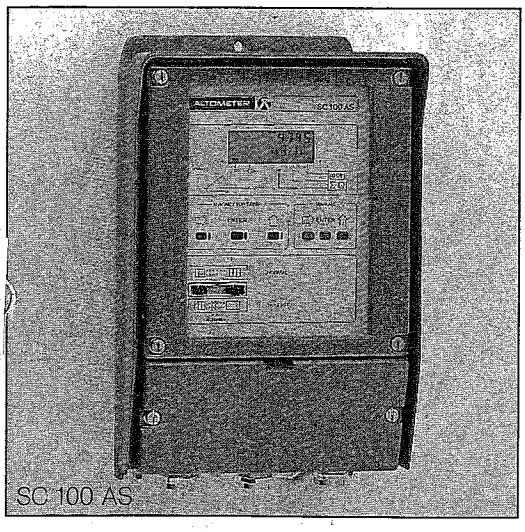
KROHNE

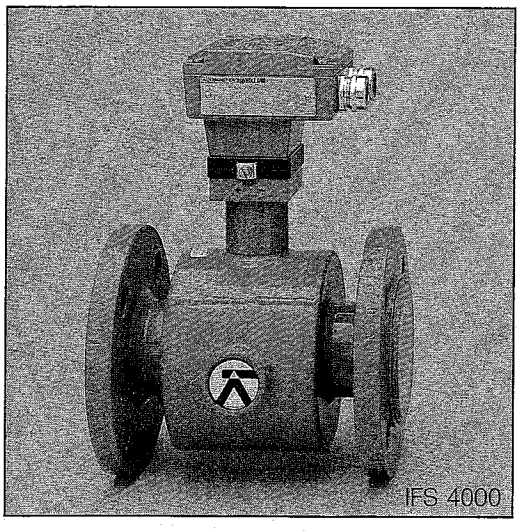
01/95

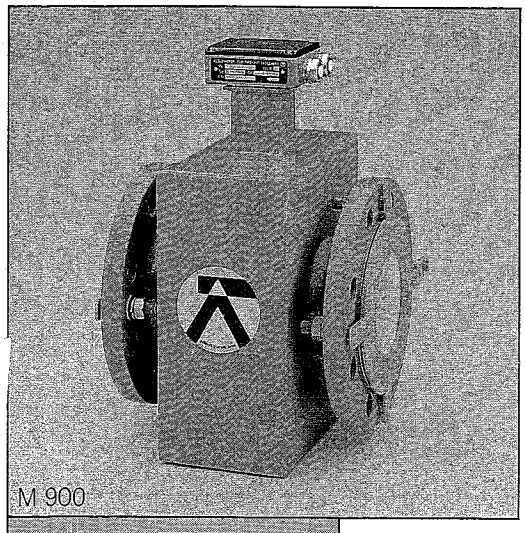
Magnetic inductive flowmeters

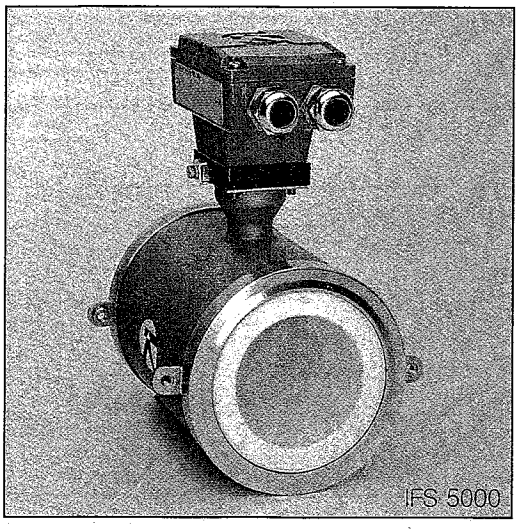
Installation and operating instructions

ALTOFLUX
IFM 2100 F
IFM 4100 F
IFM 5100 F
IFM 9100 F


SC 100 AS


IFS 4000


M 900


IFS 5000

Signal converter
SC 100 AS/F
SC 100 AS/HPC/S

Primary heads
IFS 2000
IFS 4000
IFS 5000
M 900

3.1M24EA5 019521

Order No. DIN size: 7.02130.33.00
US size: 7.02130.73.00

How to use these Installation and Operating Instructions

- For easy reference these instructions are divided into 5 parts.
- Only **Part A** (pages 6-20) is needed for **installation and initial start-up.**
- All electromagnetic flowmeters are factory-set to your order specifications. Therefore, no further adjustments are necessary prior to start-up.

Part A (pages 6-20) **Install flowmeter in the pipeline** (Sect. 1), **connect up** (Sect. 2), **power the flowmeter** (Sect. 3), **that's all!**

The system is operative.

Part B (pages 21-38) Operator control and action of the SC 100 AS/F signal converter.

Part C (pages 39-59) Special applications, service, and functional checks.

Part D (pages 60-77) Technical data, dimensions, block diagram and measuring principle.

Part E (pages 78-80) Index

Condensed instructions between pages 42 and 43, pull out form.

Product liability and warranty

These electromagnetic flowmeters are suitable solely for measuring the volumetric flowrate of electrically conductive liquids, slurries and pastes.

For use in hazardous areas, special codes and regulations are applicable which are specified in the special "Ex installation and operating instructions" (supplied only with hazardous-duty equipment).

Responsibility as to suitability and intended use of our instruments 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 ALTOFLUX flowmeters have to be returned to Krohne, please note the information given on page 83!

System description

The IFM 2100 F, IFM 4100 F, IFM 5100 F and IFM 9100 F electromagnetic flowmeters are precision instruments designed for the linear flow measurement of electrically conductive liquids, pastes and slurries with a minimum conductivity of > 5 μS/cm (μmho/cm) or > 20 μS/cm (μmho/cm) for demineralized cold water.

The full-scale range is adjustable between 6 liters per hour and 305 000 m³ per hour, or 0.02 to 1 342 800 US gallons per minute, dependent on the meter size DN 2.5 to 3000 or $^1/_{10}$" to 120". This corresponds to a flow velocity of 0.3 to 12 m/s or 1 to 40 ft/s.

Example of type designation

IFM 5 100 F

F Separate flowmeter, primary head with terminal box, SC 100 AS/F signal converter, field housing

100 Signal converter designation for SC 100 AS

2000 IFS 2000 primary head
4000 IFS 4000 primary head
5000 IFS 5000 primary head
9000 M 900 primary head

IFM Electromagnetic flowmeter (system)
IFS Primary head (sensor)
IFC Signal converter

Available versions

System	Primary head				Signal converter	Power driver
	Type	Liner	Meter size			
		Measuring section	DN mm	inches		
IFM 5100 F	IFS 5000	Fused aluminium oxid	2.5 – 100	1/10 – 4	SC 100 AS/F	–
IFM 2100 F	IFS 2000	Fused aluminium oxid	150 – 250	6 – 10	SC 100 AS/F	–
IFM 4100 F	IFS 4000	PTFE (Teflon)	10 – 20	3/8 – 3/4	SC 100 AS/F	–
		PFA	25 – 150	1 – 6		
		Varions	200 – 1200	8 – 48		
		Varions	1300 – 3000	52 – 120	SC 100 AS/F	NB 900 F
IFM 9100 F	M 900	PTFE (Teflon)	10 – 20	3/8 – 3/4	SC 100 AS/F	–
		Varions	25 – 300	1 – 12		

Items included with supply

- **Separate-system flowmeter** as ordered
  - SC 100 AS/F signal converter, field housing
  - primary head with installation material according to the following table/list
  - signal cable (field current cable not supplied, to be provided by customer)
- Installation and operating instructions with pull-out condensed instructions for operation of the SC 100 AS/F signal converter
- Certificate of system calibration data
- Report on factory setting of the signal converter

IFS 2000 and IFS 5000 Primary head

Primary head				Supplied...		X = Standard		O = Option	Size of gaskets		
Type	Meter size to...	Max. operating pressure 1)		...with centering material	...with stud bolts	...with grounding rings E and gaskets		...w/o grounding rings but with gaskets D3 and cable V	D1, D2 + D3 in mm (inches) 3)		
		bar	psig			D1	D1 + D2		da	di	s
IFS 5000	... DIN 2501 (BS 4505)										
	DN 2.5, 4, 6, 10	40	580	2xrings	4xM12	X			D1 are special O-rings 2)		
	DN 15	40	580	2xrings	4xM12	X			D1 are special O-rings 2)		
	DN 25	40	580	2xrings	4xM12		O	X	46 (1.81)	26 (1.02)	1.6 (0.06)
	DN 40	40	580	4xsleeves	4xM16		O	X	62 (2.44)	39 (1.54)	1.6 (0.06)
	DN 50	40	580	4xsleeves	4xM16		O	X	74 (2.91)	51 (2.01)	1.6 (0.06)
	DN 80	40	580	6xsleeves	8xM16		O	X	106 (4.17)	80 (3.15)	1.6 (0.06)
	DN 100	16	230	6xsleeves	8xM16		O	X	133 (5.24)	101 (3.98)	1.6 (0.06)
		25	360	6xsleeves	8xM20		O	X	133 (5.24)	101 (3.98)	1.6 (0.06)
IFS 2000	DN 150	16	230			X			D1 are special O-rings 2)		
	DN 200	10	145			X			D1 are special O-rings 2)		
	DN 250	10	145			X			D1 are special O-rings 2)		
IFS 5000	... ANSI B16.5										
	1/10, 1/8, 1/4, 3/8, 1/2"	< 20	< 290	2xrings	4x1/2"	X			D1 are special O-rings 2)		
		< 40	< 580	2xrings	4x1/2"	X			D1 are special O-rings 2)		
	1"	< 20	< 290	4xsleeves	4x1/2"		O	X	46 (1.81)	26 (1.02)	1.6 (0.06)
		< 40	< 580	2xrings	4x5/8"		O	X	46 (1.81)	26 (1.02)	1.6 (0.06)
	1 1/2"	< 20	< 290	4xsleeves	4x1/2"		O	X	62 (2.44)	39 (1.54)	1.6 (0.06)
		< 40	< 580	4xsleeves	4x3/4"		O	X	62 (2.44)	39 (1.54)	1.6 (0.06)
	2"	< 20	< 290	4xsleeves	4x5/8"		O	X	74 (2.91)	51 (2.01)	1.6 (0.06)
		< 40	< 580	6xsleeves	8x5/8"		O	X	74 (2.91)	51 (2.01)	1.6 (0.06)
	3"	< 20	< 290	4xsleeves	4x5/8"		O	X	106 (4.17)	80 (3.15)	1.6 (0.06)
		< 40	< 580	6xsleeves	8x3/4"		O	X	106 (4.17)	80 (3.15)	1.6 (0.06)
	4"	< 20	< 290	6xsleeves	8x5/8"		O	X	133 (5.24)	101 (3.98)	1.6 (0.06)
		< 25	< 360	6xsleeves	8x3/4"		O	X	133 (5.24)	101 (3.98)	1.6 (0.06)
IFS 2000	6"	< 20	< 290			X			D1 are special O-rings 2)		
	8"	< 20	< 290			X			D1 are special O-rings 2)		
	10"	< 20	< 290			X			D1 are special O-rings 2)		

1) With ANSI pipe flanges, the max. admissible operating pressure is dependent on the product temperature

2) Gaskets D2 not supplied with flowmeter, to be provided by customer!

3) da = outside diameter
di = inside diameter
s = thickness of supplied gaskets

For arrangements of gaskets D1, D2 and D3 see "grounding diagrams" in Sect. 1.2.3!

IFS 4000 and M 900 Primary heads

- Interconnecting cables V, see grounding diagrams in Sect. 1.3.11
- Grounding rings E (option), if ordered.

Supplied without installation material (stud bolts, gaskets), to be customer supplied!

Contents

Part A System installation and start-up

Part B Signal converter SC 100 AS

Part C Special applications, functional checks and service

Part D Technical data, measuring principle, block diagram

Part E Index

Part A System installation and start-up

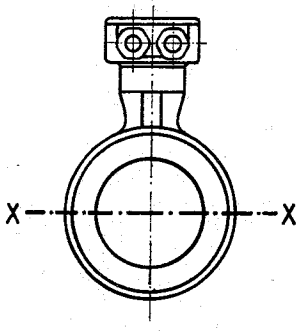
1. Installation in the pipeline

1.1 Preliminary information

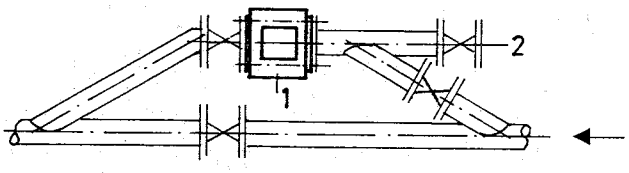
1.1.1 Selecting the installation location

1. **Location and position as required,** but electrode axis must be approximately horizontal.

Electrode axis



2. **Measuring tube must be completely filled at all times.**
3. **Flow direction +/–,** arrows on primary heads can normally be ignored. For exceptions, refer to Sect. 5.19 "factory setting".
4. **Bolts and nuts:** to install, make sure there is sufficient room next to the pipe flanges.
5. **Vibration:** support the pipeline on both sides of the flowmeter.
6. **Heavily contaminated fluids:** install flowmeter in bypass.



1 Flowmeter
2 Draining and cleaning without interrupting system operation

7. **Large meter sizes, DN > 200 (8"):** use adapter pipes to permit axial shifting of counterflanges to facilitate installation.
8. **Straight inlet run minimum of 5 x DN and outlet run minimum of 2 x DN** (DN = meter size), measured from the electrode axis.
9. **Vortex or corkscrew flow:** increase inlet and outlet sections or install flow straighteners.
10. **Strong electromagnetic fields and large "iron masses":** avoid in vicinity of flowmeter.
11. **Zero setting** is automatic in flowmeters with pulsed DC field. Electrode contamination does not therefore cause any zero drift.

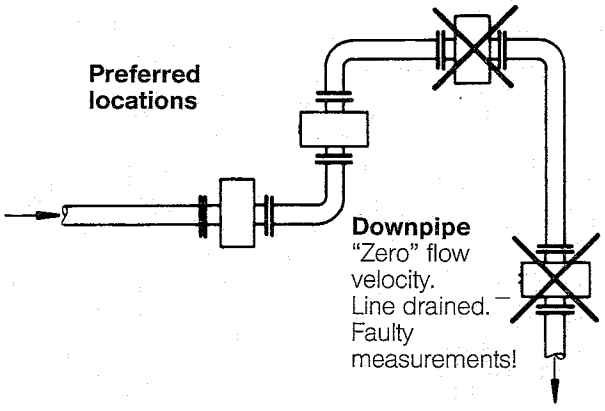
    In water and waste water applications, it is frequently not practical to shut the flow off to check zero after major repair, recalibration or inadvertent and improper adjustment of the converter. In this case the primary head zero can be checked under flowing conditions as outlined in section 7.2.

    For most applications it is convenient and customary to check the zero by shutting off the flow. Shutoff valves should therefore be provided upstream and/or downstream of the primary head unless the pipe configuration already rules out the possibility of the primary head being drained of fluid. For zero check see section 7.2.
12. **Mixing different fluid products.** Install flowmeter upstream of mixing point or at an adequate distance downstream, minimum 30 x DN (DN = meter size), otherwise output/display may be unsteady.
13. **Ambient temperature < 60 °C / < 140 °F**
    Refer to Sect. 10.5 for process temperature, pressure and vacuum limits due to material used for measuring section/liner.

1.1.2 Suggestions for installation

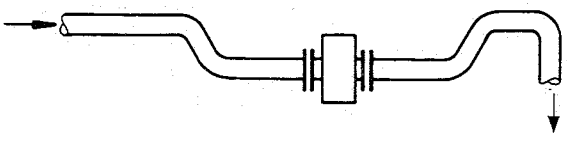
To avoid measuring errors due to air inclusion and vacuum-induced damage to PTFE and rubber liners, please observe the following:

Highest point of pipe run
(Air bubbles collect in measuring tube – faulty measurements!)

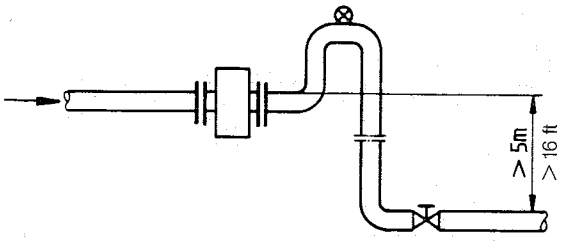


Horizontal pipe run
Install in slightly ascending pipe section. If not possible, assure adequate velocity to prevent air, gas or vapor from collecting in upper part of flow tube.

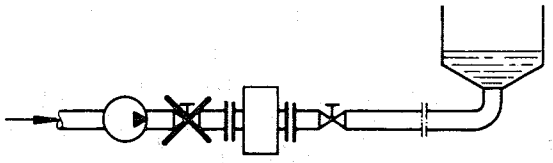
Open feed or discharge
Install meter in low section of pipe.



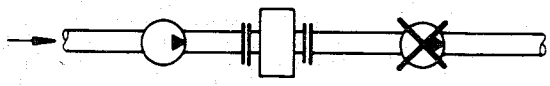
Downpipe over 5m (16 ft) length
Install air valve ⊗ downstream of flowmeter (vacuum).



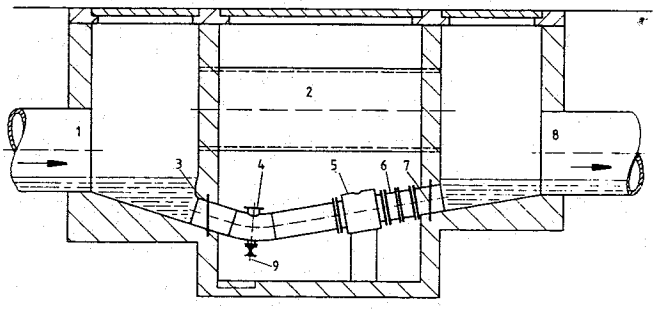
Long pipeline
Always install control and shutoff valves downstream of flowmeter (vacuum!).



Pumps
Never install flowmeter on pump suction side (vacuum!).



Sluice underpass for sewage concrete pipe with built-in flowmeter



1 Intake
2 Overflow
3 Intake sill
4 Cleaning hole
5 Flowmeter
6 Removable section
7 Wall seal
8 Outlet
9 Drain valve

1.2.1 Installation requirements

Mounting material
see Page 3 "Items included with supply"

Pipe flanges and operating pressure
see Table "torques" in Sect. 1.2.2.

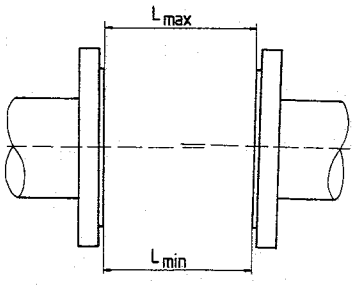
Pipe flanged spacing
- For arrangement of grounding rings and gaskets refer to Sect. 1.2.3 "Grounding".
- For size of gaskets D1, D2 and D3 refer to pape 3 "Items included with supply".

Primary head			Fitting dimensions "a" in mm (inch)	
Type	Meter size		with	without
	DN mm	inch	grounding rings	grounding rings
IFS 5000	2.5 - 15	1/10 - 1/2	65 (2.56) **1)**	- **3)**
	25	1	68 (2.68) **2)**	58 (2.28) **3)**
	40	1 1/2	93 (3.66) **2)**	83 (3.27) **3)**
	50	2	113 (4.45) **2)**	103 (4.06) **3)**
	80	3	163 (6.42) **2)**	153 (6.02) **3)**
	100	4	213 (8.39) **2)**	203 (7.99) **3)**
IFS 2000	150	6	265 (10.43) **1)**	-
	200	8	315 (12.40) **1)**	-
	250	10	365 (14.37) **1)**	-

1) **plus** 2 x thickness of gasket D2 between grounding rings and pipe flanges, gasket D2 not included with supply, customer supplied.
2) **incl.** gasket D2 between grounding rings and pipe flanges.
3) **incl.** gasket D3 between measuring tube and pipe flanges.

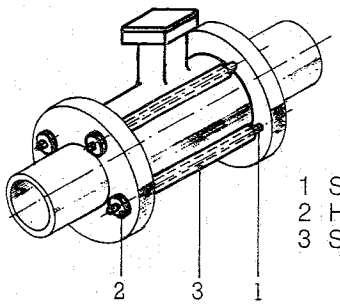
High-temperature pipelines
Where process temperatures exceed 100 °C (212 °F), provide for facilities to compensate for longitudinal expansion on heat-up of the pipeline:
- For **short** pipelines use resilient gaskets.
- For **long** pipelines install flexible pipe elements (e.g. elbows).

Position of flanges
- Install flowmeter in line with the pipe axis.
- Pipe flange faces must be parallel to each other, max. permissible deviation: $L_{max} - L_{min} \leq 0.5$ mm (0.02").

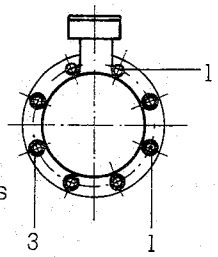


Arrangement of centering sleeves for IFS 5000
For number of supplied centering sleeves see page 3 "Items included with supply".

with four centering sleeves



with six centering sleeves

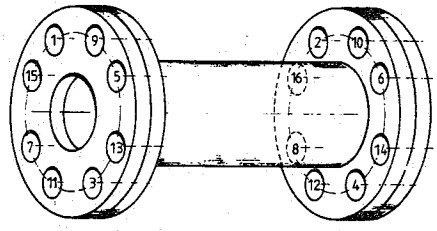


1 Stud bolts
2 Hex. nuts
3 Sleeves

1.2.2 Torques, pipe flanges and max. allowable operating pressure

IFS 5000
Stud bolts and nuts
tighten down uniformly at diametrically opposed points.

IFS 2000
Tighten down in the sequence shown in the drawing below.



Max. torques
1st sequence: approx. 50%
2nd sequence: approx. 80%
3rd sequence: approx. 100%
} of max. torque, see Table

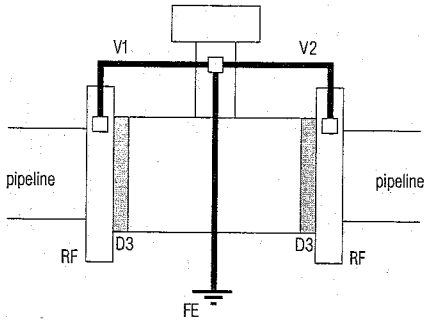
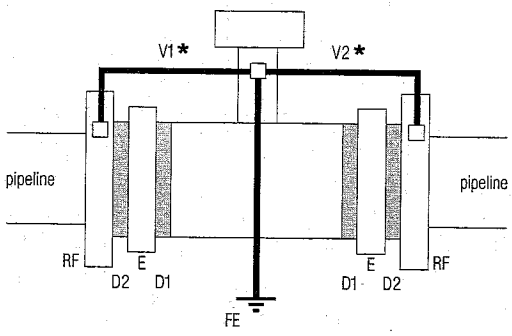
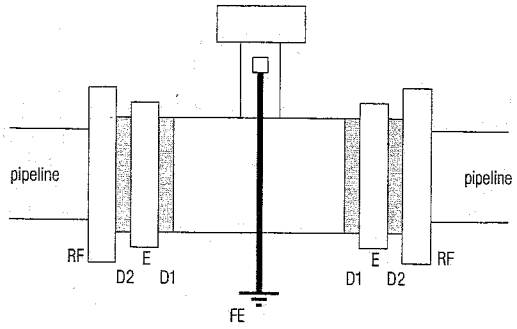
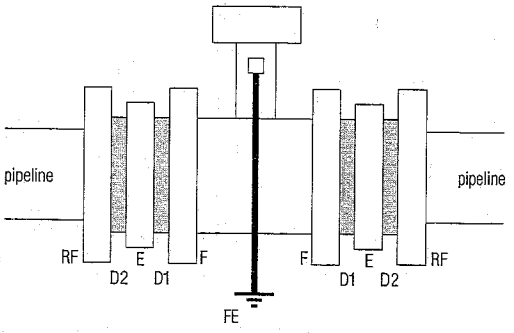
Type	Meter size of measuring tube to ...	Pipe flanges (for IFS 2000 also connecting flanges)		Max. Operating pressure 1)		Max. torques with gaskets made of ... 3)					
						... Gylon		... Chemo-therm		... built-up material	
				bar	psig	Nm	ft lbf	Nm	ft lbf	Nm	ft lbf
	... DIN 2501 (= BS 4504)										
IFS 5000	DN 2.5, 4, 6, 8, 10	DN 10, 15	PN 40	≤ 40	≤ 580					32	23
	DN 15	DN 15	PN 40	≤ 40	≤ 580					32	23
	DN 25	DN 25	PN 40	≤ 40	≤ 580	22	16	32	23		
	DN 40	DN 40	PN 40	≤ 40	≤ 580	47	34	66	48		
	DN 50	DN 50	PN 40	≤ 40	≤ 580	58	42	82	59		
	DN 80	DN 80	PN 40	≤ 40	≤ 580	48	35	69	50		
	DN 100	DN 100	PN 16	≤ 16	≤ 230	75	54	106	77		
		DN 100	PN 25	≤ 25	≤ 360	94	68	133	96		
IFS 2000	DN 150	DN 150	PN 16	≤ 16	≤ 230					148	107
	DN 200	DN 200	PN 10	≤ 10	≤ 145					183	132
	DN 250	DN 250	PN 10	≤ 10	≤ 145					158	114
	... ANSI B 16.5										
IFS 5000	1/10, 1/8, 1/4, 3/8"	1/2"	150 lbs	≤ 20	≤ 290					35	25
		1/2"	300 lbs	≤ 40	≤ 580					35	25
	1/2"	1/2"	150 lbs	≤ 20	≤ 580					35	25
		1/2"	300 lbs	≤ 40	≤ 580					35	25
	1"	1"	150 lbs	≤ 20	≤ 580	24	17	33	24		
		1"	300 lbs	≤ 40	≤ 580	30	22	42	30		
	1 1/2"	1 1/2"	150 lbs	≤ 20	≤ 580	38	28	54	39		
		1 1/2"	300 lbs	≤ 40	≤ 580	57	41	81	59		
	2"	2"	150 lbs	≤ 20	≤ 580	58	42	83	60		
		2"	300 lbs	≤ 40	≤ 580	30	22	42	30		
	3"	3"	150 lbs	≤ 20	≤ 580	98	71	138	100		
		3"	300 lbs	≤ 40	≤ 580	59	43	84	61		
	4"	4"	150 lbs	≤ 20	≤ 290	75	54	78	10,8		
		4"	300 lbs	≤ 25	≤ 360	92	67	131	95		
IFS 2000	6"	6"	150 lbs	≤ 20	≤ 290					148	107
	8"	8"	150 lbs	≤ 20	≤ 290					183	132
	10"	10"	150 lbs	≤ 20	≤ 290					158	114

1) For ANSI pipe flanges, the maximum allowable operating pressure is dependent on the process temperature!
2) Maximum torque is dependent on gaskets material. D2 gasket not supplied with flowmeter, must be provided by customer.
3) 10 Nm ≈ 1.0 kpm ≈ 7.23 ft lbf

1.2.3 Grounding IFS 2000 and IFS 5000

- All flowmeters (primary heads) must be properly grounded.
- The ground conductor must not transmit any interference voltages. Therefore, do not connect any other electrical devices to this conductor.
- In hazardous areas, the grounding system of the primary head is also used for equipotential bonding, refer to Sect. 6.1 and special "Ex" installation instructions.

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

	Metal pipeline, not internally coated Grounding without grounding rings	**Metal pipeline with or without internal coating, and plastic pipeline** Grounding with grounding rings
IFS 5000 DN 25 – 100 / 1" – 4"		
IFS 5000 DN 2.5 – 15 / 1/10" – 1/2"		
IFS 2000 DN 150 – 250 / 6" – 10"		

*** V1 and V2 not required for plastic pipelines**

D1, D3 **Gaskets,** bonded to measuring tube

D2 **Gaskets**
IFS 5000, DN 25-100 and 1"-4":
Bonded to grounding rings (option).
IFS 2000 and IFS 5000, DN 2.5-15 and 1/10"-1/2":
Not included with flowmeter, provided by customer. Refer to page 3 "Items included with supply" for dimensions.

E **Grounding rings**
IFS 5000, DN 25-100 and 1"-4":
Grounding rings (option) with bonded gasket D2 are supplied loose and must be bolted to the housing, mounting material supplied.
IFS 2000 and IFS 5000, DN 2.5-15 and 1/10"-1/2":
Grounding rings bolted to housing.

F **Flanges** of IFS 2000 primary head

FE **Functional ground,** wire ≥ 4 mm² (10 AWG) Cu, connected to U-clamp terminal on "neck" of primary head. Wire not included with supply, to be provided by customer.

RF **Pipe flanges**

V1, V2 **Connecting wires,** bolted to the "neck" of the primary head. Threaded holes for M6 bolts to be provided for flange-side (RF) connection.

1.3 Installation IFS 4000 and M 900 primary heads

1.3.1 Neoprene and hard-rubber liners

Note temperature limits

- Storage: – 20 to + 60 °C (– 4 to + 140 °F), keep immobile
- Transport: – 5 to + 50 °C (+ 23 to + 122 °F)
- Process: Neoprene – 20 to + 60 °C (– 4 to + 140 °F)
  Hard rubber – 20 to + 90 °C (– 4 to + 194 °F)
  [Temperatures below – 5 °C (+ 23 °F) are only permissible if the pipe run is supported on both sides of the flowmeter, and providing there is only slight vibration and no water hammer in the pipe.]

Gaskets are necessary for hard-rubber liners, e.g. Neoprene or soft-rubber gaskets.

Max. torques: see Sect. 1.3.10, Column B

1.3.2 PTFE liner

Install to avoid an excessive vacuum condition at the meter.

The PTFE liner is formed around the ends of the flanges, **do not** remove or damage.

The flanges are factory-fitted with special **protection covers.** Do not remove these until just before installation. Replace by pieces of smooth sheet metal [0.3 to 0.6 mm (0.012" to 0.024") thick] when fitting the flowmeter between the pipe flanges (to be removed after installation).

Attached protective rings can optionally be supplied, in which case the above-mentioned sheet metal pieces are not required. These protective rings can simultaneously be used as grounding rings, see Sect. 1.3.7.

Max. torques: see Sect. 1.3.10, Column A.

1.3.3 Irethane liner

Important for IFS 4000 primary head with irethane liner, > 12 mm / > 0.47" thick:

The flange connections are larger than the diameter of the measuring tube! Use pipe flanges according to the following tables.

Meter size DN in mm

Measuring tube	Flanges
DN 350	DN 400
DN 400, 450	DN 500
DN 500, 550	DN 600
DN 600, 650	DN 700
DN 700, 750	DN 800
DN 800, 850	DN 900
DN 900, 950	DN 1000
DN 1000	DN 1200

Meter size in inches

Measuring tube	Flanges
14"	16"
16", 18"	20"
20", 22"	24"
24", 26"	28"
28", 30"	32"
32", 34"	36"
36", 38"	40"
40"	48"

Max. torques (according to size of flanges!): see Sect. 1.3.10, Column B

1.3.4 M 900 with sanitary connections

Versions

- Sanitary pipe union to DIN 11851, DN 10 to 125
- Clamp connection, measuring tube 1" to 4"

Dimensions
Refer to Section 10.6.3

Cleaning the measuring tube
by CIP (cleaning in place) using various chemicals, acids, alkalis, steam or water up to 140°C (284°F).

Installation
To prevent damage to the PTFE liner, the factory-supplied rubber gaskets must be fitted without fail.

Grounding, refer to Section 1.3.11.

1.3.5 M 900 HJ with heating jacket

- M 900 HJ primary heads with heating jacket are available for DN 10 to 100 or 3/8" to 4" meter sizes (for dimensions see Sect. 10.6.3).
- The two connecting flanges for the heating jacket are designed to DIN 2501, DN 15, PN 40 or to ANSI, 1/2", 150 lbs.
- Max. operating pressure of heating medium: 10 bar / 150 psig.
- The maximum permissible temperature of the heating medium, in liquid or vapor state, is governed by the insulation class of the field coils (**E** up to 120 °C / 248 °F, **H** up to 180 °C / 356 °F) and the liner used for the measuring tube. Refer to Sect. 10.5 for max. permissible operating data.

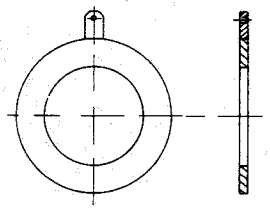
1.3.6 Pipelines with cathodic protection

For installation and grounding, refer to Sect. 6.5.

1.3.7 Grounding rings / Protective rings

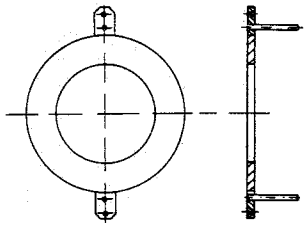
- Required in conjunction with plastic or internally coated pipes.
- Grounding rings form a conductive connection with the fluid.
- Material CrNi steel 1.4571 or SS 316 Ti-AISI, others on request.
- For grounding and connection of the grounding rings, refer to Sect. 1.3.11.

1



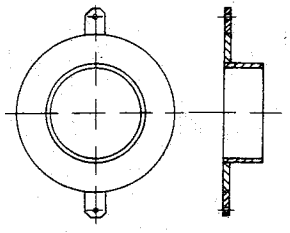
Grounding ring No. 1,
3 mm / 0.12" thick.

2



Grounding/protective ring No. 2
for primary heads with PTFE liner, fitted to the flanges, 3 mm / 0.12" thick.

3



Grounding/protective ring No. 3
with cylindrical neck, to protect the liner of the flowmeter particularly at the inlet edge in conjunction with abrasive fluids.

- Length 30 mm for DN 10 to 300 or 3/8" to 12".
- Length 100 mm for ≥ DN 350 or ≥ 14".

1.3.8 Standard electrodes

IFS 4000: DN 25 – 150 and 1″ – 6″
Primary heads with PFA liner are fitted with electrodes that are inserted from the outside such that the electrode head is flush with the inner surface of the liner. The electrodes are sealed by a specially shaped collar on the electrode shaft. Cup springs ensure constant pressure between these collars and a sealing surface moulded to the liner.

M 900: DN 10 - 300 and 3/8″ - 12″
IFS 4000: DN 10 - 20 and 3/8″ - 3/4″
DN 200 - 600 and 8″ - 24″

The electrode head, which is in contact with the process, has an elliptical shape, while the conical neck forms the sealing surface with the liner. Cup springs ensure constant pressure between this neck and the liner.

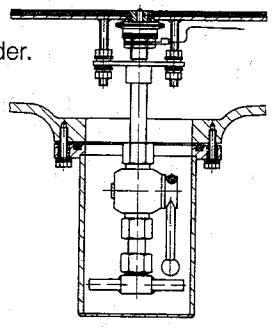
1.3.9 Field replaceable electrodes WE

M 900: DN 50 - 300 and 2″ - 12″
IFS 4000: DN 350 - 600 and 14″ - 24″

This design enables the electrodes to be removed under operating conditions and efficiently cleaned.

To remove, undo the holding screws on the protective caps. Unscrew the electrodes and pull them out until the ring mark is visible on the electrode shaft. Close valve and withdraw electrode completely.

After cleaning, install in the reverse order.



1.3.10 Torques

Bolts: tighten uniformly in diagonally opposite sequence, see Table for number and type
Column A for PTFE and PFA liners
Column B for Neoprene, Irethane, hard and soft rubber liners
IFS 4000 with Irethane liner, > 12 mm / > 0.50″: maximum torques refer to nominal diameter of connecting flange and not to nominal diameter of measuring tube, see Sect. 1.3.3!
10 Nm ≈ 1.0 kpm ≈ 7.23 ft lbf.

Meter size DN mm	Presure rating PN	Bolts	Max. torque Nm (ft lbf) A		B	
10	40	4 x M 12	7.6	(5.5)	4.6	(3.3)
15	40	4 x M 12	9.3	(6.7)	5.7	(4.1)
20	40	4 x M 12	16	(11.6)	9.6	(6.9)
25	40	4 x M 12	22	(15.9)	11	(8.0)
32	40	4 x M 16	37	(26.8)	19	(13.0)
40	40	4 x M 16	43	(31.1)	25	(18.1)
50	40	4 x M 16	55	(39.8)	31	(22.4)
65	16	4 x M 16	51	(36.9)	42	(30.4)
65	40	8 x M 16	38	(27.5)	21	(15.2)
80	25	8 x M 16	47	(34.0)	25	(18.1)
100	16	8 x M 16	39	(28.2)	30	(21.7)
125	16	8 x M 16	53	(38.3)	40	(28.9)
150	16	8 x M 20	68	(49.2)	47	(34.0)
200	10	8 x M 20	84	(60.7)	68	(49.2)
200	16	12 x M 20	68	(49.2)	45	(32.5)
250	10	12 x M 20	78	(56.4)	65	(47.0)
250	16	12 x M 24	116	(83.9)	78	(56.4)
300	10	12 x M 20	88	(63.7)	76	(54.9)
300	16	12 x M 24	144	(104.2)	105	(75.9)
350	10	16 x M 20	97	(70.1)	75	(54.2)
400	10	16 x M 24	139	(100.5)	104	(75.2)
450	10	20 x M 24	127	(91.8)	93	(67.2)
500	10	20 x M 24	149	(107.7)	107	(77.4)
600	10	20 x M 27	205	(148.2)	138	(99.8)
700	10	24 x M 27	238	(172.1)	163	(117.8)
800	10	24 x M 30	328	(237.1)	219	(158.3)
900	10	28 x M 30	–		205	(148.2)
1000	10	28 x M 35	–		261	(188.7)

Meter size inches	Body pressure rating psig	Bolts for ANSI class 150 flanges	Max. torque Nm (ft lbf) A		B	
3/8	580	4 x 1/2″	3.5	(2.5)	3.6	(2.6)
1/2	580	4 x 1/2″	3.5	(2.5)	3.6	(2.6)
3/4	580	4 x 1/2″	4.8	(3.5)	4.8	(3.5)
1	580	4 x 1/2″	6.7	(4.8)	4.4	(3.2)
1 1/4	580	4 x 1/2″	10	(7.2)	8	(5.8)
1 1/2	580	4 x 1/2″	13	(9.4)	12	(8.7)
2	580	4 x 5/8″	24	(17.4)	23	(16.6)
2 1/2	580	4 x 5/8″	27	(19.5)	24	(17.4)
3	360	4 x 5/8″	43	(31.1)	39	(28.2)
4	230	8 x 5/8″	34	(24.6)	31	(22.4)
5	230	8 x 3/4″	53	(38.3)	47	(34.0)
6	230	8 x 3/4″	61	(44.1)	51	(36.9)
8	145	8 x 3/4″	86	(62.2)	69	(49.9)
10	145	12 x 7/8″	97	(70.2)	79	(57.1)
12	145	12 x 7/8″	119	(86.1)	104	(75.2)
14	145	12 x 1″	133	(96.2)	93	(76.2)
16	145	16 x 1″	130	(94.0)	91	(65.8)
18	145	16 x 1 1/8″	199	(143.9)	143	(103.4)
20	145	20 x 1 1/8″	182	(131.6)	127	(91.8)
24	145	20 x 1 1/4″	265	(191.6)	180	(130.1)
28	145	28 x 1 1/4″	242	(175.0)	161	(116.4)
32	145	28 x 1 1/2″	380	(274.7)	259	(187.3)
36	145	32 x 1 1/2″	–		269	(194.5)
40	145	36 x 1 1/2″	–		269	(194.5)

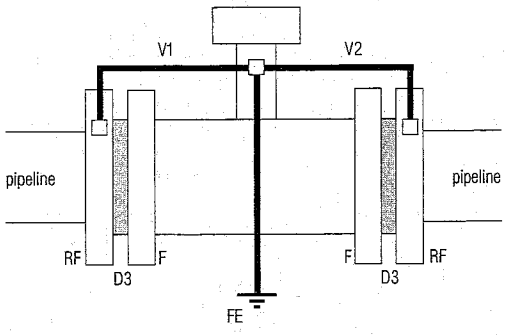
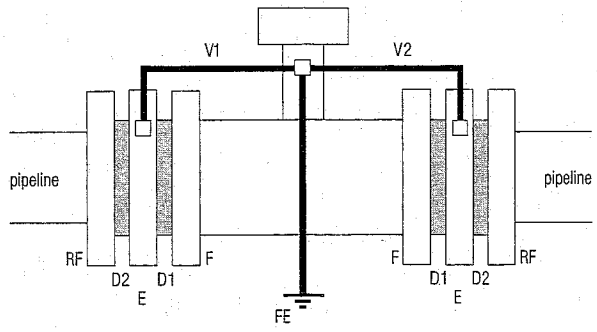
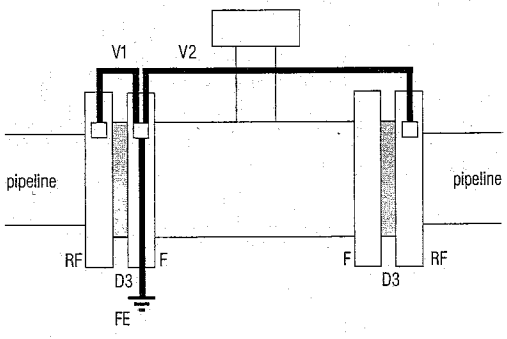
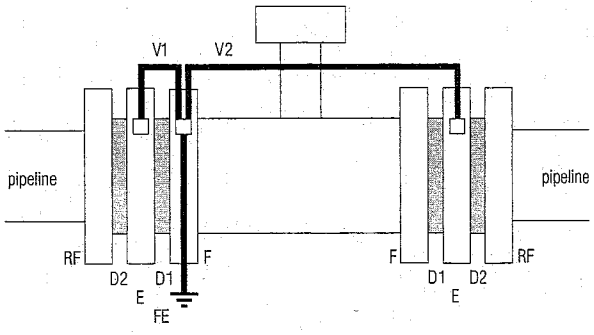
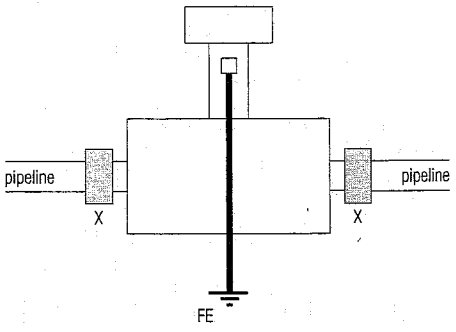
Note: Process pressure must not exceed ANSI flange rating. Refer to ANSI Standard B 16.5.

See next page for flowmeter grounding!

1.3.11 Grounding IFS 4000 and M 900

- All flowmeters (primary heads) must be properly grounded.
- The ground conductor must not transmit any interference voltages. Therefore, do not connect any other electrical devices to this conductor.
- In hazardous areas, the grounding system of the primary head is also used for equipotential bonding, refer to Sect. 6.1 and special "Ex" installation instructions.

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

	Metal pipeline, not internally coated Grounding without grounding rings	**Plastic pipeline and internally coated metal pipeline** Grounding with grounding rings (option)
IFS 4000		
M 900		
M 900 sanitary version		Refer to Section 6.5 for grounding of pipelines with cathodic protection.

D1, D2, D3 **Gaskets,** not included with supply, to be provided by customer.

E **Grounding rings,** option, see Sect. 1.3.7.

F **Flowmeter flanges**

FE **Functional ground,** wire ≥ 4 mm² (10 AWG) Cu, not included with supply, to be provided by customer.
IFS 4000: connected to U-clamp terminal on "neck" of primary head.
M 900: connected to flowmeter flange F, but for sanitary version connected to "neck" of the M 900. Fit cable lug to FE for M6 bolt (or M8 if meter size ≥ DN 40 / ≥ 1½"), not included with supply, to be provided by customer.

RF **Pipe flanges**

V1, V2 **Connecting wires,** bolted to the "neck" of the IFS 4000 or to flange F of the M 900.
Threaded holes to be provided for M6 bolts (M8 for M 900 ≥ DN 40 / ≥ 1½") for flange-side (RF) connection.
Use factory-supplied mounting material for connection of grounding rings E.

