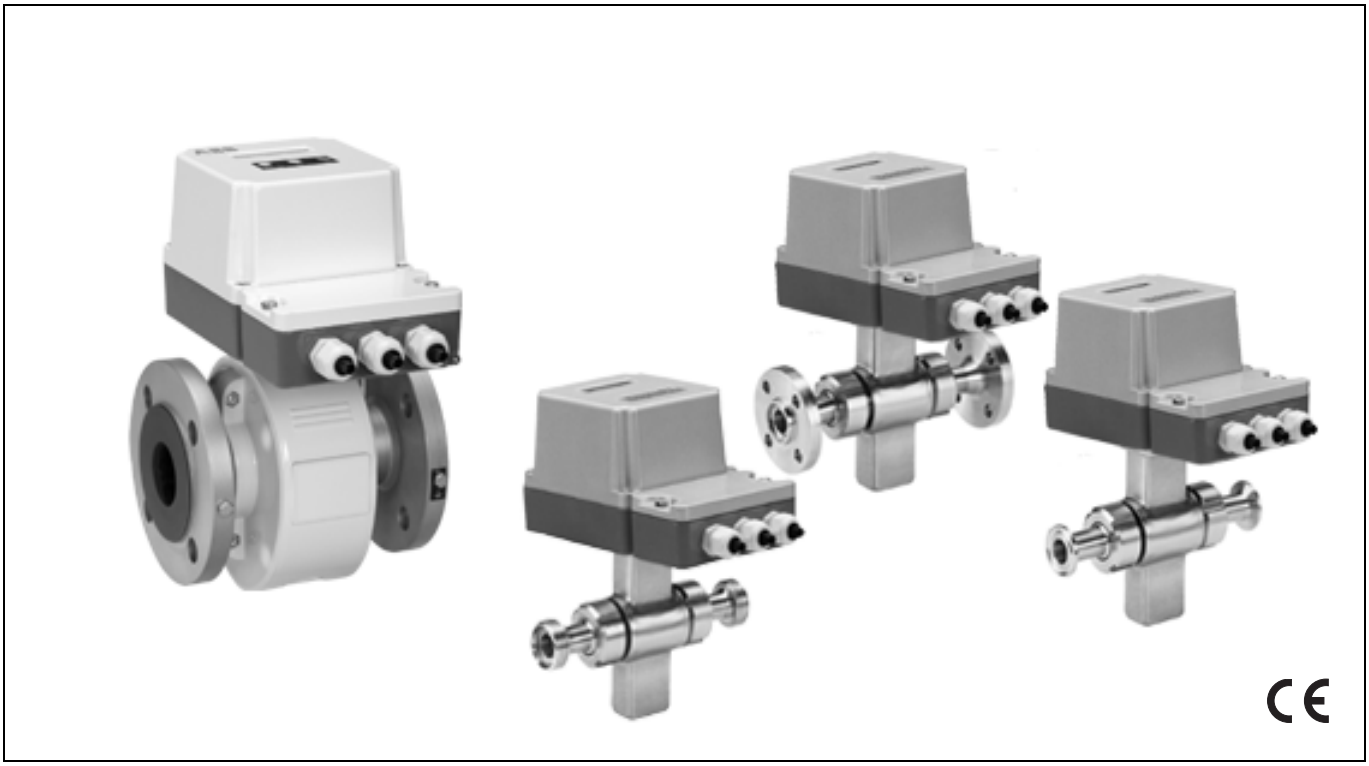
FXM2000 (COPA-XM)
FXM2000 (COPA-XM) Certified

Electromagnetic Flowmeter
with Pulsed DC Magnetic Field

Operating Instructions

D184B070U02 Rev. 04 / 05.2006



Models: DM23_/DM43F
Software Revisions A.3X
HART-Software X.3X

You have purchased a high quality, modern Electromagnetic Flowmeter system in a Compact Design from ABB Automation.
We appreciate your purchase and the confidence you have expressed in us.

This Instruction Bulletin contains information relating to the assembly and installation of the instrument and its specifications. ABB Automation reserves the right to make hardware and software improvements without prior notice. Any questions which may arise that are not specifically answered by these instructions should be referred to our main plant in Göttingen, Germany or to our Technical Service personnel.

The instruments satisfy the general safety requirements per EN 61010-1 and the EMC-Requirements per EN 61326 as well as the NAMUR-Recommendation NE21

Introductory Safety Notes for the EMF System

Regulated Usage

The Electromagnetic Flowmeter System (EMF) is manufactured to state of the art designs and is safe to operate. The flowmeter is to be installed exclusively in applications which are in accord with the specifications.

Every usage which exceeds the specifications is considered to be non-specified. Any damages resulting therefrom are not the responsibility of the manufacturer.
The user assumes all risk for such usage.

The applicable specifications include the installation, start-up and service requirements specified by the manufacturer.

Assembly, Start-Up and Service Personnel

Please read this Instruction Bulletin and the safety notes before attempting installation, start-up or service.

Only qualified personnel should have access to the instrument.
The personnel should be familiar with the warnings and operating requirements contained in this Instruction Bulletin.

Assure that the interconnections are in accordance with the Interconnection Diagrams. Ground the flowmeter system

Observe the warning notes designated in this document by the symbol 

Hazardous Material Information

If repairs are required:
In view of the Disposal Law of 27 Aug. 86 (AbfG. 11 Special Wastes) the owner of special wastes is responsible for its care and the employer also has, according to the Hazardous Material Law of 01 Oct. 86 (GefStoffV, 17 General Protection Responsibility), a responsibility to protect his employees, we must make note that

a) all flowmeter primaries and/or flowmeter converters which are returned to ABB Automation for repair are to be free of any hazardous materials (acids, bases, solvents, etc.).

b) the flowmeter primaries must be flushed so that the hazardous materials are neutralized. There are cavities in the primaries between the metering tube and the housing. Therefore after metering hazardous materials, these cavities are to be neutralized (see Hazardous Material Law -GefStoffV). For two piece housings the housing screws are to be loosened. For flowmeter primaries ≥ 18"/DN 450 the drain plug at the bottom of the housing is to be removed in order to neutralize any hazardous material in the magnet coil and electrode areas.

c) For service and repairs **written confirmation** is required that the measures listed in a) and b) have been carried out. For this purpose, please use the declaration regarding contamination on page 61.

d) Any costs incurred to remove the hazardous materials during a repair will be billed to the owner of the equipment.

EG-Konformitätserklärung
EC-Certificate of Compliance

CE

Hiermit bestätigen wir die Übereinstimmung der aufgeführten Geräte mit den Richtlinien des Rates der Europäischen Gemeinschaft. Die Sicherheits- und Installationshinweise der Produktdokumentation sind zu beachten.

Herewith we confirm that the listed instruments are in compliance with the council directives of the European Community. The safety and installation requirements of the product documentation must be observed.

Modell: *Model:*	50XM2000 DM4_F DM2_
Richtlinie: *Directive:*	EMV Richtlinie 89/336/EWG * EMC directive 89/336/EEC *
Europäische Norm: *European Standard:*	EN 61326, 5/2004 *
Richtlinie: *Directive:*	Niederspannungsrichtlinie 73/23/EWG * Low voltage directive 73/23/EEC *
Europäische Norm: *European Standard:*	EN 61010-1, 8/2002 *

* einschließlich Nachträge
including alterations

Göttingen, 06.03.2006

ppa.....
B.Kammann, Vice President PRU Flow

BZ-13-5110, Rev.2

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Content

Page

1. Functional Description 7

2. Assembly and Installation 8

2.1 Inspecting the Flowmeter Primary 8
2.2 Flowrate Metering Coordination for the Compact Design EMFs 8
2.2.1 Rotating the Display 8
2.3 Installation Requirements 9
2.3.1 Installing the Flowmeter Primary 11
2.3.2 Installations in Larger Size Pipelines 12
2.3.3 Installing the Volume Flow Integrator 13

3. Operation - Data Entry and Configuration of the Converter 14

3.1 Display Formats 14
3.2 Data Entry 15
3.3 Data Security 15
3.3.1 Data Storage Module ext. EEPROM 15
3.4 Data Entry Instructions “Condensed Form” 16
3.5 Parameter Overview and Data Entry 17

4. Parameter Entry (Additional Information) 31

4.1 User Programmable Units 31
4.1.1 Units Factor: Numeric Entry 31
4.1.2 Unit Name: Select from Table 31
4.1.3 Programmable Units with/without Density Select from Table 31
4.2 Submenu Function Test Numeric Entries only for Iout 31

5. Maintenance 32

5.1 General 32
5.2 Testing the Converter with the Flowmeter Primary Simulator 55XC4000 32
5.3 Error Messages and Checks 33
5.3.1 Error Messages During Data Entry 33
5.3.2 Checking the Measurement System 35
5.3.3 Checking the Converter 36
5.4 36
5.5 Pulse Conversion Active/Passive 37
5.6 Block Diagram 38
5.7 Circuit Boards 39
5.7.1 Assembled Power Supply-Driver Board AC 39
5.7.2 Assembled Power Supply-Driver Board DC 40
5.7.3 Assembled Digital-/Signal Board 41
5.7.4 Assembled Option Board 42

6. Locations of the Fuses, Switches, ext. EEPROM Socket and Pulse Output 43

6.1 Calibration Board 43

7. Replaceable Parts, Flowmeter Primary 44

Content

Page

8. Safety Relevant Section 46

8.1 Grounding the Flowmeter Primary 46
8.2 Supply Power Connections 48
8.3 Output Signal Connections 48
8.4 Additional Information for Connecting to the Profibus DP 49
8.5 Additional Information for Connecting to the HART-Protocol® 50
8.6 Additional Information for the Pulse Output 50
8.7 Additional Information for Piston Pump/Pulsating Flows 51
8.8 Additional Information for the Preset Totalizer 52
8.9 Additional Information for External Zero Return 53
8.10 Interconnection Diagram 54
8.11 Interconnection Examples for Peripheral Current Output and Pulse Output 55
8.11.1 Interconnection Examples for Peripheral Contact In-/Output, Data Link 56

9. Start-Up 57

9.1 Checks 57
9.2 Zero Checks 57
9.3 Detector "Empty Pipe" 57
9.4 Maintenance / Repair 58
9.5 Accessories 58
9.5.1 Gaskets 58

10. Parameter Setting Overview and Flowmeter Design Options 59

11. Declaration regarding the contamination of units and components 61

Technical Data
Electromagnetic Flowmeter FXM2000 (COPA-XM)
see Data Sheet D184S031U02 Rev. 05

1. Functional Description

ABB Automation Electromagnetic Flowmeters »EMF« are the ideal flow metering instruments for liquids, slurries, sludges which have a specific minimum electrical conductivity. The instruments measure accurately, add no additional pressure drop, have no moving or protruding parts, are wear free and chemically resistant. The flowmeters can be readily installed in existing pipelines.

The ABB Automation »EMF« has been proven over many years and is the preferred flowmeter in the Chemical and Pharmaceutical industries, Municipal Water and Waste Water treatment facilities as well as in the Food and Beverage Industries.

Principle of Operation

The basis for the operation of electromagnetic flowmeters are Faraday's Laws of Induction. A voltage is induced in a conductor as it moves through a magnetic field.

This measurement principle is applied to a conductive fluid which flows in a pipe through which a magnetic field is generated perpendicular to the flow direction (see Fig. 1).

The voltage which is induced in the fluid is measured at two electrodes located diametrically opposite to each other. This signal voltage $\mathbf{U_E}$ is proportional to the magnetic induction **B**, the electrode spacing **D** and the average fluid velocity **v**.

Noting that the magnetic induction **B** and the electrode spacing **D** are constant values indicates that a proportionality exists between the signal voltage $\mathbf{U_E}$ and the average flow velocity **v**. The equation for calculating the volume flowrate shows that the signal voltage $\mathbf{U_E}$ is linear and proportional to the volume flowrate.

Design

The electromagnetic flowmeters in a Compact Meter design occupy a special place in flow metering. In these instruments the converter is mounted directly on the flowmeter primary. The installation costs are appreciably less for this design.

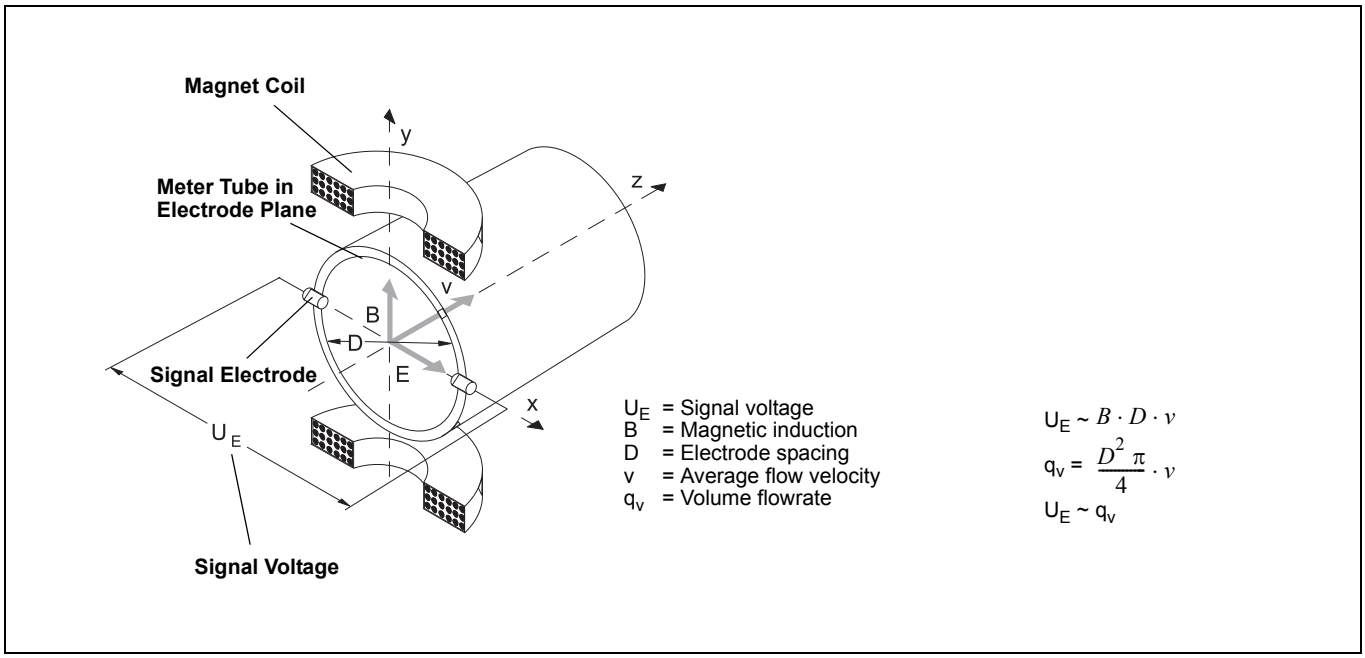


Fig. 1 Electromagnetic Flowmeter Schematic

2. Assembly and Installation

2.1 Inspecting the Flowmeter Primary

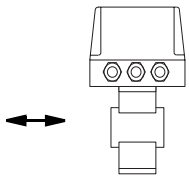
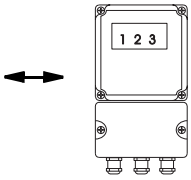
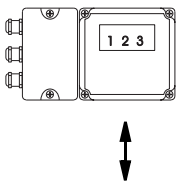
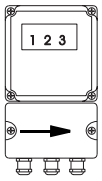
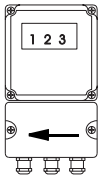
Before installing the electromagnetic flowmeter check the Compact Design EMF for mechanical damage due to possible mishandling during shipping. All claims for damage are to be made promptly to the shipper before installation.

! Instructions for opening the housing

The following instructions must be observed when opening the converter housing:

- All interconnection leads must be voltage free.
- When the housing is open the EMC-Protection is limited.

2.2 Flowrate Metering Coordination for the Compact Design EMFs

Suitable for metering the flow in the directions	Measures		Attachment of separate supplied arrow	Software settings
	Installations in horizontal pipelines	Installations in vertical pipelines		
		Display rotation required, see 2.2.1	The arrow is to be attached so that it agrees with the actual forward flow direction!	
Forward-Reverse	Install the EMF so that the display (standard) can be easily read by the operator (a vertical electrode axis is to be avoided), see **Fig. 5** Example: Front view  Example: Top view 	Install the EMF so that the display (rotated) can be easily read by the operator, see **Fig. 4** 	The loose arrow is to be cemented to the connection box cover by the user at start-up to agree with the desired forward flow direction.  	If the forward and reverse direction indicators in the display do not agree with the actual flow directions, the parameter “Flow direction” in the Submenu Operating Mode is to be changed from “standard“ to “opposite“.

2.2.1 Rotating the Display

First unscrew the large housing cover. The display is held in place by four spacer bolts (bolts 1, 2, 3 and 4). After the bolts have been removed the display can be removed and rotated 90° to the right or to the left. Carefully reinsert the rotated display and secure with the 4 bolts. When replacing and tightening the housing cover make certain that the gasket is properly seated. Only then will Protection Class IP 67 be assured.

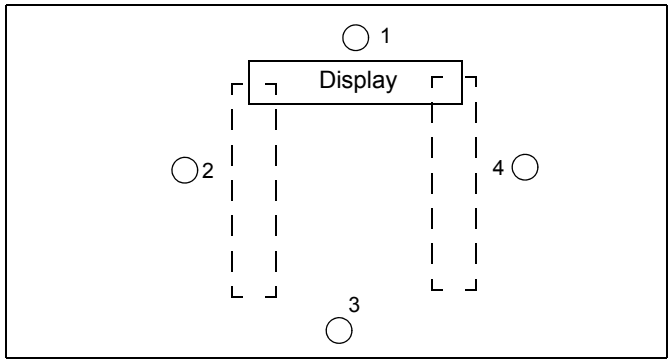


Fig. 2 Rotating the Display

2.3 Installation Requirements

! Note:

- During installation it is essential to observe that for installations in:

  a) **horizonta**l pipelines the cable connectors (for the interconnections) must **point towards the operator** for best display readability (Fig. 3).

  b) **vertical** pipelines the cable connectors (for the interconnections) must **point to the left** as viewed by the operator (Fig. 4).
  See the Flowrate Coordination described in 2.2.

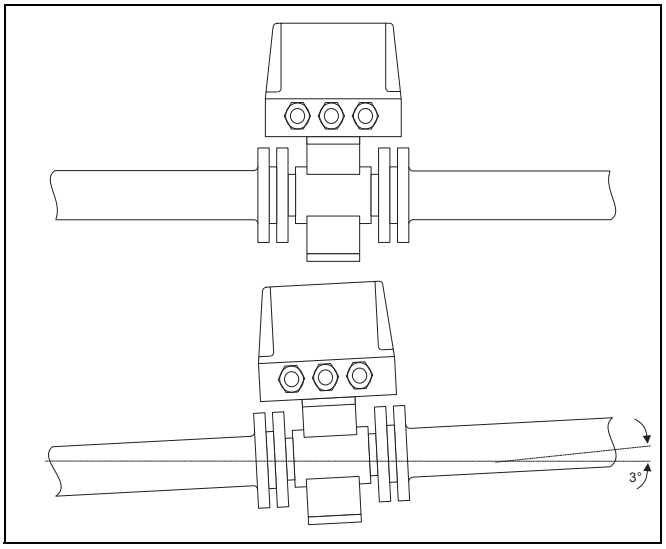


Fig. 3

The flowmeter primary must be installed so that the meter tube is always completely filled with fluid and cannot drain. A slight upward slope of approx. 3 % is desirable to prevent gas build up within the flowmeter (Fig. 3).

Vertical installations are ideal when the fluid flows in an upward direction. Installations in drop lines, i.e., the fluid flows from the top to the bottom are to be avoided because experience has shown that it is not possible to guarantee that the pipeline will remain 100% full and that an equilibrium condition between the upward flowing gas and the downward flowing fluid will not occur (Fig. 4). For vertical installations the cable connectors should point to the left (as viewed by the operator) otherwise the clockwise rotated display will be upside down.

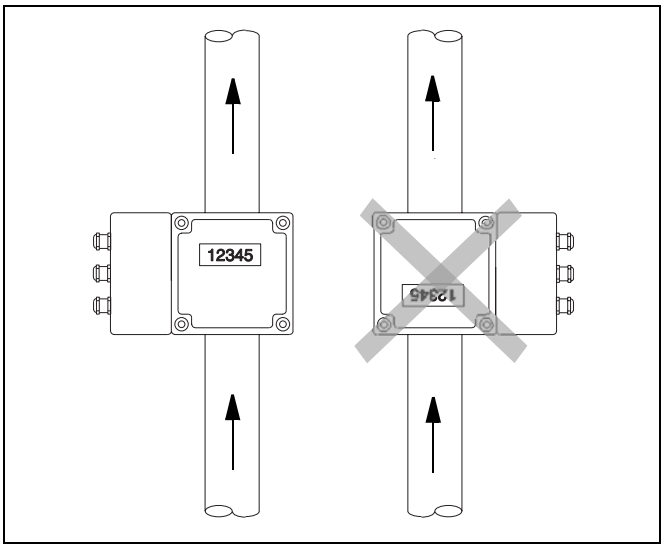


Fig. 4

In horizontal installations the imaginary line connecting the electrodes should be horizontal so that air or gas bubbles cannot affect the signal voltage. The electrode orientation is shown in Fig. 5.

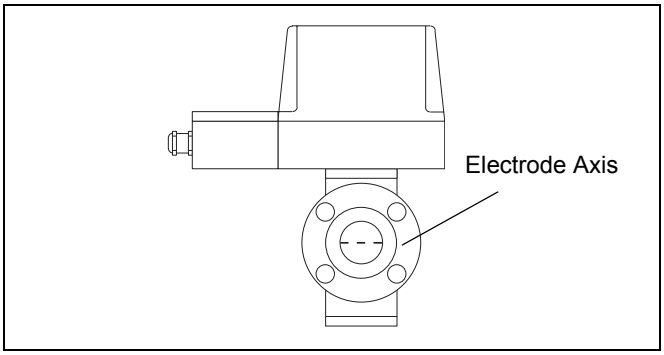


Fig. 5

For a free flow in- or outlet an invert should be provided to assure that the flowmeter primary is always filled with fluid (Fig. 6).

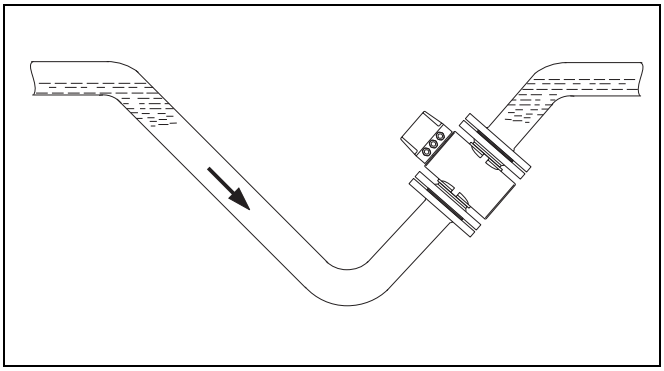


Fig. 6

In a free flow outlet (drop line) the flowmeter primary should be not be installed in the highest point or in the discharge of the pipeline (metering spool could drain, air bubbles, see Fig. 7).

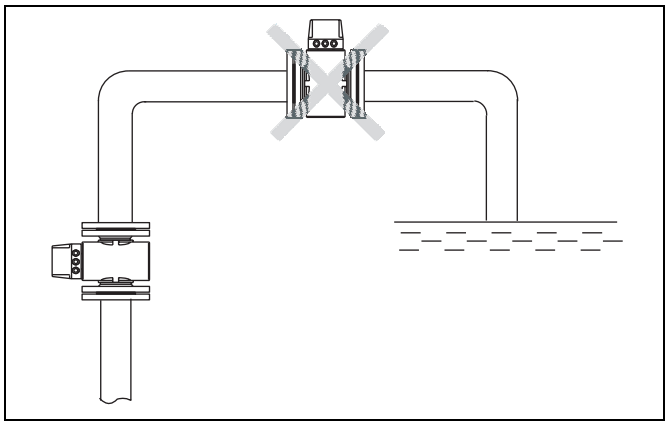


Fig. 7

The measurement principle is independent of flow profile as long as standing eddies do not extend into the measurement section (e.g. after double elbows, tangential inflows or half open valves upstream of the flowmeter primary). In such situations measures to condition the flow are required. Experience indicates that in most cases a straight upstream section with a length of 3 x D and a downstream section of 2 x D is sufficient (D = flowmeter primary size). For the EMF-Instruments in certified installations which require a PTB-Approval, the required installation specifications may be found in the Approval and on page 7. In calibration stands the reference conditions of EN 29104 require straight lengths of 10 x D upstream and 5 x D downstream.

