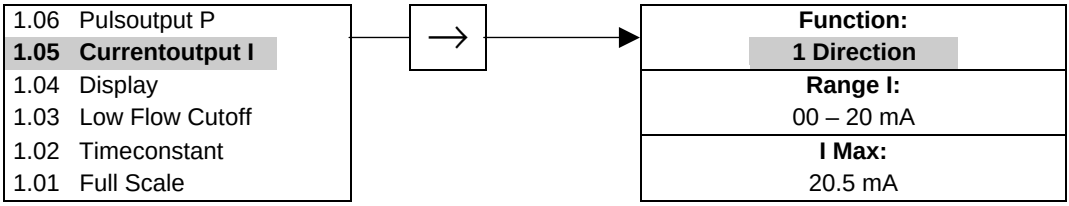


PLEASE NOTE: When "**yes"** is set under Fct. 3.04 **Entry Code**, **„Code"** appears in the display after pressing the → key. The 9-keystroke Entry Code 1 must now be entered: → → → ↵ ↵ ↵ ↑ ↑ ↑ (each keystroke acknowledged by "*").

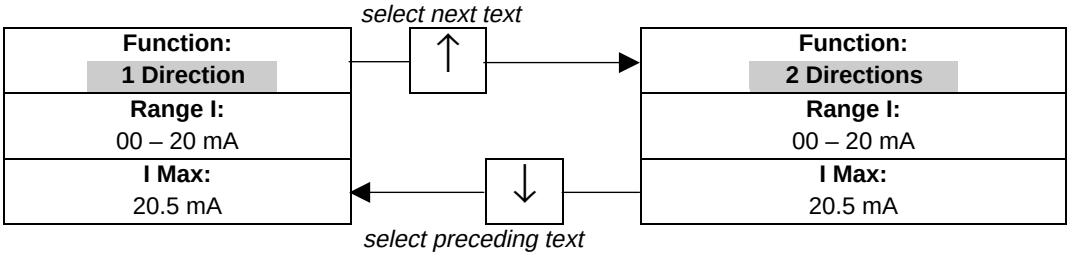
To select a function



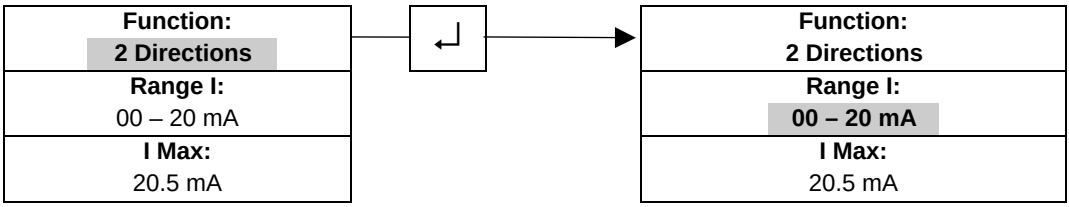
To select a subfunction



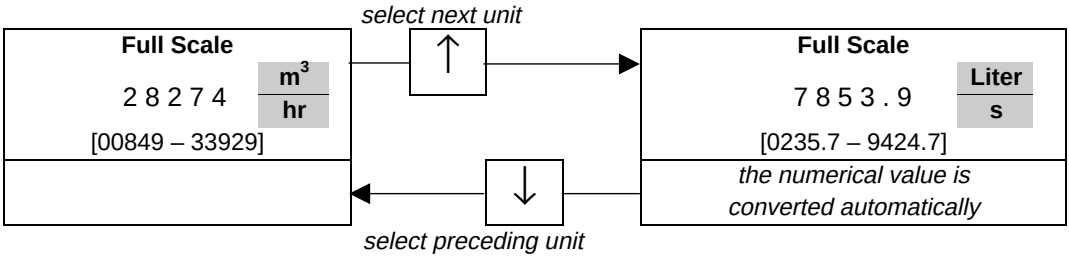
To alter texts



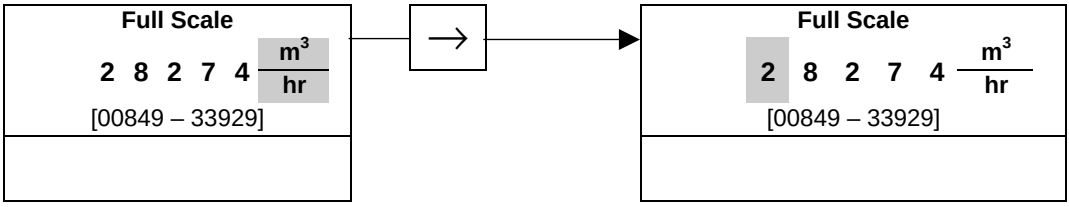
To select next subfunction



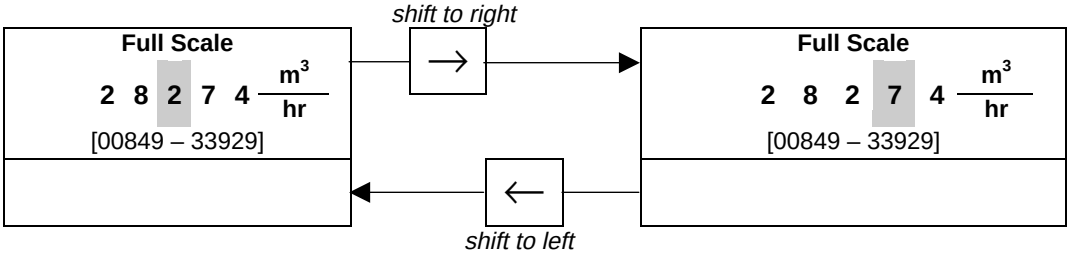
To alter units



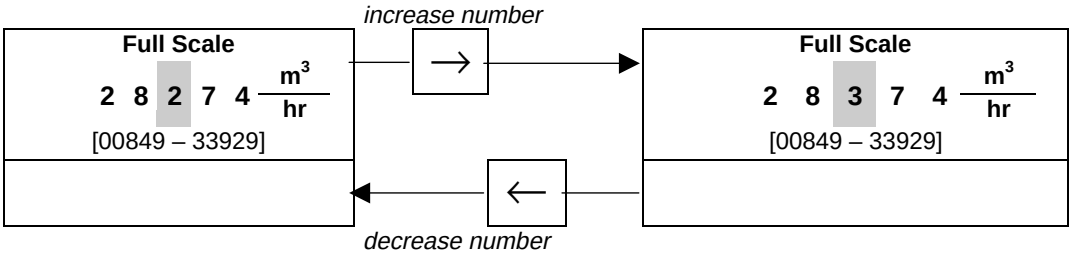
To transfer to number setting



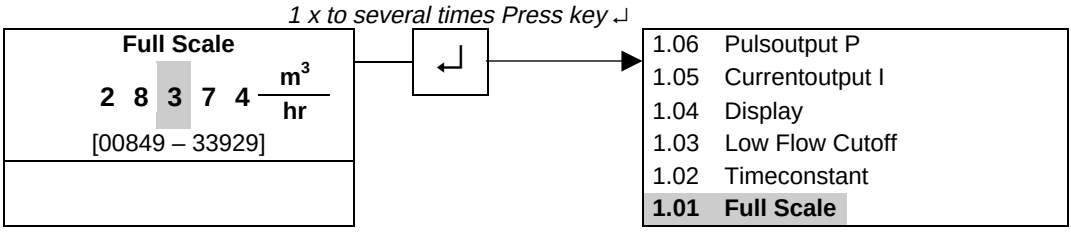
To shift cursor



To change numbers

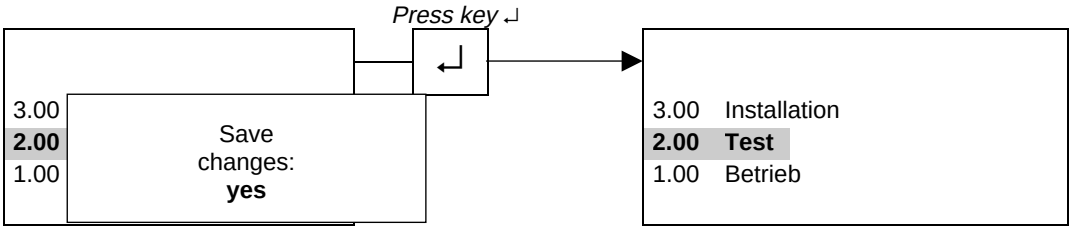


To revert to function display



To terminate operator control

Press key ↵ repeatedly until one of the following menus
1.00 Operation, 2.00 Test or **3.00 Installation**



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

New parameters not to be stored:
Press ↑ key 1 or 2 times:

1 × ↑) Save changes: **return**
= return to parameter setting after pressing ↵ key.

2 × ↑) Save changes: **No**
= new parameters not saved after pressing ↵ key.
Continue measuring mode with "old" parameters

4.4 Table of settable functions

Abbreviations used

B1/B2 Status output, control input
DN Nominal size, meter size
F_M Conversion factor volume for any unit, see Fct. 3.05 "**Factor Volume**"
F_{max} Highest frequency of pulse output
F_{min} Lowest frequency of pulse output
F_T Conversion factor time for any unit, see Fct. 3.05 "**Factor Time**"
GK Primary constant
I Current output
$I_{0\%}$ Current at 0% flow
$I_{100\%}$ Current at 100% flow
I_{max} I Max.
P Pulse output
P_{max} = F_{max} / $Q_{100\%}$
P_{min} = F_{min} / $Q_{100\%}$
I_{Error} I Error, $I_{0\%} \leq I_{Error} \geq I_{max}$

Q actual flowrate
$Q_{100\%}$ 100% flow = full scale range
Q_{max} = $\frac{\pi}{4}$ $DN^2 \times v_{max}$ (=max. full-scale range $Q_{100\%}$ at v_{max} = 12 m/s / 40 ft/s)
Q_{min} = $\frac{\pi}{4}$ $DN^2 \times v_{min}$ (=min. full-scale range $Q_{100\%}$ at v_{min} = 0,3 m/s / 1 ft/s)
SMU Low-flow cutoff for I and P
v Flow velocity
v_{max} Max. flow velocity (12 m/s / 40 ft/s) at $Q_{100\%}$
v_{min} Min. flow velocity (0.3 m/s / 1 ft/s) at $Q_{100\%}$
F/R Forward/Reverse flow at F/R operation

Fct.	Display- Texts	Description and settings
1.00	**OPERATION**	**Operations menu**
1.01	**FULL SCALE**	**Full-scale range for flowrate $Q_{100\%}$** Select unit • m^3/hr • Liter/Sec • US.Gal/min • user unit, factory set is Liter/hr or US MGal/day (see Fct. 3.05) *Press → key to transfer to number setting.* Setting ranges: The ranges are dependent on the meter size (DN) and the flow velocity (v): $Q_{min} = \frac{\pi}{4} DN^2 \times v_{min}$ $Q_{max} = \frac{\pi}{4} DN^2 \times v_{max}$ Nom. dia. /meter size — v_{min} = 0.3 m/s (1 ft/s) — v_{max} = 12 m/s (40 ft/s) • DN 2.5–1600 / $^1/_{10}$ – 64: 0.0053 – 86 859 m^3/hr 0.0237 – 401 080 US Gal/min *Press ↵ key to return to Fct. 1.01 FULL SCALE.*
	VALUE P	**Pulse value has been changed.** With the old pulse values the output frequency (F) would have been exceeded or not reached. **P_{min}** = F_{min} / $Q_{100\%}$ **P_{max}** = F_{max} / $Q_{100\%}$ **Check new values!**
1.02	**TIMECONST.**	**Time constant** Select:: • ALL (applies to display and all outputs) • ONLY Current output (only display, current and status outputs) *Press ↵ key to transfer to number setting.* Range: • 0.2 – 99.9 Sec *Press ↵ key to return to Fct. 1.02 TIMECONST.*
1.03	**L.F.CUTOFF**	**Low-flow cutoff (SMU)** • OFF (fixed values: ON = 0.1% / OFF = 0.2%) PERCENT (variable values) ON 1 – 19% OFF 2 – 20% *Press → key to transfer to number setting.* Note: Cutoff off value must be greater than cutoff on value. *Press ↵ key to return to Fct. 1.03 L.F. CUTOFF.*

Fct.	Display-Texts	Description and settings
1.04	**DISPLAY**	**Display functions**
	Contrast	**Set display contrast** • range from **+ 15** (high contrast) to **- 15** (low contrast) *Press ↵ key to transfer to subfunction "Flow".*
	Flow	**Set format for flow rate display** • #### • ### . # • ## . ## • # . #### • Auto *Press key →* to move to unit selection. Selection unit: • m^3/hr • Liter/Sec • US Gal/min user unit, factory set is Liter/hr or US MGal/day (see Fct. 3.05) *Press ↵ key to transfer to subfunction "Totalizer".*
	Totalizer	**Set format for display of volume** Select decimal positions: • ####### • ###### . # • ##### . ## • #### . ### • ### . #### • ## . ##### • # . ###### • Auto *Press →* key to move to unit selection. • m^3 • Liter • US Gal user unit, factory set is Liter or US MGal (see Fct. 3.05) *Press ↵ key to transfer to subfunction "Messages".*
	Messages	**Additional displays wanted in measuring mode?** • no • yes (overlay additional messages) *Press ↵ key to transfer to subfunction "Trend".*
	Trend	**Set graphic display** Selection: • Average (show average values over time base) • Min. & Max. (min./max. values over time base) • Every Value (all values numbered consecutively) *Press ↵ key to transfer to subfunction "Updating".* *When* "every value" *selected, transfer to subfunction* "Scaling".
	Updating	**Update measured values in graphic display** (this not shown when "every value", see above, selected) Selection: • 0.1 Sec. • 0.2 Sec. • 0.5 Sec. • 1 Sec. • 2 Sec. • 5 Sek. • 1 Min. • 2 Min. • 5 Min. *Press ↵ key to transfer to subfunction "Scaling".*
	Scaling	**Set scaling of graphic display** Selection: • 0% ... 100% • - 25% ... 100% • 0% ... 50% • 50% ... 100% • -100% ... 0% • 25% ... -100% • - 50% ... 0% • -100% ... - 50% • Auto *Press ↵ key to return to Fct. 1.04 DISPLAY.*
1.05	**Current output I**	**Set Current output I**
	Function	**Set Function** • Off (switched off) • 1 Direction (1 flow direction) • 2 Directions (forward/reverse flow, F/R flow measurement) *Press ↵ key to transfer to subfunction "Range I".*
	Range I	**Set measuring range ($I_{0\%}$ ... $I_{100\%}$)** • 0 - 20 mA • 4 - 20 mA (fixed ranges)) • mA (user-defined range) • Range: $I_{0\%}$ - $I_{100\%}$ (Value $I_{0\%} < I_{100\%}$!) 0 - 16 mA 4 - 20 mA *Press → key to transfer to number setting.* *Press ↵ key to transfer to subfunction "I Max".*
	I Max	**Set I Max** Selection: • 20,5 mA • 22 mA *Press ↵ key to transfer to subfunction "I Error".*