X **Sanitary screw connections** to DIN 11851 or clamp connections.

2. Installation of the signal converter

2.1 Please note the following information concerning installation and operation of the SC 100 AS/F

- **Electrical connection in conformity with VDE 0100**
  "Regulations governing heavy-current installations with rated voltages up to 1000 V" **or equivalent national standard.** Refer to connection diagrams, Sect. 2.5, for power connection to signal converter (and power driver, if provided).

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

- Do not cross or loop the **cables in the terminal boxes** of the primary head, signal converter and power driver, if supplied. Use separate PG or NPT screwed conduit entries for each cable.
- Special regulations apply to installation in **hazardous areas.** Refer to Sect. 6.1 and special "Ex" installation instructions.
- On normal customer orders, the GK (primary constant) of the signal converter is factory-set to match that of the primary head with which it is ordered. The GK is engraved on the primary head nameplate and also shown on the converter nameplate. **These instruments should be installed together,** otherwise the converter will need to be reset (see Sect. 4.6 and 8.2, Fct. 1.04, 1.05 and 4.07).

2.2 Choice of installation location

- Do not expose signal converter (or power driver) and switch gear cubicle(s) with installed units to direct sunlight. Install a sunshade, if necessary.
- Do not expose to intense vibration.
- Ensure adequate cooling of SC 100 AS/F unit(s) when installed in switchgear cubicle(s), e.g. use heat exchangers.
- Install signal converter as close as possible to the primary head.
- Use factory-supplied standard signal cable A (type DS), standard length 10 m (30 ft). For longer lengths and bootstrap signal cable B (type BTS), refer to Sect. 2.5.2 and 2.5.3.
- Always use the bootstrap signal cable B (type BTS) for IFS 5000 primary heads, DN 2.5 – 15 ($^1/_{10}$" – $^1/_2$"), and in conjunction with contaminated fluids having a tendency to form electrically insulating deposits.

2.3 Connection to power

- Note information given in Sect. 2.1!
- Note the information given on the **instrument nameplates** on the primary head, signal converter (voltage, frequency)!
- **Power supply 24/42 Volt AC and 24 Volt DC,** functional extra-low voltage with protective separation (PELV) to VDE 0100, Part 410, or equivalent national standards.
- Power supply for the primary head via the signal converter (or power driver, if applicable).
- **Connection diagrams** refer to Section 2.6.
- **Line resistance for 24 V DC and 24/42 V AC**
  max. internal resistance R_{max} of voltage supply (transformer or DC voltage source and cable)
  24 Volt DC / 24 Volt AC: $R_{max\ 24} \leq 1$ ohm
  42 Volt AC: $R_{max\ 42} \leq 2$ ohms

  max. length L_{max} of power cable
  $L_{max} = 28 \times A\ (R_{max}-R_i)$
  A Cross-section of power cable in mm² copper wire.
  R_{max} Internal resistance of voltage supply $R_{max\ 24}$ or $R_{max\ 42}$, see above
  R_i Internal resistance of transformer or DC voltage source

Example:
42 V AC / A = 1.5 mm² / R_i = 0.2 ohm /
$R_{max\ 42}$ = 2 ohms
L_{max} = [28 x 1.5 (2-0.2)] = 75.6 m
75.6 m x 3.3 $\frac{ft}{m} \approx$ 250 ft

Connection of several signal converters to 1 transformer (n = number of converters)
Separate power cable: R_i increases by factor "n" ($R_i \times n$)
Common power cable: L_{max} decreases by factor "n" (L_{max}/n)

2.4 Signal and field power supply cables

2.4.1 Abbreviations used and important information to Sect. 2.4

A Signal cable A (type DS) with double shielding; for max. length (L_{max}) see Diagram: curves A1 and A2
B Signal cable B (type BTS) with triple shielding; for max. length (L_{max}) see Diagram: curves B1, B2, B3 and B4
C Field power supply cable; for minimum cross-section (A_F) and length see Table
D High-temperature silicone cable, 3 x 1.5 mm² Cu / 3 x AWG 14, with single shielding, max. 5 m / 16 ft length
E High-temperature silicone cable, 2 x 1.5 mm² Cu / 2 x AWG 14, max. 5 m / 16 ft length
F Field power supply cable, connection between IFS 4000 primary head (DN ≥ 1300 / ≥ 52") and power driver; see Table for minimum cross-section (A_F) and max. length
G Cable connecting power driver and signal converter, min. cross-section 2 x 0.5 mm² Cu / 2 x 20 AWG, max. length 300 m (1000 ft)
A_F Cross-section of field power supply cables C and F in mm² (AWG) Cu, see Tables
L Length of cable
$\varkappa$ Electric conductivity
ZD Intermediate connection box, required in conjunction with cables D and E for IFS 5000 and IFS 4000 primary heads where process temperatures exceed 150°C (302°F)

- **Determining the maximum permissible distance between primary head and signal converter**
  1. The **length of signal cable A or B** is dependent on the electric conductivity $\varkappa$ of the liquid product, and also on the type and meter size of the primary head; see Table and Diagram "length of signal cable".
  2. The **length of field power supply cables** C and F is determined by the cable cross-section A_F; see Tables "field power supply cable C and F".
  3. The shortest cable length obtained either according to Point 1 or Point 2, is the **maximum permissible distance** between primary head and signal converter!
- Special regulations apply to **hazardous-area operation;** refer to Sect. 6.1 and special "Ex" installation instructions.
- Always use the bootstrap signal cable B (type BTS) for **IFS 5000 primary heads, DN 2.5 to 15 ($^1/_{10}$" to $^1/_2$")** and in conjunction with contaminated fluids having a tendency to form electrically insulating deposits.

2.4.2 General information to signal cables A (Type DS) and B (Type BTS)

General

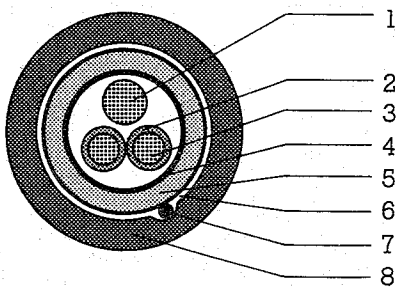
Krohne signal cables A+B with foil and magnetic shields will ensure faultless system operation.

- The signal cable must be a rigid installation. Cables must be secured so they do not move, or must be run in conduit.
- No separate installation of signal and field power supply cables required – can be run in same conduit along with other signal and field power cables. Do not run in same conduit with power cables for other devices.
- Shields are connected via stranded drain wires.
- Suitable for underwater and underground installations.
- Insulating material flame-retardant to IEC 332.1/VDE 0472
- Low in halogen and unplasticized.
- Flexible at low temperatures.

Signal cable A (Type DS)

with double shielding

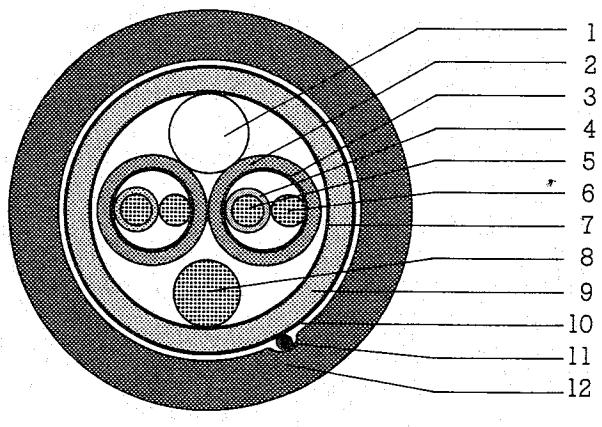
1 Stranded drain wire, 1st shield, 1.5 mm² (14 AWG)
2 Insulation
3 Stranded wire 0.5 mm² (20 AWG)
4 Special foil, 1st shield
5 Insulation
6 Mu-metal foil, 2nd shield
7 Stranded drain wire, 2nd shield, 0.5 mm² (20 AWG)
8 Outer sheath



Bootstrap signal cable B (Type BTS)

The signal converter automatically controls the individual v shields (3) to exactly the same voltage as that applied to signal wires (5). Since the voltage difference between sig wires (5) and individual shields (3) is virtually zero, there is flow of current via the line capacitances 3+5; thus, line capa tance is apparently zero. Much longer cable lengths are th permitted for fluids with low electrical conductivity levels.

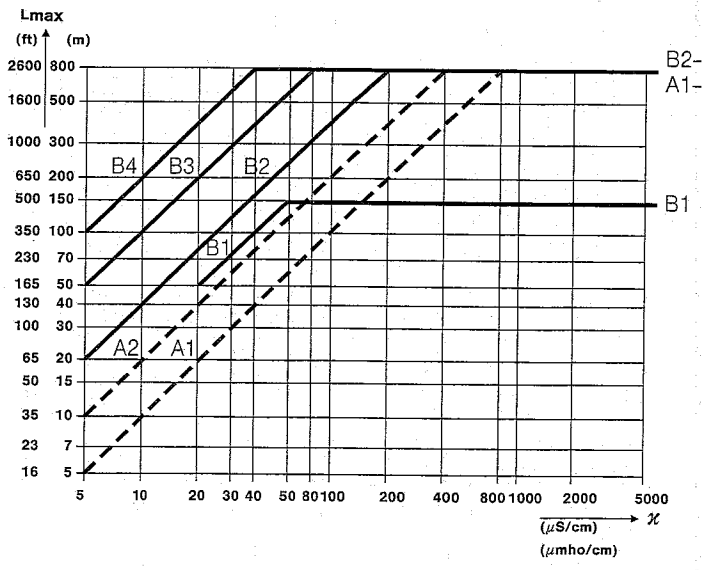
1 Dummy glider wire
2 Insulation
3 Special foil, 1st shield
4 Insulation
5 Stranded wire 0.5 mm² (20 AWG)
6 Stranded drain wire, 1st shield, 0.5 mm² (20 AWG)
7 Special foil, 2nd shield
8 Stranded drain wire, 2nd shield, 1.5 mm² (14 AWG)
9 Insulation
10 Mu-metal foil, 3rd shield
11 Stranded drain wire, 3rd shield, 0.5 mm² (20 AWG)
12 Outer sheath



2.4.3 Cable lengths: max. permissible distance between primary head and signal converter

■ Length of signal cable

Primary head	Meter size DN mm	Meter size inches	Signal cable
IFS 5000	2.5	1/10	B1
	4 to 15	1/8 to 1	B2
	25 to 100	1 to 4	A1 or B3
IFS 4000	10 to 150	3/8 to 6	A1 or B3
	200 to 3000	8 to 120	A2 or B4
IFS 2000	150 to 250	6 to 10	A2 or B4
M 900	10 to 300	3/8 to 12	A2 or B4



■ Field power supply cable C

Length L	Cross section A_F (Cu), minimum
0 to 150 m / 5 to 500 ft	2 x 0.75 mm² Cu / 2 x 18 AWG
150 to 300 m / 500 to 1000 ft	2 x 1.50 mm² Cu / 2 x 14 AWG
300 to 500 m / 1000 to 1600 ft	2 x 2.50 mm² Cu / 2 x 12 AWG
500 to 800 m / 1600 to 2600 ft	2 x 4 mm² Cu / 2 x 10 AWG

■ Field power supply cable F (with power driver NB 900 F)

Length L	Cross section A_F (Cu), minimum
0 to 85 m / 0 to 250 ft	2 x 1.5 mm² / 2 x 14 AWG
85 to 140 m / 250 to 500 ft	2 x 2.5 mm² / 2 x 12 AWG
140 to 230 m / 500 to 750 ft	2 x 4 mm² / 2 x 10 AWG

2.5 Connection diagrams I to VIII

- **Selection table for connection diagrams** on pages 15 and 16.
- Connect **hazardous-duty systems** according to the diagrams given in the special "Ex" installation instructions.

Primary head			Process temperature	Signal converter		Diagram No.	
Type	Meter size		note limits specified	SC 100 AS	Necessary options	with signal cable	
	DN mm	inches	in Sect. 10.5			A	B
IFS 5000 IFS 6000	2.5- 15	1/10 – 1/2	below 150°C / 302°F	X			II
			above 150°C / 302°F	X	ZD intermediale connection box		IV
	25 - 100	1 – 4	below 150°C / 302°F	X		I	II
			above 150°C / 302°F	X	ZD intermediale connection box	III	IV
IFS 4000	10 -1200	3/8 – 48	below 150°C / 302°F	X		I	II
			above 150°C / 302°F	X	ZD intermediale connection box	III	IV
	1300 -3000	52 – 120		X	NB 900 F power driver	VII	VIII
IFS 2000	150 - 250	6 – 10	max. 120°C	X		V	VI
M 900	10 - 300	3/8 – 12		X		V	VI

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

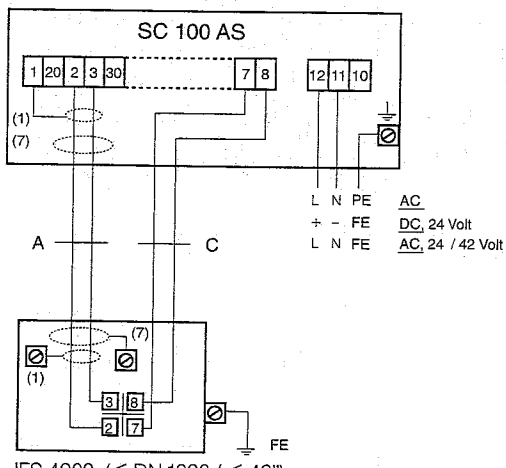
Connection diagrams

The figures in brackets refer to the stranded drain wires for the shields, see sectional drawings of signal cables A and B in Sect. 2.4.2. Refer to Sect. 2.4.3 for cable types C, D and E.

Electrical connection in conformity with VDE 0100 "Regulations governing the installation of heavy-current systems with mains voltages up to 1000 V" or equivalent national standard.

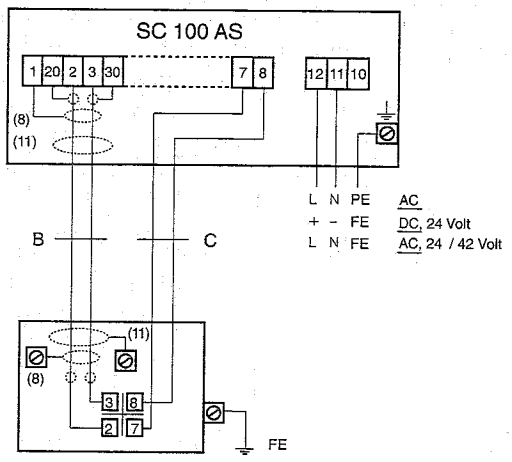
Supply power 24 (21, 42, 48) V AC and 24 V DC:
functional extra-low voltage with protective separation (PELV) to VDE 0100, Part 410 or equivalent national standard.

I



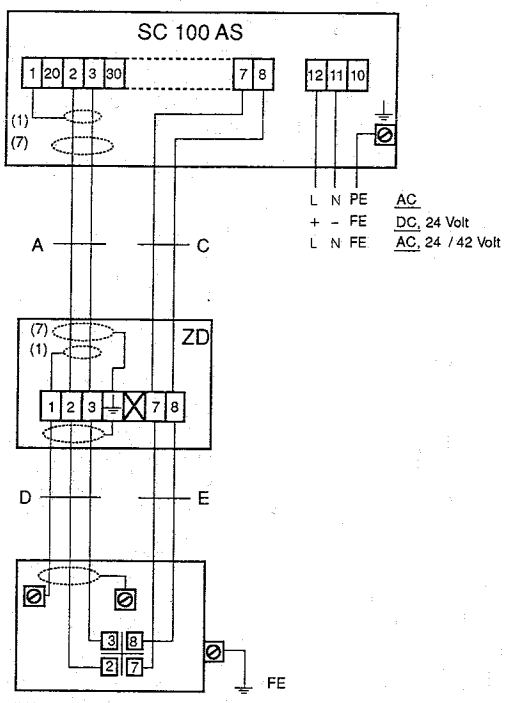
IFS 4000 (≤ DN 1200 / ≤ 48")
IFS 5000 IFS 6000

II



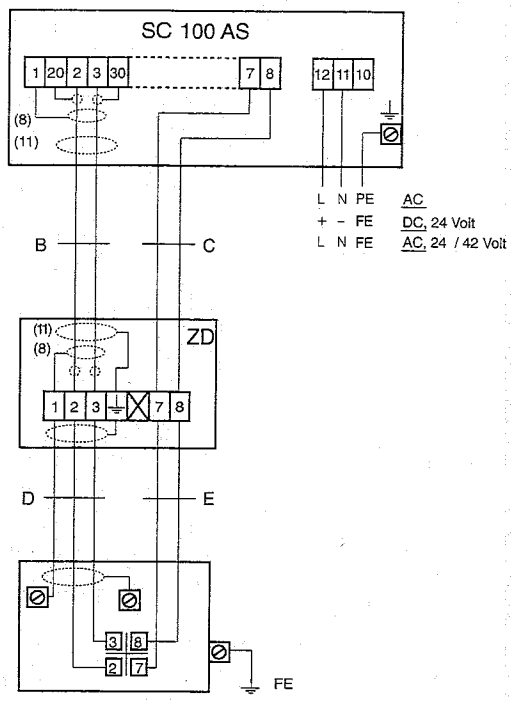
IFS 4000 (≤ DN 1200 / ≤ 48")
IFS 5000 IFS 6000

III



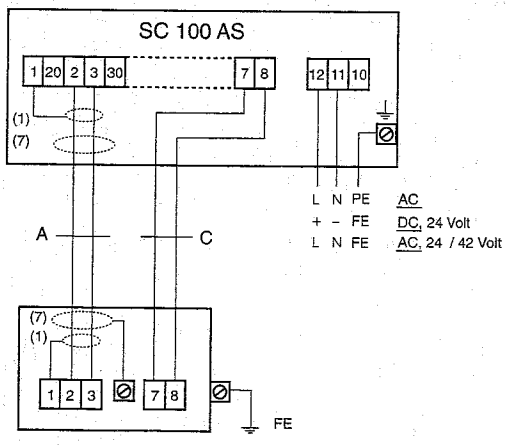
IFS 4000 (≤ DN 1200 / ≤ 48")
IFS 5000 IFS 6000

IV



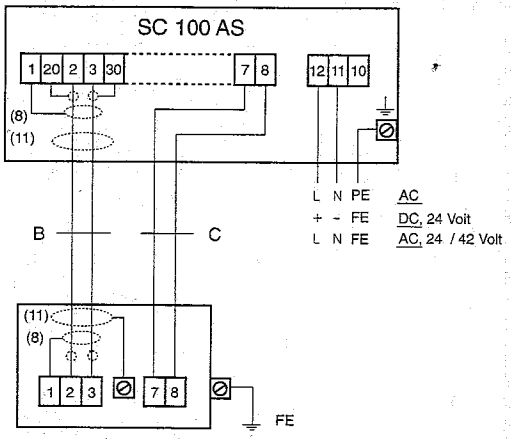
IFS 4000 (≤ DN 1200 / ≤ 48")
IFS 5000 IFS 6000

V



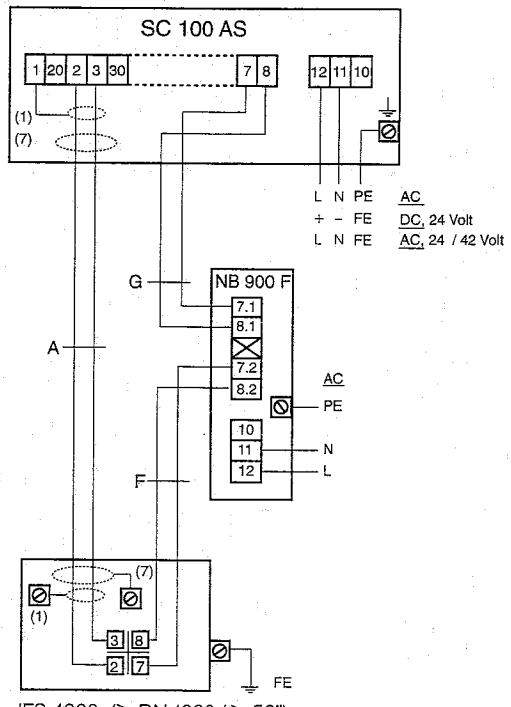
M 900 IFS 2000

VI



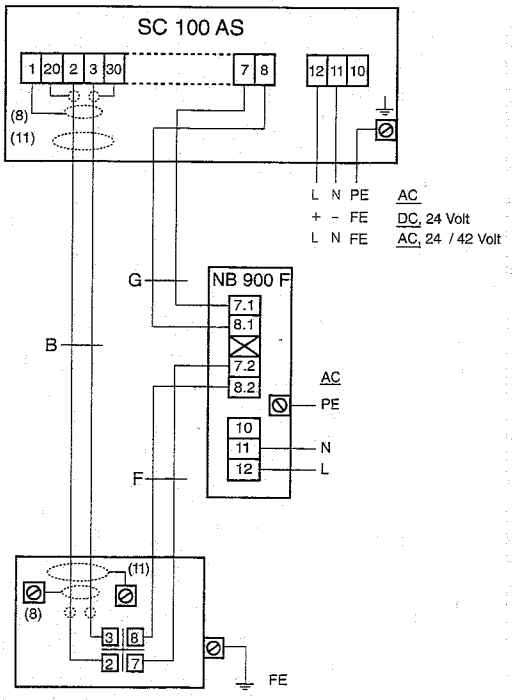
M 900 IFC 2000

VII



IFS 4000 (≥ DN 1300 / ≥ 52")

VIII



IFS 4000 (≥ DN 1300 / ≥ 52")

2.6 Outputs

2.6.1 Abbreviations used for outputs

Abbreviation	Stands for	Programming via Fct.No.	Description see Sect. .....
BA	Automatic range change	3.3.01 + 3.3.02	5.17
EC	Electronic counter	–	5.8
EMC	Electro-mechanical counter	–	5.8
F	Frequency (pulse) output	3.2.01 et seq.	5.8
$F_{100\%}$	Pulses for Q = 100% flowrate **or**	3.2.02 + 3.2.03	5.8
	pulse value	3.2.02 + 3.2.04	5.8
F_{max}	Pulses at Q higher than 100% flow (max. 115% of $F_{100\%}$)	–	5.8
G_F	Trip point for frequency output	3.3.01 + 3.3.04	5.18
G_I	Trip point for current output	3.3.01 + 3.3.03	5.18
I	Current (analog) output	3.1.01 et seq.	5.7
$I_{0\%}$	Current at Q = 0% flow	3.1.02	5.7
$I_{100\%}$	Current at Q = 100% flow	3.1.03	5.7
I_{max}	Current at Q = over 100% flow	3.1.04	5.7
$Q_{0\%}$	0% flowrate	–	5.3 (5.7 + 5.8)
$Q_{100\%}$	Full-scale range, 100% flowrate	F:1.01 / R:1.02 + 1.03	5.3 (5.7 + 5.8)
Q_{max}	Max. flow, Q greater than 100%, corresponding to I_{max} + F_{max}	–	5.3 (5.7 + 5.8)
S	Status indication output	3.3.01 et seq.	5.16
SMU	Low-flow cutoff for I + F	I:3.1.06 / F:3.2.07	5.9
SMU-I	Low-flow cutoff I / on value	3.1.07	5.9
	off value	3.1.08	5.9
SMU-F	Low-flow cutoff F / on value	3.2.08	5.9
	off value	3.2.09	5.9
F/R	Forward/reverse flow	–	5.10

2.6.2 Current (analog) output I

- **Current output is galvanically isolated,** see block diagram in Sect. 12.
- **All functions and operating data are programmable,** see Sect. 4 + 5.7.
- **Factory-set data and functions** are listed in the enclosed report on settings. This can also be used to record any changes made to the operating parameters.
- **Max. load at terminals** 5/6 for $I_{100\%}$ (Fct. 3.1.03):

  $$\text{max. load in kohms} = \frac{20\ \text{V}}{I_{100\%}\ [\text{mA}]}$$ (e.g. 1 kohm for $I_{100\%}$ = 20 mA)

- **Time constant I,** adjustable between 0.2 and 3600 seconds (Fct. 3.1.05), refer to Sect. 5.7.
- **Automatic range change BA,** ratio 1:20 to 1:1.25 (corresponding to 5 to 80% of $Q_{100\%}$), adjustable in 1% increments (Fct. 3.3.01 + 3.3.02), see Sect. 5.17. Changeover occurs from high to low range at approx. 85% of the low range, and from low to high range at approx. 98% of the low range. Operative range displayed by status indication output S.
- **Low-flow cutoff SMU-I,** adjustable independently of SMU-F (frequency output). Cutoff "on" value between 1 and 19% of $Q_{100\%}$ (Fct. 3.1.06 + 3.1.07), cutoff "off" value from 2 to 20% of $Q_{100\%}$ (Fct. 3.1.06 + 3.1.08), refer to Sect. 5.9.
- **Trip point G_I,** adjustable between 1 and 110% of $Q_{100\%}$ (Fct. 3.3.01 + 3.3.03). Status indication output S shows when trip point exceeded, refer to Sect. 5.18. Trip point G_I has a delayed action equal to the time constant of current output I.
- **Connection diagrams** 1, 4, 5, 7, 8, 9, 10, 11 + 12, refer to Sect. 2.6.5.

2.6.3 Frequency (pulse) output F

- **Frequency output is galvanically isolated,** see block diagram in Sect. 12.
- **All functions and operating data are programmable,** see Sect. 4 + 5.8.
- **Factory-set data and functions** are listed in the enclosed report on settings. This can also be used to record any changes made to the operating parameters.
- **12 Volt output** for electronic counter **EC** 10 to 36 000 000 pulses/h (0.0028 to 10 000 Hz), amplitude 12 V (5 V, selectable, see Sect. 8.6), connection terminals 4/42, counter resistance (load) min. 1 kohm, short-circuit-proof, selectable pulse widths see below.
- **24 Volt output** for electromechanical counter **EMC** or electronic counter **EC,** 10 to 36 000 000 pulses/h (0.0028 to 10 000 Hz), amplitude 24 V, connection terminals 4/41, selectable pulse width and load rating, see below.
- **Pulse width** (Fct. 3.2.05) as a factor of the frequency f (pulse rate, Fct. 3.2.03) and **maximum permissible load for 24 V output** (24 V, term. 4/41), see also Sect. 5.8.

Pulse width	Frequency $f = F_{100\%}$	Max. load current (24 Volt)	Min. load (24 Volt)
30 or 50 ms	0.0028 Hz $< f \leq$ 10 Hz	200 mA	120 Ohm
100 ms	0.0028 Hz $< f \leq$ 5 Hz	200 mA	120 Ohm
200 ms	0.0028 Hz $< f \leq$ 2,5 Hz	200 mA	120 Ohm
500 ms	0.0028 Hz $< f \leq$ 1 Hz	200 mA	120 Ohm
Pulse duty cycle 1:1*	10 Hz $< f \leq$ 1 000 Hz	50 mA	500 Ohm
160 μs*	1000 Hz $< f \leq$ 2 547 Hz	50 mA	500 Ohm
50 μs*	2547 Hz $< f \leq$ 10 000 Hz	50 mA	500 Ohm

* fixed pulse width, independent of programming in Fct. 3.2.05

- **Time constant F,** adjustable to 0.2 second or same as current output I (Fct. 3.2.06 + 3.1.05).
- **Low-flow cutoff SMU-F,** adjustable independently of SMU-I (current output). Cutoff "on" value between 1 and 19% of $Q_{100\%}$ (Fct. 3.2.07 + 3.2.08), cutoff "off" value from 2 to 20% of $Q_{100\%}$ (Fct. 3.2.07 + 3.2.09), refer to Sect. 5.9.
- **Trip point G_F,** adjustable between 1 and 115% of $Q_{100\%}$ (Fct. 3.3.01 + 3.3.04). Status indication output S shows when trip point exceeded, see Sect. 5.18. Trip point G_F has a delay action with the time constant of frequency output F.
- **Connection diagrams** 2, 4, 6, 8, 9 + 10, refer to Sect. 2.6.5.

2.6.4 Status indication output S

- **Status indication output S is galvanically isolated,** see block diagram in Sect. 12.
- **All functions and operating data are programmable,** see Sect. 4 + 5.16.
- **Factory-set data and functions** are listed in the enclosed report on settings. This can also be used to record any changes made to the operating parameters.
- **Technical data:** amplitude 24 V DC, max. 30 mA, connection terminals 4/43.

Adjustable functions	**Significance of the output signal**	
(Fct. 3.3.01), see Sect. 5.16	0 Volt	24 Volt
Switched off	At constant 0 V	Not possible
Switched on	Not possible	At constant 24 V
2 directions, current output I	Forward flow for I	Reverse flow for I
2 directions, frequency output F	Forward flow for F	Reverse flow for F
Automatic range change BA	BA high range	BA low range
Trip point G_I	Below trip point I	Above trip point I
Trip point G_F	Below trip point F	Above trip point F
Low-flow cutoff SMU-I	Outside SMU-I thresholds	Within SMU-I thresholds
Low-flow cutoff SMU-F	Outside SMU-F thresholds	Within SMU-F thresholds
Indicate ADC error(s)	Error	No error
Indicate totalizer error(s)	Error	No error
Indicate all errors	Error	No error

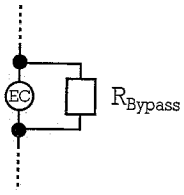
- **Changeover for F/R measurements** and **response of the limit switches G_I and G_F** are affected by the time delay in accordance with the programmed time constant for the current or frequency outputs (Fct. 3.1.05 + 3.2.06). Setting recommendations for various applications are given in the table in Sect. 5.16.3.
- **Connection diagrams** 3, 4, 5, 6, 7 + 8, see Sect. 2.6.5.

2.6.5 Connection diagrams for outputs ① to ⑫

Output characteristics

Current output I: Diagrams I1 to I8 in Sect. 5.7
Frequency output F: Diagrams F1 to F5 in Sect. 5.8
Status indication output S: Diagrams S1 to S5 in Sect. 5.16

Connection of electronic counters EC for F/R operations
Bypass resistors should be installed to avoid floating inputs.
$R_{bypass} \geq 10$ kohms
Applicable to connection diagrams 4, 6 + 10!



① I: 1 flow direction

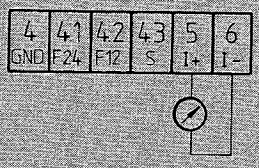


Diagram: I1

② F: 1 flow direction

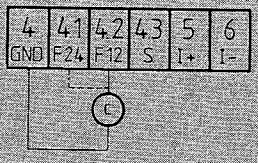
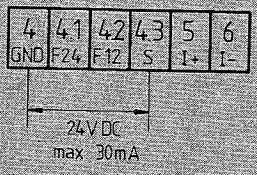


Diagram: F1

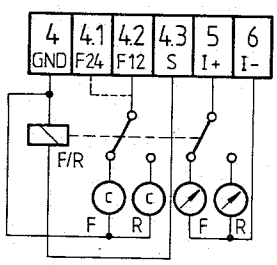
③ S: Status indication output



Diagrams: S1 to S4

④ I+F: F/R operation

F/R changeover via S

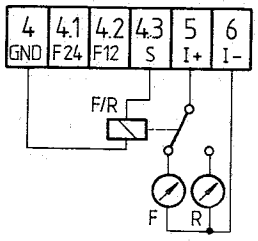


F/R relay: $R_{coil} \geq 1$ kohm
24 V DC / max. 30 mA
(e.g. Siemens relay D1)

Diagrams: I2 + F2

⑤ I: F/R operation

F/R changeover via S

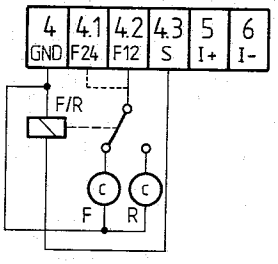


F/R relay: $R_{coil} \geq 1$ kohm
24 V DC / max. 30 mA
(e.g. Siemens relay D1)

Diagram: I2

⑥ F: F/R operation

F/R changeover via S

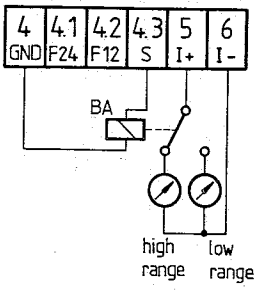


F/R relay: $R_{coil} \geq 1$ kohm
24 V DC / max. 30 mA
(e.g. Siemens relay D1)

Diagram: F2

⑦ I with BA: 1 flow direction

BA changeover via S

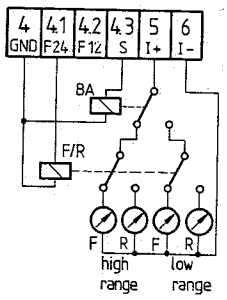


BA relay: $R_{coil} \geq 1$ kohm
24 V DC / max. 30 mA
(e.g. Siemens relay D1)

Diagram: I3

⑧ I with BA: F/R operation

BA changeover via S
F/R changeover via F

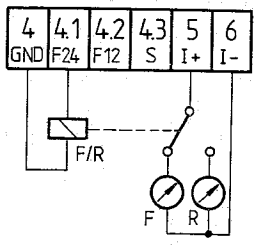


BA relay: $R_{coil} \geq 1$ kohm
24 V DC / max. 30 mA
(e.g. Siemens relay D1)
F/R relay: $R_{coil} \geq 150$ ohms
24 V DC / max. 200 mA
(e.g. Siemens relay D1)

Diagram: I4

⑨ I: F/R operation

F/R changeover via F

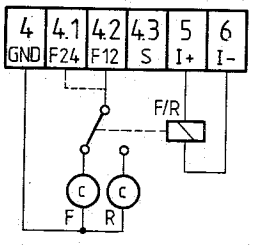


F/R relay: $R_{coil} \geq 150$ ohms
24 V DC / max. 200 mA
continuous
(e.g. Siemens relay D1)

Diagrams: I5 or F4

⑩ F: F/R operation

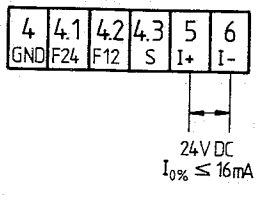
F/R changeover via I



F/R relay: max. 35 V DC
at $I_{max} \leq 22$mA (adjust via Fct. 3.1.04)
$I_{max.} = U/R$
U = rated voltage and
R = resistance of relay coil
(e.g. Siemens relay D1)

Diagrams: F3 or I6

⑪ I: e.g. operation indicator

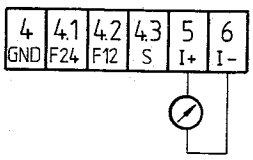


max. 35 V DC at
$I_{0\%} \leq 16$ mA (adjust via Fct. 3.1.02)
$I_{0\%} = U/R$
U = rated voltage and
R = load resistance

Diagram: I7

⑫ I: F/R operation

e.g. in 0 to 20 mA range



e.g. F: 10 to 20 mA
R: 10 to 0 mA

Diagram: I8

3. (Initial) Start-up

- Check that the system has been correctly installed as described in Sect. 1 and 2.

- Before initial start-up, check that the following details on the primary head nameplate agree with the data specified in the record on settings for the signal converter. If not, reprogramming will be necessary:

Meter size (DN)	Fct. 1.04	Sect. 5.3
Primary constant GK	Fct. 1.05	Sect. 5.15
Flow direction see arrow on primary head	Fct. 1.06	Sect. 5.4
Magnetic field frequency specified behind GK value	Fct. 4.07	Sect. 5.15

6 = 1/6
16 = 1/16 } of power frequency
32 = 1/32

- It is recommended to carry out a zero check, if the flo can be zeroed, as described in Sect. 7.2, before ever start-up and particularly where fluid products with lo electrical conductivity levels are concerned.

- When powered, the signal converter operates in th measuring mode. The Ident. No. of the signal converte appears on the display for about 3 seconds. This is follc wed by display of the actual flowrate and/or the interna count on a continuous or alternating basis (depends o programming, see report on settings).

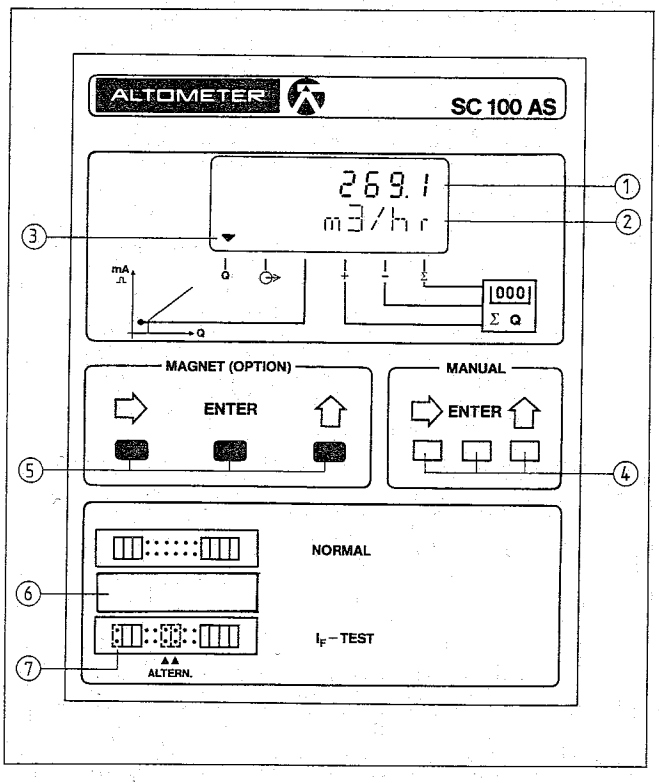
Important: With regard to the factory setting, please note information given in Sect. 5.19!

Part B Signal converter SC 100 AS

4. Operation of the signal converter

This Section 4 is repeated in the form of pull-out condensed operating instructions between pages 42 and 43.

4.1. Operating and check elements



① Display, 1st line
② Display, 2nd line
③ Display, 3rd line, cursor symbols described below:

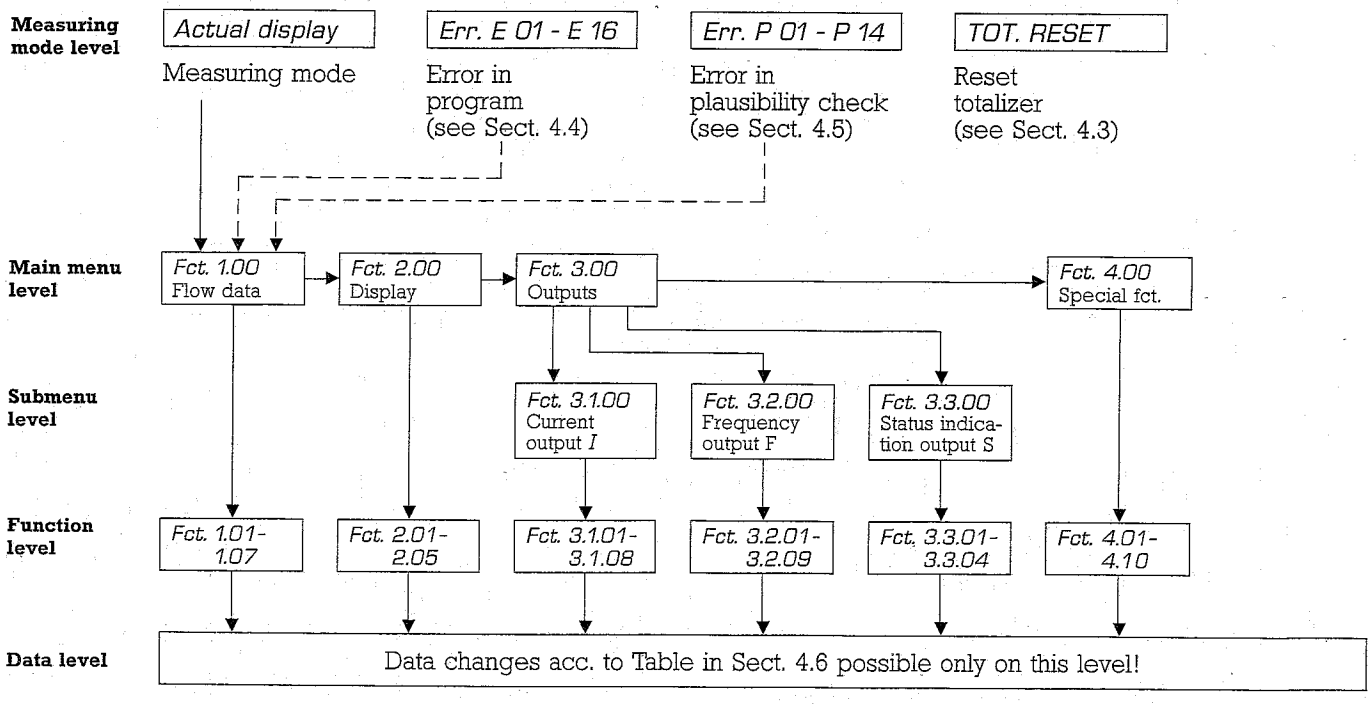
Q	Actual flowrate
⊖→	Status indication output S active (= 24 V)
+	Totalizer (**F**orward flow)
–	Totalizer (**R**everse flow)
Σ	Sum totalizer (+ and –)
⌐¬ mA / Q	Low-flow cutoff SMU for current and/or frequency output (I/F) "in function"

④ Keys for programming the signal converter, refer to Sect. 4.3 for function of keys.
⑤ Magnetic sensors (option) to program the converter by means of a hand-held bar magnet without having to open the housing, refer to Sect. 6.3. Function of sensors same as keys ④. Hold the bar magnet by the black rubber cap. Apply blue end of the magnet (north pole) to the glass pane above the magnetic sensors. Sensor response acknowledged by symbols appearing in 1st line of display.
⑥ Plug connector
⑦ Plug-in jumper positions to check field power supply, refer to Sect. 7.1.

4.2 Program organization and programming chart

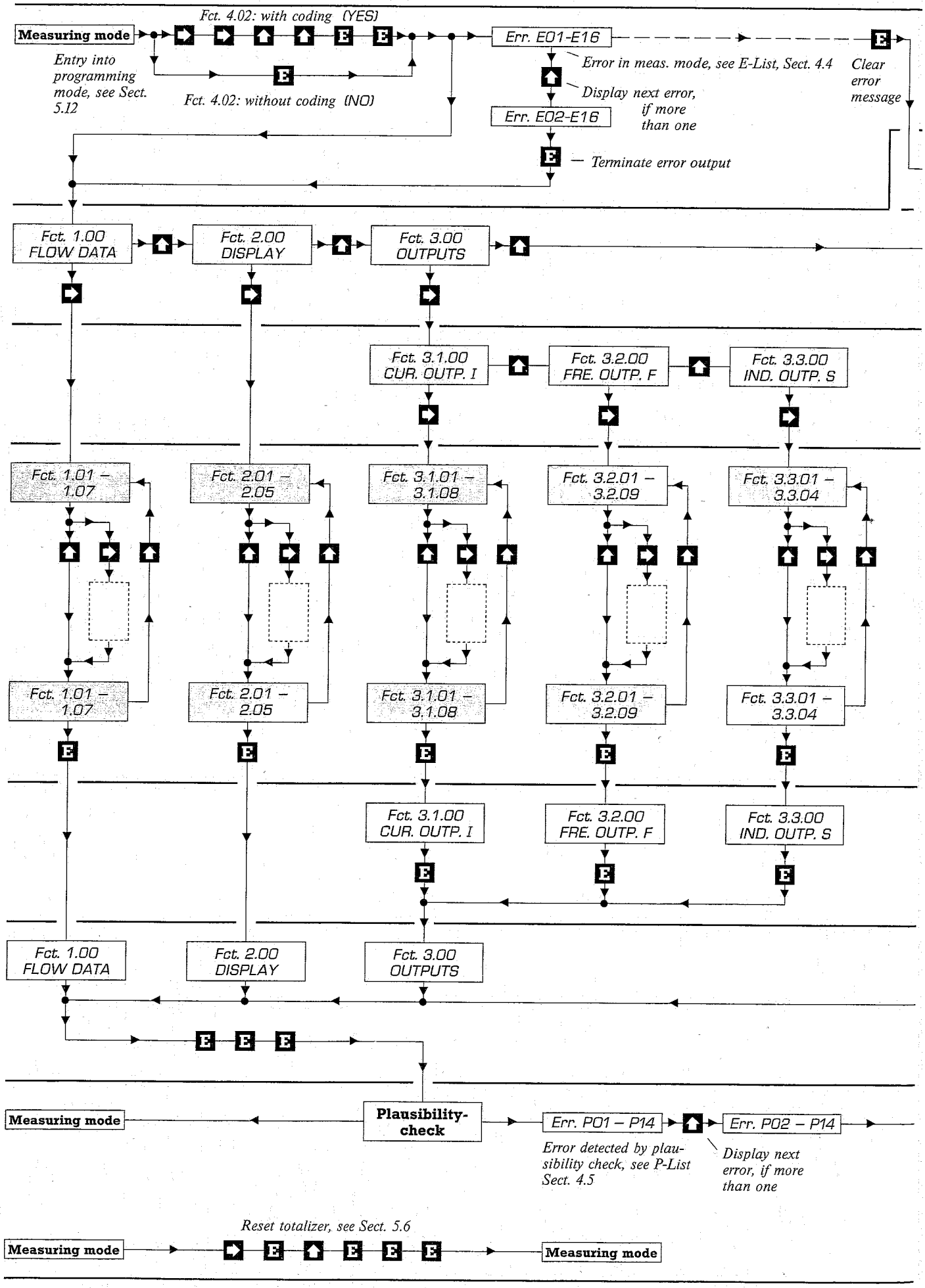
4.2.1 Menu levels

The program for the signal converter consists of 5 levels. The *Fct.No.* in the 1st line (bottom line) of the display will identify the menu level during programming.