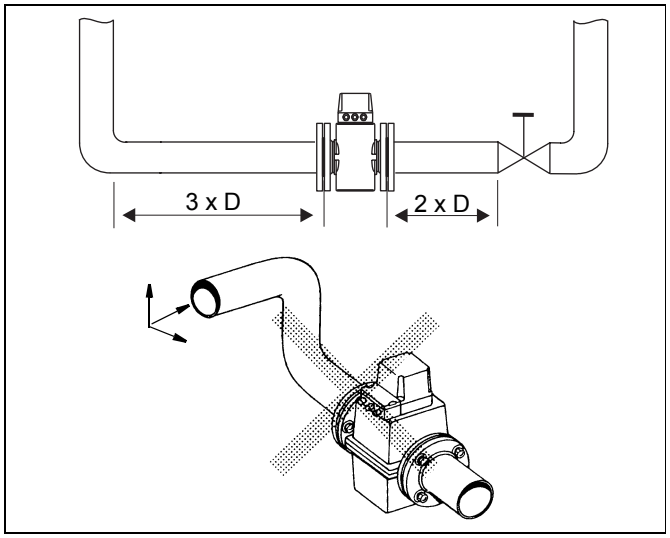


Fig. 8

Wafer valves are to be installed in such a manner that the wafer when open does not extend into the flowmeter (Fig. 8).

For highly contaminated fluids a bypass line similar to that shown in Fig. 9, Design A is recommended, so that during a mechanical cleaning procedure the operation of the process need not be interrupted.

When it is probable that the electrodes may become coated with an insulating material a bypass line similar to that shown in Fig. 9, Design B should be incorporated.

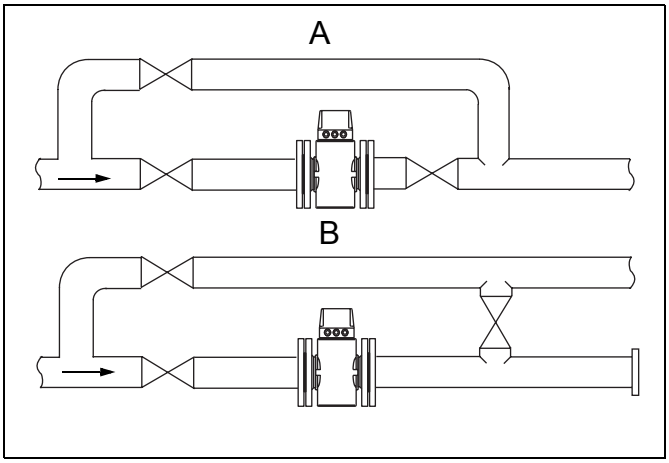


Fig. 9

For flowmeter primaries which are to be installed in the vicinity of pumps or other vibration generating equipment, the use of mechanical snubbers is advantageous (Fig. 10).

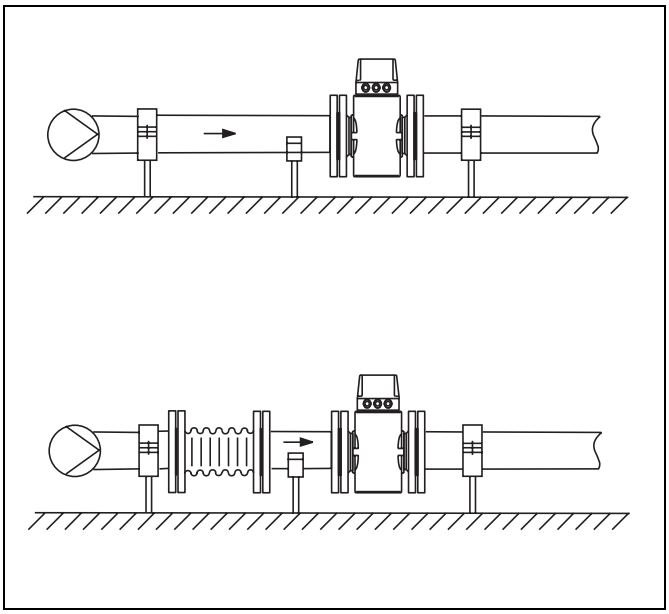


Fig. 10

2.3.1 Installing the Flowmeter Primary

The electromagnetic flowmeter can be installed at any arbitrary location in the pipeline as long as the installation requirements (see 2.3) are satisfied.

When selecting the installation site, consideration should be given to assure that moisture cannot enter into the electrical connections or converter areas. Make certain to carefully seat the gaskets and secure the covers after installation and start-up have been completed.

Gasket Surfaces on the Mating Flanges

In every installation parallel mating flange surfaces should be provided and gaskets made from materials suitable for the fluid and the temperature are installed. Only then can leaks be avoided. The flange gaskets for the flowmeter primary must be installed concentrically to achieve optimum measurement results. Wafer Design flowmeter primaries are shipped without gaskets. The installation (concentric and parallel) in the pipeline is made directly without additional gaskets. A gasket is only required when grounding plates are installed (grounding plate / mating pipeline flange). See Tables 1 to 3 for bolt torque specifications.

⚠ Warning:

Graphite should not be used to lubricate the flange or process connection gaskets because, under certain circumstances, an electrically conductive coating may form on the inside surface of the meter tube affecting operation.

The flowmeter primary should not be installed in close proximity to strong electromagnetic fields. During installation steel parts (e.g. steel mounting brackets should be spaced at least 100 mm distant from the flowmeter primary.

Vacuum shocks should be avoided to prevent damage to the liner. A vacuum shock resistant liner design is included in the flowmeter program.

Protection Plates

The protection plates for the PTFE/PFA lined flowmeter primaries are installed to prevent damage to the liner during shipment. Remove the protection plates only when ready to install the meter in the pipeline. Be careful not to cut or otherwise damage the liner in order to prevent leakage. The Dimension Drawings for your instrument design may be found in the Specification Sheet.

Bolt Toque Specifications

The mounting bolts are to be tightened equally in the usual manner without excessive one-sided tightening. We recommend that the bolts be greased prior to tightening and that they be tightened using a wrench with a normal length, in a crisscross pattern as shown in Fig. 11. Tighten the bolts during the first pass to approx. 50 %, during the second pass to approx. 80% and only during the third pass to 100% of the max. torque value. The max. torque values should not be exceeded, (see the Tables 1 to 3).

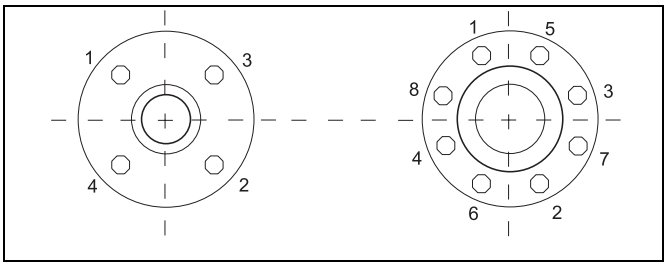


Fig. 11 Bolt Tightening Sequence

Liner	Meter Size Inch	Meter Size mm	Process Conn's	Bolts	Torque max Nm	Press Rtg bar
PFA/ PTFE/ Hard rubber (≥ 1/2" DN 15) ETFE (≥ 1"-DN 25)	1/10-3/8	3-10	Flanges, welded	4 x M12	8	40
	1/2	15		4 x M12	10	40
	3/4	20		4 x M12	16	40
	1	25		4 x M12	21	40
	1-1/4	32		4 x M16	34	40
	1-1/2	40		4 x M16	43	40
	2	50		4 x M16	56	40
	2-1/2	65		8 x M16	39	40
	3	80		8 x M16	49	40
PFA ≤ 4"-DN 100 Hard rubber PTFE ETFE (≤12"- DN 300)	4	100	Flanges, welded	8 x M16	47	16
	5	125		8 x M16	62	16
	6	150		8 x M20	83	16
	8	200		12 x M20	81	16
	10	250		12 x M24	120	16
	12	300		12 x M24	160	16
	14	350		16 x M24	195	16
	16	400		16 x M27	250	16
Hard rubber Soft rubber	20	500	Flanges, welded	20 x M24	200	10
	24	600		20 x M27	260	10
	28	700		24 x M27	300	10
	32	800		24 x M30	390	10
	36	900		28 x M30	385	10
	40	1000		28 x M33	480	10
	48	1200		32 x M36	640	10
	54	1400		36 x M39	750	10
	64	1600		40 x M45	1050	10
	72	1800		44 x M45	1100	10
	78	2000		48 x M45	1200	10
Hard rubber Soft rubber	48	1200	Flanges, welded	32 x M30	365	6
	54	1400		36 x M33	480	6
	64	1600		40 x M33	500	6
	72	1800		44 x M36	620	6
	78	2000		48 x M39	725	6

Table 1 Torques for flanged version

Liner	Meter Size Inch	mm	Process Conn's	Bolts	Torque max Nm	Press Rtg bar
PFA	1/10-1/4	3 - 6	Wafer Designs	4 x M12	2.3	40
PFA	3/8	10	Wafer Designs	4 x M12	7.0	40
	1/2	15		4 x M12	7.0	40
	3/4	20		4 x M12	11.0	40
	1	25		4 x M12	15.0	40
	1-1/4	32		4 x M16	26.0	40
	1-1/2	40		4 x M16	33.0	40
	2	50		4 x M16	46.0	40
	2-1/2	65		4 x M16	12.0	16
	3	80		8 x M16	16.0	16
	4	100		8 x M20	27.0	16

Table 2 Torques for wafer design

DN	Inch	M_A [Nm]
3-10	1/10“ - 3/8“	6,5
15	1/2“	9
20	3/4“	20
25	1“	32
32	11/4“	56
40	11/2“	80
50	2“	30
65	21/2“	42
80	3“	100
100	4“	125

Table 3 Torques for variable process connection

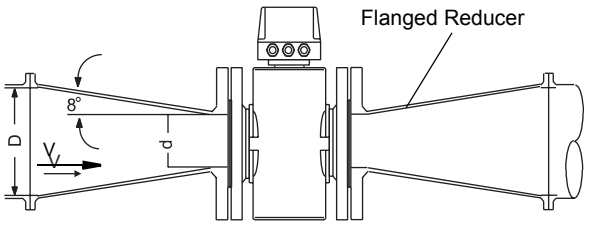
2.3.2 Installations in Larger Size Pipelines

The flowmeter can readily be installed in larger size pipelines through utilization of flanged transition sections.The pressure drop resulting from the reduction can be determined from the Diagram Fig. 12 using the following procedure:

1. Calculate the diameter ratio d/D.
2. Calculate the flow velocity as a function of the meter size and the flowrate:

$$v = \frac{\text{Q (flowrate)}}{\text{Flowmeter Primary Constant}}$$

   The flow velocity can also be determined from the Flow Rate Nomograph in the Specification Sheet D184S031U01.
3. The pressure drop can be read on the -Y- axis at the intersection of the flow velocity value and the "Diameter Ratio d/D" value on -X- axis in Fig. 12.



d = EMF inside diameter
D = Pipeline inside diameter
v = Flow velocity in m/s
Δp = Pressure drop in mbar

Pressure Drop Diagram for EMF
Flanged Reducers with $\alpha/2 = 8°$

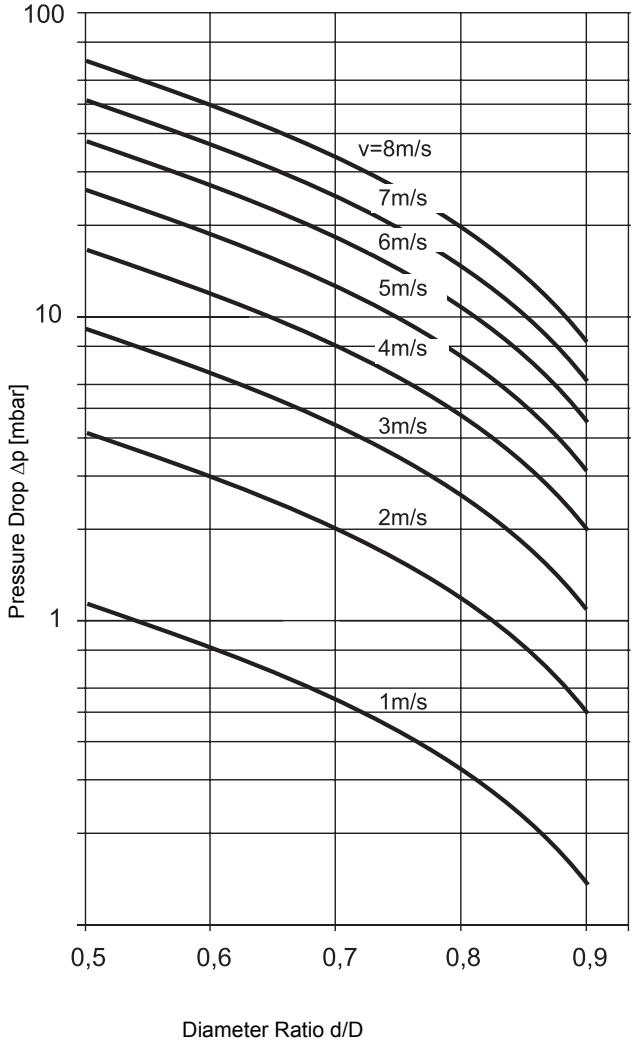


Fig. 12 Nomograph for Pressure Drop Determinations

2.3.3 Installing the Volume Flow Integrator

In essence, the installation requirements specified in 2.3 and 2.3.1 also apply to the Volume Flow Integrator. However, additional requirements apply for the Cold Water and Waste Water and for Liquids other than Water approvals.

Approvals

The design of the instrument has been approved by the Physikalisch-Technischen Bundesanstalt (National Institute of Science and Technology) in Braunschweig, Germany as an "Electromagnetic Volume Flow Integrator with Electric Counter" for the interstate certified applications.
The following approvals have been granted for the Volume Flow Integrator COPA-XM:

6.221 Electromagnetic Volume Flow Integrator
87.12 with Electric Counter in Class "B" for **Cold Water and Waste Water**

5.721 Electromagnetic Volume Flow Integrator
87.05 with Electric Counter for **Liquids other than Water This approval also applies to liquid chemicals.**

For the Electromagnetic Volume Flow Integrator with Electric Counter, Appendix 6 (EO 6) or Appendix 5 (EO 5) of the Certification Regulation of 1988 applies.

Certification

The electromagnetic flowmeter is calibrated on the ABB flow test stands in Göttingen, Germany approved for certification calibrations. After the calibration the parameters which affect the certification can only be changed in the presence of a Certification Official.

Approved Flowmeter Sizes for "Cold- and Waste Water"

Meter Size Inch	mm	Minimum allowed flow range setting (approx. 2 m/s)	Maximum allowed flow range setting (approx. 10 m/s)
1	25	2.4 m^3/h	16 m^3/h
1-1/4	32	5 m^3/h	26 m^3/h
1-1/2	40	9 m^3/h	46 m^3/h
2	50	14 m^3/h	70 m^3/h
2-1/2	65	20 m^3/h	120 m^3/h
3	80	40 m^3/h	180 m^3/h
4	100	60 m^3/h	280 m^3/h
5	125	80 m^3/h	420 m^3/h
6	150	120 m^3/h	640 m^3/h
8	200	220 m^3/h	1100 m^3/h
10	250	360 m^3/h	1800 m^3/h
12	300	500 m^3/h	2600 m^3/h
14	350	700 m^3/h	3600 m^3/h
16	400	900 m^3/h	4600 m^3/h
20	500	1400 m^3/h	7200 m^3/h
24	600	2000 m^3/h	10000 m^3/h
28	700	2800 m^3/h	14000 m^3/h
32	800	3600 m^3/h	18000 m^3/h
36	900	4600 m^3/h	24000 m^3/h
40	1000	5600 m^3/h	28000 m^3/h
44	1100	6200 m^3/h	32000 m^3/h
48	1200	8200 m^3/h	42000 m^3/h
56	1400	11000 m^3/h	54000 m^3/h
64	1600	14400 m^3/h	72000 m^3/h
72	1800	18400 m^3/h	90000 m^3/h
80	2000	22000 m^3/h	114000 m^3/h

Approved Flowmeter Sizes for "Liquids other than Water"

Flowmeter Size and Maximum Approved Flowrates		
Inch	mm	Q_{max} Liter/min
1	25	selectable from 50 to 200 in steps of 10
		selectable from 60 to 200 in steps of 10
1-1/4	32	selectable from 100 to 400 in steps of 20
1-1/2	40	selectable from 150 to 750 in steps of 50
2	50	selectable from 250 to 1000 in steps of 50
2-1/2	65	selectable from 400 to 2000 in steps of 100
3	80	selectable from 700 to 3000 in steps of 100
4	100	selectable from 900 to 4500 in steps of 100
6	150	selectable from 2000 to 10000 in steps of 500

Minimum Metered Flowrates and Fluids			
Inch	mm	Minimum Flowrate l/min	Fluid
1	25	8	Syrup
		20	Beer
1-1/4	32	20	Beer
1-1/2	40	20	Beer, Milk
2	50	200	Beer, Wort
2-1/2	65	500	Milk, Wort, Beer
3	80	500	Milk, Wort, Beer
4	100	2000	Brine, Wort
6	150	2000	Brine

Min. flow range approx. 2.5 m/s
Max. flow range approx. 10 m/s

Installation Requirements for Volume Flow Integrators

The following installation requirements are to be observed: For Cold Water and Waste Water a straight pipeline section with a length of 5-times the flowmeter size is to be installed upstream of the primary and a section 2-times downstream. For Liquids other than Water (milk, beer wort, sole) the values in parenthesis in Fig. 13 apply.

When metering the flow in both directions (forward and reverse flow) the upstream straight pipeline section length is required on both sides of the flowmeter with a length at least 5-times of the flowmeter size for the "Cold Water and Waste Water" approvals and lengths at least 10-times of the flowmeter size for "Liquids other than Water".

The piping system must always be completely filled with fluid.

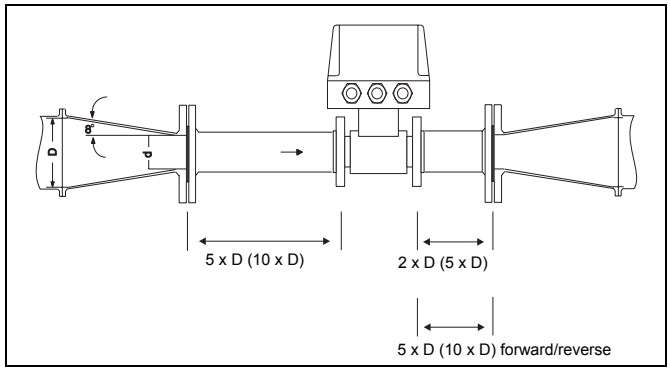


Fig. 13 Pipeline Installations, Reductions as Required

3. Operation - Data Entry and Configuration of the Converter

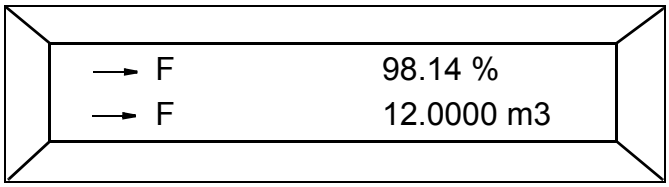
3.1 Display Formats

After the power is turned on the Model Number of the converter is displayed in the first line and the software version together with its revision level in the second line. Then the process information values are displayed.

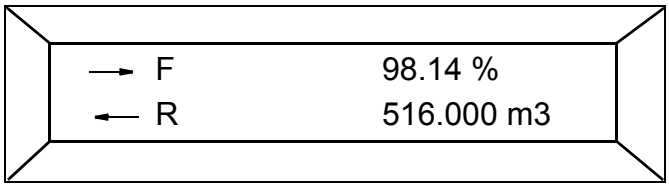
The present flow direction is indicated in the first line of the display (→F for forward or ←R for reverse) together with the instantaneous flow rate value in percent or in direct reading engineering units. In the second line the totalizer value for the present flow direction is displayed with a max. of seven digits followed by the units.

The totalizer value, in the appropriated units, always represents the true value regardless of the pulse factor setting. This display combination is referred to in the text by the term process information.

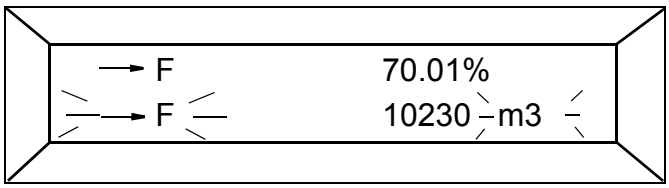
The totalizer value for the opposite flow direction can be displayed by pressing the STEP- or DATA key.



1st Line Forward direction instantaneous flowrate
2nd Line Forward direction totalizer value



1st Line Forward direction instantaneous flowrate
2nd Line Reverse totalizer value



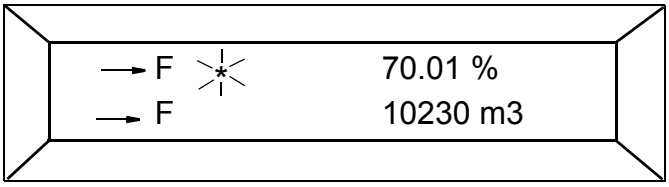
1st Line Forward direction instantaneous flowrate
2nd Line Totalizer overflow. → F and m3 blink.

A totalizer overflow occurs whenever the totalizer value reaches 9,999,999 units. When the totalizer value in one of the flow directions is greater than 9,999,999 units, the flow direction symbol (→ F or ← R) and the units (e.g. m3) blink in the 2nd line. A converter software counter can register a max. of 250 overflows. The overflow indication can be reset separately for each flow direction by pressing ENTER.

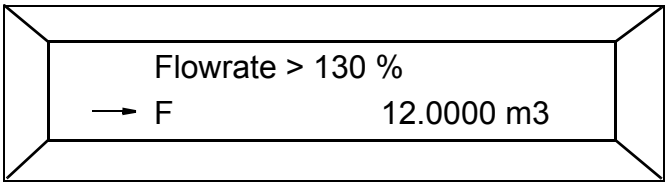
Volume Flow Integrator (Certified Design)

! Note:

In the Volume Flow Integrator COPA-XM a power interruption is indicated by a star "*"in the 1st display line. See page 28, Mains Interrupt Reset.



During an error condition an error message is displayed in the 1st line



This message is displayed alternately in clear text and then by its corresponding error code. The clear text message is only displayed for the error with the highest priority while all other detected errors are indicated by their error codes in the display (see Table or Section 5.3.1 Error Messages during Data Entry).

Error Number		Clear Text / Cause
5	RAM defective	Data in RAM corrupted
	NVRAM loaded	Automatic data exchange
4	Ext. Zero return	Ext. Zero return contact activated
0	Empty pipe	Pipeline not full
7	Urefp too large	Positive reference too large
8	Urefn too large	Negative reference too large
2	Uref too small	Pos. or neg. reference too small
1	A/D saturated	A/D-Converter saturated
3	Flowrate	Flowrate greater than 130%
6	Totalizer	Totalizer values corrupted
9	Excitation frequency	Supply power frequency or Digital-Signal board defective
A	Max. Alarm	Max. alarm value exceeded
B	Min. Alarm	Value below min. alarm value
C	Primary data	Error in ext. EEPROM or it is not installed.

Error Code Table by Priority

In addition to the error message in the display an alarm signal is transmitted over a relay/optocoupler output and the current output is set to 0 %, 3.6 mA or 130 % (does not apply to Error Codes 6, A, B; for Error Code 6 the current output is always set to 26 mA). The totalization is always interrupted (does not apply to Error Code 3).
For HART-Protocol see values in page 24 „Iout at Alarm".

3.2 Data Entry

The data is entered using the three keys Step ↑, Data ↓ and C/CE on the converter when the housing is open.

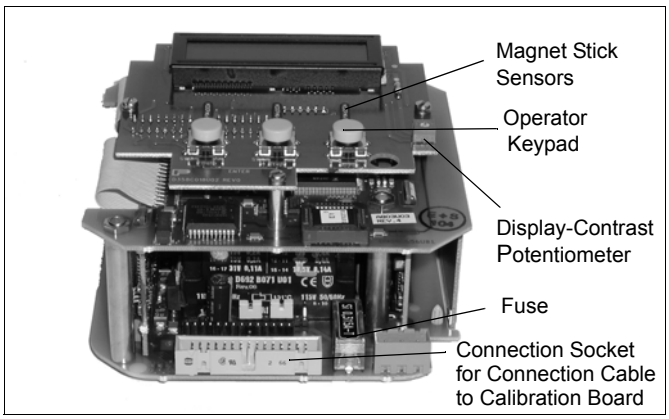


Fig. 14 Converter Keypad and Display

The Magnet Stick can be used to configure the converter with the housing cover closed.