Fct.	Display- Texts	Description and settings
	I Error	**Set current for error identification (I_{Error})** • 22 mA • 0.0 mA (... < $I_{0\%}$, variable only, see above if$I_{0\%}$ > 1 mA) *Press → key to transfer to number setting.* *Press ↵ key to transfer to subfunction "Range I".*
	Reverse Range	**Set full-scale range for reverse flow** (appears only when 2 Directions selected, see above) setting range: 005 - 150% of $Q_{100\%}$ (different value for reverse flow) *Press → key to transfer to number setting.* *Press ↵ key to return to Fct. 1.05 "Current output I".*
1.06	**Pulsoutput P**	**Set Pulsoutput P**
	Function	**Set Function** Selection: • Off (switched off) • 1 Direction (1 flow direction) • 2 Directions (forward/reverse flow, F/R flow measurement) *Press ↵ key to transfer to subfunction "Pulswidth".*
	Pulswidth	**Set pulse width** Selection: • 0.01 - 1.00 Sec (only for F_{max} < 50 pulse/s) • automatic (= 50% of the period duration) of the 100% output frequency)) • symmetrical (= pulse duty ratio 1:1 over total range) *Press ↵ key to transfer to subfunction "Pulsvalue".*
	Pulsvalue	**Set pulse value** pulse value per unit volume • 1/m^3 • 1/Liter • 1/US Gal • PulS/ user-defined unit, factory-set is Liter or US M.Gal (see Fct. 3.05) pulse value per unit time • PulSe/Sec (=Hz) • PulSe/min • PulSe/hr • PulSe/user-defined unit, factory-set is hr (see Fct. 3.05) *Press ↵ key to return to Fct. 1.06 "Pulsoutput P".*
1.07	**Output/Input B1**	**Assignment of terminal B1** see Fct. 3.07 Hardware: Either **STATUS OUTPUT** or **CONTROL INPUT** For settings, refer to one of the following descriptions.
1.08	**Output/Input B2**	**Assignment of terminal B2** see Fct. 3.07 Hardware: Either **STATUS OUTPUT** or **CONTROL INPUT** For settings, refer to one of the following descriptions.
1.0_	**Status output B1** and/or **B2**	**Setting as status output** • Off (status output switched off) • On (status output switched on, e.g. as operation indicator) EMPTY PIPE (signals that pipe is empty , only if option installed) • SIGN.I or P (F/R flow measurement) • Overflow I or P (overranging of outputs) • SMU I or P (signals when low-flow cutoff is active) } I = I only P = ALL • Inverse B1 • Trip Point: (press key ↵ to transfer to Characteristics) Selection: • + direction • - direction • 2 directions (press ↵ key to transfer to number setting) Setting range 005 - 150% • automatic range change (press ↵ key to transfer to number setting) Setting range 05 - 80% (= ratio of lower to upper range) • All Errors • Fatal error only *Press ↵ key to return to Fct. 1.07 a*nd/or 1.08 "*Statusoutput"*

Fct.	Display-Texts	Description and settings
1.0_	**Controlinput** **B1** and/or **B2**	**Set as Control input** • Off (switched off) • Ext.Range (external range change) Press ↵ key to transfer to number setting. Setting range: 05 - 80% (= ratio of lower to upper range from 1:20 to 1:1.25. Value must be greater than that of Fct. 1.03 L.F. CUTOFF). • Outp.Hold (hold value of outputs) • Outp.Zero (set outputs to min.values) • Total. Reset (reset totalizers) • Error. Reset (delete error messages) *Press ↵ key to return to Fct. 1.07 a*nd/or 1.08 "*Statusoutput"*

Fct.	Display-Texts	Description and settings
2.00	**Test**	**Test menu**
2.01	**Test Q**	**Test measuring range Q** Precautionary query • SURE NO *Press ↵ key to return to Fct. 2.01 TEST Q .* • SURE YES *Press → key to transfer to number setting.* select value: -110 / -100 / -50 / -10 / 0 / +10 / +50 / +100 / +110 PCT.. of set full-scale range $Q_{100\%}$. Displayed value present at outputs I and P. *Press ↵ key to return to Fct. 2.01 "TEST Q" .*
2.02	**Hardwareinfo**	**Hardware information and error status** Before consulting factory, please note down all codes.
	Modul ADC	X . X X X X X . X X Y Y Y Y Y Y Y Y Y Y
	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 next info.*
	Modul DISP..	X . X X X X X . X X Y Y Y Y Y Y Y Y Y Y
	Modul RS	X . X X X X X . X X (only provided if "computer interface" Y Y Y Y Y Y Y Y Y Y Option installed)
		Press ↵ key to return to Fct. 2.02 "Hardwareinfo".
2.03	**Test Display**	**Press → key to start test of display, duration approx. 5 sec.**

Fct.	Display-Texts	Description and settings
3.00	**Installation**	**Installation menu**
3.01	**Language**	**Select language for display texts** • GB / USA (English) • F (French) • D (German) • others on request *Press ↵ key to return to Fct. 3.01 "Language".*
3.02	**Flowmeter**	**Set data for primary head**
	Diameter	**Select size from meter size table** • DN 2.5 - 3000 mm equivalent to $^1/_{10}$ – 120 inch *Select with ↑ key.* *Press ↵ key to transfer to subfunction "Full Scale".*
	Full Scale	**Full-scale range for flow $Q_{100\%}$** Selection unit: • m^3/hr • Liter/Sec • US Gal/min user unit, factory set is Liter/hr or US MGal/day (see Fct. 3.05) *Press → key to transfer to number setting.* Setting ranges: The ranges are dependent on the meter size (DN) and the flow velocity (v): Q_{min} = DN^2 x v_{min} Q_{max} = DN^2 x v_{max} Nom. dia. /meter size V_{min} = 0,3 m/s (1 ft/s) V_{max} = 12 m/s (40 ft/s) • DN 2.5–1600 / $^1/_{10}$ – 64: 0.0053 – 86 859 m^3/hr 0.0237 – 401 080 US Gal/min *Press ↵ key to transfer to subfunction "Gk Value".*

Fct.	Display-Texts	Description and settings
	Value P	**Pulse value has been changed.** With the old pulse values the output frequency (F) would have been exceeded or not reached. **P_{min}** = F_{min} / $Q_{100\%}$ **P_{max}** = F_{max} / $Q_{100\%}$ **Check new values!**
	Gk Value	**Set primary constant GK** see primary head nameplate. Range: • 1.0000 - 9.9999 *Press ↵ key to transfer to subfunction "Field Frequency".*
	Field Frequency	**Set Magnetic field frequency** (f_{Net} = power frequency) • $^1/_2 \times f_{Net}$ • $^1/_6 \times f_{Net}$ • $^1/_{18} \times f_{Net}$ • $^1/_{36} \times f_{Net}$ *Select with ↑ key.* *Press ↵ key to transfer to subfunction "Flow Direction".* for DC devices to subfunction „Line Frequency"
	Line Frequency	**Normal line frequency in your country** This function is only provided for units with DC power supply • 50 Hz • 60 Hz *Select with ↑ key.* *Press ↵ key to transfer to subfunction "Flow Direction".*
	Flow Direction	**Define flow direction** (in F/R mode: forward flow). • + Direction • - Direction *Select with ↑ key.* *Press ↵ key to return to Fct. 3.02 "Flowmeter".*
3.03	**Zero Point**	**Zero calibration**
		• return (quit function without making change) • calculate (calculate new zero value) Press ↵ key to start, duration approx. 15-90 seconds. Save new value, select with ↑ key: • save no (do **not** save zero value) • save yes (save new zero value) • change (change zero value manually) Press → key to transfer to unit selection: • m^3/h • Liter/s • US Gal/min • any unit, see Fct. 3.05 (factory setting: Liter/h) Press → key to transfer to number setting. Value may be max. 10% of $Q_{100\%}$ *Press ↵ key to return to Fct. 3.03 "Zero Point".*
3.04	**Entrycode**	**Entry code required to enter setting mode?** • NO (= entry with → only) • YES(= entry with → and Code 1:→ → → ↵ ↵ ↵ ↑ ↑ ↑) *Press ↵ key to return to Fct. 3.04 "Entrycode".*
3.05	**User Units**	**Set any required unit for flowrate and counting**
	Text Volume	**Set text for required flowrate unit** (max. 5 characters) Factory-set: Liter or MGal . Characters assignable to each place: • A-Z, a-z, 0-9, or — (= blank character) *Press ↵ key to transfer to subfunction "Factor Volumen".*
	Factor Volume	**Set conversion factor (FM) for volume** Factory set 1.00000 for Liter or 2.64172E-4 for US MGal (exponent notation, here: 1x 10^3 or 2.64172x10^{-4}). Factor FM = volume per $1m^3$. 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 required time unit** (max. 5 characters) Factory-set: hr. Characters assignable to each place: • A-Z, a-z, 0-9, or — (= blank character) *Press ↵ key to transfer to subfunction "Factor Time".*
	Factor Time	**Set conversion factor (F_T) for time** Factory-set: 3.60000 E+3 for hour or 8.64000 E+4 for day (exponent notation, here: 3.6 x10^3 or 8.64 x10^{-4}). Set factor FT 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 Units".*

Fct.	Display-Texts	Description and settings
3.06	**Application**	**Set application conditions**
	Flow	**Set characterization for flow** • Steady (steady flow, max. 150% of $Q_{100\%}$) • Pulsating (pulsating flow, up to 1000% of $Q_{100\%}$ e.g. caused by reciprocating pumps, refer to Sect. 6.4) *Press ↵ key to transfer to subfunction "Empty Pipe".*
	Empty Pipe	**Signal when measuring tube is empty** (refer to Sect. 6.3) • no • yes (possible only with built-in option) *Press ↵ key to return to Fct. 3.06 "Application".*
3.07	**Hardware**	**Assign outputs and inputs to terminals B1 and B2**
	Terminal B1	**Define function of terminal B1** (valid for Fct. 1.07) • Statusoutput • Controlinput (*Select with ↑ key.*) *Press ↵ key to transfer to subfunction "Terminal B2".*
	Terminal B2	**Define function of terminal B2** (valid for Fct. 1.08) • Statusoutput • Controlinput (*Select with ↑ key.*) *Press ↵ key to transfer to subfunction "Fieldcurrent".*
	Fieldcurrent	**Define field current supply** • Intern • Extern (> DN 1600 / > 64" with power driver) *Press ↵ key to return to Fct. 3.07 "Hardware".*
3.08	**Location**	**Set measuring point tag** Factory setting: ALTOMETER Characters assignable to each place: • A-Z, a-z, 0-9 or „-" (=blank character).) *Press ↵ key to return to Fct. 3.08 "Location".*
3.09	**Communication**	**Set comminucation interface** • Off (switched off)) • HART (HART®-interface switched on)) • KROHNE (KROHNE RS 485-interface switched on), (only provided if daughter board installed (option).) • Address: „HART" 00-15 / „KROHNE" 000-239 • Baud rate: 1200, 2400, 4800, 9600 or 19200 (appears with selection "KROHNE" only)") *Press ↵ key to return to Fct. 3.09 "Communication".*

4.5 Error messages in measuring mode

The following list gives all errors that can occur during process flow measurement. Errors shown in display when “Yes” set in Fct. 1.04 Display, subfunction “Messages.”.

Error messages	Description of error	Error clearance
Line Int.	Power failure Note: no counting during power failure	Cancel error in Reset-Quit menu, see Sect. 4.6. Reset totalizer if necessary.
Overflow I	Current output overranged (Flow > I Max)	Check and if necessary correct instrument parameters. After elimination of cause, error message deleted automatically.
Overflow P	Pulse output overranged. (Flow > I Max)	Check and if necessary correct instrument parameters. After elimination of cause, error message deleted automatically.
Totalizer	Totalizer has been reset.	Cancel error message in Reset/Quit. menu, see Sect. 4.6.
ADC	Analog / digital converter overranged	Error message deleted automatically after elimination of cause.
Fatal Error	Fatal error, all outputs set to “min. values“	Please consult factory.
Empty Pipe	Pipe has run dry. This message appears only when the **“empty pipe identifier” option is installed** and the function is switched on under Fct. 3.06 Application, submenu ”Empty Pipe”.	Fill pipe.

4.6 Reset totalizer and cancel error messages

Cancel 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
		... No	Do **not** delete error messages, press ↵ twice = return to measuring mode.
↑		**... Yes**	Delete error messages
↵		**Reset totalizer …**	
↵	- - - - - - -	- - - - - / - - -	Return to measuring mode

Reset totalizer(s) 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
↵		**Reset totalizer …**	Menu for resetting totalizer
→		**... No**	Do **not** delete error messages, press ↵ twice = return to measuring mode.
↑		**... Yes**	Reset totalizer
↵	- - - - - - -	- - - - - / - - -	Return to measuring mode

4.7 Examples of setting the signal converter

As an example the **cursor**, flashing part of display, is shown below in **bold** type.

- **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” set under Fct. 3.04 Entry Code, key in the 9-keystroke Code 1 now: → → → ↑ ↑ ↑ ↵ ↵ ↵
	Fct. 1.00	**Operation**	
→	Fct. 1.**01**	**Full Scale**	
4 × ↑	Fct. 1.**05**	**Current output I**	
→		Function	
→ ↵		Range I	
→	**04-20**	mA	Old current range
2 × ↑	**00-20**	mA	New current range
2 × ↵		I Error	
→	**0**	mA	Old value for error messages
↑	**22**	mA	New value for error messages
↵	Fct. 1.**05**	**Current output I**	
↵	Fct. 1.00	**Operation**	
↵		**Store Yes**	
↵	- - - - - - -	- - - - - / - - -	Measuring range with new data for the current output

5 Description of functions

5.1 Full-scale range $Q_{100\%}$ (Fct. 1.01)

Fct. 1.01 FULL SCALE
Press → key.

Choice of unit for full-scale range $Q_{100\%}$
- **m^3/hr** (cubic metres per hour)
- **Liter/Sec** (litres per second)
- **US Gal/min** (US gallons per minute)
- User-defined unit, factory-set is „**Liter/hr**" (litres per hour) or "**US MGal/day**", see Sect. 5.07

Select with ↑ or ↓ key.
Use → key to transfer to numerical setting, 1st number (cursor) flashes..

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

$\mathbf{Q_{min}} = \frac{\pi}{4} DN^2 \times v_{min}$ $\mathbf{Q_{max}} = \frac{\pi}{4} DN^2 \times v_{max}$ (refer to flow table in Sect. 10.2)

0.00531	–	86 858	m^3/hr
0.00147	–	24 120	Liter/Sec
0.02335	–	382 420	US Gal/min

Change flashing number (cursor) with ↑ or ↓ key.
Use → key to shift cursor 1 place to right.
Press ↵ key to return to Fct. 1.01 Full Scale.

Note if "**Pulsvalue**" is displayed after pressing ↵ key:
Pulse/Vol. is set under Fct. 1.06 Puls B1, subfunction "Select P". Due to the changed full-scale range $Q_{100\%}$, the output frequency (F) of the pulse output will be over- or undershot:
$\mathbf{P_{min}} = F_{min} / Q_{100\%}$ $\mathbf{P_{max}} = F_{max} / Q_{100\%}$
Change pulse value accordingly, see Sect. 5.7 pulse output P, Fct. 1.06.

5.2 Timeconstant (Fct. 1.02)

Fct. 1.02 Timeconstant
Press → key.

Choice
- **All** (applies to display and all outputs)
- **Only I** (applies only to display, current and status output)

Select with ↑ or ↓ key.
Transfer to number setting with ↵ key. 1st number (cursor) flashes.

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

Change flashing number (cursor) with ↑ or ↓ key.
Use → key to shift cursor 1 place to right.
Press ↵ key to return to Fct. 1.02 Timeconstant.

5.3 Low Flow Cutoff (Fct.1.03)

Fct. 1.03 Low Flow Cutoff)

Press → key.