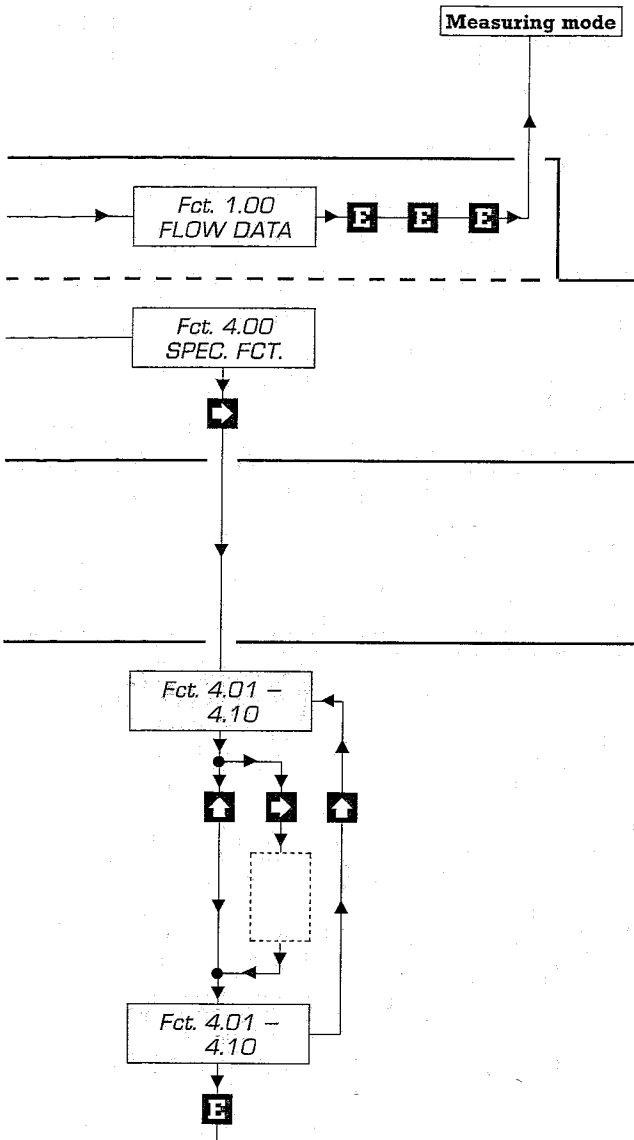


4.2.2 Programming chart

Table of functions, see Sect. 4.6



4.2.3 Description of keys



❶ Measuring mode level

- Enter programming mode
- Display errors
- Clear error messages

See left for function of keys

Important

applies to all menu levels

1. Continuously pressing ➡ or ⬆ keys will cause their function to be continuously repeated (auto-repeat function).

2. If no keystrokes made within approx. 180 sec, signal converter reverts autom. to meas. mode without accepting any changed data into meas. prog. (time-out function). **Exception:** if at start of programming *Err. E04, E05* and/or *E14* established, see Sect. 4.4.

❷ Main menu level

⬆ Select main menu

➡ Enter main menu displayed

E E E Revert to measuring mode level, see ❼

❸ Submenu level

⬆ Select menu

➡ Enter submenu displayed

E Revert to main menu level, see ❻

❹ Function level

⬆ Select function

➡ Enter function displayed, continue as under ❺ "Data level"

E Return to main menu or submenu level

❺ Data level

	Data/Units	Numerical values
⬆	Select next proposal	Increase flashing digit (cursor) by 1
➡	Return to Fct. level, retain previous data/units	Shift flashing digit 1 place to right. **Note:** if in last position, system reverts to Fct. level, last numerical value retained!
E	Return to Fct. level, store new data temporarily. **Note:** display *"Err. 0000 < MIN"* or *"9999 > MAX"* means num. value too low or too high. Press any key to display permissible min. or max. value, then enter correct numerical value.	

❻ Submenu level

E Revert to main menu level

⬆ Select submenu

➡ Enter submenu displayed

} see ❸

❼ Main menu level

E E E Return to measuring mode level, any changed data accepted into measuring program

⬆ Select main menu

➡ Enter main menu displayed

} see ❷

❽ Measuring mode level

- Plausibility check
- Reset totalizer

} see left for function of keys

❾ Main menu level

Function of keys same as under ❷

4.3 Programming and function of keys

After powering, the signal converter enters the normal measuring mode.

Programming start		
Key	***Display*** *1st line [2nd line]*	**Comments**
▶ ▶ ▲ ▲ E E **or** E	*[ENTER 1, 2, 3, 4, 5]*	**with** **without** } **Coding,** dependent on programming of Fct. 4.02 (*YES* or *NO*), refer to Sect. 4.6 + 5.12
 ▲ E	*Err. 01...16* *Err. 02...16*	**Error(s) in measuring mode,** see E-List, Sect. 4.4 appears only, if one or more errors have occurred during measuring operation display next error, if more than one terminate error display
	Fct. 1.00 [FLOW DATA]	**Main menu level,** 1st main menu displayed, continued as described below

Function of keys in main menu, submenu, functional and data levels, see Sect. 4.6				
Key	**Main menu level**	**Submenu level** **Functional level**	**Data level**	
			Data/Units	Numerical values
▲	Select main menu	Select submenu or function	Select next proposal	Increase flashing digit (cursor) by 1
▶	Enter displayed main menu	Enter displayed submenu or function	Return to functional level, previous data/units retained	Shift flashing digit (cursor) 1 place to the right. **Note:** If in last position, system will revert to functional level, last numerical value retained
E	———	Revert to main menu or submenu level	Revert to functional level, store new data, units or numerical values temporarily. *	

* Flashing display *Err. 0000 < MIN* or *Err. 9999 > MAX* = numerical value too low or too high. Press any key to obtain display of permissible minimum or maximum value, then enter correct numerical value.

Important

1. Continuously pressing the ▶ or ▲ key will cause the function of these keys to be continuously repeated (autorepeat function).
2. If no keystrokes are made for approx. 180 seconds, the signal converter will automatically revert to the measuring mode without accepting any changed data into the measuring program (time-out function). **Exception:** if at start of programming errors *Err. E04, E05* and/or *E14* are established, see Sect. 4.4.

Newly entered data will only be accepted into the measuring program if the programming mode is terminated by following the procedure below.

Programming end		
Key	**Display** *1st line [2nd line]*	**Comments**
1, 2 or 3 x E	*Fct. 1.00...4.00*	Select main menu level
E E E	*Actual measured value*	**Revert to measuring mode level** Plausibility check, lasts approx. 5 seconds **No error** in plausibility check, any changed data accepted into measuring program, actual measured value displayed (measuring mode level)
 ▲ E	*Err. P01...14* *Err. P02...14* *Fct. 1.00 [FLOW DATA]*	**Error(s)** in plausibility check, see P-List, Sect. 4.5 Display next error, if more than one Terminate error display and revert to main menu level, 1st main menu displayed, select faulty function(s) and correct data, see Sect. 4.6

Totalizer reset		
Key	**Display** *[2nd line]*	**Comments**
▶ E ▲	*[ENTER 1, 2]*	Measuring mode **not** interrupted
E E E	*[TOT. RESET]* *Actual measured value*	Totalizer reset **Measuring mode level,** actual measured value displayed

Clearing error messages in measuring mode, see Sect. 4.4		
Key	***Display*** *1st line [2nd line]*	**Comments**
▶ ▶ ▲ ▲ E E **or** E	*[ENTER 1,2,3,4,5]*	**with** **without** } Coding, dependent on programming of Fct. 4.02 (*YES* or *NO*), refer to Sect. 4.6 + 5.12
E	*Err. E01...E16* *Fct. 1.00 [FLOW DATA]*	Error messages (not with *Err. E04, E05* and/or *E14*) **Main menu level**
E E E	*Actual measured value*	**Measuring mode level,** actual measured value displayed

4.4 Error messages, E-List

E-List Error messages		Description of error	Rectify instrument fault and/or clear error message	Error output in measuring mode via - Display (Fct. 2.04) and/or - Status indication output (Fct. 3.3.01) dependent on programming				
Display				*NO MESS.*	*ADC ERROR*	*TOT. ERROR*	*ALL ERROR*	
1st line*	2nd line							
Err. E01	*LINE INT.*	**Power failure since last programming** Note: no counting during power failure	□ reset totalizer(s) if necessary	–	–	yes	yes	
Err. E02	*TOTALIZER*	**Counts lost or totalizer overflow** Note: totalizer was reset!	□	–	–	yes	yes	
Err. E03	*DISPLAY*	**Numerical overflow of display** Display 1st line: ======= Display 3rd line: note ▼ Marker!	Check data Fct. 2.00	–	–	–	yes	
Err. E04	*EEPROM 1*	**Data error in EEPROM 1 (parameters)**	Check instrument parameters ○	* *	* *	* *	* *	
Err. E05	*CAL. DATA*	**Calibration data lost**	Recalibrate signal converter, please consult factory	* *	* *	* *	* *	
Err. E06	*EEPROM 2*	**Data error in EEPROM 2 (totalizer)** Note: totalizer deviation possible	□ reset totalizer(s) if necessary	–	–	yes	yes	
Err. E07	*RAM*	**Check-sum error in RAM**	○	–	–	–	yes	
Err. E08	*ROM*	**Check-sum error in ROM**	○	–	–	–	yes	
Err. E09	*ADC*	**ADC value overranged or ADC defective**	○	–	yes	–	yes	
Err. E12	*FREQ.OUTP. F*	**Frequency output overranged**	□ If necess., check data, Fct. 3.2.00	–	–	–	yes	
Err. E13	*CUR.OUTP. I*	**Current output overranged**	□ If necess., check data, Fct. 3.1.00	–	–	–	yes	
Err. E14	*EE1 EE2*	**Current calibration values EPPROM 1+2 are different** (occurs only when pc board changed)	Terminate programming mode (press **E** key 4x), values corrected automatically	* *	* *	* *	* *	
Err. E16	*FUSE*	**F5 fuse for power failure identification defective**	Fit new F5 fuse, see Sect. 8.5	yes***	yes***	yes***	yes	

* When errors are displayed during the measuring mode, "*a numeral*" and "*Err.*" will appear in the 1st line. The numeral gives the number of momentarily occurring errors that are displayed alternately with the actual measured value.

* * No output in measuring mode! With these errors, the signal converter is automatically in the programming mode.

* * * No output via status indication output (Fct. 3.3.01)

□ Invoke and then terminate programming mode.
Keystrokes: 2 x ➡ / 2 x ⬆ / 2 x **E** and 4 x **E** **or** 1 x **E** and 4 x **E** (dependent on programming in Fct. 4.02)

○ Invoke and then terminate programming mode.
Keystrokes: 2 x ➡ / 2 x ⬆ / 2 x **E** and 4 x **E** **or** 1 x **E** and 4 x **E** (dependent on programming in Fct. 4.02)
Consult factory if these errors occur several times in succession.

4.5 Plausibility check, P-List

Err. P..	*Text*	Description
Err. P01	*V RANGE*	Velocity v outside possible range (0.3 to 12 m/s or 1 to 40 ft/s) *FULL SCALE* (Fct. 1.01) < > *DIAMETER* (Fct. 1.04)
Err. P02	*REV. SCALE*	*REV. SCALE* (Fct. 1.03) > *FULL SCALE* (Fct. 1.01)
Err. P03	*I RANGE*	*I 0 PCT.* (Fct. 3.1.02) > *I 100 PCT.* (Fct. 3.1.03) or difference < 4 mA
Err. P04	*I MAX mA*	*I MAX mA* (Fct. 3.1.04) < *I 100 PCT.* (Fct. 3.1.03)
Err. P05	*I CUTOFF*	*I: CUTOFF ON* (Fct. 3.1.07) ≥ *CUTOFF OFF* (Fct. 3.1.08)
Err. P06	*F CUTOFF*	*F: CUTOFF ON* (Fct. 3.2.08) ≥ *CUTOFF OFF* (Fct. 3.2.09)
Err. P09	*F > 10 KHZ*	*Frequency* for $Q_{100\%}$ > *10 kHz*
Err. P10	*PULS WIDTH*	Max. pulse width exceeded (see Fct. 3.2.05)
Err. P12	*RNG./CUTOFF*	2nd range of automatic range change (see Fct. 3.3.02) ≤ I *CUTOFF ON* (see Fct. 3.1.07)
Err. P14	*I TRIP PT.*	*I TRIP PT.* (Fct. 3.3.03) outside range of current output (see Fct. 3.1.04)

4.6. Table of programmable functions

Fct. No.	Text	**Description** and input
1.00	*FLOW DATA*	**Main menu 1.00 Measurement**
1.01	*FULL SCALE*	**Full-scale range for flowrate $Q_{100\%}$** *Unit:* select from list (Sect. 5.1) Range: (Sect. 5.3): *0.0034 to 542900 m^3/hr* or *0.8962 to 143400000 US G/min* After selecting unit, call numerical value with ➡ key, 1st digit flashes
1.02	*REV. SCALE*	**Different range for reverse flow?** *NO* or *YES*
1.03	*VALUE*	**Full-scale range for reverse flow** (appears only if *YES* entered under Fct. 1.02) *Unit:* select from list (Sect. 5.1) Range: (Sect. 5.3): *0.0034 to 542900 m^3/hr* or *0.8962 to 143400000 US G/min* *Value must not be greater than that of Fct. 1.01* *After selecting unit, call numerical value with* ➡ key, 1st digit flashes
1.04	*DIAMETER*	**Meter size** Unit in *mm* or *inch* Range: *2 to 4000 mm* or *0.0787 to 157.5 inch* After selecting unit, call numerical value with ➡ key, 1st digit flashes
1.05	*GK VALUE*	**Primary constant GK** (see primary head nameplate) Range: *0.5 to 14*
1.06	*FLOW DIR.*	**Define direction of forward (normal) flow** Enter acc. to direction of arrow *(+ or −)* on primary head
1.07	*ZERO CALIB.*	**Zero calibration** (Sect. 7.2) Carry out only at "0" flow and when measuring tube compl. filled with fluid! 1) Inquiry: *CALIB. NO* or *YES* 2) If *YES:* calibration (duration 45 sec) with zero display in *PERCENT* of $Q_{100\%}$ 3) Inquiry: *STORE NO* or *YES*
2.00	*DISPLAY*	**Main menu 2.00 Display**
2.01	*DISP. FLOW*	**Unit for flowrate display** ● *m^3/Sec* ● *m^3/min* ● *m^3/h* ● *Liter/Sec* ● *Liter/min* ● *Liter/h* ● *US G/Sec* ● *US G/min* ● *US G/h* ● *h Liter/hr* or *US MG/DAY* (=hectoliters per hour, for US version US million gallons per day) factory set, can be changed as required via Fct. 4.04, 4.05+4.06 (Sect. 5.14) ● *PERCENT* ● *NO DISPLAY*
2.02	*UNIT TOTAL.*	**Unit for totalizer display** ● *m^3* ● *Liter* ● *US G* ● *h Liter* or *US MG* (hectoliters or US million gallons) see Fct.No. 2.01 *(h Liter/hr* or US G/DAY)
2.03	*DISP. TOTAL.*	**Function of totalizer display** ● *+ TOTAL.* (= forward totalizer) ● *− TOTAL.* (= reverse totalizer) ● *+/− TOTAL.* (= forward and reverse flow totalizers, alternating) ● *SUM TOTAL.* (= sum of + and − totalizers) ● *ALL TOTAL.* (= sum, + and − totalizers, alternating) ● *NO DISPLAY* (= totalizer switched on but no display) ● *TOTAL. OFF* (= totalizer switched off)
2.04	*ERROR MSG*	**Which error messages to be displayed?** (Sect. 4.4) ● *NO MESSAGE* (= no error messages) ● *ADC ERROR* (= only ADC conversion errors) ● *TOT. ERROR* (= only errors of internal totalizer) ● *ALL ERROR* (= all errors)
2.05	*DISP. TEST*	**Carry out display test** Start with ➡ key

Fct. No.	Text	**Description** and input
3.00	*OUTPUTS*	**Main menu 3.00 Outputs**
3.1.00	*CUR. OUTP. I*	**Submenu 3.1.00** **Current output (I),** Sect. 5.7
3.1.01	*FUNCTION I*	**Function, current output (I)** ● *OFF* (= switched off) ● *F/R IND. F* (= F/R indication for F) ● *1 DIR.* (= 1 flow direction) ● *I < I 0 PCT.* (= **F**orward/**R**everse flow, e.g. in 0-20 mA range: **F**=10-20 mA, **R**=10-0 mA) ● *2 DIR.* (= forward/reverse flow, F/R measurement)
3.1.02	*I 0 PCT.*	**Current for 0% flow** ($I_{0\%}$) Range: *00 to 16 mA*
3.1.03	*I 100 PCT.*	**Current for 100% flow,** Full-scale range ($I_{100\%}$) Range: *04 to 20 mA* (Value at least 4 mA greater than that of Fct. 3.1.02)
3.1.04	*I MAX mA*	**Adjustment of max. output current** (I_{max}) Range: *04 to 22mA* (Value must be greater than/equal to that of Fct. 3.1.03)
3.1.05	*T-CONST. I*	**Time constant, current output** Range: *0.2 to 3600 Sec.*
3.1.06	*L.F.CUTOFF I*	**Low-flow cutoff (SMU) for current output?** *NO* or *YES* (Sect. 5.9)
3.1.07	*CUTOFF ON*	**Cutoff "on" value SMU-I** (appears only if *YES* entered under Fct.No. 3.1.06) Range: *01 to 19 PERCENT*
3.1.08	*CUTOFF OFF*	**Cutoff "off" value SMU-I** (appears only if *YES* entered under Fct. 3.1.06) Range: *02 to 20 PERCENT* (Value must be greater than that of Fct. 3.1.07)
3.2.00	*FRE. OUTP. F*	**Submenu 3.2.00** **Frequency output (F),** Sect. 5.8
3.2.01	*FUNCTION F*	**Function, frequency output (F)** ● *OFF* (= switched off) ● *F/R IND. I (= F/R indication for I)* ● *1 DIR.* (= 1 flow direction) ● *2 DIR.* (= forward/reverse flow, F/R measurement)
3.2.02	*PULSOUTP.*	**Unit, frequency output** ● *PULSRATE* (= input in pulses per unit time) ● *PULSE/UNIT* (= input in pulses per unit volume)
3.2.03	*PULSRATE*	**Pulse rate for 100% flowrate** (appears only if *PULSRATE* entered under Fct. 3.2.02) Range: *2.778*10^{-3} to 10000 pulses/Sec* *0.1667 to 600 000 pulses/min* *10 to 36 000 000 pulses/hr* After selecting unit, call numerical value with ➡ key, 1st digit flashes
3.2.04	*PULSE/UNIT*	**Pulse value** (appears only if *PULSE/UNIT* entered under Fct. 3.2.02), Unit in pulses per m^3, Liter, US G or unit of Fct. 4.04, 4.05 + 4.06 (Sect. 5.14) – Range: *0.0001 to 0.9999*10^9 pulses* [**no** input check but: $Q_{100\%}$* pulse value ≤ 36 000 000 pulses ≙ 10 kHz] After selecting unit, call numerical value with ➡ key, 1st digit flashes
3.2.05	*PULS WIDTH*	**Pulse width for frequencies ≤10Hz** ● *30mSec.* ● *50mSec.* ● *100mSec.* ● *200mSec.* ● *500mSec.*
3.2.06	*T-CONST. F*	**Time const. for frequency output** *T < F > = 0.2 Sec.* *T < F > = T < I >* (= time constant for F same as for I, Fct. 3.1.05)
3.2.07	*L.F.CUTOFF F*	**Low-flow cutoff (SMU) for frequency output** *NO* or *YES* (Sect. 5.9)

Fct. No.	Text	**Description** and input
3.2.08	*CUTOFF ON*	**Cutoff "on" value SMU-F** (appears only if *YES* entered under Fct. 3.2.07) Range: *01 to 19 PERCENT*
3.2.09	*CUTOFF OFF*	**Cutoff "off" value SMU-F** (appears only if *YES* entered under Fct. 3.2.07) Range: *02 to 20 PERCENT* (Value must be greater than that of Fct. 3.2.08)
3.3.00	*IND. OUTP. S*	**Submenu 3.3.00 Status indication output (S),** Sect. 5.16
3.3.01	*FUNCTION S*	**Funct. of status indication output** ● *OFF* (= switched off, 0 V at term. 4/43) ● *ON* (= switched on, 24 V at term. 4/43, e.g. as operational status indicator ● *F/R IND. I (= F/R indication* for I), Sect. 5.10 ● *F/R IND. F* (= F/R indication for F), Sect. 5.10 ● *AUTO. RANGE* (= automatic range change), Sect. 5.16 ● *I TRIP. PT.* (= trip point I as % of $Q_{100\%}$, Fct. 3.3.03) ● *F TRIP. PT.* (= trip point F as % of $Q_{100\%}$, Fct. 3.3.04) ● *L.F.CUTOFF I (= low-flow cutoff I),* Fct. 3.1.06 ● *L.F.CUTOFF F* (= low-flow cutoff F) Fct. 3.2.07 ● *ADC ERROR* ● *TOT. ERROR* } s. E-List Sect. 4.4 ● *ALL ERROR*
3.3.02	*AUTO. RANGE*	**Automatic range change for current output,** see Sect. 5.17 (appears only if *AUTO. RANGE* entered under Fct. 3.3.01) Range: *05 to 80 PERCENT* of $Q_{100\%}$, (Value must be greater than SMU-I cutoff "on" value, Fct. 3.1.07)
3.3.03	*I TRIP PT.*	**Trip point for current output,** Sect. 5.18 (appears only if *I TRIP PT.* entered under Fct. 3.3.01) Range: *001 to 110 PERCENT* of $Q_{100\%}$ (Value must be greater than SMU-I cutoff "off" value, Fct. 3.1.08)
3.3.04	*F TRIP PT.*	**Trip point for frequency output,** Sect. 5.18 (appears only if *F TRIP PT.* entered under Fct. 3.3.01) Range: *001 to 115 PERCENT* of $Q_{100\%}$ (Value must be greater than SMU-F cutoff "off" value, Fct. 3.2.09)

Fct. No.	Text	**Description** and input
4.00	*SPEC. FCT.*	**Main menu 4.00 Special functions**
4.01	*LANGUAGE*	**Language of display texts,** Sect. 5.11 ● *GB/USA* (= English) ● *D* (= German) ● *F* (= French) ● *SF* (= Finnish) ● others pending
4.02	*ENTRY CODE*	**Coding for entry into programming mode?** Sect. 5.12 ● *NO* = entry with E key ● *YES* = entry with keys → → ↑ ↑ E E
4.03	*OUTP. HOLD*	**Hold values of outputs during programming?** *NO* or *YES* (Sect. 5.13)
4.04	*UNIT TEXT*	**Text for field-programmable unit,** Sect. 5.14 *A...Z / a...z / 0...9 / ___* (= space)
4.05	*FACT. QUANT.*	**Conversion factor for quantity F_M,** Sect. 5.14 Factor F_M = quantity per 1 m^3 Range: *0.00001*10^{-9} to 9.99999*10^{+9}*
4.06	*FACT. TIME*	**Conversion factor for time F_T** Sect. 5.14 Factor F_T in seconds Range: *0.00001*10^{-9} to 9.99999*10^{+9}*
4.07	*FIELD FREQ.*	**Magnetic field frequency,** Sect. 5.15+8.2 ● *1/6* ● *1/16* ● *1/32*
4.08	*NOISE*	**Noise rejection,** Sect. 6.2 ● *NO NOISE* ● *NOISE*
4.09	*REF. SEL.*	**Selecting the reference voltage** Sect. 6.2 ● *AUTO. REF.* (= automatic reference) ● *HIGH-FLOW* (= high flow range) ● *MED1-FLOW* (= 1st medium flow range) ● *MED2-FLOW* (= 2nd medium flow range) ● *MED3-FLOW* (= 3rd medium flow range) ● *LOW FLOW* (= low flow range)
4.10	*FIELD CUR.*	**Input of field current** Range: *225.00 to 275.00 mA* (see sticker at term 7 + 8 on "basic" pc board/with power driver NB 900 F always ± 250 mA) Must not be changed, Sect. 7.2 + 8.1!

5. Description of program functions

5.1 Physical units

Fct. 1.01 Full-scale range $Q_{100\%}$
(**F**orward flow)

Fkc. 1.03 Full-scale range $Q_{100\%}$
(**R**everse flow)

Fct. 2.01 Units for flowrate display

- *m^3/Sec*
- *m^3/min*
- *m^3/hr*
- *Liter/Sec*
- *Liter/min*
- *Liter/hr*
- *US G/Sec*
- *US G/min*
- *US G/hr*

(G = gallons)

- 1 field-programmable unit, refer to Fct. 4.04 to 4.06, Sect. 5.14 for flowrate, e.g. liters per day, hectoliters per hour, or for mass flowrate where density is consistent and known, e.g. kg per hour or tonnes per day. Factory-programmed: *h/Liter/hr* (hectoliters per hour) for US version *US MG/DAY* (US million gallons per day).
- *PERCENT* (%), only for Fct. 2.01 (display).

Fct. 1.04 Diameter (meter size)
in *mm* (millimeters) or *inch* (inches).

Fct. 2.02 Unit for totalizer display
m^3, Liter, US G (G = gallons) and
1 field-programmable unit, e.g. deciliters (d Liters). Hectoliters (h Liter) or US million gallons (US MG) factory-programmed, see Fct. 2.01.

Fct. 3.2.02 Unit for frequency output F
Pulse rate: Enter in pulses per second, minute or hour.
Pulses per unit: *Puls/m^3, Puls/Liter, Puls/US G*(allons) or pulses per field-programmable unit, see above.

5.2 Numerical format

- **Display of actual flowrate**
  Max. 7-digit with floating decimal point.
- **Display of internal totalizers**
  Max. 7-digit with floating decimal point. Where count values exceed 9 999 999, automatic changeover to exponent notation, max. *9.999 19* (= $9.999 * 10^{19}$).
- **Display overflow**
  The display format is fixed by the parameters entered in the main menu *"2.00 DISPLAY"*. The following display will appear when a displayed value exceeds the limit:
  - Top line ≡≡≡≡≡≡≡
  - Middle line Unit of measured variable
  - Bottom line Marker ▼ identifies the measured variable for which the selected display format is no longer adequate.

  Necessary action: check data in main menu "*2.00 DISPLAY*" and alter if necessary.
- **Input of numerical values.**

Examples	Exponent notation	Input
0.0008	$0.8 * 10^{-3}$	*0.8000 −3*
0.5	$0.5 * 10^{0}$	*0.5000 ±0*
1.378	$0.1378 * 10^{1}$	*0.1378 +1*
10 000	$0.1 * 10^{5}$	*0.1000 +5*
36 000 000	$0.36 * 10^{8}$	*0.3600 +8*

5.3 Full-scale range $Q_{100\%}$ and meter size

Fct. 1.01 Full-scale range $Q_{100\%}$
(**F**orward flow)

Enter full-scale range $Q_{100\%}$ depending on meter size DN, Fct. 1.04 (forward flow in the case of F/R measuring mode; if different full-scale range required for reverse flow, see Fct. 1.02+1.03).

- Unit: see Sect. 5.1. Change of unit will cause automatic conversion of numerical value.
- Range:

0.0000*	to	150.8	m^3/Sec
0.0001	to	9 048.0	m^3/min
0.0034	to	542 900	m^3/hr
0.0009	to	150 800	Liter/Sec
0.0565	to	9 048 000	Liter/min
3.393	to	542 900 000	Liter/hr
0.0002	to	39 840	US G/Sec
0.0149	to	2 390 000	US G/min
0.8962	to	143 000 000	US G/hr

  *The true value is 0.0000009.
- If the numerical value is changed in Fct. 1.01, it is advisable to record the totalizer counts and then reset the totalizers (see Sect. 5.6), otherwise an incorrect count will be displayed.

Fct. 1.02 Separate full-scale range required for reverse flow?
Enter *"YES"* if a separate range is required for reverse flow, which is different from the forward flow range. If not required, enter *"NO"*.

Fct. 1.03 Full-scale range $Q_{100\%}$ for reverse flow
This function will only appear during programming if *"YES"* has been entered under Fct. 1.02.

- Unit: see Sect. 5.1. Change of unit will cause automatic conversion of numerical value.
- Range: see above, Fct. 1.01.

The entered value must be smaller than that entered in Fct. 1.01, otherwise a plausibility error will occur (Err. P02) see Sect. 4.5. This function has no effect on the totalizers.

Fct. 1.04 Meter size

- Unit: *mm* (millimetres) or *inch* (inches)
- Range: *2 to 4000 mm* **or** *0.0787 to 157.5 inch*
- If the numerical value in Fct. 1.04 is changed, it is advisable to record the totalizer counts and then reset the totalizers (see Sect. 5.6), otherwise an incorrect count will be displayed.

Programming

- For Fct. 1.01, 1.03 + 1.04, (see also 3.2.03 + 3.2.04), enter the unit first and then the numerical value.
- Proceed as follows: select appropriate Function number and then press ▶ key. The signal converter is now in the data level. The "units" abreviation in the lower line of the display flashes. First select the unit by pressing the ▲ key. After pressing the ▶ key, the left digit of the numerical value on the top line of the display will flash. Pressing the ▲ key will increase the numerical value. Pressing the ▶ key will shift the flashing digit (cursor) 1 place to the right.
- If the flashing digit (cursor) is in the last position (to the right) and the ▶ key is pressed again, the signal converter will revert to the function level without temporarily storing any changed data.
- Temporary storage of changed data takes place only after pressing the E key with simultaneous return to the function level.

5.4 Flow direction

- The flow direction or, in case of F/R operations, the direction of the forward flow is determined for full-scale range $Q_{100\%}$ (see Fct. 1.01) under Fct. 1.06.
- Two arrows on the primary head identify the possible flow directions with *"+"* und *"–"*.
- Enter *"+"* or *"–"* under Fct. 1.06 in accordance with the actual direction of flow.

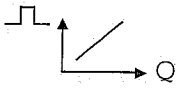
5.5 Display

The following measured variables and functions are displayed. 6 markers ▼ identify the active display.

- \+ totalizer (in F/R mode, forward totalizer)
- – totalizer (in F/R mode, reverse totalizer)
- Σ totalizer (sum of + and – totalizers)
- actual flowrate Q

These four displays depend on the program. If only one display is programmed, the marker indicates the active display continuously. If more than one display is programmed, the display sequences from one display to the next every 10 seconds, and the marker indicates the active display.

- ⊖→: Marker indicates that the status indication output S is switched on according to the programmed function (see Fct. 3.3.01), i.e. 24 V present at terminals 4/43 (see Sect. 5.16).

- mA  Q

  Marker indicates that the "on" threshold of the SMU (low-flow cutoff) for I or F is activated and the outputs have been set to $I_{0\%}$ or 0Hz, respectively (see Sect. 5.9).

Note: The signs for + and – totalizers identify forward and reverse flow, resp., and have nothing to do with definition of the flow direction "+/–" (see Sect. 5.4, Fct. 1.06). For example, assume forward flow according to the arrow on the primary head is the "–" direction. Forward flow, however, is always counted with the "+" totalizer.

Display overflow is shown as follows:

Top line: ≡≡≡≡≡≡

Middle line: Unit used for measured value

Bottom line: Marker ▼ identifies the measured variable for which the selected display format is no longer adequate.

Necessary action: check data in main menu *"2.00 DISPLAY"* and change if necessary (e.g. select different unit).

Display for flow Q = 100% (full-scale range)in F/R mode + setting in *PERCENT* (Fct. 2.01)

The display always refers to the setting of the full- scale range for forward flow (Fct. 1.01)

Setting	Display
$Q_{F\ 100\%}$ equals $Q_{R\ 100\%}$ (Fct. 1.01/1.02 = *NO*)	**F:** 100% **R:** 100%
$Q_{F\ 100\%}$ greater than $Q_{R\ 100\%}$ (Fct. 1.01/1.02 = *YES*/1.03)	**F:** 100% **R:** $\frac{Q_{R\ 100\%}}{Q_{F\ 100\%}} * 100\%$

Fct. 2.01 Unit for flowrate display
Selectable units, refer to Sect. 5.1.
If *"NO DISPLAY"* is entered, the actual flowrate is not displayed.

Fct. 2.02 Unit for totalizer values on display
Selectable units, refer to Sect. 5.1.

Fct. 2.03 Function of totalizer display

+ TOTAL.	forward flow totalizer only
– TOTAL.	reverse flow totalizer only
+/– TOTAL.	forward and reverse flow totalizers, alternating
SUM TOTAL.	sum of + and – totalizers
ALL TOTAL.	sum, + and – totalizers, alternating
NO DISPLAY	internal totalizer in operation, but no display
TOTAL. OFF	internal totalizer switched off

Fct. 2.04 Error messages
Select error messages (see E-List, Sect. 4.4).

NO MESSAGE	no error messages
ADC ERROR	ADC conversion errors
TOT. ERROR	internal totalizer errors
ALL ERROR	all errors

Error messages alternate with actual flow data.

Fct. 2.05 Testing the display
Start display test by pressing the ◘ key. Duration of test: approx. 30 seconds.

Important
Please refer to Sect. 5.19 for factory settings!

5.6 Internal electronic totalizer

- The internal electronic totalizer counts the volume in mathematically determined volumetric units. These numerical values are put into a non-volatile memory (EEPROM), converted into the programmed physical units and displayed every 0.3 seconds.

  Counting is interrupted in the event of a power failure, entry into the programming mode or when the low-flow cut off (SMU) is activated. After these conditions have been eliminated, counting continues with the values stored prior to the interruption.
- The counting period without overflow is at least 1 year at 100% of flow ($Q_{100\%}$).
- Set the time constant under Fct. 3.2.06:

T<F>=0.2 Sec	Time constant F = 0.2 seconds
T<F>=T<I>	Same time constant as current output I (see Fct. 3.1.05).

Resetting the totalizer

- To reset the totalizer press the keys in the following order:
  ◘ E ▲ E E E
- No interruption of measuring mode.
- If the numerical values in Fct. 1.01, 1.04, 1.05 + 4.07 are changed (e.g. given a change of the full-scale range, see Fct. 1.01, or the signal converter is replaced, see Sect. 8.2), it is advisable to record the totalizer counts and then reset the totalizers, as otherwise an incorrect count will be displayed.

Important
Please refer to Sect. 5.19 for factory settings!

5.7 Current (analog) output I

5.7.1 Application I (Fct. 3.1.01)

Application I	Programming via Fct. ...			Other functions programmable via Fct. ...		Connection diagrams for outputs see Sect. 2.6.5	Charac-teristic of outputs see Sect. 5.7.3 (+5.16.4
	I 3.1.01	*F* 3.2.01	*S* 3.3.01	*SMU I* 3.1.06 to 3.1.08	*I TRIP PT.* 3.3.01 + 3.3.03		
1 flow direction	*1 DIR.*	any	any	possible	possible	①	I1(S1+S2)
F/R operation F/R changeover via S	*2 DIR.*	any	*F/R IND. I*	*possible*	*no*	⑤	I2(S1)
I with BA 1 flow direction	*1 DIR.*	any	*AUTO. RANGE*	possible	no	⑦	I3(S1)
I with BA F/R operation	*2 DIR.*	*F/R IND. I*	*AUTO. RANGE*	possible	no	⑧	I4(S1)
F/R operation F/R changeover via F	*2 DIR.*	*F/R IND. I*	*any*	*possible*	*possible*	⑨	I5(S1+S2)
Direction indication for F	*F/R IND. F*	*2 DIR.*	any	no	no	⑩	I6
e.g. operation indicator	*OFF*	any	any	no	no	⑪	I7
F/R operation with 1 indicating instrument	*I<I 0PCT.*	any	any	possible	possible	⑫	I8

5.7.2 Other programmable functions for I

Fct. 3.1.02 Current for 0% flowrate ($I_{0\%}$)
Range from *00 to 16 mA* (e.g. 04 mA at output span 4 to 20 mA)

Fct. 3.1.03 Current for 100% flowrate ($I_{100\%}$)
Range from *04 to 20 mA* (e.g. 20 mA at output span 4 to 20 mA). This value must be at least 4 mA greater than that Fct. 3.1.02, otherwise error in plausibility check (Err. P03), see Sect. 4.5.

Fct. 3.1.04 Maximum output current I_{max}
Range from *04 to 22 mA* (e.g. 06 mA at output span 1 to 5 mA, prevents damage to connected 5-mA instruments). This val must be greater than or equal to that of Fct. 3.1.03, otherwise error in plausibility check (Err. P04), see Sect. 4.5.

Fct. 3.1.05 Time constant (T) for I
Range optionally programmable from *0.2 to 3600* seconds.

Fct. 3.1.06 to 3.1.08 Low-flow cutoff SMU
Refer to Section 5.9.

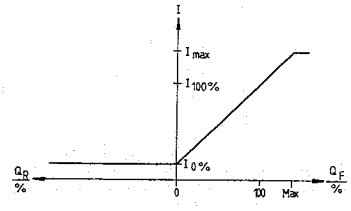
Automatic range change for I
Refer to Section 5.17.

Important
Please refer to Sect. 5.16 for factory settings!

5.7.3 Characteristics of current output I

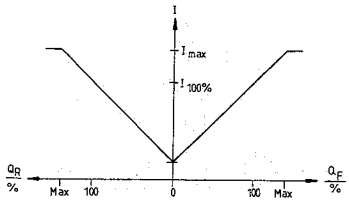
I1

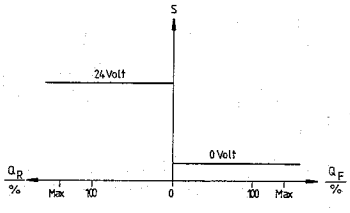
1 flow direction



I2

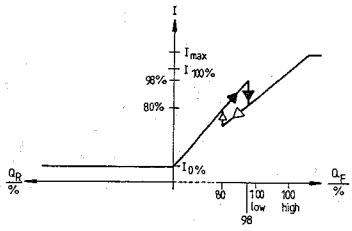
F/R operation
F/R changeover via S

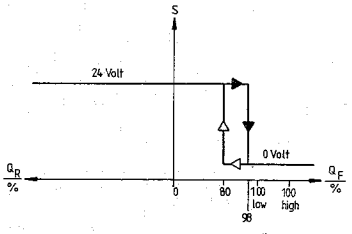




I3

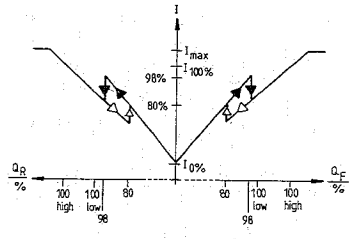
I with BA 1 flow direction
BA changeover via S

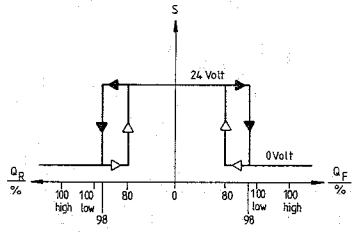


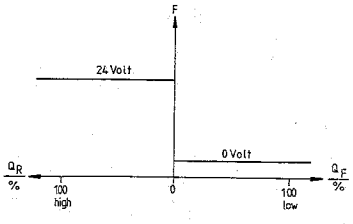


I4

I with BA F/R operation
BA changeover via S
F/R changeover via F

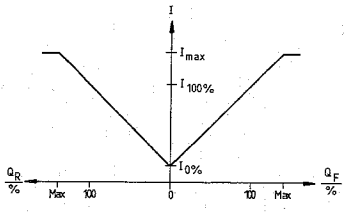


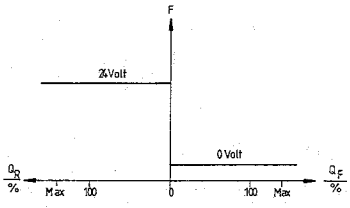




I5

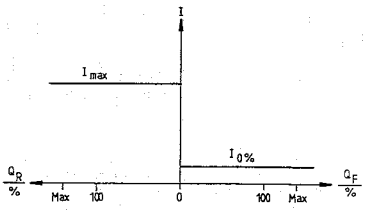
F/R operation
F/R changeover via F

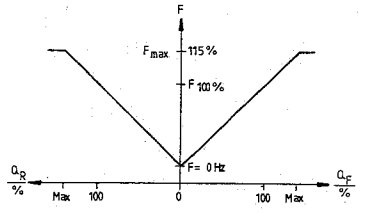




I6

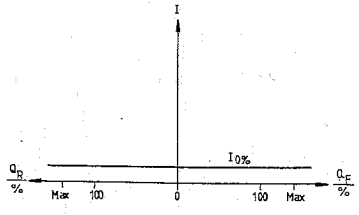
Direction indication for F





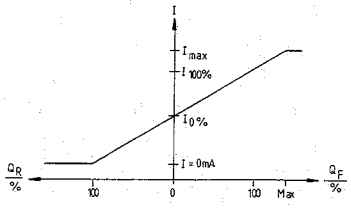
I7

e.g. operation indicator



I8

F/R operation
with 1 indicating instrument



5.8 Frequency output F

5.8.1 Application F (Fct. 3.2.01)

Application F	**Programming** via Fct. ...			**Other functions** programmable via Fct. ...		**Connection diagrams** for outputs see Sect. 2.6.5	**Charac-teristic** of outputs see Sect. 5.8.3(+5.16.4)
	F 3.2.01	***I*** 3.1.01	***S*** 3.3.01	***SMU F*** 3.2.07 to 3.2.09	***TRIP PT.F*** 3.3.01 + 3.3.04		
1 flow direction	*1 DIR.*	any	any	possible	possible	②	F1(S1+S2)
F/R operation F/R changeover via S	*2 DIR.*	any	*F/R IND. F*	possible	no	⑥	F2(S1)
F/R operation F/R changeover via I	*2 DIR.*	*F/R IND. F*	any	possible	possible	⑩	F3(S1+S2)
Direction indication for I	*F/R IND.I*	*2 DIR.*	any	no	no	⑨	F4
Switched off (≙ 0Hz/0 V)	*OFF*	any	any	no	no	—	F5

5.8.2 Other programmable functions for F

Fct. 3.2.02 Unit for frequency output F
PULSRATE Enter pulses per unit time (see Fct. 3.2.03)
PULSE/UNIT Enter pulses per unit volume (see Fct. 3.2.04)

Example of *PULSRATE*

Full-scale setting:	1000 Liter per second (set via Fct. 1.01)
Pulse rate:	1000 pulses per second (set via Fct. 3.2.03)
Pulse value:	1 pulse per Liter
Changeover of full-scale setting:	2000 Liter per second (change over via Fct. 1.01)
Pulse rate:	unchanged (see above), 1000 pulses per second
Pulse value **now:**	1 pulse per 2 Liter

Example of *PULSE/UNIT*

Full-scale setting:	1000 Liter per second (set via Fct. 1.01)
Pulse value:	1 pulse per Liter (set via Fct. 3.2.04)
at 1000 Liter per second:	1000 pulses per second ≙ 1 pulse per Liter
Changeover of full-scale setting:	2000 Liter per second (change over via Fct. 1.01)
Pulse value:	unchanged (see above), 1 pulse per Liter
at 2000 Liter per second:	2000 pulses per second ≙ 1 pulse per Liter as before

Fct. 3.2.03 Pulse rate for 100% flowrate ($F_{100\%}$)
(appears only if *"PULSRATE"* entered in Fct. 3.2.02)
Range: *2.778 * 10^{-3} to 10000 PulSe/Sec*
0.1667 to 600000 PulSe/min
10 to 36000000 PulSe/hr

Fct. 3.2.04 Pulse value
(appears only if *"PULSE/UNIT"* entered in Fct. 3.2.02)
Unit: Select from List in Section 5.1
Range: *0.0001 to 0.9999 * 10^{9} PulSe/Unit*
Programming: Refer to Sect. 5.3 "Programming"!
Entry is **not** checked **but:**
$Q_{100\%}$ * pulse value must be less than or equal to 36 000 000 pulses/hr (equivalent to 10 kHz)!