During data entry the converter remains on-line, the current and pulse outputs continue to indicate the present operating values. The function of the individual keys is described below:

C/CE	The C/CE key is used to toggle back and forth between the operating mode and the menus.
STEP ↑	The STEP key is one of two arrow keys. **STEP** is used to scroll **forward** through the menus. All desired parameters can be accessed with the STEP key.
DATA ↓	The DATA key is one of two arrow keys. **DATA** is used to scroll **backward** through the menus. All desired parameters can be accessed with the DATA key.
ENTER STEP ↑	The ENTER-Function requires that the arrow keys **STEP** and **DATA** be pressed simultaneously. ENTER is used to turn the program protection on and off. Additionally,
DATA ↓	ENTER is utilized to access the values in the parameter to be changed and to accept the new values or selections. The ENTER function is active only for 10 seconds. If no entries are made during this 10 second period it must be activated again.

ENTER Function for Magnetic Stick Operation

The ENTER function is initiated when the DATA/ENTER sensor is activated for more than 3 seconds. The display blinks to indicate that the function is active.
The are two types of data entry formats:

- Direct numeric entries
- Selections from a predefined table.

Note:

- During data entry the values entered are checked for plausibility and if necessary rejected with an appropriate message
(see “Error Messages and Checks“ on page 33).

  If no data is entered within a 20 second time interval, the converter displays the old value and after an additional 10 seconds displays the process information.

Note:

- When configuring the converter with the housing opened the EMC-Protection and personnel contact protection is voided.

Note:

- After the completing the configuration the parameter settings should be stored in the external EEPROM. The parameter settings for the specific design of the converter can be recorded on the last page of this Instruction Bulletin for service and repair purposes.

3.3 Data Security

All data is stored when the power is turned off or interrupted in a NV-RAM. The parameter settings, process information and flowmeter primary specific calibration data are stored in a serial EEPROM and additionally in an external EEPROM. If a converter module exchange is necessary it is possible to upload all the data from the external EEPROM into the new converter module .

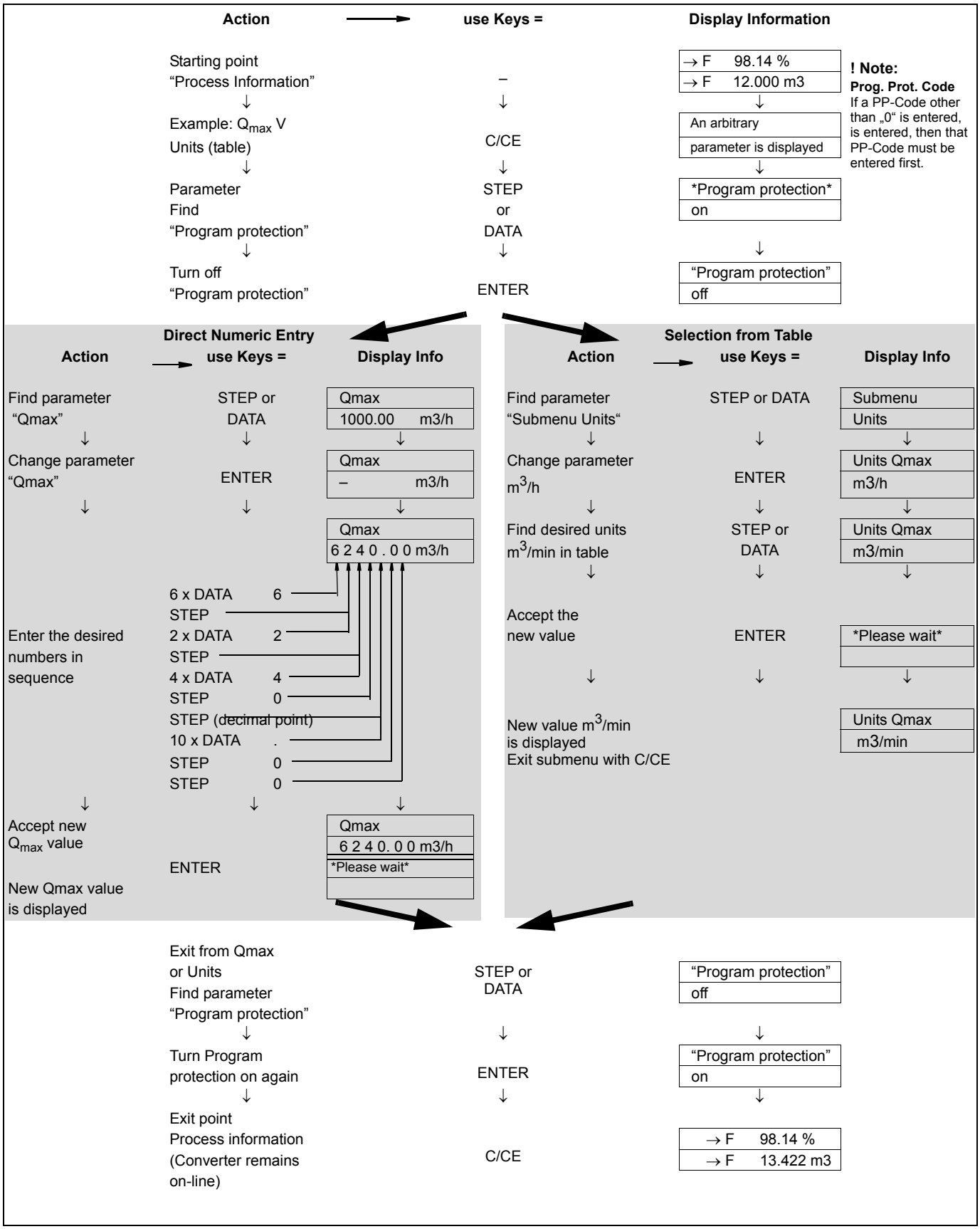
3.3.1 Data Storage Module ext. EEPROM

When the flowmeter is shipped an ext. EEPROM is installed in the socket provided on the connection board of the flowmeter primary. The Order Number of the flowmeter is marked on the ext. EEPROM and should be identical to the Order Number on the Instrument Tag.

Note:

- Does not apply for HART-Protocol.
  After an entry has been completed with ENTER the message *Please wait* is displayed while the converter is processing the entry.

3.4 Data Entry Instructions “Condensed Form”



3.5 Parameter Overview and Data Entry

C/CE The C/CE key is used to toggle back and forth between the operating mode and the menu.

STEP ↑ Use **STEP** to scroll **forward** through the menu. Any desired parameter can be accessed.

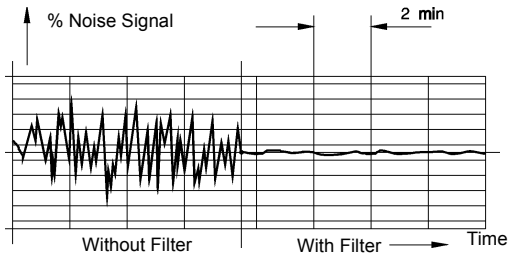
ENTER-Function requires both keys to pressed simultaneously

DATA ↓ Use **DATA** to scroll **backward** through the menu.

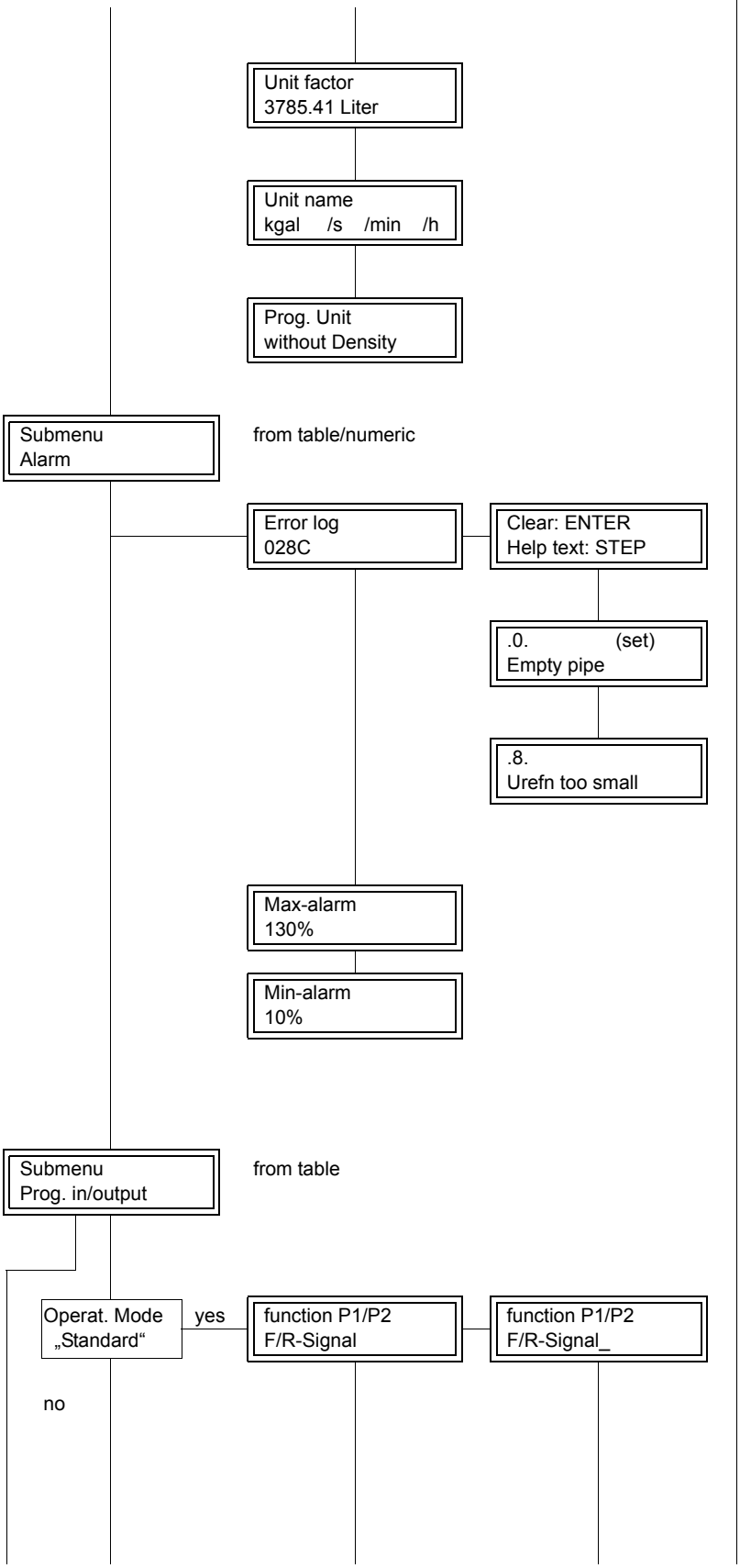
ENTER The ENTER-Function is used to turn the program protection on or off. For data entry scroll through the menu to the parameter to be changed and select it using the Enter-Function.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
Prog. protection on	from table/numeric		Data can be entered only after the Program Protection has been turned off. on / off
	Prog. protection off		Parameters can only be changed after the Program Protection has been turned off. After the Program Protection is turned off it is also possible to change the PP-Code.
Prog. prot. code	numeric		If a number other than “0” (factory setting) has been programmed for the Program Protection Code, the Program Protection can only be turned off after the correct PP-Code (1-255) has been entered.
	Old PP-Code? 0		Enter old PP-Code 0 = Factory setting
	New PP-Code: 0		Enter new PP-Code (0-255)
Language English	from table		German, English, French, Finnish, Spanish, Italian, Dutch, Danish or Swedish can be selected for the display language.
Meter size 250 mm 10 in	from table Warning: Only in the 50XM/CM1000 Mode can the meter size be selected		1/25” - 94” / DN 1 - DN 2400. Select using the arrow keys. Size listed in mm and inches. When the meter size is changed the value of Qmax is automatically set to 10 m/s. The pulse factor is also set to a value of 1. A message “Warning! New meter size” is displayed when a size change occurs.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
Submenu Primary	from table		In the 50XM/CM2000 Mode the Submenu Primary is displayed instead of the parameter Meter Size.
	Meter size 250 mm 10 in		See Instrument Tag for the correct meter size.
	Span Cs 6.25 Hz 56.123%		Flowmeter span value Cs for the selected excitation frequency. See Instrument Tag.
	Zero Cz 6.25 Hz 0.1203%		Flowmeter zero value Cz for the selected excitation frequency. See Instrument Tag.
	Short model no. DM43		Short Model Number of the flowmeter primary.
	Order no. 000036116/X001		Flowmeter Order Number. This number is identical to the one on the Instrument Tag of the flowmeter primary and on the sticker on the external EEPROM.
	Preamplifier no		Information indicating if the flowmeter primary has a preamplifier installed or not. If the parameter is set to “yes“ then the Submenu “Detector empty pipe“ cannot be activated.
Cal-fact 10 m/s 1800.00 m3/h	-		Automatic setting based on the meter size selection.
Range 400.00 m3/h	numeric		Flow range for forward and reverse flow directions Min. flow range setting selections 0-0.5 m/s Max. flow range setting selections 0 -15 m/s. Flow range end value selections 0.5 to 15 m/s. **Note:** The Range display is a function of the operating mode. See Submenu Operating Mode page 29.
Preset totalizer 0.0000 m3	numeric		Only for Operating Mode „Preset Totalizer“
Preset totalizer start	from table		Only for Operating Mode „Preset Totalizer“
Pulse factor 1.0000 /m3	numeric		For int. and ext. flow totalization, range 0.001-1000 pulses per selected flow unit, max. count frequency 5 kHz. **Note:** The max. count frequency is checked by the software and the pulse width adjusted if required.

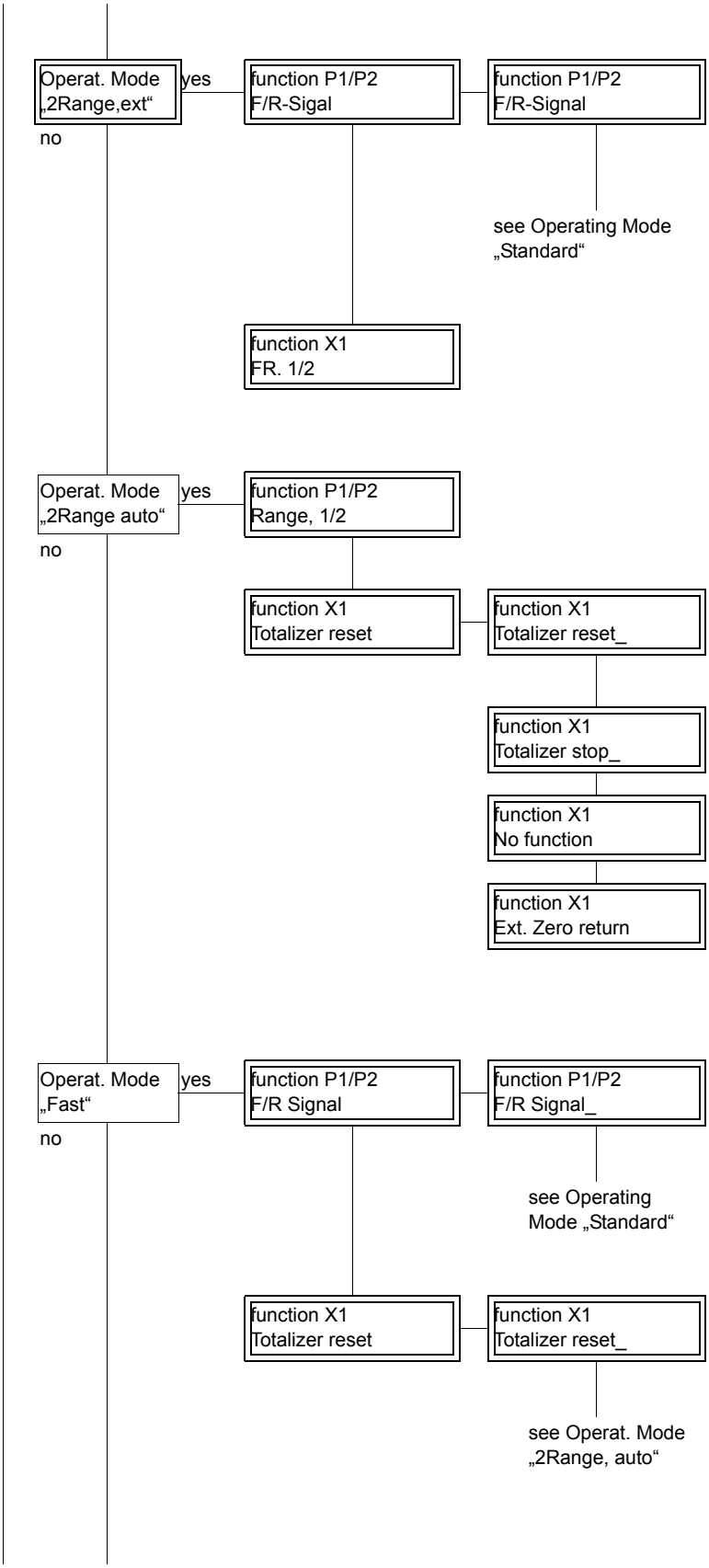
Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
Pulse width 30.000 ms	numeric		For external pulse output. Pulse width can be set between 0.1 ms and 2000 ms in multiples of 0.100 ms. The max. allowable pulse width is checked by the software and adjusted if required.
Low flow cut off 1.000%	numeric		Range 0-10 % of the flow range setting, applies to the display indication and all outputs. The switching point for the low flow cut off incorporates a hysteresis of 0.5 %.
Damping 10.0000 s	numeric		Range 0.125 - 99.9999 s, response time for the current output to reach 99 % of a flowrate step change (5τ) as a function of the excitation frequency selection e.g. 6 ¼ Hz from 0.5 s 12 ½ Hz from 0.25 s 25 Hz from 0.125 s
Filter on	from table		 On/off. Standard is off. If the output signal is noisy, turn filter on and set damping to >2.4 s. For applications with piston or membrane pumps (pulsating flowrate) a special measurement algorithm is required. Faster measurements can be made using a higher excitation frequency (excitation frequency = 25 Hz, Operating Mode = fast) and, when necessary, using difference totalization to subtract any reverse flow from the totals, i.e. the totalizer counts backward. For pulsating flows the filter should be turned "on" (pulsation free output, see Additional Information in 8.7).
Density 2.54300 g/cm3	numeric		Range 0.01 - 5 g/cm^3. Mass flowrate for the display and the totalizers in g, kg, t, uton or pound.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
System zero adj. 3.5 Hz	from table/numeric		
	System zero adj. manual		Zero point monitor (required for use with older flowmeter primaries).
	System zero adj. automatic?		Manual entry, e.g. when a converter is replaced Valve must be closed, flow must be at absolute zero. The automatic adjustment is initiated with ENTER. The limits for the zero value are ±50 Hz. If the value is outside of these limits, no adjustment is made.
Submenu Unit	from table/numeric		
	Range unit l/s		Flowrate units available for selection ml/s, ml/min, ml/h, Ml/h, Ml/min, Ml/day, lbs/s, lbs/min, lbs/h, uton/min, uton/h, uton/day, l/s, l/min, l/h, hl/s, hl/min, hl/h, m^3/s, m^3/min, m^3/h, igps, igpm, igph, mgd, gpm, gph, bbl/s, bbl/min, bbl/h, bls/day, bls/min, bls/h, kg/s, kg/min, kg/h, t/s, t/min, t/h, g/s, g/min, g/h, kgal/s[1)], kgal/min[1)], kgal/h[1)].These units apply to RangeMax, Qmax forward, Qmax reverse and to the instantaneous display, when the display is to be in direct reading engineering units. [1)] User configurable units
	Totalizer unit m3		ml, l, hl, igal, gal, mgal, bbl, bls, kg, t, g, Ml, lb, uton, kgal[1)]. The totalizer units selected are checked by the converter as a function of the flow range, the pulse factor (0.01 to 1000 pulses/unit), the pulse width (0,100ms to 2000 ms) and the density correction value when mass units (e.g. g, kg, t) have been selected. If any one of these parameters is changed, the pulse width may not exceed 50 % of the period of the output pulses at 100% flowrate (on/off ratio 1:1). If the pulse width is greater than 50% it is automatically reduced to 50 % of the period and a message "Warning: New pulse width" is displayed. Messages are also displayed if the output frequency is too high or too low and corrective measures initiated. (See “Additional Information for the Pulse Output” on page 50.)


Submenu / Parameter
Submenu / Parameter
Submenu / Parameter
Comments
Unit factor
3785.41 Liter
Unit name
kgal /s /min /h
Prog. Unit
without Density
Submenu
Alarm
from table/numeric
Error log
028C
Clear: ENTER
Help text: STEP
.0. (set)
Empty pipe
.8.
Urefn too small
Max-alarm
130%
Min-alarm
10%
Submenu
Prog. in/output
from table
Operat. Mode
„Standard“
yes
no
function P1/P2
F/R-Signal
function P1/P2
F/R-Signal_
User programmable flowrate units based on liters; value shown is for kgal units (default setting). Additional information may be found on page 31 „User Programmable Units“
Four character name for the user programmable units.
Programmable units for mass (with density) or volume (without density) flowrate
All detected errors (Errors 0-C) are stored. Use ENTER to clear the Error Register.
After pressing the STEP key the clear text message for each Error Code is displayed. Active errors are indicated by the text "(set)".
Use the C/CE key to exit the help-text information display. Additional information about the error messages and remedies may be found under See “Error Messages and Checks” on page 33.
Alarm, range 0 -130% of the flow range setting. Can be set in 1% steps.
Switching hysteresis 1%. The message is shown in the display by a blinking arrow "↑".
Alarm, range 0 -130% of the flow range setting. Can be set in 1% steps.
Switching hysteresis 1%. The message is shown in the display by a blinking arrow "↓".
If both errors nave been detected, a blinking double arrow is displayed.
The function of the contact input is defined by the operating mode selection (settings in „Submenu Operating Mode“).
If the operating modes "Standard“, „2 flow ranges external selection“, „2 flow ranges F/R“ and the Operating Mode „Fast“ are selected the following menus are displayed. The operation of the contact can be selected as normally open or normally closed, except for the forward/reverse flow direction signal (see contact symbols in the display).
F/R-Signal for the flow direction (contact is closed for forward flow)

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
		function P1/P2 No function	No function assigned to Terminals P1/P2
		function P1/P2 MAXalarm	If a low flowrate is to be signalled over the terminals, select MIN-Alarm, shown as normally open. The low flow alarm limit is set in the parameter MIN-Alarm in the Submenu Alarm. Similarly the high flow alarm limit is set in the parameter MAX-Alarm. If the parameter MAX/ MIN-Alarm is selected then an alarm signal will be transmitted over the terminals when the flow exceeds the high alarm setting or drops below the low alarm setting.
		function P1/P2 MIN alarm	
		function P1/P2 MAX/MIN alarm	It is also possible in this mode to transmit a signal when the flowrate is between the two limits, MIN- and MAX-Alarm. In this instance the MAX-Alarm limit must be set lower than the LOW-Alarm limit. In the flowrate is within this flow range an alarm indication is displayed and an alarm signal is transmitted over the terminals.
		function P1/P2 General Alarm	All detected errors (Errors 0 to 9, A, B) are signalled over the terminals.
		function P1/P2 Empty pipe	Output signal when the pipe is empty.
	function X1 Totalizer reset	function X1 Totalizer reset	Closing the contacts resets the internal totalizer and overflow counter.
		function X1 Totalizer stop	Only for Operating Mode „Preset Totalizer“
		function X1 No function	No function assigned to Terminals X1/G3
		function X1 Ext. Zero return	Outputs are turned off when the contact is closed. Application examples: Undefined pipeline fill level when a pump is shut off or during a repetitive cleaning or flushing cycle during which time the flow is not to be measured.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments



.

The functions available for the contact input are dependent on the operating mode selection (selected in the Submenu Operating Mode)
If the Operating Mode "2 Flow Ranges, external switching“ is selected, then the contact is to be closed to switch to Flow Range 2 (Terminals G2/X1) active.

If the Operating Mode "2 Flow Ranges automatic switching“ is selected then Terminals P1/P2 are closed when Flow Range 2 is active.

Closing the contacts resets the internal totalizer and overflow counter.