Choice

- **Off** fixed tripping point:: ON = 0.1 % / OFF = 0.2 %
- **Percent** variable tripping points: ON = 1 - 19 % / OFF = 2 - 20 %

Select with ↑ or ↓ key.
Transfer to number setting using → key (only if "PERCENT" selected).
1st number (cursor) flashes.

Setting the numerical value when "Percent" selected

- **01** to **19** (cutoff "on" value, left of hyphen)
- **02** to **20** (cutoff "off" value, right of hyphen)

Note: The cutoff "off" value must be greater than the cutoff "on" value.

Change flashing number (cursor) with ↑ or ↓ key.
Use → key to shift cursor 1 place to right.
Press ↵ key to return to Fct. 1.03 Low Flow Cutoff.

5.4 Internal electronic totalizer

The internal electronic totalizer counts in m^3, regardless of the unit set under Fct. 1.04, subfunction "totalizer".
The counting range is dependent upon the meter size and has been selected such that the totalizer will count for a minimum of 1 year without overflow:

Meter size		**Counting range**	
DN mm	inch	in m^3	US Gal equivalent
2.5 - 50	$^1/_{10}$ - 2	0 - 999 999.99999999	0 - 264 172 052.35800
65 - 200	$2^1/_2$ - 8	0 - 9 999 999.9999999	0 - 2 641 720 523.5800
250 - 600	10 - 24	0 - 99 999 999.999999	0 - 26 417 205 235.800
700 -1600	28 - 64	0 - 999 999 999.99999	0 – 264 172 052 358.00

Only part of the totalizer count is shown in the display because it is not possible to output a 14-digit number. Unit and format of the display are freely selectable, see Fct. 1.04, subfunction "totalizer" and Sect. 5.5. This determines which part of the count is to be displayed.
Display overflow and totalizer overflow are independent of one another.

Example

Internal count	0000123 . 7654321	m^3
Format, display unit	XXXX . XXX	Liter
Internal count in unit	0123765 . 4321000	Liter
Displayed	3765 . 432	Liter

5.5 Display (Fct. 1.04)

Fct. 1.04 Display
Press → key.

Contrast = set required contrast

- Range adjustable from **+15** (high contrast) **to –15** (= low contrast)

Change setting with ↑ or ↓ key,
Press ↵ key to transfer to subfunction "flow".

Flow = set required flow unit and number format

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

Change setting with ↑ or ↓ key,
Transfer to Unit Selection with → key.

- **m^3/hr** (cubic metres per hour)
- **Liter/Sec** (litres per second)
- **US Gal/min** (US gallons per minute)
- User-defined unit, factory setting = **Liter/hr** (litres per hour) or **US MGal/day** , see Sect. 5.17

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "totalizer".

Totalizer = set required totalizer unit and number format

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

Change setting with ↑ or ↓ key,
Transfer to Unit Selection with → key.

- **m^3** (cubic metres)
- **Liter** (litres)
- **US. Gal** (US gallons)
- User-defined unit, factory setting = **Liter** (litres) or **US MGal/day** , see Sect. 5.17

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "messages".

Messages= additional messages desired in measuring mode

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

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "Trend".

Trend = set graphic display (trend)

- **Mean values** Show mean values over time base
- **Min. & Max.** Min./Max. values over time base
- **Every value** All values numbered consecutively

Select with ↑ or ↓ key.
Press ↵ key to transfer to subfunction "Updating".

Updating = update measured values in the graphic display
(This selection not shown when "every value" selected, see above)

Selection:					
	• 0.1 sec.	**• 0.2 sec.**	**• 0.5 sec.**	**• 1 sec.**	**• 2 sec.**
	• 5 sec.	**• 1 min.**	**• 2 min.**	**• 5 min.**	

Select with ↑ or ↓ key.
Press ↵ key to transfer to subfunction "Scaling"

Scaling = Set scaling of graphic display

Selection:					
	• Auto	**• 0% ... 100%**	**• -100% ... 0 %**	**• -25% ... 100%**	**• -100% ... 25%**
		• 0% ... 50%	**• - 50% ... 0%**	**• 50% ...100%**	**• -100% ... - 50%**

Select with ↑ or ↓ key.
Press ↵ key to return to Fct. 1.04 Display

Please refer to Section 3.2 Factory settings

5.6 Currentoutput I (Fct. 1.05)

Fct. 1.05 Currentoutput I

Press → key.

Function = Select function for current output,

- **Odd** switched off, no function
- **1 Direction** 1 flow direction
- **2 Directions** 2 flow directions, F/R mode, forward/reverse

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "Range I".
***Exceptions:** When "Off" selected, return to Fct. 1.05 Currentoutput I.*

Range I = select measuring range ($I_{0\%}$ - $I_{100\%}$)

- **0 - 20 mA**
- **4 - 20 mA**

} fixed ranges

- **mA (**user-defined value) $I_{0\%}$ – $I_{100\%}$ (Wert $I_{0\%} < I_{100\%}$!)
  0...16 mA – 4...20 mA

Press → key to transfer to number setting.
Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "I Max".

I Max = Set (I_{max})

- **20.5 mA** • **22 mA**

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "I Error".

I Error = set error value, (I_{Error})

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

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "Reverse Range".

Reverse Range = define full-scale range for reverse flow

- **XXX . XX** % 5 - 150 % of full-scale range for forward flow

Change negative-image number (cursor) using ↑ or ↓ key,
Move cursor 1 place to right with → key.
Press ↵ key to return to Fct. 1.05 Currentoutput I

Please refer to Sect. 3.2 Factory settings .

Refer to Sect. 2.5 for connection diagrams, and to Sect. 5.22 for characteristics.

5.7 Pulsoutput P (Fct. 1.06)

Fct. 1.06 Pulsoutput P

Press → key.

Function = select function for pulse output,

- **Off** switched off, no function
- **1 Direction** 1 flow direction
- **2 Directions** 2 flow directions, F/R mode, forward/reverse

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "Pulswidth".
***Exceptions:** When "Off" selected, return to Fct. 1.06 Pulsoutput P.*

Pulswidth = Set puls width

- **0.01 – 1.00 s** Only for F_{max} < 50 pulses (select this function when operating with EMC.)
- **Automatic** = 50 % of cycle duration of 100 % output frequency
- **Symmetric** = pulse duty factor 1:1 across entire range

Please note !

$\mathbf{F_{min}}$ = 10 pulses/hr

$\mathbf{F_{max}} = \frac{1}{2 \times \text{Pulswidth[s]}}$ ≤ 10 kHz, if „automatic" or „symmetric is selected under subfunction Pulswidth.

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "Pulsvalue".

Pulse value = set pulse value

Pulses per unit volume
- **1/m³** • **1/Liter** • **1/US Gal**
- any unit, see Fct. 3.05, factory-set is "Pulses per Liter"

Pulses per unit time
- **1/s** (= Hz) • **1/min** • **1/h**
- any unit, see Fct. 3.05, factory-set is "Pulses per hour"

Select with ↑ or ↓ key.
Press ↵ key to return to Fct. 1.06 Pulsoutput P

Please refer to Sect. 3.2 Factory settings .

Refer to Sect. 2.5 for connection diagrams, and to Sect. 5.22 for characteristics.

5.8 Statusoutput B1 and / or B2

Statusoutput: Fct. 1.07 (output terminal **B1**) and **Fct. 1.08** (output terminal **B2**)
Press → key.

Select function of status outputs, *Select with ↑ or ↓* key.

- **Off** switched off, no function
- **On** indicates that flowmeter is operative
- **All Error** indicates all errors
- **Only Fatal** indicates fatal errors only
- **Signum I** or **P** for V/R mode, measurement in both flow directions, see also Sect. 5.10
- **Overrange I** or **P** signals overranging of outputs
- **Low Flow Cutoff I** or **P** signals active low-flow cutoff (SMU)

I = I only
P = All

- **Invers B1** Status output B2 inverse function to B1 (only provided if B1 and B2 are set as status output)
- **Trip Point** see also Sect. 5.12

  Define flow direction (characteristics) for limit value
  - + direction
  - - direction
  - 2 directions

  Select with ↑ or ↓ key

Define limit value		
XXX	**-**	**YYY**
0...150%	-	0...150%

  NO contact: XXX **>** YYY
  NC contact: XXX **<** YYY
  Hysteresis: Difference XXX **to** YYY

  Transfer to number setting with ↵ key,
  1st number (cursor)with negative image.
  Change negative-image number (cursor) with ↑ or ↓ key, move cursor 1 place to right or left with → and ← key, resp..
- **Auto Range** see also Sect. 5.11
  Setting range: 05 – 80 %
  ratio of upper to lower range, 1:20 to 1:1.25
  (value must be greater than that of Fct. 1.03 L.F.Cutoff , s. also Sect. 5.3)
- **Empty Pipe** Signals that tube is empty (only with built-in option), see Sect. 6.4 – 6.6.

Press ↵ key to return to Fct. 1.07 or 1.08 Statusoutput.

Characteristics of status outputs	**Switch open**	**Switch closed**
Off (switched off)	no function	
On (e.g. operation indicator)	power OFF	power ON
Empty Pipe	Tube is empty	Tube is full
Signum I or **P**	**F**orward flow	**R**everse flow
Overflow I or **P**	not overranged	overranged
Low Flow Cutoff I or **P**	inactive	active
Invers B1	B2 closed	B2 open
Trip Point (limit switch)	inactive	active
Auto Range	high range	low range
All Error (all errors)	errors	no error
Only Fatal (fatal errors only)	errors	no error

Please refer to Sect. 3.2 Factory settings .

Refer to Sect. 2.5 for connection diagrams, and to Sect. 5.22 for characteristics.

5.9 Controlinput

Controlinput: Fct. 1.07 (output terminal **B1**) and **Fct. 1.08** (output terminal **B2**)
Press → key.

Select function of control inputs, *Select with ↑ or ↓* key.

- **Off** switched off, no function
- **Hold Value** hold value of outputs and display
- **Zero Value** set outputs and display to "min. values"
- **Total Reset** reset totalizers
- **Error Reset** delete/acknowledge error messages
- **Extern Range** external range change

  setting range: 05 – 80 %
  ratio of high to low range, 1:20 to 1:1,25, (value must be greater than that of Fct. 1.03 L.F.Cutoff, s. also Sect. 5.3)

  Transfer to number setting with ↵ key,
  1st number (cursor)with negative image.
  Change negative-image number (cursor) with ↑ or ↓ key, move cursor 1 place to right or left with → and ← key, resp..

Press ↵ key to return to Fct. 1.07 or 1.08 Statusoutput.

Characteristics of status inputs	**inactive** (no voltage)	**active** (voltage present)
Off	no function	
Extern Range	high range	low range
Hold Value	Measured values follow the measurement	Hold measured values
Zero Value	Measured values follow the measurement	Set measured values to "zero"
Total Reset	inactive	Reset totalizer
Error Reset	inactive	Delete error messages

5.10 F/R mode, forward/reverse flow measurement

- **Refer to Sect. 2.5 for electrical connection of outputs.**
- **Define direction of forward (normal) flow,** see Fct. 3.02, subfunction Flow Dir. :
  in conjunction with F/R operation, set the direction for the forward flow here.
  „**+**" signifies the same direction as shown by the arrow on the primary head,
  „**-**" signifies the opposite direction.
- Set the **status output** to SIGN I or SIGN P , see Fct. 1.07.
- **Current and/or pulse output** must be set to 2 Directions,
  see Fct. 1.05 and/or 1.06, subfunction "Function".

5.11 Set limit values (status output B1 and/or B2)

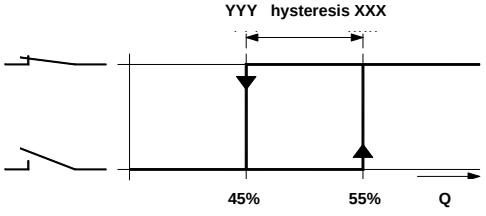
(Before the following settings can be carried out, set the **"Status output"** mode for output terminals B1 and/or B2 in Fct. 3.07, see Sect. 5.19.)

Status output: Fct. 1.07 (output terminal **B1**) and / or **Fct. 1.08** (output terminal **B2**)

- *Press → key.*
- **Set Function "Trip Points"** *with ↑ or ↓* key.
- *Press ↵ key.*
- **Set flow direction:** + direction
  – direction
  2 directions
- *Press ↵ key.* Display: **XXX - YYY**
- **Set Trip Point**, cursor for the 1st digit shown negatively.
  Set with ↑ *or* ↓ keys..
  Use → key to shift cursor 1 place to right.
  Setting ranges for **XXX** and **YYY**: **0 – 150 %** of $Q_{100\%}$ full-scale range
  hysteresis ≥ 1%
  (=difference between XXX and YYY value)
- *Press ↵ key to return to Fct. 1.07 or 1.08 Statusoutput.*
- **Switching behaviour** (N/O or N/C contact) and **hysteresis** are adjustable.

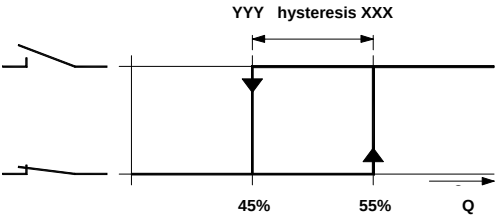
N/O contact: XXX- value **>** YYY- value
Switch **closes** when flow **exceeds** XXX value

Example 1: XXX = 55%
YYY = 45%
hysteresis = 10%



N/C contact: XXX- value **<** YYY- value
Switch **opens** when flow **exceeds** YYY value

Example 2: XXX = 45%
YYY = 55%
hysteresis = 10%



Please note !: When the two status outputs B1 and B2 are activated (see Sect. 5.19), **min. and max. values** can, for example, be signalled.

5.12 Automatic range change BA (with status output B1 or B2) and external range change (with control input B1 or B2)

1. Description of automatic range change BA and external range change

The automatic range change BA has two measuring ranges that are automatically changed over as a function of the flow rate. The ratio between low and high range is adjustable between 1:20 and 1:1.25, equivalent to 05 – 80% of $Q_{100\%}$ (full-scale range).
- changeover from high to low range: at approx. 85% of the low range
- changeover from low to high range: at approx. 98% of the low range

F/R flow operation is also possible, direction then identified via the 2nd status output.

In the case of external range change, changeover from high to low range (and conversely from low to high range) is effected by the control input being activated by an external pulse.

2. Automatic range change BA by one of the status outputs B1 or B2

(Before the following settings can be carried out, the **"status output"** mode for output terminal B1 or B2 must be set in Fct. 3.07, see Sect. 5.19.)

Status output: Fct. 1.07 (terminal **B1**) or **Fct. 1.08** (terminal **B2**)

- *Press → key.*
- **Set Function "Auto Range"** *with ↑ or ↓* key.
- *Press ↵ key.*
- **Set Range Value**, cursor for the 1st digit shown negatively.
  Set with ↑ *or* ↓ keys.
  Use → key to shift cursor 1 place to right.
  Setting range **05 – 80%** of $Q_{100\%}$ full-scale range (ratio between low and high range between 1:20 and 1:1,25)
- *Press ↵ key to return to Fct. 1.07 or 1.08 Statusoutput.*

3. External range change by one of the control input B1 or B2

(Before the following settings can be carried out, the **" control input"** mode for output terminal B1 or B2 must be set in Fct. 3.07, see Sect. 5.19.)