Programming of Fct. 3.2.03 + 3.2.04 see Section 5.3.

Fct. 3.2.05 Pulse width
Five pulse widths are selectable for frequencies less than or equal to 10 Hz: *30 / 50 / 100 / 200 / 500 m Sec.*
(Note output load and frequency ranges, see Table in Sect. 2.6.3.)

Fixed pulse widths are provided for frequencies above 10 Hz (see Sect. 2.6) regardless of the pulse width (see above) that has been programmed.

Fct. 3.2.06 Time constant (T) for F

T < F > = 0.2 Sec.	Time constant = 0.2 second (best for counting and/or batching processes)
T < F > = T < I >	Same time constant as for current output I, see Fct. 3.1.05 (practical if frequency output F used for instantaneous-value measurements)

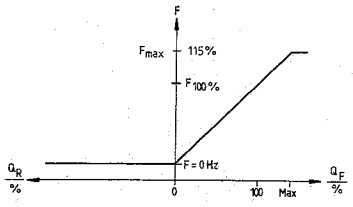
Fct. 3.2.07 to 3.2.09 Low-flow cutoff SMU
Refer to Section 5.9.

Important
Please refer to Sect. 5.19 for factory settings!

5.8.3 Characteristics of frequency output F

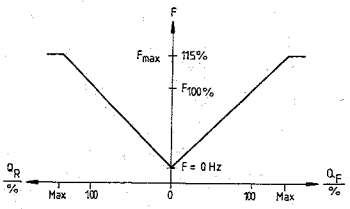
F1

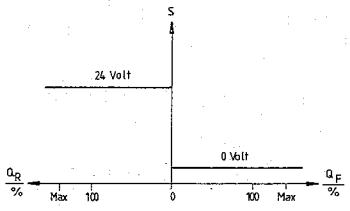
1 flow direction



F2

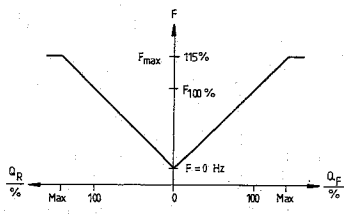
F/R operation
F/R changeover via S

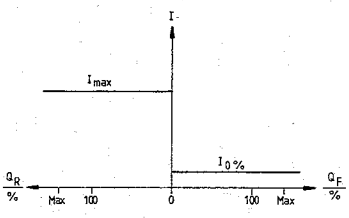




F3

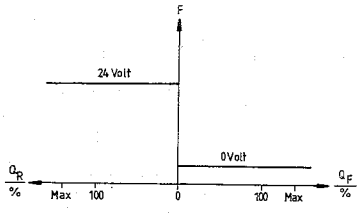
F/R operation
F/R changeover via I

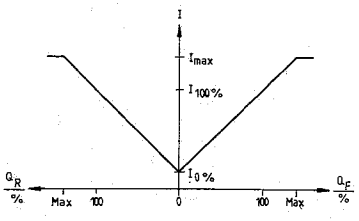




F4

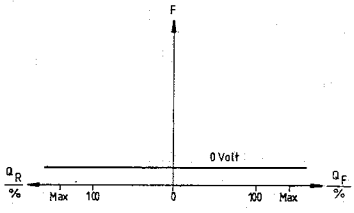
Direction indication for I





F5

Switched off



Frequency or pulses/unit time at frequency output for flowrate Q = 100% (full-scale range) for F/R operation + setting in *PULSE/UNIT* (Fct. 3.2.02 + 3.2.03)

Frequency or pulses/unit time at the output always refer to the setting of the full-scale range for the forward range $F_{100\%}$ (Fct. 3.2.03).

Setting	Frequency or pulses/unit time
$Q_{F\ 100\%}$ equals $Q_{R\ 100\%}$ (Fct. 1.01/1.02 = *NO*)	**F:** $F_{100\%}$ **R:** $F_{100\%}$
$Q_{F\ 100\%}$ greater than $Q_{R\ 100\%}$ (Fct. 1.01/1.02 = *YES*/1.03)	**F:** $F_{100\%}$ **R:** $\frac{Q_{R\ 100\%}}{Q_{F\ 100\%}} * F_{100\%}$

5.9 Low-flow cutoff (SMU) for I + F

- To avoid erroneous measurements at low flowrates, the SMU switches the current and frequency outputs (I+F) off. I goes to $I_{0\%}$ (Fct. 3.1.02) and F to 0 Hz.
- If *"NO"* is entered under functions 3.1.06 + 3.2.07, fixed cutoff "on" and cutoff "off" values of 0.1 and 0.25%, resp., of $Q_{100\%}$ (full-scale range, see Fct. 1.01) act on the outputs I + F.
- If *"YES"* is entered under functions 3.1.06 + 3.2.07, the cutoff "on" and cutoff "off" values for I + F are separately adjustable in the ranges specified below.
- The low-flow cutoff (SMU) can be indicated either for I or for F via the status indication output S (see Sect. 5.16).

Fct. 3.1.06 Low-flow cutoff (SMU) for I desired?
Enter *NO or YES.*

Fct. 3.1.07 Cutoff "on" value for SMU-I
(appears only if *"YES"* entered in Fct. 3.1.06)
Range: *01 to 19 PERCENT* of $Q_{100\%}$
The low-flow cutoff drives the current output to $I_{0\%}$ when the flow decreases to the cutoff "on" value (see Fct. 3.1.02).

Fct. 3.1.08 Cutoff "off" value for SMU-I
(appears only if *"YES"* entered in Fct. 3.1.06)
Range: *02 to 20 PERCENT* of $Q_{100\%}$
This value must be greater than that of Fct. 3.1.07, otherwise a "plausibility" error (Err. P05) will occur, see Sect. 4.5. When the flow returns to the cutoff "off" value, the current output returns to normal.

Fct. 3.2.07 Low-flow cutoff (SMU) for F desired?
Enter *NO or YES:*

Fct. 3.2.08 Cutoff "on" value for SMU-F
(appears only if *"YES"* entered in Fct. 3.2.07)
Range: *01 to 19 PERCENT* of $Q_{100\%}$
The low-flow cutoff drives the frequency output to 0 Hz when the flow decreases to the cutoff "on" value.

Fct. 3.2.09 Cutoff "off" value for SMU-F
(appears only if *"YES"* entered in Fct. 3.2.07)
Range: *02 to 20 PERCENT* von $Q_{100\%}$
This value must be greater than that of Fct. 3.2.08, otherwise a "plausibility" error (Err. P06) will occur, see Sect. 4.5. When the flow returns to the cutoff "off" value, the frequency output returns to normal.

5.10 F/R operation for I and/or F

Electrical connection, characteristic and programming of outputs, refer to Sect. 2.6, 5.7 + 5.8.

Fct. 1.06 Define direction of forward (normal) flow (+ or -)
In the case of F/R operation, program the direction of the forward flow with *"+" or "–"*, in accordance with the arrows marked "+" and "–" on the primary head. Note that if the flowmeter does not have a "+" and "–" on the primary head the "+" direction is the direction the arrow is pointing.

Fct. 1.01 Full-scale setting for flowrate $Q_{100\%}$
Program the full-scale range. Unit and range, see Sect. 5.1 + 5.3.

Fct. 1.02 Separate range desired for reverse flow?
Enter *"YES"* only if the range required for reverse flow is different from the range for the normal (forward) flow. If not, enter *"NO"*.

Important
Please refer to Sect. 5.19 for factory settings!

Fct. 1.03 Full-scale range for reverse flow
(appears only if *"YES"* entered in Fct. 1.02). This is used fo programming the full-scale range for reverse flow. Uni and range, see Sect. 5.1 + 5.3. This value must not be greater than that of Fct. 1.01, otherwise "plausibility" erro (Err. P02) will occur, see Sect. 4.5.

5.11 Language of display texts

A choice of languages for the display texts is offered in Fct. 4.01:

- *GB/US* English
- *D* German
- *F* French
- *SF* Finnish

other languages pending.

5.12 Coding desired for entry into programming mode?

- Enter *NO* or *YES.*
- If *"NO"* entered, there are 2 ways of entering the programming mode:
  1. by pressing the E key only **or**
  2. by pressing the → → ↑ ↑ E E keys.
- If *"YES"* entered, the only way of entering the programming mode is to press keys as follows:
  → → ↑ ↑ E E

5.13 Behavior of outputs during programming

- Enter in Fct. 4.03 whether or not the outputs shall hold the last values (before entry into the programming mode).
- If *"YES"* entered: output values prior to entry into the programming mode are retained during programming. After leaving the programming mode, the outputs go to the values corresponding to the actual operating conditions.
- If *"NO"* entered: the outputs go to the programmed minimum values:
  I to the value of $I_{0\%}$ (see Fct. 3.1.02)
  F to 0 V, consequently no pulses
  S to 0 V.

5.14 Field-programmable unit

An arbitrary volumetric flow unit or, if density of the fluid product is consistent and known, a unit of mass (weight) can be programmed in functions 4.04 to 4.06. The unit *"h Liter/hr"* (hecto-liters per hour) is factory-set unless another special unit is specified. US-version: *"US MG/DAY"* (US million gallons per day).

Fct. 4.04 Text for field-programmable unit

- Volumetric (or mass) unit per unit time
- Text for volume (mass): 6 characters (places)
- Text for time: 3 characters (places)
- The fraction bar "/" in the 7th place has a fixed position.
- Alpha characters *A-Z* and *a-z*, numbers *0-9* or blank character (_) are selectable for every place.
- Pressing the ◘ key will sequence the alpha characters and numbers in the order given above.
- The ◘ key shifts the cursor 1 place to the right.
- Text examples are given in the following Tables in brackets (...../...).

Fct. 4.05 Conversion factor Quantity F_M

Enter the factor F_M = quantity per 1 m^3.

Volumetric unit	Factor F_M	Inputit
Cubic meters (*m 3*)	1.0	*1.00000 ± 0*
Liters (*Liter*)	1 000	*1.00000 + 3*
Hecto-liters (*h Liter*)	10	*1.00000 + 1*
Deci-liters (*d Liter*)	10 000	*1.00000 + 4*
Centi-liters (*c Liter*)	100 000	*1.00000 + 5*
Milli-liters (*m Liter*)	1 000 000	*1.00000 + 6*
US gallons (*US G*)	264.172	*2.64172 + 2*
US million gallons (*US MG*)	0.000264172	*2.64172 – 4*
Imperial gallons (*GB G*)	219.969	*2.19969 + 2*
Imperial mega-gallons (*GB MG*)	0.000219969	*2.19969 – 4*
Cubic feet (*Feet 3*)	35,3146	*3.53146 + 1*
Cubic inches (*inch 3*)	61 024.0	*6.10240 + 4*
US barrels liquid	8.38364	*8.38364 ± 0*
US fluid ounces	33 813.5	*3.38135 + 4*

Fct. 4.06 Conversion factor Time F_T

Enter the factor F_T in seconds.

Time unit	Factor F_T [seconds]	Input
Second (*Sec*)	1	*1.00000 ± 0*
Minute (*min*)	60	*6.00000 + 1*
Hour (*hr*)	3 600	*3.60000 + 3*
Day (*DAY*)	86 400	*8.64000 + 4*
Year (*YR*) (≙ 365 days)	31 536 000	*3.15360 + 7*

Examples of volume per unit time

Desired units:	Hecto-liters per year	Deci-liters per hour
Volumetric unit in Fct. 4.04	*h Liter*	*d Liter*
Factor F_M (see Table)	10	10 000
Input in Fct. 4.05	*1.00000 + 1*	*1.00000 +4*
Time unit in Fct. 4.04	*YR*	*hr*
Factor F_T (see Table)	31 536 000 (seconds)	3600 (seconds)
Input in Fct. 4.06	*3.15360 + 7*	*3.60000 +3*

Examples of mass per unit time

Product density ϱ = 1.2 g/cm^3 = 1.2 kg/Liter = constant
Mass of 1 m^3 product = 1200 kg = 2646 pounds

Desired unit:	Kilograms per minute	Pounds per hour
Mass unit in Fct. 4.04	*kg*	*lbs*
Factor F_M (see Table)	1200	2646
Input in Fct. 4.05	*1.20000 + 3*	*2.646 + 3*
Time unit in Fct. 4.04	*min*	*hr*
Factor F_T (see Table)	60	3600
Input in Fct. 4.06	*6.00000 + 1*	*3.60000 +3*

5.15 Magnetic field frequency and primary constant GK

Fct. 1.05 GK value

The primary constant GK is factory-set. Range: *0.5 to 14*, dependent on primary head, see instrument nameplate.

Fct. 4.07 Magnetic field frequency

The magnetic field frequency is factory-set to *1/6, 1/16 or 1/32* of the power frequency, see signal converter nameplate.

Data of Fct. 1.05 + 4.07 must not be changed! Exception: replacement of primary head, see Sect. 8.2

5.16 Status indication output S

5.16.1 Application S (Fct. 3.3.01)

Application S	Programming via Fct.			Other functions programmable via Fct.	Characteristic of output signals			Connecti diagram
					S		Diagrams	
	S 3.3.01	I 3.1.01	F 3.2.01		0 V	24 V	S: Sect. 5.16.4 I : Sect. 5.7.3 F: Sect. 5.8.3	for outputs se Sect. 2.6.5
Switched off	*OFF*	any	any	no	constant	–	S6	–
e.g. operation indicator	*ON*	any	any	no	–	constant	S4	③
Direction indication for I	*F/R IND. I*	*2 DIR.*	any	no	forward flow	reverse flow	I 2	⑤
Direction indication for F	*F/R IND. F*	any	*2 DIR.*	no	forward flow	reverse flow	F 2	⑥
Automatic range change BA 1 flow direction F/R operation	 *AUTO.RANGE* *AUTO.RANGE*	 *1 DIR.* *2 DIR.*	 any *F/R IND. I*	 *BA:* 3.3.02 (Sect. 5.17) *BA:* 3.3.02 (Sect. 5.17)	 high range high range	 low range low range	 I 3 I 4	 ⑦ ⑧
Trip point G_I	*I TRIP PT.*	any	any	G_I: 3.3.03 (Sect. 5.18)	below G_I	above G_I	S 2	③
Trip point G_F	*F TRIP PT.*	any	any	G_F: 3.3.04 (Sect. 5.18)	below G_F	above G_F	S 2	③
Low-flow cutoff SMU-I	*L.F.CUTOFF I*	*any*	*any*	*SMU I:* 3.1.06 to 3.1.08 (Sect. 5.9)	outside SMU-I values	within SMU-I values	S 1	③
Low-flow cutoff SMU-F	*L.F.CUTOFF F*	*any*	*any*	*SMU F:* 3.2.07 to 3.3.09 (Sect. 5.9)	outside SMU-F values	within SMU-F values	S 1	③
Indicate errors	*ADC ERROR* *TOT. ERROR* *ALL ERROR*	any any any	any any any	no no no	error error error	no error no error no error	S 3 S 3 S 3	③ ③ ③

5.16.2 Other programmable functions for S

Fct. 3.3.02 Automatic range change BA for I
(appears only if *"AUTO.RANGE"* entered in Fct. 3.3.01)

- The BA is programmable in 1% increments in the ratio of 1:20 to 1:1.25, corresponding to *05 to 80 PERCENT* of $Q_{100\%}$.
- This value must be greater than the SMU-I cutoff "on" value see Fct. 3.1.07, Sect. 5.9, otherwise "plausibility" error (Err. P12) will occur, see Sect. 4.5.

Fct. 3.3.03 Trip point for I
(appears only if *"I TRIP PT."* entered in Fct. 3.3.01)

- The trip point is programmable in 1% increments in the range of *01 to 110 PERCENT* of $Q_{100\%}$.
- This value must be within the output range of current output I (I_{max}, Fct. 3.104) and greater than the SMU-I cutoff "off" value (Fct. 3.1.08), otherwise a "plausibility" error (Err. P14) will occur, see Sect. 4.5.
- If $I_{100\%}$ (Fct. 3.1.03) is programmed to values less than 2 mA, the trip point can be set to a maximum value o

$$G_I \leq \frac{22\ mA}{I_{100\%}} * 110\%$$

- The limit switch operates with a delay equal to the tim constant of current output I (Fct. 3.1.05), see Sect. 5.16.

Fct. 3.3.04 Trip point for F
(appears only if *"F TRIP PT."* entered in Fct. 3.3.01)

- The trip point is programmable in 1% increments in th range of *01 to 115 PERCENT* of $Q_{100\%}$.
- This value must be greater than the SMU-F cutoff "of value (Fct. 3.2.09).
- The limit switch operates with a delay equal to the tim constant of frequency output F (Fct. 3.2.06), see Sec 5.16.3.

5.16.3 Response time, setting of time constant

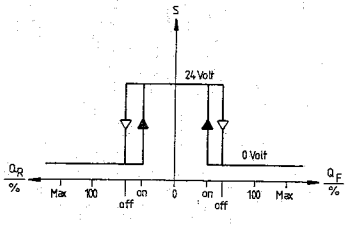
- Changeover in F/R mode and operation of the limit switches G_I and G_F take place with a time delay in accordance with the set time constant for I (Fct. 3.1.05) or for F (Fct. 3.2.06).
- Recommended settings for time constant I and F

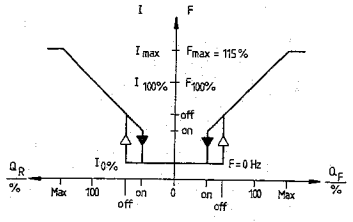
Function	Response time	Time constant		Function S	Application
		I Fct. 3.1.05	F Fct. 3.2.06	Fct. 3.3.01	
F/R operation I + F	delayed	any	*T< F> = T< I>* (same as I)	*F/R IND. I*	Volumetric counting in both directions
F/R operation F	delayed	any	*T< F> = T< I>* (same as I)	*F/R IND. F*	Volumetric counting in both directions
F/R operation F	instanteneous	any	*T< F>=0.2 sec.*	*F/R IND. F*	e.g. for fast reverse flow indications
Limit switch G_I	delayed	acc. to desired response time	any	*I TRIP PT*	delayed alarm
Limit switch G_F	instantaneous	any	*T< F>=0.2 sec.*	*F TRIP PT.*	instantaneous alarm

5.16.4 Characteristic of status indication output S

S1

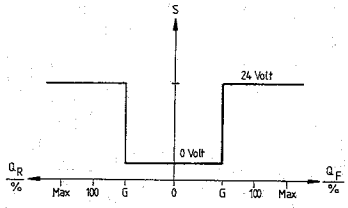
Low-flow cutoff for I or F

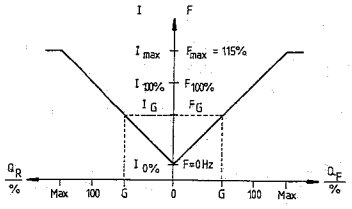




S2

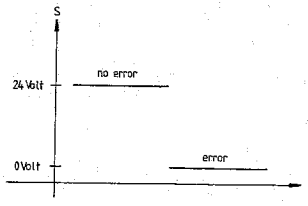
Limit switch for I or F





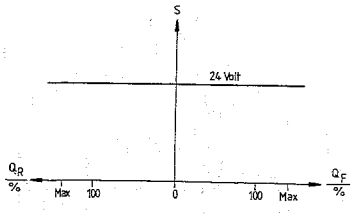
S3

Error messages



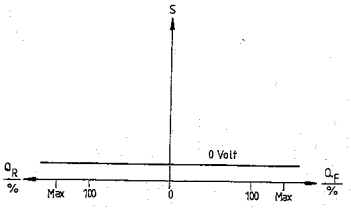
S4

S switched on



S5

S switched off



5.17 Automatic range change BA

- The automatic range change features 2 measuring ranges that are automatically switched as a function of the flowrate.
- The ratio between low and high range is programmable between 1:20 and 1:1.25 (corresponding to *5* to *80* PERCENT of $Q_{100\%}$), see Fct. 3.3.02 + Sect. 5.16.
- This value must be greater than that of the SMU-I cutoff "on" value, see Fct. 3.1.07, Sect. 5.9, otherwise "plausibility" error (Err. P12) will occur, see Sect. 4.5.
- Changeover occurs from high to low range on decreasing flow at approx. 85% of the low range, and from low to high range on increasing flow at approx. 98% of the low range.
- The status indication output (term. 4/43) always displays the active range: 0 V = high range and 24 V = low range.
- Electrical connection is shown in connection diagram ⑦ or ⑧ in Sect. 2.6.5; for characteristic of outputs I + S, see diagrams I3 and I4 in Sect. 5.7.3.

5.18 Trip points for I + F

- The status indication output S can be used as a trip point switch (G_I or G_F) for current or frequency output, see Sect. 5.16.
- When the current (I) or frequency (F) exceeds the trip point, the status output (S) switches from 0 V to 24 V. There is no dead band associated with this function.
- Trip point switches G_I and G_F operate with a time delay equivalent to the set time constant for I or F (see also Sect. 5.16.3 in this connection).
- **Trip point switch G_I**
  Set *"I TRIP PT."* under Fct. 3.3.01.

  The trip point can be set under Fct. 3.3.03 in the range of *01 to 110 PERCENT* of $Q_{100\%}$ (Fct. 1.01).

  This value must be within the output range of current output (I_{max}, Fct. 3.1.04) and greater than that of the SMU-I cutoff "off" value (Fct. 3.1.08), otherwise "plausibility" error (Err. P07) will occur, see Sect. 4.5.

  If $I_{100\%}$ (Fct. 3.1.03) is programmed to a value less than 20 mA, the trip point can be set to a maximum of

$$G_I \leq \frac{22\ mA}{I_{100\%}} * 110\%$$

- **Trip point switch G_F**
  Set *"F TRIP PT."* under Fct. 3.3.01.

  The trip point can be set under Fct. 3.3.04 in the range of *01 to 115 PERCENT* of $Q_{100\%}$ (Fct. 1.01).

  This value must be greater than that of the SMU-F cutoff "off" value (Fct. 3.2.09).

5.19 Factory settings

To facilitate easy and rapid initial start-up, current outp and pulse output are set to process flow measuremen "2 flow directions" (Fct. 3.1.01 + 3.2.01) so that instantaneous flowrate is displayed and the volume fl counted independent of the flow direction ("+" or ' Fct. 1.06). Measured values may possibly be displa with a "–" sign.

This factory setting may possibly lead to measuring err particularly in the case of volume flow counting:

For example, if pumps are switched off and a "backfl occurs which is not within the range of the low-flow cu (SMU-I, Fct. 3.1.06 and SMU-F, Fct. 3.2.07, see also S 5.9), or if separate displays and counts are required both flow directions.

To avoid faulty measurements in these cases, therefor may be necessary to change the factory setting of som all of the following functions:

- flow direction, Fct. 1.06 (Sect. 5.4)
- current output, Fct. 3.1.01 (Sect. 5.7 + 5.10)
- frequency (pulse output, Fct. 3.2.01 (Sect. 5.8 + 5.
- status indication output, Fct. 3.3.01 (Sect. 5.16)
- low-flow cutoff, Fct. 3.1.06 and 3.2.07 (Sect. 5.9)
- display, Fct. 2.01 and 2.03 (Sect. 5.5 + 5.6).

Signal converter SC 100 AS/HPC/S
The new structure of the main menu 4.00 spe functions is described in Sect. 13, pages 78–79.

Part C Special applications, functional checks and service

6. Special applications

6.1 Use in hazardous areas

Altoflux electromagnetic flowmeters are certified to **European standards** and to **Factory Mutual standards (FM)** as electrical appliances suitable for use in hazardous areas.

Only the primary heads are permitted to be installed in the hazardous area. The signal converter must always be installed **outside** the hazardous area.

Allocation of temperature class to temperature of the fluid, meter size and material of the measuring tube liner is specified in the test certificate.

Since the intrinsically safe signal circuit is grounded under field conditions via the fluid, equipotential bonding is required in the entire hazardous area and in the cable run of the intrinsically safe signal circuit (inside and outside the hazardous area).

Test certificate, certificate of conformity and wiring instructions are attached to the Installation and Operating Instructions (applies only to hazardous-duty equipment).

6.2 Short response time in conjunction with rapid changes in flowrate

The signal converter is equipped with an internal automatic reference unit which ensures optimum adjustment to the input signal from the primary head during changing flowrates.

In the case of rapidly changing flowrates, e.g. batching processes and where operation with reciprocating pumps is involved, it may be necessary to influence or cut out this automatic unit via Fct. 4.08 and 4.09.

With Fct. 4.08, the response time of the automatic unit is decreased by up to 30%.

The automatic unit is switched off via Fct. 4.09. However, this reduces the measuring accuracy of the signal converter.

Since there are no hard and fast rules for applying Fct. 4.08 and 4.09, it is advisable to determine the optimum setting as follows.

Always switch off the power source before connecting and disconnecting cables!

- Connect an LED with series resistor (0.68 to 2 kohms) or an oscilloscope to terminals 4 + 43 (digital voltmeters are unsuitable).
- Program *"ADC ERROR"* in Fct. 3.3.01 (status indication output).
- Start the flow.
- The optimum setting for the signal converter is found when the LED does **not** turn off (remains lighted).
- If the LED turns off, even momentarily, reprogram the signal converter in the following order until the LED remains on (lighted).

Order	Fct. 4.08	Fct. 4.09
1st	*NOISE*	*AUTO. REF.*
2nd	*NO NOISE*	*HIGH FLOW*
3rd	*NO NOISE*	*MED1–FLOW*
4th	*NO NOISE*	*MED2–FLOW*
5th	*NO NOISE*	*MED3–FLOW*
6th	*NO NOISE*	*LOW FLOW*

- Subsequently, reprogram Fct. 3.3.01 (status indication output) according to its original application.
- If the above procedure does not lead to the desired effect, please consult factory.

6.3 Stable signal outputs when measuring tube empty

Output values can be stabilized to values as for "zero" flow to prevent random output signals when the measuring tube is empty or when the electrodes are not wetted in the event the measuring tube is partially full.

This means:

Totalizer Display ⟶ does not accumulate random counts

Current output ⟶ value of $I_{0\%}$ (see Fct. 3.1.02)

Frequency output ⟶ 0 V (= no pulses)

Preconditions

- Electrical conductivity of fluid ≥ 200 µS/cm (µmho/cm) [≥ 500 µS/cm (µmho/cm) in conjunction with primary head IFS 5000 (-Ex), DN ≤ 15 or ≤ 1/2"]
- Max. signal cable length 50 m (165 ft), for cable type DS or BTS.

Changes on basic pc board
(see components drawing, Sect. 9.1)

- Insert two resistors R_x = 10 Mohms
- Insert soldering jumper L_x.

Additional change to programming

Program low-flow cutoff (SMU) for current output I and frequency output F as follows (minimum values):

Fct.	I	F	Comments
3.1.06 3.2.07	*YES*	*YES*	Activate SMU
3.1.07 3.2.08	*1 PERCENT*	*1 PERCENT*	Cut off "on" value
3.1.08 3.2.09	*2 PERCENT*	*2 PERCENT*	Cut off "off" value

Note
The low-flow cutoff function does not affect the flowrate display, Fct. 2.01: *DISP. FLOW*. Therefore, depending upon the resolution of this display, there may be a slight positive or negative flowrate displayed during the period the pipe is empty or the measuring tube electrodes are not wetted.

6.4 Magnetic sensors, programming with hand-held bar magnet

- The signal converter can **optionally** be equipped with magnetic sensors, see Sect. 4.1, Item 5.
- This allows programming of the signal converter by means of a hand-held bar magnet. Function of sensors without removing the front cover is the same as the corresponding keys. Sensor response is acknowledged by symbols in the 1st line of the display.
- Hold the bar magnet by the black rubber cap. Apply blue end of the magnet (north pole) to the glass pane above the magnetic sensors.

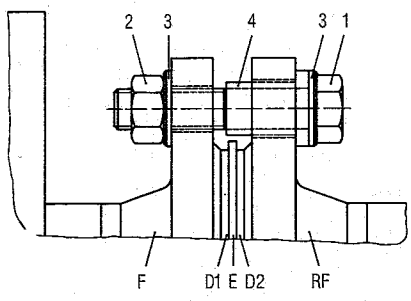
6.5 Installation and grounding in pipelines with cathodic protection for IFS 4000 and M 900

Pipes with electric corrosion protection are generally insulated inside and outside so that the liquid has no conductive connection to ground. The primary head must be insulated from the pipe. Note the following when installing the flowmeter:

- Grounding rings that are insulated from the pipe flange must be fitted to both sides of the flowmeter. Groundin rings, flowmeter and functional ground must be intercor nected.
- The pipe flanges must be connected to each other using copper cable (L) but must not be connected to the primai head.

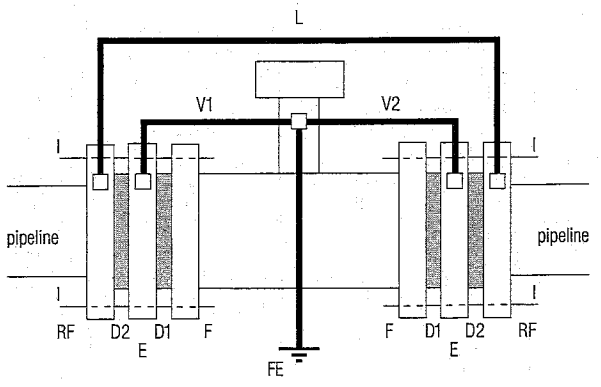
Insulated installation in the pipeline

Fit **insulated** stud bolts for the flange connections. Use **bushes and washers made of insulating material,** not included with supply, to be provided by customer.

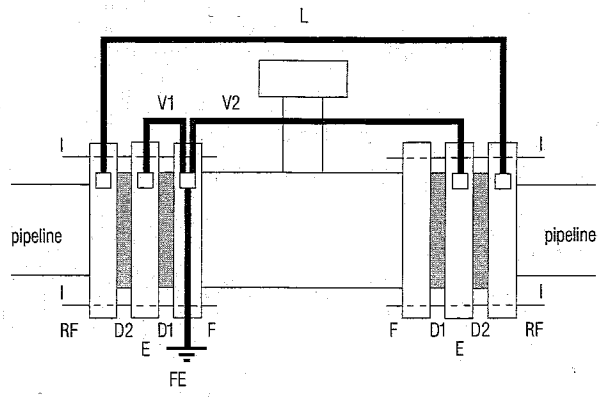


D1, D2	Gaskets, not included with supply, to be provided by customer
E	Grounding rings, option, see Sect. 1.3.6.
F	Flange, primary head
RF	Pipe flanges
1	Bolt
2	Nut
3	Washer
4	Insulator

Gronding IFS 4000



Grounding M 900



D1, D2 **Gaskets,** not included with supply, to be provided by customer

E **Grounding rings,** option, see Sect. 1.3.7.

F **Flanges, primary head**

FE **Functional ground,** cable ≥ 4 mm² Cu (10 AWG), not included with supply, to be provided by customer
IFS 4000: connection to U-clamp terminal on "neck" of primary head
M 900: connection to flange F of primary head.
Equip FE cable with cable lug for M6 bolt (M8 for ≥ DN 40 or ≥ 1½"), not included with supply, to be provided by customer

I **Insulated stud bolt**

L **Copper cable,** cross-section ≥ 4 mm² C (10 AWG), not included with supply, to be provide by customer

RF **Pipe flanges**

V1, V2 **Connecting wires,** bolted to grounding rings and to "neck" of the IFS 4000, or to flange F of th M 900.

7. Functional checks

7.1 Check of field power supply

Always switch off power source before connecting and disconnecting cables!

Connect milliammeter (Class 0.1% at 125 mA) **in series** to the field coils of the primary head (terminals 7/8). Make sure it is connected properly!

Power the system. Wait 15 minutes for system to warm up.

Plug jumper ⑦ **alternately** into the two positions "▲" on plug board ⑥ located on the front panel of the signal converter (see Sect. 4.1). 115 to 135 mA must be measured in both positions with the polarity **reversing** between the two positions.

The sum total must agree with the value stored under Fct. 4.10. Max. variation 1 mA.

Switch off the system!

Replace jumper ⑦ in normal position.

Disconnect milliammeter and **make sure** that the field power supply cable for the primary head is **properly** connected to terminals 7 and 8.

7.2 Zero check

Always switch off power source before connecting and disconnecting cables!

Set "zero" flow in the pipeline, but make sure that the **primary head** is **completely filled** with fluid.

If this is not possible, switch off the signal converter, remove signal cable from terminals 1, 2 + 3 in the terminal box and short terminals 1, 2 + 3 together.

Switch on the signal converter and wait 15 minutes.

Press the following keys for zero measurement (Fct. 1.07):

- ➡➡⬆⬆E E
- If *"Err..."* appears on the display, press the E key; otherwise proceed as follows.
- ➡, 5(6) ✶ ⬆ key, display: *Fct. 1.07 ZERO CALIB.*
- ➡, display *"CALIB. NO"* (= do not perform zero measurement)
- ⬆, display *"CALIB. YES"* (= perform zero measurement)
- E, **zero measurement in progress,** duration approx. 45 seconds. Display: actual flowrate 0.0% of full-scale range, max. deviation ± 0.2%; if greater, check whether flowrate is actually "zero".
- **After zero measurement:**
  Display *"STORE NO"* (= do not store new zero value, retain old value).
  Press ⬆ key, display *"STORE YES"* (= store new zero value).
- Regardless of whether the new zero value is to be stored or not, **exit** from the **programming mode** as follows:
  Press E key 5 ✶; signal converter reverts to measuring mode.
- If terminals 1, 2 + 3 had been shorted together (see above), switch off signal converter, remove shorting jumpers, and reconnect signal cable to terminals 1, 2+3.

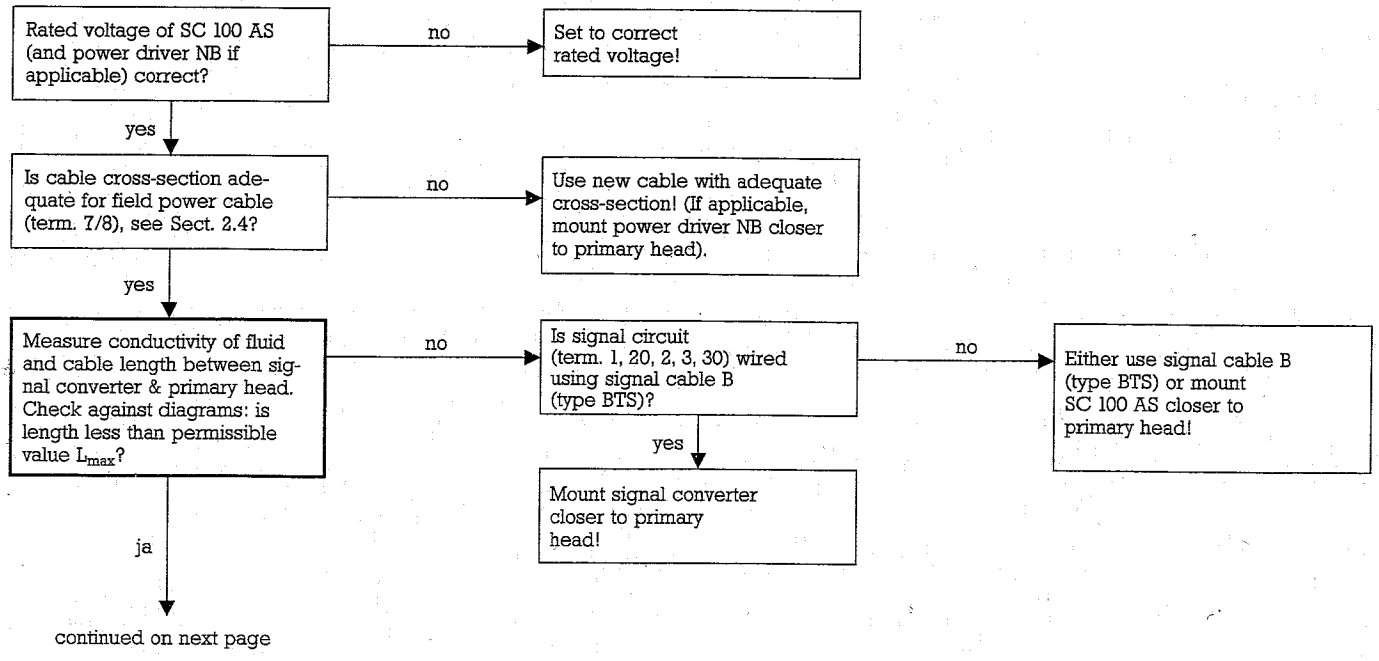
7.3 System check-out

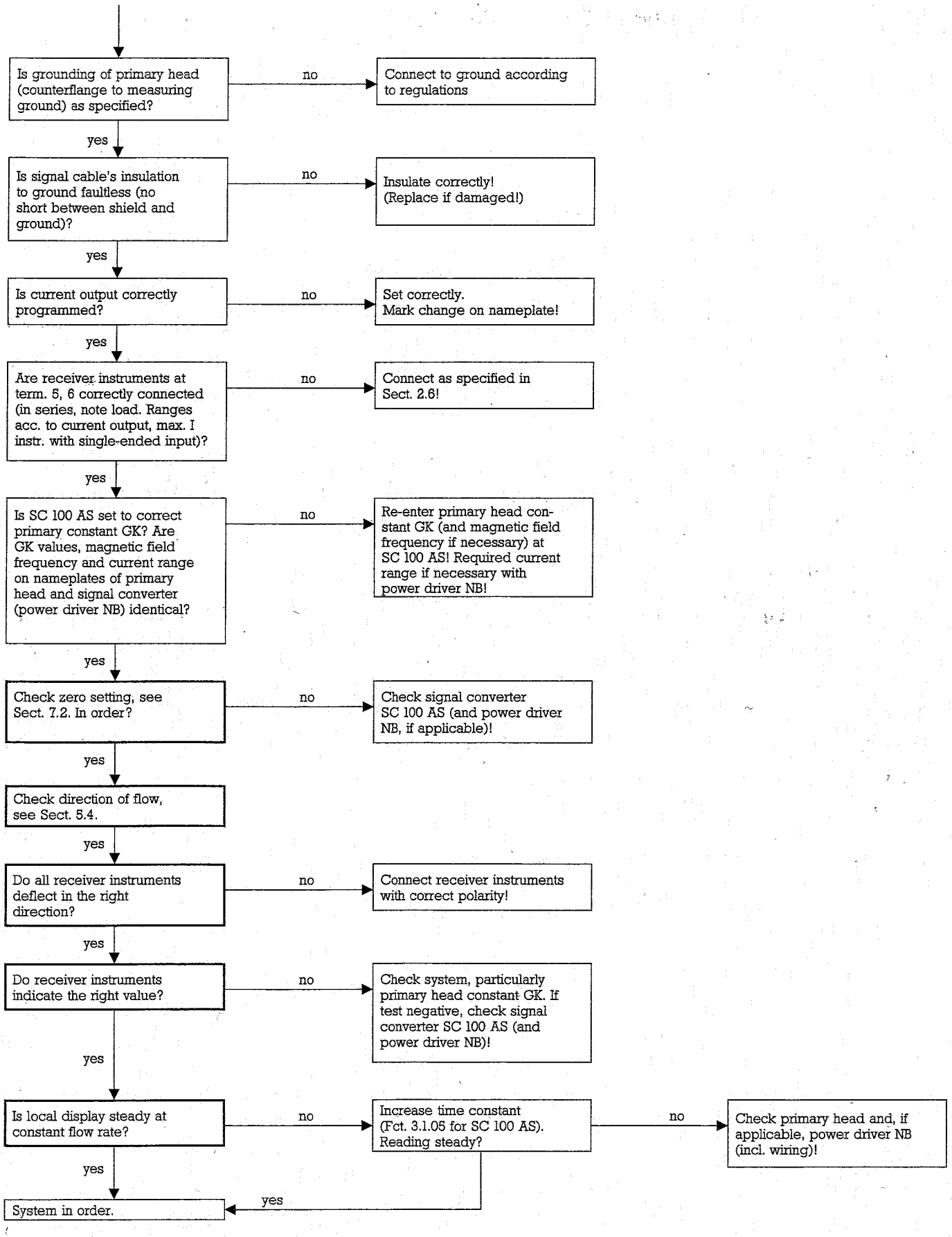
Always switch off power source before connecting and disconnecting cables!

The test points in boxes with thin line borders need only be checked when:

1. The system has been newly installed,
2. Signal converter or primary head has been replaced,
3. The wiring arrangement has been changed.

The test points in boxes with **thick** line borders should be checked every time the system is tested.





If you have to return your ALTOFLUX flowmeter to Krohne, please note information given on page 83!

Condensed Instructions – SC 100 AS

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Programming and function of keys

After powering, the signal converter enters the normal measuring mode.

Programming start

Key	**Display** *1st line [2nd line]*	Comments
➡ ➡ ⬆ ⬆ E E or E	**(ENTER 1, 2, 3, 4, 5]**	**with** **without** **Coding,** dependent on programming of Fct. 4.02 (*YES* or *NO*), refer to Sect. 4.6 + 5.12
⬆ E	*Err. 01...16* *Err. 02...16*	**Error(s) in measuring mode,** see E-List, Sect. 4.4 appears only, if one or more errors have occurred during measuring operation display next error, if more than one terminate error display
	Fct. 1.00 [FLOW DATA]	**Main menu level,** 1st main menu displayed, continued as described below

Function of keys in main menu, submenu, functional and data levels, see Sect. 4.6

Key	Main menu level	Submenu level Functional level	Data level	
			Data/Units	Numerical values
⬆	Select main menu	Select submenu or function	Select next proposal	Increase flashing digit (cursor) by 1
➡	Enter displayed main menu	Enter displayed submenu or function	Return to functional level, previous data/units retained	Shift flashing digit (cursor) 1 place to the right. **Note:** If in last position, system will revert to functional level, last numerical value retained
E	———	Revert to main menu or submenu level	Revert to functional level, store new data, units or numerical values temporarily. *	

* Flashing display *Err. 0000 < MIN* or *Err. 9999 > MAX* = numerical value too low or too high. Press any key to obtain display of permissible minimum or maximum value, then enter correct numerical value.

Important

1. Continuously pressing the ➡ or ⬆ key will cause the function of these keys to be continuously repeated (autorepeat function).
2. If no keystrokes are made for approx. 180 seconds, the signal converter will automatically revert to the measuring mode without accepting any changed data into the measuring program (time-out function). **Exception:** if at start of programming errors *Err. E04, E05* and/or *E14* are established, see Sect. 4.4.

Newly entered data will only be accepted into the measuring program if the programming mode is terminated by following the procedure below.