Only for Operating Mode „Preset Totalizer“

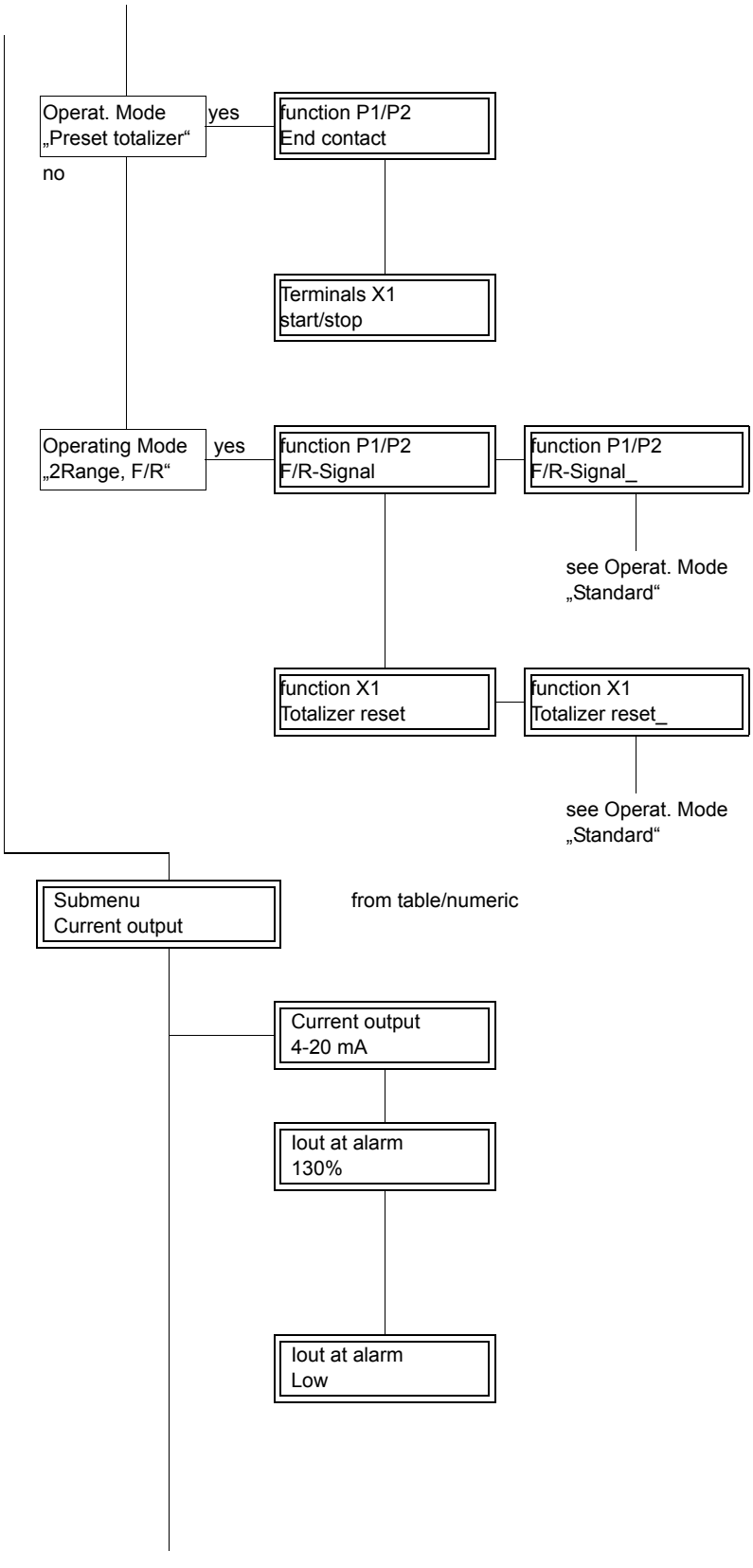
No function assigned to Terminals X1/G3

Outputs are turned off when the contact is closed. Application examples: Undefined pipeline fill level when a pump is shut off or during a repetitive cleaning or flushing cycle during which time the flow is not to be measured.

Operating Mode "Fast" is utilized for fast batch operations >3 s and for piston pump applications, when the converter operates at a higher excitation frequency. In this Operating Mode the accelerated measurement cycles improve the repeatability for short time flowrate measurements or for piston pump operation.

see additional information on page 51.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments



When the Operating Mode “Preset Totalizer“ is selected a contact is opened when the preset flow total is reached.
Note: Check if the jumper BR 610 on the calibration board is set to either General Alarm or Prog. Output on the calibration board. See “Calibration Board” on page 43.

In the Operating Mode "2 Flow ranges forward/ reverse" different flow ranges can be selected for each of the flow directions, forward (Qmax F) and reverse (Qmax R). The alarm limits for the MIN- and MAX-Alarms are based on the actual active flow range .

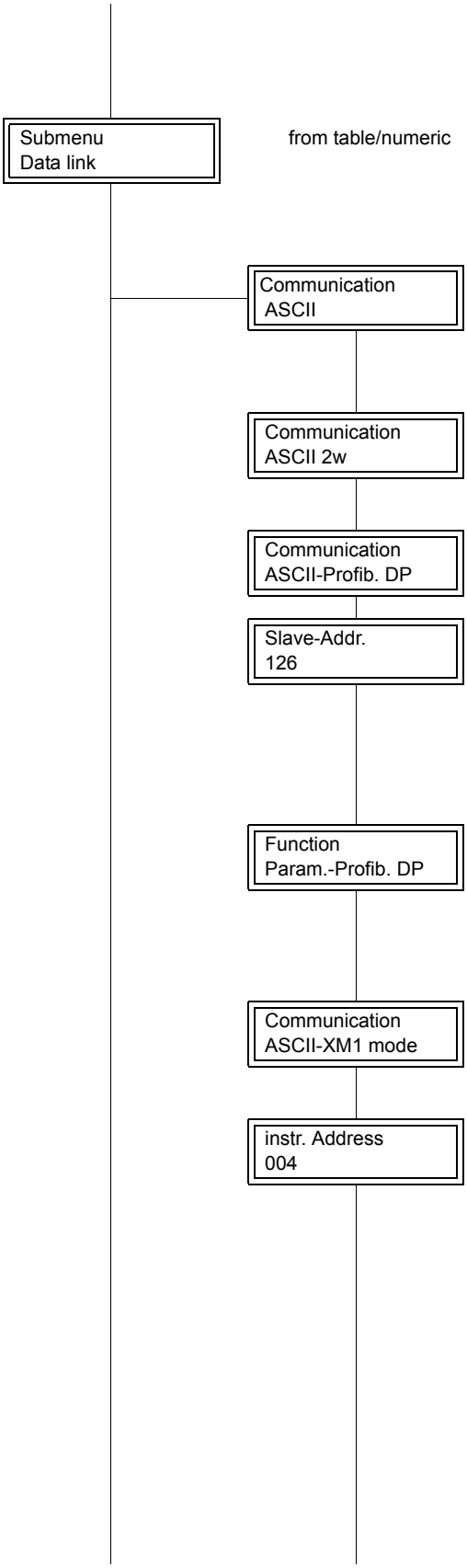
Not available with HART-Protocol.

The selections are: 0-20 mA / 4-20 mA, 0-10 mA / 2-10 mA, 0-5 mA / 0-10, 10-20 mA / 4-12, 12-20 mA

The current output during an alarm condition can be selected, 0/4 mA for 0% or 3.6 mA or 26 mA for 130%. For Error 3 Flowrate >130%, current output is always set to 26 mA . If Error 0 (empty pipe) is active the current output is set to the value selected in the Submenu “Detector empty pipe“ in the Parameter “Iout at empty pipe“ .

For converters with HART-Protocol only Low or High can be selected. For the Low value a number between 3.00 and 4.00 mA can be selected and for the High value a number between 20.00 and 30.00 mA.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments



Note: Automatic recognition
These menus are only visible when a RS 485 module is installed in the converter and has been recognized. Details for ASCII- or Profibus DP communication may be found in the corresponding Instruction Bulletins. For HART-Protocol only the Parameter Address is displayed.

Communications protocol ASCII,
Print 5 batch, Print 6 continuous
(Printer Protocols) or μDCI binary over
data link RS 485.

The Protocol ASCII 2w is for those designs with a 2-Wire data cable.

ASCII-Profibus DP
The Slave-Address must be entered as a three digit number, address range 000, 001, to 126.
If a bus address is entered as a one or two digit number incorrect interpretation of the bus address by the converter will result.

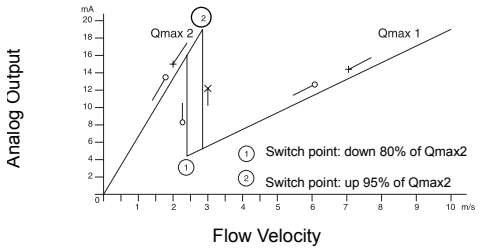
This function is used to access the parameters from the Profibus DP-Module. See also Section 13 „Functions in the Data Link Menu“ in the Profibus Data Link Description, Part Number D184B093U05.

ASCII-XM1000-Mode
In this protocol the contents of the Error Register can be transmitted bitwise.
Instrument address: 0-99. (Not available with the selection Printer Protocol or Profibus DP). If more than one instrument is connected to a single bus (RS 485), each instrument must have a unique address. For instruments with HART-Protocol addresses between 0 - 15 can be selected.
Note: If the address 0 is entered, the current output range for the flowrate is changed to 4 - 20 mA. If multiple instruments are connected and addresses between 1 and 15 are selected, the converter operates in the Multidrop-Mode. The current output value is fixed at 4 mA. The measurement of the output values is then only possible using the HART-Communication.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
	Baudrate 2400 Bd		Baudrate: 110-28800 Baud selectable. Not available with Profibus DP or HART-Protocol.
	Printer type Standard		This parameter is only displayed when a Printer Protocol is selected. Selections available are a Standard Printer Type[1)] and the Report Printer ABB 55DE1000.
	Time		This parameter is only displayed when a Printer Protocol is selected and the corresponding printer type has been selected. Entry for Report Printer ABB 55DE1000: Year, Month, Day, Hour, Minutes
			[1)] Minimum requirements for the Standard Printer Type: 40 characters/line, 1 Kbyte buffer, ASCII-character set
Submenu Function test	from table/numeric		The converter functions can be tested independent of the actual flowrate. **In the Function Test mode the converter is no longer on-line.**
	Function test Iout		Function test Current Output: Enter data in mA. Function test Pulse Output: (See “Submenu Function Test Numeric Entries only for Iout” on page 31.).
	Function test NVRAM		Function test internal component groups, automatic test NVRAM, RAM (ASIC), EPROM (Program), EEPROM, ext. EEPROM. Additional functions: Alarm contact, function P1/P2, Switch S401, Data Link HART-Transmitter, HART-Commands, Pulse Output, Display, function X1, Simulation and Test Mode.
Submenu Detector e. pipe	from table/numeric		**! Note:** For proper operation of the function "Detector empty pipe" the conductivity of the fluid must be greater than 20 μS/cm and the flowmeter size 3/8”/ DN 10 and up. off = Detector not functional. on = When the meter tube is empty an indication is displayed and a signal is sent to the terminals when the alarm setting is "on“.
	Detector e. pipe on		
	alarm e. pipe on		off = When an "empty pipe" condition exists, no signal. on = When the pipe is empty a signal over the General Alarm.
	Iout at empty pipe 0%		If the signal “Alarm empty pipe” is set to "on" then the outputs during an empty pipe condition can be set to 0 %, 130 % flowrate or to 3.6 mA.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
	Iout at e. pipe Low		For instruments with HART-Protocol only Low or High can be selected. For the Low value a number between 3.00 and 4.00 mA can be selected and for the High value a number between 20.00 and 30.00 mA.
	Iout at e. pipe High		
	Threshold 2400 Hz		Set Threshold to 2400 Hz. (default setting). The threshold should 400 Hz above the adjustment value with a full pipe.
	Adjust Detector e. pipe		The converter displays the adjustment value in the lower display line. The pipeline must be full. Use the arrow keys to adjust the value to 2000 Hz +/- 25 Hz. Accept the adjustment with "ENTER". Empty pipeline. Adjustment value must be over 2400 Hz (Threshold).
	Adjust 2000 Hz		
Submenu Totalizer	from table/numeric		
	Totalizer → F reset		The forward totalizer can be reset using ENTER. If the overflow counter >0, then the message reset Overflow >F is displayed. **Note:** If the totalizer function "Difference Totalizer" is selected, then the message reset difference totalizer is displayed.
	Totalizer → F 250,0 m3		If the totalizer function “Preset Totalizer“ is selected, the message reset Difference Totalizer is displayed. Preset the value of the totalizer, difference totalizer or preset totalizer 2nd display line = present value (e.g. after a converter replacement).
	Overflow → F 250		Overflow counter max. 250, 1 Overflow = pulse totalizer >9,999,999 units (display value is reset and the overflow counter incremented by 1). **Overflow Calculation Example** Overflow 12 x 10,000,000 units = 120,000,000 units + 23,455 present totalizer value 120,023,455 units
	Totalizer ← R reset		See Forward Totalizer

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
	Totalizer ← R 625.000 m3		See Forward Totalizer
	Overflow ← R 004		See Forward Overflow Counter
	Totalizer function Standard		Standard: For the "Totalizer Function Standard" the totalizer pulses for the forward and reverse flows are integrated independently in two separate totalizers. If the forward flow direction only is selected, only the forward totalizer counts. The selection is made using the STEP and DATA keys and accepted using ENTER. Difference Totalizer: Only a single internal totalizer is used for integrating both flow directions. In the forward flow direction the totalizer adds the pulses while in the reverse flow direction the pulses are subtracted. The pulse output (active or passive) is not affected by this selection. Preset totalizer: Only a single internal totalizer is used for integrating both flow directions. In the forward flow direction the totals are increased and in the reverse flow direction they are decreased.
	Mains interrupt reset		Reset mains interrupt counter. Only available for Volume Flow Integrators (Certified Design). Reset using ENTER.
Submenu Display	from table		
	1st Line Q[%]		Process information: Various options can be selected for displaying the process information (independently for each display line): Q [%] Flowrate in % Q [Unit] Flowrate in direct reading engineering units Q [mA] Flowrate in mA Bargraph Flowrate as a bargraph Totalizer Totalized flow values for forward/reverse flow directions or only as a forward totalizer or a reverse totalizer or a difference totalizer (for totalizer function Diff. Tot.) Preset Totalizer Grand totalized flow value Qg and batch totalizer Q, TAG-No. Meter location identification number off no function Blank line only for 2nd display line
	2nd Line Totalizer		

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
	1st Line multiplex off		off/on In the multiplex mode an additional value can be displayed in the 1st line. The display alternates every 10 s. For values which can be displayed see Display 1st Line above.
	2nd Line multiplex TAG Number		See 1st Line Multiplex
Submenu Operating Mode	from table		
	Operating Mode Standard	Operating Mode Standard_	Operating Mode "Standard" should be selected for continuous flow metering.
		Operating Mode 2Range, ext._	The flow range is switched by closing a contact across input “X1” when “2 Flow ranges ext.” is selected. Flow ranges must be entered for Qmax 1 and Qmax 2. In the process display the active flow range is indicated by a "1" or "2" directly after the flow direction indicator. The limits for the MIN- and MAX-Alarms are always based on the active flow range.
		Operating Mode 2Range, auto_	For the automatic flow range change selection the output P1/P2 is used to signal the active flow range (open for flow range 1, closed for flow range 2). Flow ranges must be entered for Qmax 1 and Qmax 2. In the process display the active flow range is indicated by a "1" or "2" directly after the flow direction indicator. The limits for the MIN- and MAX-Alarms are always based on Qmax 1.  Example for auto. Range Change Qmax 1 = 10 m/s; Qmax 2 = 3 m/s
		Operating Mode Fast	Operating Mode "Fast" is utilized for fast batch operations >3 s and for piston pump applications, when the converter operates at a higher excitation frequency. In this Operating Mode the accelerated measurement cycles improve the repeatability for short time flowrate measurements or for piston pump operation.

Submenu / Parameter	Submenu / Parameter	Submenu / Parameter	Comments
		Operating Mode Preset totalizer	In this Operating Mode the measurements are made similar to those in the Operating Mode “Fast“. The preset totalizer is started from the contact input X1. The batch totalizer is set to 0 and the contact output P1/P2 (end contact) is closed. When the preset value is reached the end contact is opened. Not available with HART-Protocol.
		Operating Mode 2Range, F/R	In the Operating Mode "2 Flow Ranges Forward/ Reverse" different flow ranges can be set for the forward flow (Qmax F) and the reverse flow (Qmax R). The limits for the MIN- and MAX-Alarm are based on the active flow range. Not available with HART-Protocol.
	Flow indication Forward/reverse		Flow direction selection: forward/reverse of forward only
	Flow indication standard		Standard / opposite reverses the flow direction indicators in the display: forward and reverse display.
Load data from external EEPROM			When a converter is replaced the meter location parameters can be uploaded into the new converter. The parameters do not have to be individually entered anew.
Store data in external EEPROM			After the start-up has been completed or a change has been made to the instrument settings the new parameter settings should be stored in the external EEPROM.
50XM2000 01/00 D699B123U01 A.31			Software Version The instrument identification is displayed in the first line together with the software revision date (01/00). In the second line the software identification (D699B123U01) and the software revision level (A.31) is displayed. Instruments with HART-Protocol 50XM2000 7/99 D699B138U01 X.33
TAG-Number			An alphanumeric TAG-Number can be entered with a max of 16 characters (upper case and lower case letters, numbers).
Code number			Only for ABB Service personnel.

4. Parameter Entry (Additional Information)

4.1 User Programmable Units

With this function it is possible to program any desired units in the converter. The following three parameters are included in the this function:

a) Units factor

b) Unit name

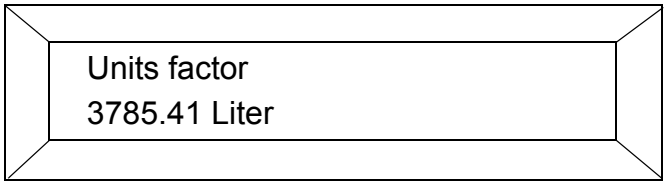
c) Programmable units with/without density

! Note:

- Entering data in the parameters a), b) and c) is only necessary if the desired direct reading engineering units are not listed in the Table on Page 14 integrated in the converter.

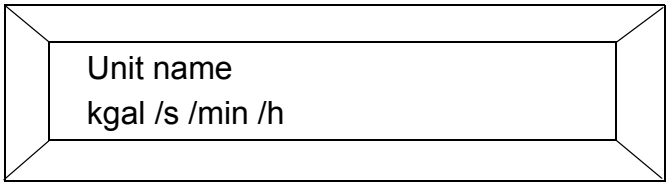
4.1.1 Units Factor: Numeric Entry

The value in this parameter is equivalent to the number of liters in the new unit. Shown is kgal = 3785.41 Liter.



4.1.2 Unit Name: Select from Table

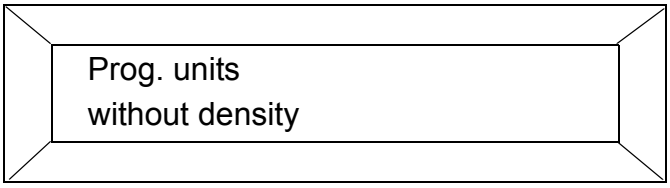
The selection is made with the STEP and DATA keys. Scroll through the alphabet forward with DATA. The lower case letters appear first followed by the upper case letters. Pressing the STEP key shifts the entry location. A maximum of four characters can be entered.



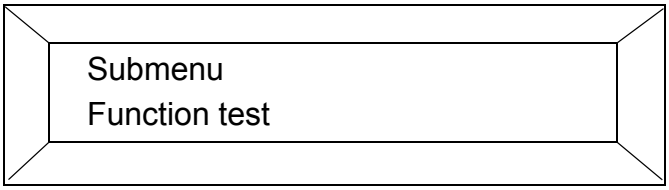
The time units /s, /min and /h can be assigned to the entered engineering unit.

4.1.3 Programmable Units with/without Density Select from Table

This function is utilized to indicate whether the programmed units are mass units (with density) or volume units (without density). If “with Density” is selected, also see page 19.



4.2 Submenu Function Test Numeric Entries only for I_{out}



The Function Test offers 15 functions to test the instrument independent of the instantaneous flowrate.

In the Function Test mode the converter is no longer on-line (current and pulse outputs do not indicate the existing operating conditions). The individual test routines can be selected using the STEP and DATA keys.

I_{Out}, RAM (ASIC), NVRAM, EPROM (Program), EEPROM, external EEPROM, alarm contact, terminals P1/P7, switch S401 (not available for certified designs), data link, pulse output, display, terminal X1, Simulation and Test Mode.

The function tests can be terminated by pressing C/CE.

Select **I_{out}** and press ENTER and enter the desired value in mA. Monitor the output value at terminals + and - with a digital multimeter (mA range) or with the process instrumentation.

Note: No automatic return to process metering. Terminate using C/CE key.

Select **RAM** (ASIC) and press ENTER. The converter automatically tests the RAM and displays its diagnosis.

Select **NVRAM** and press ENTER. The converter automatically tests the NVRAM and displays its diagnosis.

Select **EPROM** (Program) and press ENTER. The converter automatically tests the EPROM and displays its diagnosis.

Select **EEPROM** and press ENTER. The converter automatically tests the EEPROM and displays its diagnosis.

Select **Ext. EEPROM** and press ENTER. The converter automatically tests the ext. EEPROM and displays its diagnosis. This test is not available in the 50XM/CM1000 Mode.

Select **Alarm Contact** [1] and press ENTER. The alarm contact can be toggled on and off using the STEP or DATA keys. Monitor terminals 39 and 40 with an ohmmeter (if a simulator is being used for the test; the **operate** LED on the simulator indicates **on/off)**.

Select **Terminals P1/P2** [1] and press ENTER. The contact can be toggled on and off using the STEP or DATA keys. Monitor terminals V8/V9 with an ohmmeter (if a simulator is being used for the test; the **forward** LED on the simulator indicates **on/off**).

Select **Switch S401** and press ENTER. The four positions of switch S401 can be individually activated
(see Digital Signal Board Page 41). The display indicates an „on-condition“ by a „*“.
Note: No automatic return to process metering. Terminate using C/CE key.

[1] This function is only available when switch contact was selected for the in-/output function.

Note

- The Submenu „Function test“ is not available for the Certified Design!

Data Link Test

Before initiating the test connect the transmitter to the receiver at the connection terminals. The computer sends 1000 ASCII-Code 31 hex characters and monitors the received characters.On the left side of the display the number of characters sent is displayed. On the right side the number of characters received is displayed. After 1000 characters are transmitted the computer no longer monitors the received characters but continues to send the 31 Hex character until the C/CE key is pressed.

Select **Data Link** and press ENTER. The test runs automatically.
Note: No automatic return to process metering. Terminate using C/CE key.

Select **Pulse Output** and press ENTER. Use the STEP and DATA keys to output a test frequency (1 Hz, pulse width 500 ms) for forward or reverse flow and monitor at terminals V1-V3 (on the simulator, at sockets 9/11).
Note: No automatic return to process metering. Terminate using C/CE key.

Select **Display** and press ENTER. The converter writes the numbers 0 to 9 and the letters A to F in the 1st and 2nd lines of the display. Visually monitor for proper operation of the dot matrix.

Select **Terminal X1** and press ENTER. Connect terminals X1 and G2 together. The display indicates on/off.
Note: No automatic return to process metering. Terminate using C/CE key.

Select ****Simulation**** and press ENTER. Use the STEP or DATA key to turn simulation "on or off". When the simulation is turned on, press C/CE to return to process metering. Any desired flowrate value in steps of 1 % can be set using the STEP (+) and DATA (-) keys. The output values correspond to the values entered. The message **Simulation** is displayed in the 2nd line alternately with the totalizer value. After completion of the test program the parameter **Simulation** should be turned off.
Note: No automatic return to process metering. Terminate using C/CE key.

Test Mode If the converter is to be checked with a simulator, the parameter Test Mode **must** be turned on. The flowmeter primary span and zero values are set 100% and 0%. The system zero value is set to 0 Hz. After the test has been completed the parameter Test Mode should be turned off.
Note: No automatic return to process metering. Terminate using C/CE key.

5. Maintenance

5.1 General

Warning

The are electrostatic sensitive parts on the circuit boards (Observe ESD-Guidelines).
Before touching the electronic components be sure that you are statically discharged.

5.2 Testing the Converter with the Flowmeter Primary Simulator 55XC4000

The test procedure is described in the Simulator Instruction Bulletin. Part No. D184B049U01.

5.3 Error Messages and Checks

5.3.1 Error Messages During Data Entry

The following list of the error messages includes explanations for the Error Codes displayed.