Control input: Fct. 1.07 (terminal **B1**) or **Fct. 1.08** (terminal **B2**)

- *Press → key.*
- **Set Function "Extern Range"** *with ↑ or ↓* key.
- *Press ↵ key.*
- **Set Range Value**, cursor for the 1st digit shown negatively.
  Set with ↑ or ↓ key.
  Use → key to shift cursor 1 place to right.
  Setting range **05 – 80%** of $Q_{100\%}$ full-scale range (ratio between low and high range between 1:20 and 1:1,25)
- *Press ↵ key to return to Fct. 1.07 or 1.08 Statusoutput.*

Please note:	Only one of the two functions can be used.
Automatic range change and external range change act only on the current output.	

5.13 Language (Fct. 3.01)

Fct. 3.01 Language
Press → key.

Select language for texts in display

- **D** (German)
- **GB/USA** (English)
- **F** (French)
- others on request

Select with ↑ or ↓ key.
Press ↵ key to return to Fct. 3.01 Language.

5.14 Zero check (Fct. 3.03)

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

Key	Display		Description
→			If "Yes" set under Fct. 3.04 ENTR Y CODE, key in 9-keystroke CODE 1 now: → → → ↵ ↵ ↵ ↑ ↑ ↑
	Fct. 1.00	Operation	
2x ↑	Fct. 3.00	Installation	
→	Fct. 3.01	Language	
2x ↑	Fct. 3.03	Zero Point	
→		back	
↑		enquire	
↵	0.00	- - - - - / - - -	Zero measurement in progress, duration approx. 50 seconds. When flow > 0 WARNING notice appears, confirm with ↵ key.
		Store No	If new value not to be stored, press ↵ key (3x) 4x = return to measuring mode.
↑		Store Yes	
↵	Fct. 3.03	Zero Point	Store new zero value.
(2x) 3x ↵	- - - - - - -	- - - - - / - - -	Measuring mode with new zero.

5.15 Determine Entry Code (Fct. 3.04)

Fct. 3.04 Entry Code
Press → key.

Choice

- **No** (no code, enter setting mode with → key)
- **Yes** (enter setting mode with → key and Code 1: → → → ↵ ↵ ↵ ↑ ↑ ↑)

Select with ↑ or ↓ key.
Press ↵ key to return to Fct. 3.04 Entry Code.

5.16 Primary head – Set data (Fct. 3.02)

Fct. 3.02 Flow Meter
Press → key.

Diameter = set meter size (see instrument nameplate)
Select size from table of meter sizes:
DN 2.5 - 1600 mm equivalent to **$^{1}/_{10}$ - 64 inch**

Select using ↑ or ↓ key.
Transfer to subfunction "Full Scale" with ↵ key.

Full Scale = set full-scale range
Set as described in Sect. 5.1.

Note: if "**Pulsvalue**" is displayed after pressing ↵ key.
Pulse/Vol. is set under Fct. 1.06 Pulsoutput P, subfunction "Pulsvalue" . Because the full-scale range $Q_{100\%}$ has been changed, the output frequency (F) of the pulse output is over- or undershot:
$\mathbf{P_{min}} = F_{min} / Q_{100\%}$ $\mathbf{P_{max}} = F_{max} / Q_{100\%}$
Change pulse value accordingly, see Sect. 5.7 Pulseoutput P, Fct. 1.06.

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

GK Value = set primary constant GK,

- **1.0000 - 9.9999** (note information on instrument nameplate, do not change setting !)

Change flashing digit (cursor) with ↑ or ↓ key.
Shift cursor 1 place to right or left with → or ← key.
Press ↵ key to change to subfunction "Field Frequency".

Field Frequency = set magnetic field frequency

- **1/2** • **1/18**
- **1/6** • **1/36**

(1/2, 1/6, 1/18 or 1/36 of power frequency, see instrument nameplate, do **not** change setting !)

Select with ↑ or ↓ key.
Press ↵ key to change to subfunction "Flow Direction".
(only for units with DC power supply, transfer to subfunction "Line Frequency").

Line Frequency = normal line frequency in your country
(Please note, applicable for flowmeters equipped with DC in power supply!)

- **50 Hz** *Select with ↑ or ↓* key.
- **60 Hz** *Press ↵ key to change to subfunction "Flow Direction".*

Flow Direction = set flow direction

- **+ Direction** (for identification of flow direction, see "+ arrow" on primary head;
- **– Direction** for F/R mode, identifies the positive flow direction)

Select with - or ¯ key.
Press ↵ key to return to Fct. 3.02 Flow Meter.

Zero check, see Fct. 3.03 in Sect. 5.14 or in Sect. 7.1.

Please refer to Sect. 3.2 Factory settings .

5.17 User-defined unit (Fct. 3.05)

Fct. 3.05 User Units

Press → key.

Text Volume = set text for user-defined unit

- **Liter** (max. 5 characters, factory-set: Liter or US MGal)
  Characters assignable to each place: **A-Z, a-z, 0-9,** or „–“ (=blank character)

Change flashing digit (cursor) with ↑ or ↓ key.
Shift cursor 1 place to right or left with → or ← key.
Press ↵ key to change to subfunction “Factor Volume”.

Factor Volume = set factor F_M set factor

- **1.00000 E+3** (factory-set: 10^3 or 2.64172 x 10^{-4} / factor $\mathbf{F_M}$ = volume per 1 m^3)
  Setting range: 1.00000 E-9 to 9.99999 E+9 (= 10-9 to 10+9)

Change flashing digit (cursor) with ↑ or ↓ key.
Shift cursor 1 place to right or left with → or ← key.
Press ↵ key to change to subfunction “Text Time”.

Text Time = set text for required time

- **hr** (max. 3 places, factory-set: hr = hour or day)
  Characters assignable to each place: **A-Z, a-z, 0-9,** or „–“ (=blank character)

Change flashing digit (cursor) with ↑ or ↓ key.
Shift cursor 1 place to right or left with → or ← key.
Press ↵ key to change to subfunction “Factor Time”.

Factor Time = set factor F_T for time

- **3.60000 E+3** (factory-set: 3.6 x 10^3 for hour or 8.64 x 10^4 for day / set factor F_T in seconds)
  Setting range: 1.00000 E-9 to 9.99999 E+9 (= 10^{-9} to 10^{+9})

Change flashing digit (cursor) with ↑ or ↓ key.
Shift cursor 1 place to right or left with → or ← key.
Press ↵ key to return to Fct. 3.05 User Units.

Factors for volume F_M (factor F_M = volume per 1 m^3)

Volumetric unit	Text examples	Factor F_M	Setting
Cubic metres	**m^3**	1.0	**1.00000 E+0**
Litres	**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	**Feet^3**	35.3146	**3.53146 E+1**
Cubic inches	**inch^3**	61 024.0	**6.10240 E+4**
US barrels liquid	**US BaL**	8.36364	**8.38364 E+0**
US barrels ounces	**US BaO**	33 813.5	**3.38135 E+4**

Factors for time F_T (factor F_T in seconds)

Time unit	Text examples	Factor F_T (seconds)	Setting
Seconds	**Sec**	1	**1.00000 E+0**
Minutes	**min**	60	**6.00000 E+1**
Hours	**hr**	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**

5.18 Application (Fct. 3.06)

Fct. 3.06 Application

Press → key.

Flow = Set characterization for the flow

- **steady** flow is steady, max. 150 % of $Q_{100\%}$
- **pulsating** pulsating flow, = up to 1000 % of $Q_{100\%}$, e.g. due to reciprocating pumps, see also Sect. 6.4 - 6.6.

Select with ↑ or ↓ key.

Press ↵ key to return to Fct. 3.06 Application.

Empty pipe = signals that measuring tube is empty (possible only with built-in option)

- **No** • **Yes** *Select with ↑ or ↓ key.*

see also Sect. 6.4 - 6.6.

Press ↵ key to return to Fct. 3.06 Application.

5.19 Hardware (Fct. 3.07) Assignment of terminals B1 + B2 and field current supply

Fct. 3.07 Hardware

Press → key.

Terminal B1 = define function of terminal B1 (valid for Fct. 1.07)

- **Statusoutput** • **Controlinput** *Select with ↑ or ↓ key.*

Press ↵ key to change to subfunction "Terminal B2".

Terminal B2 = define function of terminal B2 (valid for Fct. 1.08)

- **Statusoutput** • **Controlinput** *Select with ↑ or ↓ key.*

Press ↵ key to change to subfunction "Fieldcurrent".

Field current = define field current supply

- **Intern** • **Extern** (> DN 1600 / > 64") *Select with ↑ or ↓ key.*

Press ↵ key to return to Fct. 3.07 Hardware.

Please note:
Only correct settings will give accurate measurement results.
The setting "external" is only required if a field current power driver is connected.

5.20 Measuring point identification – Location (Fct. 3.08)

Fct. 3.08 Location

Press → key.

Set measuring point identification using max. 10 characters, (e.g. TQ1_532197)
You can use any out of: A...Z / a...z / 0...9 / or _(= underscore)

- *Select with ↑ or ↓* key.
- *Use key → to shift one place to the right, back with ← key.*

Press ↵ key to return to Fct. 3.08 Location.

5.21 Set communication interface (Fct. 3.09)

Fct. 3.09 Communication

Press → key.

Specify function

Select with ↑ or ↓ key *and subsequently acknowledge by pressing ↵ key.*

- **Aus** Switched off
- **HART** HART® interface selected
  *Press ↵ key to set ad*dresses: 000 - 015 Press ↑ ↓ → key to set
- **KROHNE** RS 485 Interface gewählt
  *Press ↵ key to set ad*dresses: 000 - 239 Press ↑ ↓ → key to set
  Press ↵ key to set baud rate:
  - 1200
  - 2400
  - 4800
  - 9600
  - 19200

  Press ↑ ↓ → key to set

Press ↵ key to return to Fct. 3.09 Communication.

5.22 Characteristic of outputs

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

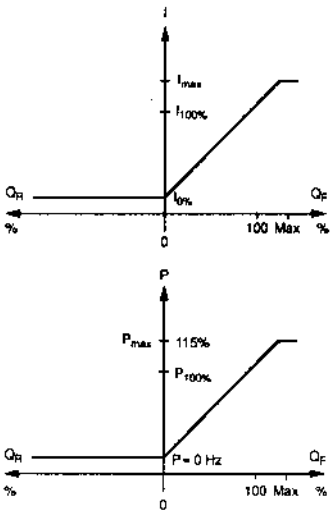
P Pulse output
$P_{100\%}$ Pulses at $Q_{100\%}$, full-scale range

Q_F 1 flow direction, forward flow in F/R operation
Q_R Reverse flow in F/R operation
$Q_{100\%}$ Full-scale range

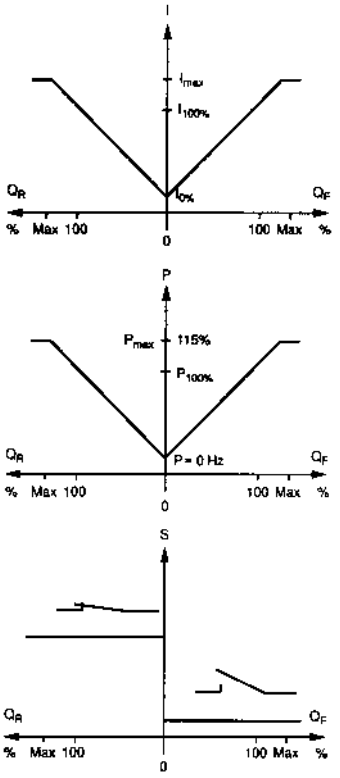
S Status output B1 and / or B2

switch open
switch closed

1 flow direction



2 flow directions, F/R mode



6 Special applications

6.1 IFC 210 E – EEx for primary heads in hazardous areas

6.1.1 General

The following notes and directions contain only the data relevant to explosion protection. The technical details given in the Installation and Operating Instructions for the non-hazardous-duty version apply unchanged unless excluded or superseded by these directions.

In compliance with European Directive 94/9/EC (ATEX 100a), signal converters of the IFC 210E – EEx series are, in conformity with European Standards EN 50xxx, certified as associated electrical apparatus for supplying intrinsically safe equipment in hazardous areas by the Physikalisch – Technische Bundesanstalt (PTB) under PTB 00 ATEX 2026 X (see Sect. 13).

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"** !

6.1.2 Electrical connection

The signal converter must be installed **outside the hazardous area**. If used inside the hazardous area, type IFC 210E- EEx signal converters need to have additional type of protection (e. g. flameproof enclosure “d”).

The electrical connection of all circuits leading into the device is carried out using plug-in connectors in conformity with DIN 41612, Style F. Type IFC 210E –EEx signal converters are delivered with associated socket connectors with soldering tags. Operation is only permitted with these socket connectors.

To ensure that the **thread measure is min. 50 mm** between the connections of the intrinsically safe electrode circuit and those of the non-intrinsically safe circuits, all live connections on socket connectors XA, XC, XD need to be insulated with shrinkdown sleeves. In this connection, non-intrinsically safe circuits of adjacent subassemblies will also need to be taken into consideration.

Both generation of the ungrounded intrinsically safe electrode circuit and also fuse-protection of the field current circuit by fusible cutouts are integral components of the IFC 210E-EEx signal converter.

The connections for the **intrinsically safe electrode circuit, including the shield connections,** are safety-separated up to a peak value of 375 V from the connections for supply power, for the inputs/outputs and for the field current circuit, and are metallically separated from the housing (PE/PA).

For connection of the **intrinsically safe electrode circuit, including shield connections,** to the primary head, please refer to Point 12 in EN 60079-14.

Connect the **non-intrinsically safe field current circuit** to the primary head in keeping with the requirements specified in Point 9 of EN 60079-14.

The **non-intrinsically safe input and output circuits** may only be routed into the hazardous area taking relevant measures into account in accordance with EN 60079-14.

Important, please note!

- All **unused cores and shield ends** of the power cables to be carefully insulated from each other and from ground.
- All **shields** to be joined to the shield terminals by the shortest route.
- **Undocumented terminals** of all connectors to be left unused.
- Please take note of details given in Sect. 1.3.3 and 1.3.5.