Programming end

Key	**Display** *1st line [2nd line]*	Comments
1, 2 or 3 x E	*Fct. 1.00...4.00*	Select main menu level
E E E	*Actual measured value*	**Revert to measuring mode level** Plausibility check, lasts approx. 5 seconds **No error** in plausibility check, any changed data accepted into measuring program, actual measured value displayed (measuring mode level)
⬆ E	*Err. P01...14* *Err. P02...14* *Fct. 1.00 [FLOW DATA]*	**Error(s)** in plausibility check, see P-List, Sect. 4.5 Display next error, if more than one Terminate error display and revert to main menu level, 1st main menu displayed, select faulty function(s) and correct data, see Sect. 4.6

Totalizer reset

Key	**Display** *[2nd line]*	Comments
➡ E ⬆	*[ENTER 1, 2]*	Measuring mode **not** interrupted
E E E	*[TOT. RESET]* *Actual measured value*	Totalizer reset **Measuring mode level,** actual measured value displayed

Clearing error messages in measuring mode, see Sect. 4.4

Key	**Display** *1st line [2nd line]*	Comments
➡ ➡ ⬆ ⬆ E E or E	*[ENTER 1,2,3,4,5]*	**with** **without** Coding, dependent on programming of Fct. 4.02 (*YES* or *NO*), refer to Sect. 4.6 + 5.12
E	*Err. E01...E16* *Fct. 1.00 [FLOW DATA]*	Error messages (not with *Err. E04, E05* and/or *E14*) **Main menu level**
E E E	*Actual measured value*	**Measuring mode level,** actual measured value displayed

Table of programmable functions

Fct. No.	Text	**Description** and input
1.00	*FLOW DATA*	**Main menu 1.00 Measurement**
1.01	*FULL SCALE*	**Full-scale range for flowrate $Q_{100\%}$** *Unit:* select from list (Sect. 5.1) Range: (Sect. 5.3): *0.0034 to 542900 m^3/hr* or *0.8962 to 143400000 US G/min* After selecting unit, call numerical value with ➡ key, 1st digit flashes
1.02	*REV. SCALE*	**Different range for reverse flow?** *NO* or *YES*
1.03	*VALUE*	**Full-scale range for reverse flow** (appears only if *YES* entered under Fct. 1.02) *Unit:* select from list (Sect. 5.1) Range: (Sect. 5.3): *0.0034 to 542900 m^3/hr* or *0.8962 to 143400000 US G/min* *Value must not be greater than that of Fct. 1.01* *After selecting unit, call numerical value with* ➡ key, 1st digit flashes
1.04	*DIAMETER*	**Meter size** Unit in *mm* or *inch* Range: *2 to 4000 mm* or *0.0787 to 157.5 inch* After selecting unit, call numerical value with ➡ key, 1st digit flashes
1.05	*GK VALUE*	**Primary constant GK** (see primary head nameplate) Range: *0.5 to 14*
1.06	*FLOW DIR.*	**Define direction of forward (normal) flow** Enter acc. to direction of arrow *(+ or −)* on primary head
1.07	*ZERO CALIB.*	**Zero calibration** (Sect. 7.2) Carry out only at "0" flow and when measuring tube compl. filled with fluid! 1) Inquiry: *CALIB. NO* or *YES* 2) If *YES:* calibration (duration 45 sec) with zero display in *PERCENT* of $Q_{100\%}$ 3) Inquiry: *STORE NO* or *YES*
2.00	*DISPLAY*	**Main menu 2.00 Display**
2.01	*DISP. FLOW*	**Unit for flowrate display** ● *m^3/Sec* ● *m^3/min* ● *m^3/h* ● *Liter/Sec* ● *Liter/min* ● *Liter/h* ● *US G/Sec* ● *US G/min* ● *US G/h* ● *h Liter/hr* or *US MG/DAY* (=hectoliters per hour, for US version US million gallons per day) factory set, can be changed as required via Fct. 4.04, 4.05+4.06 (Sect. 5.14) ● *PERCENT* ● *NO DISPLAY*
2.02	*UNIT TOTAL.*	**Unit for totalizer display** ● *m^3* ● *Liter* ● *US G* ● *h Liter* or *US MG* (hectoliters or US million gallons) see Fct.No. 2.01 *(h Liter/hr* or US G/DAY)
2.03	*DISP. TOTAL.*	**Function of totalizer display** ● *+ TOTAL.* (= forward totalizer) ● *− TOTAL.* (= reverse totalizer) ● *+/− TOTAL.* (= forward and reverse flow totalizers, alternating) ● *SUM TOTAL.* (= sum of + and − totalizers) ● *ALL TOTAL.* (= sum, + and − totalizers, alternating) ● *NO DISPLAY* (= totalizer switched on but no display) ● *TOTAL. OFF* (= totalizer switched off)
2.04	*ERROR MSG*	**Which error messages to be displayed?** (Sect. 4.4) ● *NO MESSAGE* (= no error messages) ● *ADC ERROR* (= only ADC conversion errors) ● *TOT. ERROR* (= only errors of internal totalizer) ● *ALL ERROR* (= all errors)
2.05	*DISP. TEST*	**Carry out display test** Start with ➡ key

Fct. No.	Text	**Description** and input
3.00	*OUTPUTS*	**Main menu 3.00 Outputs**
3.1.00	*CUR. OUTP. I*	**Submenu 3.1.00** **Current output (I),** Sect. 5.7
3.1.01	*FUNCTION I*	**Function, current output (I)** ● *OFF* (= switched off) ● *F/R IND. F* (= F/R indication for F) ● *1 DIR.* (= 1 flow direction) ● *I< I 0 PCT.* (= **F**orward/**R**everse flow, e.g. in 0-20 mA range: **F**=10-20 mA, **R**=10-0 mA) ● *2 DIR.* (= forward/reverse flow, F/R measurement)
3.1.02	*I 0 PCT.*	**Current for 0% flow** ($I_{0\%}$) Range: *00 to 16 mA*
3.1.03	*I 100 PCT.*	**Current for 100% flow,** Full-scale range ($I_{100\%}$) Range: *04 to 20 mA* (Value at least 4 mA greater than that of Fct. 3.1.02)
3.1.04	*I MAX mA*	**Adjustment of max. output current** (I_{max}) Range: *04 to 22mA* (Value must be greater than/equal to that of Fct. 3.1.03)
3.1.05	*T-CONST. I*	**Time constant, current output** Range: *0.2 to 3600 Sec.*
3.1.06	*L.F.CUTOFF I*	**Low-flow cutoff (SMU) for current output?** *NO* or *YES* (Sect. 5.9)
3.1.07	*CUTOFF ON*	**Cutoff "on" value SMU-I** (appears only if *YES* entered under Fct.No. 3.1.06) Range: *01 to 19 PERCENT*
3.1.08	*CUTOFF OFF*	**Cutoff "off" value SMU-I** (appears only if *YES* entered under Fct. 3.1.06) Range: *02 to 20 PERCENT* (Value must be greater than that of Fct. 3.1.07)
3.2.00	*FRE. OUTP. F*	**Submenu 3.2.00** **Frequency output (F),** Sect. 5.8
3.2.01	*FUNCTION F*	**Function, frequency output (F)** ● *OFF* (= switched off) ● *F/R IND. I (= F/R indication for I)* ● *1 DIR.* (= 1 flow direction) ● *2 DIR.* (= forward/reverse flow, F/R measurement)
3.2.02	*PULSOUTP.*	**Unit, frequency output** ● *PULSRATE* (= input in pulses per unit time) ● *PULSE/UNIT* (= input in pulses per unit volume)
3.2.03	*PULSRATE*	**Pulse rate for 100% flowrate** (appears only if *PULSRATE* entered under Fct. 3.2.02) Range: *2.778*10^{-3} to 10000 pulses/Sec* *0.1667 to 600 000 pulses/min* *10 to 36 000 000 pulses/hr* After selecting unit, call numerical value with ➡ key, 1st digit flashes
3.2.04	*PULSE/UNIT*	**Pulse value** (appears only if *PULSE/UNIT* entered under Fct. 3.2.02), Unit in pulses per m^3, Liter, US G or unit of Fct. 4.04, 4.05 + 4.06 (Sect. 5.14) – Range: *0.0001 to 0.9999*10^9 pulses* [**no** input check but: $Q_{100\%}$* pulse value ≤ 36 000 000 pulses ≙ 10 kHz] After selecting unit, call numerical value with ➡ key, 1st digit flashes
3.2.05	*PULS WIDTH*	**Pulse width for frequencies ≤10Hz** ● *30mSec.* ● *50mSec.* ● *100mSec.* ● *200mSec.* ● *500mSec.*
3.2.06	*T-CONST. F*	**Time const. for frequency output** *T< F> = 0.2 Sec.* *T< F> = T< I>* (= time constant for F same as for I, Fct. 3.1.05)
3.2.07	*L.F.CUTOFF F*	**Low-flow cutoff (SMU) for frequency output** *NO* or *YES* (Sect. 5.9)

Fct. No.	Text	Description and input
3.2.08	CUTOFF ON	**Cutoff "on" value SMU-F** (appears only if *YES* entered under Fct. 3.2.07) Range: *01 to 19 PERCENT*
3.2.09	CUTOFF OFF	**Cutoff "off" value SMU-F** (appears only if *YES* entered under Fct. 3.2.07) Range: *02 to 20 PERCENT* (Value must be greater than that of Fct. 3.2.08)
3.3.00	IND. OUTP. S	**Submenu 3.3.00 Status indication output (S),** Sect. 5.16
3.3.01	FUNCTION S	**Funct. of status indication output** ● *OFF* (= switched off, 0 V at term. 4/43) ● *ON* (= switched on, 24 V at term. 4/43, e.g. as operational status indicator ● *F/R IND. I (= F/R indication* for I), Sect. 5.10 ● *F/R IND. F* (= F/R indication for F), Sect. 5.10 ● *AUTO. RANGE* (= automatic range change), Sect. 5.16 ● *I TRIP. PT.* (= trip point I as % of $Q_{100\%}$, Fct. 3.3.03) ● *F TRIP. PT.* (= trip point F as % of $Q_{100\%}$, Fct. 3.3.04) ● *L.F.CUTOFF I (= low-flow cutoff I),* Fct. 3.1.06 ● *L.F.CUTOFF F* (= low-flow cutoff F) Fct. 3.2.07 ● *ADC ERROR* ● *TOT. ERROR* } s. E-List Sect. 4.4 ● *ALL ERROR*
3.3.02	AUTO. RANGE	**Automatic range change for current output,** see Sect. 5.17 (appears only if *AUTO. RANGE* entered under Fct. 3.3.01) Range: *05 to 80 PERCENT* of $Q_{100\%}$, (Value must be greater than SMU-I cutoff "on" value, Fct. 3.1.07)
3.3.03	I TRIP PT.	**Trip point for current output,** Sect. 5.18 (appears only if *I TRIP PT.* entered under Fct. 3.3.01) Range: *001 to 110 PERCENT* of $Q_{100\%}$ (Value must be greater than SMU-I cutoff "off" value, Fct. 3.1.08)
3.3.04	F TRIP PT.	**Trip point for frequency output,** Sect. 5.18 (appears only if *F TRIP PT.* entered under Fct. 3.3.01) Range: *001 to 115 PERCENT* of $Q_{100\%}$ (Value must be greater than SMU-F cutoff "off" value, Fct. 3.2.09)

Fct. No.	Text	Description and input
4.00	SPEC. FCT.	**Main menu 4.00 Special functions**
4.01	LANGUAGE	**Language of display texts,** Sect. 5.11 ● *GB/USA* (= English) ● *D* (= German) ● *F* (= French) ● *SF* (= Finnish) ● others pending
4.02	ENTRY CODE	**Coding for entry into programming mode?** Sect. 5.12 ● *NO* = entry with **E** key ● *YES* = entry with keys → → ↑ ↑ E E
4.03	OUTP. HOLD	**Hold values of outputs during programming?** *NO* or *YES* (Sect. 5.13)
4.04	UNIT TEXT	**Text for field-programmable unit,** Sect. 5.14 *A...Z / a...z / 0...9 / ___* (= space)
4.05	FACT. QUANT.	**Conversion factor for quantity F_M,** Sect. 5.14 Factor F_M = quantity per 1 m^3 Range: $0.00001*10^{-9}$ to $9.99999*10^{+9}$
4.06	FACT. TIME	**Conversion factor for time F_T** Sect. 5.14 Factor F_T in seconds Range: $0.00001*10^{-9}$ to $9.99999*10^{+9}$
4.07	FIELD FREQ.	**Magnetic field frequency,** Sect. 5.15+8.2 ● *1/6* ● *1/16* ● *1/32*
4.08	NOISE	**Noise rejection,** Sect. 6.2 ● *NO NOISE* ● *NOISE*
4.09	REF. SEL.	**Selecting the reference voltage** Sect. 6.2 ● *AUTO. REF.* (= automatic reference) ● *HIGH-FLOW* (= high flow range) ● *MED1-FLOW* (= 1st medium flow range) ● *MED2-FLOW* (= 2nd medium flow range) ● *MED3-FLOW* (= 3rd medium flow range) ● *LOW FLOW* (= low flow range)
4.10	FIELD CUR.	**Input of field current** Range: *225.00 to 275.00 mA* (see sticker at term 7 + 8 on "basic" pc board/with power driver NB 900 F always ± 250 mA) Must not be changed, Sect. 7.2 + 8.1!

Please note: signal converter **SC 100 AS/HPC/S,** new structure of main menu 4.0 special functions

Fct. No.	Text	Description and input
4.00	SPEC. FCT.	**Main menu 4.00 Special functions**
4.01	LANGUAGE	**Language of display texts,** Sect. 5.11 ● *GB/USA* (= English) ● *D* (= German) ● *F* (= French) ● *SF* (= Finnish) ● others pending
4.02	ENTRY CODE	**Coding for entry into programming mode?** Sect. 5.12 ● *NO* = entry with **E** key ● *YES* = entry with keys → → ↑ ↑ E E
4.03	OUTP. HOLD	**Hold values of outputs during programming?** *NO* or *YES* (Sect. 5.13)
4.04	UNIT TEXT	**Text for field-programmable unit,** Sect. 5.14 *A...Z / a...z / 0...9 / ___* (= space)
4.05	FACT. QUANT.	**Conversion factor for quantity F_M,** Sect. 5.14 Factor F_M = quantity per 1 m^3 Range: $0.00001*10^{-9}$ to $9.99999*10^{+9}$
4.06	FACT. TIME	**Conversion factor for time F_T** Sect. 5.14 Factor F_T in seconds Range: $0.00001*10^{-9}$ to $9.99999*10^{+9}$

Fct. No.	Text	Description and input
4.07	FIELD FREQ.	**Magnetic field frequency,** Sect. 5.15+8.2 ● *1/6* ● *1/16* ● *1/32*
4.08	SCALE SEL.	**Select preamplification,** Sect. 13 ● *AUTO* (automatic) ● *HIGH FLOW* (high flow range) ● *MED. FLOW* (medium flow range) ● *LOW FLOW* (low flow range)
4.09	FIELD CUR.	**Input of field current** Range: *225.00 to 275.00 mA* (see sticker at term 7 + 8 on "basic" pc board/with power driver NB 900 F always ± 250 mA) Not to be changed, see Sect. 7.2 + 8.1
4.10	NOISE	**Noise rejection,** see Sect. 13 ● *NO* ● *YES*
4.11	LIMIT CNT	Counter for off-limit condition (appears only if *YES* entered under (Fct. 4.10 *NOISE*), see Sect. 13 Range: *001* to *250*
4.12	LIMIT VAL	**Limit value for noise amplitude** (appears only if *YES* entered under Fct. 4.10 *NOISE*), see Sect. 13 Range: *01* to *90 PERCENT*

Plausibility check, P-List

Err. P..	*Text*	**Description**
Err. P01	*V RANGE*	Velocity v outside possible range (0.3 to 12 m/s or 1 to 40 ft/s) *FULL SCALE* (Fct. 1.01) <> *DIAMETER* (Fct. 1.04)
Err. P02	*REV. SCALE*	*REV. SCALE* (Fct. 1.03) > *FULL SCALE* (Fct. 1.01)
Err. P03	*I RANGE*	*I 0 PCT.* (Fct. 3.1.02) > *I 100 PCT.* (Fct. 3.1.03) or difference < 4 mA
Err. P04	*I MAX mA*	*I MAX mA* (Fct. 3.1.04) < *I 100 PCT.* (Fct. 3.1.03)
Err. P05	*I CUTOFF*	*I: CUTOFF ON* (Fct. 3.1.07) ≥ *CUTOFF OFF* (Fct. 3.1.08)
Err. P06	*F CUTOFF*	*F: CUTOFF ON* (Fct. 3.2.08) ≥ *CUTOFF OFF* (Fct. 3.2.09)
Err. P09	*F > 10 KHZ*	*Frequency* for $Q_{100\%}$ > *10 kHz*
Err. P10	*PULS WIDTH*	Max. pulse width exceeded (see Fct. 3.2.05)
Err. P12	*RNG./CUTOFF*	2nd range of automatic range change (see Fct. 3.3.02) ≤ I *CUTOFF ON* (see Fct. 3.1.07)
Err. P14	*I TRIP PT.*	*I TRIP PT.* (Fct. 3.3.03) outside range of current output (see Fct. 3.1.04)

Error messages, E-List

E-List Error messages		**Description of error**	**Rectify instrument fault** and/or **clear error message**	**Error output in measuring mode vi – Display** (Fct. 2.04) **and/or – Status indication output** (Fct. 3.3.0 dependent on programming			
Display				*NO MESS.*	*ADC ERROR*	*TOT. ERROR*	*ALL ERROR*
1st line*	2nd line						
Err. E01	*LINE INT.*	**Power failure since last programming** Note: no counting during power failure	□ reset totalizer(s) if necessary	–	–	yes	yes
Err. E02	*TOTALIZER*	**Counts lost or totalizer overflow** Note: totalizer was reset!	□	–	–	yes	yes
Err. E03	*DISPLAY*	**Numerical overflow of display** Display 1st line: ≡≡≡≡≡≡≡ Display 3rd line: note ▼ Marker!	Check data Fct. 2.00	–	–	–	yes
Err. E04	*EEPROM 1*	**Data error in EEPROM 1 (parameters)**	Check instrument parameters ○	* *	* *	* *	* *
Err. E05	*CAL. DATA*	**Calibration data lost**	Recalibrate signal converter, please consult factory	* *	* *	* *	* *
Err. E06	*EEPROM 2*	**Data error in EEPROM 2 (totalizer)** Note: totalizer deviation possible	□ reset totalizer(s) if necessary	–	–	yes	yes
Err. E07	*RAM*	**Check-sum error in RAM**	○	–	–	–	yes
Err. E08	*ROM*	**Check-sum error in ROM**	○	–	–	–	yes
Err. E09	*ADC*	**ADC value overranged or ADC defective**	○	–	yes	–	yes
Err. E12	*FREQ.OUTP. F*	**Frequency output overranged**	□ If necess., check data, Fct. 3.2.00	–	–	–	yes
Err. E13	*CUR.OUTP. I*	**Current output overranged**	□ If necess., check data, Fct. 3.1.00	–	–	–	yes
Err. E14	*EE1 EE2*	**Current calibration values EPPROM 1+2 are different** (occurs only when pc board changed)	Terminate programming mode (press **E** key 4x), values corrected automatically	* *	* *	* *	* *
Err. E16	*FUSE*	**F5 fuse for power failure identification defective**	Fit new F5 fuse, see Sect. 8.5	yes***	yes***	yes***	yes

* When errors are displayed during the measuring mode, "*a numeral*" and "*Err.*" will appear in the 1st line.
The numeral gives the number of momentarily occurring errors that are displayed alternately with the actual measured value.

* * No output in measuring mode! With these errors, the signal converter is automatically in the programming mode.

* * * No output via status indication output (Fct. 3.3.01)

□ Invoke and then terminate programming mode.
Keystrokes: 2 x ➡ / 2 x ⬆ / 2 x **E** and 4 x **E** **or** 1 x **E** and 4 x **E** (dependent on programming in Fct. 4.02)

○ Invoke and then terminate programming mode.
Keystrokes: 2 x ➡ / 2 x ⬆ / 2 x **E** and 4 x **E** **or** 1 x **E** and 4 x **E** (dependent on programming in Fct. 4.02)
Consult factory if these errors occur several times in succession.

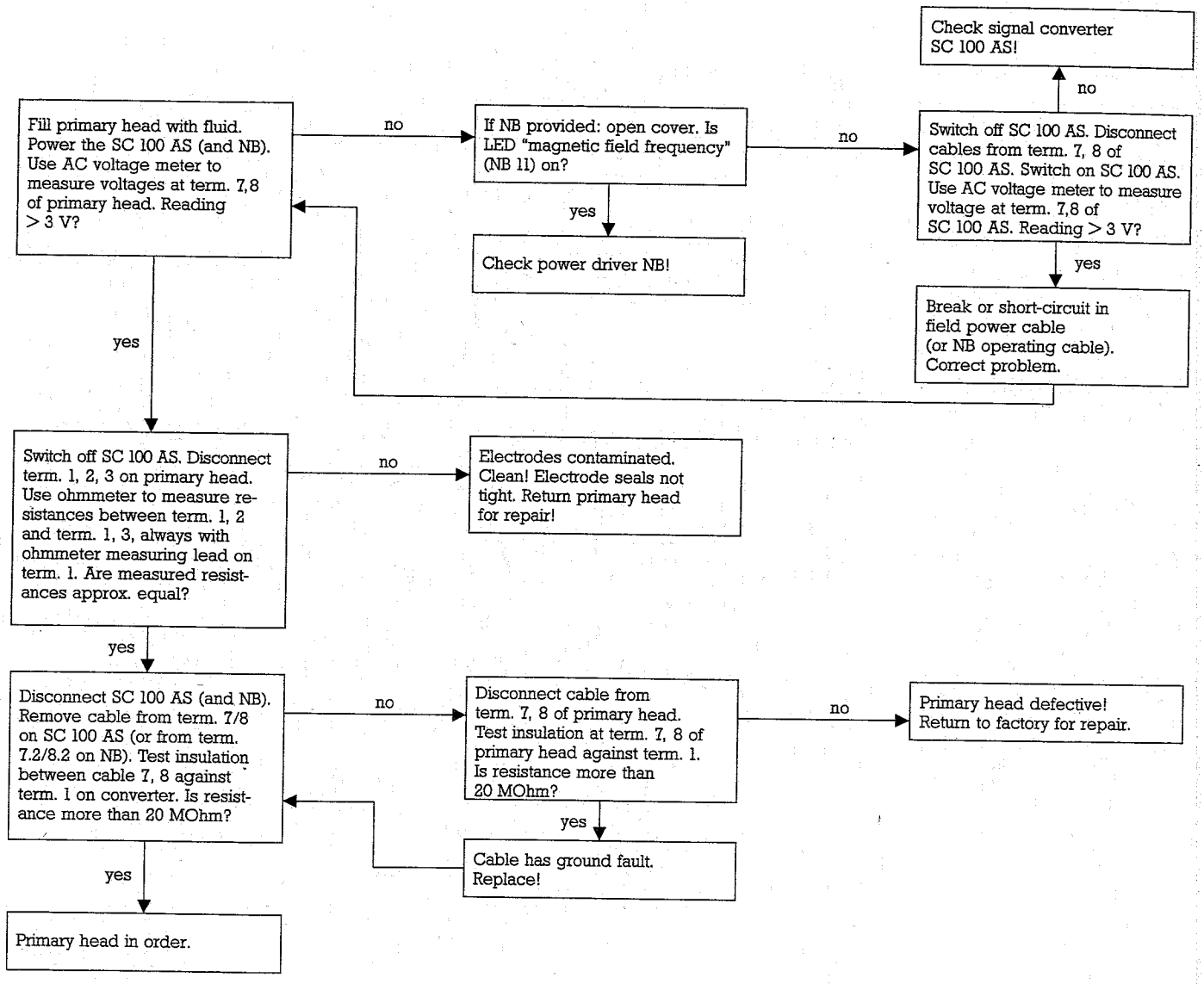
Contents, condensed operating instructions – SC 100 AS

The Sect. Nos. referred to in these Condensed Instructions will be found in the SC 100 AS Installation and Operating Instructions

7.4 Testing of primary head

Always switch off power source before connecting and disconnecting cables!

Required measuring instruments:
ohmmeter with at least 6 Volt range or AC voltage/resistance bridge, AC voltage multirange instrument.



If you have to return your ALTOFLUX flowmeter to Krohne, please note information given on page 83!

7.5 Testing of signal converter SC 100 AS

Always switch off power source before connecting and disconnecting cables!

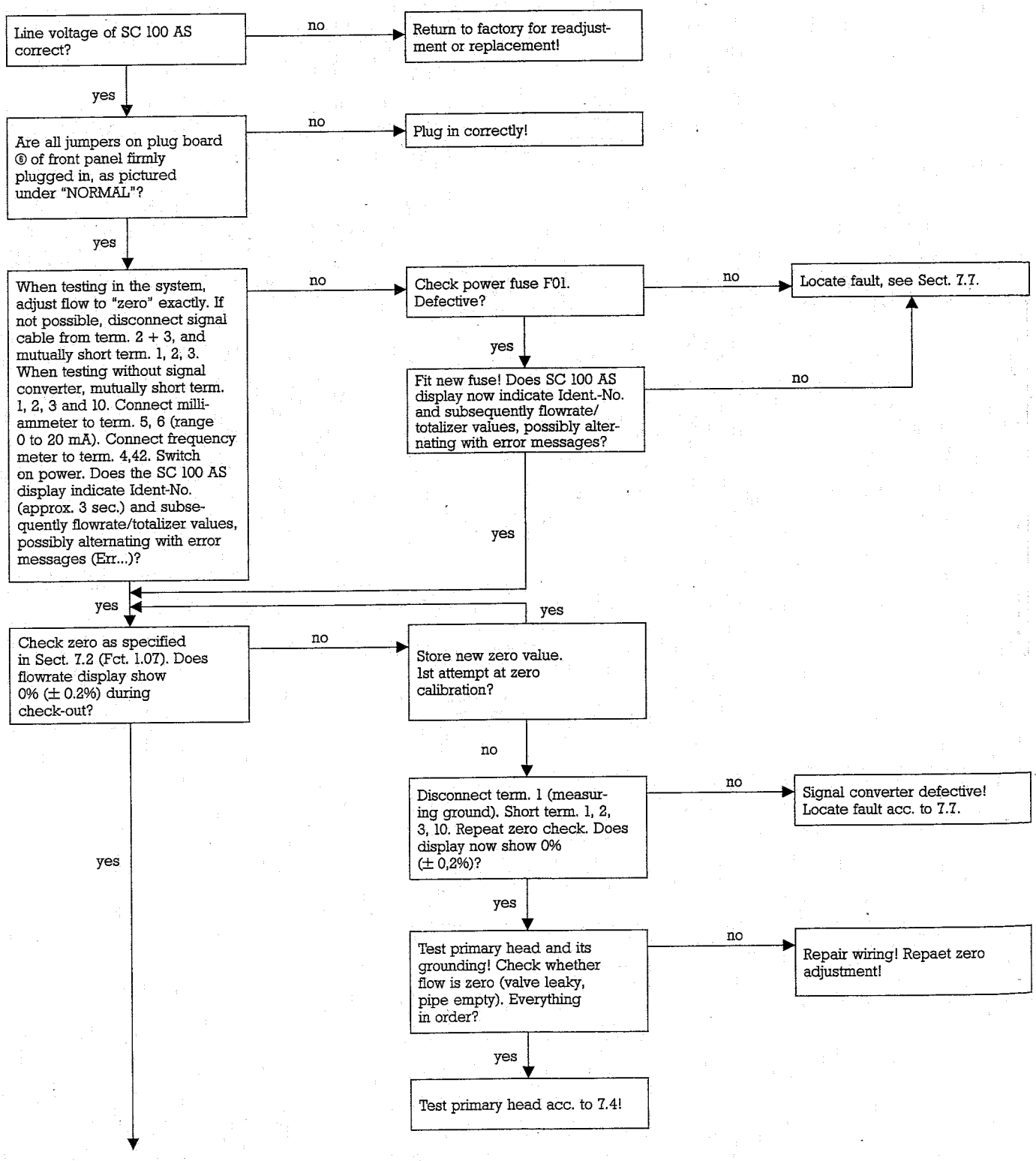
The testing procedure is designed to provide information on the functionality and correct programming of the SC 100 AS.

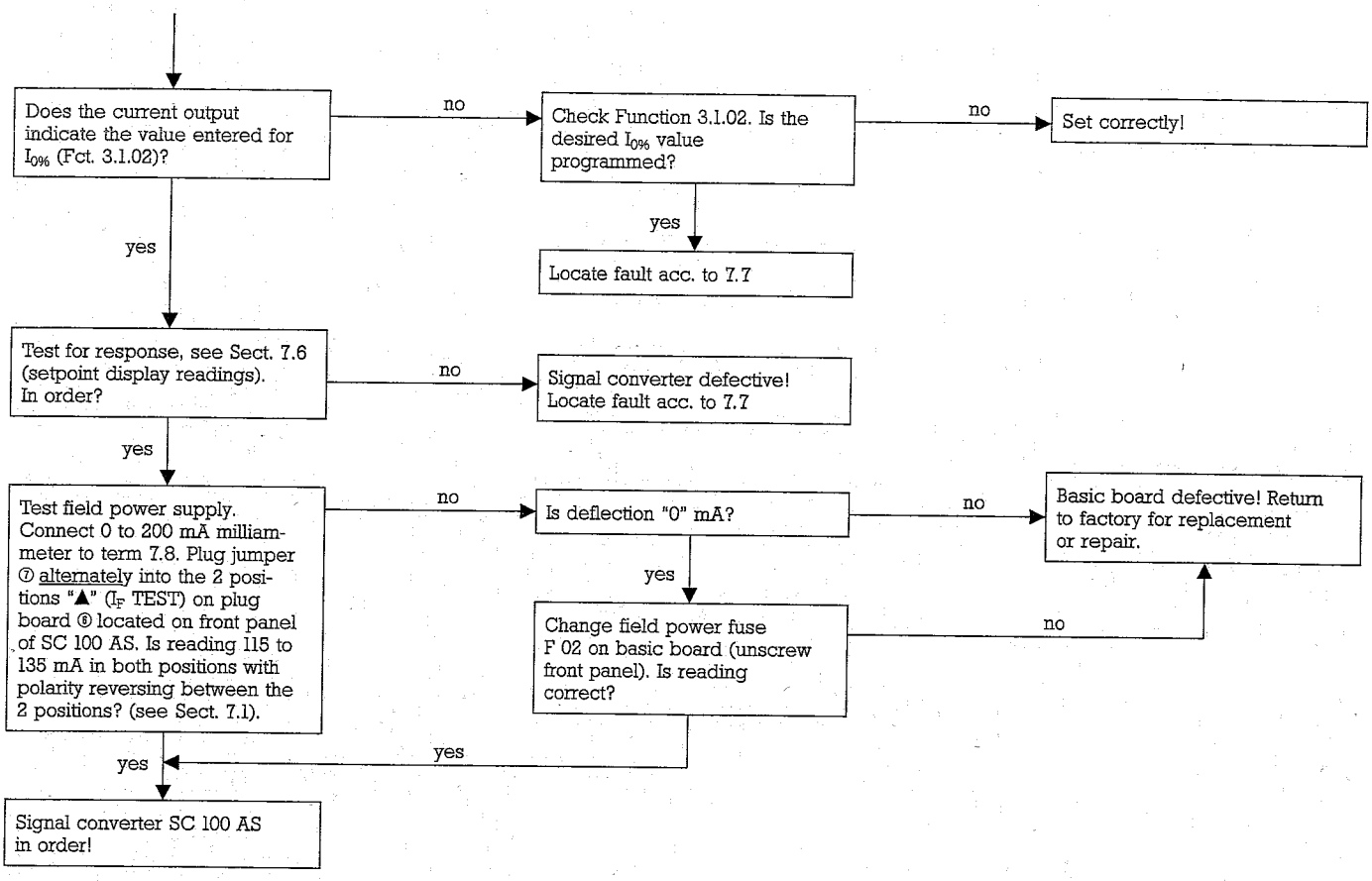
The cause of faults or setpoint deviations can be determined with the aid of the troubleshooting instructions, Sect. 7.7.

Required instruments

- Ammeters: 0 to 20 mA, Class 0.1 and 0 to 200 mA, Class 0.1
- Primary head simulator GS 8
- Frequency meter: Range 0 to 10 kHz, Time base 1 or 10 s, Load > 2 kOhm

Testing can also be carried out without the frequency meter.

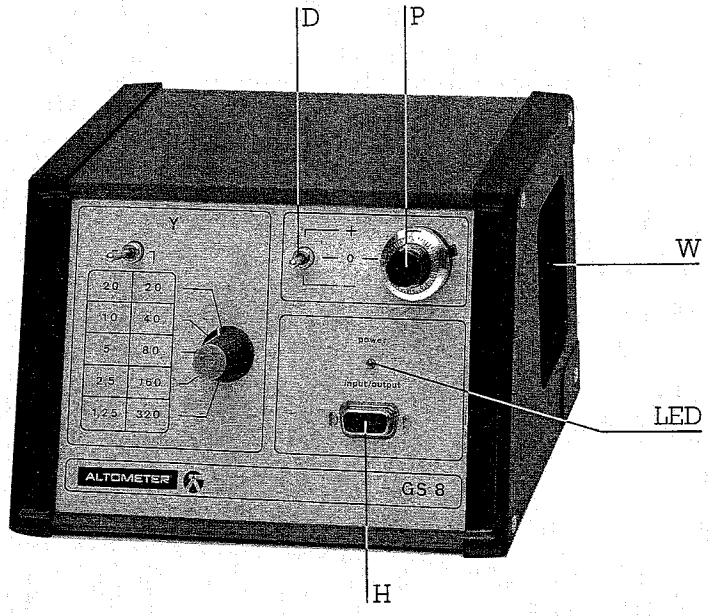




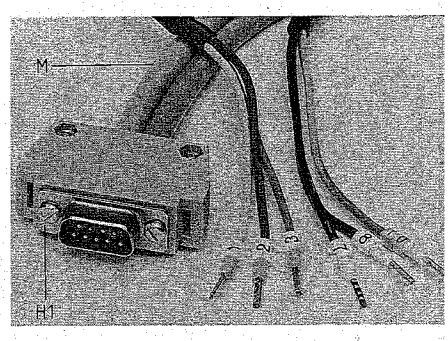
If you have to return your ALTOFLUX flowmeter to Krohne, please note information given on page 83!

7.6 Setpoint display SC 100 AS with primary head simulator GS 8

7.6.1 GS 8: Operating elements and connection cable



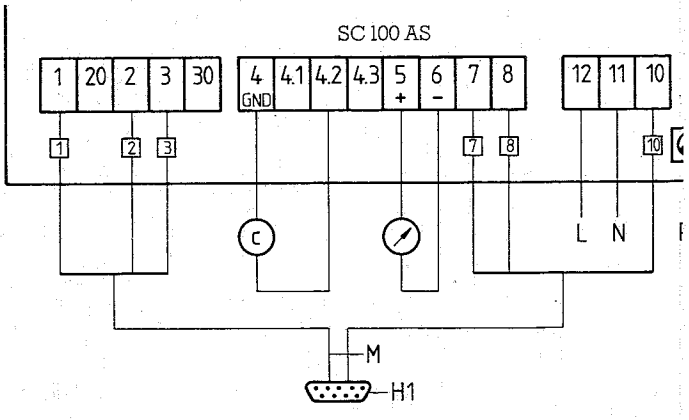
D switch, flow direction
H socket for plugs **H1** of connection cables **M**
LED power supply "on"
P potentiometer "zero point"
W compartment for connection cables **M**
Y switches measuring ranges
M connection cable between SC 100 AS and GS 8



7.6.2 Electrical connection between SC 100 AS and GS 8

1. **Switch off power source!**
2. Remove cover from connection compartment.
3. Disconnect primary head cables from terminals 1, 2 (20), 3 (30), 7 + 8.

   Important:
   note terminal assignment beforehand!
4. Electrical connection as shown in the following diagram using 2 round cables **M**. Insert plug connector **H1** into socket **H** on the front panel of the GS8.



Ⓜ = milliammeter
accury class 0.1

R_i < 800 ohms

range 0 to 20 mA

Ⓒ = electronic frequency counter
input resistance min. 1 kOhm

range 0 to 10 kHz

time base min. 1 second

7.6.3 Check of setpoint display

1. Switch on power source, allow at least 15 minutes' warm-up time.
2. Set switch **D** (front panel GS8) to "0" position.
3. Adjust zero with the 10-turn potentiometer **P** (front panel GS8) to $I_{0\%} \pm < 10\ \mu A$.
4. Determine position of switch **Y** and setpoints I and f as follows:

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

$Q_{100\%}$ = full-scale range (100%) in volumetric units **(V)** per unit time **(t)**

GK = primary constant (see primary head nameplate)

F = 2, if GK value begins with "L"
= 1, GK value without L

DN = meter size in mm or inches

t = time in seconds (Sec.) minutes (min), hours (hr)

V = volume

K = constant, see following Table

DN	**V** \ t	Sec.	min	hr
mm	Liter	25464	424.4	7.074
	m^3	25464800	424413	7074
	US gal	96396	1607	26.78
inches	Liter	39.47	0.6578	0.0196
	m^3	39470	657.8	10.96
	US gal	149.4	2.49	0.0415

4.2 Determine position of switch Y

Use table (front panel GS8) to determine the value Y which comes closest to the factor X and meets condition $Y \leq X$.

4.3 Calculate setpoint reading (I) current output

$$I = I_{0\%} + \frac{Y}{X} (I_{100\%} - I_{0\%})\ [mA]$$

$I_{0\%}$ = current at 0% flowrate, see Fct. 3.1.02 (e.g. 4 mA, at 4 to 20 mA)

$I_{100\%}$ = current at 100% flowrate, see Fct. 3.1.03 (e.g. 20 mA, at 0/4 to 20 mA)

4.4 Calculate setpoint reading (f) frequency output

$$f = \frac{Y}{X} * f_{100\%}\ [Hz]$$

$f_{100\%}$ = pulses per second at 100% flowrate, see Fct. 3.2.03

5. Set switch **D** (front panel GS8) to position „+" or "–" (forward or reverse flow).
6. Set switch **Y** (front panel GS8) to the value determined by the method described above.
7. Check setpoint readings I or f (see Points 4.3 and 4.4).
8. Deviation < 1.5% of setpoint! If greater, locate fault as described in Sect. 7.5 + 7.7. First check field power supply as described in Sect. 7.1.
9. Linearity test: adjust lower Y values, readings will drop in proportion to the determined Y value (see Point 4.2).
10. Switch of power source after completing the test.
11. Disconnect GS8.
12. Reconnect leads of primary head.
13. Replace housing cover.
14. The system is ready for operation after the power source has been switched on.

7.6.4 Example

Full scale range	$\mathbf{Q_{100\%}}$	= 280m^3/hr (Fct. 1.01)
Meter size	**DN**	= 80 mm (≙ 3") (Fct. 1.05)
Current at $Q_{0\%}$	$\mathbf{I_{0\%}}$	= 4 mA (Fct. 3.1.02)
Current at $Q_{100\%}$	$\mathbf{I_{100\%}}$	= 20 mA (Fct. 3.1.03)
Pulses at $Q_{100\%}$	$\mathbf{f_{100\%}}$	= 280 pulses/hr (Fct. 3.2.03)
Primary head constant	**GK**	= 3.571 (see nameplate)
Factor (GK valve without "L")	**F**	= 1
Constant (**V** in m^3, **t** in hr / **DN** in mm)	**K**	= 7074 (see Table)

Calculation **„X"** and position of switch **„Y"**

$$\mathbf{X} = \frac{F \times Q_{100\%} \times K}{GK \times DN^2} = \frac{1 \times 280 \times 7074}{3.571 \times 80 \times 80} = \mathbf{86.67}$$

Y = 80, position of switch Y, see front panel GS8 (comes closest to X value and is smaller than X)

Calculation setpoint reading **I** and **f**

$$\mathbf{I} = I_{0\%} + \frac{Y}{X} (I_{100\%} - I_{0\%}) =$$

$$4\ mA + \frac{80}{86.67} (20\ mA - 4\ mA) \approx \mathbf{18.8\ mA}$$

Deviations are permissible between 18.5 and 19.1 mA (equivalent to ± 1.5%).

$$\mathbf{f} = \frac{Y}{X} \times f_{100\%} = \frac{80}{86.67} \times 280\ pulses/hr \approx \mathbf{258.5\ pulses/hr}$$

Deviations are permissible between 254.6 and 262.3 pulses/hr (equivalent to ± 1.5%).

If you have to return your ALTOFLUX flowmeter to Krohne, please note information given on page 83!

7.7 Troubleshooting SC 100 AS

Always switch off power source before connecting and disconnecting cables!

This chart will help to locate the defective PCB of a signal converter that revealed a fault when tested according to Section 7.5.

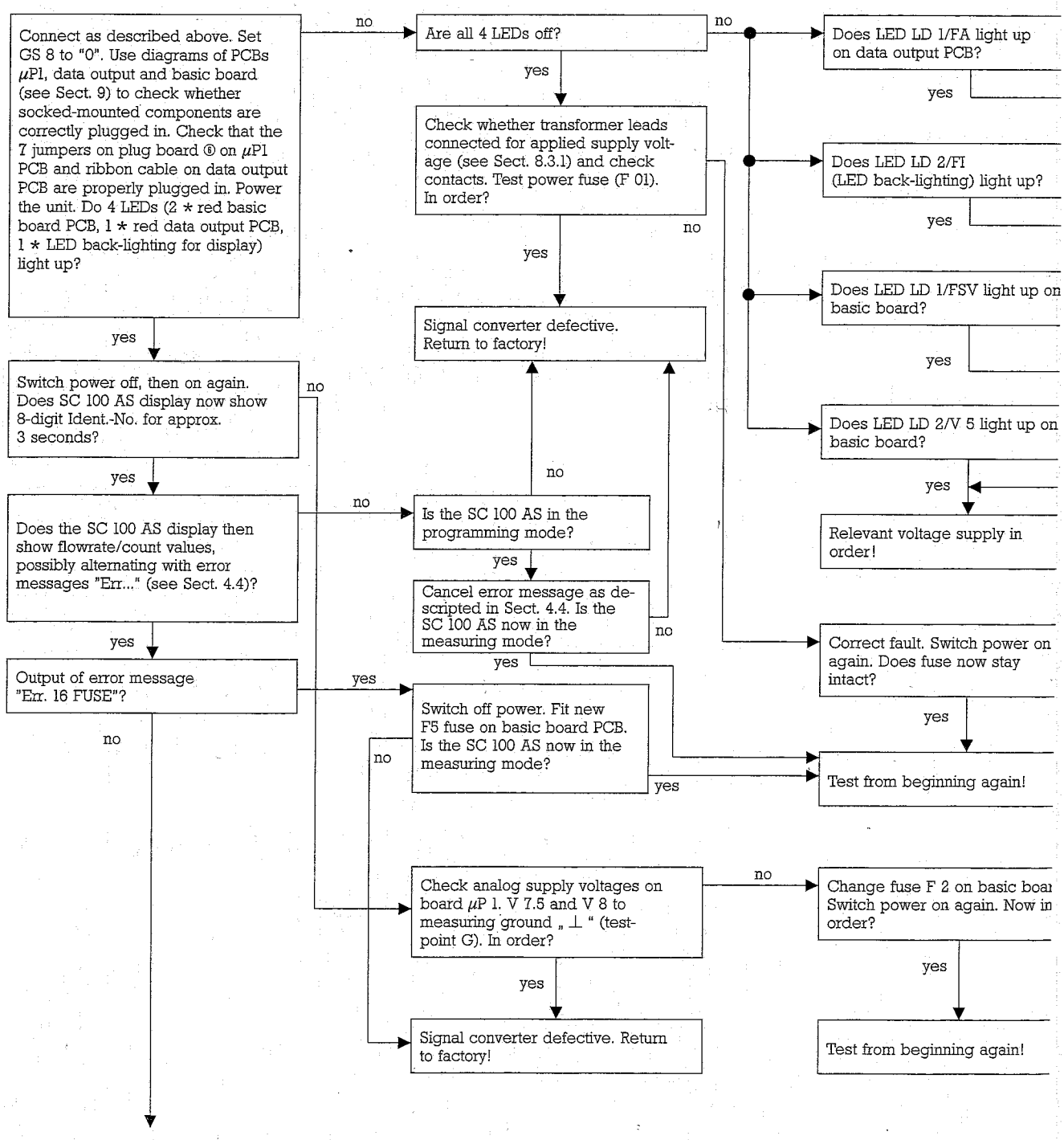
Instructions are based on the assumption that only one fault has occurred. The SC 100 AS is operated with open front p

Required instruments

- Digital multimeter with the following ranges: 0 to 20 mA / 0 to 200 mA / 0 to 10 V
- Frequency meter: 0 to 20 kHz / time base 1 or 10 sec / load > 2 kohms
- Primary head simulator GS 8

Connections

- Milliammeter to term. 5,6
- Frequency meter to term. 4,42
- Primary head simulator GS 8 to term. 1, 2, 3, 7, 8 + 10 (see Sect. 7.6.2)
- Power source to term. 11, 12
- Also connect up protective conductor (because of screening function) even if low voltage is involved, e.g. 24 V.