Error Codes 0 to 9, A, B, C do not occur during data entry

Error Code	Detected System Error	Corrective Measures
0	Pipeline not full.	Open shut off devices; fill pipeline; adjust Empty Pipe Detector
1	A/D-Converter	Reduce flowrate, throttle shut off devices.
2	Positive or negative reference too small.	Check connection board and converter;
3	Flowrate greater than 130 %.	Reduce flowrate, change flow range
4	External zero return contact activated.	Zero Return activated by pump or field contact.
5	RAM defective Function 1: Data in EEPROM corrupted Function 2: Data loaded in NVRAM	Start test program, reinitialize program if necessary; Request Customer Number from the Service department No corrective measures. Information: Incorrect data in NVRAM, the converter initiates an auto. reset and reloads the data from the EEPROM.
7	Positive reference too large	Check signal cable and magnetic field excitation, see 5.3.3.
8	Negative reference too large	Check signal cable and magnetic field excitation, see 5.3.3.
6	Error totalizer >F Error totalizer >R Error totalizer	Reset forward totalizer or preset new values in totalizer, see page 27. Reset reverse totalizer or preset new values in totalizer, see page 27. Forward, reverse or difference totalizer defective, Reset forward/reverse totalizer, see page 27.
9	Excitation frequency defective	For 50/60 Hz supply power, check line frequency or for AC/DC supply power, error in the digital-/signal board
A	MAX-Alarm limit value	Reduce flowrate
B	MIN-Alarm limit value	Increase flowrate
C	Primary data invalid (not available in 50XM/CM1000 Mode)	The flowmeter primary data in the external EEPROM is invalid Compare values in the Submenu “Primary“ with those on the Instrument Tag. If the values are identical the error message can be cleared by calling “Store data”. If they are not identical, the flowmeter primary data must be entered first and the procedure completed by calling ”Store primary”.
10	Entry >1.50 $Range_{max}$ >15 m/s	Reduce flow range Q_{max}
11	Entry < 0.05 $Range_{max}$ < 0.5 m/s	Increase flow range Q_{max}
13	$Range_{max} \leq 0$	Increase entry value
16	Entry > 10% low flow cut off	Decrease entry value
17	Entry < 0% low flow cut off	Increase entry value
20	Entry ≥ 100 s damping	Decrease entry value
21	Entry < 0.5/0.25 (0.125) s damping	Increase entry value (is a function of the excitation frequency) Values in brackets ( ) apply for 25 Hz excitation frequency.
22	Entry >99 Instrument address	Decrease entry value
38	Entry > 1000 pulses/unit	Decrease entry value
39	Entry < 0,001 pulses/unit	Increase entry value
40	Max. count frequency exceeded, scaled pulse output, value >5kHz	Reduce pulse factor
41	Below min. count frequency < 0.00016 Hz	Increase pulse factor
42	Entry > 2000 ms pulse width	Decrease entry value
43	Entry < 0.100 ms pulse width	Increase entry value
44	Entry > 5.0 g/cm^3 density	Decrease entry value
45	Entry < 0.01 g/cm^3 density	Increase entry value
46	Entry too large	Reduce pulse width entry value
54	Primary zero > ± 50 Hz	Check ground and electrode signals. Adjustment can only be made when the flowmeter is completely filled with fluid and the flowrate is absolutely zero.
56	Entry > 3000 threshold, detector empty pipe	Decrease entry value, check adjust Detector empty pipe.
58	Entry > ± 10.0% calibration correction factor	Reduce correction factor

Continued on the next page

Error Code	Detected System Error	Corrective Measured
74/76	Entry > 130% MAX- or MIN-Alarm	Decrease entry value
80	I > Pulse width recalculated	Check pulse width, pulse factor.
91	Data in EEPROM invalid	Data in internal EEPROM invalid, for corrective measures see Error Code 5.
92	Data in ext. EEPROM invalid	Data (e.g. Qmax, damping) in the ext. EEPROM invalid. Access possible. Occurs when function “Store data in ext. EEPROM“ was not called. To clear the error message, call the function “Store data in ext. EEPROM“.
93	Ext. EEPROM defective or not installed	Access not possible, EEPROM defective. If the EEPROM is not installed then the ext. EEPROM assigned to the flowmeter primary must be installed.
94	Ext. EEPROM version incorrect	The data base is not correct for the software version. Call the function “Load data from in ext. EEPROM“ to automatically update the external data. The function “Store data in ext. EEPROM” clears the error message.
95	External primary data invalid	See Error Code C.
96	EEPROM version incorrect	Data base in the EEPROM has a different version than the installed software. Calling the function “Update“ clears the error message.
97	Primary data invalid	The flowmeter primary data in the internal EEPROM are invalid. Use the function “Load Primary“ to clear the error. (See Error Code C).
98	EEPROM defective or not installed	Access not possible, EEPROM defective. If the EEPROM is not installed then the ext. EEPROM assigned to the flowmeter primary must be installed.
99	Entry too large	Decrease entry value
99	Entry too small	Increase entry value

5.3.2 Checking the Measurement System

Warning

When the housing cover is removed and the power is turned on the personnel protection and EMC protection is voided!

A check of the measurement system is made after the flowmeter primary and the converter have been installed.

Does the supply power agree with the values listed on the converter Instrument Tag?

no → Install required solder jumpers for the supply power specified on the Instrument Tag, see page 39, Fig. 17.

yes

Is the meter installed in a proper location? (Primary: Protection Class, temperature, vibration):

no → Check allowable installation conditions, temperature, Protection Class, vibration, interconnections per ID.

yes

Are the ground connections made correctly?

no → Check the grounds (see page 46)

yes

Is the supply power at the terminals within the limits for the nominal voltage?

Term.	Supply Power	Limits
L N	230, 115, 110 V AC	-15% + 10%
1L1 1L2	24/48 V AC	-15% + 10%
L+ L-	24 V AC	-25% + 30%

no → Provide correct supply power.

yes

Is the flowmeter primary filled with fluid?

no → Fill pipeline.

yes

Is the correct flow range set? Units Q_{max} and totalizer units selected?

no → Set flow range and select units, also see converter data entry

yes

Under flow do the direction indicators in the display ($\rightarrow$ F for forward, $\leftarrow$ R for reverse) agree with the actual flow direction and is the flowrate displayed in percent or direct reading engineering units? Does the output signal agree with the flowrate displayed?

no → Fuse defective, conductivity < 5 μS/cm.
Defective flowmeter primary or converter. Check per 5.3.3

yes

Measurement system operational.

5.3.3 Checking the Converter

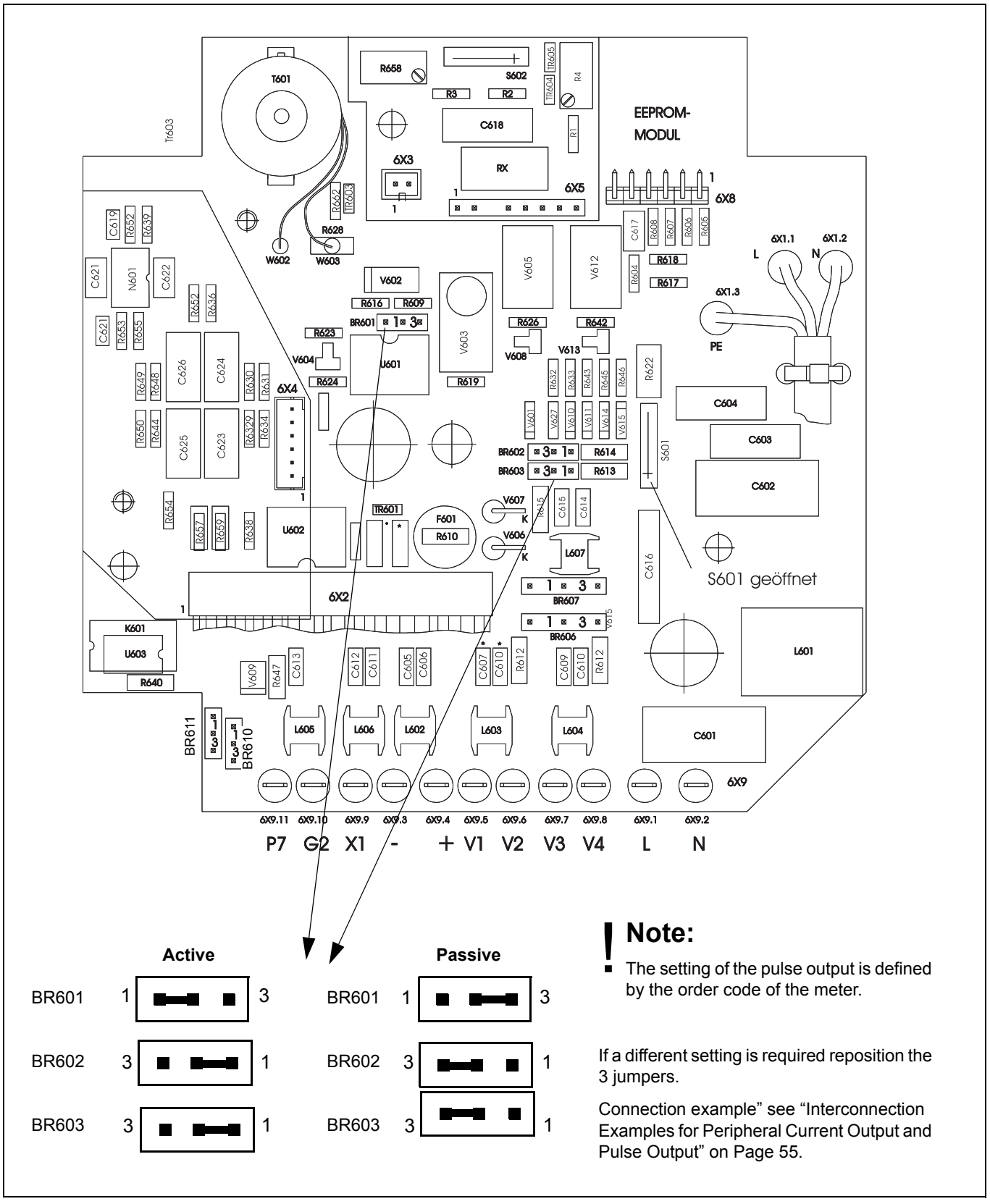
The test setup for the simulator is described in the Simulator Instruction Bulletin

Warning

When the housing cover is removed and the power is turned on the personnel protection is voided!

Connections per Interconnection Diagram. Were the measurement system checks completed?	no	Check measurement system, see 5.3.2 Checking the Measurement System
yes		yes
Connect an oscilloscope across 16 and 3. Is a pulsating DC signal present at approx. 70 mV rms ± 30%?	no	Possible errors: Driver circuit, calibration module, converter fuse defective. Turn off power and remove converter. Remove the magnet coil supply plug (M1/ M3). With an insulation measurement instrument, measure the resistance at the socket to the housing. The resistance must be greater than 10 MOhm.
yes		yes
Measure the electrode resistance under a full pipeline condition with an ac voltage bridge. Electrode E1 to 3 and E2 to 3. Are the resistances the same ± 5% ? Is the supply power turned off? The converter must be removed for this check.	no	Electrodes are contaminated; clean with usual cleaning liquid or water. Electrodes leak. The flowmeter primary must be returned to the factory for repair. Please observe the Note: Introductory Safety Note „General Protection Responsibilities“.)
yes		
Flowmeter primary operational		

5.4 Pulse Conversion Active/Passive



Note:

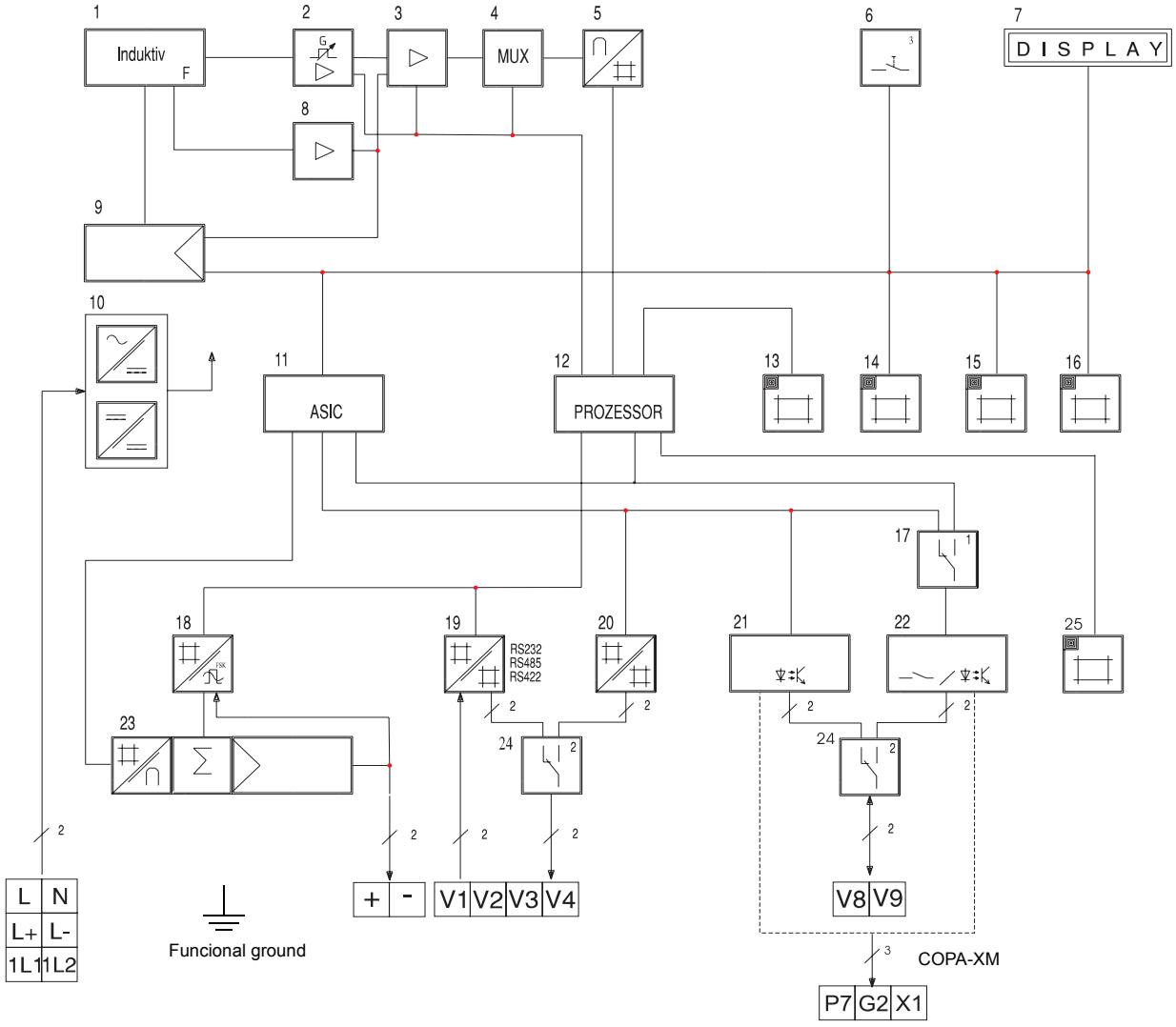
The setting of the pulse output is defined by the order code of the meter.

If a different setting is required reposition the 3 jumpers.

Connection example” see “Interconnection Examples for Peripheral Current Output and Pulse Output” on Page 55.

Fig. 15 Pulse Conversion Active/Passive

5.5 Block Diagram

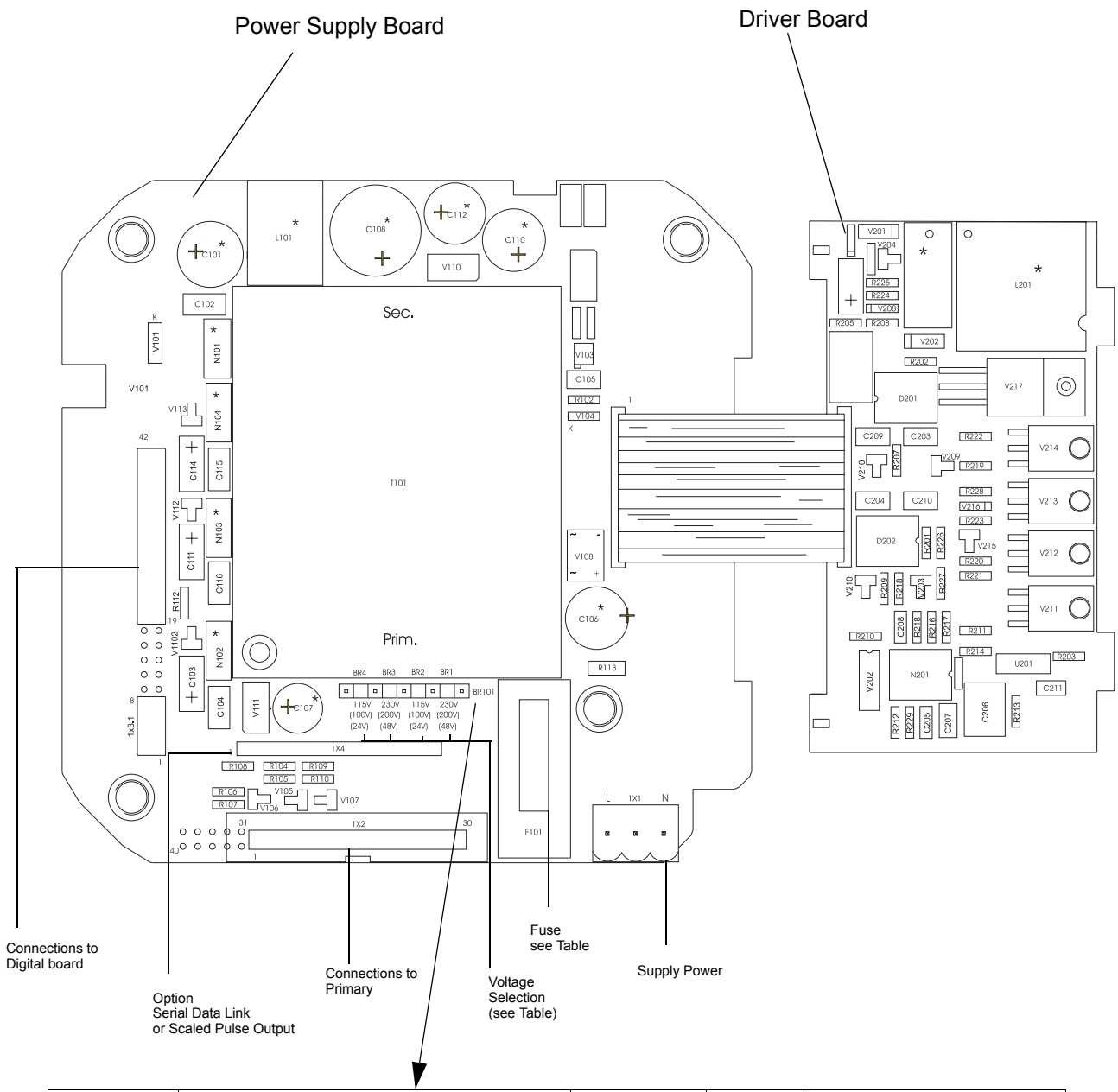


1	Flowmeter primary	14	Parameter memory
2	Input signal amplifier and empty pipe circuit	15	Memory - totalizer values
3	Signal conditioning	16	Program memory
4	Signal multiplexer	17	Selector switch - Contact output / alarm
5	Analog / Digital converter	18	HART® Interface
6	Operator keys	19	Data link RS232 / RS485 / RS422
7	2x16 character display	20	Scaled pulse output
8	Reference amplifier	21	Contact input
9	Driver / current controller	22	Contact output / alarm
10	Power supply AC/DC or DC/DC	23	Current output
11	Digital ASIC	24	Selector switch- scaled pulse output RS485 / RS422
12	Processor	25	Ext. EEPROM
13	Memory - customer parameters		

Fig. 16 Block Diagram

5.6 Circuit Boards

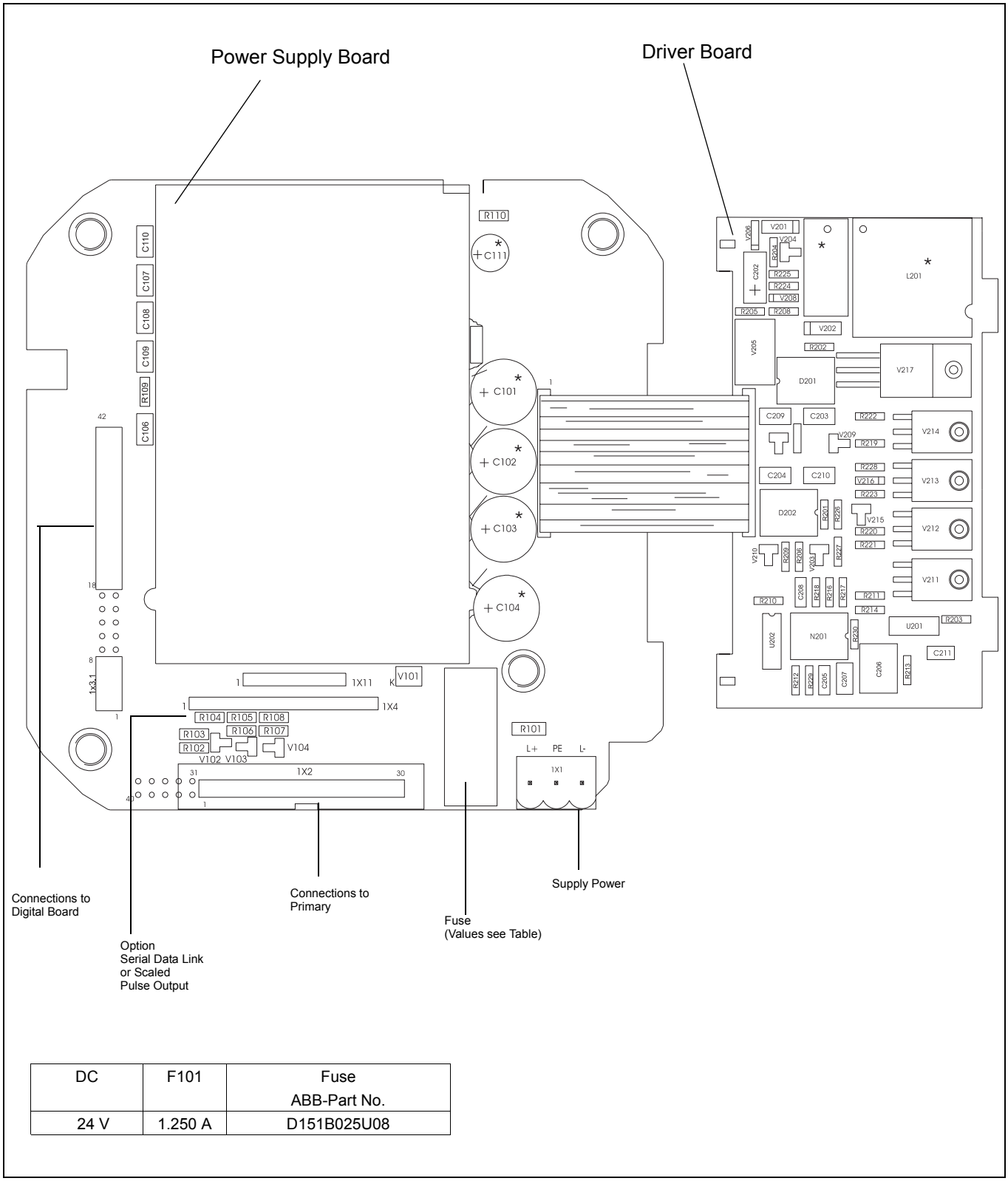
5.6.1 Assembled Power Supply-Driver Board AC



AC	BR 101				Transformer	F101	Fuse
	Br. 1	Br. 2	Br. 3	Br. 4	T101		ABB-Part No.
230 V	X		X		D692B071U01	0.160 A	D151B025U02
115 V		X		X		0.315 A	D151B025U04
48 V	X		X		D692B071U02	0.630 A	D151B025U06
24 V		X		X		1.250 A	D151B025U08

Fig. 17 Supply -Driver Board AC

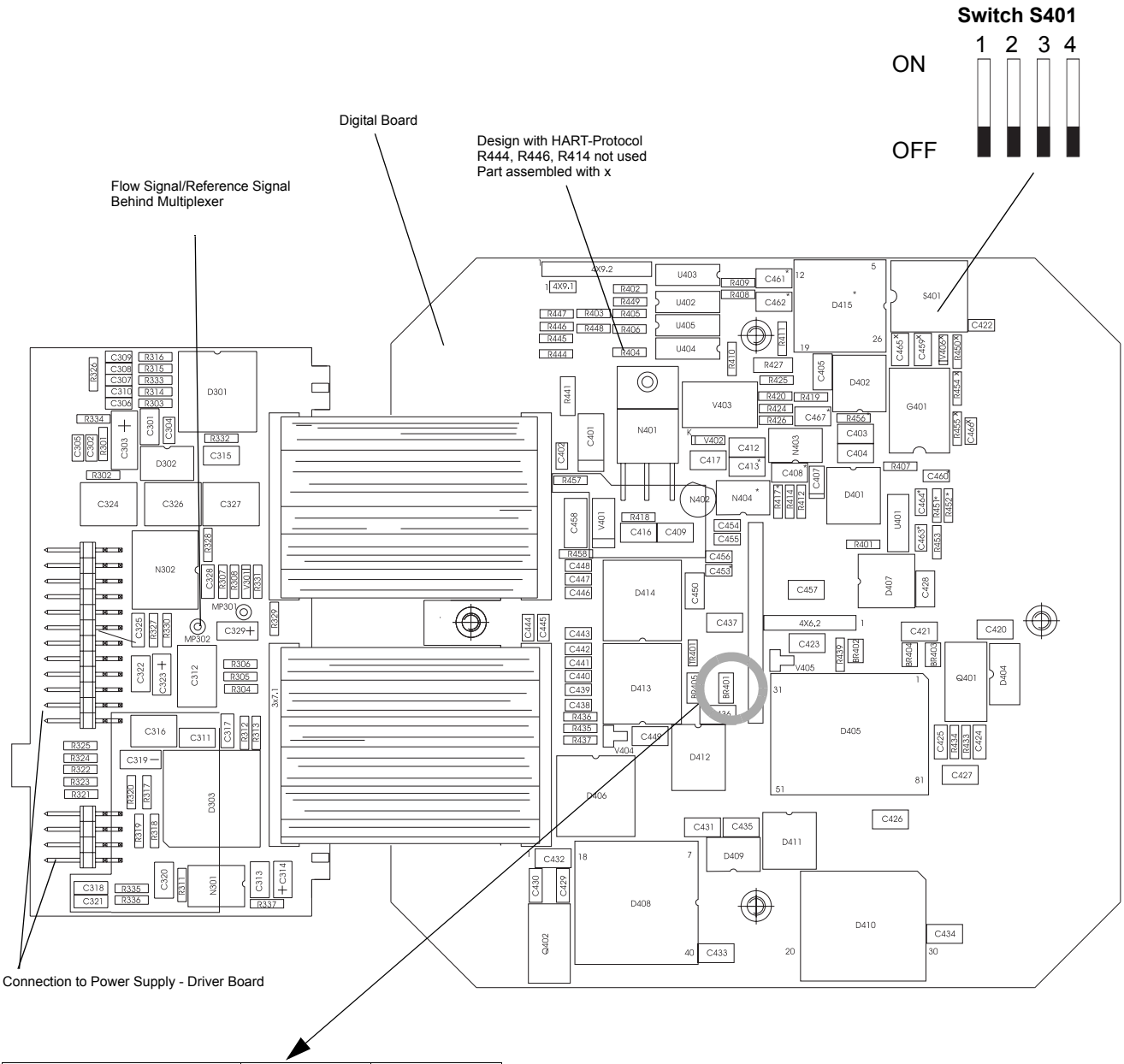
5.6.2 Assembled Power Supply-Driver Board DC