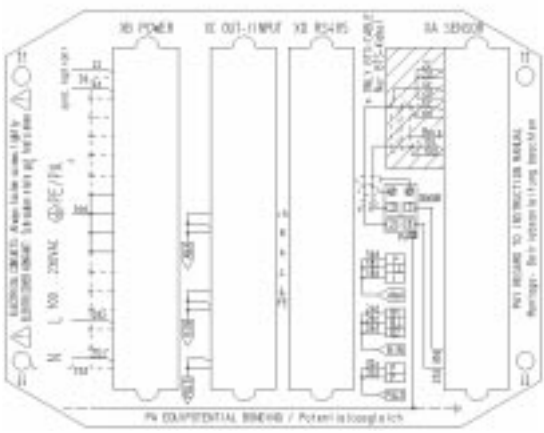
Rated insulation levels
The insulation of IFC 210 E - EEx signal converters is dimensioned in conformity with VDE 0110/IEC 664 and takes into account the following ratings:
- overvoltage category for the power line circuit: III
- overvoltage category for the signalling circuits: II
- insulation contamination level: 2

6.1.3 Technical data and terminal assignment

Supply power			
Terminals		**L** or **1L**: z28	Plug XB
		N or **0L**: z32	Plug XB
24 DC / AC		U_N = 24 V DC +30% / -25%, 15 W	
		U_N = 24 V AC +10% / -15%, 20 VA	
		I_N ≤ 1.6 AT internal fuse protection	
100 ... 230 V AC		U_N = 100 ... 230 V AC +10% / -15%, 25 VA	
		I_N ≤ 0.8 AT internal fuse protection	
Protective conductor/equipotential bonding		**PE / PA**	
Terminals		d14, d16, d18, d20	Plug XB
		d2 ... d12, d22 ... d32	plug XB (optional)
Signalling circuits		Outputs and inputs	
Terminals:	Analog	d16, d18, z18	Plug XC:
	Binary	d24, d26, z26	Plug XC
	Pulses	d32, z32	Plug XC
	RS 485	d16, d18, d20, d22, d24	Plug XC (optional)
DC voltage	U_N (DC)	≤ 50 V (connection to devices with	
AC voltage	U_N (AC)	≤ 25 V operating voltages up to 250 V)	
Field circuit			
Terminals	Core 7	d30	Plug XA
	Core 8	d32	Plug XA
Frequency-controlled DC voltage		U_N ≤ 40 V	
Internal fuse protection		I_N ≤ 160 mAF	
Electrode circuit		in Intrinsic Safety type of protection EEx ib IIC	
Terminals:	Signal cores 2, 3 Shield 20, 30	Z6, z10	Plug XA
	(BTS conductor only)	D6, d10	Plug XA
	Shield 1	d8, z8	Plug XA
	Outer shield	d2, z2, d4, z4	Plug XA
Peak values		U_0 ≤ 18 V	(cumulative value)
		I_0 ≤ 40 mA	(cumulative value)
		P_0 ≤ 80 mW	

The intrinsically safe electrode circuit is safety-separated (isolated) from the non-intrinsically safe circuits up to a peak nominal voltage of 375 V.

Ambient temperature	max. allowable –20 to +55°C



Note polarization code of plug XA!

Important, please note.

- **Univeral supply 24 V DC / AC**
  When connected to a **"functional extra-low voltage with safety separation"** power source (SELV or PELV) in accordance with VDE 0100, Part 410, connection of a safety conductor (PE) is not required.

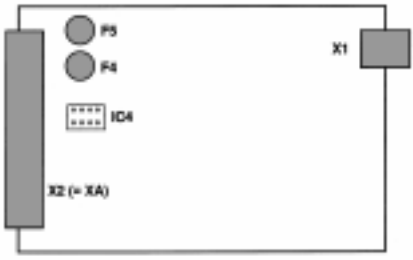
- **Equipotential bonding**
  Independent of the type of power supply, IFC 210 E – EEx signal converters must be incorporated in the PA equipotential bonding system. To achieve equipotential bonding, terminals d14, d16, d18, d20 must be connected to the appropriate ground potential of the hazardous area.

  IFC 210E-EEx is ungrounded in the electrode circuit, but the primary head is not! For that reason, equipotential bonding is required in the entire run of the intrinsically safe cable!

  Cancellation of equipotential bonding is only permitted when the device is **disconnected from supply**.

6.1.4 Fuse protection of the field power circuit

The field power circuit is fuse-protected in the IFC 210E –EEx signal converter by two TR5 fusible links on the amplifier board (ADC/FSV), see Fig. A in Sect. 8.4.
Before starting up the system, check that both nominal fuse values are consistent with the maximum allowable nominal value specified for the primary head.



6.2 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"** !

6.2.1 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.

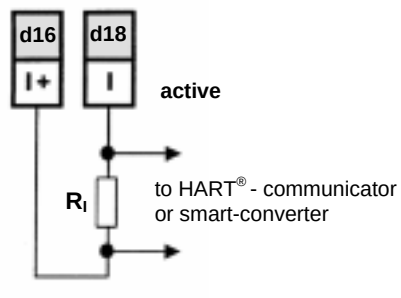
The following HART® features are supported:

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

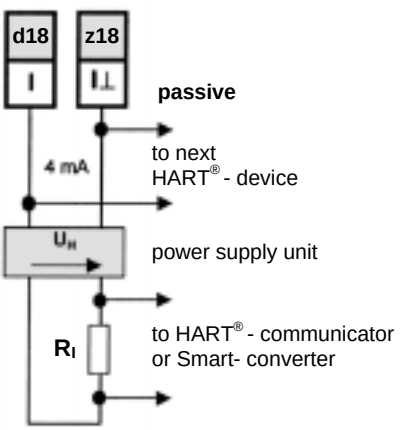
The burst mode is not normally used.
Further information about HART is available from the HART® Communication Foundation, of which KROHNE is a member.

Electrical connection

HART® - active



HART® - passive



Power supply unit (and section switch amplifier) must be set up accordingly if in use for HART® operation.

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.

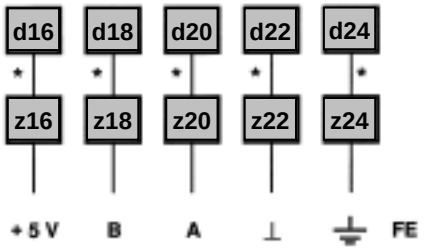
Operator control by means of the HART® communicator requires a device description (DD) which we can load for you into the communicator. We can, of course, also load the DDs of all manufacturers who have filed their DDs with the HART® Communication Foundation.

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®.

6.2.2 KROHNE RS 485 Interface (Option)

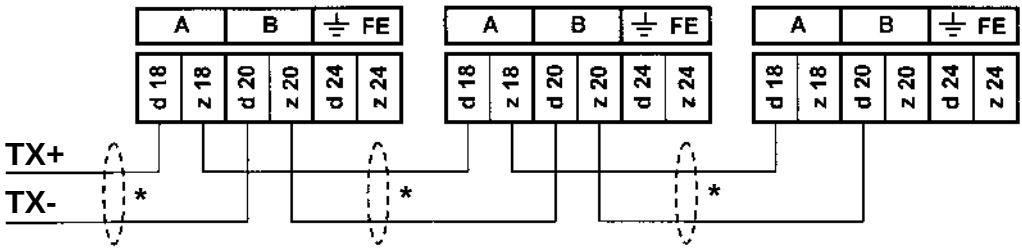
Electrical connection

RS 485 Interface (Option, connection at multipole connector **XD**)



* internal connection

Address, e.g.: **001** **002** **003**



***** 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.

6.3 Unsteady display and outputs

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"** !

Unsteady display and outputs can occur in connection with
– high solids contents,
– non-homogeneity,
– poor blending, or
– chemical reactions still in progress in the process liquid.

If, in addition, flow is also pulsating due to the use of diaphragm or reciprocating pumps, refer to Sect. 6.4.

Operator control of the signal converter for the new settings, see Sect. 4 and 5.

To change settings

- Fct. 1.04 Display Flow (change display presentation of the flow)
  Change setting to "Trend" to allow better assessment of display unsteadiness.

- Fct. 1.02 Timeconstant (change time constant)
  – Setting to "Only Current I", to "All" if pulse output too unsteady.
  – Set time constant to approx. "20 s", observe unsteadiness of display and adjust time constant if necessary.

- Fct. 3.06 Application (adjust overload point of the A/D converter to the application).
  Set to "Pulsating" on trial basis, if unsuccessful return to "Steady".

- Fct. 3.02 Field Frequency (change magnetic field frequency) On trial basis,
  change setting to "1/2"; if unsuccessful return to previous setting, usually "1/6".

  Only practical with IFS 5000 F (DN 2.5-100 / $^1/_{10}$"-4")
  and IFS 4000 F (DN 10, 15, 50-100 / $^1/_{10}$", $^1/_2$", 2"-4"),
  Consult factory where other types and meter sizes are concerned.

6.4 Pulsating flow

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"** !

Application
downstream of positive-displacement pumps (reciprocating or diaphragm pumps) without pulsation dampener

Operator control of the signal converter for the new settings, see Sect. 4 and 5.

To change settings

- Fct. 3.2 Field Frequency (change 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 practical with IFS 5000 F (DN 2.5-100 / $^1/_{10}$"-4") and IFS 4000 F (DN 10, 15, 50-100 / $^1/_{10}$", $^1/_2$", 2"-4"), Please consult factory where other types and meter sizes are concerned.
  - Please note: given stroke frequencies close to the tripping point of 80 strokes/min, additional measuring errors of approx. ± 0.5% of the measured value may occasionally occur.

- Fct. 3.06 Application (adjust overload point of the A/D converter to the application) Change setting to "pulsating".

- Fct. 1.04 Display (change display presentation of flow)
  Change setting to "Trend" to allow better assessment of display unsteadiness.

- Fct. 1.02 Timeconstant (change time constant)
  - Set to "All" and time (**t**) in seconds.

  - Recommended: $t\ [Sec] = \dfrac{1000}{\text{min. strokes / min}}$

  - Example: min. number of strokes in operation = 50 strokes/minute

    $t\ [Sec] = \dfrac{1000}{50 / min} = 20\ Sec$

    With this setting, the residual ripple of the display will amount to approx. ±2% of the measured value. Doubling the time constant will reduce the residual ripple by a factor of 2.

6.5 Rapid changes in flowrate

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"** !

Application
in conjunction with batching processes, fast-response control loops, etc.

Operator control of the signal converter for the new settings refer to chapters 4 and 5

To change settings

- Fct. 1.02 Timeconstant (change time constant)
  Setting to "Only Current I" and set time to 0.2 s.

- Dynamic response with meter sizes DN 2.5-300 / $^1/_{10}$"-12"
  Dead time: approx. 0.06 s at 50 Hz line frequency
  approx. 0.05 s at 60 Hz line frequency
  Time constant: set as above, current output (mA) additionally plus 0.1 s

- Reducing the dead time by a factor of 3 (possible by changing the magnetic field frequency)
  Fct. 3.02 Flow Meter, subfunction "Field Frequency", change to „$^1/_2$" only practical with IFS 5000 F (DN 2.5-100 / $^1/_{10}$"-4") and IFS 4000 F (DN 10, 15, 50-100 / $^1/_{10}$", $^1/_2$", 2"-4".
  Please consult factory where other types and meter sizes are concerned.

6.6 Stable signal outputs when measuring tube empty

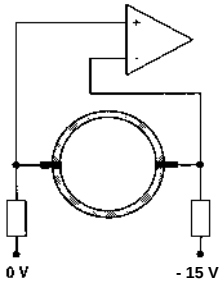
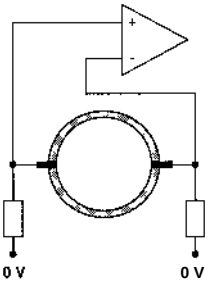
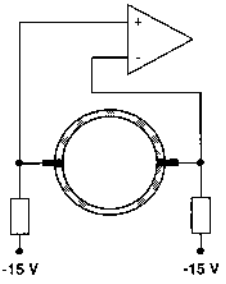
Important, please note!

- 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 random output signals when the measuring tube is empty.

- Display: 0
- Current output: 0 or 4 mA, see setting in Fct. 1.05
- Pulse output: no pulses (= 0 Hz), see setting in Fct. 1.06

Precondition:
- electrical conductivity of product: ≥ 200 µS/cm, ≥ 500 µS/cm for meter sizes DN 2.5 – 15 and $^1/_{10}$" – $^1/_2$"
- Signal cable length ≤ 10m and vibration free with signal converter
- Homogeneous liquid products, free of solids and gasses an do not tend to electrical or catalytic reactions.

LA / S3 Empty Tube indication	**LA / S2 Empty Tube stabilization** steady display at "0" flow	**LA / S4 electrode cleaning and Empty Tube stabilization**
LA / S3 actively detects an empty measuring tube and switches outputs and display to "0" flow. When the measuring tube is empty, resistance between the electrodes becomes very high. A low current flows through the -15 V at the one electrode (the other is connected to 0 V, chassis) via the high-resistance resistor and overdrives the instrumentation amplifier and then the A/D converter. This overdriving is evaluated.	LA / S2 should be used when problems are encountered with LA / S3, e.g. due to electrolysis effects. Display is then particularly unsteady. 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 –15 V via high-resistance resistors.
		
To join the "semicircles" of the two **soldering points S1** and **S4**, see under "Point 5".	To join the "semicircles" of the two **soldering points S1** and **S2**, see under "Point 5".	To join the "semicircles" of the two **soldering points S3** and **S4**, see under "Point 5".
Under Fct. 3.06 Applications, set "yes" for empty pipe.	Possibly reset low-flow cutoff (SMU), see under Point 8	Possibly reset low-flow cutoff (SMU), see under Point 8

Changes on amplifier PCB, see Fig. in Sect. 8.7.

Always switch off power source before starting work!

Please refer to the Figure in Sect. 8.1.

1) Detach 4 screws (S1) from the front side.
2) Pull the plug-in module out of the subrack.
3) Detach 4 recessed-head screws (S3) on the rear side and remove the imprinted rear panel from the plug-in unit.
4) Carefully pull the now visible rear panel with mounted pc boards out of the plug-in unit.
5) On the back of the amplifier board, join the “semicircles“ of 2 points with tin-lead solder, depending on activation of the desired function, see Table and Figures in Sect. 6.6. Previous to that, carefully scrape off the protective varnish at the selected soldering points ..... Be careful not to damage circuit-board conductors.
6) Assemble in the reverse order, Points 4) – 1).
7) Power the unit.
8) 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 Zero check

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

Key	Display		Description
→			If "Yes" set under Fct. 3.04 ENTR Y CODE, key in 9-keystroke CODE 1 now: → → → ↵ ↵ ↵ ↑ ↑ ↑
	Fct. 1.00	Operation	
2x ↑	Fct. 3.00	Installation	
→	Fct. 3.01	Language	
2x ↑	Fct. 3.03	Zero Point	
→		back	
↑		enquire	
↵	0.00	- - - - - / - - -	Zero measurement in progress, duration approx. 50 seconds. When flow > 0 WARNING notice appears, confirm with ↵ key.
		Store No	If new value not to be stored, press ↵ key (3x) 4x = return to measuring mode.
↑		Store Yes	
↵	Fct. 3.03	Zero Point	Store new zero value.
(2x) 3x ↵	- - - - - - -	- - - - - / - - -	Measuring mode with new zero.

7.2 Test of measuring range Q

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

Key	Display		Description
→			If "Yes" set under Fct. 3.04 ENTR Y CODE, key in 9-keystroke CODE 1 now: → → → ↵ ↵ ↵ ↑ ↑ ↑
	Fct. 1.00	Operation	
↑	Fct. 2.00	Test	
→	Fct. 2.01	Test Q	
→		sure no	
↑		sure yes	
↵	0	%	Current, pulse and status indication outputs indicate the corresponding values.
	± 10	%	
↑	± 50	%	Select using ↑ or ↓ key
	± 100	%	
	± 110	%	
↵	Fct. 2.01	Test Q	End of test, actual measured values again present at outputs.
(2x) 3x ↵	- - - - - - -	- - - - - / - - -	Measuring mode

7.3 Hardware information and error status, Fct. 2.02

- Before consulting factory about errors or flow measurement problems, please invoke Fct. 2.02 Hardwareinfo (hardware information).
- An 8-character and a 10-character status code are stored under this function in each of 3 (4) "windows". These 6 (8) status codes allow rapid and simple diagnosis of your compact flowmeter.
- Switch on system.
- Press the following keys for display of the status codes:

Key	Display		Description	
			If "Yes" set under Fct. 3.04 ENTR Y CODE, key in 9-keystroke CODE 1 now: → → → ↵ ↵ ↵ ↑ ↑ ↑	
	Fct. 1.00	Operation		
↑	Fct. 2.00	Test		
→	Fct. 2.01	Test Q		
↑	Fct. 2.02	Hardware Information		
→	→ Modul ADW	-.- - - - -.- - - - - - - - -	**1st window**	
↵	→ Modul EA	-.- - - - -.- - - - - - - - -	**2nd window**	Sample status code **3.25105.02** (8-character code, 1st line)
↵	→ Modul Anzeige	-.- - - - -.- - - - - - - - -	**3rd window**	**3A47F01DB1** (10-character code, 2nd line)
↵	→ Modul RS	-.- - - - -.- - - - - - - - -	**4rd window**	(only provided if "computer interface" Option installed)
PLEASE NOTE DOWN ALL 6 (8) STATUS CODES !				
↵	Fct. 2.02	Hardware Information	Terminate hardware information	
(2x) 3x ↵	- - - - - - - -	- - - - - / - - -	Measuring mode	

If you need to return your flowmeter to KROHNE, please refer to last but one page of these Instructions !