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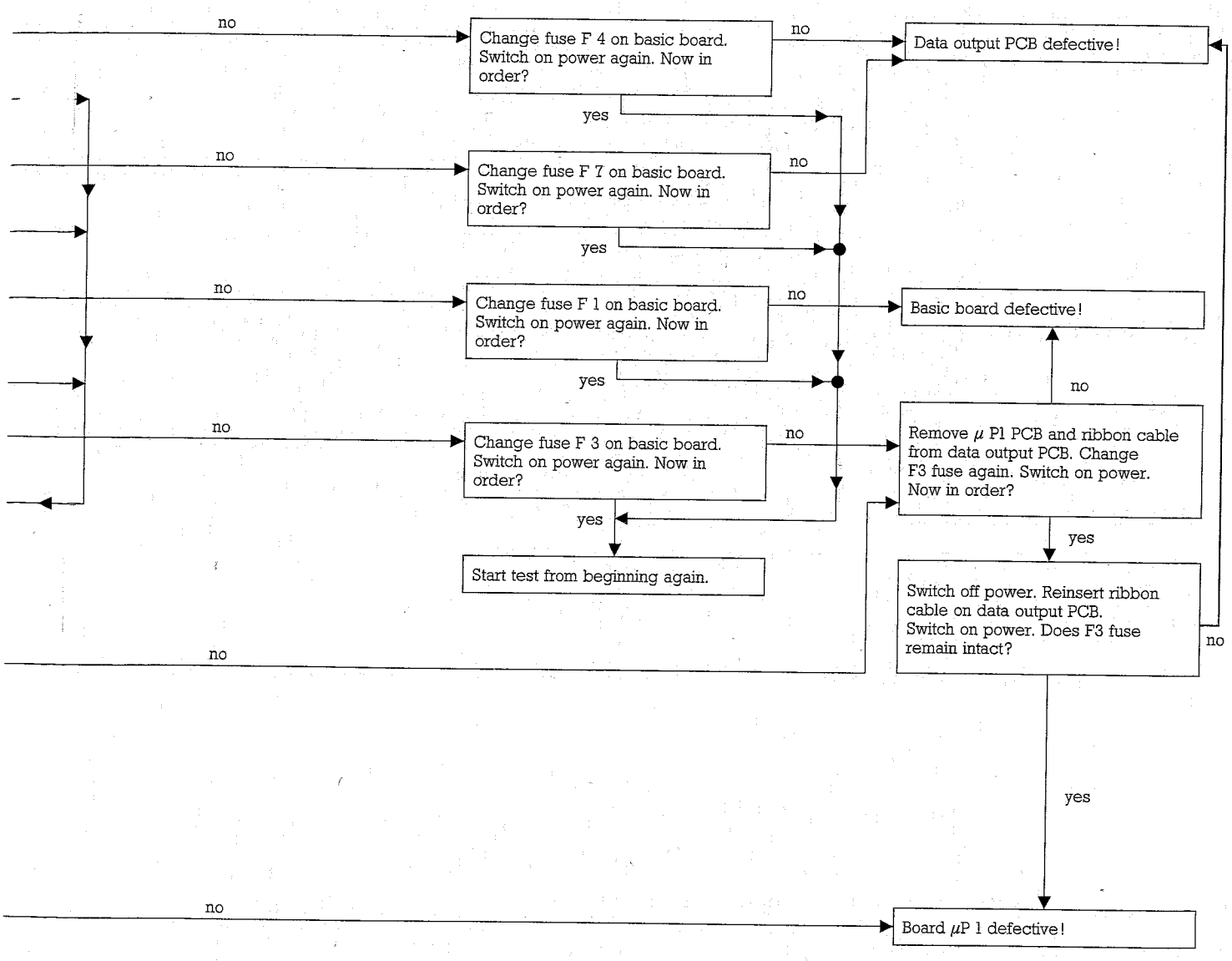
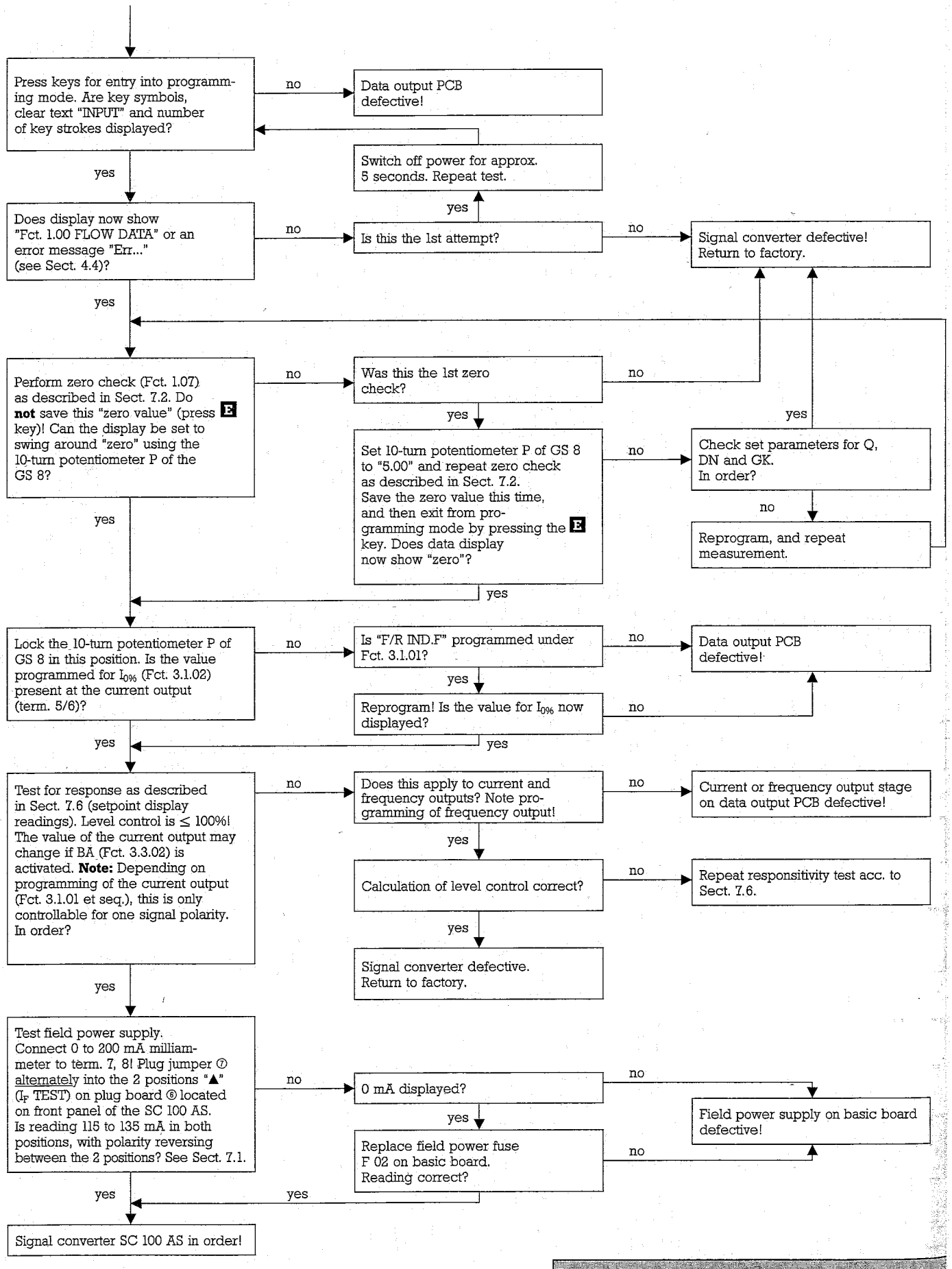

no
Change fuse F 4 on basic board. Switch on power again. Now in order?
no
Data output PCB defective!
yes
no
Change fuse F 7 on basic board. Switch on power again. Now in order?
no
yes
no
Change fuse F 1 on basic board. Switch on power again. Now in order?
no
Basic board defective!
yes
no
Change fuse F 3 on basic board. Switch on power again. Now in order?
no
Remove μ P1 PCB and ribbon cable from data output PCB. Change F3 fuse again. Switch on power. Now in order?
yes
yes
Start test from beginning again.
Switch off power. Reinsert ribbon cable on data output PCB. Switch on power. Does F3 fuse remain intact?
no
no
yes
no
Board μP 1 defective!



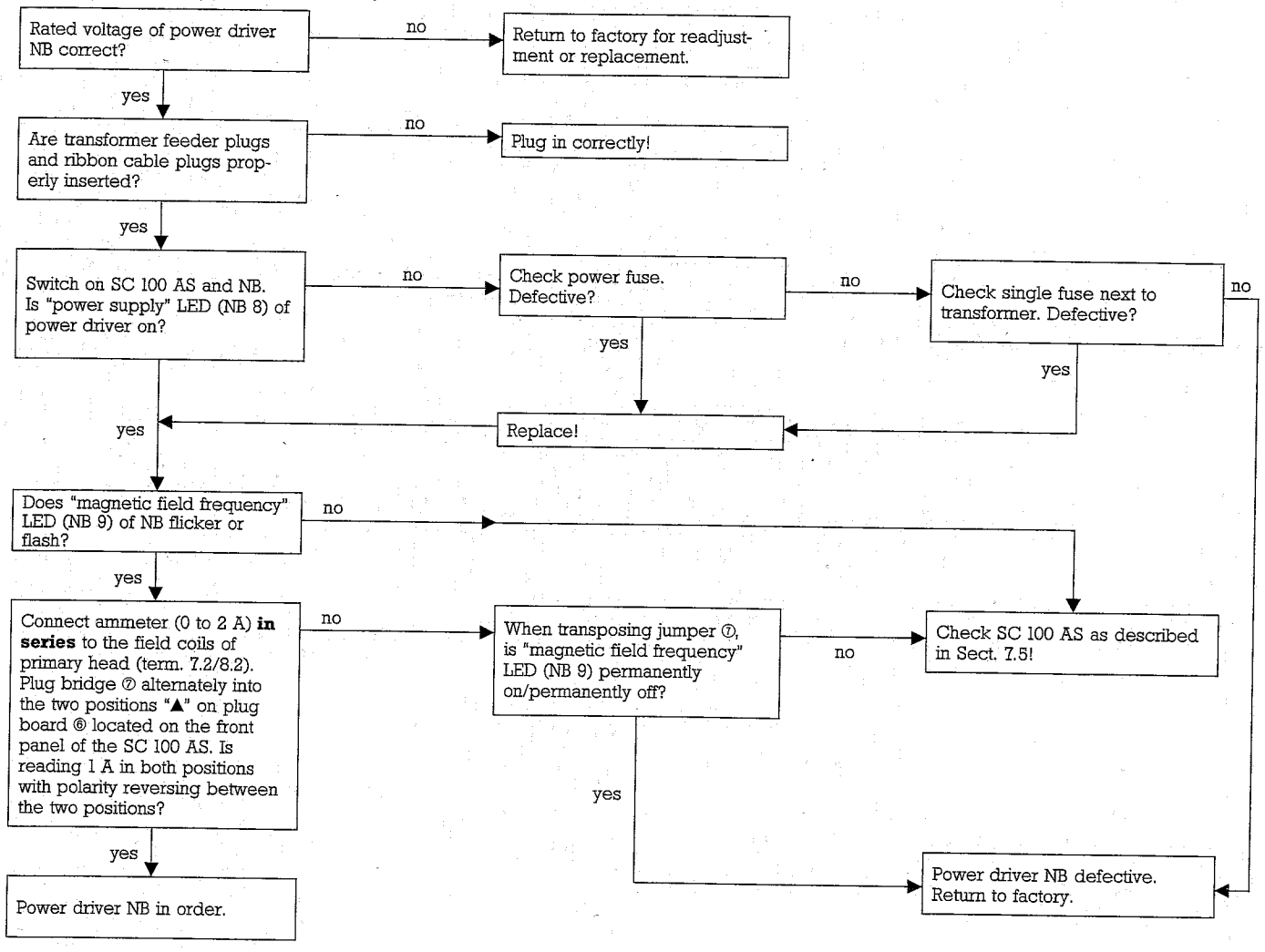
If you have to return your ALTOFLUX flowme to Krohne, please note information given on page 83!

7.8 Testing of NB 900 Γ power driver

Always switch off power source before connecting and disconnecting cables!

Required instrument:
Ammeter 0 to 2 A, Class 0.1

Connect terminals 7, 8 of a functioning SC 100 AS to terminals 7.1 and 8.1 of the power driver. Note power supply rated voltages (on nameplate) of both SC 100 AS and NB.



If you have to return your ALTOFLUX flowmeter to Krohne, please note information given on page 83!

8. Service

8.1 Replacement of pc boards

Always switch off power source before commencing work!

- All pc boards (PCBs) can be replaced individually without interaction with other, existing, pc boards.
- Remove the metal partition between connection and signal converter compartments before replacing the **basic PCB.** Remove 1 screw, accessible from the connection compartment.

  Following replacement, take note of the field power specified on the basic PCB near terminals 7 + 8 and compare it with the setting in Fct. 4.10 (see Sect. 4.6 and report on preset data for the SC 100 AS). If there is any deviation, reprogram to this value in Fct. 4.10.

  Range: *225.00 to 275.00 mA*

  Note: If power driver NB 900 F is used, the value of *250 mA* set under Fct. 4.10 must **not** be changed!
- The customer-specific data (see report on preset data for the SC 100 AS) must be reprogrammed following replacement of the **μP1 PCB.**

  Error message *"Err. E14"* is displayed, see E-List in Sect. 4.4. Subsequently, be sure to perform zero calibration and store the new zero value.
- All data of the internal totalizer are lost on replacement of the **measured-value output PCB.** Error message *"Err.E14"* is displayed, see E-List, Sect. 4.4.

8.2 Replacement of primary head

Always switch off power source before commencing work!

- Specific calibration data for each primary head, specified on the nameplate, are determined during factory calibration. This includes the primary head constant GK and the magnetic field frequency.

  Example
  Nameplate, line GK: 2.371/6
  2.371 → primary head constant, and
  6 → magnetic field frequency
  = 1/6 of power frequency
- The signal converter must be reprogrammed when a primary head is replaced.
- Enter primary constant GK in Fct. 1.05 and the magnetic field frequency in Fct. 4.07.
- A zero check (Fct. 1.07) is advisable following reprogramming, see Sect. 7.2.
- If the new primary head has a different meter size (diameter), enter the new size in Fct. 1.04 and the new full-scale range for $Q_{100\%}$ in Fct. 1.01; in the case of F/R operation, see also Fct. 1.02 + 1.03.
- A zero check (Fct. 1.07) is advisable following reprogramming, see Sect. 7.2.
- At all events reset the internal totalizer as described in Sect. 5.6. Note down totalizer counts beforehand.

8.3 Change of operating voltage and power fuses

8.3.1 SC 100 AS signal converter

Note: Only possible if signal converter has built-in universal transformer of 100 to 240 V AC.

- **Disconnect signal converter (and NB power driver, if applicable) from power supply.**
- Open housing and remove front panel.
- Reconnect the colored cables at terminal strip X6 on the basic board of the SC 100 AS (see Sect. 9.1) for the desired system voltage according to the following table.
- Change fuse F 01 "LINE" in accordance with the new operating voltage.
- Enter new operating voltage on the instrument nameplate.
- Refit front panel and close housing.

	Terminals of terminal strip X6								**Fuse**	
Voltage	1	2	3	4	5	6	7	8	F 01 (LINE)	Order No.
220 V AC	grn	blu	gre	vio+brn	red	–	yel	or	T 0.16/250 G	5.07379
230/240 V AC	grn	blu	vio	brn+gre	red	–	or	yel	T 0.16/250 G	5.07379
200 V AC	grn	vio	gre	blu+brn	or	–	yel	red	T 0.2/250 G	5.05678
120 V AC	brn+grn	blu	vio	–	–	red	or	yel+gre	T 0.315/250 G	5.05804
110 V AC	brn+grn	blu	gre	–	–	red	yel	or + vio	T 0.315/250 G	5.05804
100 V AC	brn+grn	vio	gre	–	–	or	yel	red+blu	T 0.4/250 G	5.05892

blu = blue gre = grey or = orange yel = yellow
brn = brown grn = green vio = violet

8.3.2 NB 900 F power driver

- **Disconnect power driver from power supply.**
- Open housing.
- Reconnect the colored cables at terminal strip NB 12 on the basic board of the NB 900 F (see Sect. 9.4) for the desired system voltage according to the following table.
- Change fuses F6 and F7 (NB 4) in accordance with the new operating voltage.
- Enter new operating voltage on the instrument nameplate.
- Close housing.

	Terminals of terminal strip NB 12						**Fuses**	
Voltage	1	2	3	4	5	6	F6 + F7	Order No.
220 V AC	red	or	gre+brn	blu	yel	yel/grn	2 * T 0.5/250 G	5.07094
230/240 V AC	yel	gre	blu+brn	red	or	yel/grn	2 * T 0.5/250 G	5.07094
110 V AC	yel+brn	–	blu	or	gre+red	yel/grn	2 * T 1.0/250 G	5.06258
120 V AC	yel+brn	gre	–	red	blu+or	yel/grn	2 * T 1.0/250 G	5.06258

8.4 Output voltage 5/12 V for electronic counters EC, terminals 4/42

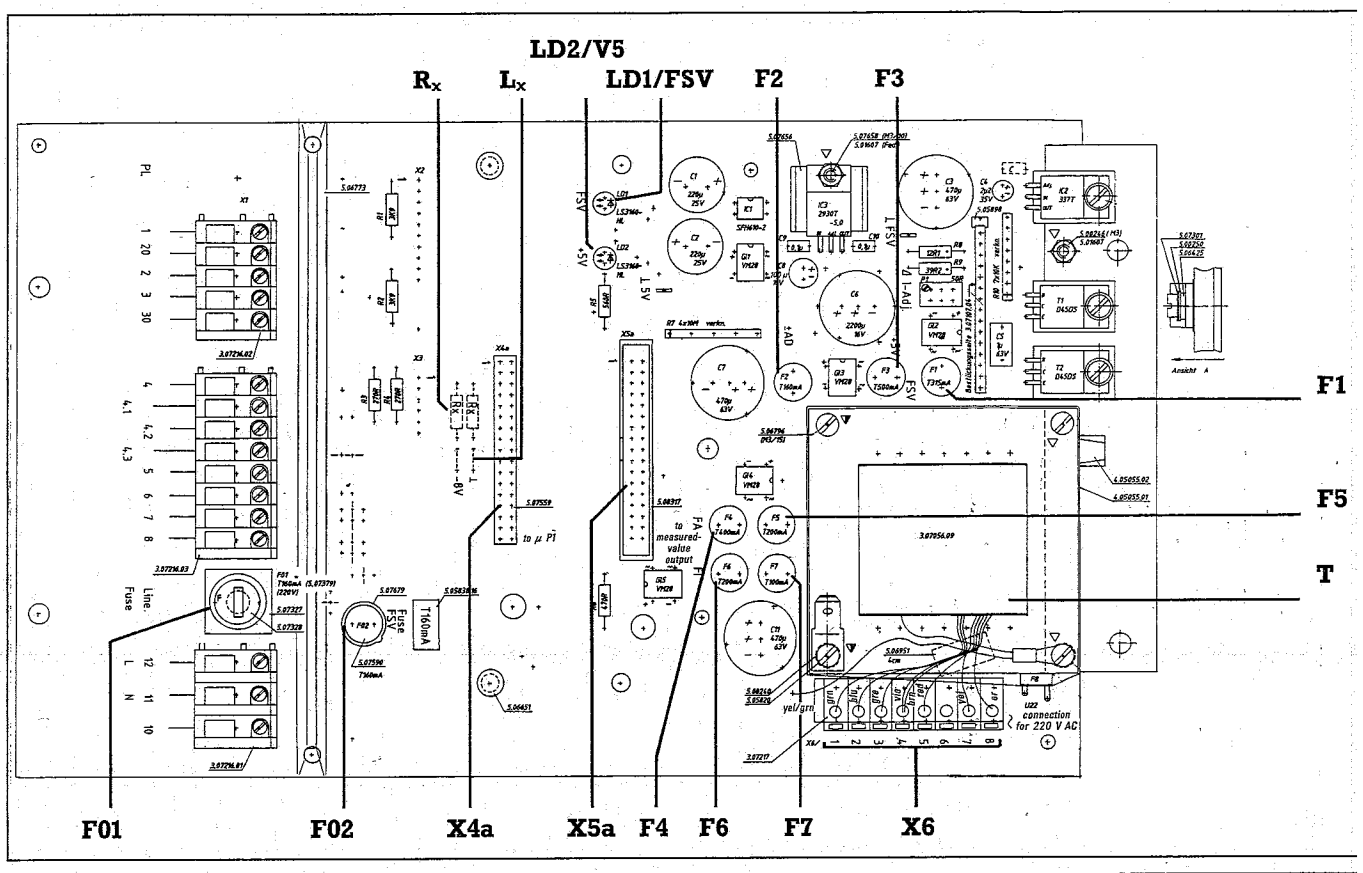
- The output voltage at term. 4/42 is factory-set to 12 V.
- The output voltage can be changed to 5 V by inserting soldering jumper "LEZ" on the data output PCB, see Sect. 9.3.
- **Switch off power source before commencing work.**

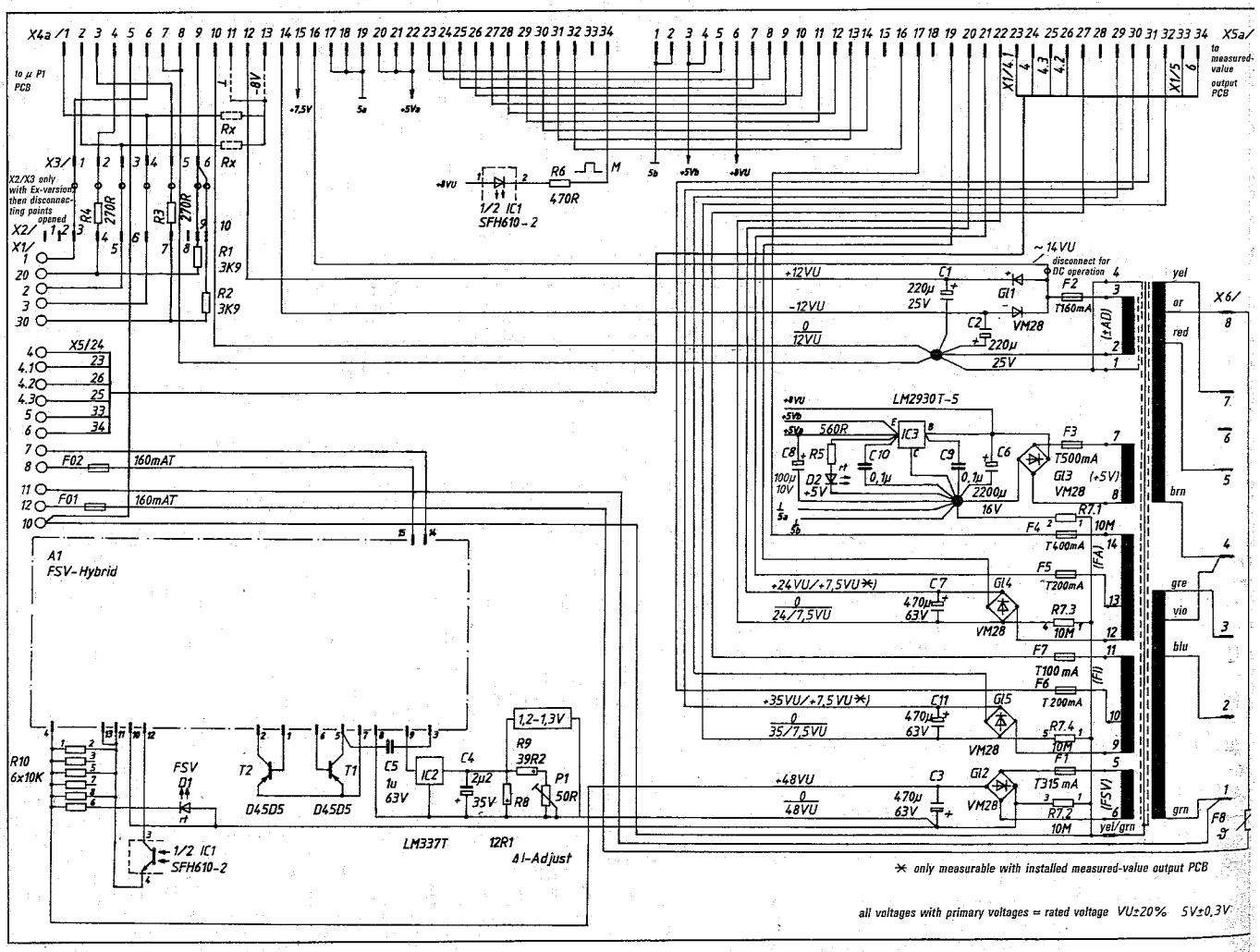
8.5 F5 fuse, identification of power failure

- The SC 100 AS signal converter is equipped with a module for power failure identification.
- This module is fuse-protected with an F5 fuse (200 mA T, Order No. 5.07562) on the basic PCB (see Sect. 9.1).
- A defective F5 fuse is indicated during measuring operations by the error message *"Err. E16 FUSE"* (see E-List, Sect. 4.4).
- **A defective F5 fuse must be replaced immediately,** because otherwise the totalizer counts are no longer saved in memory submodule M2. Also the signal converter can not be reprogrammed.

9. Connection and operating points on pc boards, circuit diagrams and spare parts

9.1 Basic board 110 to 240 Volt AC





F 01 Fuse, power supply, for values and order number see Sect. 8.3

F 02 Fuse, field power supply, M 0.16/250 C to G (M 0.125/250 C to G for X 1000-Ex)

F 1 Miniature fuse 315 mAT for field current voltage supply

F 2 Miniature fuse 160 mAT for analog voltage supply

F 3 Miniature fuse 500 mAT for logic voltage supply

F 4 Miniature fuse 400 mAT for voltage supply, frequency output

F 5 Miniature fuse 200 mAT for power failure identification

F 6 Miniature fuse 200 mAT for voltage supply, serial interface (for SC 100 B)

F 7 Miniature fuse 100 mAT for voltage supply, analog output

LD 1/FSV LED for field power supply: voltage check

LD 2/5 V LED for 5-V supply voltage: logic voltage check

L_x Soldered jumper
R_x 2 resistors 10 Mohms
} insert for stable analog output when measuring tube empty, see Sect. 6.3

T Universal transformer 100 to 240 V AC

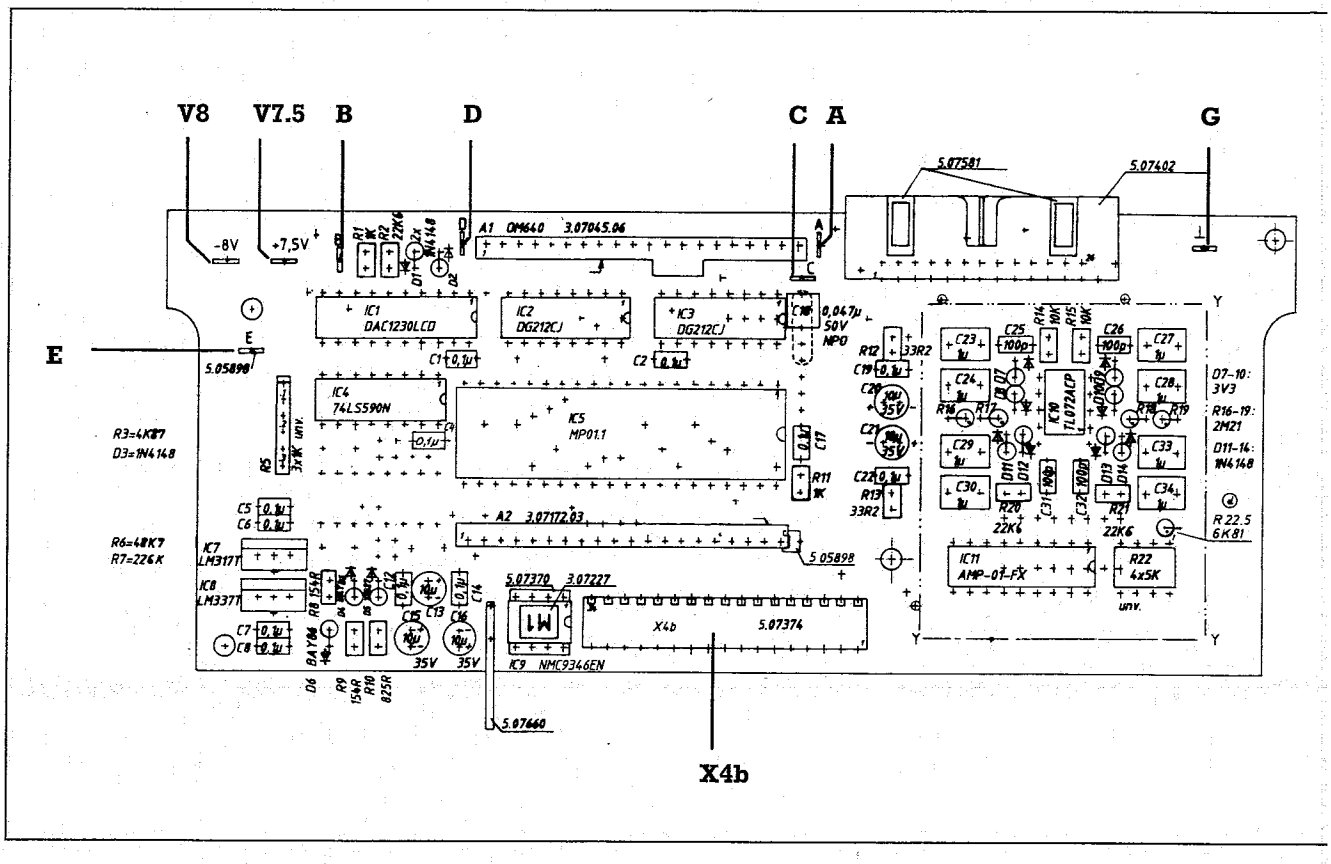
X 4a Base for plug board X 4b, μPl pc board

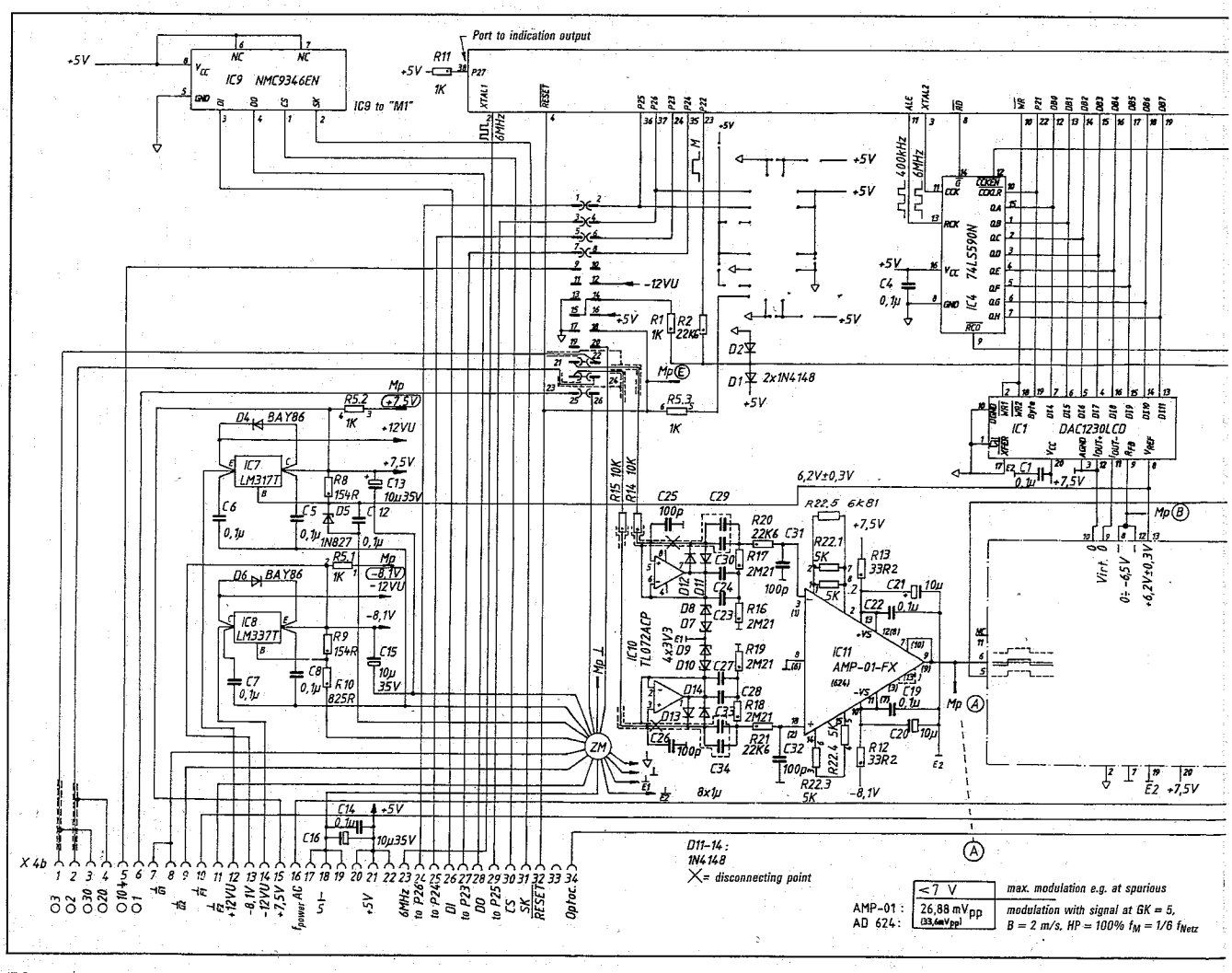
X 5a Base for plug X 5b, measured-value output pc board

X 6 Terminal strip, transformer, change of operating voltage, see Sect. 8.3

Symbol	Description	Part No.
	Basic board, compl. 110-220 V AC	2.07170.00
	Basic board, compl. 24/42 V AC	2.07143.00
	Circuit board	3.07209.09
R 1,2	Resistor, carbon, 3.9 kOhm, ± 5%, 0,25 W	5.05926
R 3,4	Resistor, carbon, 270 Ohm, ± 5%, 0,25 W	5.06051
R 5	Resistor, carbon, 560 Ohm, ± 5%, 0,25 W	5.05936
R 6	Resistor, carbon, 470 Ohm, ± 5%, 0,25 W	5.06023
R 7	Resistor, 4 * 10 MOhm, network, SIP	5.07324
R 8	Resistor, metal film, 12.1 Ohm, ± 1%, 0,25 W	5.05422
R 9	Resistor, metal film, 39.2 Ohm, ± 1%, 0,25 W	5.05428
R 10	Resistor, 7 * 10 kOhm, network, SIP	5.07461
C 1,2	Capacitor, electrolytic, 220 μF, 25 V (R5)	5.06502
C 3,7,11	Capacitor, electrolytic, 470 μF, 63 V	5.07325
C 4	Capacitor, tantalum, 2.2 μF, 35 V (R2.5)	5.03100
C 5	Capacitor, electrolytic, 1 μF, 63 V (R7.5)	5.06508
C 6	Capacitor, electrolytic, 2200 μF, 16 V	5.07028
C 8	Capacitor, electrolytic, 100 μF, 16 V (R2.5)	5.06861
C 9,10	Capacitor, Sibatit, 0.1 μF, 63 V (R5)	5.07492
P 1	Potentiometer, 50 Ohm, 68 W	5.06518
Gl 1,2,3,4,5	Rectifier VM 28	5.06729
T 1,2	Transistor D 45D5	5.07069
A 1	Hybrid	3.07107.04
IC 1	Integrated circuit SFH 610-2	5.07414
IC 2	Integrated circuit LM 337 T	5.06739
IC 3	Integrated circuit LM 2930 T-5,0	5.07320
LED 1	LED, red CQV 10-3	5.03152
F 1	Fuse 315 mA T	5.07591
F 2,5,6, F 02	Fuse 200 mA T	5.07563
F 3	Fuse 500 mA T	5.07586
F 4	Fuse 400 mA T	5.07565
F 8	Fuse X 114-105 (113°C~235°F)	5.07480
F 7	Fuse 100 mA T	5.07561
	Transformer, 110–220 V AC	3.07056.09
	Fuse holder FAC 031.3803	5.07327
	Fuse holder, Wickmann No. 19560	5.07679
	Spring terminal block, 8 pin, Phönix	3.07217
	Terminal block, 3 pin, Weidmüller, FA	3.07216.01
	Terminal block, 5 pin, Weidmüller, FA	3.07216.02
	Terminal block, 8 pin, Weidmüller, FA	3.07216.03
X 4a	Pin socket, 34 pin, Bergstik 2 * 17	5.07559
X 4b	3M socket, 34 pin, Bergstik 2 * 17	5.08317
	Soldering pin	5.05898

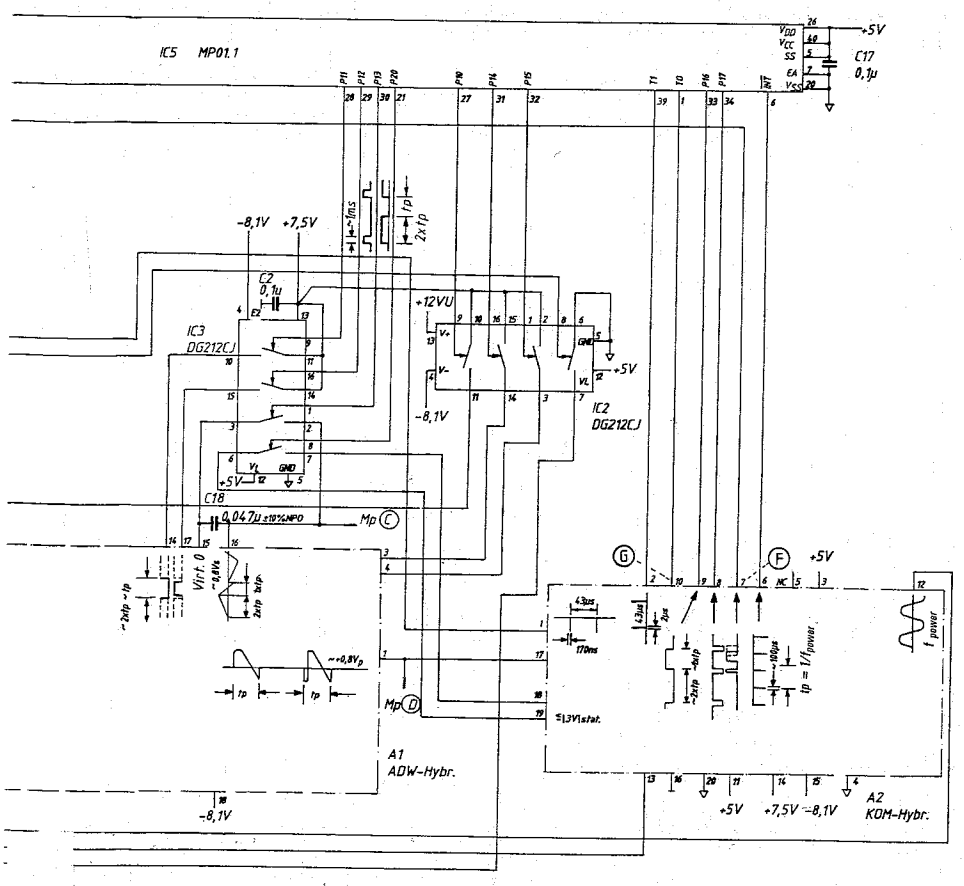
grn = green
brn = brown
blu = blue
vio = violet
gre = grey
or = orange
yel = yellow


V8
V7.5
B
D
C
A
G
E
X4b
-8V
+7,5V
IC1 DAC1230LCD
IC2 DG212CJ
IC3 DG212CJ
IC4 74LS590N
IC5 MP01.1
IC7 LM317T
IC8 LM337T
IC9 NMC9346EN
IC10 TL072ACP
IC11 AMP-01-FX
A1 OM640 3.07045.06
A2 3.07172.03
5.07581
5.07402
5.05898
5.07370
3.07227
5.07374
5.07460
R3=4K87
D3=1N4148
R6=48K7
R7=226K
D7-10: 3V3
R16-19: 2M21
D11-14: 1N4148
R 22.5 6K81


Port to indication output
IC9 NMC9346EN
IC9 to "M1"
IC1 DAC1230LCD
IC4 74LS590N
IC10 TL072ACP
IC11 AMP-01-FX
D1 2x1N4148
D2
D4 BAY86
D6 BAY86
D11-14: 1N4148
X = disconnecting point
AMP-01 : AD 624 :
≤7 V
26,88 mVpp
max. modulation e.g. at spurious
modulation with signal at GK = 5, B = 2 m/s, HP = 100% fM = 1/6 fNetz
X4b
Optoc.