DC	F101	Fuse ABB-Part No.
24 V	1.250 A	D151B025U08

Fig. 18 Power Supply - Driver Board DC

5.6.3 Assembled Digital-/Signal Board



Pulse Output	BR 401	TR 401
Standard over Pulse Output	open	closed
Over Alarm Contact (with Serial Data Link)	closed	closed

Switch	**Switch S401Functions**	
	On	Off
1	-	-
2	50XM/CM1000 Mode	Standard 50XM/CM2000 Mode
3	-	-
4	Certified Design Prog. Protection active	No Certified Protection

Fig. 19 Assembled Digital-/Signal Board

5.6.4 Assembled Option Board

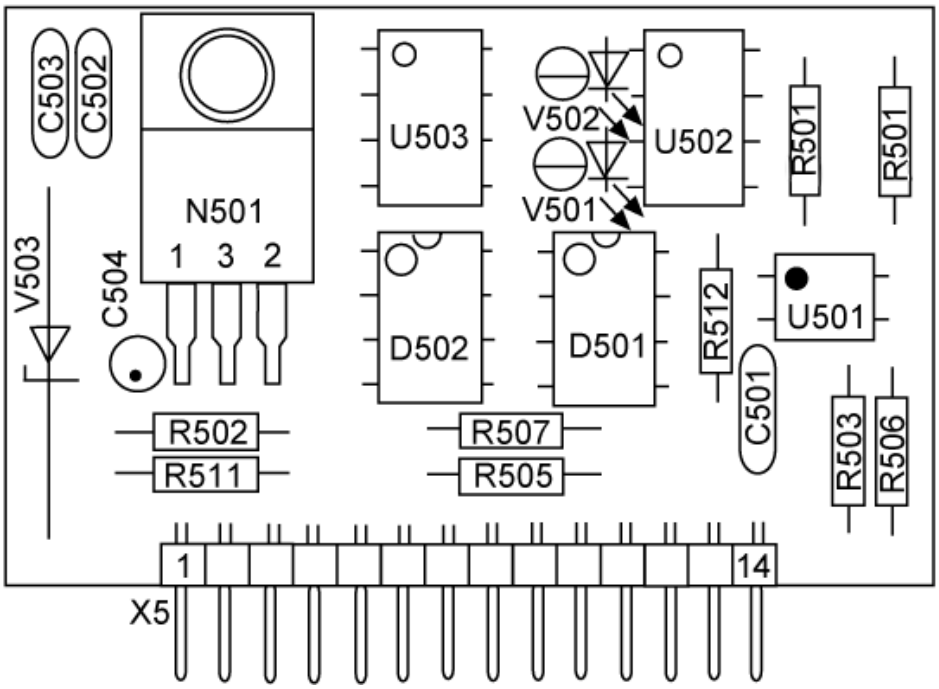


Fig. 20 Serial Data Link RS 485 (RS 422)

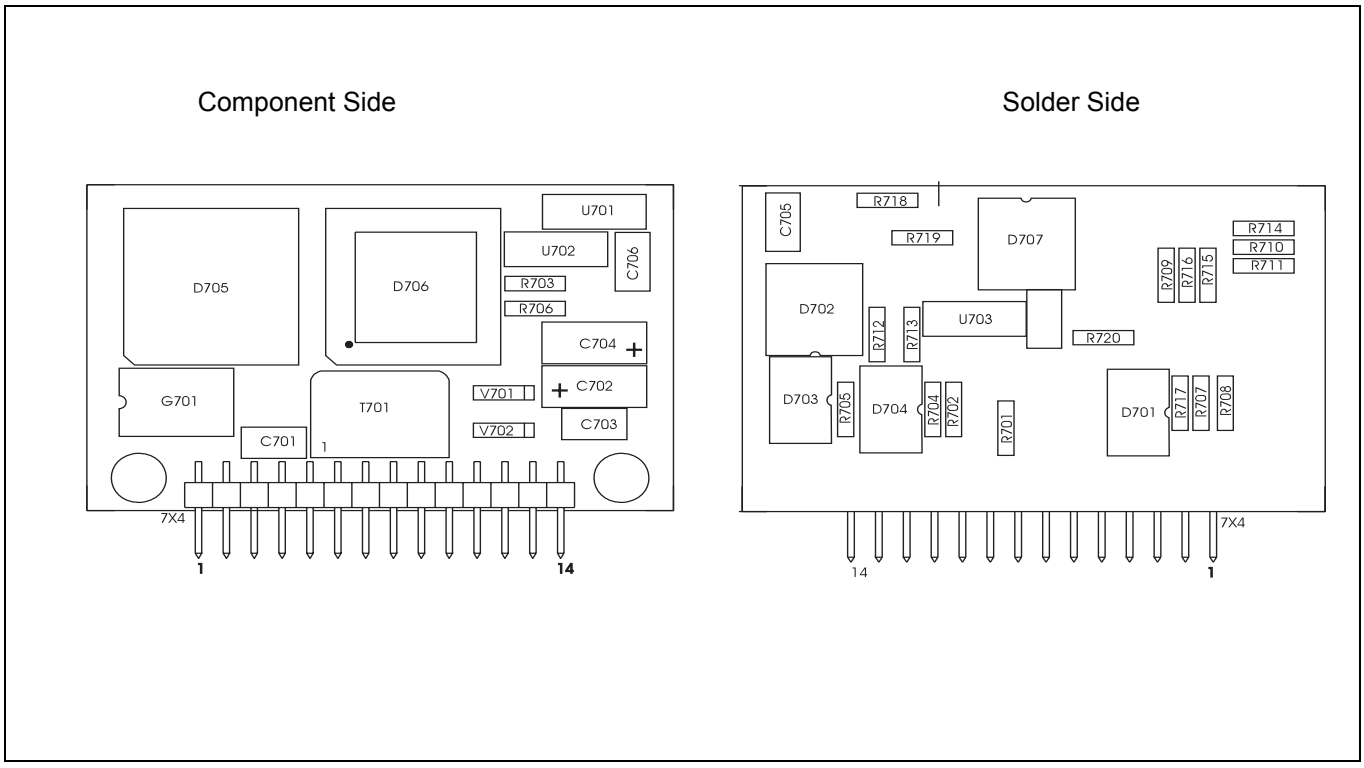
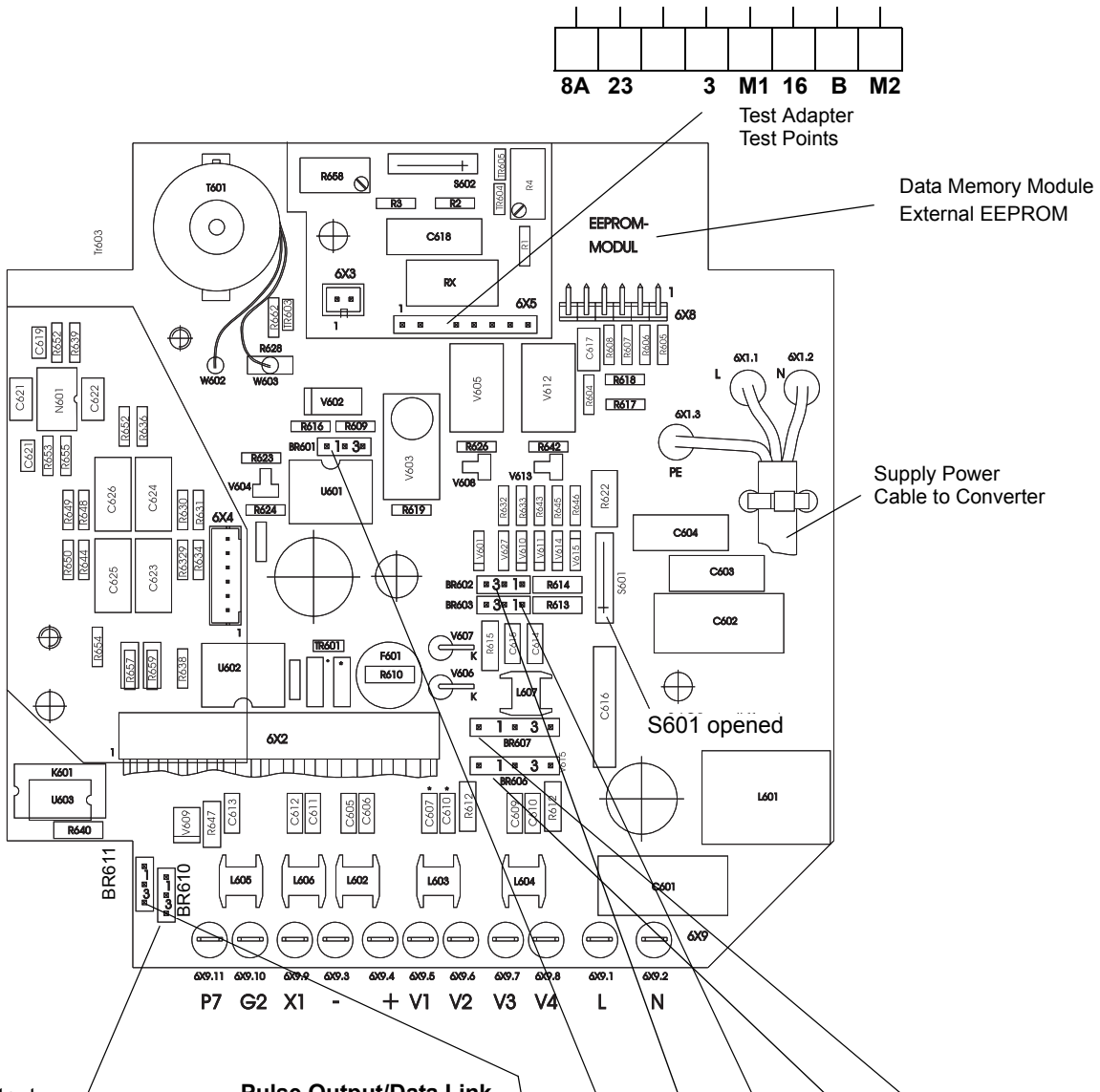


Fig. 21 Profibus DP

6. Locations of the Fuses, Switches, ext. EEPROM Socket and Pulse Output

6.1 Calibration Board



Contact Output

Jumper	BR610	
Position	1	3
Alarm output	x	
Prog. output		x

Coil Current

S602	Function
open	< DN 300
closed	≥ DN 300

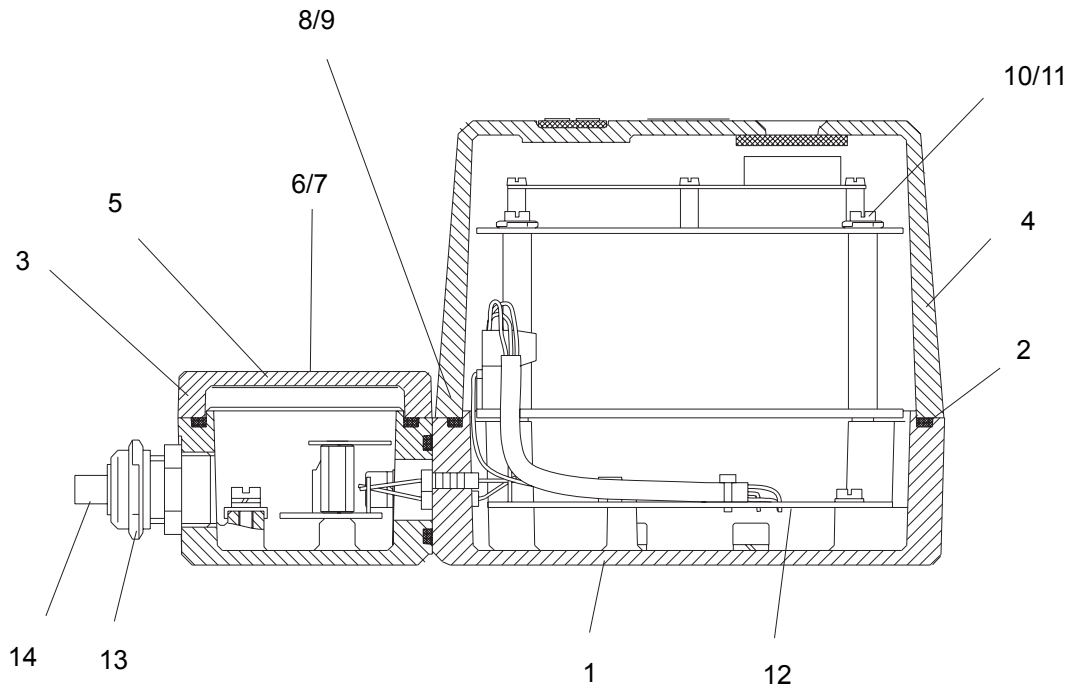
Pulse Output/Data Link

Jumper	BR611		BR601		BR602		BR603		BR606		BR607	
Position	1	3	1	3	1	3	1	3	1	3	1	3
Data Link RS485									x		x	
Data Link RS485+Passive	x								x		x	
Profibus DP									x		x	
Pulse Active 1-channel			x		x		x			x		x
Pulse Passive 1-channel				x		x		x		x		x
Pulse Active 2-channel									x		x	
Pulse Passive 2-v									x		x	
Frequency Output		x										

X with short circuit jumper, RM 2.54
Part NO. D172A001U01

Fig. 22 Calibration Board

7. Replaceable Parts, Flowmeter Primary



No.	Description	Part No.
1a	Lower section with connection box (process connection, wafer design, PTFE/PFA, Tri-Clamp, Food Ind. fitting)	D612A115U02
1b	Lower section with connection box, process connection, wafer design, ceramic	
1c	Lower section with connection box, process connection, flanged	D612A084U02
2	Gasket, large	D101A009U01
3	Gasket, small	D333F004U01
4	Cover with glass window	D612A181U01
5	Cover, small	D379D024U02
6	Cap screw, hex head M6 x 16 DIN 933 stn. stl.	D022J112AU20
7	Spring washer 6.0 DIN 137 stn. stl.	D085D026AU20
8	Cap screw, hex head M6 x 16 DIN 912 stn. stl.	D009J112AU20
9	Spring washer 6.0 DIN 7980	D085L026ZU05
10	Cap screw, hex head M4 x 60	D396A011U01
11	Spring washer A 4,0 DIN 137	D085D020AU05
12	Connection board with relay	D685A811U06
	Connection board with optocoupler	D685A811U05
13	Cable connector Pg 13.5	D15A008U02
14	Seal plug	D114A001U13
Accessories	Common parts, Magnet Stick	D614L537U01

Fig. 23 Replacable Parts List, Flowmeter Primary

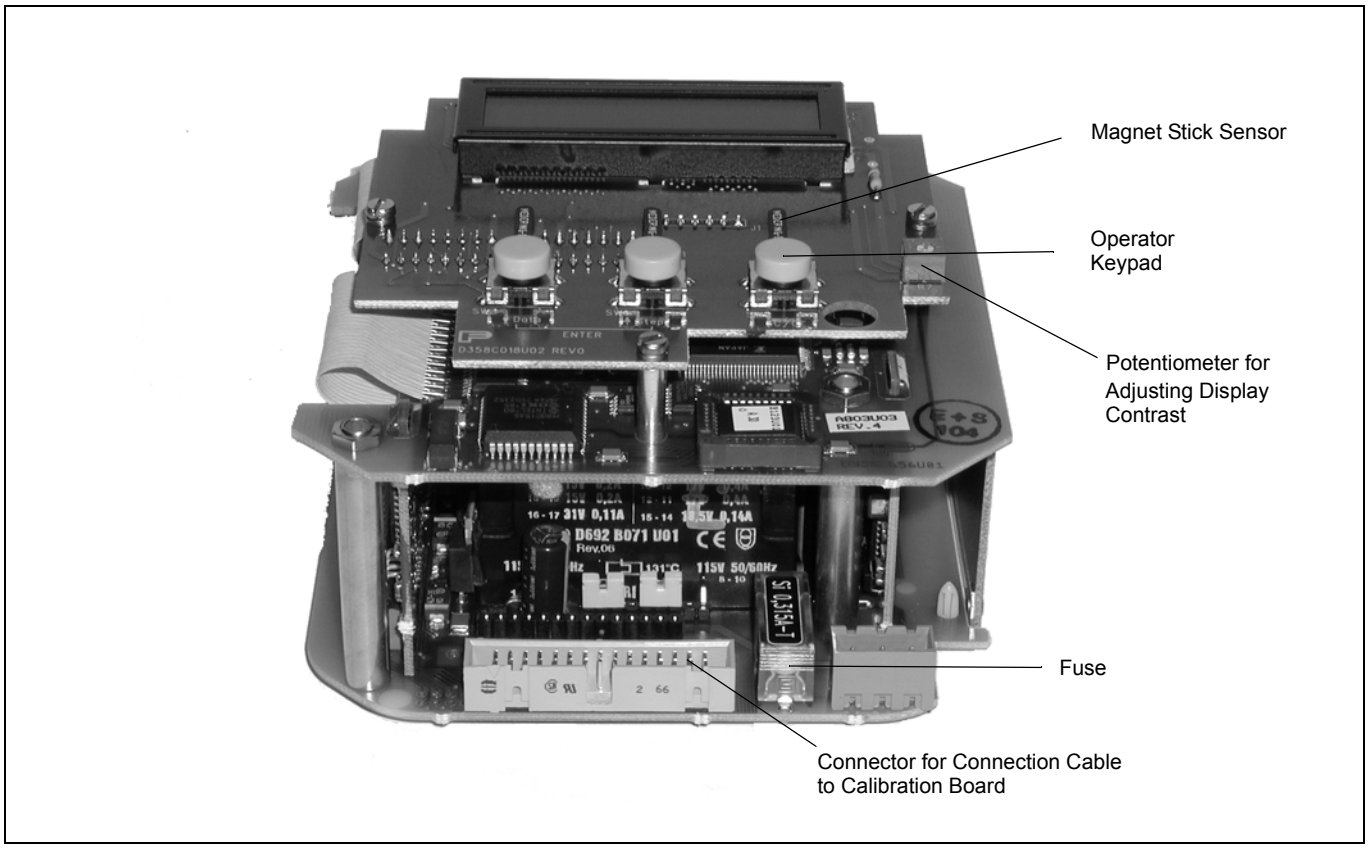


Fig. 24 Converter Module

Converter Module

Supply Power	Part No.
230 V AC w/o Accessories	D674A593U01
115/120 V AC w/o Accessories	D674A594U01
48 V AC w/o Accessories	D674A595U01
24 V AC w/o Accessories	D674A596U01
24 V / 48 V DC w/o Accessories	D674A597U01

Delay action fuse insert 5 x 20 mm

Fuse 0.160 A Fuse 0.315 A	D151B001U09 D151B001U01
Fuse 0.630 A Fuse 1.250 A	D151B001U13 D151B001U16

No.	Description	Part No.
13 (Page 42) 14	Profibus DP Serial Data Link RS 485 (RS422)	D685A835U03 D685A299U01

8. Safety Relevant Section

8.1 Grounding the Flowmeter Primary

The grounding procedure described is to be observed. In accordance with DIN VDE 0100, Part 540 a 4 mm^2 Cu wire is to be connected between the ground screw on the flowmeter primary (on the flange and on the converter housing) and ground. A ground connection at the converter is essential to meet the EMC requirements. For technical reasons it also important that the ground potential be the same as the potential of the pipeline. An additional ground connection at the connection terminals is not required.

When installed in plastic or lined insulating pipelines the connections to ground are made from a grounding plate or grounding electrode. Grounding electrodes are used in sizes 6" : DN 150 and up with hard and soft rubber liners. When there are stray potentials in the fluid the installation of a grounding plate on both sides of the flowmeter primary is recommended.

! Note:

concerning the flowmeter primaries with integrated grounding electrodes (option)

If the flowmeter primary is installed in plastic or earthenware pipelines, or in pipelines with an insulating lining, transient current may flow through the grounding electrode in special cases. In the long term, this may destroy the flowmeter primary because the ground electrode will in turn degrade electrochemically. In these special cases, the connection to the ground must be performed using grounding plates.

Four grounding possibilities are described below. In cases a) and b) the fluid is in electrical contact with the pipeline. In cases c) and d), it is isolated from the pipeline.

! Note:

For instruments with Food Industry fittings, Tri-Clamp and hose connectors the meter tube is in electrical contact with the fluid. It is only necessary to connect the grounding connection of the flowmeter primary to ground.

a) Metal Pipe

1) Drill blind holes in the flanges of the pipeline.
2) Thread holes, (M6 = 6 mm)
3) Attach the ground strap to the flange using a screw (M6), spring washer and flat washer and connect it to the ground connection on the flowmeter primary.
4) Connect a 4 mm^2 Cu wire between the ground connection on the flowmeter primary and a good ground.

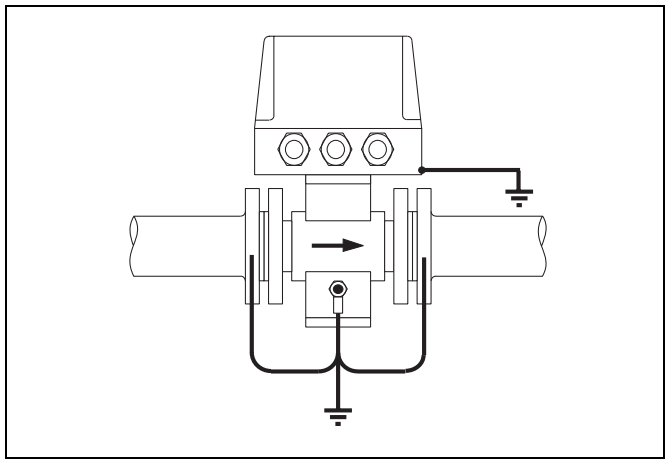


Fig. 25 Flowmeter Primary 1/8" - 1-1/2" (DN 3 - DN 40)

! Note:

Instruments 5" (DN 125) and larger with hard/soft rubber liners include a conductive section integrated in the liner. This section grounds the fluid.