7.4 Faults and symptons during start-up and process flow measurement

CAUTION!
The following applies to primary heads in hazardous areas:
Installation, electrical connection, commissioning and maintenance work may only be carried out by persons who have been trained for work in hazardous areas and are authorized to do so.

- Most faults and symptoms occurring with the flowmeters can be eliminated with the aid of the following tables.
- For greater clarity, faults and symptoms in the tables are divided into various groups.

Groups:	**D**	Display
	I	Current output
	P	Pulse output
	B	Status output or control input
	D / I / P / B	Display, current output, pulse output, binary outputs/inputs

Before contacting KROHNE Service, please read through the following tables. THANK YOU !

Safety notice
Some of the following measurements are carried out when the system is in the switched on condition. Exercise caution when handling measuring leads in the vicinity of power connections – electric shock hazard and risk of short-circuiting!

Gruppe D	Display shows . . .	Cause	Remedial action
D 1	Line Int.	Power failure. Note: no counting during power failure.	Delete error message in RESET/QUIT. menu. Reset totalizer(s) if need be.
D 2	I Overrange	Current output overranged. (Flow > measuring range)	Check instrument parameters and correct if necessary. Error message deleted automatically after cause has been eliminated.
D 3	P Overrange	Pulse output overranged. Note: totalizer deviation possible (Flow > I Max)	Check instrument parameters, correct if necessary, and reset totalizer(s). Error message deleted automatically after cause has been eliminated.
D 4	Totalizer	Counts lost (overflow, data error)	Delete error message in RESET/QUIT. menu.
D 5	ADC	Analog/digital converter overranged.	Error message deleted automatically after cause has been eliminated.
D 6	Fatal Error	Fatal-Error, all outputs set to "min." values.	Replace signal converter (see Sect. 8.3) or contact KROHNE Service, having first noted down hardware information and error status, see Fct. 2.02.
D 7	Startup cyclic flashing	Hardware fault, Watchdog activated.	Replace signal converter (see Sect. 8.3) or contact KROHNE Service.
D 8	Pipe empty	The measuring tube is empty. This message appears only when the **Option "empty pipe identifier"** is built in and when the function is switched on under Fct. 3.06 Application, submenu "empty pipe".	Fill the pipe.
D 9	Unsteady display	– Process product conductivity too low, particles/air inclusions too large or inhomogeneous – Pulsating flow – Time constant too low or switched off.	Increase time constant, see Fct. 1.02, or switch on.
D 10	No display	Power supply OFF	Power supply ON
		Check power fuse F5.	Replace if defective (see Sect. 8.2).
Group I	**Fault / Symptom**	**Cause**	**Remedial action**
I 1	Receiver instrument indicates "0".	Incorrect connection/polarity	Connect properly, see Sect. 2.4.
		Receiver instrument or current output defective.	Check output (see Sect. 7.2) with new milliammeter: Test ok, check connection cables and receiver instrument, replace if necessary. Test unsuccessfully, current output defective. Replace signal converter (see Sect. 8.3) or contact KROHNE Service
		Current output disabled, see Fct. 1.05	Activate under Fct. 1.05.
		Short-circuit between current output and pulse output.	Check connection and cables, see Sect. 2.4. Voltage between I+ and I⊥ (connecting block XC Pins d16 and z18), approx. 24 V. Switch off device, eliminate short-circuit, and switch device on again.
		External voltage source defective	Check power lines and/or external voltage source, and replace if necessary.

Group I	Fault / Symptom	Cause	Remedial action
I 2	Unsteady display	– Process product conductivity too low, particles/air inclusions too large or inhomogeneous – Pulsating flow – Time constant too low or switched off.	Increase time constant, see Fct. 1.02
Group P	**Fault / Symptom**	**Cause**	**Remedial action**
P 1	Totalizer connected but does not count any pulses	Incorrect connection/polarity	Connect properly, see Sect. 2.4.
		Totalizer or external voltage source defective.	Check output (see Sect. 7.2) with new totalizer: Test ok, check connection cables and previous totalizers and external voltage source, and replace if necessary. Test faulty, pulse output defective, replace signal converter (see Sect. 8.3) or contact KROHNE Service.
		Current output is external voltage source, short circuit or current / pulse output defective	Check connection and cables, see Sect. 2.4. Voltage between I+ and I⊥ (connecting block XC Pins d16 and z18), approx. 24 V. Switch off device, eliminate short-circuit, and switch device on again. If no function, then current or pulse output defective. Replace signal converter (see Sect. 8.3) or contact KROHNE Service.
		Pulse output is deactivated, see Fct. 1.06.	Switch on under Fct. 1.06.
P 2	Unsteady pulse rate	– Process product conductivity too low, particles/air inclusions too large or inhomogeneous – Pulsating flow – Time constant too low or activated only for current output I	Increase or switch on time constant, under Fct. 1.02 or switch on if necessary.
P 3	Pulse rate too high or too low.	Incorrect setting for pulse output.	Change setting under Fct. 1.06.
Group B			
B 1	No function	Faulty connection	Connect properly, see Sect. 2.4.
		Output/input defective	Replace electronics unit of signal converter, see Sect. 8.3
		External or internal voltage source not supplying voltage	Check voltage source, rectify any short-circuit or replace defective voltage source.
		Receiver instruments faulty	Check connection, if necessary replace receiver instruments.
		Function setting faulty	Correct function settings.
Gruppe D / I / P / B			
D / I / P / B 1	Unsteady display and outputs	– Process product conductivity too low, particles/air inclusions too large or inhomogeneous – Pulsating flow – Time constant too low	Increase time constant, under Fct. 1.02
D / I / P / B 2	No display and no function of outputs	Power supply OFF	Power supply ON
		Check power fuse F5.	Replace if defective, see Sect. 8.2.

7.5 Checking the primary head

This method describes the testing of the primary head and its interconnecting cables at the installation location of the signal converter.

CAUTION!
The following applies to primary heads in hazardous areas:
Installation, electrical connection, commissioning and maintenance work may only be carried out by persons who have been trained for work in hazardous areas and are authorized to do so.

Always switch off power source before starting work on the subrack connections.

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.**
- Pull plug-in unit out of the subrack.
- Fill the measuring tube of the flowmeter completely with process liquid.
- **Please note:** the following measurements must only be carried out for connections which are occupied (used).

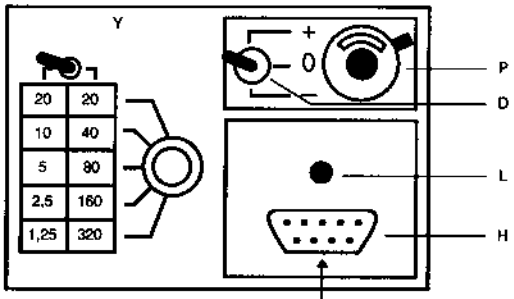
The **Nos. in brackets** (_ _ _) identify the power terminals at the primary head.

Action Resistance measurements at the **plug connector XA**, electrical connection to primary head: **signalling cable** (max. 5-pin) and **field current cable**		**Typical result**	**Incorrect result for 1 – 3 =** defective primary head, return to factory for repair, refer to last-but-one page !
1	Measure resistance of cables between Pins **d30** and **d32** (7 and 8)	30 – 170 Ω	**If lower**, interwinding fault. **If higher**, wire break.
2	Measure resistance of cables between Pins **d8/z8** and **d30** (1 and 7) or Pins **d8/z8** and **d32** (1 and 8)	> 20 M Ω	**If lower**, interwinding fault to PE or FE.
3	Measure resistance of cables between Pins **d8/z8 a**nd **z6** (1 and 2), and also between Pins **d8/z8 a**nd **z10** (1 and 3). **Always** use the same measuring lead on Pin **d8/z8** (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 cable B (type BTS/ bootstrap) is used: measure resistance between the following lines: Pins **d8/z8** and **d6** (1 and 20), Pins **d8/z8** and **d10** (1 and 30), Pins **d6** and **d10** (20 and 30), Pins **z6** and **d6** (2 and 20), Pins **z10** and **d10** (3 and 30).	> 20 M Ω	**If lower,**, line fault. Check connection cables, replace signal cable if necessary.

7.6 Test of signal converter using GS 8 A simulator (option)

CAUTION!
The following applies to primary heads in hazardous areas:
Installation, electrical connection, commissioning and maintenance work may only be carried out by persons who have been trained for work in hazardous areas and are authorized to do so.

GS 8 A operating elements and accessories



D Switch, Flow direction

H Socket for **H1** plug On cable **M**

H1 Plug of cable **M**

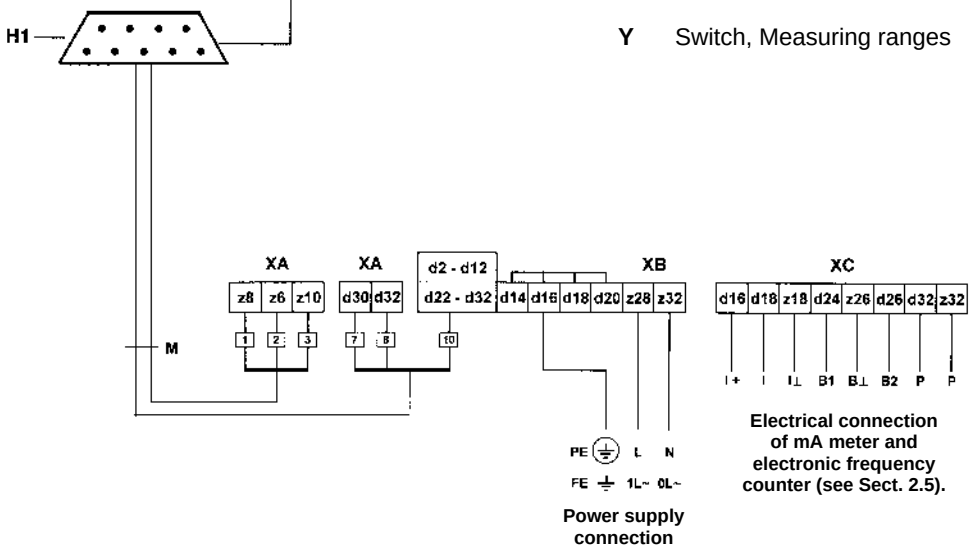
L Power supply ON

M Cable between GS 8A and **IFC 210 E** signal converter

P Potentiometer "zero point"

Y Switch, Measuring ranges

Electrical connection



Power supply connection

Electrical connection of mA meter and electronic frequency counter (see Sect. 2.5).

a) Switch off power supply before starting work !
b) Unscrew the 4 recessed head screws (S1) on the front plate (see Sect. 8.1, Fig.).
c) Carefully pull off plug-in unit from subassembly support.
d) The electrical connection is on the X1 and X2 connectors at the rear hand side of the IFC 210 E signal converter as shown in connection diagram with cable M.

A mA meter, accuracy class 0.1, R_i < 500 Ohm, range 4-20 mA

Electronic frequency counter, input resistance approx. 1 k Ohm, range 0-1 kHz, time basis min. 1 second, see connection diagrams in Sect. 2.5.

Check of setpoint display

1) Switch on power supply, allow at least 15 minutes' warm-up time.
2) Set switch D (front panel of GS 8A) to "0" position.
3) Adjust zero to 0 or 4 mA with the 10-turn potentiometer P (front panel of GS 8A), depending on setting in Fct. 1.05, deviation < ±10 µA.
4) Calculate 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 volumetric unit **V** per unit time **t**
GK primary constant, see instrument nameplate
DN meter size DN im mm, not inches, see instrument nameplate
t time in seconds (Sec), minutes (min) or hours (hr)
V volumetric unit
K constant, according to following table:

t / **V**	Sec	min	hr
Liter	25 464	424.4	7.074
m^3	25 464 800	424 413	7 074
US-Gallonen	96 396	1 607	26.78

4.2) Determine position of switch **Y**: Use table (front panel GS 8A) 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% flowrate
$I_{100\%}$ current (20mA) at 100% flowrate

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% flowrate

5) Set switch **D** (front panel GS 8A) to position "+" or "-" (**f**orward/ **r**everse flow).
6) Set switch **Y** (front panel GS 8A) to the value determined by the method described above.
7) Check setpoint readings **I** and **f**, see points 4.3 and 4.4 above.
8) Deviation < 1.5% of setpoint. If greater, replace signal converter, see Sect. 8.3.
9) Test of linearity: set lower Y values, readings will drop in proportion to the calculated Y values.
10) **Switch off power supply** after completing the test.
11) Disconnect the GS 8A.
12) Reassemble in reverse order, see points e) – b) under "electrical connection", see illustration in Sect. 8.1.
13) The system is ready for operation after the power supply has been switched on.