A Test point for the output signal of the input amplifier.
B Test point for the output voltage of the DAC, 0 to – 6.5 Volt
C Test point for the output voltage of the integrator
D Test point for the output voltage of the rectifier
E Test point for the residual pulse generation by watchdog
G Measuring ground
V 7.5 Test point, supply voltage + 7,5 Volt
V 8 Test point, supply voltage – 8 Volt
X 4b Plug board

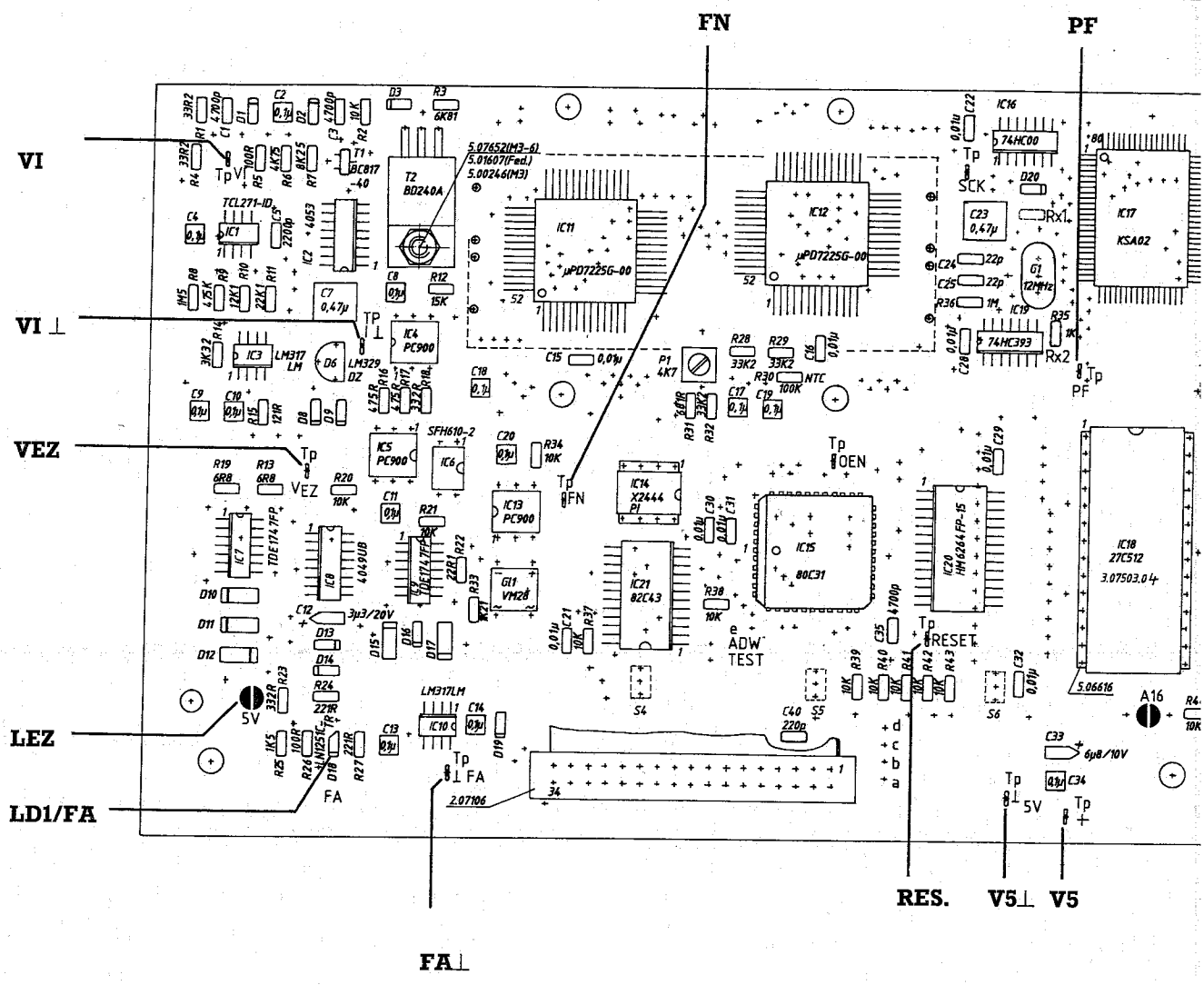
Symbol	Description	Part No.
	µP1, board, compl.	2.06034.01
	Circuit board	3.07220.02
R 1,11	Resistor, metal film, 1 kOhm, ± 1%, 0,25 W	5.07732
R 2,20,21	Resistor, metal film, 22.1 kOhm, ± 1%, 0,25 W	5.07735
R 3	Resistor, metal film, 4.75 kOhm, ± 1%, 0,5 W	5.07733
R 4	Resistor, metal film, 562 kOhm, ± 1%, 0,5 W	5.07738
R 5	Resistor, 3 x 1 kOhm, network, SIP	5.07385
R 6	Resistor, metal film, 47.5 kOhm, ± 1%, 0,5 W	5.07736
R 7	Resistor, metal film, 221 kOhm, ± 1%, 0,5 W	5.07737
R 8,9	Resistor, metal film, 150 kOhm, ± 1%, 0,5 W	5.07730
R 10	Resistor, metal film, 825 kOhm, ± 1%, 0,5 W	5.07731
R 12,13	Resistor, metal film, 33.2 kOhm, ± 1%, 0,5 W	5.07729
R 14,15	Resistor, metal film, 10 kOhm, ± 1%, 0,5 W	5.07734
R 16,17,18,19	Resistor, metal film, 2.21 MOhm, ± 1%, 0,25 W	5.07278
R 22	Resistor, 4 * 5 kOhm, network, DIL	5.07662
C 1,2,4,5,6,7,8,11,12,14,17,19,22	Capacitor, Sibatit, 0,1 µF, 63 V	5.07492
C 3,23,24,27,28,29,30,33,34	Capacitor, electrolytic, 1 µF, 50 V	5.06924
C 9,10	Capacitor, electrolytic, 0.47 µF, 50 V	5.06982
C 13,15,16,20,21	Capacitor, electrolytic, 10 µF, 35 V	5.07450
C 18	Capacitor, NPO ceramic, 0.047 µF, 50 V	5.07567
C 25,26,31,33	Capacitor, ceramic, 100 µF, 200 V	5.06560
D 1,2,3,11,12,13,14	Diode N4148	5.05586
D 4,6	Diode BAY 86 (1N645)	5.07674
D 5	Diode 1 N 827	5.05799
D 7,8,9,10	Zenerdiode, 3 V 3, 0,4 W	5.05568
IC 1	Integrated circuit DAC 1230 LCD	5.07305
IC 2,3	Integrated circuit DG 212 CJ	5.07378
IC 4	Integrated circuit SN 74LS590N,0	5.07307
IC 5	Integrated circuit TMP 80 C 49 AP-6	3.07218
IC 6	Integrated circuit MC 14538 BCP	5.06785
IC 7	Integrated circuit LM 317 T	5.06419
IC 8	Integrated circuit LM 337 T	5.06739
IC 9	Integrated circuit NµC 9346 EN	5.08239
IC 10	Integrated circuit TL 072 ACP.	5.07664
IC 11	Integrated circuit AMP-01-FX	5.07663
A 1	Hybrid	3.07045.06
A 2	Hybrid	3.07172.03
	Plug socket, flat, 40 pin, DIL 40 EG	5.06602
	Plug socket, 34 pin, Nr. 67118-017	5.07374
	Pin socket, 26 pin, 90°	5.07402
	Plug socket, flat, 8 pin, DIL 8 EG	5.07370
	Soldering pin	5.05898



all voltages with primary voltage = rated voltage

5V ±0,3V
7,5V ±0,5V
8,1V ±0,6V
VU ±20%

9.3 Measured-value output board



FN Test point for line frequency: frequency = 2 * f_{line}, if F5 fuse on basic PCB in order.

LD1/FA LED for supply voltage, frequency output; "on" when voltage present.

LEZ Soldering jumper for changeover of 12-V frequency output, term. 4+42 (12 V ◄► 5 V), see Sect. 8.4 a "VEZ and FA ⊥" below.

PF Test point for power failure identification
F5 fuse on basic PCB: in order = +5 V
defective = 0 V

RES. RESET test point: + 5 V = faultless operation
periodic occurrence of 0 V = faulty communication with µP1 PCB

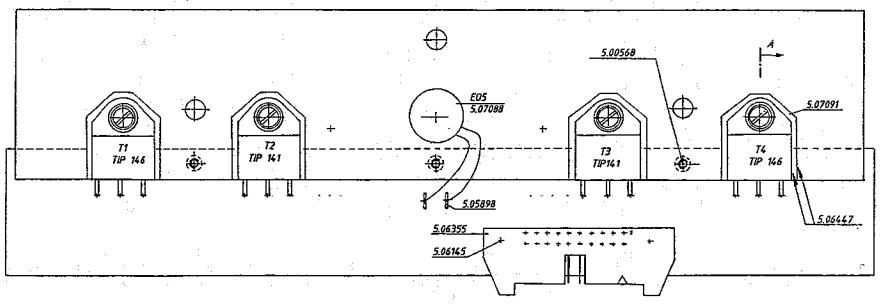
+ V5/V5 ⊥ Test points for supply voltage, digital circuits (5 V ± 0.3 V)

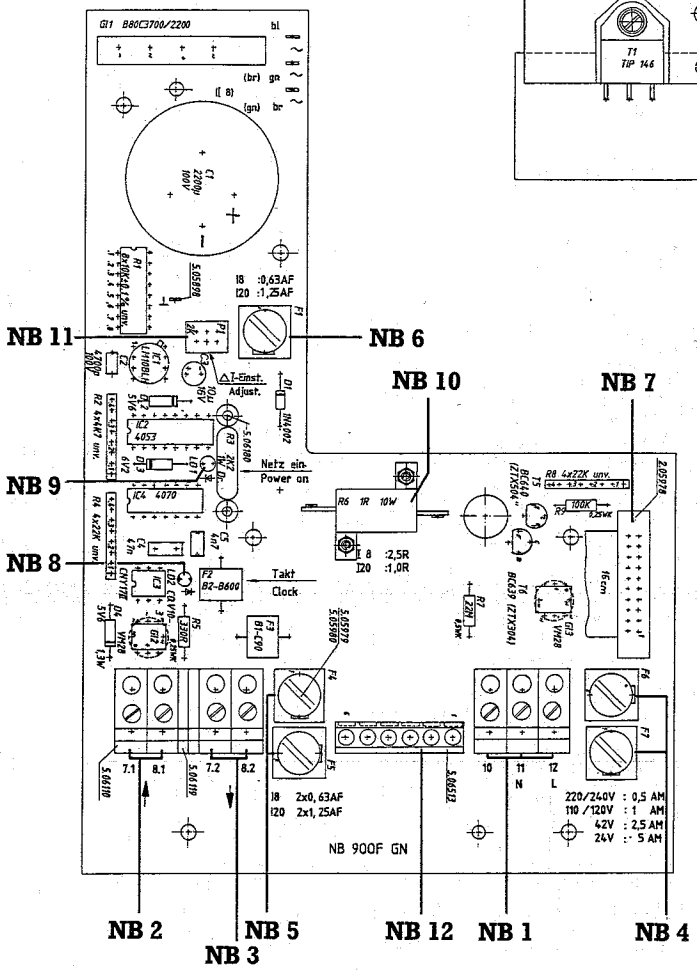
VEZ / FA⊥ Test points for voltage of 12 V frequency output, term. 4 + 42:
without soldering jumper LEZ = 12 V (11 to 12.5 V)
with soldering jumper LEZ = 5 V (4.7 to 5.5 V)

VI / VI⊥ Test points for supply voltage, current output (10.5 to 13 V), LCD back-lit when voltage present.

Symbol	Description	No.
	PCB, data output, compl. board assembly	2.07125

9.4 NB 900 F boards





NB 1 Line connection: Term. 12 → L
Term. 11 → N
Term. 10 for internal testing purpose **only,** connect external protective conductor to separate hoop terminal in housing

NB 2 Input (from signal converter) term. 7.1/8.1
NB 3 Output (to M 460), term. 7.2/8.2
NB 4 Line fuses F 6 and F 7
NB 5 Fuses, field power supply F 4 and F5
NB 6 Fuse, operating voltage (for NB) F 6
NB 7 20-pin ribbon cable
NB 8 LED (LD 1) "Power ON"
NB 9 LED (LD 2) "Clock frequency"
NB 10 Precision measuring resistor for primary head current
NB 11 Potentiometer P1 for adjustment of primary head current
NB 12 Terminal strip, transformer, change of operating voltage (see Sect. 8.3.2)

9.5 Spare parts of SC 100 AS housing

Symbol	Description	Part No.
	Housing base	2.06039.01
	Housing with glass window and seal	2.06039.03
	Cover seal for display and connection compartment, available by the metre	3.13703.00

Part D Technical data, measuring principle, block diagram

10. Technical data

10.1 Signal converter SC 100 AS

Full-scale range	operating data programmable
Flowrate Q = 100%	6 liters/hr to 305000 m^3/hr **or** 0.02 to 1342800 US gallons per minute, corresponding to flow velocity v = 0.3 to 12 m/s **or** 1 to 40 ft/s
Unit	m^3, liters or US gallons per second, minute or hour, and 1 field-programmable unit, e.g. liters per hour or US million gallons per day
Forward/reverse measurements (F/R)	$Q_{100\%}$ separately adjustable for both directions
Current output (term. 5/6)	galvanically isolated, operating data programmable
Current $I_{0\%}$ for Q = 0% $I_{100\%}$ for Q = 100 %	 0 to 16 mA 4 to 20 mA } adjustable in increments of 1 mA
Low-flow cutoff (SMU) cutoff "on" value cutoff "off" value	 1 to 19% 2 to 20% } of $Q_{100\%}$, adjustable in1% increments, independent of frequency output
Forward/reverse measurements (F/R)	selectable performance, direction identified via status indication or frequency output
Automatic range change (BA)	programmable in 1% increments from 1:20 to 1:1.25 (equivalent to 5 to 80% of $Q_{100\%}$)
Time constant	0.2 to 3600 seconds, programmable in increments of 1 or 0.1 seconds
Max. load at $I_{100\%}$	$\frac{20V}{I_{100\%}\ [mA]}$ in kohms (e.g. 1 kohm at 20 mA, 4 kohms at 5 mA)
Frequency outputs	galvanically isolated, operating data programmable
Pulse rate (at Q = 100%)	10 to 36000000 pulses per hour 0.167 to 600000 pulses per minute 0.0028 to 10000 pulses per second (= Hz) optionally in pulses per m^3, liters or US gallons
12-V output Terminals Amplitude Load (totalizer resistance)	for electronic totalizers (EC) 4 + 42 12 V, changeable to 5 V min. 1 kohm
24-V output Terminals Amplitude Load rating	for electromechanical (EMC) or electronic (EC) totalizers 4 + 41 24 V see "pulse width" table below

Pulse width	Frequency f = $F_{100\%}$	Max. load current (24 V)	Min. load (24 V)
30 or 50 ms	0.0028 Hz < f ≤ 10 Hz	≤ 200 mA	≥ 120 Ohm
100 ms	0.0028 Hz < f ≤ 5 Hz	≤ 200 mA	≥ 120 Ohm
200 ms	0.0028 Hz < f ≤ 2.5 Hz	≤ 200 mA	≥ 120 Ohm
500 ms	0.0028 Hz < f ≤ 1 Hz	≤ 200 mA	≥ 120 Ohm
Pulse duty factor 1:1	10 Hz < f ≤ 1000 Hz	≤ 50 mA	≥ 500 Ohm
160 µs	1000 Hz < f ≤ 2547 Hz	≤ 50 mA	≥ 500 Ohm
50 µs	2547 Hz < f ≤ 10000 Hz	≤ 50 mA	≥ 500 Ohm

Low-flow cutoff (SMU) cutoff "on" value cutoff "off" value	 1 to 19% 2 to 20% } of $Q_{100\%}$, adjustable in 1% increments, independent of current output
Forward/reverse measurements (F/R)	selectable performance, direction identified via status or current output
Time constant	0.2 second or same as current output (see above)

Indication outputs	Current output **I**	Frequency output **F**	Indication output **S**
Terminals	5 + 6	4 + 4.1	4 + 4.3
Voltage	U ≤ 35 Volt DC	U = 24 Volt DC	U = 24 Volt DC
Current	I_{load} ≤ 22 mA programmable	I_{load} ≤ 200 mA	I_{load} ≤ 30 mA
Load (relay)	$R_{coil} = U/I_{max}$	R_{coil} ≥ 150 ohms	R_{coil} ≥ 1 kohms
Galvanically isolated from ... Current output I Frequency output F Indication output S	 ——— yes yes	 yes ——— no	 yes no ———
Function	only indication of flow direction for F (F/R operation) or operation indicator	only indication of flow direction for I (F/R operation)	indication of flow directior for I and/or F, trip point for I or F, self diagnostics (error indication), low-flow cutoff SMU counter overflow, operation indicator or automatic range change BA

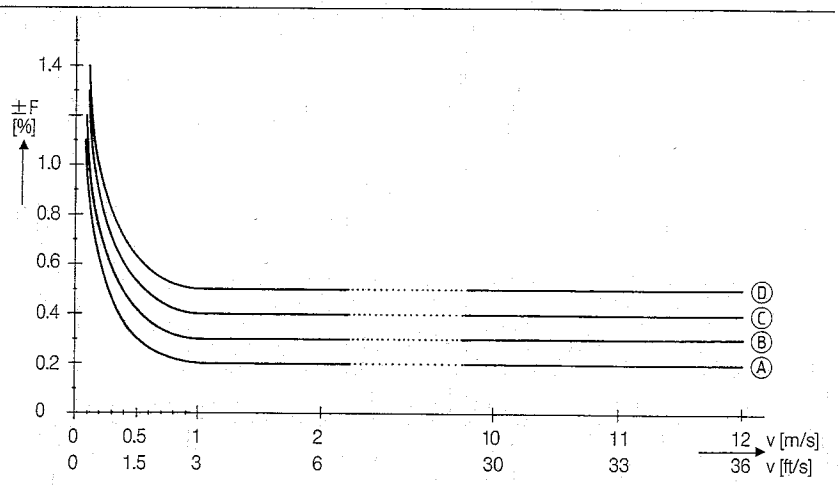
Other functions and versions	
Standard	– Hold last value of outputs during programming or set to "zero" – Coding for entry into programming mode (can be deactivated) – Primary constant GK, programmable in keeping with value on instrument nameplates of all Krohne primary heads with pulsed DC field excitation, including older models
Options	
Magnet programming MP	SC 100 AS/MP, programming by means of bar magnet from outside without opening the housing
Hazardous-duty version	SC 100 AS/..-Ex, with integrated buffer stage (Zener barrier principle), PTB.-No. Ex 86.B.2140X for intrinsically safe signal cable, signal converter must be installed outside hazardous area.
Local display	3-line back-lit LCD
Display functions	actual flowrate, forward, reverse and sum totalizers (7 digits), each programmable for continuous or sequential display, and output of error messages
Display units	
Actual flowrate	m^3, liters or US gallons per second, minute or hour, 1 field-programmable unit (e.g. hectoliters per hour or US million gallons per day) and percent of full-scale range
Totalizers	m^3, liters or US gallons and 1 field-programmable unit (e.g. hectoliters), min. 1 year overflow time
Language of plain texts	German, English, French, Finnish, others pending
Display:	
1st line	8-digit, 7-segment numeral and sign display, symbols for key acknowledgement
2nd line	10-character, 14-segment text display
3rd line	6 markers ▼ to identify actual display functions and status for indication output and low-flow cutoff (SMU)
Field power supply	
Terminals 7/8	for primary heads with pulsed DC field excitation, galvanically isolated from all input and output circuits
Current/voltage	± 0.125 A (± 10%) / max. 60 V
Clock frequency	1/6, 1/16 or 1/32 of line frequency, programmable according to calibration data of primary head
Power supply	
Standard	230 V AC $^{+10\%}_{-10\%}$ **or** 120 V AC $^{+10\%}_{-15\%}$ (changeable to 100, 110, 200, 220, 240 V AC $^{+10\%}_{-15\%}$), 48 to 63 Hz
Special versions	24 V AC (changeable to 21, 42, 48 V AC) $^{+10\%}_{-10\%}$, 48 to 63 Hz 24 V DC $^{+30\%}_{-30\%}$ } functional extra-low voltage with fail-safe galvanic isolation to VDE 0100, Part 410
Power consumption	AC : 25 VA DC : 25 W } incl. primary head DN ≤ 1200 (48"), DN ≥ 1300 (52") see NB 900 F
Field housing	
Material	die-cast aluminium with electrostatic powder coating
Protection category (DIN 40050, acc. IEC 144)	IP 65 equivalent to NEMA 4X
Environment class (DIN 40040)	HUD
Ambient temperature	
In operation	
SC 100 AS	– 25 to + 60°C or – 13 to + 140°F
SC 100 AS/..-Ex	– 25 to + 40°C or – 13 to + 104°F to EN 50014
In storage	– 40 to + 60°C or – 40 to + 140°F

10.2 Power driver NB 900 F

Input (rated current, term 7.1/8.1)	± 0.125 A from SC 100 AS
Output	
Terminals 7.2/8.2	galvanically isolated from input and power supply
Current/voltage	± 1 A / max. 50 V
Clock frequency for field power	controlled by SC 100 AS
Power supply	
Standard	230 V AC $\pm^{10\%}_{10\%}$ **or** 120 V AC $\pm^{10\%}_{15\%}$ (changeable to 100, 110, 200, 220, 240 V AC $\pm^{10\%}_{15\%}$), 48 to 63 Hz
Special versions	42, 24 V AC $\pm^{10\%}_{10\%}$, 48 to 63 Hz 24 V DC $\pm^{30\%}_{30\%}$
Power consumption	AC: ≤ 75 VA (≤ 100 VA with SC 100 AS) DC: ≤ 75 W (≤ 100 W with SC 100 AS) } including primary head
Field housing	
Material	die-cast aluminium with electrostatic powder coating
Protection category (DIN 40050, acc. IEC 144)	IP 65 equivalent to NEMA 4X
Environment class (DIN 40040)	HUD (ambient temperature – 25 to + 60°C or – 13 to + 140°F)

10.3 Accuracies for complete system at reference conditions

Frequency output
F Error (±) as % of flowrate (measured value)
v Flow velocity in m/s (ft/s)



Reference conditions

Product	Water at 10 to 30°C (50 to 86°F) and > 300 µS/cm (µmho/cm)
Power supply (line voltage)	U_N (± 2%)
Ambient temperature	20 to 22°C (68 to 71.6°F)
Warm-up time	60 min.
Maximum error of calibration system	10 * times smaller than F
Inlet/outlet runs	5 DN/2 DN (Curves A + B: 10 DN/5 DN), DN = meter size
Primary head	properly grounded and centered

Primary head	Meter size		Standard details			Option 1)		
	DN		v ≥ 1 m/s or 3 ft/s	v < 1 m/s or < 3 ft/s	Curve	v ≥ 1 m/s or 3 ft/s	v < 1 m/s or < 3 ft/s	Curve
	mm	inches	% v. MV	% v. MV + mm/s **or** % of MV + inch/s		% v. MV	% v. MV + mm/s **or** % of MV + inch/s	
IFS 5000	2.5 – 6	1/10 – 1/4	± 0.5 %	± (0.4 % + 1 mm/s) **or** ± (0.4 % + 0.04 inches)	D	–	–	–
IFS 5000 IFS 2000	10 – 100 150 – 250	3/8 – 4 6 – 10	± 0,4 %	± (0,3 % + 1 mm/s) **or** ± (0.3 % + 0.04 inch/s)	C	± 0,2 %	± (0,1 % + 1 mm/s) **or** ± (0.1 % + 0.04 inch/s)	A
IFS 4000, M 900	10 – 25	3/8 – 1	± 0.4 %	± (0.3 % + 1 mm/s) **or** ± (0.3 % + 0.04 inch/s)	C	–	–	–
	32 – 800	1 1/4 – 32	± 0.4 %	± (0.3 % + 1 mm/s) **or** ± (0.3 % + 0.04 inch/s)	C	± 0,2 %	± (0.1 % + 1 mm/s) **or** ± (0.1 % + 0.04 inch/s)	A
	900 – 1200	36 – 48	± 0.4 %	± (0.3 % + 1 mm/s) **or** ± (0.3 % + 0.04 inch/s)	C	± 0.2 %[2]	± (0.1 % + 1 mm/s)[2] **or** ± (0.1 % + 0.04 inch/s)[2]	A
	1250 – 2000	50 – 80	± 0.4 %	± (0.3 % + 1 mm/s) **or** ± (0.3 % + 0.04 inch/s)	C	± 0.3 %	± (0.2 % + 1 mm/s) **or** ± (0.2 % + 0.04 inch/s)	B
	> 2000	> 80	± 0,5 %	± (0,4 % + 1 mm/s) **or** ± (0.4 % + 0.04 inch/s)	D	–	–	–

[1] at extra charge
[2] SC 100 AS / NB

Current output

same as above accuracies for frequency output **plus ...**

genrally: ± 0.05 % * $\frac{20\ mA}{I_{100\%} - I_{0\%}}$

0 to 20 mA: ± 0.05 %
4 to 20 mA: ± 0.062 %

} of full-scale range

External influences

Ambient temperature

Frequency output	± 0.01 %	of measured value per 1K temperature variation	**or** ± 0.006 % of measured value per 1°F temperature variation
Current output	± 0.025 %		± 0.014 %

Power supply: ± 0.05 % of measured value at 10% variation

Load: ± 0.02 % of measured value at max. load (see under "current output")

10.4 Primary heads

10.4.1 IFS 5000 and IFS 2000

Primary head	IFS 2000	IFS 5000
Version	with flanges	Sandwich (flangeless) design
Meter size	DN 150 – 250 6″ – 10″	DN 2.5 to 100 $^1/_{10}$″ to 4″
Scope of supply	see "IFS 2000" Table, page 3	see "IFS 5000" Table, page 3
Pipe flanges and **rated pressure of measuring tube** (max. operating pressure)	see "Torques" Table in Sect. 1.2.2 and "Limits", Sect. 10.5	see "Torques" Table in Sect. 1.2.2 and "Limits", Sect. 10.5
Electrical conductivity	≥ 5μS/cm (μmho/cm); ≥ 20μS/cm (μmho/cm) for demineralized cold water	≥ 5μS/cm (μmho/cm); ≥ 20μS/cm (μmho/cm) for demineralized cold water
Process temperature (see Sect. 10.5)	refer to Sect. 10.5 "Limits" – 60 to + 120°C or 76 to + 248°F	refer to Sect. 10.5 "Limits" – 60 to + 180°C **or** – 76 to + 356°F
Ambient temperature	– 25 to + 60°C **or** – 13 to + 140°F	– 25 to + 60°C **or** – 13 to + 140°F
Change in process temperature Temperature rising Temperature falling	 – –	 $\Delta T \leq$ 150°C or 302°F, in 10 minutes $\Delta T \leq$ 100°C or 212°F, for sudden change $\Delta T \leq$ 80°C or 176°F, in 10 minutes $\Delta T \leq$ 60°C or 140°F, for sudden change
Vacuum load	0 mbar abs. or 0 psia	0 mbar abs. or 0 psia
Insulation class of field coils	E, ≤ 120°C or ≤ 248°F process temperature	H, ≤ 180°C or ≤ 356°F process temperature
Power supply for field coils	max. 60 V from signal converter	max. 60 V from signal converter
Electrode design	flat-elliptical, self cleaning, surface-polished	fused-fitted electrodes
Protection category (DIN 40050 / IEC 144)	IP 65 equivalent to NEMA 4X	IP 67 equivalent to NEMA 6
Environment class (DIN 40040)	HUD (ambient temperature – 25 to + 60°C or – 13 to + 140°F, relative humidity < 80% annual mean)	HUD (ambient temperature – 25 to + 60°C or – 13 to + 140°F, relative humidity < 80% annual mean)

Primary head	IFS 2000	IFS 5000
Materials		
Measuring section	fused aluminium oxide, 99.7% Al_2O_3	fused aluminium oxide, 99.7% Al_2O_3
Electrodes		
Standard	stainless steel 1.4571 or SS 316 Ti – AISI	platinum
Special	Hastelloy C4, titanium, tantalum, platinum	
Housing		
≤ DN 15, ≤ 1/2"	–	stainless steel 1.4462/Duplex
≥ DN 25, ≥ 1"	tubular steel or grey cast iron GG 20 *	stainless steel 1.4301 or SS 304 – AISI
Terminal box *	die-cast zinc	die-cast aluminium
Grounding rings **		
Standard	stainless steel 1.4301 or SS 304 – AISI	stainless steel 1.4571 or SS 316 Ti – AISI
Special	Hastelloy C4	–
Gaskets **		
≤ DN 15, ≤ 1/2"	–	Viton O-rings, optionally with PFA coating
≥ DN 25, ≥ 1"	Viton O-rings, as option with PFA sheath	Gylon 3500 (beige) gaskets (range of application similar to that of PTFE), optionally Chemotherm (graphite) gaskets
Centering material **		
≤ DN 25, ≤ 1"	–	EPDM rings
≥ DN 40, ≥ 1 1/2"	–	rubber sleeves
Stud bolts		
Standard	–	steel, electrogalvanized
Special version	–	stainless steel 1.4301 or SS 304 – AISI
Connecting flanges *	cast steel (GS 45 N)	–

* with polyurethane finish
** see Tables on page 3 for scope of supply

10.4.2 IFS 4000 and M 900

Primary head	M 900	IFS 4000
Versions/meter sizes with flange connections for the food industry Sanitary connection DIN 11851 Clamp connection SMS connection	DN 10–300 and $^3/_8$" to 12" (see below) Meter sizes DN 10–25 Pressure rating PN Measuring tube nom. dia. 1" to 4" on request	DN 10–3000 and $^3/_8$" to 120" (see below) – – –
Rated pressure	dependent on meter size, connecting flange, liner and process temperature, see Sect. 10.5 "Limits"	dependent on meter size, connecting flange, liner and process temperature, see Sect. 10.5 "Limits"
Connecting flanges to DIN 2501 (= BS 4504) to ANSI to AWWA special versions	DN 10 to 50 and DN 80: PN 40 DN 65 and DN 100 to 150: PN 16 DN 200 to 300: PN 10 $^3/_8$" to 12" Class 150 or 300 lbs / RF – on request	DN 10 to 50 and DN 80: PN 40 DN 65 and DN 100 to 150: PN 16 DN 200 to 1000: PN 10 DN 1100 to 2000: PN 6 DN 2200 to 3000: PN 2.5 $^3/_8$" to 24" Class 150 lbs / RF 24" to 120" / Class B or D / FF on request
Electrical conductivity	$\geq$ 5 μS/cm (μmho/cm); $\geq$ 20 μS/cm (μmho/cm) for demineralized cold water	$\geq$ 5 μS/cm (μmho/cm); $\geq$ 20 μS/cm (μmho/cm) for demineralized cold water
Process temperature (see Sect. 10.5)	– 60 to + 180°C **or** – 76 to + 356°F	– 60 to + 180°C **or** – 76 to + 356°F
Ambient temperature	– 25 to + 60°C **or** – 13 to + 140°F	– 25 to + 60°C **or** – 13 to + 140°F
Insulation class of field coils / process temperature Standard Special version	E / $\leq$ 120°C **or** $\leq$ 248°F H / $\leq$ 180°C **or** $\leq$ 356°F	DN 10 to 300 ($^3/_8$" to 12"): H / $\leq$ 180°C **or** $\leq$ 356°F DN 350 to 3000 (14" to 120"): E / $\leq$ 120°C **or** $\leq$ 248°F DN 350 to 3000 (14" to 120"): H / $\leq$ 180°C **or** $\leq$ 356°F
Power supply for field coils	max. 60 V from converter	max. 60 V from converter
Electrode design Standard Special version	flat elliptical, solidly fitted, surface-polished, self-cleaning DN 50 to 300 **or** 2" to 12" field replaceable electrodes WE	DN 25 to 150 **or** 1" to 6 " replaceable when measuring tube drained DN 10 to 20 / DN 200 to 3000 **or** $^3/_8$" to $^3/_4$" / 8" to 120" flat elliptical, surface-polished, self-cleaning DN 350 to 3000 **or** 14" to 120" field replaceable electrodes WE
Protection category (to DIN 40050/IEC 144) Standard Special version	IP 65 equivalent to NEMA 4 and 4X IP 67, IP 68 equivalent to NEMA 6	IP 67 equivalent to NEMA 6 (IP 65 equivalent to NEMA 4 and 4X with field replaceable electrodes WE) IP 68 equivalent to NEMA 6
Environment class (DIN 40040)	HUD (ambient temperature –25 to +60°C or –13 to +140°F, relative air humidity < 80% annual mean)	HUD (ambient temperature –25 to +60°C or –13 to +140°F, relative air humidity < 80% annual mean)
Grounding rings	available as option	available as option

Primary head	M 900	IFS 4000
Materials		
Measuring tube	stainless steel (1.4301 or higher material number) equivalent to SS 304 – AISI	stainless steel (1.4301 or higher material number) equivalent to SS 304 – AISI
Liner		
Standard: DN 10–20 or $^3/_8$ – $^3/_4$″	PTFE (Teflon)	PTFE (Teflon)
DN 25–150 or 1″ – 6″	Hard rubber or PTFE (Teflon)	PFA (reinforced with stainless steel mesh)
≥ DN 200 or ≥ 8″	Hard rubber or PTFE (Teflon)	Hard rubber or PTFE (Teflon)
Special versions		
≥ DN 200 or ≥ 8″	Irethane, soft rubber, Neoprene, others on request	Irethane, soft rubber, Neoprene, others on request
Food version	PTFE (Teflon)	–
Electrodes		
Standard	Hastelloy C4	Hastelloy C4
Special versions	stainless steel 1.4571 or SS 316 Ti – AISI, Hastelloy B2, titanium, tantalum, platinum, others on request	stainless steel 1.4571 or SS 316 Ti – AISI, Hastelloy B2, titanium, tantalum, platinum, platinum/iridium, others on request
Food version	stainless steel 1.4571 or SS 316 Ti – AISI	–
Field replaceable electrodes WE	stainless steel 1.4571 or SS 316 Ti – AISI	stainless steel 1.4571 or SS 316 Ti – AISI
Housing *		
DN 10 – 40 or $^3/_8$″ – $1^1/_2$″	GTW 30	GTW 30
≥ DN 50 or ≥ 2″	sheet steel	sheet steel
Food version	optionally stainless steel 1.4571 or SS 316 Ti – AISI without enamel finish	–
Terminal box *		
Standard	die-cast zinc	die-cast aluminium
Food version	aluminium, without enamel finish	–
Connecting flanges *		
to DIN 2501: DN 10 – 50, DN 80	steel 1.0402 (C22) or AISI: C 1020	steel 1.0402 (C22) or AISI: C 1020
DN 65, ≥ DN 100	steel 1.0501 (RST 37.2) or AISI: C 1035	steel 1.0501 (RST 37.2) or AISI: C 1035
to ANSI:	steel ASTM A 105 N	steel ASTM A 105 N
Grounding rings	stainless steel 1.4571 or SS 316 Ti – AISI	stainless steel 1.4571 or SS 316 Ti – AISI

* with polyurethane finish

10.5 Limits (operating pressure, process temperature and vacuum load rating)

Please note!

- The limits specified in the Tables for temperature and pressure allow for liner and flange standard.
- With **insulation class E** of the field coils, the **maximum** permissible **process temperature is 120°C/248°F. Insulation class H** is required for **temperatures above 120°C/248°F.**
- The max. permissible operating data for hazardous-duty versions are specified in the certificates of conformity, which are supplied only together with explosion-protected equipment.

Limits for fused aluminium oxide, PFA and PTFE

Liner	Flange standard	Nominal diameter of measuring tube and flanges	Flange pressure rating or class	S= Standard O= Option	Max. operating pressure in bar (and psig) at a product temperature of ... ≤ 40°C (≤ 105°F)	≤ 60°C (≤ 140°F)	≤ 70°C (≤ 158°F)	≤ 90°C (≤ 195°F)	≤ 100°C (≤ 210°F)	≤ 120°C (≤ 250°F)	≤ 140°C (≤ 285°F)	≤ 180°C (≤ 355°F)
Fused aluminium oxide	DIN 2501	DN (2.5) 15–80*	PN 40	S	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)
		DN 100*, DN 150	PN 16	S	16 (230)	16 (230)	16 (239)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)
		DN 100*	PN 25	O	25 (360)	25 (360)	25 (360)	25 (360)	25 (360)	25 (360)	25 (360)	25 (360)
		DN 200–250	PN 10	S	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)	–	–
	ANSI B 16.5	(1/10") 1/2"–4" *	150 lbs	S	19.6 (284)	19 (275)	18.7 (271)	18.1 (262)	17.7 (256)	17 (246)	16.2 (235)	14.7 (213)
		6"	150 lbs	S	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)
		8"–10"	150 lbs	S	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)
		(1/10") 1/2"–3" *	300 lbs	O	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)
		4" *	300 lbs	O	25 (360)	25 (360)	25 (360)	25 (360)	25 (360)	25 (360)	25 (360)	25 (360)
PFA	DIN 2501	DN 25–50, DN 80	PN 40	S	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)
		DN 65, DN 100–150	PN 16	S	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)
	ANSI B 16.5	1"–6"	150 lbs	S	19.6 (284)	19 (275)	18.7 (271)	18.1 (262)	17.7 (256)	17 (246)	16.2 (235)	14.7 (213)
PTFE (Teflon)	DIN 2501	DN 10–50, DN 80	PN 40	S	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	on request
		DN 65, DN 100-150	PN 16	S	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)
		DN 200–600	PN 10	S	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)	10 (150)
		DN 65, DN 100–150	PN 40	O	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	on request
		DN 200–600	PN 16	O	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)	16 (230)
		≥ DN 700	≥ PN 10	S/O	on request							
	ANSI B 16.5	3/8"–24"	150 lbs	S	19.6 (284)	19 (275)	18.7 (271)	18.1 (262)	17.7 (256)	17 (246)	16.2 (235)	14.7 (213)
		3/8"–24"	300 lbs	O	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	40 (580)	on request
		≥ 28"	≥ 150 lbs	S/O	on request							

* Pipe flanges, DN 2.5–100 and 1/10"–4" are flangeless design!

Limits for neoprene, irethane, hard and soft rubber

Liner	Flange standard	Nominal diameter of measuring tube and flanges	Flange pressure rating or class	S= Standard O= Option	Max. operating pressure in bar (and psig) at max. possible product temperature of ... Soft rubber ≤ 40°C (≤ 105°F)	Neoprene ≤ 60°C (≤ 140°F)	Irethane ≤ 70°C (≤ 158°F)	Hard rubber ≤ 90°C (≤ 195°F)
Neoprene, irethane, hard and soft rubber	DIN 2501	DN 25–50, DN 80	PN 40	S	40 (580)	40 (580)	40 (580)	40 (580)
		DN 65, DN 100–150	PN 16	S	16 (230)	16 (230)	16 (230)	16 (230)
		DN 200–1000	PN 10	S	10 (150)	10 (150)	10 (150)	10 (150)
		DN 25–1000	PN 16–1500	O	** 16-64 (150-920)	** 16-100 (150-1450)	** 16-1500 (150-20000)	** 16-80 (150–1160)
		≥ DN 1100	PN 2.5–6	S/O	** 2.5-6 (37-90)	** 2.5-6 (37-90)	** 2.6-6 (37-90)	** 2.5-6 (37-90)
	ANSI B 16.5	1"–40"	150 lbs	S	*** ≤ 19.6 (≤ 284)	*** ≤ 19.0 (≤ 275)	*** ≤ 18.7 (≤ 271)	*** ≤ 18.1 (≤ 262)
		1"–40"	300 lbs	O	*** ≤ 50.8 (≤ 737)	*** ≤ 49.2 (≤ 714)	*** ≤ 48.4 (≤ 702)	*** ≤ 46.8 (≤ 679)
		1"–40"	600 lbs	O	≤ 64 (≤ 920)	≤ 100 (≤ 1450)	≤ 100 (≤ 1450)	≤ 80 (≤ 1160)
	AWWA	≥ 24"	B	S	6 (90)	6 (90)	6 (90)	6 (90)
		≥ 24"	D	O	10 (150)	10 (150)	10 (150)	10 (150)
	API 6 BX	≥ 1"	20000 psig	O	–	–	≤ 1500 (≤ 20000)	–

** dependent on flange pressure rating
*** dependent on product temperature

Vacuum load

Liner	Meter size DN mm	inches	Max. allowed vacuum load in mbar abs. (and psia) at a product temperature of ... ≤ 40°C (≤ 105°F)	≤ 60°C (≤ 140°F)	≤ 70°C (≤ 158°F)	≤ 90°C (≤ 195°F)	≤ 100°C (≤ 210°F)	≤ 120°C (≤ 250°F)	≤ 140°C (≤ 285°F)	≤ 180°C (≤ 355°F)
Fused aluminium oxide	2.5 – 250	1/10 – 10	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
PFA	25 – 100	1 – 4	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	150 (2.2)	200 (2.9)
	125 – 150	5 – 6	50 (0.7)	50 (0.7)	50 (0.7)	50 (0.7)	100 (1.5)	200 (2.9)	300 (4.4)	400 (5.8)
PTFE (Teflon)	10 – 20	3/8 – 3/4	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	500 (7.3)	750 (10.9)	1000 (14.5)
	25 – 150	1 – 6	no vacuum allowed, use IFS 4000 or IFS 5000							
	200 – 600	8 – 24	500 (7.3)	750 (10.9)	1000 (14.5)	1000 (14.5)	1000 (14.5)	1000 (14.5)	1000 (14.5)	1000 (14.5)
	700 – 800	28 – 32	on request							
Neoprene	25 – 300	1 – 12	400 (5.6)	400 (5.6)	–	–	–	–	–	–
	350 – 3000	14 – 120	600 (8.7)	600 (8.7)	–	–	–	–	–	–
Irethane	25 – 3000	1 – 120	500 (7.3)	–	–	–	–	–	–	–
Hard rubber	25 – 300	1 – 12	250 (3.6)	400 (5.8)	400 (5.8)	400 (5.8)	–	–	–	–
	350 – 3000	14 – 120	500 (7.3)	600 (8.7)	600 (8.7)	600 (8.7)	–	–	–	–
Soft rubber	25 – 300	1 – 12	500 (7.3)	–	–	–	–	–	–	–
	350 – 3000	14 – 120	600 (8.7)	–	–	–	–	–	–	–

10.6 Dimensions and weights

10.6.1 IFS 5000 primary head

Dimensions in mm and (inches)

Necessary flange spacing

DN 2.5 to 15, 1/10" to 1/2": Dimension a + 2 times gasket thickness (gasket between grounding rings and pipe flanges)

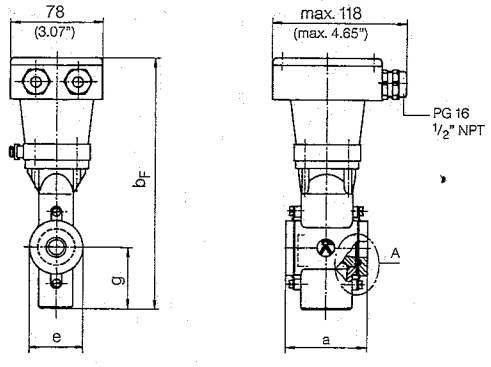
DN 25 to 100, 1" to 4"
without grounding rings: Dimension a incl. gaskets between primary head and pipe flanges
with grounding rings (option): Dimension a + 10 mm or a + 0.4", incl. gaskets between grounding rings and pipe flanges

**** Meter size DN 2.5 – 15 and 1/10" – 1/2":** Pipe flanges DN 15 / PN 40 or 1/2" / Class 150 lbs (300 lbs).

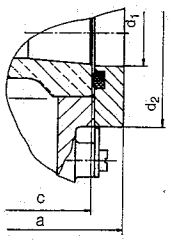
Meter size		**Dimensions** in mm (inches)								**approx. weight**
DN mm	inches	a	b_F	c	d_1	d_2	e	f	g	in kg (lbs)
2.5 – 15 **	1/10 – 1/2 **	65 (2.56)	208 (8.19)	50 (1.97)	15 (0.58)	–	44 (1.73)	–	51 (1.99)	1.7 (3.7)
25	1	58 (2.28)	189 (7.44)	55 (2.17)	26 (1.02)	46 (1.81)	102 (4.02)	68 (2.68)	34 (1.34)	1.7 (3.7)
40	1 1/2	83 (3.27)	204 (8.03)	80 (3.15)	39 (1.54)	62 (2.44)	117 (4.61)	83 (3.27)	42 (1.63)	2.5 (5.5)
50	2	103 (4.06)	222 (8.74)	100 (3.94)	51 (2.01)	74 (2.91)	135 (5.31)	101 (3.98)	51 (1.99)	3.0 (6.6)
80	3	153 (6.02)	254 (10.00)	150 (5.91)	80 (3.15)	106 (4.17)	167 (6.57)	133 (5.24)	67 (2.62)	5.6 (12.3)
100	4	203 (7.99)	279 (10.98)	200 (7.87)	101 (3.98)	133 (5.24)	192 (7.56)	158 (6.22)	79 (3.11)	8.9 (19.6)

IFS 5000
Primary head

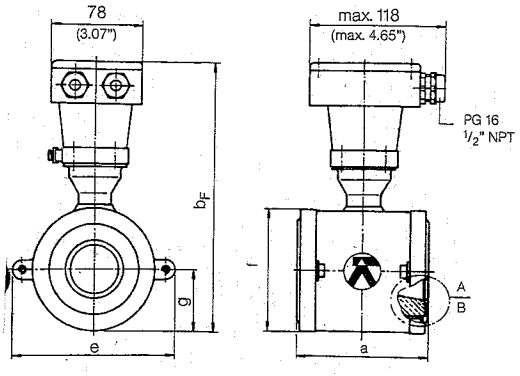
DN 2.5 to 15
1/10" to 1/2"



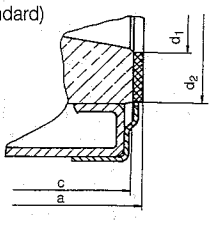
Detail A



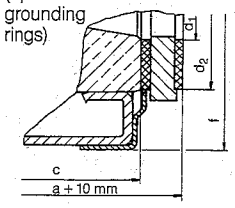
DN 25 to 100
1" to 4"



Detail A
(standard)



Detail B
(option with grounding rings)



10.6.2 IFS 4000 primary head

Flanged connections
... DIN 2501 (=BS 4504) / DN 10–300 / PN 40, 16 or 10: see Table
... ANSI B 16.5 / 3/8"–12" / Class 150 lbs / RF: see Table

Dimensions in mm (inches)

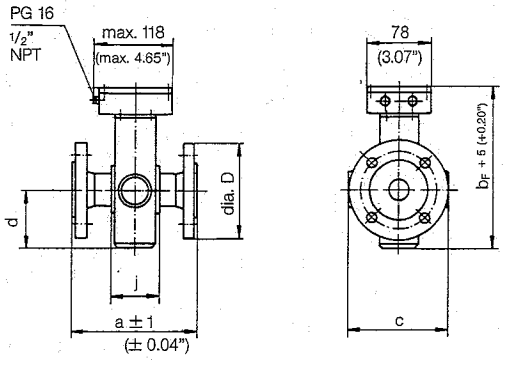
Dimension a without flange gaskets: Not supplied with flowmeter, to be provided by customer.