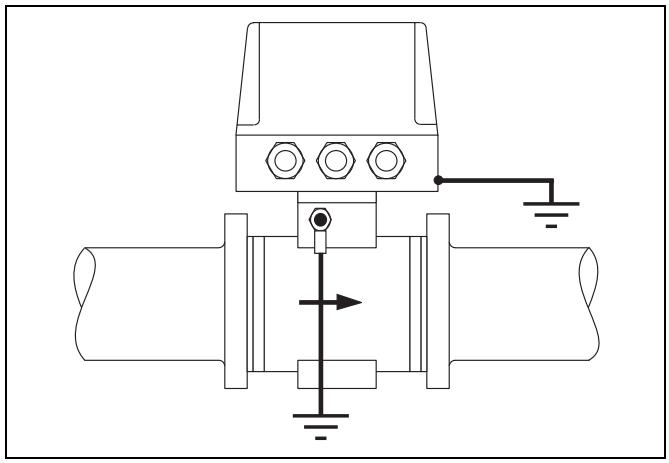


Fig. 26 Flowmeter Primary 1/8" - 4" (DN 3 - DN 100), Wafer Design

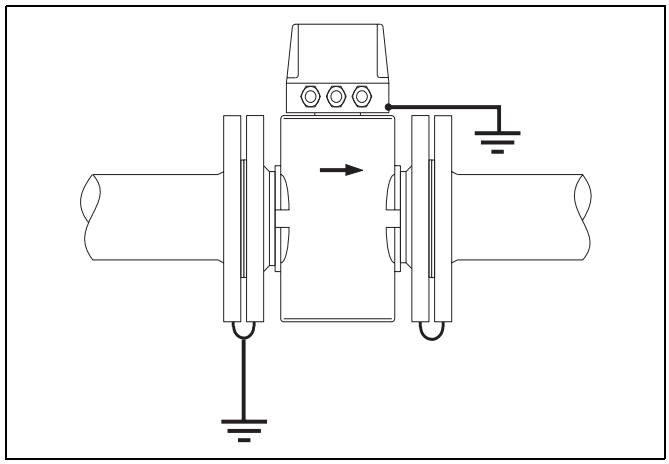


Fig. 27 Flowmeter Primary 3/8" - 16" (DN 10 - DN 400), Two Piece Housing with Fixed Flanges

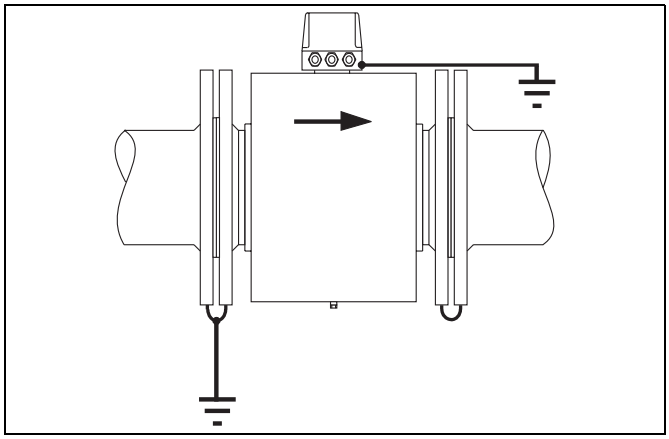


Fig. 28 Flowmeter Primary from 18” (DN 450 an up), Welded Steel Design

b) Metal Pipe with Loose Flanges

1) In order to assure a trouble free ground connection to the fluid and to the flowmeter primary installed in the pipeline with loose flanges, 6 mm threaded studs should be welded onto the pipeline.
2) Attach the ground strap to the threaded stud using a nut, spring washer and flat washer and connect to the ground connection on the flowmeter primary.
3) Connect a 4 mm^2 Cu wire between the ground connection on the flowmeter primary and a good ground.

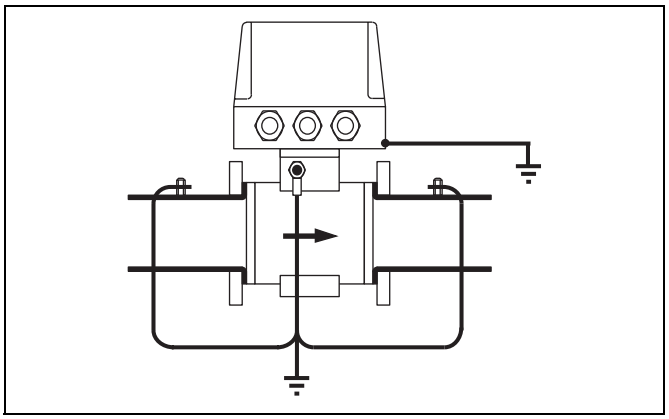


Fig. 29 Flowmeter Primary 1/8” - 4” (DN 3 - DN 100), Wafer Design

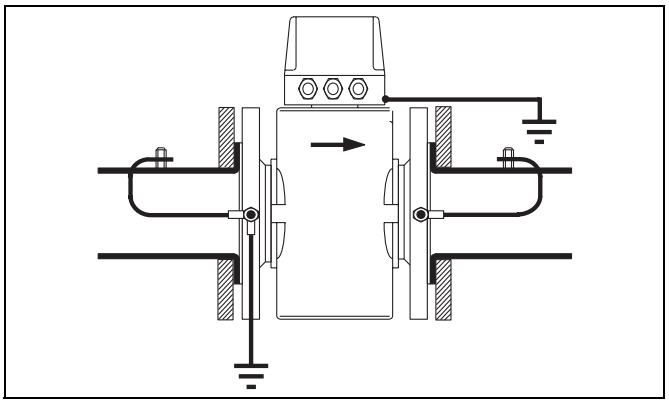


Fig. 30 Flowmeter Primary 3/8” - 16” (DN 10 - DN 400), Two Piece Housing with Fixed Flanges

c) Plastic. Concrete or Pipelines with Insulating Liners

1) Install EMF in pipeline with a grounding ring.
2) Connect the connection tab on the grounding ring to the ground connection on the flowmeter primary with a ground strap.
3) Connect a 4 mm^2 Cu wire between the ground connection on the flowmeter primary and a good ground.

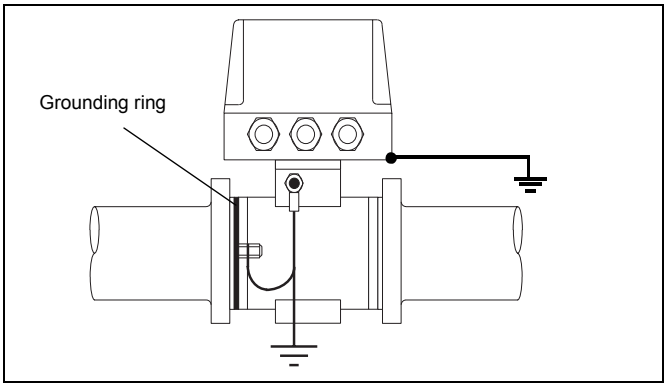


Fig. 31 Flowmeter Primary 2” - 4” (DN 50 - DN 100), Wafer Design

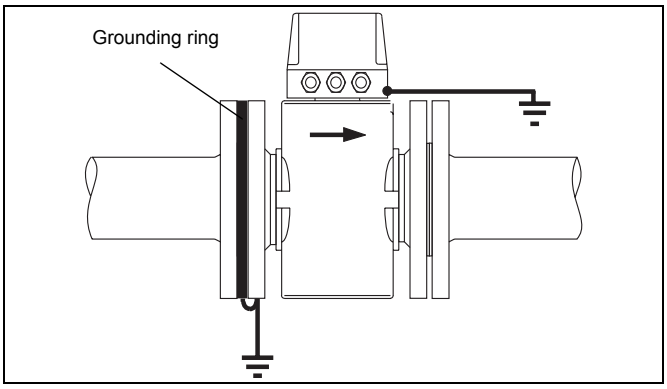


Fig. 32 Flowmeter Primary 3/8” - 16” (DN 10 - DN 400), Two Piece Housing with Fixed Flanges

d) Plastic. Concrete or Pipelines with Insulating Liners. Fluid is Not in Electrical Contact with the PIpeline. Flowmeter Primary with Grounding Electrode(s)

1) Connect a 4 mm^2 Cu wire between the ground connection on the flowmeter primary and a good ground.
2) Ground straps can be connected to the flanges or the pipeline.

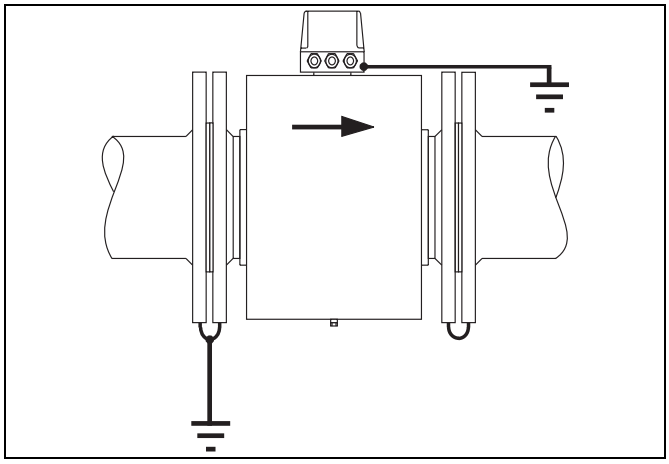


Fig. 33 Flowmeter Primary from 18" (DN 450 an up), Welded Steel Design

8.2 Supply Power Connections

The supply power, in accordance with the specifications listed on the Instrument Tag, is connected at terminals L (phase) N (neutral), L+ and L-, or 1L1 and 1L2 (see "Interconnection Diagram COPA-XM and COPA-XM Volume Flow Integrator" on Page 54) of the flowmeter primary across a main fuse and a main switch. The conductor cross-section and the fuse size for the line connections must be compatible (VDE 0100). The maximum power of the flowmeter primary including the converter is 23 VA.

8.3 Output Signal Connections

The output signals are connected to terminals +/- (current output) and 9/11 forward, 9/11R reverse (scaled pulse output) in the connection area of the flowmeter primary. A scaled pulse output or a serial data link are available as options. These can easily be added later. If a serial data link is installed, the scaled pulse output is not available. However, if a scaled pulse output is required see "Interconnection Diagram COPA-XM and COPA-XM Volume Flow Integrator" on Page 54.

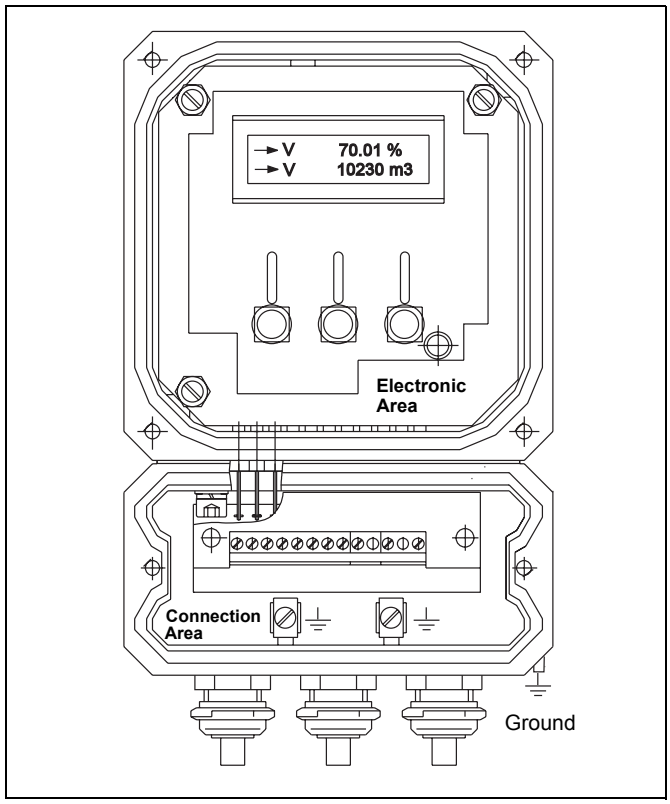


Fig. 34 Connection and Electronic Areas

When connecting to the RS485 data link a shielded data cable with individually twisted pairs is recommended.

Warning

When installing the cables at the flowmeter primary a water trap should be provided. (Fig. 35)

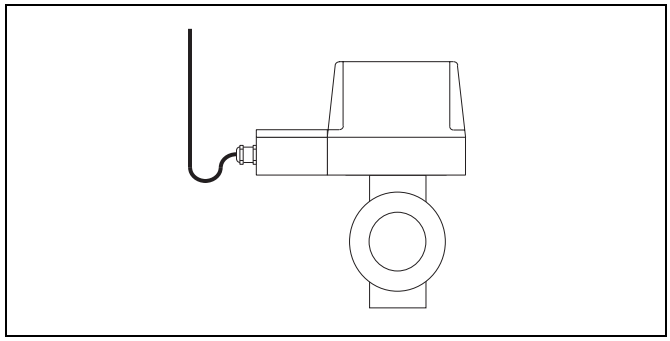


Fig. 35 Cable Installation with a Water Trap

8.4 Additional Information for Connecting to the Profibus DP

A converter option is available which includes communication utilizing the Profibus DP Protocol. The digital communication uses the RS 485 Data Link.

Transmission technology	RS 485 Data Link
Communication speed	9.6 to 1500 KBit/s
Protocol	per EN 50170
Ident-No.	6666 HEX

Cyclic (For output variables see separate Data Link Description for COPA/MAG-XM, Part No. D184B093U05)

Terminal	Function	Reference
+VD	VP	Supply voltage +5V
A	RxD/TxD-N	Receive/Send-Data-N
B	RxD/TxD-P	Receive/Send-Data-P
GND	C DGND	Data reference potential M5V

Cable
A twisted shielded data cable is recommended.
Max. cable length 1200 m (Cable Type A)
Characteristic impedance 135-165Ω
Max. 32 instruments on a single bus
Baudrate: 9.6-1500 kbit/s
Distributed capacitance <30 pF/m, loop resistance 110 Ω/km
Tap line max. length 1 m.
Incoming and outgoing signals on the same terminal.

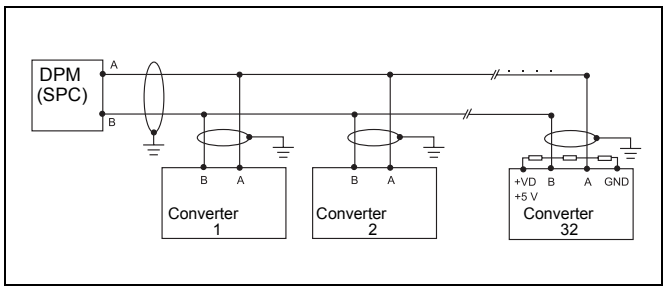


Fig. 36 Communication Profibus DP

Bus Termination for Profibus DP
Both ends of the bus cable must be provided with a bus terminator (Fig. 37). In addition to the bus terminator resistor R2 specified in the EIA-RS-485 Standard an additional resistor R1 (Pull-down) must be connected to the data reference potential GND and a resistor R3 (Pull-up) connected to VP (plus supply voltage). These two resistors are used to define a specific idle potential on the bus, when no participant is transmitting (idle time between telegrams, the so called idle-status). For values see DIN 19245 Part 1 and Part 3.
Cable Type A: R1 = 390 Ω, R2 = 220 Ω , R3 = 390 Ω

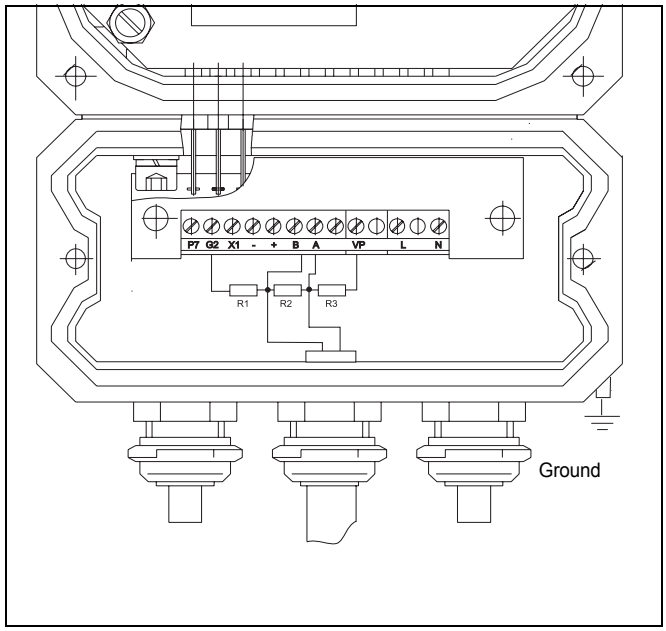
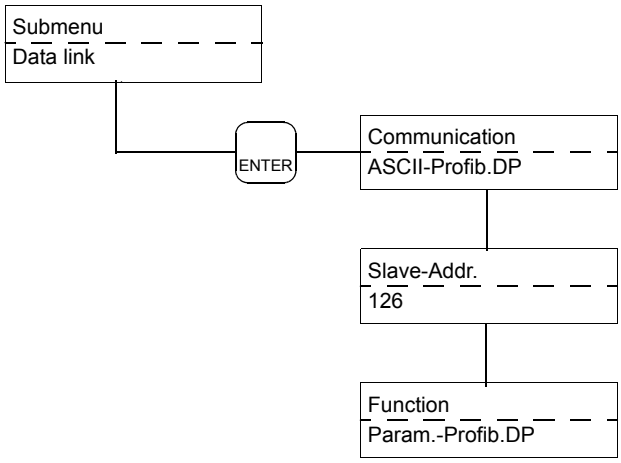


Fig. 37 Bus Termination for Profibus DP, when the Instrument is Connected at the End of the Bus

GSD File (Instrument Data Base)- File Name FP6666, GSD, Included with Shipment



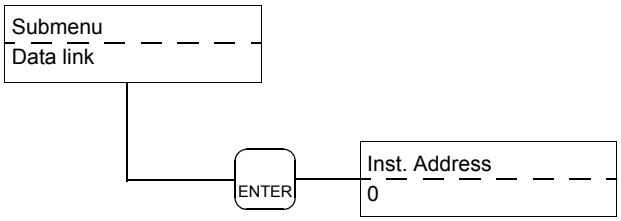
The communication mode Profibus DP is selected in the Submenu Data Link.

The Slave-Address must always have 3 digits, Address-Range 000, 001 to 126.
If a one or two digit bus address is entered, an incorrect interpretation of the bus address will be made by the converter.

This function can be used to access the parameters in the Profibus DP-Module. Also see Point 13 „Data Link Functions" Part No.D184B093U05.

8.5 Additional Information for Connecting to the HART-Protocol®

The converter Instrument Tag includes the term HART-Protocol. The software can be recognized by the label attached to the EPROM with the identification, e.g. D699B138U01 X.33 , abbreviated as B138U01 X.33. There are a number of parameter functions pre-installed in this software.The current output is set to 4-20 mA, the min. load is 250 Ohm. Not all standard settings are available in HART. Please observe the note in Section 3.5 Parameter Overview and Data Entry.



The instrument address can be set between 0 and 15.
If the Address is set to 0, then the current output value for the flowrate is changed to the range from 4.00 to 20.00 mA. If additional instruments are connected to the bus and an Address 1-15 is set, then the converter operates in the Multidrop-Mode. The current output is then set to a fixed 4.00 mA value. The evaluation of the measurement values is then only possible over the HART-Communication.

8.6 Additional Information for the Pulse Output

The scaled pulse output function can be changed from active to passive at any time by changing the jumpers on the calibration board. See Fig. 20 on Page 42 . The pulse output for both flow directions uses a single channel. An option is available for a 2-channel pulse output, one each for forward and for reverse flow. When configuring the parameter the following parameter settings must be observed:

Pulse
1.0000 / m^3

Pulse Factor
The pulse factor is the number of output pulses for measured flowrate unit. When the pulse factor is changed, the totalizer value in the selected units remains unchanged. The pulse factor can be selected in the range from 0.001 to 1000 pulses/unit.
The selected pulse factor is checked by the converter as a function of the flow range, the pulse width, the volume (e.g. ml, l, m3) or mass (e.g. g, kg, t) units. If any one of these parameters is changed the pulse width cannot exceed 50% of the period of the output frequency at 100% flowrate (on/off ratio 1:1). If the pulse width exceeds this limit it is automatically reduced to 50% of the period and the message **Warning! New pulse width** is displayed.

Pulse width
230 ms

Pulse Width
The pulse width (length of the pulses) for the selected pulse output can be set between 0.1 and 2000ms. The pulse width must be sufficiently short so that at a maximum output frequency (flowrate max. 100% = 5 kHz) there is no overlapping of the pulses. On the other hand, the pulse width must be long enough to assure that it can be measured by the connected instrumentation (SPC).

Totalizer units
m^3

Example:
Flow range = 100 l/min (Qmax = 100 % flow range end value)
Totalizer = 1 pulse/l

$$f = \frac{100\,\text{pulses/min}}{60\,s} = 1.666\ \text{Hz}$$

To allow for a 30% overrange

$$f = 1.666\ \text{Hz} \times 1.3 = 2.166\ \text{Hz (1/s)}$$

On/off ratio of 1:1 (pulse width = pause width)

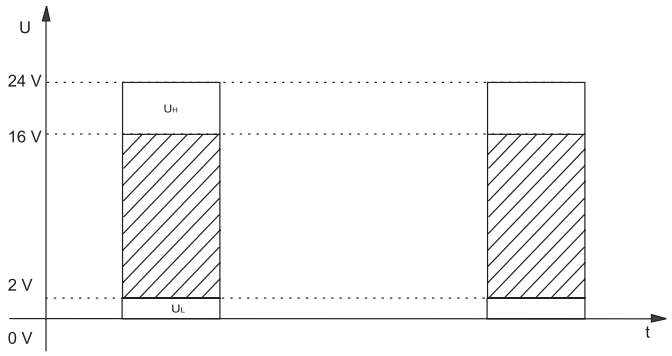
$$t_p = \frac{1}{2{,}166\,s^{-1}} \times 0.5 = 230\ \text{ms}$$

Any value < 230 ms can be set. Counters usually require a pulse width ≥ 30 ms.
The converter automatically checks the pulse width setting. Its maximum can be 80 % to the output frequency at 130 % flowrate. If this limit is exceeded, the new value will not be accepted and the message entry too large will be displayed.

Observe current and frequency values.

When connecting an active or passive counter the max. allowable current and frequency values must be considered.

Example:
When a passive 24 V counter is connected:
The max. allowable output frequency is 5 kHz



Voltage

$0\ V \leq U_L \leq 2\ V$; $16V \leq U_H \leq 24\ V$

Current

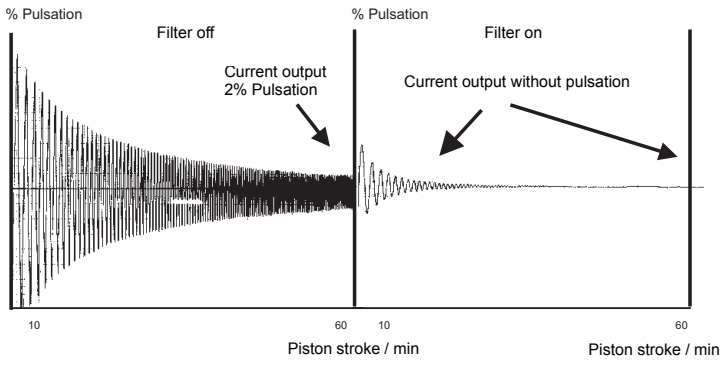
$20\ mA \leq I \leq 220\ mA$

8.7 Additional Information for Piston Pump/Pulsating Flows

Submenu Primary
Span CS 25 Hz -79.8 %
Damping 5.0000 s
Filter on
Operating mode Fast

The primary applications for the pulsed DC field are the metering of continuous flows. When pulsation dampers are used for pulsating flow conditions it is also possible to take advantage of the pulse DC field technology. If the use of pulsation dampers is undesirable or impossible, then instruments with higher magnetic field excitation frequencies must be employed. For metering the flow after single stage piston, hose and membrane pumps the converter must be able to correctly process the peak flowrates. These peaks seldom reach more than three times the average flowrate. As long as the converter can linearly process these flowrate peaks and sufficient samples are measured, the accuracy for longer totalizer periods of the measurement system is unaffected.
Exact knowledge of the type and operating characteristics of the pump must be available. Then, based on established criteria, a decision can be made if the application can utilize a pulsed DC system or if a AC system is required. The pulsed DC system can accurately measure constantly rising piston pump flows with a max. cycle frequency of 120 strokes/minute. The magnetic field excitation must be 25 Hz, the filter must be turned on and a damping value >2.4s should be set. In the Submenu Operating Mode the parameter “Fast” should be selected.
A digital filter is incorporated in the converter especially for pulsating flows or noisy flow signals. It smooths the instantaneous display indications and a noisy output current. The damping value can be reduced when the filter is turned on. The response time of the converter is not affected.
There is no relationship between the HART-Protocol and the filter and the damping.

! Warning ! Not all flowmeter primaries can be operated at an excitation frequency of 25 Hz. Please contact ABB.



8.8 Additional Information for the Preset Totalizer

Submenu Operating mode

A batch with a specific quantity can be programmed in the software.
The minimum batch time, which is a function of the excitation frequency, is 3min (for 12.5 or 25 Hz excitation frequencies).
The preset totalizer can be started from the keypad or from an external contact (Terminal G2/X1). At the start, the contact (Terminal P1/P2) is closed. When the preset quantity is reached (batch quantity) the contact is opened.

Operating mode Preset totalizer

Turn off the program protection and in the Submenu Operating Mode select the function „Preset Totalizer".
Exit the Submenu and enter the desired batch quantity in the parameter „Preset Totalizer".

Submenu Units

The selection of the units for the preset totalizer; scroll to the Submenu Units and then select the desired totalizer units.

Units totalizer l (Liter)

The pulse factor / measurement unit affects the batch accuracy.
Calculation of the total pulses for a batch:
Pulse total = pulse factor / units setting x batch quantity
Example: 10 [pulses/l] x 300 [l] = 3000 [pulses]

Pulse 10.000 /l

Preset totalizer 300 l (Liter)

The desired preset quantity for the batch can be set in the parameter Preset Totalizer.

Preset totalizer Start

The Preset Totalizer can be started from the keypad or from an external contact (Terminals G2/X1). A DC voltage source must be connected to the optocoupler input G2/X1 for an external start (see Preset Totalizer Connections, Page 47).
To start the batch the contact (Terminals P1/P2) must be closed. When the preset batch quantity is reached the contact opens.

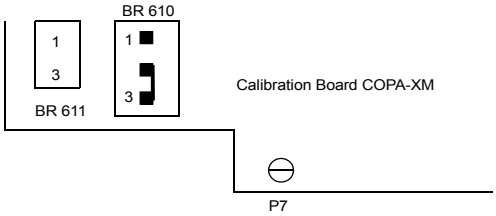
! Note ! The contact input for Start/Stop should closed for at least 350 ms, but not longer than 1.5 s.

Submenu Prog. In/output

Before the batch system can be used, the function selection for the contact input and the contact output in the Submenu Prog. must be made.

Terminal P1/P2 End contact

If these settings are to made later locally, make sure that the jumper setting for BR 610 on the calibration board is set for Prog. Output (Position 3) or for Alarm Output (Position 1). For the end contact the jumper BR 610 must be set to Position 3.



Terminal X1 Start/stop

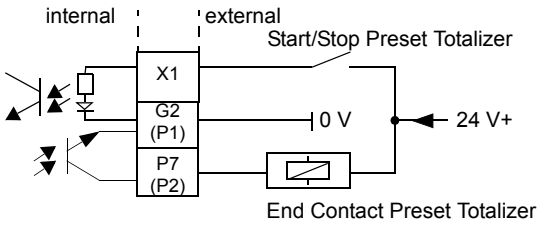
–> F 42.50 l/h Qg E 5890 l

Qg is the grand totalizer value, the sum of the individual batch quantities. “E” indicates if a batch cycle has been started and is presently active. When the batch cycle has been completed, the “E” disappears from the display.

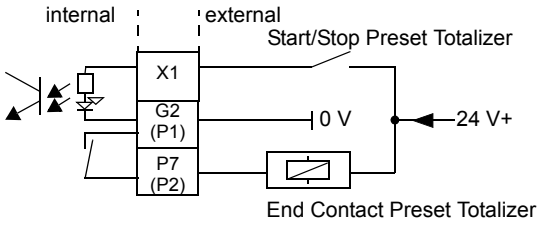
–> V 42.50 l/h Q E 250 l

Q indicates the present actual totalizer value. This totalizer integrates the flow during the batch cycle. The counter is reset to zero for each batch cycle start.

Contact In-/Output Optocoupler



Contact input optocoupler
Contact output relay



8.9 Additional Information for External Zero Return

Submenu
Prog. In/Output

Terminal X1
Ext. zero return

Passive over a contact input (normally open). When actuated the instantaneous flowrate display is set to "zero", the output signals are turned off and the totalization interrupted. The messages “Error Code 4” and “External zero return” are alternately displayed.
Can be used, for example, when the fluid level in the pipe line is undefined after a pump is shut off or for repetitive cleaning procedures (CIP cleaning) during which measurements are to be suspended.
Terminals G2/X1.

Safety Information

! Note

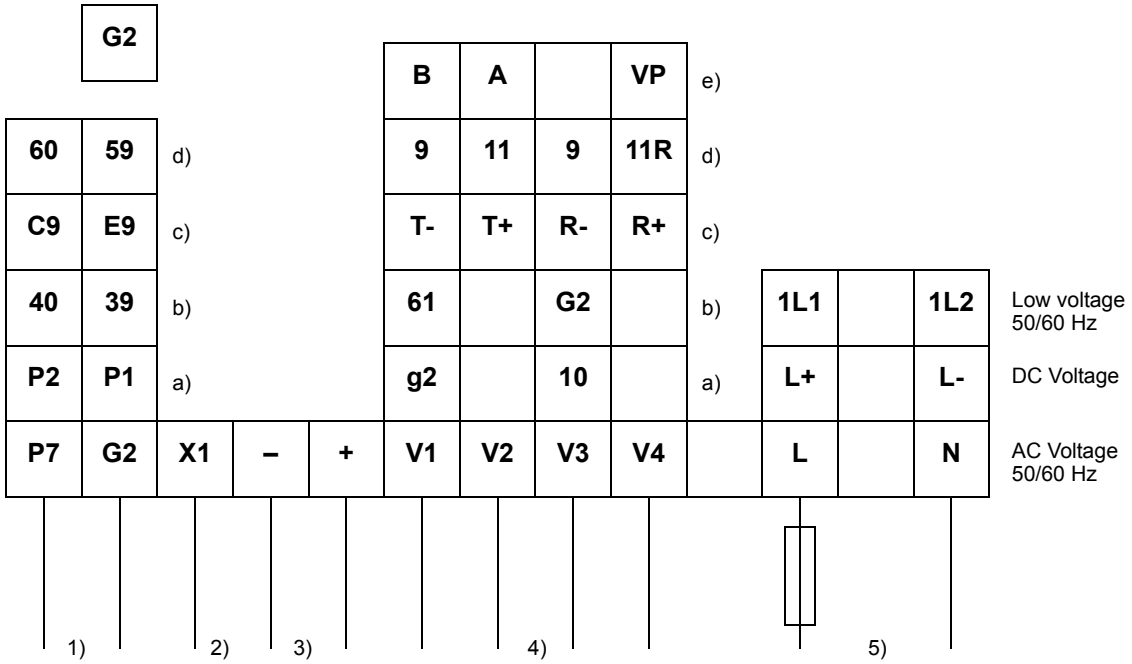
There are circuits in the flowmeter primary and converter which are dangerous to contact. Therefore the supply power should be turned off before the housing is opened. Only trained personnel should operate the instrument when the housing is opened.

The converter and the flowmeter primary are to be grounded in accordance with the applicable international Standards.

The line supply connections must be sized for the current in the flowmeter primary. The cable must correspond to IEC227 or IEC245.

A switch or circuit breaker should be installed in the supply power line to the flowmeter which should be located near the flowmeter and be appropriately identified.

8.10 Interconnection Diagram



1) **Contact output** Terminals P7, G2
The contact types and function options can be specified in the order.
a)[1] Software selections for the function to be assigned to the contact output:
General alarm, alarm, empty pipe, forward direction signal, flow range signal,
end contact preset totalizer, Function P1/P2,
Optocoupler: 16 V ≤ U_{CEH} < 30 V, 0 V ≤ U_{CEL} < 2 V, 0 mA ≤ I_{CEH} < 0.2 mA, 2 mA ≤ I_{CEL} < 15 mA or
relay: 16 V ≤ U < 30 V, 0 mA ≤ I < 250 mA, P ≤ 3 Watt
b) Alarm output relay contact; normally closed, specifications see a), Function 39, 40
c) Alarm output optocoupler; normally closed, specifications see a), Function C9, E9
d) Pulse output unscaled, 0-10 kHz optocoupler output, specifications see a), Function 59, 60

2)[2] **Contact input** Terminals G2, X1
The following functions can be selected in the software:
External zero return, external totalizer reset, flow range 2,
start/stop preset totalizer, passive 16 V ≤ U < 30 V, R_i = 2 kΩ

3) **Current output** selectable, load ≤ 1000 Ohm for 0/4-20 mA, 0-10-20 mA,
4-12, 12-20 mA, load ≤ 2000 Ohm for 0/2-10 mA, load ≤ 4000 Ohm for 0-5 mA.
Option HART-Protocol for 4-20 mA per Bell 202 Standard.

4) **Scaled pulse output** 1-channel, active or passive, pulse width selectable from 0.100 ms to 2000 ms or
serial data link Terminals V1-V4
a) Active, 24 V DC load ≥ 150 Ohm, f_{max} = 5 kHz
Function 10, g2
b) Passive, Function 61, G2
c)[3] Serial data link RS 485, Function T-, T+, R-, R+
d) Option: Scaled pulse output 2-channel, data link not available
active 24 V DC load ≥ 150 Ω or passive relay contact (normally open), ≤ 3 W; ≤ 250 mA; ≤ 28 V DC, f_{max} = 20 Hz
or passive optocoupler, 5 V < U_{CE} < 28 V DC; 5 mA < I_{CE} < 30 mA; f_{max} = 5 Hz
Terminals: V1, V2 forward; Function 9, 11
Terminals: V3, V4 reverse; Function 9, 11R
e) Data link Profibus DP, Terminals V1, V2, V4, G2, Function (RxD/TxD-P(B), RxD/TxD-N(A),
+5 V (VP), DGND (G2) for bus termination).

5) **Supply power**, see Instrument Tag

[1] Factory default setting is the Function “Forward Direction Signal”.
[2] Factory default setting is the Function “External Zero Return”.
[3] For use with a data link RS 485 a shielded data cable with individually twisted pairs is recommended.

Fig. 38 Interconnection Diagram COPA-XM and COPA-XM Volume Flow Integrator

8.11 Interconnection Examples for Peripheral Current Output and Pulse Output

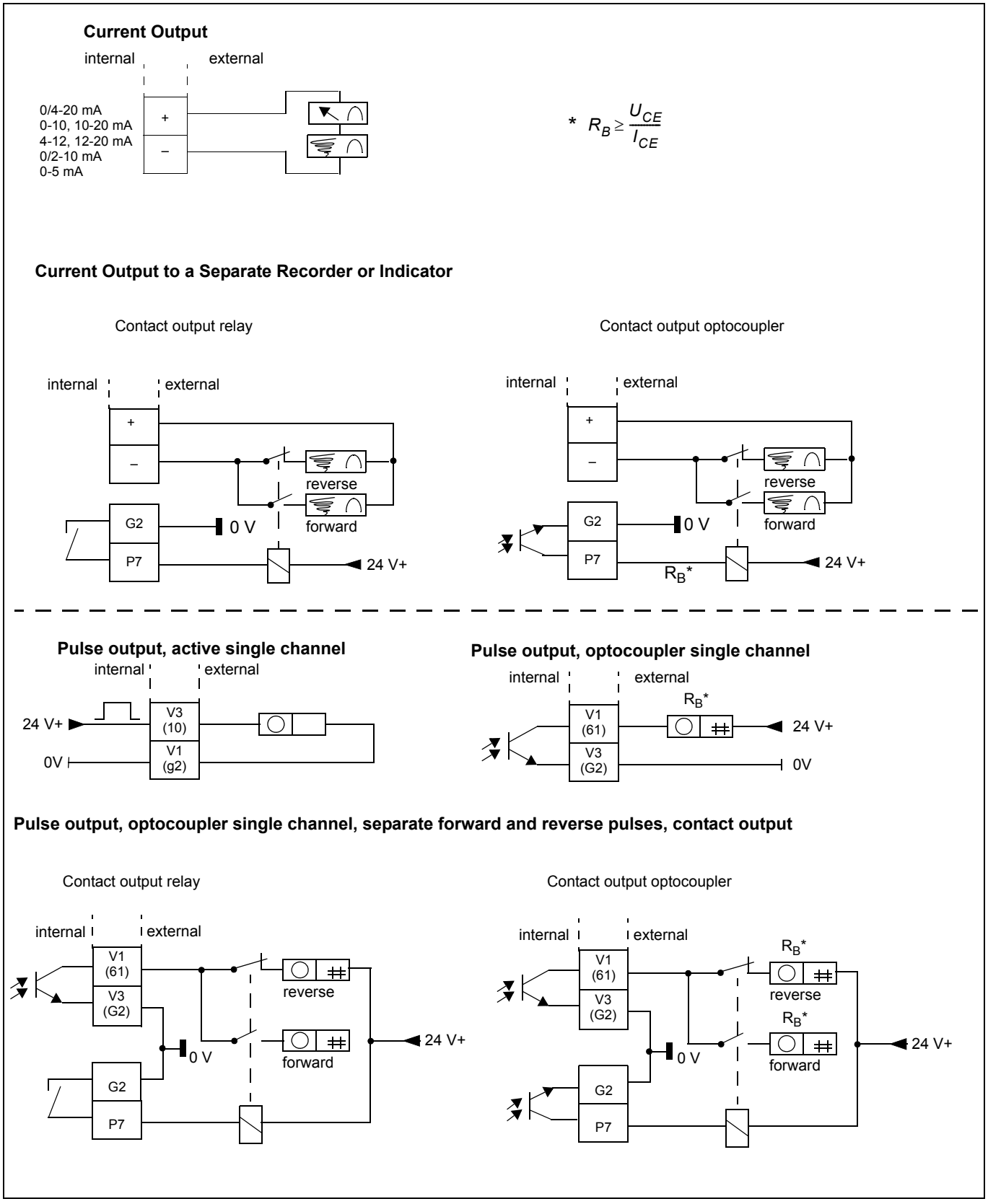
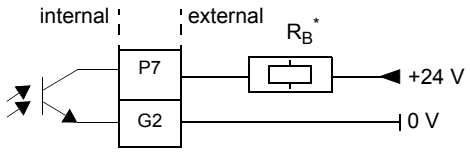


Fig. 39 Interconnection Examples, Peripherals

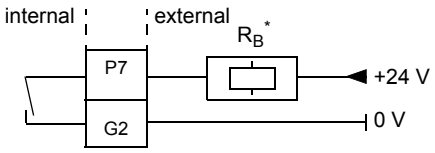
8.12 Interconnection Examples for Peripheral Contact In-/Output, Data Link

Contact output for general alarm, max-min-alarm, empty pipe, forward/reverse direction signal, flow range 1/2 or end contact (preset totalizer). Functions selectable in Submenu „Prog. In/Output“

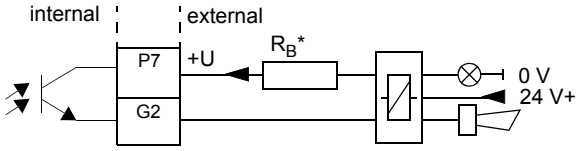
Contact Output optocoupler



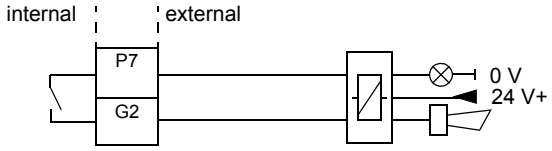
Contact Output relay



Contact Output General Alarm optocoupler

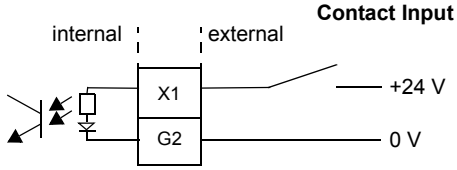


Contact Output General Alarm relay



Contact input for external zero return of the outputs (undefined pipeline fill level after pumps are turned off or during repetitive cleaning or flushing procedures during which flow is not to be metered) or external totalizer reset, flow range switching FR2, or start/stop contact for preset totalizer. Functions selectable in Submenu „Prog. In/Output“.

Contact Input passive



$$^{*}R_B \geq \frac{U_{CE}}{I_{CE}}$$

Profibus DP

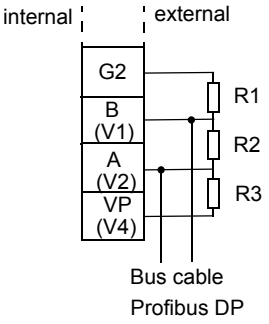
The resistors R1, R2, R3 are bus termination resistors. They are to be installed when the instrument is connected at either end of the bus cable.
R1 = 390Ω; R2 = 220Ω; R3 = 390Ω

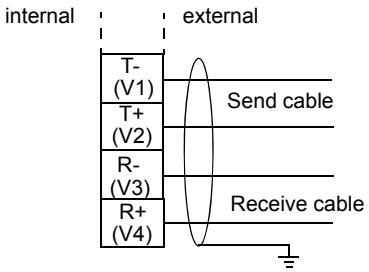
Serial Data Link RS 485

Serial data transmission over data link RS 485:
Max. cable length: 1200m, max. 32 instruments in parallel on the bus, shielded, twisted data cable.
Baudrate: 110-9600 Baud, 14400/28800 Baud selectable.

HART-Protocol®

FSK-Modulation on the 4-20mA current output per Bell 202 Standard.
Max. cable length: 1500 m twisted cable
Baudrate: 1200 Baud
Min. load: 250 Ohm





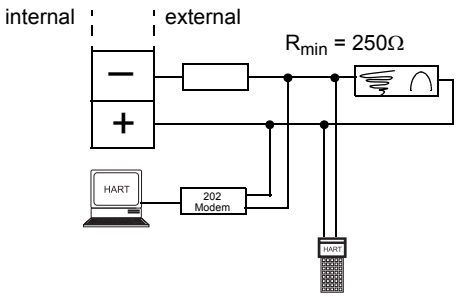


Fig. 40

9. Start-Up

9.1 Checks

The start-up procedure is to be begin after the flowmeter primary and converter have been installed.

- Check if the flow direction agrees with the direction indicated by the arrow on the flowmeter primary housing.
- Check the grounds per Section 8.1.
- Check the interconnections per the Interconnection Diagram Fig. 38 on Page 54 .
- Check that the supply power agrees with the specifications on the Instrument Tag.
- Check if the ambient temperature is within the limits listed in the Specification Sheet.

Turn on the power.

- Check the contrast setting of the display. A small screw-driver can be used to adjust the “Contrast” potentiometer for the ambient conditions.
- In order for the instrument to be operational it is necessary to select or enter only a few parameters. Read the flowmeter size on the Instrument Tag and check that it agrees with the value selected in Submenu “Primary”. The flow range is automatically set to 10 m/s. Enter the desired flow values for the forward and reverse flow directions with the appropriate engineering units. Hydraulically ideal are flow range end values of approx. 2-3 m/s. In the “Submenu Current Output” select the desired current output range. If the converter includes a passive or active pulse output, select the pulses/unit for the selected units. The pulse width suitable for an external counter or for processing in the converter can be set between 0.100 and 2000 ms.
- When using a serial data link see the separate Document for the ASCII-Protocol or Profibus DP.
- Check the system zero.

The data settings for the parameters and the options included in the instrument can be recorded on the last page of this Instruction Bulletin for service or repair purposes.

9.2 Zero Checks

The system zero of the measurement system is to be set at the converter. The fluid in the flowmeter primary must be at absolute zero flow. The meter tube must be guaranteed full. The parameter "System zero" can be used to manually or automatically adjust the system zero as follows: select the parameter with ENTER, use the DATA or STEP arrow keys to select either manual or automatic and press the ENTER key to initiate the adjustment. During the automatic adjustment the converter counts down from 255 to the actual zero value in the 2nd display line, after which the system zero adjustment is completed. The adjustment requires approx. 20 seconds. Max. frequency is ±50Hz. If these limits are exceeded a correct adjustment cannot be made. Check to make sure that the flowrate is at zero and that the meter tube is completely filled with fluid.

9.3 Detector "Empty Pipe"

During start-up the Detector “Empty pipe” module is to be adjusted to the existing flow conditions. (See Page 20)

9.4 Maintenance / Repair

The flowmeter is essentially maintenance free. An annual check should be conducted of the ambient conditions (air circulation, humidity), seal integrity of the process connections, cable connectors and cover screws, functional reliability of the supply voltage, the lightning protection and the grounds.

The electrodes in the flowmeter primary should be cleaned if the flow indications in the converter for the same flowrate begin to change. As insulating coating will cause the indications to increase while a conductive coating will cause them to decrease.

It the liner, electrodes or magnet coils require repair the flowmeter primary must be returned to the factory in Göttingen, Germany. Please observe the following note.

9.5 Accessories

! Note:

If the flowmeter system is damaged or must be returned to ABB Automation Göttingen, Germany for repair (liner, electrodes coils), please observe the note „Hazardous Material Information“.

! Service Information:

Original replacement parts are to be used when repairing or exchanging individual parts.

⚠ Warning

The electronic components on the circuit boards can be severely damaged by static electricity (observe ESD-Guidelines). Before touching the electronic components be sure that you are statically discharged.

9.5.1 Gaskets

Gaskets are included with the shipment for certain of the flowmeter designs. Leaks will be avoided if only these gaskets are used and properly installed.

For all other flowmeter designs, commercially available gaskets which are compatible with the fluid and temperature should be used (rubber, PTFE, It, EPDM, Silicone, Viton etc.).

! Note:

Wafer design flowmeter primaries are to be installed directly in the pipeline without gaskets.

10. Parameter Setting Overview and Flowmeter Design Options

Meter Location:		TAG-No.:	
Primary Type:		Converter Type	
Order No.:	Instrument No.:	Order No.:	Instrument No.:
Fluid Temp.:		Voltage Supply:	
Liner:	Electrodes:	Excitation Frequency:	Hz
C_{Zero}:	C_{Span}:	System Zero:	

Parameter		Setting Range
Prog. Protection Code		0–255 (0 = factory setting)
Language		German, English, French, Finnish, Spanish, Italian, Dutch, Danish, Swedish
Meter Size:		1/25" – 94" (DN 1 – 2400)
Q_{max}:		0.05 $Range_{max}$ to 1.5 $Range_{max}$
Pulse Factor:		0.01 to 1000 pulses/Eng'g unit
Pulse Width:		0.100 – 2000 ms
Low Flow Cutoff:		0 – 10 % of flow range end value
Damping:		0.125 – 99.99 seconds
Filter:		ON/OFF
Density:		0.01 g/cm^3 – 5.0 g/cm^3
Units Q_{max}:		l/s, l/min, l/h, hl/s, hl/min, hl/h, m^3/s, m^3/min, m^3/h, igps, igpm ,igph, mdg, gpm, gph, bbl/s, bbl/min, bbl/h, bls/day, bls/min, bls/h, kg/s, kg/min, kg/h, t/s, t/min, t/h, g/s, g/min, g/h, ml/s, ml/min, ml/h, Ml/min, Ml/h, Ml/day, lb/s, lb/min, lb/h, uton/min, uton/h, uton/day, kgal/s, kgal/min, kgal/h
Units Totalizer:		l, hl, m^3, igal, gal, mgal, bbl, bls, kg, t, g, ml, Ml, lb, uton, kgal
Max. Alarm		%
Min. Alarm		%
Terminals P1/P2:		Max. Alarm, Min Alarm, Max./Min. Alarm, General Alarm, Empty Pipe, F/R-Signal, No Function, End Contact, FR 1/2
Terminals X1/G2:		External Zero Return, Totalizer Reset, No Function, Start/Stop, FR 1/2
Current Output:		0/4–20 mA, 0/2–10 mA, 0–5 mA, 0–10–20 mA, 4–12–20 mA
I_{out} at Alarm:		0 %, 130 %, 3.6 mA
Detector e. Pipe:		ON/OFF
Alarm e. Pipe:		ON/OFF
I_{out} at e. Pipe:		0 %, 130 %, 3.6 mA
Threshold:		2400 Hz
Adjust e. Pipe:		Software potentiometer value
Totalizer Function		Standard, Difference Totalizer
1st Display Line:		Q (%), Q (Units), Q (mA), Totalizer F/R, Difference Totalizer, Grand Totalizer Qg, Batch Totalizer Q, TAG-Number, Bargraph
2nd Display Line:		Q (%), Q (Units), Q (mA), Totalizer F/R, Difference Totalizer, Grand Totalizer Qg, Batch Totalizer Q, TAG-Number, Bargraph
1st Line Multiplex:		ON/OFF
2nd Line Multiplex:		ON/OFF
Operating Mode:		Standard/Fast, 2 FR auto., 2 FR ext., 2 FR F/R, Preset Totalizer
Flow Direction:		Forward/reverse, forward
Direction Indication:		Standard, opposite
Store data in ext. EEPROM		Yes/No

FR = Flow Range

Contact In-/Output:	❑ Yes	❑ No	
Detector Empty Pipe:	❑ Yes (not with COPA-CM)	❑ No	
Communication:	❑ HART-Protocol	❑ RS 485	❑ Profibus DP
Pulse output:	❑ Active	❑ Passive	
Alarm:	❑ Yes	❑ No	
Agency Approved:	❑ Yes (not with COPA-CM	❑ No	

11. Declaration regarding the contamination of units and components

Unit and component repair and/or service will be carried out only after a fully completely declaration is submitted.

Otherwise the consignment can be rejected. The present declaration may be completed and signed only by authorised and qualified personnel of the operating company.

Customer details:

Company:	
Address:	
Contact person:	Phone:
Fax:	E-Mail:

Unit details:

Type:	Serial no.:
Reason for returning the unit/Description of defect:	

Has this unit been used for working with substances susceptible of causing a hazard or a health risk?

❒ Yes ❒ No

If yes, please specify type of contamination (tick where appropriate).

biologic	❒	caustic/irritating	❒	flammable (highly flammable)	❒
toxic	❒	explosive	❒	other noxious substances	❒
radioactive	❒				

Which substances did the unit come in contact with?

1.

2.

3.

We herewith confirm that the units / parts returned were cleaned and are free from any hazardous and/or noxious substances in accordance with the Hazardous Materials Decree.

Place, Date	Signature and company stamp

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