Example: see overleaf

Example

Full-scale range			$\mathbf{Q_{100\%}}$	= 200 m^3/hr (Fct. 1.01)
Meter size			**DN**	= 80 mm = 3" (Fct. 3.02)
Current at	$Q_{0\%}$		$\mathbf{I_{0\%}}$	= 4 mA } (Fct. 1.05)
	$Q_{100\%}$		$\mathbf{I_{100\%}}$	= 20 mA }
Pulses at	$Q_{100\%}$		$\mathbf{P_{100\%}}$	= 200 Pulse/hr (Fct. 1.06)
Primary head constant			**GK**	= 3.571 (s. Geräteschild)
Constant	(**V**	in **m^3**)		
	(**t**	in **hr**)	**K**	= 7074 (see Table)
	(**DN**	in **mm**)		

Calculation of **„X"** and position 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 = 40, position of switch Y, see front panel GS 8A
(comes closest to X value 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 %)

$$f = \frac{Y}{X} \times P_{100\%} = \frac{40}{61.905} \times 200\ pulses/hr = 129.2\ pulses/hr$$

Deviations are permissible between 127.3 and 131.1 pulses/hr (equivalent to ± 1.5 %)

**If you need to return your flowmeter to KROHNE,
please refer to last but one page of these Instructions !**

8 Service

8.1 Illustrations used for service work

Fig. 1 Front view

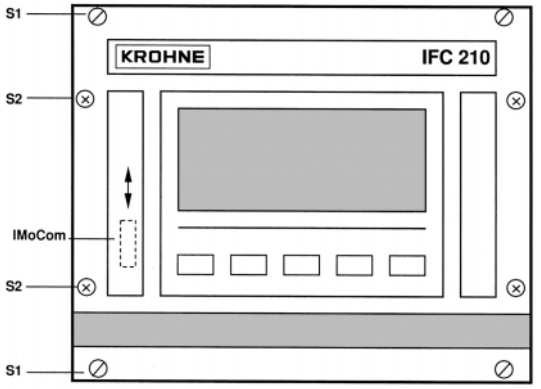


Fig. 2 Back view

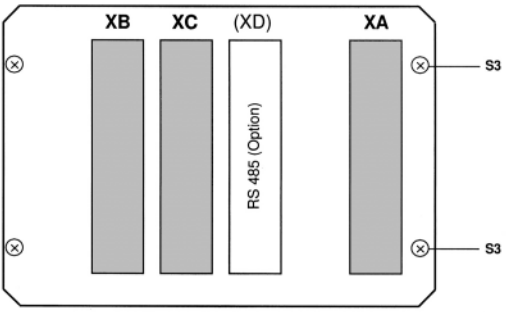
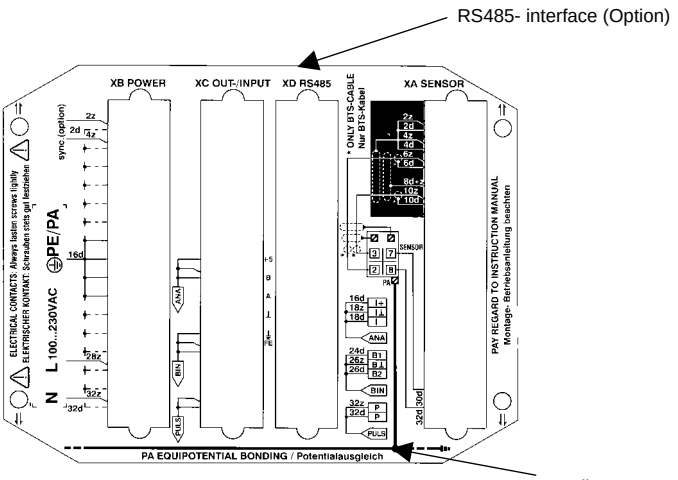


Fig. 3 Marking of terminal strips (on rear side of plug-in unit)



8.2 Replacement of power supply fuse

CAUTION!
The following applies to primary heads in hazardous areas:
Installation, electrical connection, commissioning and maintenance work may only be carried out by persons who have been trained for work in hazardous areas and are authorized to do so.

Switch off power supply before starting work

Refer to Sect. 8.1 for Figs. 1 and 2.

1) Unscrew the 4 recessed head screws (S1), on the front **(Fig. 1).**
2) Carefully remove the plug-in unit from the subassembly support.
3) Detach 4 recessed-head screws (S3) on the rear side of the plug-in unit **(Fig. 2).**
4) Carefully remove the electronics insert from the plug-in unit.
5) Change power fuse F5 on the “power supply unit“ board (Fig. in Sect. 8.4). For values and order no., refer to Sect. 9.
6) Reassemble in reverse order, points 4) - 1) above.

8.3 Replacement of electronics unit of signal converter

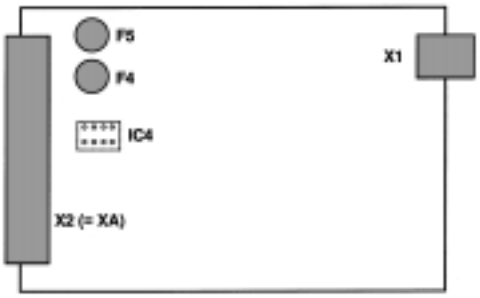
CAUTION!
The following applies to primary heads in hazardous areas:
Installation, electrical connection, commissioning and maintenance work may only be carried out by persons who have been trained for work in hazardous areas and are authorized to do so.

Refer to Sect. 8.1 for Figs. 1 and 2.

1) Unscrew the 4 recessed head screws (S1), on the front **(Fig. 1).**
2) Carefully remove the plug-in unit from the subassembly support.
3) Detach 4 recessed-head screws (S3) on the rear side of the plug-in unit **(Fig. 2).**
4) Carefully remove the electronics insert from the plug-in unit.
5) Carefully transpose DATAPROM (IC 4) on conductor side the amplifier-PCB (see Fig. in Sect. 8.4) from the “old” and the “new” electronic unit . Watch the position of the IC 4 when putting it on.
6) Check the power supply and fuse F5 on the new electronic unit.
7) Reassemble in reverse order, points 4) - 1) above.

8.4 Illustrations of the PCBs

A) Amplifier PCB



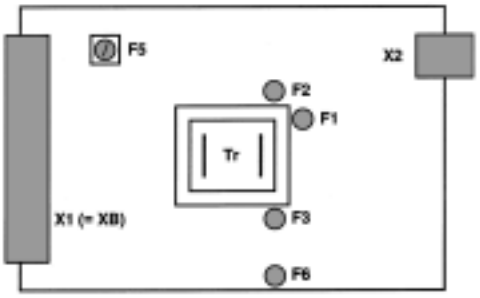
X1 Plug for internal connections
NOTE: not provided for **EEx version,** which instead has the additional **GTEX board**

X2 (= XA) Push-on terminal strip XA, external connection via socket connector to DIN 41 612, Style F, 32-pin

F4 + F5 Field current fuse, 160 mAF, miniature fuse TR 5
(for IFC 210 E-EEx: if necessary, adjust to max. permissible fuse nominal value for the primary head)

IC 4 DATAPROM, stores all operating data, see Sect. 8.3 and 8.4 (on conductor side, see separate Figure)

B) Power supply PCB
AC versions (100 – 230 V AC)



X1 (= XB) Push-on terminal strip XB, external connection via socket connector to DIN 41 612, Style F, 32-pin

X2 Plug for internal connections

Tr Transformer

F5 Power fuse, 800 mAT,
(5 x 20 G, switching capacity 1500 A)
For order No. see Sect. 9

Sundry miniature fuses TR 5,
For order No. see Sect. 9

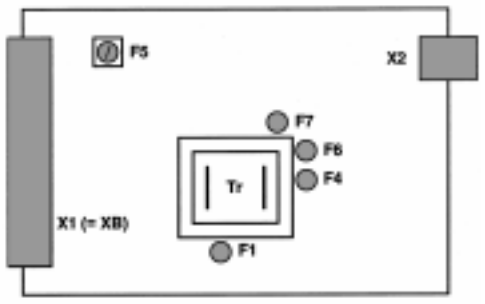
F1 Optocoupler, fuse 50 mAT

F4 5V/15V fuse, 630 mAT

F6 Current output, fuse 200 mAT

F7 Field current supply, fuse 630 mAT

C) Power supply PCB
AC-Version (24 V AC/DC)



X1 (= XB) Push-on terminal strip XB, external connection via socket connector to DIN 41 612, Style F, 32-pin

X2 Plug for internal connections

Tr Transformer

F5 Power fuse, 1.6 AT,
(5 x 20 G, switching capacity 1500 A)
for order No. see Sect. 9

Sundry miniature fuses TR 5,
for order No. see Sect. 9

F1 Current output, fuse 200 mAT

F2 Field current supply, fuse 630 mAT

F3 5V/15V fuse, 630 mAT

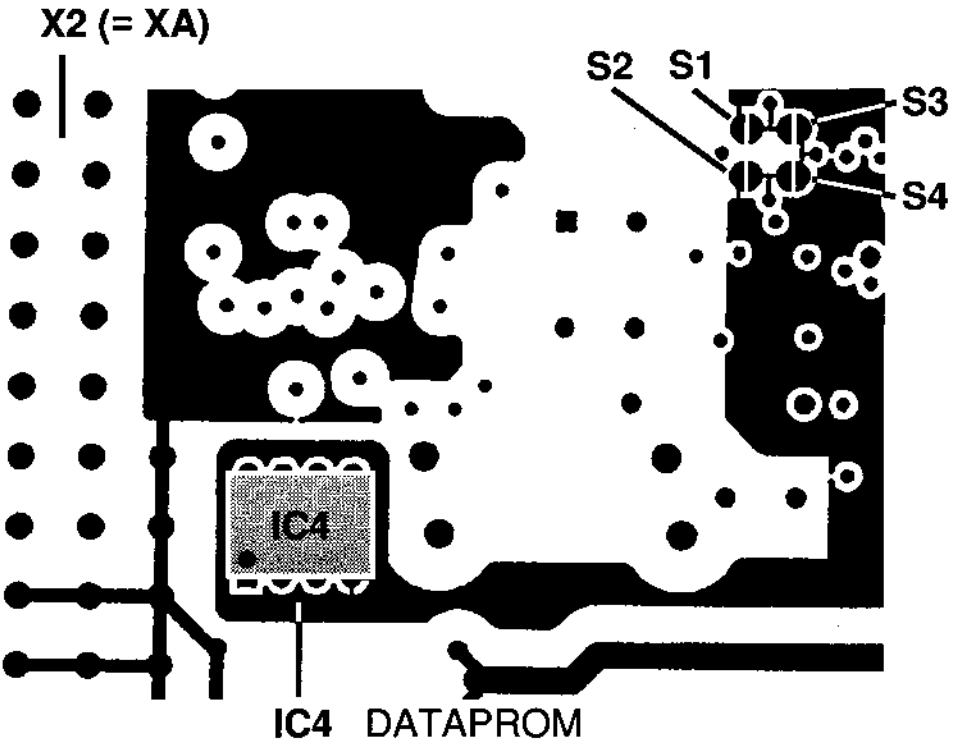
F6 Optocoupler, fuse 100 mAT

D) Amplifier PCB (conductor side)

X2 (= XA) Plug connector XA, external connection via socket connector to DIN 41 612, Style F, 32-pin

IC 4 DATAPROM, stores all operating data, see Sect. 8.4

S1 – S4 Soldering jumpers for various functions, see Sect. 6.3



9 Order numbers

Electronic unit, complete		
100 – 230 V AC	Standard (**not EEx / not RS 485**)	2.12233.01.00
24 V AC / DC		2.12233.02.00
PCBs, single		
PCB – Power supply unit for	100 – 230 V AC	2.11671.01.00
	24 V AC / DC	2.12070.01.00
PCB – Amplifier	Standard (**not EEx**)	2.11556.01.00
PCB – I / O	(Inputs / Outputs)	2.11615.01.00
Power fuses F5 (5 x 20 G / switching capacity 1500 A)		
800 mA T	(100 – 230 V AC)	5.08085.00.00
1.6 A T	(24 V AC / DC)	5.07823.00.00
miniature fuses TR 5		
50 mA T		5.07576.00.00
100 mA T		5.07561.00.00
160 mA F		5.10283.00.00
200 mA T		5.07563.00.00
500 mA T		5.07586.00.00
630 mA T		5.08019.00.00
19" subrack with guide rails, preassembled		On request
19" subrack, fully assembled with built-in IFC 210 E, socket connectors with solder terminals		
100 – 230 V AC		On request
24 V AC / DC		On request
Blanking plates		
2 TE		3.06660.00
3 TE		3.06738.00
5 TE		3.06739.00
8 TE		3.06740.00
14 TE		3.06741.00
21 TE		3.06590.00

10 Technical data

10.1 IFC 210 E signal converter

1 Range of application	Flow measurement of liquid products

2 Mode of operation and system structure

Measurement principle	Faraday`s laws of induction
Modularity	Measuring system consisting of signal converter and separate primary head
Versions – signal converter	
IFC 210 E (Standard)	- Standard version with large graphic LC display and integrated HART® interface
IFC 210 E / **RS 485** (Option)	- same as standard version, but additionally with RS 485 interface
IFC 210 E / _ / **EEx** (Option)	- same as standard version, for operation with primary heads installed in hazardous areas
Interface module (Option)	- RS 485 / Profibus PA (in preparation)
Versions – primary head	Refer to Technical Data in separate Installation Instructions

3 Input

Measured variable	Volumetric flow rate (electrode voltage from primary head)
Measuring range	Dependent on meter size of primary head see also Table in Sect. 10.2
Full-scale range	6 Liter/h to 86 860 m^3/h, corresponding flow velocity v = 0.3 to 12 m/s
Selectable units	m^3/h, Liter/s, US Gallons/min or freely selectable unit, e.g. Liter/day

4 Output

Output/input signal	**Current-Output**	**Pulse-output**	**Status-output**	**Control-input**
Operation	active/ passive	active/ passive	passive	Passive
Failure signal (error)	22 mA, and others	–	yes	–
Load impedance	max. 800 Ω	–	–	–
Low flow	Yes	–	yes	–
F/R mode	Yes	yes	–	–
Other functions detailed technical data (see below)	Yes	yes	yes	yes

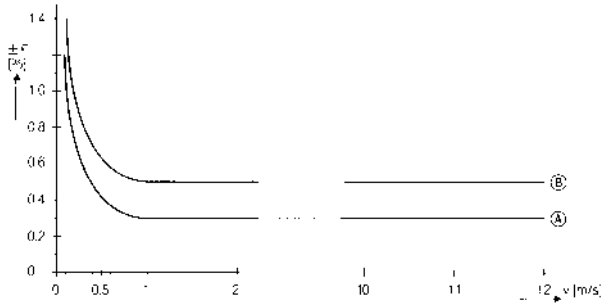
Current output		
Function		- all operating data settable - galvanically isolated from all output and input circuits - for active or passive mode
Current:	fixed ranges:	0 - 20 mA and 4 - 20 mA
	variable ranges:	for Q = 0% $I_{0\%}$ = 0 - 16mA for Q = 100% $I_{100\%}$ = 4 - 20mA for Q > 100% I_{max} = 22mA } adjustable in 1mA increments
Active mode		max. 800 Ω load
Error identification		0 / 22 mA and variable
Forward/reverse flow measurment		direction identified via status output
Pulse output		
Function		- all operating data settable - galvanically isolated from current output and all input circuits - digital pulse division, interpulse period non-uniform, - therefore if frequency and cycle meters connected allow for minimum counting interval:: gate time, totalizer≥ $\frac{1000}{P_{100\%}\ [Hz]}$
Activ mode		connection: electronic totalizers
Passive mode		connection: electronic or electromechanical totalizers
Electrical data		see connection diagrams in Sect. 2.5
Pulse width		automatic: pulse duty cycle 1:1, max 10 000 pulses/Sec = 10 kHz variable: 10 ms - 1 s $P_{100\%}\ [pulses/s] = f_{max}\ [Hz] = \frac{1}{2x\ pulse\ width}$
Forward/reverse flow measurement		flow direction identified via status output
Status output (passive)		
Function		settable as measuring range identification for BA mode, automatic range change, Overrange, Low Flow Cutoff, indicator for flow direction, errors or trip point, change-over contact (Statusoutput B2 inverse to B1)
Electrical data		see connection diagrams in Sect. 2.5
Control input (passive)		
Function		- settable for range change, totalizer reset, error reset, set outputs to min. values or hold actual output values - initiate function by low or high control signals
Control signals		U_{max}: 24 V **AC** 32 V **DC** (any polarity) low: ≤ 1,4 V ≤ 2 V high: ≥ 3 V ≥ 4 V
Time constant		0.2 - 99.9 s, adjustable in increments of 0.1 second
Low-flow cutoff		Cutoff on value: 1 - 19 % Cutoff on value: 2 - 20 % } of $Q_{100\%}$, adjustable in 1% increments

5 measuring accuracy

Display, digital values, pulse output
F maximum error in % of measured value (**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 mS/cm
Power supply (rated voltage)	U_N (± 2%)
Ambient temperature	20 – 22°C
Warm-up time	60 min
Max. calibration equipment error	10 × smaller than F
Inlet/outlet runs	10 × DN / 2 × DN (DN = meter size)
Primary head	properly grounded and centered

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



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

Type/Meter size		**Maximum error** in % of **m**easured **v**alue (MV) ...		**Curve**
DN mm	inch	v ≥ 1 m/s / ≥ 3 ft/s	v < 1 m/s	
DN 2.5 – 6*	$^1/_{10}$'' – $^1/_4$'' *	≤ ± 0.5% of MV	≤ ± (0.4% of MV + 1 mm/s) ≤ ± (0.4% of MV + 0.04 inch/s	**B**
≥ DN 10	≥ $^3/_8$''	≤ ± 0.3% of MV	≤ ± (0.2% of MV + 1 mm/s) ≤ ±(0.2% of MV + 0.04 inch/s)	**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 temperature variation
Current output	0,01 % of MV (1)	0,025% of MV (1)	
Power supply	< 0,02 % of MV	0,05 % of MV.	at 10% variation
Load	< 0,01 % of MV	0,02 % of MV	at max. permissible load, see Sect. 10.1 and 2.5

(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.