**** Meter size 3/8":** Flanged connection 1/2"

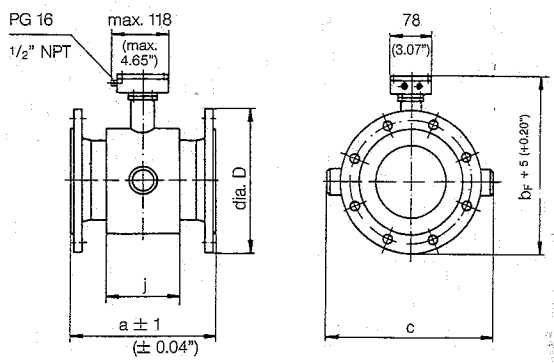
Meter size to ...			**Dimensions** in mm (inches)							**Approx. weight**
DIN		**ANSI**								
DN mm	PN	Inches	a	b_F	c	d	j	dia. D_{DIN}	dia. D_{ANSI}	in kg (lbs)
10	40	3/8**	150 (5.91)	231 (9.09)	121 (4.76)	61 (2.40)	58 (2.28)	90 (3.54)	88.9 (3.50)	4 (8.8)
15	40	1/2	150 (5.91)	231 (9.09)	121 (4.76)	61 (2.40)	58 (2.28)	95 (3.74)	88.9 (3.50)	4 (8.8)
20	40	3/4	150 (5.91)	231 (9.09)	121 (4.76)	61 (2.40)	58 (2.28)	105 (4.13)	98.6 (3.89)	6 (13)
25	40	1	150 (5.91)	231 (9.09)	121 (4.76)	61 (2.40)	58 (2.28)	115 (4.53)	108.0 (4.25)	6 (13)
32	40	–	150 (5.91)	247 (9.72)	139 (5.47)	70 (2.76)	73 (2.87)	140 (5.51)	–	7 (15)
40	40	1 1/2	150 (5.91)	252 (9.92)	150 (5.91)	75 (2.95)	73 (2.87)	150 (5.91)	127.0 (5.00)	7 (15)
50	40	2	200 (7.87)	290 (11.42)	181 (7.13)	–	99 (3.90)	165 (6.50)	152.4 (6.00)	8 (18)
65	16	–	200 (7.87)	300 (11.81)	181 (7.13)	–	99 (3.90)	185 (7.28)	–	12 (27)
80	40	3	200 (7.87)	307 (12.09)	195 (7.68)	–	99 (3.90)	200 (7.87)	190.5 (7.50)	12 (27)
100	16	4	250 (9.84)	358 (14.09)	257 (10.12)	–	131 (5.16)	220 (8.66)	228.6 (9.00)	14 (31)
125	16	–	250 (9.84)	369 (14.53)	257 (10.12)	–	131 (5.16)	250 (9.84)	–	19 (42)
150	16	6	300 (11.81)	399 (15.71)	281 (11.06)	–	143 (5.63)	285 (11.22)	279.4 (11.00)	22 (49)
200	10	8	350 (13.78)	457 (17.99)	342 (13.46)	–	177 (6.97)	340 (13.39)	342.9 (13.50)	35 (77)
250	10	10	400 (15.75)	509 (20.04)	383 (15.08)	–	205 (8.07)	395 (15.55)	406.4 (16.00)	49 (108)
300	10	12	500 (19.69)	572 (22.52)	433 (17.05)	–	235 (9.25)	445 (17.52)	482.6 (19.00)	61 (134)

IFS 4000 Primary head

DN 10 – 40
3/8" – 1 1/2"



DN 50 – 300
2" – 12"



Flanged connections

	Dimensions in mm (inches)
... DIN 2501 (=BS 4504) / DN 350–2000 / PN 10 or 6:	see Table
... DIN 2501 (=BS 4504) / DN 350–2000 / PN 25:	see Table, dimension a_{DIN} + 200 mm or + 7.87"
... ANSI B 16.5 / 14" – 40" / Class 150 lbs / RF:	see Table
... ANSI B 16.5 / 14" – 40" / Class ≥ 300 lbs / RF:	Dimensions supplied on request
... AWWA / ≥ 24" / Class B or D / FF:	Dimensions supplied on request

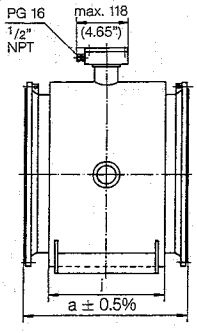
Dimension a without flanged gaskets: Not supplied with flowmeter, to be provided by customer

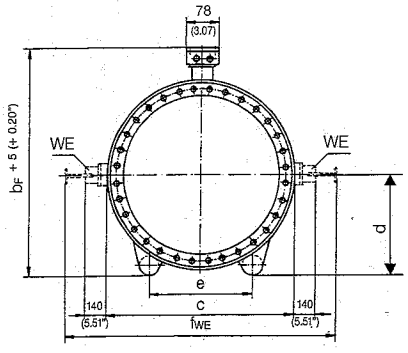
Irethane liner, thickness > 12 mm/> 10.5": Size of flange greater than size of measuring tube, see Tables below.

Meter size to ...			**Dimensions** in mm (inches)							**Approx. weight**
DIN		**ANSI**								
DN mm	PN	Zoll	a_{DIN}	a_{ANSI}	b_F	c	d	e	j	in kg (lbs)
350	10	14	500 (19.69)	700 (27.56)	753 (29.65)	570 (22.44)	329 (12.95)	332 (13.07)	305 (12.01)	145 (320)
400	10	16	600 (23.62)	800 (31.50)	802 (31.57)	620 (24.41)	353 (13.90)	349 (13.74)	385 (15.16)	180 (400)
500	10	20	600 (23.62)	800 (31.50)	903 (35.55)	720 (28.35)	404 (15.91)	371 (14.61)	385 (15.16)	240 (530)
600	10	24	600 (23.62)	800 (31.50)	1005 (39.57)	822 (32.36)	455 (17.91)	493 (19.41)	385 (15.16)	330 (730)
700	10	28	700 (27.56)	900 (35.43)	1105 (43.50)	922 (36.30)	505 (19.88)	521 (20.51)	465 (18.31)	430 (950)
800	10	32	800 (31.50)	1000 (39.37)	1206 (47.48)	1024 (40.31)	555 (21.85)	555 (21.85)	545 (21.46)	540 (1190)
900	10	36	900 (35.43)	1100 (43.31)	1306 (51.42)	1122 (44.17)	606 (23.86)	569 (22.40)	635 (25.00)	650 (1440)
1000	10	40	1000 (39.37)	1200 (47.24)	1406 (55.35)	1222 (48.11)	656 (25.83)	645 (25.39)	705 (27.76)	800 (1770)
1200	6	48	1200 (47.24)	–	1627 (64.06)	1424 (56.06)	776 (30.55)	792 (31.18)	865 (34.06)	870 (1920)
1400	6	56	1400 (55.12)	–	1823 (71.77)	1624 (63.94)	872 (34.33)	858 (33.78)	1045 (41.14)	1230 (2720)
1600	6	64	1600 (62.99)	–	2033 (80.04)	1826 (71.89)	981 (38.62)	876 (34.49)	1245 (49.02)	1550 (3420)
1800	6	72	1800 (70.87)	–	2227 (87.68)	2026 (79.76)	1075 (42.32)	1053 (41.46)	1405 (55.31)	2080 (4590)
2000	6	80	2000 (78.74)	–	2428 (95.59)	2229 (87.76)	1175 (46.26)	1108 (43.62)	1605 (63.19)	2600 (5740)

IFS 4000 Primary head

DN 350 – 2000
14" – 40"





Flange size for irethane liner, thickness > 12 mm/> 0.5"

Nominal size DN in mm (DIN 2501)

Measuring tube	Flanges
DN 350	DN 400
DN 400, 450	DN 500
DN 500, 550	DN 600
DN 600, 650	DN 700
DN 700, 750	DN 800
DN 800, 850	DN 900
DN 900, 950	DN 1000
DN 1000	DN 1200

Nominal size in inches (ANSI B 16.5)

Measuring tube	Flanges
14"	16"
16", 18"	20"
20", 22"	24"
24", 26"	28"
28", 30"	32"
32", 34"	36"
36", 38"	40"
40"	48"

WE = Field replaceable electrodes

f_{WE} = Dimension c + 900 mm or c + 35.50" (minimum dimension)

10.6.3 M 900 primary head

Flanged connections
... DIN 2501 (=BS 4504) / DN 10–300 / PN 40, 16 or 10: see Table
... ANSI B 16.5 / 3/8"–12" / Class 150 lbs / RF: see Table
... ANSI B 16.5 / 3/8"–12" / Class ≥ 300 lbs / RF: dimensions on request

Dimensions in mm and (inches)

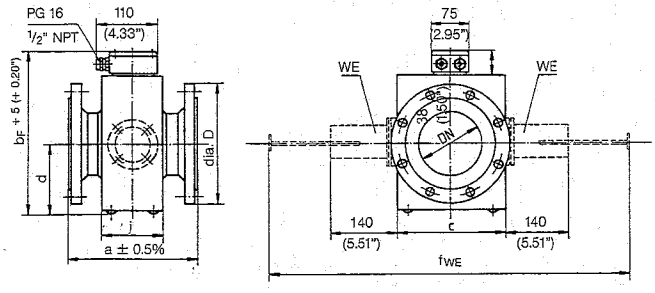
Dimension a without flange gaskets: Not supplied with flowmeter, to be provided by customer.

**** Meter size 3/8":** Flanged connection 1/2"

WE = Field replaceable electrodes, optional for meter sizes DN 50 – 300 and 2" – 12"
f_{WE} = Dimension c + 900 mm or c + 35.50" (minimum dimension)

Meter size to ...			**Dimensions** in mm (inches)							**Approx. weight**
DIN		**ANSI**								
DN mm	PN	inches	a	b_F	c	d	j	dia. D_{DIN}	dia. D_{ANSI}	in kg (lbs)
10	40	3/8**	200 (7.87)	169 (6.65)	92 (3.62)	66 (2.60)	70 (2.76)	90 (3.54)	88.9 (3.50)	10 (22)
15	40	1/2	200 (7.87)	169 (6.65)	92 (3.62)	66 (2.60)	70 (2.76)	95 (3.74)	88.9 (3.50)	10 (22)
20	40	3/4	200 (7.87)	169 (6.65)	92 (3.62)	66 (2.60)	70 (2.76)	105 (4.13)	98.6 (3.89)	10 (22)
25	40	1	200 (7.87)	191 (7.52)	96 (3.78)	77 (3.03)	94 (3.70)	115 (4.53)	108.0 (4.25)	11 (24)
32	40	1 1/4	200 (7.87)	191 (7.52)	96 (3.78)	77 (3.03)	94 (3.70)	140 (5.51)	117.3 (4.62)	11 (24)
40	40	1 1/2	200 (7.87)	236 (9.29)	184 (7.24)	99 (3.90)	94 (3.70)	150 (5.91)	127.0 (5.00)	13 (29)
50	40	2	200 (7.87)	236 (9.29)	184 (7.24)	99 (3.90)	94 (3.70)	165 (6.50)	152.4 (6.00)	14 (31)
65	16	2 1/2	200 (7.87)	256 (10.08)	184 (7.24)	109 (4.29)	94 (3.70)	185 (7.28)	177.8 (7.00)	15 (33)
80	40	3	200 (7.87)	256 (10.08)	184 (7.24)	109 (4.29)	94 (3.70)	200 (7.87)	190.5 (7.50)	17 (37)
100	16	4	250 (9.84)	316 (12.44)	234 (9.21)	139 (5.47)	125 (4.92)	220 (8.66)	228.6 (9.00)	28 (62)
125	16	5	250 (9.84)	316 (12.44)	234 (9.21)	139 (5.47)	125 (4.92)	250 (9.84)	254.0 (10.00)	35 (77)
150	16	6	300 (11.81)	336 (13.23)	266 (10.47)	149 (5.87)	172 (6.77)	285 (11.22)	279.4 (11.00)	45 (99)
200	10	8	350 (13.78)	396 (15.59)	354 (13.94)	179 (7.05)	210 (8.27)	340 (13.39)	342.9 (13.50)	56 (123)
250	10	10	400 (15.75)	456 (17.95)	434 (17.09)	209 (8.23)	244 (9.61)	395 (15.55)	406.4 (16.00)	75 (165)
300	10	12	500 (19.69)	532 (20.94)	490 (19.29)	247(9.72)	280 (11.02)	445 (17.52)	482.6 (19.00)	110 (243)

M 900
Primary head
DN 10 – 300
3/8" – 12"



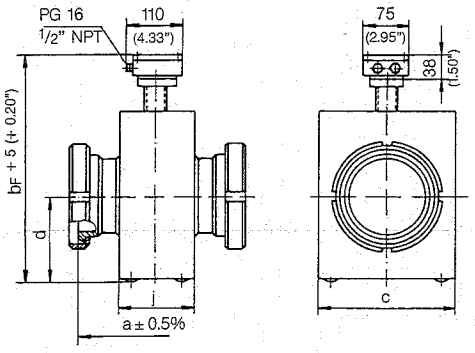
M 900 with sanitary connection to DIN 11851

Dimensions in mm and (inches)

**** For stainless steel housing:** Dimension c + 14 mm or + 0.55"

Meter size	**Dimensions** in mm (inches)				
DN mm	a	b*	c**	d	j
10 and 20	200 (7.87)	223 (8.78)	92 (3.62)	66 (2.60)	70 (2.76)
25 and 32	200 (7.87)	245 (9.65)	96 (3.78)	77 (3.03)	94 (3.70)
40 and 50	200 (7.87)	290 (11.42)	184 (7.24)	99 (3.90)	94 (3.70)
65 and 80	200 (7.87)	310 (12.20)	184 (7.24)	109 (4.29)	94 (3.70)
100 and 125	250 (9.84)	370 (14.57)	234 (9.21)	139 (5.47)	125 (4.92)

M 900 primary head
with sanitary connection to DIN 11851
DN 10 – 125 / PN 10



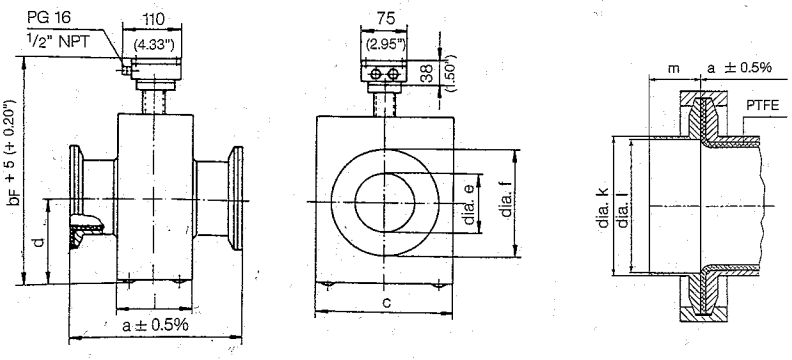
M 900 with clamp connection

Dimensions in mm and (inches)

**** For stainless steel housing:** Dimension c + 14 mm or + 0.55"

Meter size	**Dimension** in mm (inches)									
inches	a	b*	c**	d	dia. e	dia. f	j	dia. k	dia. l	m
1	200 (7.87)	245 (9.65)	96 (3.78)	77 (3.03)	18.5 (0.71)	49.6 (1.95)	94 (3.70)	25.5 (1.00)	22.1 (0.87)	25.4 (1.00)
1 1/2	200 (7.87)	245 (9.65)	96 (3.78)	77 (3.03)	28.5 (1.12)	49.6 (1.95)	94 (3.70)	38.2 (1.50)	34.8 (1.37)	25.4 (1.00)
2	200 (7.87)	290 (11.42)	184 (7.24)	99 (3.90)	44.5 (1.73)	76.6 (3.02)	94 (3.70)	51.0 (2.01)	47.5 (1.87)	25.0 (0.98)
3	200 (7.87)	310 (12.20)	184 (7.24)	109 (4.29)	64.5 (2.52)	117.7 (4.63)	94 (3.70)	76.3 (3.00)	72.9 (2.87)	25.4 (1.00)
4	250 (9.84)	370 (14.57)	234 (9.21)	139 (5.47)	93.8 (3.66)	117.7 (4.63)	125 (4.92)	108.9 (4.25)	97.6 (3.84)	24.3 (0.96)

M 900 primary head
with clamp connection
1" – 4"



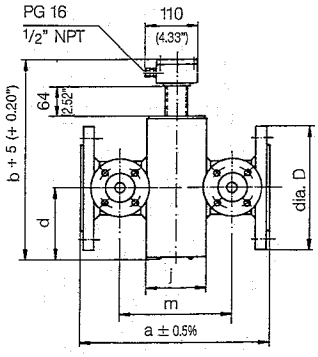
M 900 HJ primary head with heating jacket

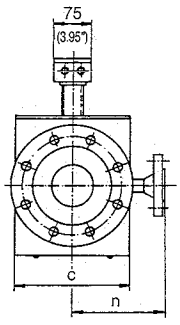
Flange connections for measuring tube — **Dimensions in mm and (inches)**
... DIN 2501 (=BS 4504) / DN 10–100 / PN 40 or 16: see Table
... ANSI B 16.5 / 3/8"–4" / Class 150 lbs / RF: see Table
... ANSI B 16.5 / 3/8"–4" / Class ≥ 300 lbs / RF: dimensions on request

Flange connections for heating jacket
... DIN 2501 (=BS 4504) / DN 15 / PN 40 / stud bolts 4 x M 12
... ANSI B 16.5 / 1/2" / Class 150 lbs / RF / stud bolts 4 x 1/2"

Dimension a without flange gaskets: Not supplied with flowmeter, to be provided by customer.

*** Meter size 3/8":** Flange connection 1/2"





Meter size to ...			**Dimensions** in mm (inches)								
DIN		**ANSI**									
DN mm	PN	inches	a	b	c	d	j	m	n	dia. D_{DIN}	dia. D_{ANSI}
10	40	3/8*	250 (9.84)	233 (9.17)	106 (4.17)	66 (2.60)	70 (2.76)	150 (5.91)	110 (4.33)	90 (3.54)	88.9 (3.50)
15	40	1/2	250 (9.84)	233 (9.17)	106 (4.17)	66 (2.60)	70 (2.76)	150 (5.91)	110 (4.33)	95 (3.74)	88.9 (3.50)
20	40	3/4	250 (9.84)	233 (9.17)	106 (4.17)	66 (2.60)	70 (3.76)	150 (5.91)	110 (4.33)	105 (4.13)	98.6 (3.89)
25	40	1	250 (9.84)	255 (10.04)	109 (4.29)	77 (3.03)	94 (3.70)	150 (5.91)	110 (4.33)	115 (4.53)	108.0 (4.25)
32	40	1 1/4	250 (9.84)	255 (10.04)	109 (4.29)	77 (3.03)	94 (3.70)	150 (5.91)	110 (4.33)	140 (5.51)	117.3 (4.62)
40	40	1 1/2	250 (9.84)	300 (11.81)	198 (7.80)	99 (3.90)	94 (3.70)	150 (5.91)	160 (6.30)	150 (5.91)	127.0 (5.00)
50	40	2	250 (9.84)	300 (11.81)	198 (7.80)	99 (3.90)	94 (3.70)	150 (5.91)	160 (6.30)	165 (6.50)	152.4 (6.00)
65	16	2 1/2	250 (9.84)	380 (14.96)	248 (9.76)	139 (5.47)	125 (4.92)	160 (6.30)	160 (6.30)	185 (7.28)	177.8 (7.00)
80	40	3	250 (9.84)	380 (14.96)	248 (9.76)	139 (5.47)	125 (4.92)	160 (6.30)	160 (6.30)	200 (7.87)	190.5 (7.50)
100	16	4	300 (11.81)	380 (14.96)	248 (9.76)	139 (5.47)	125 (4.92)	180 (7.09)	180 (7.09)	220 (8.66)	228.6 (9.00)

10.6.4 IFS 2000 primary head

Dimensions in mm and (inches)

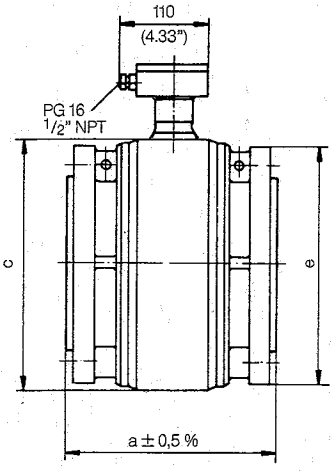
Necessary distance between pipe flanges (dimension a)
DN 150 – 250 and 6" – 10": dimension a + 2 x thickness of gaskets between grounding ring and pipe flange. These gaskets not supplied with flowmeter, to be provided by customer.

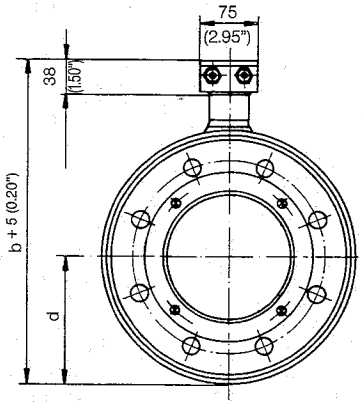
Dimension a incl. grounding rings and gaskets between primary head and grounding rings.

Flange Standard	**Nominal size**	**Dimensions** in mm (inches)					**Approx. weight**
		a	b	c	d	e	in kg (lbs)
DIN 2501 (= BS 4504)	DN 150/PN 16	265 (10.43)	379 (14.92)	292 (11.50)	146 (5.75)	283 (11.14)	37 (82)
	DN 200/PN 16	315 (12.40)	420 (16.54)	324 (12.76)	171 (6.73)	342 (13.46)	53 (117)
	DN 250/PN 16	365 (14.37)	482 (18.98)	394 (15.51)	198 (7.80)	395 (15.55)	87 (192)
ANSI B16.5	6", 150lbs, FF	265 (10.43)	385 (15.16)	292 (11.50)	152 (5.98)	295 (11.61)	37 (82)
	8", 150lbs, FF	315 (12.40)	426 (16.77)	324 (12.76)	177 (6.97)	354 (13.94)	53 (117)
	10", 150lbs, FF	365 (14.37)	488 (19.21)	394 (15.51)	204 (8.03)	407 (16.02)	87 (192)

IFS 2000

DN 150 – 250
6" – 10"

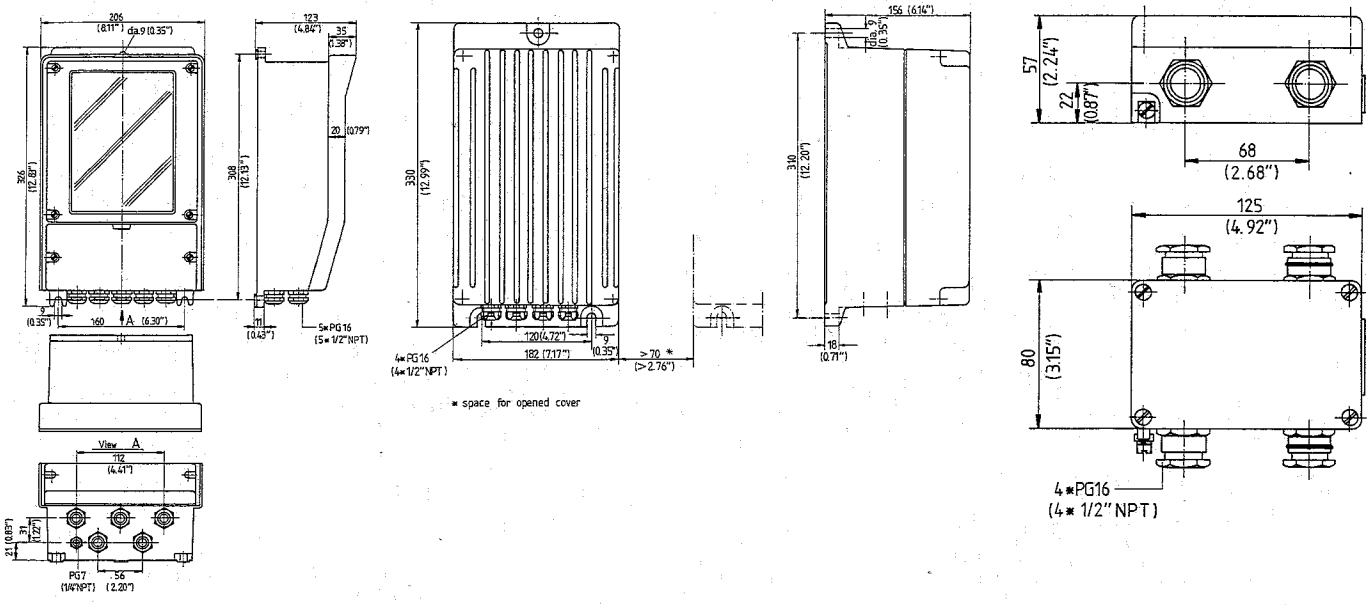




SC 100
Weight approx. 4.5 kg (9.9 lbs)

NB 900 F
Weight approx. 8.5 kg (18.7 lbs)

Intermediate connection box ZD
Weight approx 0.5 kg (1.1 lbs)



10.7 Instrument nameplates

Signal converter: SC 100 AS

KROHNE Sliedrecht, Holland
Altometer
SIGNAL CONVERTER - MESSUMFORMER
Type / Typ
No. / Nr.
Power / Hilfsenergie

OUTPUTSIGNALS - AUSGANGSSIGNALE
Magn.field freq. / Magnetfeldfreq. 1: . Line / Netz
Current / Strom (mA) I — $R_L \leq$ (kΩ)
Pulses / Impulse P

SPECIAL FUNCTIONS - SPEZIALFUNKTIONEN

CALIBRATION FOR - KALIBRATION FÜR
Primary head / Meßwertaufn.
No. / Nr.
Meter Size / Nenndurchm. DN
Primary const. / Geberkonst. GK
Range(s) / Meßbereich(e) F V R
Tag. No. / Meßst.Nr.

Power driver: NB 900 F

KROHNE Sliedrecht, Holland
Altometer
MID - BOOSTER - MID - LEISTUNGSTREIBER
Type / Typ
No. / Nr.
Power / Hilfsenergie
Power Consumption / Leistungsaufnahme

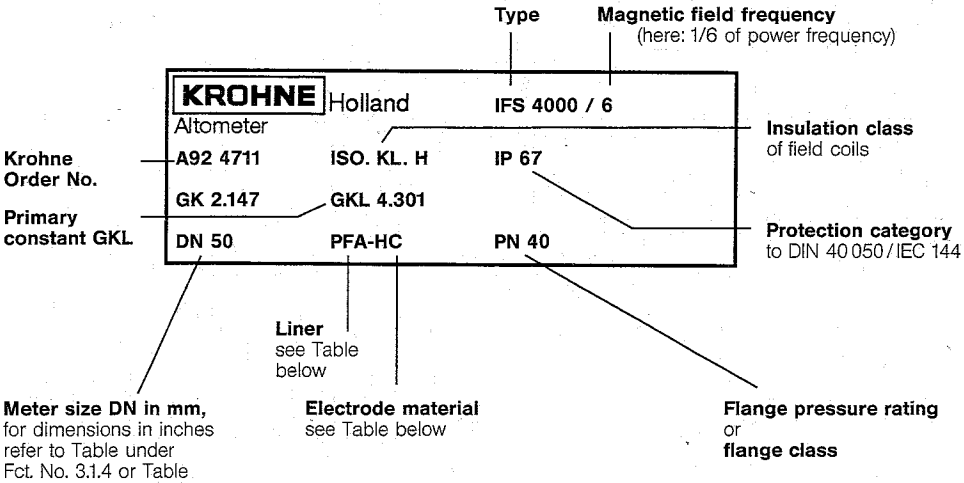
Primary heads:

IFS 2000

IFS 4000

IFS 5000

M 900



Liner

AL	Fused aluminium oxide (99.7% Al_2O_3)
H	Hard rubber
NE	Neoprene
PFA	Teflon-PFA
PS	Polysulfone
PUI	Irethane
T	Teflon-PTFE
W	Soft rubber
ZR	Zirconium oxide

Electrode material

HB	Hastelloy B2
HC	Hastelloy C4
IN	Incoloy
M4	Monel 400
Ni	Nickel
PT	Platinum cap on stainless steel 1.4571 (SS 316 Ti)
TA	Tantalum
TI	Titanium
V4A	Stainless steel 1.4571 (SS 316 Ti)

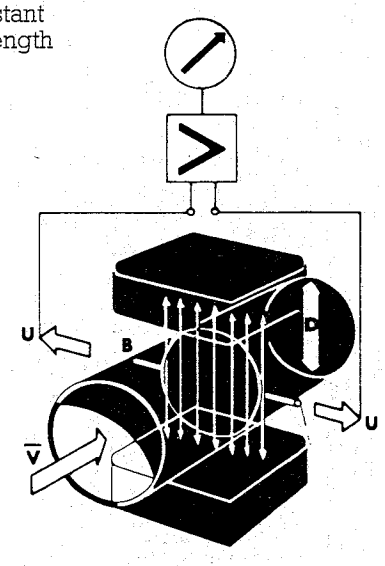
11. Measuring principle and function of the system

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.

$U = K * B * \bar{v} * D$

where:
U = induced voltage
K = an instrument constant
B = magnetic field strength
$\bar{v}$ = mean velocity
D = pipe diameter



Thus the induced voltage is proportional to the mean flow velocity, when the field strength is constant.

Inside the magnetic inductive 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 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 * 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 and description of the signal converter

The SC 100 AS is divided into five functional groups.

Functional group 1 contains an input amplifier allowing bootstrapping of the signal wire shield, and a high-resolution analog/digital converter that is controlled by microprocessor μP 01.

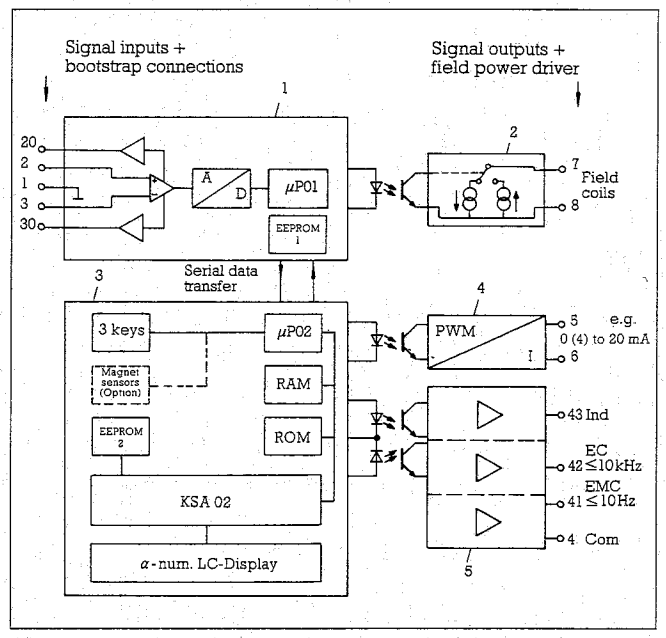
Functional group 2 generates a pulsed, electronically controlled direct current for the primary head coils. This group is galvanically isolated from all other groups.

In **functional group 3** the digitalized data supplied by μP 01 are evaluated by microprocessor μP 02 in acordance with the functions, operating and primary head data programmed by way of the 3 keys. Microprocessor μP 02 controls with the aid of the KROHNE-developed LSI circuit (KSA) the outputs that are galvanically isolated by optocouplers (functional assemblies 4 and 5). The last measured value and other information are forwarded via this circuit to the alphanumeric LCD for indication.

The KSA module is also used to feed last counts to the EEPROM. In the event of a power failure, last counts are saved in EEPROM 2. In the same way as operating and functional data are permanently stored in EEPROM 1, both are retained for 10 years without auxiliary power.

Functional group 4 converts a frequency into a proportional current. This group is galvanically isolated from the other groups.

Functional group 5 consists of power drivers for control of electronic (EC) and electromechanical (EMC) counters, and an indication output that can be programmed for many different tasks. This group is galvanically isolated from the other groups.

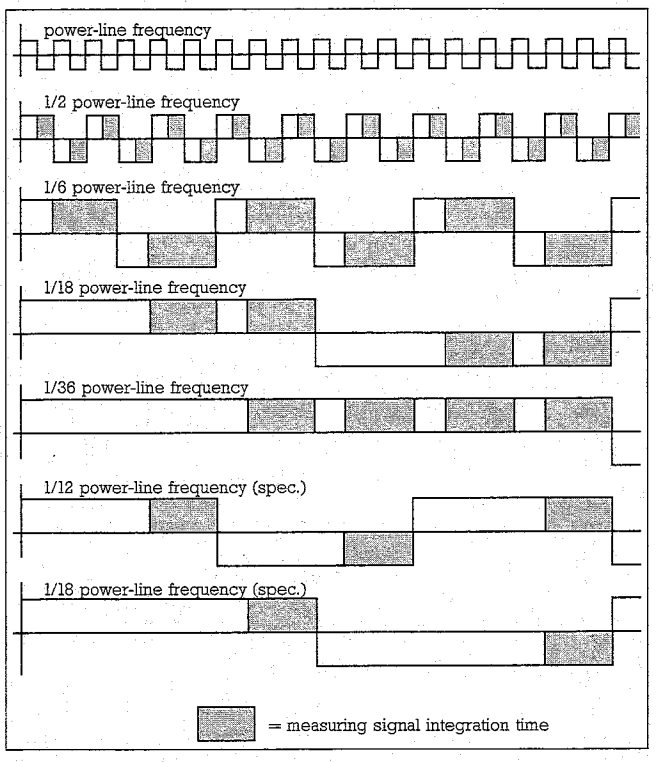


Use of the „µPI-HPC" pc board and special software „8.06267.xx" in an SC 100 AS requires a different layout of menu 4.00. Other menu items are not affected.

Fct. No.	Text	Description and input
4.00	*SPEC. FCT.*	**Main menu 4.00 Special functions**
4.01	*LANGUAGE*	**Language of display texts,** Sect. 5.11 ● *GB/USA* (= English) ● *D* (= German) ● *F* (= French) ● *SF* (= Finnish) ● others pending
4.02	*ENTRY CODE*	**Coding for entry into programming mode?** Sect. 5.12 ● *NO* = entry with **E** key ● *YES* = entry with keys **→ → ↑ ↑ E E**
4.03	*OUTP. HOLD*	**Hold values of outputs during programming?** *NO* or *YES* (Sect. 5.13)
4.04	*UNIT TEXT*	**Text for field-programmable unit,** Sect. 5.14 *A...Z / a...z / 0...9 / ___* (= space)
4.05	*FACT. QUANT.*	**Conversion factor for quantity F_M,** Sect. 5.14 Factor F_M = quantity per 1 m^3 Range: *0.00001*10^{-9} to 9.99999*10^{+9}*
4.06	*FACT. TIME*	**Conversion factor for time F_T** Sect. 5.14 Factor F_T in seconds Range: *0.00001*10^{-9} to 9.99999*10^{+9}*
4.07	*FIELD FREQ.*	**Magnetic field frequency,** Sect. 5.15+8.2 ● *1/6* ● *1/16* ● *1/32*
4.08	*SCALE SEL.*	**Select preamplification,** Sect. 13 ● *AUTO* (automatic) ● *HIGH FLOW* (high flow range) ● *MED. FLOW* (medium flow range) ● *LOW FLOW* (low flow range)
4.09	*FIELD CUR.*	**Input of field current** Range: *225.00 to 275.00 mA* (see sticker at term 7 + 8 on "basic" pc board/with power driver NB 900 F always ± 250 mA) Not to be changed, see Sect. 7.2 + 8.1
4.10	*NOISE*	**Noise rejection,** see Sect. 13 ● *NO* ● *YES*
4.11	*LIMIT CNT*	Counter for off-limit condition (appears only if *YES* entered under (Fct. 4.10 *NOISE*), see Sect. 13 Range: *001* to *250*
4.12	*LIMIT VAL*	**Limit value for noise amplitude** (appears only if *YES* entered under Fct. 4.10 *NOISE*), see Sect. 13 Range: *01* to *90 PERCENT*

Fct. 4.07 Magnetic field frequency

In addition to the normal magnetic field frequencies, three new values are available. These are ***„1/2", „SPEC. 1/12"*** and ***„SPEC. 1/18"*** of the power frequency. The following chart shows the transient recovery time for the magnetic field and the integration time of the measuring signal.

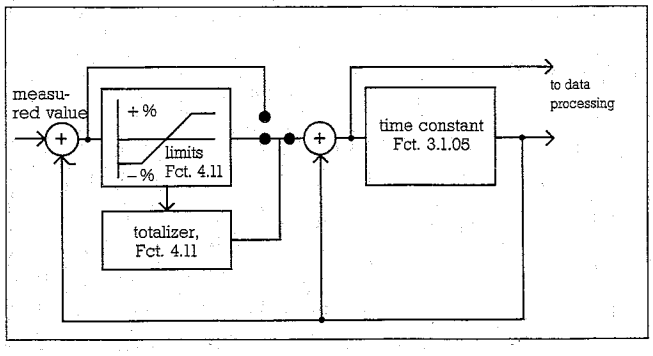


Fct. 4.08 Range selection

This function can be used to influence the preamplifier stage. In the ***AUTO*** mode, the microprocessor automatically takes over the setting in keeping with the interference level and the size of the wanted signal. In some applications it may prove useful to change the gain manually. Since there are no hard and fast rules for applying Fct. 4.08, it is advisable to determine the best setting by trial and error.

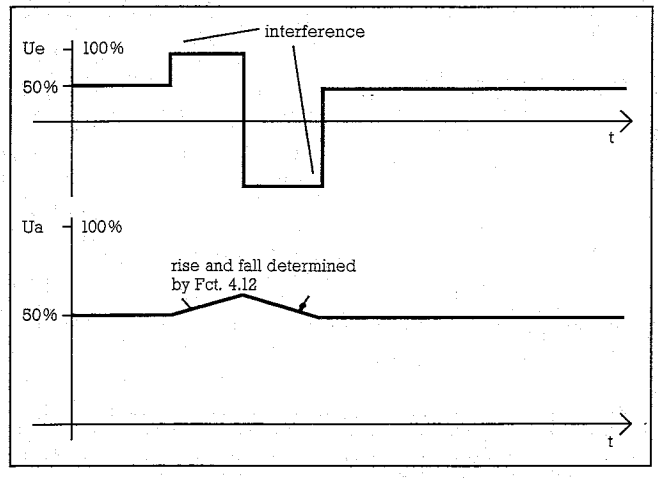
Fct. 4.10 Noise rejection

This function activates a special noise rejection filter (input: ***YES***). The task of this filter is to reject spurious peaks and thus provide steadier display and output of the measured values. The data of the two following functions, Fct. 4.11 and Fct. 4.12, are used for operation of the noise rejection filter. These input functions are not shown in the menu when ***NO*** has been entered in Fct. 4.10. The block diagram below serves to illustrate filter action and the parameters of functions 4.11 and 4,12.



Functional description
The old measured value, weighted with the time constant, is subtracted from the newly calculated measured value, and the result checked to establish whether it exceeds the limit set in Function 4.11. If it does, the totalizer count increases and the differential signal is limited to the specified limit value. To this differential signal is added the old measured value again, and forwarded to the time constant program. When the totalizer attains the default value from function 4.11, the limiter unit is bypassed. If the set limit is not exceeded, the totalizer is reset to the value '0', and the limiter bypass de-energized. Two examples are given below to illustrate the function.

Example 1:
Transient interference superposed on the measured value.

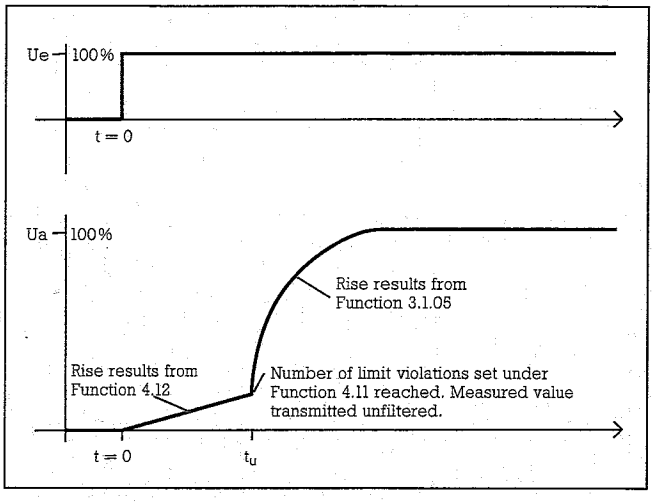


In this example it is important that the number of violations of the limit value from Function 4.11 be selected such that the limiter function always remains activated. The following equation can be used to establish by approximation the input values for function 4.11:

$$\text{LIMIT CNT} = \frac{\text{max. duration of interference (in sec)}}{0.06}$$

For function 4.12, the maximum user-acceptable deviation from the measuring signal is the determining factor. But noise duration, noise amplitude and the shape of the curve are also crucial factors. This parameter can only be determined by trial and error, since too many factors would have to be considered before any hard and fast rule can be laid down.

Example 2:
The measured value skips from 0% to 100% of the flowrate. No interference and no noise signals.



As shown in the diagram, the step change of the wanted signal is forwarded to the outputs after a time interval. The rate of rise is dependent on the setting of time constant T and the value from Fct. 4.12 LIMIT VAL. The time constant in the $t < t_u$ range is:

$$\text{TLimit} = \frac{\text{T[s]}}{\text{LimitVal}} \times 100\%$$

given a 100% skip of the wanted signal.

The instant t_u of switchover to the set time constant T is:

$t_u \approx \text{LimitCnt} \times 0.06$ s

For delta Δ Ue (%) LimitVal we obtain a maximum output response of:

$$\frac{\Delta \text{Ua}}{\Delta \text{T}} = \frac{\text{LimitVal}}{\text{T}}$$

where T is the TIMECONSTANT set under Fct. 3.1.05.

Note: Additional dead times for all signal outputs result from functions 4.11 and 4.12. This means that function 3.1.05 T-CONST.I is no longer the sole determining factor for the response time of the SC 100 AS.

Retrofitting the μP1-HPC board

1. Note down all input parameters.
2. De-energize the device!
3. Exchange the μP1 board and the EPROM for the μP2. (if necessary unsolder OTP. and insert a 28-pin socket-mount).
4. Switch on device.
5. The device displays Err14 and E01.
   (Also refer to page 25 of SC 100 AS operating instructions, current calibration data different!)
6. Press key E 4 times, the values are corrected automatically.
7. Enter all input parameters again according to the old setting. With the new extra functions it is advisable to select a basic setting first,
   (i. e. 4.7 = 1/6 (f line); 4.8 = auto; 4.10 = no).
8. Calibrate the zero.

The device is again fully functionable. The new facilities can now be used according to application. Repeat zero calibration at the end of the experimental phase.

Part E Index

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

Your ALTOFLUX 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 an ALTOFLUX 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.: .....

The enclosed electromagnetic flowmeter

ALTOFLUX, 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:

KROHNE

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