6 Field service conditions

6.1 Installation conditions

Signal converter	Installation in 19" rack, dust-free and dry, For further information, refer to Sect. 1.1 and 10.3
Primary head	Refer to separate Installation Instructions

6.2 Ambient conditions

Signal converter	
Ambient temperature	-25 to +60 °C (EEx: -20 to +55 °C)
Storage temperature	-25 to +60 °C
Protection category (IEC 529/EN 60 529)	IP 20
Electromagnetic compatibility EMC	to EN 61326-1 (1997) and A1 (1998), and NAMUR Standard NE 21
Primary head	Refer to separate Installation Instructions

6.3 Process product conditions

Electrical conductivity	≥ 5 µS/cm ≥ 20 µS/cm for demineralized cold water
Other product conditions	Refer to Installation Instructions for the primary head

7 Construction

Signal converter	19" plug-in unit to DIN 41 494, 28 modules wide, 3 upright modules high
Dimensions	Refer to Sect. 10.3
Weight	approx. 1.3 kgs
Material	Aluminium section, stainless steel and aluminium sheet, partially polyester-coated
Electrical connection	
Terminal strips	XA: Primary head, see Sect. 1.3.5 XB: Power supply, see Sect. 1.3.5 XC: Inputs and outputs, see Sect. 2.5 XD: Option, RS 485 interface, see Sect. 6.2.2
Styles	• 32-pin, contact surface gold-plated • plug connectors Style F to DIN 41 612 • socket connectors Style F to DIN 41 612 and transverse soldered connections (included) • Special versions on request
Primary head	Refer to separate Installation Instructions

8 Display and User Interface

Local display		
		High-contrast, illuminated graphic LC display, temperature-compensated, very good readability, 128x64 dots, view surface approx. 69 mm x 36 mm
Display function		current flow, forward, reverse and sum totalizers or bar graph with status messages
Units:	actual flow	m^3/hr , Liter/Sec, US gallons/min. or user-defined unit such as Liter/day or US MGal/day
	totalizer	m^3, Liter or US gallons or user-defined unit such as hectolitres or US MGal (adjustable counting time up to overflow)
Language of clear texts		German, English, French, other languages on request
Operation		by 5 keys: ← → ↵ ↑ ↓

9 Power supply

Field current supply			
Type		bipolar, pulsed DC field for all KROHNE primary heads, galvanically isolated from all output and input circuits	
Terminals		Plug connector XA, pins z30 and z32 (primary head: terminals 7 and 8)	
Current/voltage		± 0.125 A (± 5%) / max. 40V	
Clock frequency		$^1/_{36}$ to $^1/_2$ of line frequency, adjustable acc. to calibration data of primary head	
signal converter	**AC-version** standard	**AC/DC version** optional	
Voltage range (without change-over)	**100 - 230 V AC**	**24 V AC**	**24 V DC**
Tolerance range	85 - 255 V AC	20.4 - 26.4 V AC	18 - 31.2 V DC
Frequency	48 - 63 Hz	48 - 63 Hz	
Power input (incl. primary head)	11 VA, typical (max. 14 VA)	11 VA, typical (max. 14 VA)	11 W typical (max. 14 VA)
	When connected to a functional extra-low voltage, **24 V AC/DC**, safety separation (PELV) must be ensured.		

10 Certificates and Approvals

Signal converter	[EEx ib] IIC / II(2)G PTB 00 ATEX 2026X
Primary head	see separate Installation Instructions

11 Order information

Versions Signal converter	see Sect. 10.1, part 2 „Mode of operation and system structure“
Versions Primary head	Refer to Technical Data in separate Installation Instructions

12 External Standards and Directives see Page 5

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

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

Flow rate Q = 100% — 6 liter/hr up to 86 860 m^3/hr, (0.03 – 401 000 US Gal/min), adjustable required, equivalent flow velocity 0.3 - 12 m/s (1 - 40 ft/s)

Unit — m^3/hr, Liter/Sec, US gallons/min or user-defined unit, e.g. Liter/day or US MGal/day

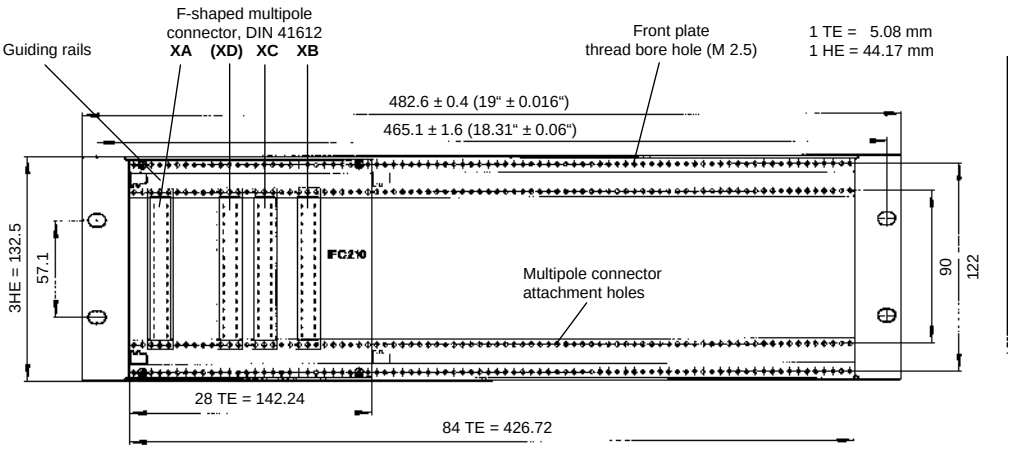
Flow table

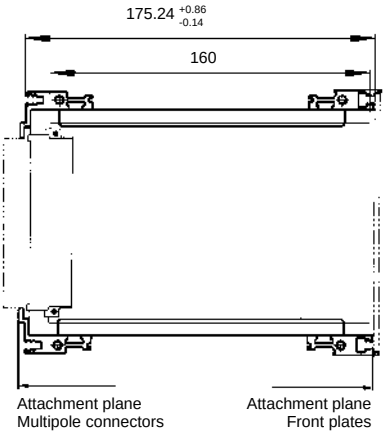
v = flow velocity in m/s

Meter size		Full-scale range $Q_{100\%}$ in m^3/hr			$Q_{100\%}$ in US Gal/min	
DN		v = 0.3 m/s	v = 1 m/s	v = 12 m/s	v = 1 ft /s	v = 40 ft /s
mm	inch	(minimum)		(maximum)	(minimum)	(maximum)
2.5	1/10	0.0053	0.0177	0.2121	0.0245	0.979
4	1/8	0.0136	0.4520	0.5429	0.0383	1.530
6	1/4	0.0306	0.1018	1.222	0.1530	6.120
10	3/8	0.0849	0.2827	3.392	0.3735	14.93
15	1/2	0.1909	0.6362	7.634	0.8405	33.61
20	3/4	0.3393	1.131	13.57	1.494	59.75
25	1	0.5302	1.767	21.20	2.334	93.34
32	-	0.8686	2.895	34.74	3.824	153.0
40	1 1/2	1.358	4.524	54.28	5.979	239.0
50	2	2.121	7.069	84.82	9.339	373.5
65	-	3.584	11.95	143.3	15.78	630.9
80	3	5.429	18.10	217.1	23.90	955.6
100	4	8.483	28.27	339.2	37.35	1493
125	-	13.26	44.18	530.1	37.35	2334
150	6	19.09	63.62	763.4	84.05	3361
200	8	33.93	113.1	1357	149.43	5975
250	10	53.02	176.7	2120	233.4	9334
300	12	76.35	254.5	3053	336.2	13442
400	16	135.8	452.4	5428	597.9	23899
500	20	212.1	706.9	8482	933.9	37345
600	24	305.4	1018	12215	1345	53781
700	28	415.6	1385	16625	1919	76760
800	32	542.9	1810	21714	2507	100272
900	36	662.8	2290	26510	3173	126904
1000	40	848.2	2827	33929	3917	156672
1200	48	1221	4072	48858	5640	225608
1400	56	1663	5542	66501	7677	307080
1600	64	2171	7238	86859	10027	401080

10.3 Dimensions and weights IFC 210 E-EEx / ZD / ZD-EEx

IFC 210 E and IFC 210 E-EEx Signal converters / IFC 210 E-EEx
Dimensions in mm
Weight approx. 1,3 kg **support 3 HE**, assembly dimensions in compliance with DIN 41494, Part 5





19” Subassembly support purchase order numbers

– Subassembly support
including guiding rails, pre-installed 2.07230

– Subassembly support fully installed
including IFC 210 E,
multipole connectors plus solder points

– Blind plates

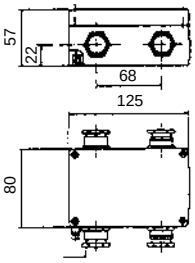
2 TE	3.06660.00
3 TE	3.06738.00
5 TE	3.06739.00
8 TE	3.06740.00
14 TE	3.06741.00
21 TE	3.07590.00

– Special design of
multipole connectors X1 and X2:

Threaded terminal end [1]	5.08400
Wire-Wrap (1 x 1) mm	5.08402
Termi-Point (0.8 x 1.6) mm	5.08403

[1] Designated BG
connection component 2.07412

ZD and ZD-EEx Intermediate connection box
Weight approx. 0.5 kg/1.1 lbs

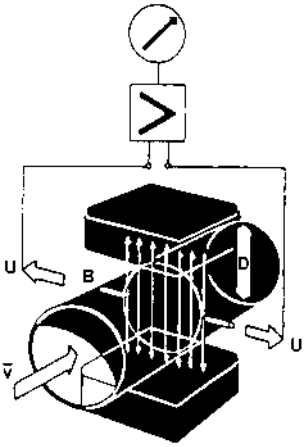


dimensions in mm

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:

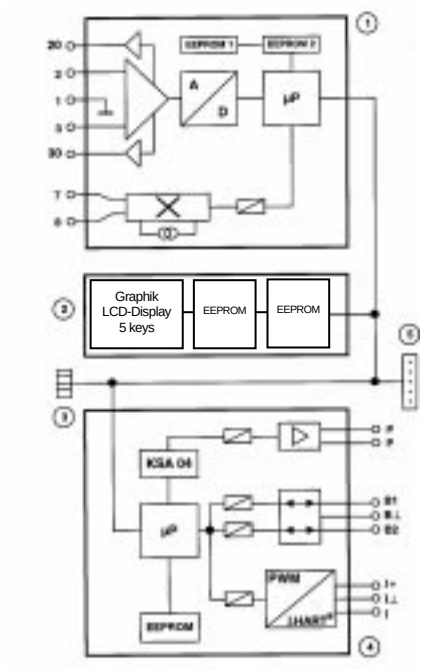
1) No pressure loss through pipe constriction or protruding parts.
2) Since the magnetic field passes through the entire flow area, the signal represents a mean value over the pipe cross-section; therefore, only relatively short straight inlet pipes 5 x DN from the electrode axis are required upstream of the primary head.
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 primary head 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 primary head 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 primary head or in the connecting cables are similarly suppressed.

12 Block diagram – signal converter IFC 210 E

The standard

- outstanding accuracy
- practice-oriented standard equipment, current and pulse output (galvanically isolated)
- status and/or control input, adjustable for numerous tasks: limit switch, direction indication, error messages, external initiation of functions, etc.
- IMoCom bus, suitable for numerous internal and external tasks
- simplified, standard KROHNE operator control concept
- low power consumption



① **Printed circuit board ADC/FSV**

- overdrive-proof signal processing, processes flow rate peaks up to 20 m/s and more, fast and accurate
- digital signal processing and sequence control
- patented, high-resolution analog/digital converter, digitally controlled and monitored
- input amplifier with facility for voltage grading of the signalling core shield (bootstrap)
- high signal-to-noise ratio through low-loss field current supply with high frequencies and high currents
- pulsed DC current, electronically controlled, for supplying the magnetic coils in the primary head
- customer parameters and internal calibration data are filed in separate EEPROMs (easily replaceable in the event of a service)

② **Printed circuit board: display/operator control unit**

- large illuminated graphic LC display
- 5 keys for operation of the signal converter
- connection to the internal IMoCom bus
- distribution of general signals, such as IMoCom bus, supply power, etc..

③ **IMoCom bus plug for connection of** external control and testing equipment, such as adapters and CONFIG software for operator control via MS-DOS PC

④ **Printed circuit board I/O-HART®, outputs and inputs**
All outputs and inputs galvanically isolated

Current output I

- for active or passive operation
- converts the digital output signal from microprocessor µP into a proportional current

Pulse output P

- for electronic totalizers up to max. 10 kHz
- for electromechanical totalizers up to max. 50 Hz
- KROHNE-specific integrated circuit KSA 04 for fine quantization of the output signals over a wide dynamic range

Binary output and input B1 and B2

- any output/input combination selectable
- status output for limit value, error detection, flow direction in F/R mode, etc.
- control input for totalizer and error resets, also for holding outputs or setting to “zero“

⑤ **Plug-in module slots for upgrading or retrofitting the signal converter**

- RS 485 interface module
- GTEX module for Ex-i operation of the signal converter outside hazardous areas
- Further modules in preparation

13 EU-Model test certificate ATEX

Physikalisch-Technische Bundesanstalt

PTB

EG-Baumusterprüfbescheinigung

PTB 00 ATEX 2026 X

Physikalisch-Technische Bundesanstalt

PTB

Anlage

Physikalisch-Technische Bundesanstalt

PTB

Braunschweig und Berlin

Anlage zur EG-Baumusterprüfbescheinigung PTB 00 ATEX 2026 X

(17) Besondere Bedingungen

Zur Sicherstellung des Fadenmaßes von ≥ 30 mm zwischen den Anschlüssen der eigensicheren und nichteigensicheren Stromkreise ist vom Anwender eine Isolierung aller spannungsführenden Anschlüsse der Federleiste mit Schrumpfschlauch auszuführen.

Die Anschlüsse für den Schutzleiter/Potentialausgleich (PE/PA) sind mit dem entsprechenden PA-Anschluss innerhalb des explosionsgefährdeten Bereiches zu verbinden.

(18) Grundlegende Sicherheits- und Gesundheitsanforderungen

erfüllt durch die zuvor genannten Normen

Braunschweig, 24. März 2000

Im Auftrag

Dr.-Ing. U. Johannsmeyer

Regierungsdirektor

Seite 1/1

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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 such dangerous substances. (Directions on how you can find out whether the primary head 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.

SPECIMEN certificate

Company: ..... Address: .....

Department: ..... Name: .....

Tel. No.: ..... Fax-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: