Operating Instruction
D184B122U02

Electromagnetic Flowmeter FSM4000 with AC Field Technology Converter Model S4

Valid for Software Levels from B.2X
For Flowmeter Primaries:
Models SE21_/SE41F
(OI D184B121U02)



HART® FIELD COMMUNICATIONS PROTOCOL
PROFIBUS
Fieldbus Foundation

ABB

Instrument Designation
S4

Operating Instruction

Part No. D184B122U02

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Manufacturer:

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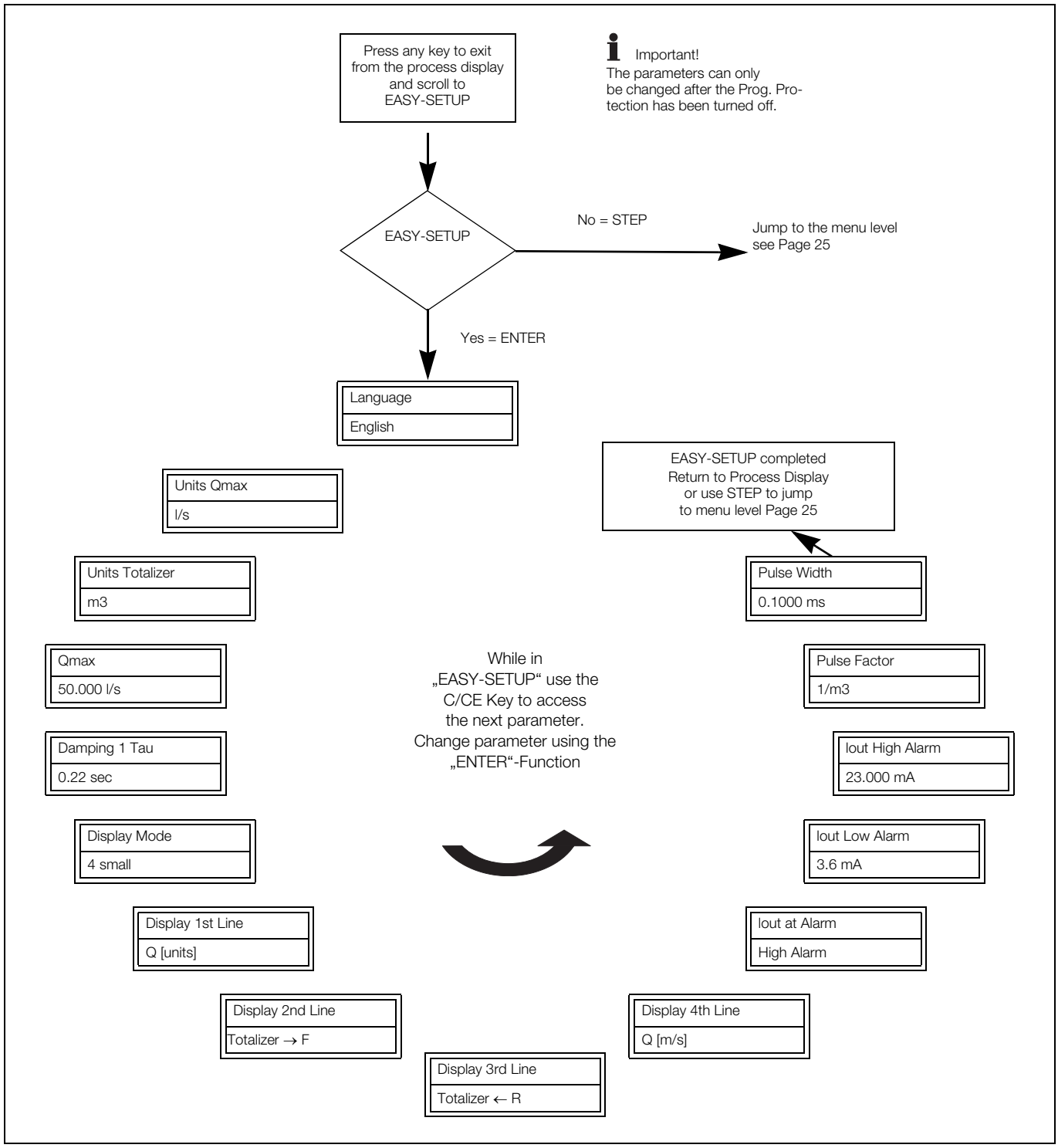
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1 EASY-SETUP, for uncomplicated configuration

The EASY-SETUP function makes it possible to configure the converter for operation in the simplest and quickest possible manner. For additional configuration information, see the detailed descriptions beginning on Page 24.



2 Safety Information

2.1 Basic Safety Requirements

2.1.1 Safety Standards for the Instrument

- This instrument complies with the basic safety requirements and state of the art technology. It was tested and shipped from the factory in a safe operating condition. In order to maintain this condition during operation, the requirements listed in this Operating Instruction must be observed and followed.
- The instruments satisfy all the general safety requirements contained in EN 61010-1 and the EMC-Requirements per EN 61326 as well as the NAMUR-Recommendation NE 21.
- When a power interruption occurs, all instrument parameters are stored in a memory module (see Page 20) . After the power is restored, the instrument is ready for immediate operation .

2.1.2 Regulated Usage

This instrument is used for:

- transporting and metering the flowrate of electrically conductive liquids, slurries or pastes
- measuring the actual volume at operating conditions
- determining the mass flowrate (at constant pressure/temperature) when mass units have been selected

The regulated usages include:

- installation within the specification limits,
- observing and following the information the Operating Instruction.
- observing and following the information in the accompanying documentation (Specifications, Diagrams, Dimensions)

The following usages of the instrument are not permissible:

Repairs, modifications and expansions, and the use of replacement parts is only permissible as specifically described in the Operating Instruction. Extensive activities must be approved by us. Excepted are repairs made in locations authorized by ABB. For unauthorized activities we accept no liability.

The operation and maintenance requirements in this Operating Instruction must be observed.
For damage resulting from improper or non-regulated usage the manufacturer assumes no liability.

2.1.3 Specification Limits

The instrument is to be used exclusively within the limits specified on the factory and type tags and listed in the Operating Instruction. The following limits are to be observed:

- the maximum operating temperatures listed in the instrument specifications should not be exceeded,
- the maximum ambient temperatures listed in the instrument specifications should not be exceeded,
- the allowable test specifications for the supply power (see type tag and Specifications) may not be exceeded.

2.1.4 Safety Marks, Symbols, Type and Factory Tags and CE-Identification

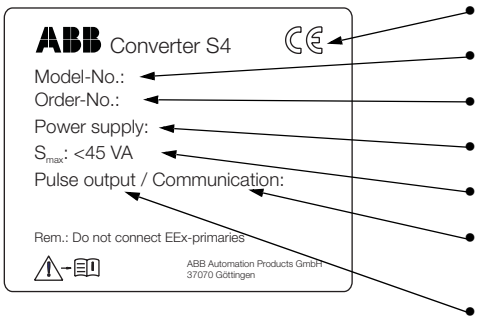
All safety marks, symbols and the factory and type tags should be maintained in a readable state and protected from damage or loss. Note the following generalized information:

STOP	**Warning!**	Information indicating that a risk or danger exists which could result in serious or fatal injuries to personnel.
!	**Attention!**	Information indicating that a dangerous situation may exist. If it is not avoided, the product or an item in its vicinity may be damaged.
i	**Information!**	The symbol „Information“ indicates a user tip or other important information, which if ignored, could result in a loss of operating ease or adversely affect system functionality. (Not an indicator for a dangerous/ damaging situation!) Example: „Written C-Routines for these may be found on the Support Diskette
CE	**CE-Mark**	The CE-Mark identifies compliance of the instrument with the following directives and the fulfillment of the basic safety requirements: • CE-Mark on the type tag (on the converter) – Conformity with the EMC-Directive 89/336/EWG – Conformity with the Low Voltage Directive 73/23/EWG • CE-Mark on the factory tag (on the flowmeter primary) – Conformity with the Pressure Equipment Directive (PED/DGRL) 97/23/EU No CE-Mark is required on pressure equipment when: – the max. allowable pressure (PS) is less than 0.5 bar. – there are minimal pressure risks (meter sizes ≤ DN 25 [1"]). A certification procedure is not required. – the instrument is installed to meter water in the Water/Waste Water sector. Applies to meter sizes >DN 600 / 24”.

2.1.5 Type Tag Specifications

The type tag is located on the converter housing.

The following specifications are contained on the type tag:



- CE-Tag per EU-Conformity
- Model number of the instrument
- Order number
- Supply power– voltage range / frequency
- Power used by the converter and flowmeter primary
- Design variant based on the ordering information with/ without HART-Protocol or PROFIBUS PA
- Design variant based on the ordering information active (24 V- pulse at output) passive (application of 24 V DC at the terminals) (a change between active or passive can be made at the meter location, see Chapter 9.9)

2.1.6 Qualification of Personnel

- The electrical installation, start-up and maintenance of the instrument should only be carried out by trained personnel authorized by the system operator. The personnel must read and understand the Operating Instruction and follow its instructions.

2.1.7 Responsibilities of the Operator

- Observe the national standards in your country applicable to testing the operation, repair and maintenance of electrical instruments.

2.1.8 Possible Dangers During Electrical Installation

The electrical installation is to be completed only by authorized, trained personnel in accordance with the Interconnection Diagrams.

- In particular, observe the information regarding the electrical connections in this Operating Instruction, otherwise the electrical protection type may be adversely affected.
- The installation of the cabling for the supply power should be completed in accordance with the applicable national and international standards. A separate fuse is to connected for each instrument which should be located near the instrument and appropriately identified. The Protection Class of the instrument is in accord with Overvoltage Category II (IEC664).
- The voltage supply and the circuits for the coil excitation in the flowmeter primary are dangerous for personnel contact.
- The excitation and signal circuits may only be connected to the associated flowmeter primary from ABB. The cable D173D147U01included with the shipment is to be used for the excitation circuit (magnet coil supply). Exceptions are the older flowmeter primary models 10D1422, 10DI1425 (≥ DN 500/20”). For these instruments the magnet coils are supplied from the mains (see type tag on the flowmeter primary).
  The signal cable D173D025U01 included with the shipment is to be used for the flow signal connections.
- The remaining signal in-/outputs may only be connected to circuits which are not or cannot become hazardous to personnel contact.
- Earth the flowmeter system and the converter housing.



Warning!

When the housing cover is opened EMC and personnel protection are no longer provided.

Possible dangers during normal operation, inspection or maintenance

- The are circuits in the housing which are dangerous to contact. Therefore, before opening the housing cover the supply power must be turned off.
- Installation and maintenance operations may only be carried out by trained personnel.
- During maintenance only original replaceable parts from ABB may be used.
- The instruments are maintenance free.

2.1.9 Returns

- If it is necessary to return the instrument for repair or recalibration to the ABB factory in Göttingen, Germany, use the original packaging material or a suitably protective packing material. Please include the reason for the return. The flowmeter primary must be free of all hazardous materials (acids, bases, solvents, etc.). Observe the Hazardous Material Directives.

3 Flowmeter Primary and Converter Coordination

Attention!

You are using a flowmeter system designed for AC magnetic field technology. The flowmeter system consists of a flowmeter primary for installation in the pipeline and a remotely mounted converter. To assure proper operation only the Model S4 converter should be used. The complete model number is listed on the type tag.

3.1 Metering System Design

A magnetic flowmeter system is comprised of a flowmeter primary and a converter. The flowmeter primary is installed in the pipeline while the converter for evaluating the flow signals can be mounted locally at the meter location or in a centralized location.

Flowmeter System using AC Magnetic Field Excitation

3.2 Application Areas

The electromagnetic flowmeter provides a precise and economical system for metering the flow liquids, slurries and pastes with an electrical conductivity of at least 20 µS/cm (option 0.5 µS/cm). The measurement system is especially suited for fast changing processes, two phase fluids, continuous or pulsating flows (piston pump operation).

3.3 Model Number Coordination

Flowmeter Primary		Converter
Stn. stl. housing Series 2000 SE21_/SE21F (Flanged)	FSM4000	S4
Older models Series 2000 DS21_/DS21F, 10DS2111	MAG-SM	S4 compatible
Aluminum housing Series 4000 SE41F (Flanged)	FSM4000	S4
Older models Series 3000/4000 DS41F/DS44F, 10DS3111/2, 10DS3121, 10DI1425, 10D1422	MAG-SM	S4 compatible

3.4 Operating Instructions

Flowmeter Primary		Converter
ABB Part No.: D184B121U02	FSM4000	ABB Part No.: D184B122U02

3.5 Condensed Instructions

Assembly and Installation
ABB Part No.: D184B121U11

3.6 Specifications Converter

	FSM4000	ABB Part No.: D184S073U02

4 Assembly and Installation

4.1 Inspection

Before mounting the converter, check for mechanical damage due to improper handling during shipment. All claims for damages are to made promptly to the shipper prior to installation.

4.2 Mounting the Converter

The installation site for the converter must essentially be free of vibrations, see Specifications. The listed ambient temperature limits between -20 °C and +60 °C are to be observed. The max. signal cable length between the converter and the flowmeter primary for the standard design is 50 m, for designs with preamplifiers 200 m may not be exceeded.

Information!

When selecting an installation location assure that the converter is not subjected to direct sunlight. The ambient temperature specifications are to be observed. When it is impossible to avoid direct sunlight, a sun shade is required.

Field Mount Housing

The housing is designed for Protection Class IP 67 (EN 60529). The housing is mounted using 4 screws. Dimensions see Fig. 1.

Exchangeability of the Converter

The function of the converter module for all flowmeter sizes is identical so that it can be exchanged without problems. Check that the supply power and the in- and output functions are the same. After the exchange, the meter location parameters are automatically uploaded into the converter.
See Information Chapter 9.2.

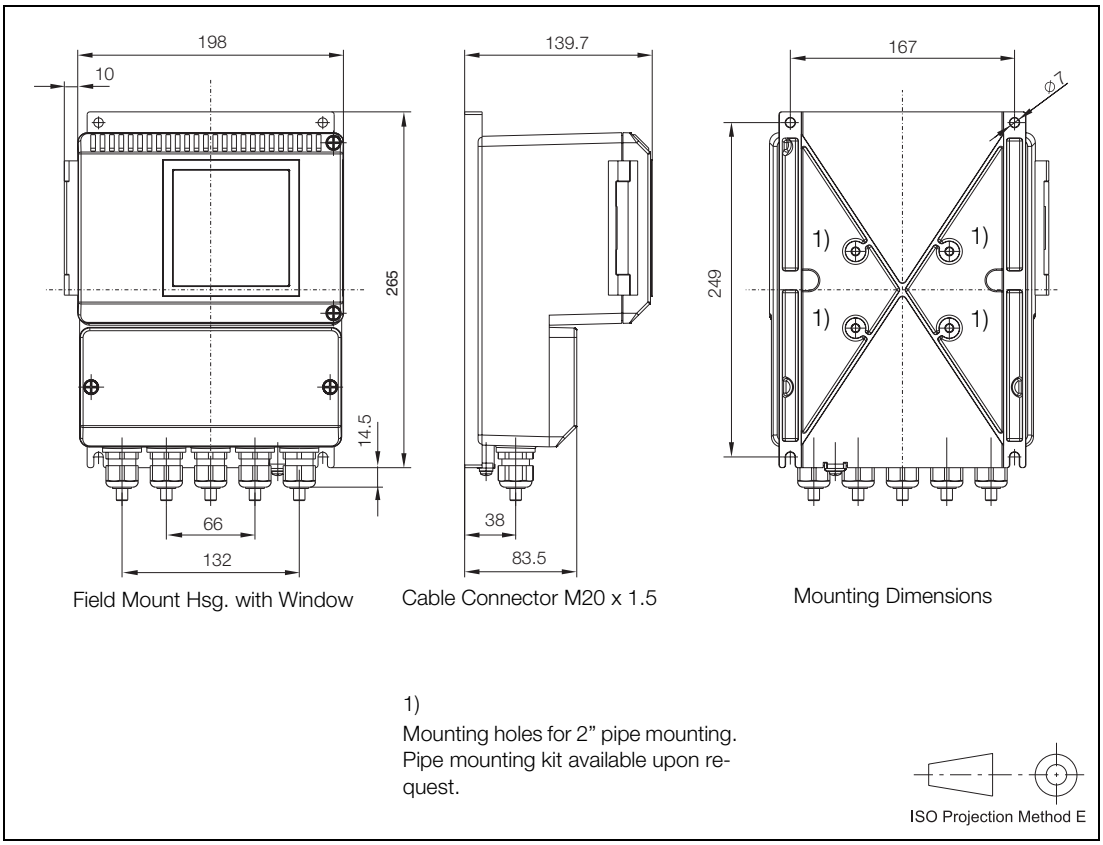


Fig. 1: Dimensions, Converter Housing

4.3 Installation Examples

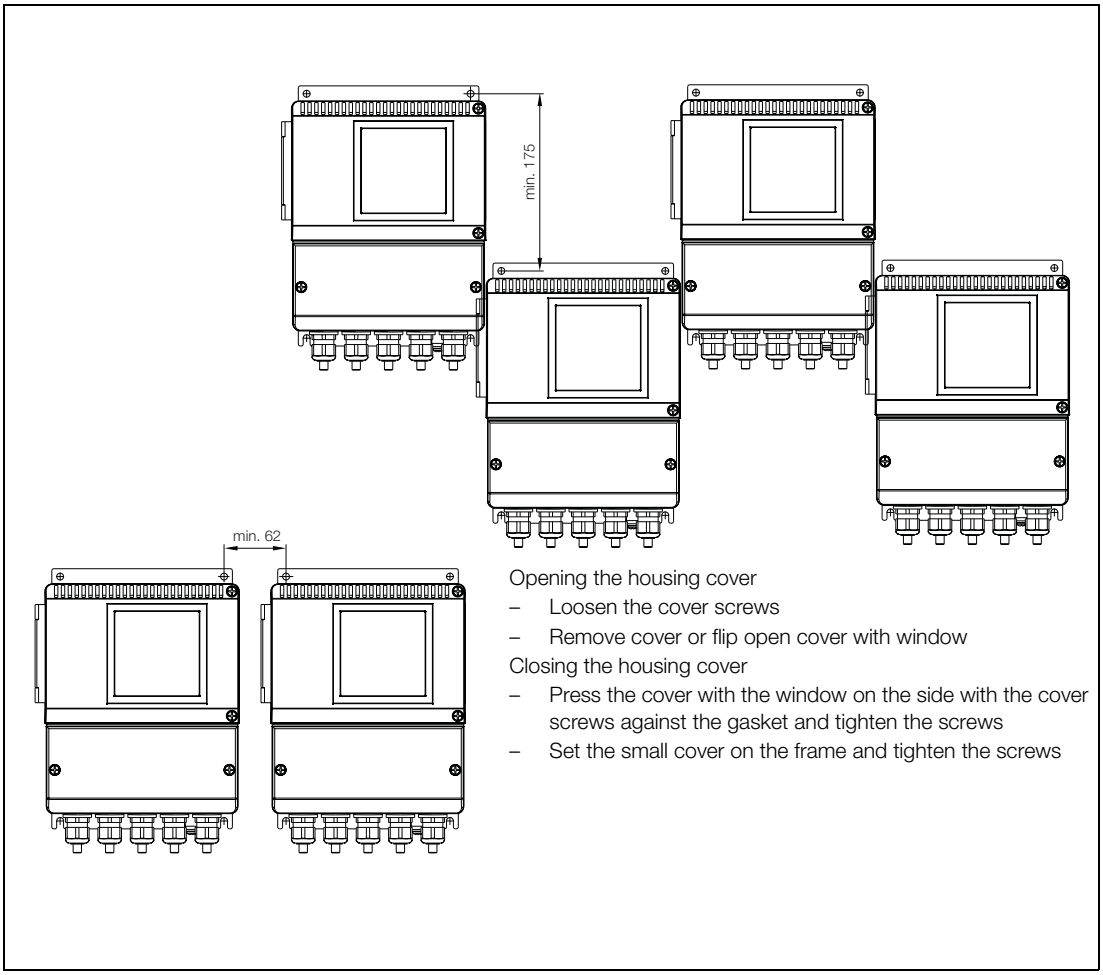


Fig. 2: Mounting Recommendations for Cluster Mounting

5 Electrical Interconnections Converter

5.1 General (Power Usage)

The connection voltage and the current draw is listed on the type tag on the converter. The wire cross section for the supply power and the size of the main fuse to be used must be compatible (VDE 0100). The power usage is ≤ 45 VA (flowmeter primary including the converter).

5.2 Supply Power Connections

The supply power connection, in agreement with the specifications on the type tag is connected to terminals L (Phase), N (Neutral) or 1+, 2- and ⏚. The supply power connection must be sized for the current. The leads must correspond to IEC 227 or IEC 245. A switch or line switch is to be installed in the supply power line, in close proximity to the converter, and identified as belonging to the instrument. The converter and the flowmeter primary are to connected in accord with the international standards to earth ⏚.



Attention!

Observe the limiting values for the supply power (for values see Specifications). The voltage drop for the 24 V AC/DC supply power cable must be taken into account when the cable lengths are long.

The connections are made in accordance with the Interconnection Diagrams beginning on Page 14.

5.3 Magnet Coil Supply

The magnet coils are supplied directly from the converter over terminals M1, M3 using cable (Part No. D173D147U01), shielded 2 x 1.0 mm^2. 10 m are included at no charge with the shipment unless a special order has been requested.

5.4 Signal Cable Connections

The signal cable carries an AC voltage of only a few millivolts and should therefore to be routed over the shortest path. The cables should not be routed in the vicinity of large electrical machinery and switch gear equipment which could induce stray fields, pulses and voltages. The signal cable should not be fed through branch fittings or terminal strips.

The maximum allowable signal cable length for flowmeter primary designs without a preamplifier is 50 m. If the flowmeter primary includes a preamplifier, the maximum signal cable length is 200 m.

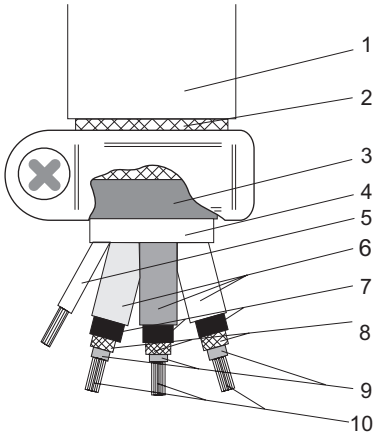
In the cable, a shielded reference voltage cable runs parallel to the signal leads, so only two cables are required to interconnect the flowmeter primary and the converter (signal cable and magnet coil supply cable). The construction of the signal cable includes a aluminium polyester foil (common potential) which surrounds the individually shielded signal leads and the shielded reference leads. A steel outer shield is connected to the terminal on the converter housing. The signal lead shields are operated as “Driven Shields” for the flow signal transmission. The signal/reference voltage cable is connected according the Interconnection Diagram to the flowmeter primary and the converter.

The voltage supply for the FSM4000 with a preamplifier is made over -U and +U, instead of over 1S and 2S. If the actual flow direction does not correspond to the flow direction arrow then leads connected to 1 and 1S must be interchanged with those connected to 2 and 2S. For flowmeter primaries with a preamplifier only the leads connected to terminals 1 and 2 need be interchanged.

The common potential 3 is the same as the common potential of the flowmeter primary, which is connected to earth per VDE 0100.

Important!

The signal cable shields may not contact each other or the outer shields (signal short circuit).



1) Jacket PVC, white, ∅10.3 ± 0.4 mm [0.41" ± 0.02"]
2) Woven steel wire shield, ∅ 0.2 mm, cover sheet 78 %
3) Aluminium polyester foil
4) Inter-coat PVC, white
5) Meas. ground, yellow cu wire ∅ 0.21 mm [0.01"]
6) Electrode and Reference signal
   Electrode 1 red; Electrode 2 blue;
   Reference voltage white
7) 1 each, filter layer conductively black
8) 1 each, woven cu wire shield ∅ 0.1 mm
9) Insulation from Polyolefincopolymer
   natural colored
10) 1 each, woven cu wire ∅ 0.16 mm [0.01"]

Fig. 3: Signal Cable Construction D173D025U01

Important!

The flowmeter system satisfies EN 61326 and the NAMUR-Recommendations NE 21 „Electromagnetic Compatibility of Equipment in Processes and Laboratories". To satisfy these recommendations a new signal cable was developed with a second, separate outer shield. The outer shield to connected to terminal SE on the flowmeter primary and the terminal on the converter.

If the flowmeter primary is an older model (10D1422, 10DI1425, 10DS3111, DS4_, DS2_) and does not have a SE-terminal, then the outer shield is connected only at one end to the converter.

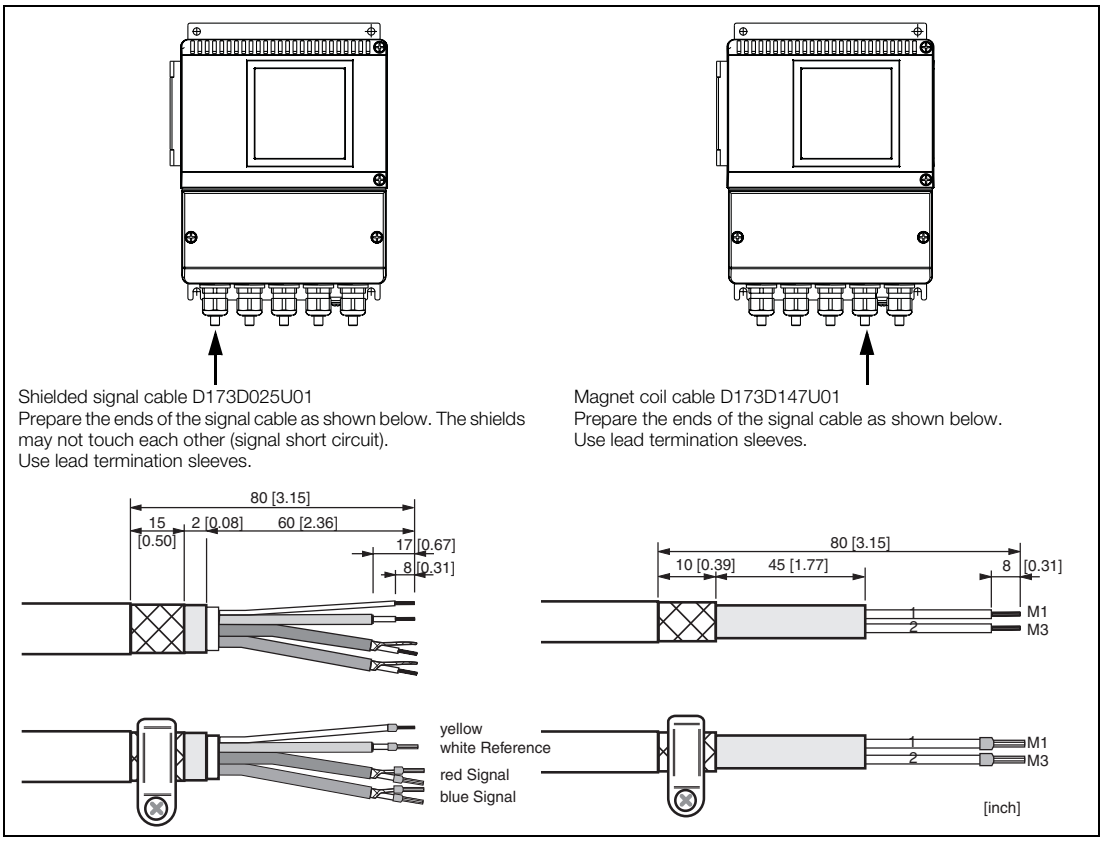
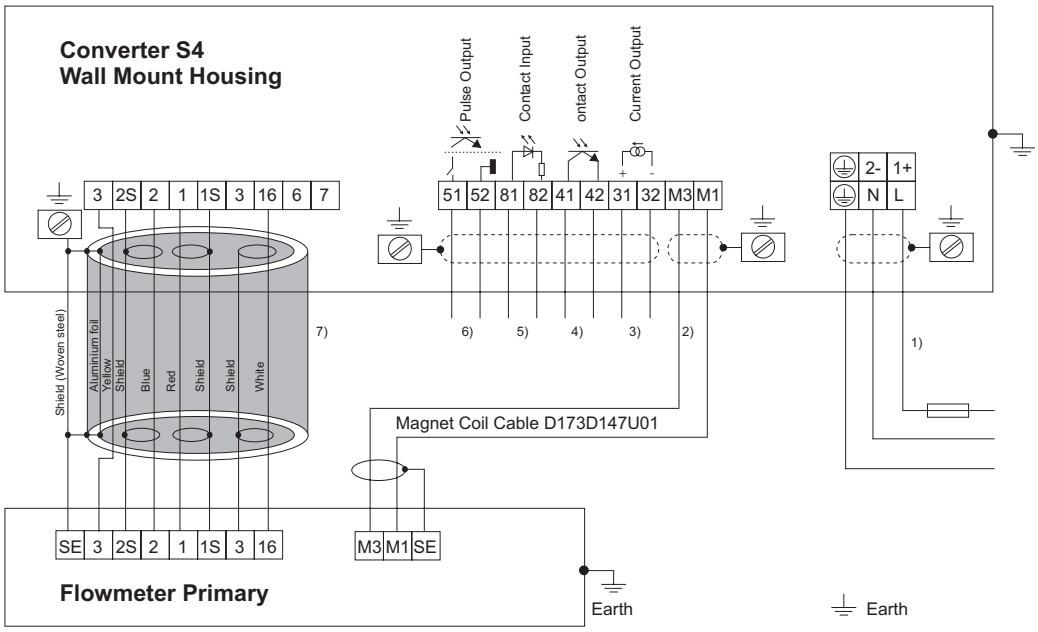


Fig. 4:

5.5 Interconnection Diagrams: Flowmeter Primaries DN 1 - 1000 [1/25” - 40”], Converter Field Mount Housing

5.5.1 Flowmeter Primary Standard DN 10 - 1000 [3/8” - 40”]

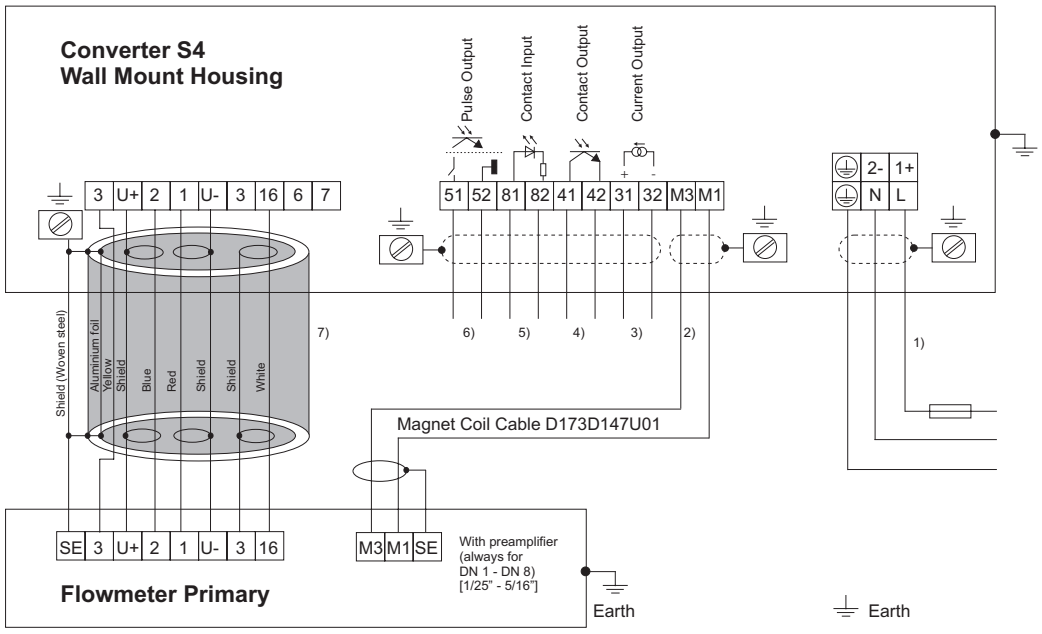


1)	Supply Power	
	High voltage:	AC 100–230 V Terminals L, N, ⏚
	Low voltage:	AC 20.4 to 26.4 V DC 20.4 to 31.2 V Terminals 1+, 2-, ⏚
	Frequency:	47 Hz ≤ f ≤ 53 Hz; 50 Hz supply power 56 Hz ≤ f ≤ 64 Hz, 60 Hz supply power
2)	Magnet Coil Supply:	Shielded 2 x 1 mm² CE Typ 227 TEC 74 ABB Part No. D173D147U01 10 m included in shipment, standard
3) – 6)	Output Cables	See Page 18
7)	Shielded Signal Cable:	ABB Part No. D173D025U01, 10 m included in shipment.

Comment:
We recommend that shielded output cables be used with the shields connected to earth at one end.

Fig. 5: Interconnection Diagram Standard DN 10 to DN 1000 [3/8” to 40”]

5.5.2 Flowmeter Primary with Preamplifier DN 1 to DN 1000 [1/25" to 40"]



Attention!

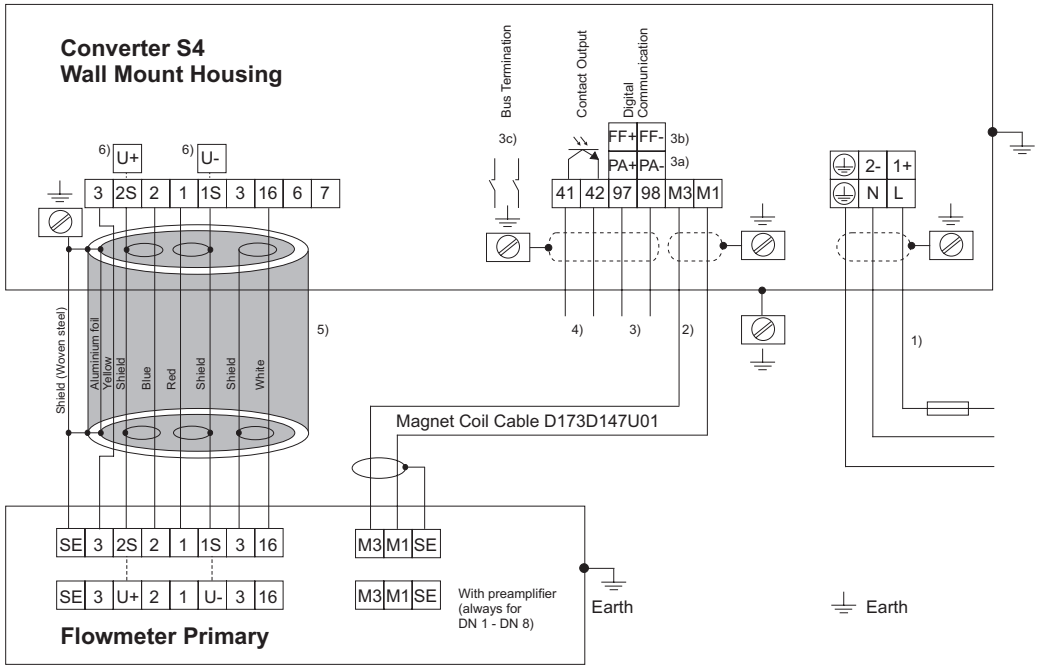
If the flowmeter primary includes a preamplifier for low conductivity of for small flowmeter size DN 1 to DN 8 [1/25" to 5/16"], then the voltage supply ±12 V DC must be connected to the terminals U+ and U- and be connected to the flowmeter primary as well as at the converter.

1)	Supply Power	
	High voltage:	AC 100–230 V Terminals L, N, ⏚
	Low voltage:	AC 20.4 to 26.4 V DC 20.4 to 31.2 V Terminals 1+, 2-, ⏚
	Frequency:	47 Hz ≤ f ≤ 53 Hz; 50 Hz supply power 56 Hz ≤ f ≤ 64 Hz, 60 Hz supply power
2)	Magnet Coil Supply:	Shielded 2 x 1 mm² CE Typ 227 TEC 74 ABB Part No. D173D147U01 10 m included in shipment Standard
3) – 6)	Output Cables	See Page 18
7)	Shielded Signal Cable:	ABB Part No. D173D025U01, 10 m included in shipment.

Comment:
We recommend that shielded output cables be used with the shields connected to earth at one end.

Fig. 6: Interconnection Diagram DN 1 - DN 8[1/25" - 5/16"] and DN 10 - DN 1000 [3/8" - 40"] with Preamplifier

5.5.3 Flowmeter Primary DN 1 to DN 1000 [1/25" - 40"], Converter Field Mount Housing with PROFIBUS PA/FOUNDATION Fieldbus



Attention!

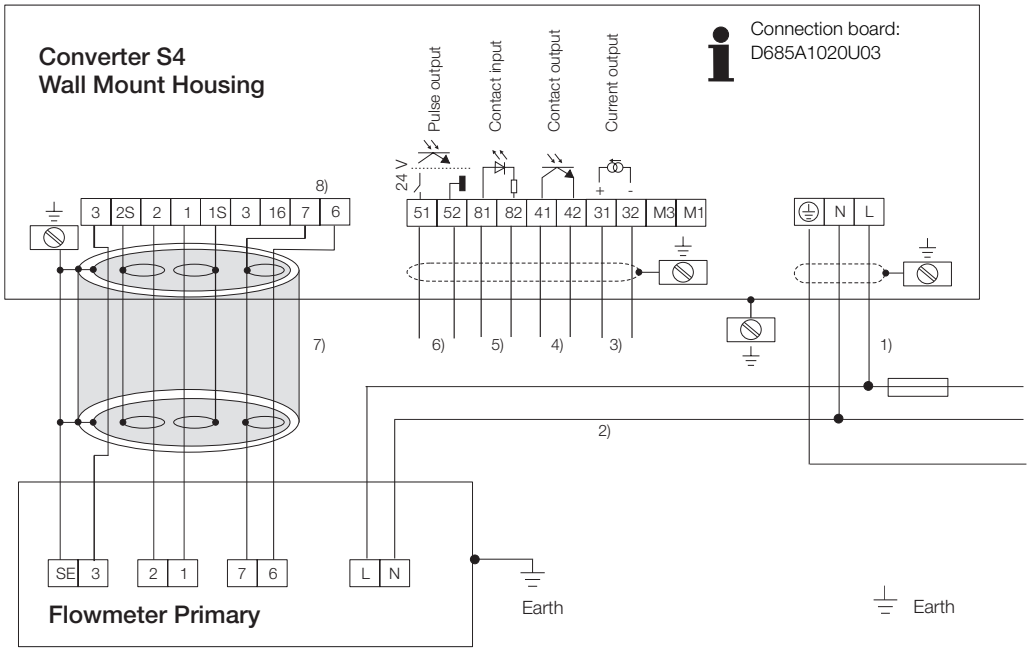
If the flowmeter primary includes a preamplifier for low conductivity of for small flowmeter size DN 1 to DN 8 [1/25" to 5/16"], then the voltage supply ±12 V DC must be connected to the terminals U+ and U- and be connected to the flowmeter primary as well as at the converter.

1)	Supply Power	
	High voltage:	AC 100–230 V Terminals L, N, ⏚
	Low voltage:	AC 20.4 to 26.4 V DC 20.4 to 31.2 V Terminals 1+, 2-, ⏚
	Frequency:	47 Hz ≤ f ≤ 53 Hz; 50 Hz supply power 56 Hz ≤ f ≤ 64 Hz, 60 Hz supply power
2)	Magnet Coil Supply:	Shielded 2 x 1 mm² CE Typ 227 TEC 74 ABB Part No. D173D147U01 10 m included in shipment Standard
3a)	Design: PROFIBUS PA:	PROFIBUS PA per IEC 61158-2 (Profil 3.0) U = 9–32 V, I = 10 mA (normal operation) I = 13 mA (during error condition/FDE) Terminals: 97/98, PA+/PA- For interconnection example using M12 plug see Page 19
3b)	Design: FOUNDATION Fieldbus:	FOUNDATION Fieldbus per IEC 61158-2 U = 9–32 V, I = 10 mA (normal operation) I = 13 mA (during error condition/FDE) Terminals: 97/98, FF+, FF-
3c)	Bus Termination:	Bus termination using installed bus termination components, close hook switches. For interconnection example using M12 plug see Page 19
4)	Contact Output: Function:	Software selectable Passive „closed": 0V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 220 mA „open": 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 2 mA Terminals: 41, 42
5)	Shielded Signal Cable:	ABB Part No. D173D025U01, 10 m included in shipment.
6)	Shielded Signal Cable:	Voltage supply for flowmeter primary with preamplifier Terminals +U, -U instead of 2S and 1S in the standard instrument.

Comment:
We recommend that shielded output cables be used with the shields connected to earth at one end.

Fig. 7: Interconnection Diagram Converter S4 with PROFIBUS PA/FOUNDATION Fieldbus

5.6 Interconnection Diagram: Older Flowmeter Primary DN 3–1000 [1/10”–40”], Converter Field Mount Housing Model 10D1422 (10DI1425, 10DS3111A-D DN 500–1000 [20”– 40”])



Attention!

Check supply voltage and flowmeter primary, see type tag on flowmeter primary. On the connection board in the converter the hook switch S903 must be closed. See Pages 60 and 65.

1)	Supply Power High voltage:	 AC 100–230 V Terminals L, N, ⏚
	Frequency:	47 Hz ≤ f ≤ 53 Hz; 50 Hz Supply Power 56 Hz ≤ f ≤ 64 Hz, 60 Hz Supply Power
2)	Magnet Coil Supply:	Magnet Coil Supply from Supply Power
3) – 6)	Output Cables	see Page 18
7)	Shielded Signal Cable:	Use ABB Part No. D173D025U01 or incorporate into the existing wiring.
8)	Reference Cable:	Only for connection to Model 10D1422 Reference Cable to Terminals: 6,7 and hook switch S903 must be closed.

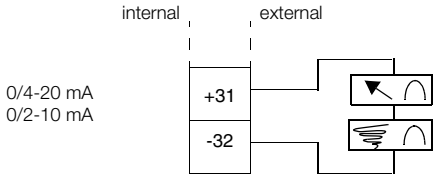
Comment:
We recommend that shielded output cables be used with the shields connected to earth at one end.

Fig. 8: Interconnection Diagram Converter S4 Older Flowmeter Primaries

5.7 Interconnection Examples for Peripherals

Current Output

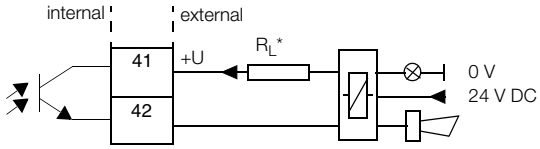
Current output active with/without HART-Protocol (4–20 mA)



3) Current output: software selectable
Function: Active
0/4–20 mA, 0/2–10 mA, 0 Ω ≤ R_L ≤ 560 Ω
Terminals: 31, 32

Contact Output

Contact output for System Monitor, Max.-Min.-Alarm, Empty Pipe or Froward/Reverse Signal



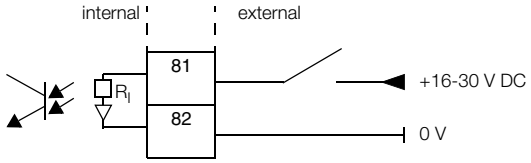
Important:
Horn and alarm lights are only shown as examples. Other suitable alarm instruments; bell, siren, buzzer etc. could be also be used.

4) Contact output: software selectable
Function: Passive
„closed“: 0V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 220 mA
„open“: 16 V ≤ U_{CEH} ≤ 30 V, 0 mA ≤ I_{CEH} ≤ 2 mA
Terminals: 41, 42

$$* R_L \geq \frac{U_{CE}}{I_{CE}}$$

Switch Contact Input

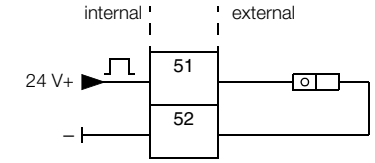
Contact input for external totalizer reset or external zero return



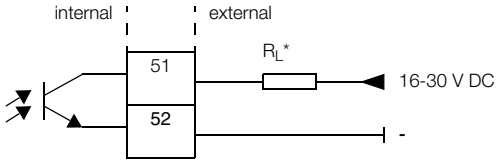
5) Contact input: software selectable
Function: Passive
„On“: 16 V ≤ U_{SM} ≤ 30 V
„Off“: 0 V ≤ U_{SM} ≤ 2 V
R_i = 2 kΩ
Terminals: 81, 82

Pulse Output

Scaled pulse output active



Scaled pulse output passive, optocoupler



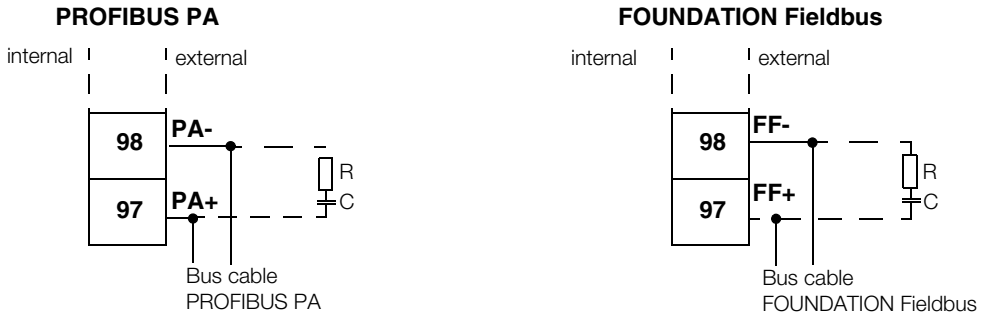
Active/passive selection using jumpers (see Chap. 9.9)

6) Pulse Output: Settable
Function: Active/passive
fmax: 5 kHz, fmin: 1/100 Hz
Setting range: Pulses/unit, pulse width (observe dynamic limits)
„closed“: 16 V ≤ U_{CEH} ≤ 30 V, 2 mA ≤ I_{CEH} ≤ 220 mA
„open“: 0 V ≤ U_{CEL} ≤ 2 V, 0 mA ≤ I_{CEL} ≤ 2 mA
Terminals: 51, 52

$$* R_L \geq \frac{U_{CE}}{I_{CE}}$$

Fig. 9: Interconnection Examples for Peripherals

5.8 Interconnection Examples Peripherals with PROFIBUS PA



The resistance R and the capacitor C form the bus termination. They are to be installed if the instrument is connected at the end of the bus.. R = 100 Ohm; C = 1 µF

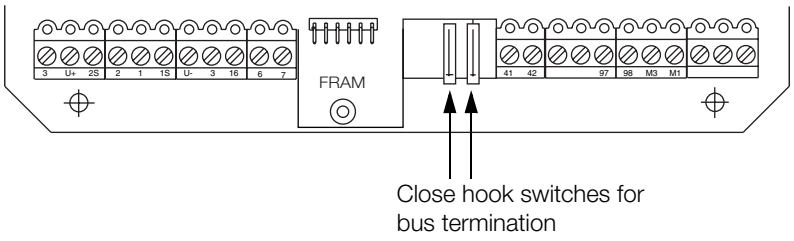
Contact output see Page 18

Bus termination in converter S4

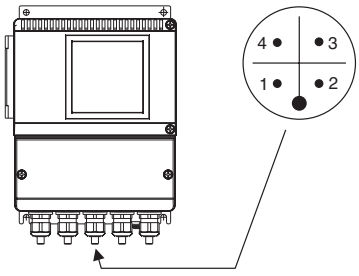
To terminate the bus if the instrument is at the end of the bus cable, the termination components in the converter S4 can be used. To accomplish this, close both hook switches in the connection area of the converter.

Important!

If the converter module is removed, the bus termination is also removed.



Interconnection Example for PROFIBUS PA using M12-Plug (option)



Pin designations
(View from the front onto the pin insert and pins)
PIN 1 = PA+
PIN 2 = nc
PIN 3 = PA-
PIN 4 = Shield

Connections using the M12-Plug (only for PROFIBUS PA design)

As an option, the bus termination can be made using the M12-plug instead of the cable connector (see Ordering Information for the instrument).

The instrument is then shipped completely wired. Suitable receptacles (Type EPG300) together with other accessories may be found in the List Sheet 10/63.6.44DE.

Fig. 10: Interconnection Examples for Peripherals with PROFIBUS PA or FOUNDATION Fieldbus

6 Managing the Data Storage Module

Data Storage Module FRAM (Ferroelectric Nonvolatile Random Access Memory)

When the flowmeter primary and converter are shipped together, the data storage module (external FRAM) is plugged onto the flowmeter primary. Prior to start-up, the ext. FRAM should be plugged into the socket on the connection board in the converter.

If the converter is ordered for use with an older flowmeter primary model (see Model Number), the ext. FRAM is already plugged into the connection board. The text Cs = 100 % and Cz = 0 % is printed on the FRAM. This data is only required for older flowmeter primary models.



External data storage module (FRAM) for flowmeter primaries SE2_, SE4_

i Important!
Plug the data storage module into the socket on the connection board in the converter!

The flowmeter primary data are stored in the data storage module, e.g. meter size, Cs, Cz, Type, etc. After start-up, the parameter settings of the converter are also stored in this module.

Fig. 11:



External data storage module (FRAM)

i Important!
Plug in the FRAM from the associated flowmeter primary (printed on the FRAM are the Order Number and the TAG-No., if this was requested) into the socket (see arrow) and secure by screwing on the protective cover to the connection board.

Fig. 12:

7 Start-up

7.1 Checks Before Turning on the Supply Power

Before start-up of the instrument check that

- the coordination between the flowmeter primary/converter is correct (important for converters with fixed flow range settings, flowmeter primary must be designed for AC technology),
- the wiring was installed correctly in accord with the Interconnection Diagram, see Pages 14 to 19.
- the earth connections of the flowmeter primary were properly made (see Operating Instruction Flowmeter Primary),
- the data storage module (FRAM) from the flowmeter primary was plugged in the connection board in the converter,
- the ambient conditions agree with the limits in the Specification see Page 68,
- the supply power corresponds to the values on the type tag.

7.2 Checks after the Supply Power is Turned On

- that the parameter Primary Type in the converter (for older versions also the excitation frequency) have been correctly entered in the submenu Primary and that the correct Operating Mode has been selected, see Pages 25 and 28.

After Start-up:

- that the flow direction indication in the display agrees with actual flow direction.
  Example:
  → F: Forward
  ← R: Reverse
- that the parameters are configured corresponding to the operating conditions.
- that the System Zero has been adjusted (see Section 7.4 zero adjustment).
- that the contrast setting for the display has been adjusted for the local ambient lighting conditions. In the submenu Display, adjust the contrast using the arrow keys Step/Data.

General Information

- If the flowrate direction indication is incorrect, it is possible to correct the indication by reversing the signal lead connections. Interchange the connections to 1 and 1S with those to 2 and 2S at the flowmeter primary. For flowmeter primaries with preamplifiers (DN 1–DN 8 [1/10"–5/16"]) only the connections to terminals 1 and 2 are to be interchanged, U+ and U- are not interchanged.
- The location of the fuses and their values are shown in Fig. 28 and Fig. 29. (See Pages 60/62)

7.3 Primary Setup

The special menu structure for entering data for an older flowmeter primary model, see Chapter 10.

7.4 Zero Adjustment

During the start-up of an older flowmeter primary model or when checking the system, the zero can be set in the converter after the warm up phase. First the flowrate of the fluid in the flowmeter primary must be at absolute zero. The meter pipe must be completely filled. Then the parameter „System-Zero" in the converter can be used to manually or automatically adjust the zero. Select the parameter with ENTER, select „automatic" with the arrow keys and initiate with the ENTER-key. The adjustment procedure takes approx. 60 seconds and the value should be within the range of ±10%.

7.5 Detector Empty Pipe

It is not necessary to make an adjustment on-site if the DEP mode „Standard" is selected. The converter operates with the standard data settings. If it does not function correctly, then an adjustment must be made on-site with the actual fluid. This adjustment can be made with a full or empty meter pipe.
See Page 30/31.

8 Data Entry

8.1 General Description

The data can be entered in a number of languages using the three keys on the converter. After the power is turned on, the instrument automatically conducts a number of selftest routines. After they have been successfully completed the standard display appears (process information). The variables to be displayed can be selected by the user.

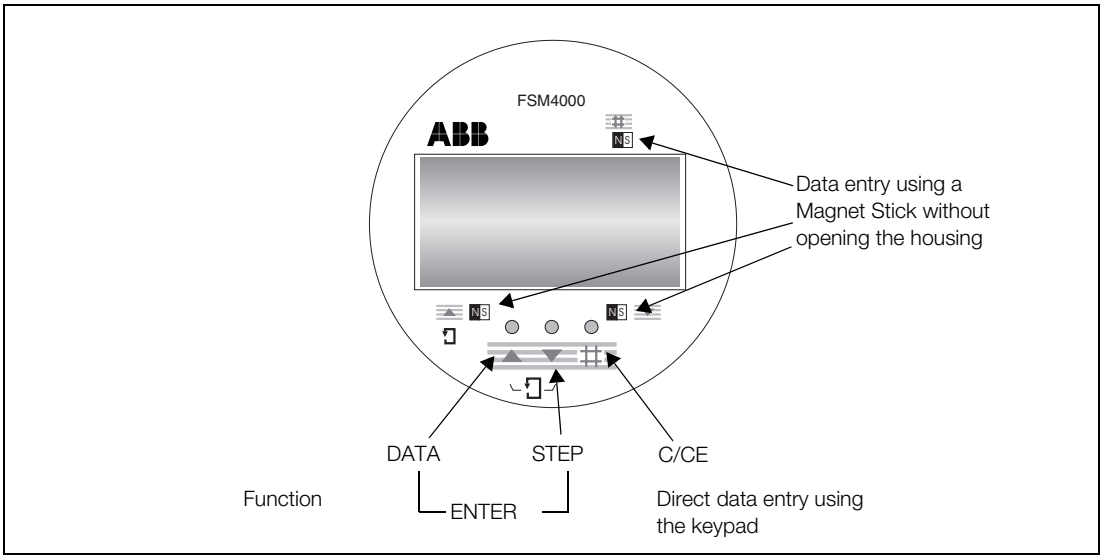


Fig. 13: Converter Keypad and Display

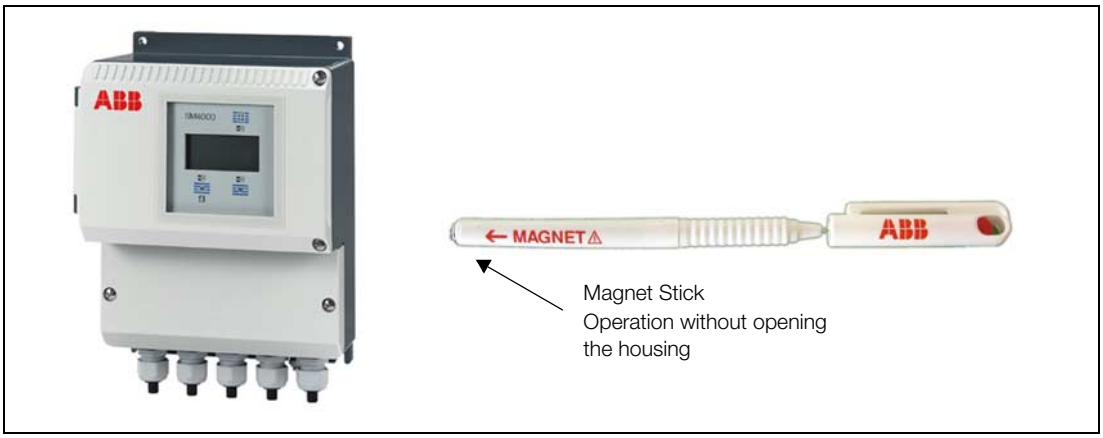


Fig. 14: Magnet Stick Operation

Data can be entered using the Magnet Stick without opening the housing cover.

Important!

If a converter design is used with the tropicalization option – high humidity –, data entry should use the Magnet Stick exclusively.

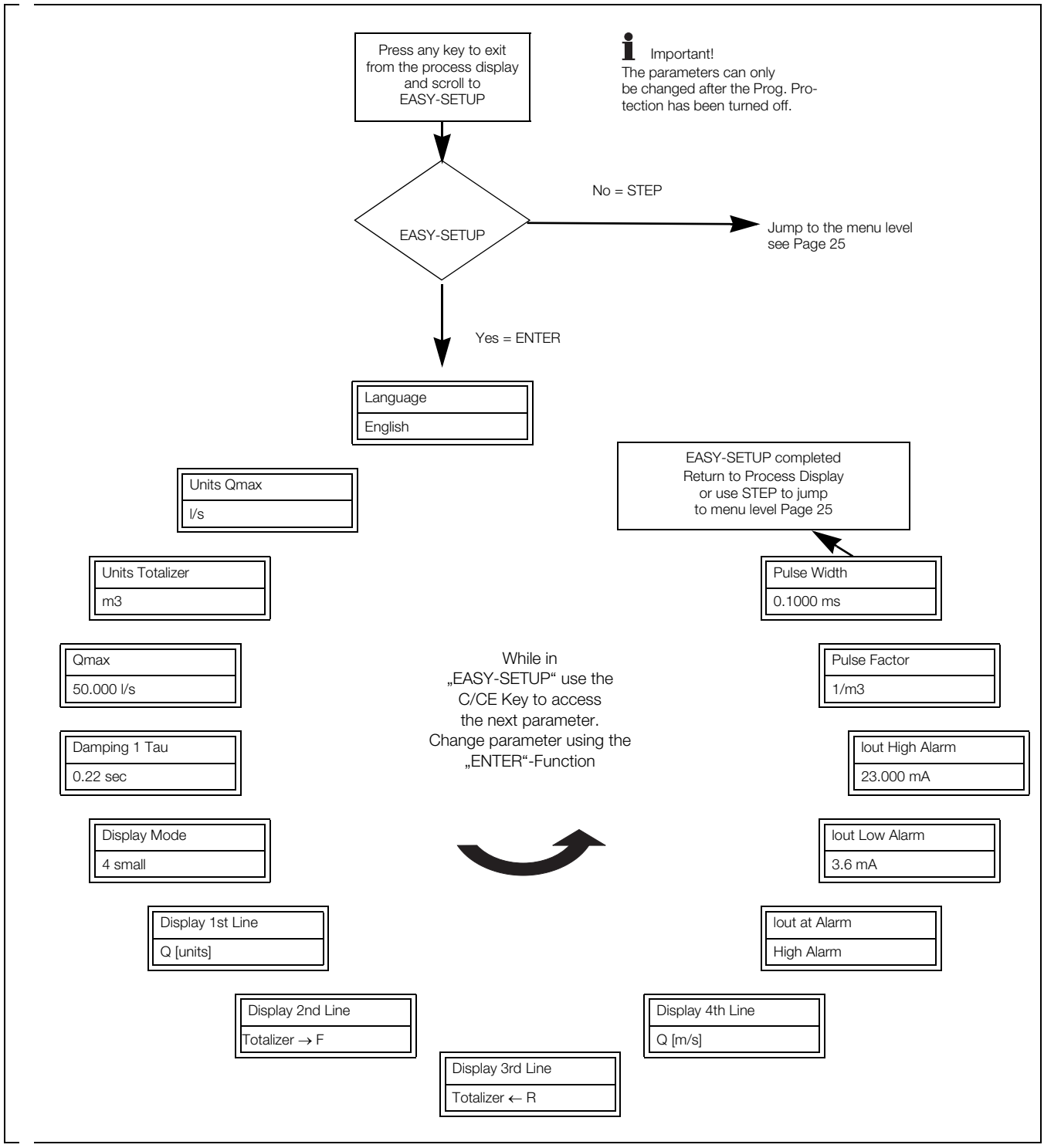
Warning!

When the housing cover is removed EMC and personnel contact protection is no longer provided.

The values can be displayed in a four line format, or for improved readability at the meter location, in a two line format with larger characters. The values to be displayed can be individually selected in the submenu Display. The contrast setting in the submenu Display can be used to adjust the display for the ambient light conditions. During data entry the converter remains online, i.e., the current and pulse outputs continue to indicate the actual flowrate values. During a power outage or when the power is turned off, all parameter settings and totalizer values are securely stored in a FRAM.

8.2 EASY-SETUP, for uncomplicated configuration

The EASY-SETUP function makes it possible to configure the converter for operation simplest and quickest possible manner. For additional configuration information, see the detailed descriptions beginning on Page 24.



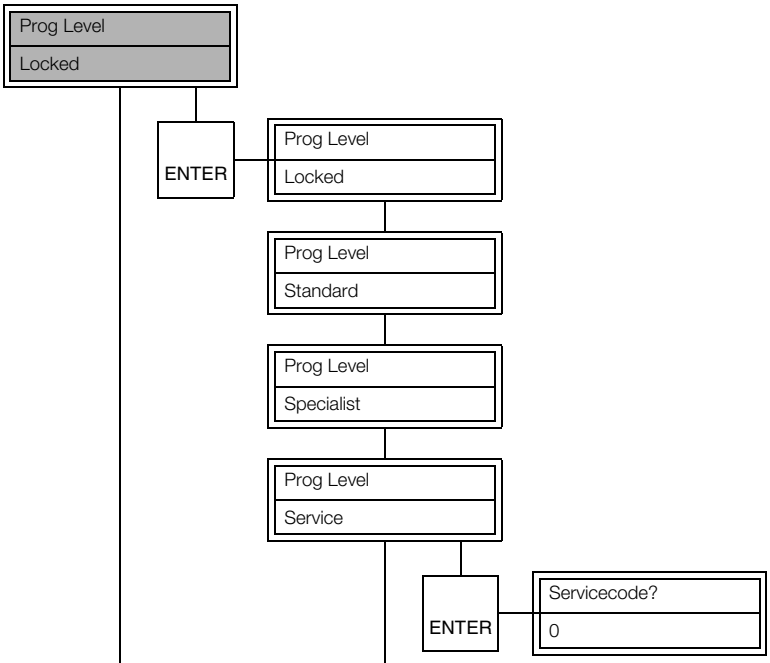
8.3 Parameter Overview and Data Entry

Key	Key Symbol	Magnet Stick	Description
C/CE	#	# N S	The C/CE-key is used to toggle back and forth between the operating mode and the menus. For Magnet Stick operation hold over the NS symbol .
STEP	▼	N S ▼	The STEP-key is used to scroll down through the menus. All desired parameters can be accessed. For Magnet Stick operation hold over the NS symbol.
DATA	▲	▲ N S	The DATA-key is used to scroll up through the menus. For Magnet Stick operation hold over the NS symbol.
ENTER	▼▲ simultaneously ▲ press for an extended time	 ▲ N S	ENTER-Function press both keys simultaneously If only the DATA-key is pressed for an extended time, the ENTER-Function is activated. For Magnet Stick operation hold over the NS symbol for an extended time.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments

Information!

If the converter S4 is used with an older flowmeter primary model, then after pressing any key the menu „Primary Setup“ must be entered. If at a later time it is determined that the entries are incorrect, the entries can be corrected in the Submenu Systemdata „Primary“. See Page 29 and Chapter 10.



"Locked": All entries in the standard menus can read

All standard“ Menus are shaded in gray

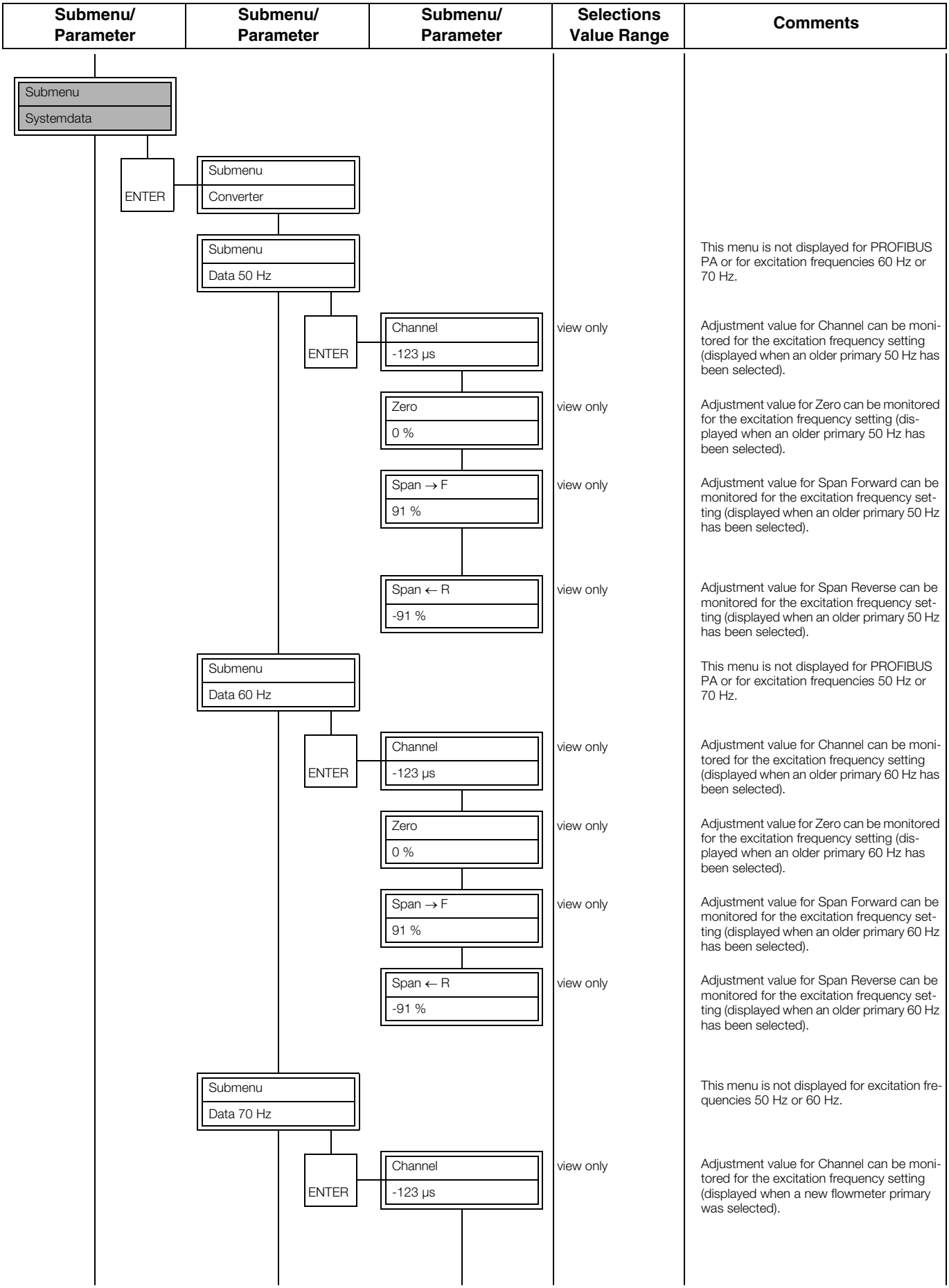
"Standard": Contains all menu entries required to operate the instrument.

"Specialist": Contains all customer accessible menu entries.

"Service": additional menus displayed after the correct Service Code number has been entered, only for ABB Service).

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	Prog Level PP-Code			
	ENTER	Old PP-Code: 0	1–9999	Normally the Prog. Protection Code is equal to "0". If the Prog. Prot. is selected, the question "New PP Code?" is displayed. If a code is entered between (1 and 9999) then an attempt to access the PP Code protected menus by an operator will result in the display of the message ** PP Code ? ** indicating that the operator must enter the correct code before access to the menus is granted. To delete the PP Code it is necessary to access the submenu "PP Code". After pressing ENTER the "Old PP-Code?" is requested. After entering the correct value it is possible in the next submenu "New PP-Code?" to enter a new PP-Code value or by entering "0" to turn off the program protection.
		New PP-Code 0	1–9999	
Submenu EASY SETUP			Language Unit Qv Unit Tv Qmax Damping 1Tau Display mode Display 1st line Display 2nd line Display 3rd line Display 4th line Iout type Iout Low Alarm Iout High Alarm Pulse factor Pulse width	With EASY -SETUP it is possible to configure the metering system for operation using the fewest possible steps. The menus listed to the right are displayed for entry one after the other in "EASY-SETUP". If the selections 1 big, 1 small are selected then the selection menus Display 3rd line, Display 4th line are not displayed. For HART instruments the selection “Iout type” is not displayed. Using ENTER the parameters can be changed one after the other, or if they are not to be changed, the C/CE key can be used to proceed to the next parameter. After making an entry with ENTER the entry can still be changed if necessary by using the ENTER Function and then using the STEP-key to proceed to the next parameter. For numeric entries, the minimum and maximum entry values are also displayed.
	ENTER	EASY SETUP		
Language English			German English French Finish Spanish Italian Dutch Danish Swedish Turkisch	The languages available for the menu display are shown in the “Language” submenu. Menus in the Service Code section use the English language.
	ENTER	Language English		
Submenu Operating mode				
	ENTER	Operating mode Standard	Standard Fast Piston Pump	"Standard": selection used for continuous flow metering. "Fast": accelerated measured value processing (e.g. short batch operation" “Piston Pump”: for pulsating flows. In this operating mode improved reproducibility of the measurements is achieved for pulsating flow in piston pump operation. The totalizer is automatically set for the operating mode Difference Totalizer. Any reverse flow which may occur is automatically deducted from the totalizer value.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	Flow direction Standard		Standard, Invers	Standard/Invers, reverse the flow direction indicators in the display for forward and reverse flow.
	Flow indication Forward/Reverse		Forward/Reverse Forward	When the flow indication "Forward/Reverse" is selected the flow direction is indicated in the display by "→ F" for forward and "← R" for reverse. When the flow indication "Forward" is selected the totalizer only totalizes flow in the forward direction. If the flow should reverse Warning 10 „Reverse Q“ is displayed.
Submenu Unit				
ENTER	Unit totalizer ml		ml; l; m3; ugl; igl; bbl; g; kg; t; lb; Prog. Unit [1] ft3 [2]	Selection of the engineering units for the volume and mass flowrate totalization. When the engineering units for the totalizer are changed, the converter, the flow range, pulse factor and the pulse width (0.1 ms to 2000 ms) are checked and changed when required. The converter first changes the pulse factor and then the pulse width. See Page 66. 1) kgal = factory setting 2) ft3 = added only for PROFIBUS PA
	Unit Qmax l/s		l/s; l/min; l/h; m3/s; m3/min; m3/h; m3/d; usgps; usgpm; usgph; usmgd; igps; igpm; igph; igpd; bbl/s; bbl/m; bbl/h; bbl/d; g/s; g/min, g/h; kg/s; kg/min; kg/h; kg/d; t/min; t/h; t/d; lb/s; lb/min; lb/h; lb/d; ml/s ml/min Prog. Unit/s 1) Prog. Unit/min 1) Prog. Unit/h 1) Prog. Unit/d 1)	Selection of the units for the volume and mass flowrate measurements. The units are used for Cal-fact, Qmax and the instantaneous flowrate display, when Q [unit] is selected as the displayed value. With PROFIBUS PA the following units are also displayed ft^3/s; ft^3/min; ft^3/h; ft^3/d. With PROFIBUS PA Prog. Unit and ml/s units are not available.
	Submenu Prog. Unit			This menu is not displayed for PROFIBUS PA.
	ENTER	Unit name kgal	text entry	Four character name for the user programmable units. 1) kgal = factory setting.
		Unit factor 3785.1	numeric entry	Reference factor for the user programmable units based on liters; default value in for the kgal units (factory setting).
		Prog. Unit without density	without density with density	User programmable unit for mass (with density) or volume (without density).
	Density 1 g/cm3		numeric entry	Density range 0.1 g/cm^3 to 5 g/cm^3. Mass flowrate for display and totalization. The density is only considered when mass flow units are and/or totalizer mass units are selected.


Submenu/ Parameter
Submenu/ Parameter
Submenu/ Parameter
Selections Value Range
Comments
Submenu
Systemdata
ENTER
Submenu
Converter
Submenu
Data 50 Hz
This menu is not displayed for PROFIBUS PA or for excitation frequencies 60 Hz or 70 Hz.
ENTER
Channel
-123 µs
view only
Adjustment value for Channel can be monitored for the excitation frequency setting (displayed when an older primary 50 Hz has been selected).
Zero
0 %
view only
Adjustment value for Zero can be monitored for the excitation frequency setting (displayed when an older primary 50 Hz has been selected).
Span → F
91 %
view only
Adjustment value for Span Forward can be monitored for the excitation frequency setting (displayed when an older primary 50 Hz has been selected).
Span ← R
-91 %
view only
Adjustment value for Span Reverse can be monitored for the excitation frequency setting (displayed when an older primary 50 Hz has been selected).
Submenu
Data 60 Hz
This menu is not displayed for PROFIBUS PA or for excitation frequencies 50 Hz or 70 Hz.
ENTER
Channel
-123 µs
view only
Adjustment value for Channel can be monitored for the excitation frequency setting (displayed when an older primary 60 Hz has been selected).
Zero
0 %
view only
Adjustment value for Zero can be monitored for the excitation frequency setting (displayed when an older primary 60 Hz has been selected).
Span → F
91 %
view only
Adjustment value for Span Forward can be monitored for the excitation frequency setting (displayed when an older primary 60 Hz has been selected).
Span ← R
-91 %
view only
Adjustment value for Span Reverse can be monitored for the excitation frequency setting (displayed when an older primary 60 Hz has been selected).
Submenu
Data 70 Hz
This menu is not displayed for excitation frequencies 50 Hz or 60 Hz.
ENTER
Channel
-123 µs
view only
Adjustment value for Channel can be monitored for the excitation frequency setting (displayed when a new flowmeter primary was selected).

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
		Zero 0 %	view only	Adjustment value for Zero can be monitored for the excitation frequency setting (displayed when a new flowmeter primary was selected).
		Span → F 91 %	view only	Adjustment value for Span Forward can be monitored for the excitation frequency setting (displayed when a new flowmeter primary was selected).
		Span ← R -91 %	view only	Adjustment value for Span Reverse can be monitored for the excitation frequency setting (displayed when a new flowmeter primary was selected).
	Submenu Data Iout			This menu is not displayed for PROFIBUS PA.
	ENTER	Adjust Iout 4 mA 4.0 mA	view only	Display of the converter adjustment value for a current output at 4.0 mA.
		Adjust Iout 20 mA 20.0 mA	view only	Display of the converter adjustment value for a current output at 20.0 mA.
	Submenu Primary			
	ENTER	Primary Type DS2_, DS4_		Display of the connected flowmeter type. The selection is automatically uploaded from the FRAM in the converter. If an older flowmeter primary model (see list) was selected, then a FRAM with Cs = 100%, Cz = 0% must be used. The Models 10D1422 (10DI1425, 10DS3111A-C ≥ DN 500) can only be connected to a special converter connection board designed for these meters. The switch S903 on the connection board must be closed. The other flowmeter models are operated with their assigned FRAM. Therefore, when older model flowmeter primaries are connected to the converter the menu "Primary Setup" is displayed during the initial start-up and in the parameter “Primary” in the Submenu “Systemdata” additional parameter settings can be entered. See also Chapter 10 in the Operating Instruction.
		Mains Frequency 50 Hz	view only	Display of the mains frequency at which the flowmeter primary was calibrated. Displayed only for “Older Model” 50/60 Hz. Not displayed for the newer flowmeter primaries.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
		Meter size 1 mm 1/25 in	view only 1 mm 1/25 in 1.5 mm 1/17 in 2 mm 1/12 in 3 mm 1/10 in 4 mm 5/32 in 6 mm 1/4 in 8 mm 5/16 in 10 mm 3/8 in 15 mm 1/2 in 20 mm 3/4 in 25 mm 1 in 32 mm 1-1/4 in 40 mm 1-1/2 in 50 mm 2 in 65 mm 2-1/2 in 80 mm 3 in 100 mm 4 in 125 mm 5 in 150 mm 6 in 200 mm 8 in 250 mm 10 in 300 mm 12 in 350 mm 14 in 400 mm 16 in 450 mm 18 in 500 mm 20 in 600 mm 24 in 700 mm 28 in 750 mm 30 in 800 mm 32 in 900 mm 36 in 1000 mm 40 in	Display of the flowmeter size. Not displayed when no flowmeter type has been selected (Type of primary = none).
		Span Cs 100.0 %	view only	Flowmeter primary span value Cs. For "Older Model" always 100 %.
		Zero Cz 0.0 %	view only	Flowmeter primary zero value Cz. For "Older Model" always 0 %.
		Phase 90	view only	Phase difference between reference and signal voltages.
		Reference voltage 70 mV	view only	Display of the reference voltage value, for selection "Older Model". Not displayed for Model 10D1422.
		Order Number „----------“	view only	Display of the ABB-Order Number of the flowmeter primary.
		Primary Setup ENTER	Only for selection „Older Model“	Display required for "Older Model". Use ENTER Function and STEP-key to access the parameters: Mains Frequency, Type of Primary, Meter Size, Reference Voltage one after the other and change as required. Not displayed when a newer flowmeter primary model is connected! See also Chapter 10.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
		Mains frequency 50 Hz	view only	Display of the mains frequency for the flowmeter primary. Selections only available for „Older Model“.
		Type of Primary SE2_, SE4_	view only	Display of the type of flowmeter primary connected.
		Meter Size 1 mm 1/25 in	view only	Display of the flowmeter primary size. Selections only available for „Older Model“.
		Reference Voltage 70 mV	view only	Display of the reference voltage value only for „Older Model“, see type tag on the flowmeter primary. Not displayed for Model 10D1422.
Cal-fact 50 m3/h			view only	Display of the max. possible flow range . Automatically selected from the flowmeter size selection.
Qmax 50 m3/h			numeric entry	Flow range end value for forward and reverse flow directions. Flow range end value range can be set between 0.5 and 10 m/s.
Damping 1 τ 1 sec			numeric entry	Response time, after 1τ the displayed value has reached 63% of its actual value (after 5τ). The following values can selected under operating mode: 0.2 to 20 s, Fast/Piston pump 0.07 to 20 s.
Low flow cut off 1.0 %			numeric entry 0–10 % of Qmax	Applies to the values displayed and all outputs. The switch point has a built in hysteresis off 0.1 % .
Submenu Detector e. pipe				**i** Information! Only if the meter pipe is completely filled will a correct measurement be made. The function "Detector empty pipe" can be used to continuously monitor this condition. If the fluid level drops below the electrode level, then all outputs can be automatically set to zero. Thereby erroneous pulses and indications can be avoided when the meter pipe is empty. When the meter pipe is full, the error message „empty pipe“ is turned off and the systems returns to normal operation.
	ENTER	Detector e. pipe Off	Off On	Turn the empty pipe detector on or off. Not available for meter sizes: 1 mm 1/25 in 1.5 mm 1/17 in 2 mm 1/12 in 3 mm 1/10 in 4 mm 5/32 in 6 mm 1/4 in 8 mm 5/16 in **i** Information! Empty pipe detection is not available for flowmeter primaries with preamplifiers.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	DEP Mode Standard		Standard New Adjust	Selection of the function „Standard“ or „New Adjust“. The converter is shipped with the „Standard“ DEP Mode set. For most applications the DEP function will operate satisfactorily in the „Standard“ mode. For all other applications the DEP Mode „New Adjust“ should be selected. The adjustment can be made with a full and/or empty meter pipe. Not displayed when the DEP is turned Off.
	Adj. empty pipe 1000		Manual Automatic	Adjustment value for an empty meter pipe. The pipeline must be empty. After the adjustment has been completed the converter displays the adjustment value and calculates a new threshold value. Not displayed when the DEP is turned Off or the DEP Mode is Standard.
	Adj. full pipe 500		Manual Automatic	Adjustment value for a full meter pipe. The pipeline must be filled. After the adjustment has been completed the converter displays the adjustment value and calculates a new threshold value. Not displayed when the DEP is turned Off or the DEP Mode is Standard.
	Threshold 100000		numeric entry	The threshold value for turning off the "Empty pipe". This value is calculated and entered internally after the adjustment „Empty pipe“ or „Full pipe" is completed. It can also be manually entered (e.g. after both adjustment values (full and empty) were determined and the threshold, based on these values, is to be optimized (the converter always uses the last adjustment value)). The threshold value is the basic criteria used for the DEP function. The adjustment values serve only for the calculation of the threshold value. Not displayed when the DEP is turned Off or the DEP Mode is Standard.
	Alarm e. pipe Off		Off On	If the alarm is turned On, then when the pipe empties the empty pipe contact is actuated. For this to occur, the contact output function „empty pipe“ or „General_Alarm“ must be selected in the submenu „Progr. in/output“. When the function is turned Off, the alarm does not respond. Not displayed when the DEP is turned Off.
	Iout at e. pipe Low Alarm		Low Alarm High Alarm 0%	Setting of the current output value Low or High during an error condition. Not displayed when the DEP is turned Off.
Submenu Display				In this submenu the different values to be displayed for the process display are selected for each individual line. The contrast for the display can also be adjusted to local ambient conditions by pressing the arrow keys.
	ENTER Display mode 1 big, 1 small		1 big, 1 small 4 small	Select 1 big and 1 small or 4 small lines.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	Display 1st line Q [Percent]		Q [Percent]; Q [Unit]; Iout [mA]; Q [m/s]; Q Bargraph Totalizer; Totalizer → F; Totalizer ← R; Totalizer Diff.; HART TAG; Detector e. pipe; Blank line	Selections for the 1st display line
	Display 1st line PA Addr + State			For instruments with PROFIBUS PA there are in other display values available in addition to the following: flowrate in percent, engineering units, m/s, Bargraph, totalizer, totalizer → F, Totalizer ← R, Totalizer Diff., Detector empty pipe: **PA Addr+State** The Bus-Address and the status of the cyclical communication (STOP, CLEAR or OPERATE) are displayed.
	Display 1st line TB VolFlow Value			**TB VolFlow Value** The value for the Volume_Flow (Transducer block Index 17) is displayed.
	Display 1st line TB VolFlow Status			**TB VolFlow Status** The Status of the Volume_Flow (Transducer block Index 17) is displayed.
	Display 1st line TBT→F Value			**TB Total → F Value** The Value of the totalizer → F (Transducer block Index 102) is displayed.
	Display 1st line TBT→F Status			**TB Total → Status** The Status of the totalizer → F (Transducer block Index 102) is displayed. **TB Total ← R Value** The Value of the totalizer ← R (Transducer block Index 104) is displayed. **TB Total ← R Status** The Status of the totalizer ← R (Transducer block Index 104) is displayed. TB **Total Diff Value** The Value of the difference totalizer (Transducer block Index 106) is displayed. **TB Total Diff Status** The Status of the difference totalizer (Transducer block Index 106) is displayed.
	Display 1st line FB AI OUT			**FB AI OUT** The OUT-Value of the AI-Block is displayed. The after the decimal point numbers result from the Decimal-Point in the OUT_SCALE-Structure. The displayed Unit is the UNIT_INDEX from the OUT_SCALE-Structure.
	Display 1st line FB AI Status			**FB AI Status** Here the Actual-Mode of the particular block and the status of the Output-Variables (OUT. Status) is displayed. After the Status, if required, the Substatus is displayed as a number. Example BAD 3 indicates that the Status is BAD, Substatus is 3 = device failure. For descriptions of the number codes see the Data Link documentation.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	Display 1st line FB TOT1 Total			**FB TOT1 Total** Here the Total-Value of the Totalizer-Block is displayed. The displayed unit is the UNIT_TOTAL. **FB TOT1 Status** Here the Actual-Mode of the particular Block and the Status of the Output-Variables (Total. Status) is displayed. After the Status, if required, the Substatus is displayed as a number. Example BAD 3 indicates that the Status is BAD, Substatus is 3 = device failure. **FB TOT2 Total** Here the Total-Value of the Totalizer-Block is displayed. The displayed unit is the UNIT_TOTAL. **FB TOT2 Status** Here the Actual-Mode of the particular Block and the Status of the Output-Variables (Total. Status) is displayed. After the Status, if required, the Substatus is displayed as a number. Example BAD 3 indicates that the Status is BAD, Substatus is 3 = device failure. For descriptions of the number codes see the Data Link documentation.
	Display 1st line FF Adress			For instruments with FOUNDATION Fieldbus there are in other dsiplay values available in addition to the following: Flowrate in percent, engineering units, m/s, Bargraph, totalizer, totalizer >F, totalizer <R, totalizer diff., Detector empty pipe: FF- Adress is shown as hex number.
	Display 1st line TB VolFlowValue			The value or status of the flow (TB Primary_Value, Index 14) is shown.
	Display 1st line TB Total →V Value			The value or status of the totalizer >F (TB Secondary_Value, Index 28) is shown.
	Display 1st line TB Total ←R Value			The value or status of the totalizer <R (TB Third_Value, Index 30) is shown.
	Display 1st line TB TotalDiffValue			The value or status of the totalizer diff. (TB Fourth_Value, Index 31) is shown.
	Display 1st line TB AI1 Out. Value			The value or status of the Out-Parameter from the function block AI1 is shown.
	Display 1st line TB AI2 Out. Value			The value or status of the Out-Parameter from the function block AI2 is shown.
	Display 1st line TB AI3 Out. Value			The value or status of the Out-Parameter from the function block AI3 is shown.
	Display 1st line PID In. Value			The value or status of the In-Parameter from the function block PID is shown.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	Display 1st line PID Out. Value			The value or status of the Out-Parameter from function block PID is shown.
	Display 1st line PID Cas_In. Value			The value or status of the Cas_In-Parameter from function block PID is shown.
	Display 1st line PID FF_Val.Value			The value or status of the FF_Val-Parameter from function block PID is shown.
	Display 1st line PID Trk_Value			The value or status of the Trk_Val-Parameter from function block PID is shown.
	Display 1st line TB VolF GOOD0			**Example:** The Status is shown as text, the sub status as number.
	Display 1st line AI1 Auto GOOD0			For the function blocks the actual mode is shown together with the status.
	Display 2nd line Q [Percent]		same as 1st display line	Selections for the 2nd display line
	Display 3rd line Q [Percent]		same as 1st display line	No selections possible when the display mode is 1 big, 1 small
	Display 4th line Q [Percent]		same as 1st display line	No selections possible when the display mode is 1 big, 1 small
	Contrast			Set the contrast for the display for the local ambient conditions, STEP = darker; DATA = lighter. **i** Information! Adjust the display contrast so that the display always remains readable.
Submenu Alarm				
ENTER	Min. Alarm 0 %		numeric entry 0% – Max. Alarm	Range for the Min. Alarm 0% – Max. Alarm (= flow range setting). Set in 1 % steps, switching hysteresis 1 %.
	Max. Alarm 100 %		numeric entry Min. Alarm – 105%	Range for the Max. Alarm Min. Alarm –105% of the flow range setting. Set in 1 % steps, switching hysteresis 1 %.

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
Submenu Totalizer				The function of the totalizer is automatically set based on the selection in the submenu "Operating mode". Operating mode Standard = totalizer function Standard, Operating mode Piston Pump = totalizer function Difference totalizer. Standard = in the totalizer function Standard the count pulses for the forward and reverse flow directions are integrated on two separate totalizers. If only forward flow metering is selected, then only the forward flow totalizer counts. Difference totalizer = in the totalizer function Difference totalizer a single totalizer is used for both flow directions. For the forward flow direction the totalizer adds the pulses while in the reverse flow direction they are subtracted. If the totalizer value is negative, i.e., the reverse flow totals are greater than the forward flow totals, the flow direction indicator in the display changes from "F" to "R". The pulse output (active or passive) is not affected by this switch.
ENTER	Overflow → F 0		view only	Overflow totalizer max. 65535. 1 overflow = pulse counter 9,999,999 units. The display is reset and the overflow counter incremented by one. Example for overflow: overflow display is 012 = 12 x 10,000,000 units = 120,000,000 units + 23,455 present totalizer value result in the total = 120,023,455 units
	Totalizer → F 0.0 kg/h		numeric entry 0–9999999	Display or entry of the forward totalizer value.
	Overflow ← R 0		view only	Overflow totalizer max. 65535. 1 overflow = pulse counter 9,999,999 units. The display is reset and the overflow counter incremented by one.
	Totalizer ← R 0.0 kg/h		numeric entry 0–9999999	Display or entry of the reverse totalizer value.
	Totalizer reset			The forward/reverse flow totalizer and overflow counters are reset using the ENTER-Function.
	Overflow Diff. 0		view only	Display of the difference totalizer overflows.
	Totalizer Diff. 0.0 kg/h		numeric entry 0–9999999	Display or entry of the difference totalizer value.
Submenu Current Output				This menu is not display for PROFIBUS PA.
ENTER	Current Output 0–20 mA		0–20 mA, 4–20 mA 0–10 mA, 2–10 mA	Selection of the current output range. For HART-Protocol always 4-20 mA.

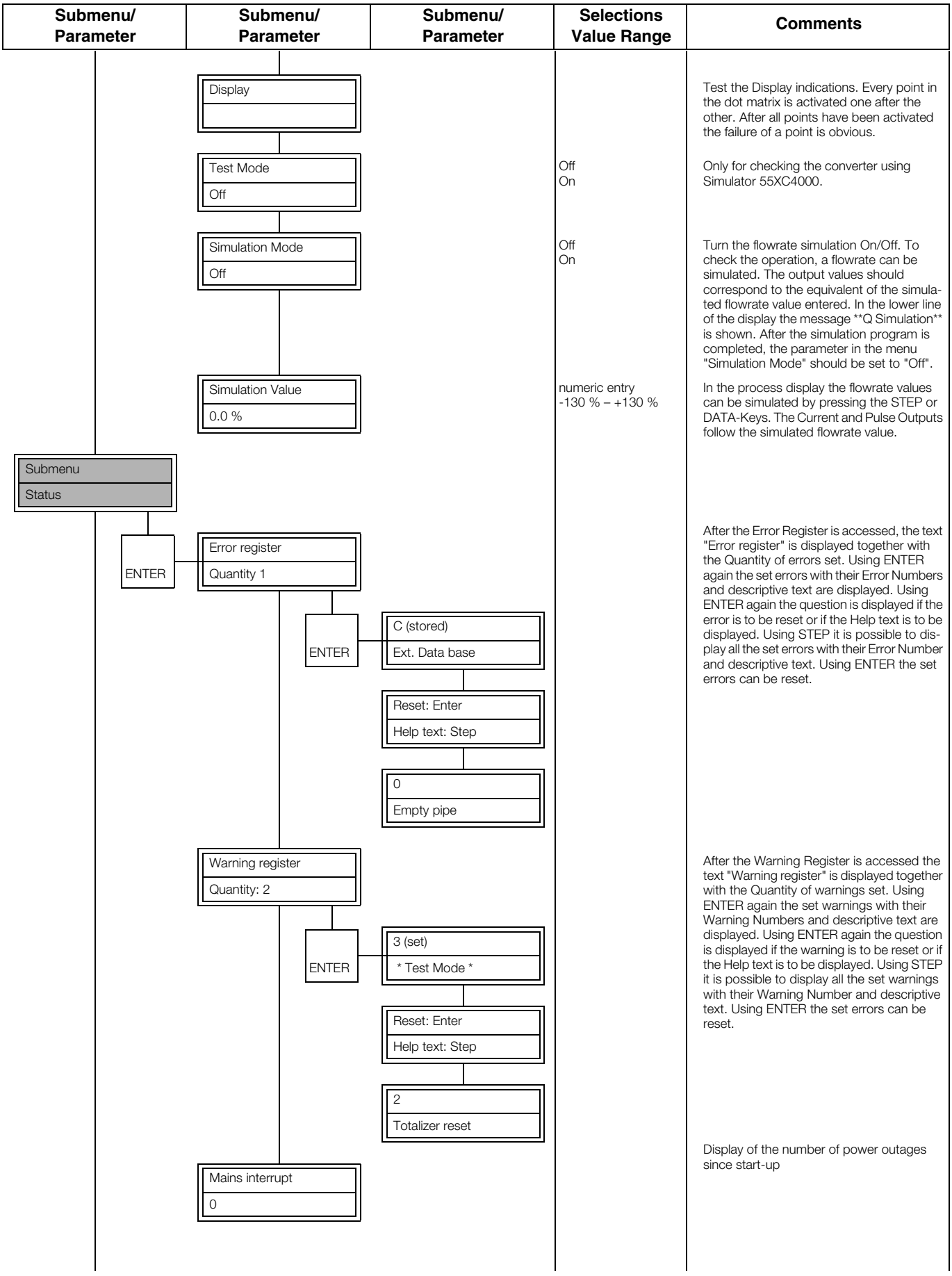
Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	Iout at Alarm Low Alarm		Low Alarm High Alarm	Behavior of the current output during an alarm condition. Low-Alarm is only available for current output selections 2-10 mA and 4-20 mA. If error 0 (empty pipe) occurs, the current output is set to the value programmed for the parameter "Iout at empty pipe" in the submenu "Detector empty pipe". If error 3 (flowrate > 105 %) occurs, the current output is always set to the "High Alarm" value.
	Iout Low Alarm 3.60 mA		numeric entry	Low-Alarm is only available for current output selections 2-10 mA and 4-20 mA. Set the current output value during a Low Alarm condition. No selection is possible when the current output selection Iout High Alarm for Iout at Alarm was made and when the converter version is standard and the current output range is 0-20 mA 0-10 mA
	Iout High Alarm 21.80 mA		numeric entry	Set the current output value during a High Alarm condition. If error 3 (flowrate > 105 %) occurs, the current output is always set to the "High Alarm" value. No selection possible when the current output selection Iout Low Alarm is selected for Iout at Alarm.
Submenu Pulse Output				This menu is not displayed for PROFIBUS PA.
ENTER	Range - Pulse 2.5 m3/h		numeric entry	Expanded flow totalization to the maximum flowrate Cal-Fact. The parameter is only displayed when a flow range smaller than Cal-Fact was programmed.
	Pulse factor 100 l		numeric entry dynamic limits	The dynamic limits for the pulse factor are calculated by the converter, and the pulse factor changed, if necessary, so that the limits are not exceeded. See Page 66.
	Pulse width 0.1 ms		numeric entry dynamic limits	The pulse width can be set only within the limits calculated by the converter. The limits are a function of the value of the pulse factor. The converter must be within the limits from 2000 ms to 0.1 ms. See Page 66.
	Pulse (act/pas) active		view only	Display of the jumper positions "active" or "passive" (See also Page 59).
Submenu Progr. in/output				
ENTER	Contact input No Function		No function Totalizer Reset Zero Return	The contact input function is not displayed for PROFIBUS PA. Assignment of the function for the contact input terminals 81/82. For the selection "Totalizer Reset" the internal totalizer and overflow values are reset when a voltage is applied. For "Zero return" all outputs are turned off when a voltage is applied. Application example: Undefined full pipeline condition when the pumps are turned off or a cyclic cleaning or flushing procedure is initiated during which time flow metering is to be suspended.

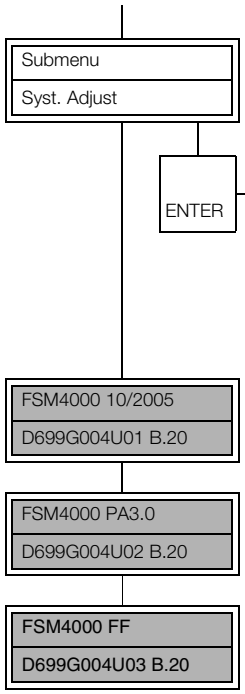
Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	Contact output No function		No function F/R-Signal /_ F/R-Signal __ General-Alarm /_ General-Alarm __ Max/Min Alarm/_ Max/Min Alarm __ Min Alarm /_ Min Alarm __ Max Alarm /_ Max Alarm __ Empty pipe /_ Empty pipe __	The switch status of the Contact Output (Terminals 41/42) can be selected as normally open (/_) or normally closed (_ _). For the "General-Alarm" all detected Errors (0-6, A, B, C, D, F) are signaled over the terminals. If a low flow condition is to be signaled, then "Min-Alarm" should be selected. Similarly a high flow condition is signaled when "Max-Alarm" is selected. If the signal is set for "Max/Min-Alarm" then a signal is sent over the terminals when the flowrate is above or below the range between the "Max-Alarm" value and the "Min-Alarm" value, i.e., when the flowrate is larger than the "Max-Alarm" value or less than the "Min-Alarm" value.
Submenu Label				
ENTER	Actu. Variant Puls active no HART		view only Pulse active no HART Pulse active with HART Pulse passive no HART Pulse passive with PROFIBUS PA FOUNDATION Fieldbus Variant error	Display of the pulse output and communication configuration for the shipped design.
	Primary TAG „----------“		Text entry	A TAG-Number to identify the flowmeter primary max. 32-character can be entered or read.
	Converter TAG „----------“		Text entry	A TAG-Number to identify the converter max. 32-character can be entered or read.
Submenu Data Link				
ENTER	Communication none		Without HART	**1. Communication HART** Set the HART Communication ON or OFF. When HART-Communication is not required, Current Output ranges 0–20, 0–10, 2–10 mA can be selected. For HART-Communication the Current Output range must always be 4-20 mA. No entries possible for Standard instruments (no HART-Hardware).
	Instr. Address 0		numeric entry 0–15	For instruments using the HART-Protocol an Address between 0-15 can be selected. If the Address 0 is entered, then the Current Output varies with flowrate in the range of 4-20 mA. If multiple instruments are connected to the bus and an Address between 1 and 15 is assigned, then the converter operates in the Multidrop-Mode. The Current Output value is then constant at 4 mA. The output values can then only be read using the HART-Communication. Warning 11 is displayed. No entries possible for Standard instruments (no HART-Hardware).

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	HART TAG „HART TAG“		Text entry	A unique instrument identifier using the HART TAG Number. Max 8-character TAG-Number (PCKASCII String). Only capital letters are recognized, no special characters can be used. No entries possible for Standard instruments (no HART-Hardware).
	HART Descriptor „HART Descriptor“		Text entry	Description max. 16-character (PCKASCII String). Only capital letters are recognized, no special characters can be used. No entries possible for Standard instruments (no HART-Hardware).
	HART Date 03.11.2003		Day Month Year	A date can be entered and read here. Not available for Standard instruments (no HART-Hardware).
	PA Address 126		Numeric entry 0–125	**2. Communication PROFIBUS PA** Only available if the Variant PROFIBUS PA was ordered. Display of the Slave Address. Factory setting 126 (valid Addresses 0-125). The PA-Address can be entered using the following functions: Hardware switch (see Section 8.5.2), Bus or the menu PA-Address. The hardware switch setting has the highest priority. An Address set using the hardware switch cannot be changed, either over the Bus or using the menu. If the switch address setting is not active, DIP-Switch 8=OFF, then the Address can be set over the Bus or the menu, but only if cyclic communication is not active.
	DipSwitch 123456789A _ _ _ _ _ _ _ _		view only	Display indicating which DIP-Switches are set (- = OFF, X = ON). If the DIP-Switch 8 = ON: the Address setting can be binary coded using switches 1-7. Switches 9 and A have no function. Example: Set Address 50 using the switches. 50dec=32hex = 110010 binary → DIP-switch 2, 5, 6 and 8 to ON = PA-Address 50. An Address-switch setting change is only recognized after the instrument is rebooted, not if changed during normal operation. Factory setting for the switch is : OFF
	IdentNo Selctor FSM4000 0x078C AI + 2* TOT			Setting the Ident-Number-Selectors. The settings cannot be changed when cyclical operation is not active, only during status STOP. Profile 0x078C: AI + 2* TOT (AI-Block + 2 Totalizer)
	ENTER → IdentNo Selctor Profile 0x9700 AI			Profile 0x9700 (AI-Block)
	IdentNo Selctor profile 0x9740 AI + TOT			Profile 0x9740 (AI-Block + Totalizer)

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
	AI Channel TB Flow Value			Channel setting for the AI-Block. When setting the channel, the Unit for the channel is also copied to the AI-Block (from OUT_SCALE. UNIT_INDEX). Selection: TB (Transducer Block) Flow Value TB Total → F TB Total ← R TB Diff Total
	ENTER	AI Channel TB Total → F		
		AI Channel TB Total ← R		
		AI Channel TB Diff Total		
	TOT 1 Channel TB Flow Value			Channel setting for the Totalizer-Block. Only the selection TB Flow Value available. When setting the channel, the volume or mass Units of the channel are also copied from UNIT_TOT (Example: $m^3/h \rightarrow m^3$). See TOT 1
	TOT 2 Channel TB Flow Value			
	Software Rev. Communication: 0		view only	Display of the Communication Software Revision level.
	FF Adress 0x15 Dev-ID 0003200017_FSM4000_12345			**3. Communication FOUNDATION Fieldbus** The Address and device ID is shown: 000320 = Manufacture-Code ABB, hex 0017 = Device Type Code FSM4000, hex_FSM4000_ = Device-name 12345 = Serial number of instrument expressed as 5-digit decimal figure.
	Dip Switch			Hardware-Switch
	ENTER	Dip Switch 1234567890 1: Sim Enable off 2: Write Prot. off		Inside of the converter unit is a 10 times switch. The switches can be set or reset, when the converter housing is open. The switch setting can be checked on the local display of the device in the submenu data link, menu Dip switch. It can also be read over FF communication in the Transducer block (Index 87). An open switch is shown as -, a closed switch as x. The following switches are occupied: Switch 1 = Simulate Enable off = Simulation Mode disabled on = Simulation Mode enabled Switch 2 = Write Protect off = Simulation Mode disabled on = Write protect enabled. „Simulation Mode enabled“ only allows to make a simulation, but don´t activate the simulation. Simulation is switched on or off within the parameter „Simulate“ (structure on index 9 of AI-block). „Write protect enabled“ prevents writing of block parameters. The switches 3 to 10 have no function.
	Error Mask			This menu shows the mask for the error register (TB index 95).

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
		ENTER → Bitstring 0 ON EF0F0000 / Fehler A Max-Alarm		Line one shows the setting of the Bit (on/off), which is referred by his Bitstring-Number. Line two shows the complete mask as hex number. Line three and four show the meaning of the Bit. Handling: Keys Data and Step to select a Bit, ENTER to switch on/off this Bit. Refer to Error register 9.8.2 and Interface Description part D184B093U32, Page 45.
	Warning Mask			This manu shows the mask for the warning register (TB Index 96).
		ENTER → Bitstring 0 OFF 020000100 / Warnung: 10 Rücklauf Q		Handling same like menu Error Mask. Refer to Error register 9.8.3 and Interface Description part D184B093U32, Page 46.
	Software Rev. Communication / 1			This menu shows the revision of the Communication-part of the software.
Submenu / Self check				**Attention** As soon as a Self Test function is initiated, the converter no longer operates online, i.e. the outputs no longer track the flowrate.
	ENTER → Memory Test			Test the Memory. Internal FRAM, Ext. FRAM and calc. Flash can be interrogated one after the other using the ENTER-Function.
	Pulse Output / 0 Hz		numeric entry	This menu is not displayed for PROFIBUS PA or FOUNDATION Fieldbus Test the Pulse Output. Enter a value in Hz directly. Attention! In the submenu Test, the converter no longer operates online, i.e. the outputs no longer track the flowrate.
	Current Output / 4 mA		0-20 mA, 4-20 mA 0-10 mA, 2-10 mA	This menu is not displayed for PROFIBUS PA or FOUNDATION Fieldbus Test the Current Output. Monitor the displayed value at the connection terminals with a digital voltmeter or the process instrumentation. Entries directly in mA. Attention! In the submenu Test, the converter no longer operates online, i.e. the outputs no longer track the flowrate. No selection possible if the Hart Instrument Address is other than 0.
	Contact input / Off		Off On	This menu is not displayed for PROFIBUS PA or FOUNDATION Fieldbus Test the Contact Input. Before a signal is applied to the Contact Input, the text "Off" is displayed in this menu; after a signal is applied the text "On" is displayed (to check with a the simulator, use the Totalizer Reset key).
	Contact output / Off		Off On	Test the Contact Output. Toggle the value "On"/"Off" - the Contact Output condition (open/closed) follows the settings selected in the parameter "Progr. in/output " - "Contact output".


Submenu/ Parameter
Submenu/ Parameter
Submenu/ Parameter
Selections Value Range
Comments
Display
Test the Display indications. Every point in the dot matrix is activated one after the other. After all points have been activated the failure of a point is obvious.
Test Mode
Off
Off
On
Only for checking the converter using Simulator 55XC4000.
Simulation Mode
Off
Off
On
Turn the flowrate simulation On/Off. To check the operation, a flowrate can be simulated. The output values should correspond to the equivalent of the simulated flowrate value entered. In the lower line of the display the message **Q Simulation** is shown. After the simulation program is completed, the parameter in the menu "Simulation Mode" should be set to "Off".
Simulation Value
0.0 %
numeric entry
-130 % – +130 %
In the process display the flowrate values can be simulated by pressing the STEP or DATA-Keys. The Current and Pulse Outputs follow the simulated flowrate value.
Submenu
Status
ENTER
Error register
Quantity 1
After the Error Register is accessed, the text "Error register" is displayed together with the Quantity of errors set. Using ENTER again the set errors with their Error Numbers and descriptive text are displayed. Using ENTER again the question is displayed if the error is to be reset or if the Help text is to be displayed. Using STEP it is possible to display all the set errors with their Error Number and descriptive text. Using ENTER the set errors can be reset.
ENTER
C (stored)
Ext. Data base
Reset: Enter
Help text: Step
0
Empty pipe
Warning register
Quantity: 2
After the Warning Register is accessed the text "Warning register" is displayed together with the Quantity of warnings set. Using ENTER again the set warnings with their Warning Numbers and descriptive text are displayed. Using ENTER again the question is displayed if the warning is to be reset or if the Help text is to be displayed. Using STEP it is possible to display all the set warnings with their Warning Number and descriptive text. Using ENTER the set errors can be reset.
ENTER
3 (set)
* Test Mode *
Reset: Enter
Help text: Step
2
Totalizer reset
Mains interrupt
0
Display of the number of power outages since start-up

Submenu/ Parameter	Submenu/ Parameter	Submenu/ Parameter	Selections Value Range	Comments
				
			Manual Auto. adjustment	Zero value check if required (required for matching older model flowmeter primaries). Manual entry, e.g. after a converter exchange. Automatic adjustment:Valve must be closed, liquid in flowmeter primary must be at absolute zero flow. Initiate the automatic adjustment with ENTER. The limits for the zero value are ± 10 %. If the value is outside of these limits, the adjustment is rejected.
			numeric entry	
			view only	Display of the software revision. 10/2005 identifies the issue date.B. 20 = Revision level for the Standard and HART-Protocol software.
			view only	Only for software PROFIBUS PA
			view only	Only for software FOUNDATION Fieldbus

8.4 HART®-Communication

8.4.1 HART®-Protocol

HART®-Protocol provides the ability to simultaneously output process variables and to digitally communicate without any added installation expenses. The 4–20 mA current output signal transmits both the process information and the digital signal used to communicate bidirectionally. The analog process value output allows connection to analog indicators, recorders and controllers while the simultaneous digital communication uses HART-Protocol.

The HART-Protocol utilizes Frequency Shift Keyed (FSK) modulation for communication based on the Bell Standard 202. The digital signal is composed of two frequencies 1200 Hz and 2200 Hz, which represent the 1 or 0 bit information.

This design utilizes the HART hard- and software and the 4–20 mA current output. Terminals 31/32 require a load of at least 250 Ω.

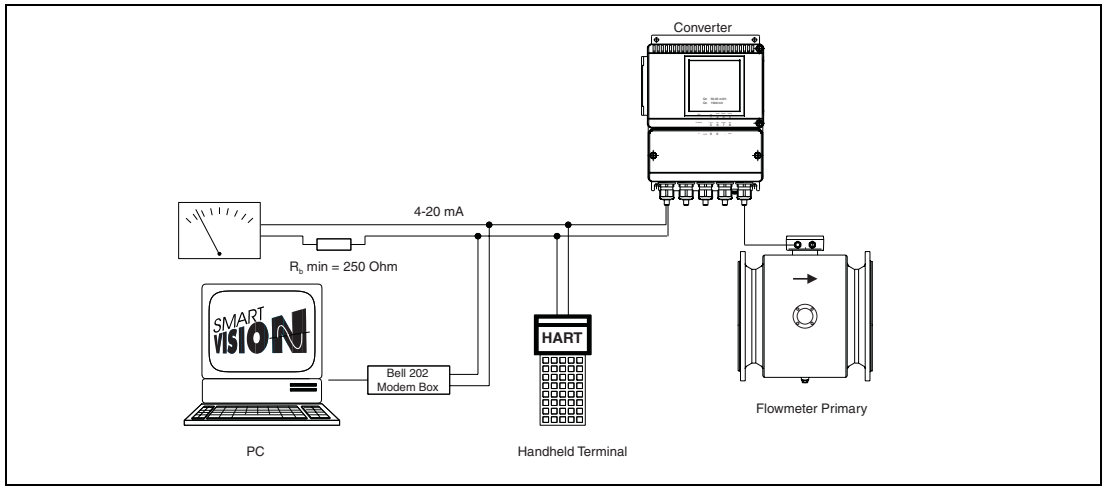


Fig. 15: Communication with HART-Protocol

A FSK-Modem must be installed for HART-Communication when connecting to a PC. The HART-Modem converts the analog 4–20 mA signal into a digital output signal per the Bell 202 Standard with a RS 232C output to the PC.

The SM4000 can also be configured and accessed using a handheld terminal Type 275. The connection is made in parallel with the 4–20 mA current output. Please see the Operating Instruction for the Handheld Terminal for details.

The software program SMART VISION from ABB can be used in the control room or the service area to monitor and evaluate the data from field instruments utilizing the HART-Protocol. The SMART VISION program includes the ability to configure and display the process relevant variables with a periodic self monitoring function to check the connected field instruments.

8.4.2 Software SMART VISION ®

General Description

SMART VISION ® is a universal and intuitive graphic Management Software for use with intelligent field instruments.

SMART VISION ® communicates with all HART-capable instruments within the extent of the „universal“ and „common practice“ HART-Commands. For ABB-instruments, the manufacturer specific commands are also supported, so that the entire functional range of the instruments can be utilized.

SMART VISION ® supports both HART- and PROFIBUS-DTMs as well as all other PROFIBUS instruments within the framework of Profile Specification 2.0/3.0.

Application Spectrum

- Configuration and setting parameters in field instruments.
- Diagnosis of instruments, access status messages.
- Visual overview of the instruments connected to the system using a picture of the connections.
- Storage/management of instrument data.
- Instrument measurement site planning and management
- Online display of instrument data (measurement values, diagnostics, configuration/parameter and status information) in multi visual form.

PC-/ Notebook Requirements

Minimum Requirements

– Intel-Pentium II Processor 233 MHz or compatible
– 64 MB RAM memory
– 50 MB free hard drive capacity
– Microsoft Windows 95, NT 4.0 with Service Pack 5
– Internet Explorer 5.0

Recommended Components

– Intel-Pentium III-Processor 450 MHz or compatible
– 128 MB RAM memory
– 50 MB free hard drive capacity
– Windows NT 4.0 with Service Pack 5 or 6a
– Internet Explorer 5

Functionality/Special Features

Management

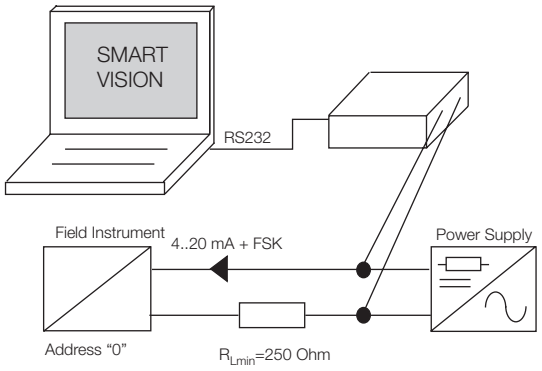
– Management of instruments and networks in projects.
– Defining projects using the graphic interactive project editor.
– Assignment of meter location names in the project editor.
– Automatic assignment of meter location names/instrument addresses and multiplexer channels.
– Instrument selection/access by simply clicking the instrument in the project.
– Instrument recognition using the instrument tag number or address.
– Simultaneous communication with multiple field instruments.
– Scan a Contrans I-Bus connection for connected HART-instruments.

Information!

The complete SMART VISION program version is available for a 90 day free evaluation without a license. This also applies to all DTM‘s. When this time period, beginning at start-up, has expired and a license has not been obtained, the software will no longer be functional.

8.4.3 Interconnection Options HART

a) „Point-to-Point“ Using a FSK-Modem (Notebook/Desktop)



SMART VISION

HART-FSK-Modem

Galvanic isolation, Ex-Protection [EEx ib] incl. connection cable 4/2 mm and 4/4 mm

or

HART-FSK-Modem

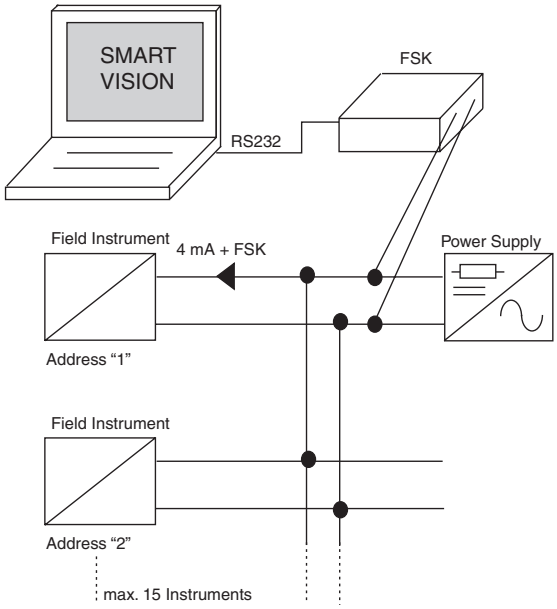
Clip on version, Galvanic isolation with alligator clips

Information!

For operation as a network component a 250 Ω resistor is to be connected in series.

Fig. 16: Connections „Point to Point“

b) „Multidrop“ Using a FSK-Modem (Notebook/Desktop)



SMART VISION

HART-FSK-Modem

Galvanic isolation, Ex-Protection [EEx ib] incl. connection cable 4/2 mm and 4/4 mm

or

HART-FSK-Modem

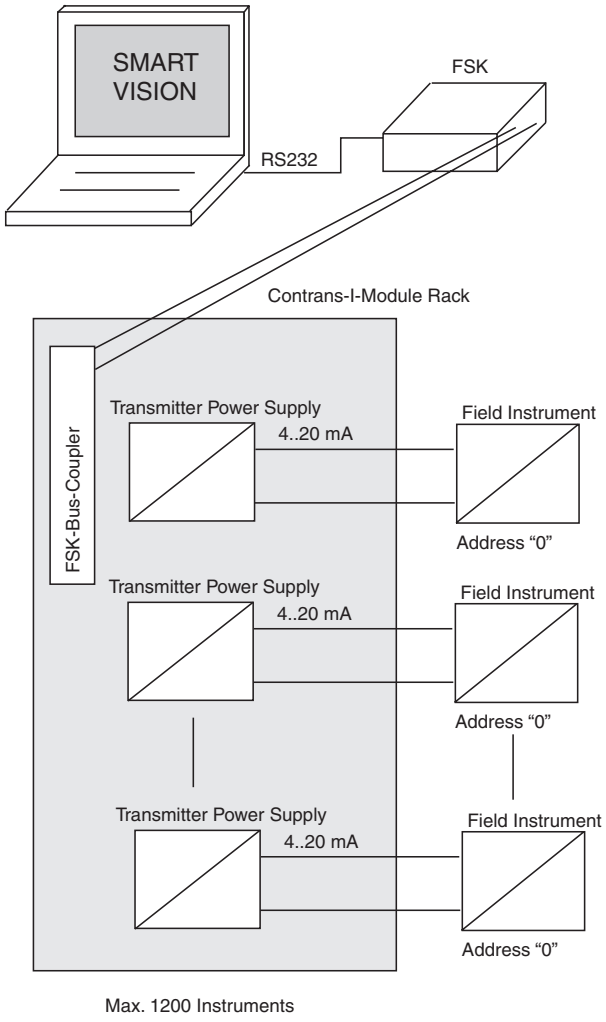
Clip on version, Galvanic isolation with alligator clips

Information!

To operate in the Multidrop-Mode, all field instrument addresses must not be set to 0. The current is thereby fixed at 4 mA.

Fig. 17: Connections „Multidrop Mode“

c) „Contrans I“ Using FSK-Modem (Notebook/Desktop)



SMART VISION

HART-FSK-Modem

Galvanic isolation, Ex-Protection [EEx ib] incl. connection cable 4/2 mm and 4/4 mm

or

HART-FSK-Modem

Clip on version,
Galvanic isolation with alligator clips

Module mount 8 unit

8 plug in locations for Contrans I-Modules. Isolation protection of the supply power, modules and signal circuit. Process up to 16 Ex- or Non-Ex signals

or

Module Rack 16unit / 21 unit

16/21 plug in locations for Contrans I-Modules. Isolation protection of the supply power, modules and signal circuit. Process up to 31/42 Ex- or Non-Ex signals, redundant power supply with alarm contact.

FSK-Bus-Coupler for 16, 21, 32 channels

FSK-Bus design with Contrans I-Modules in a module rack, bidirectional transmission of the FSK signals per HART-Protocol, economical, centralized operation, communication with intelligent field instruments using SMART VISION.

Fig. 18: Connections Using „Contrans I“

8.5 PROFIBUS PA

This section of the Operating Instruction contains information for the converter with the Communication PROFIBUS PA option.

The converter is designed to be connected to a Segment Coupler DP/PA as well as the ABB Multibarrier MB204.

The PROFIBUS PA data link in the FSM4000 conforms to Profile 3.0 (Fieldbus Standard PROFIBUS, EN 50170, alias DIN 19245[PRO91]). The transmission signal of the converter corresponds to the IEC 61158-2 requirements. The manufacturer specific PROFIBUS PA Ident-No. for the FSM4000 is: 078C hex.

The instrument can also be operated using PROFIBUS Standard Ident Numbers 9700 hex and 9740 hex.

8.5.1 Layout and Design Information

The following picture shows a typical PROFIBUS PA-Network.

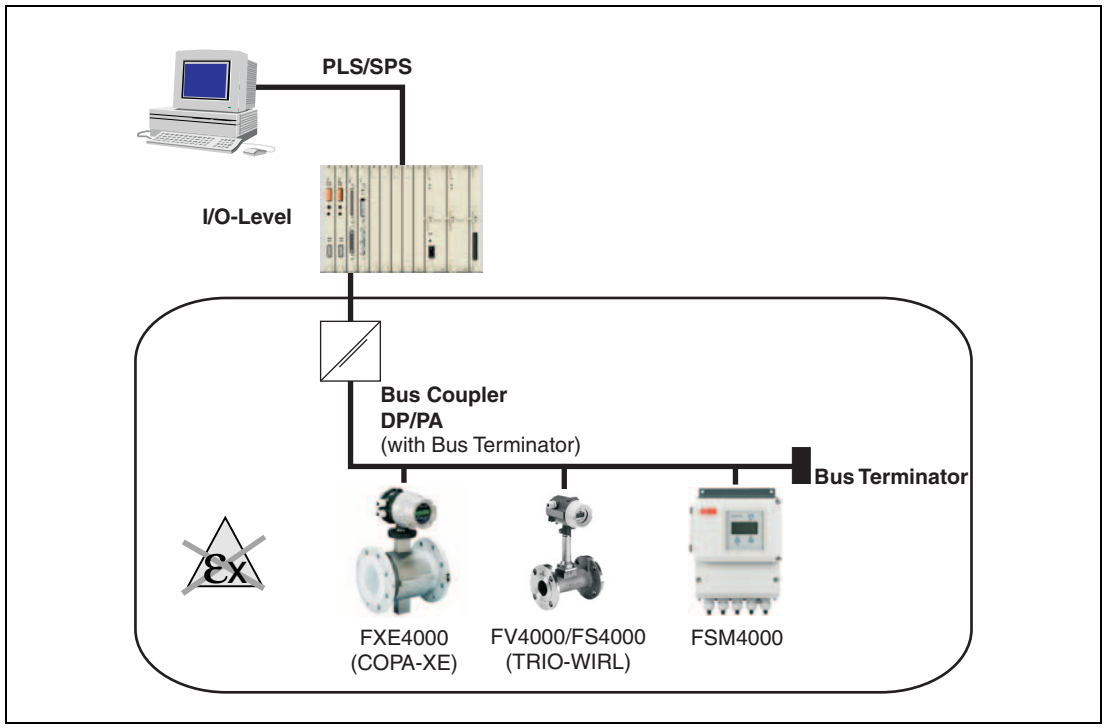


Fig. 19: Typical PROFIBUS PA-Network

A shielded twisted cable is recommended (based on IEC 61158-2, Type A or B is preferred).

Additional detailed layout and design information may be found in the Brochure "PROFIBUS - Solutions from ABB" (No.30/FB-10). Accessories such as splitters, connectors and cables may be found in List Sheet 10/63-6.44. Additional information is available on the PROFIBUS Organization home web page at http://www.profibus.com.

8.5.2 Setting the Bus-Address for PROFIBUS PA

If no customer requirements regarding the bus address were made when the order was placed, the instrument was set at the factory to "126". The Address must be reset during start-up of the FSM 4000 to a number in the valid range (0 - 125). An Address may only be used once in a segment.

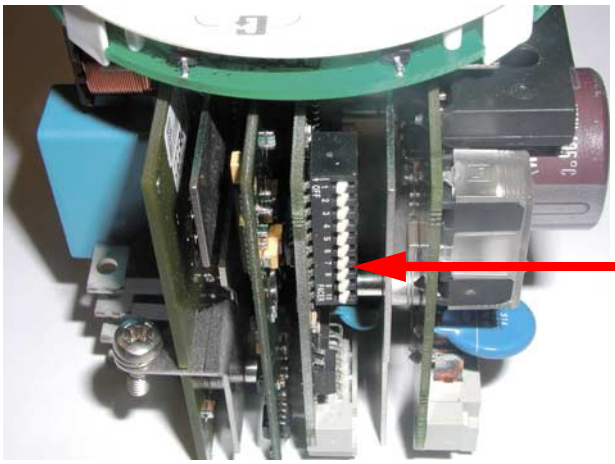
The are three methods for setting the PA-Address:

- Hardware switches (in the converter)
- Bus communication
- Menu "Slave Address" (in submenu "Data Link")

There is a hardware switch in the converter. It is not visible from the outside. The switch settings can be read in the menu “Data Link” or using the communication in the Transducer Block. Before opening the housing cover the supply power must be turned off. To change the switch settings, loosen the screws on the housing cover. The hardware switches are accessible when the housing cover is opened. See Fig. 20. After the supply power is turned on again the hardware switch Address settings will be recognized by the computer.

Alternately, the Address can also be changed during normal operation using the menus accessed by pressing the buttons on the display board of the converter.

The hardware switch setting has the highest priority. An Address set using the hardware switch cannot be changed, either over the Bus or using the menu. If the switch address setting is not active, DIP-Switch 8=OFF, then the Address can be set over the Bus or the menu, but only if cyclic communication is not active.



Example for Address switch settings (Switch 8 = On):
Switches 1, 5, 7 = ON = 1 + 16 + 64 = Bus address 81

Switch	1	2	3	4	5	6	7	8	9	A
Status	**Instrument Address**							Address Mode	No Function	No Function
OFF	0	0	0	0	0	0	0	Bus	No Function	No Function
ON	1	2	4	8	16	32	64	Local	No Function	No Function

Assignments for switches 1 to 7:
PROFIBUS PA Address
Switch 8:
Defines the Address Setting Mode:
Off = Set Address using the Bus (factory setting)
On = Set Address using the DIP-Switches 1–7
Factory switch setting is: 0000000000

Fig. 20: Setting Address for PROFIBUS PA

8.5.3 Information for Voltage / Current Usage

The average current usage by the FSM4000 on the bus is 10 mA. During a fault condition the FDE-Function (Fault Disconnection Electronic) integrated in the instrument assures that the current usage cannot exceed 13 mA. The upper value of the current is electronically limited. The voltage on the bus must be within the range of 9–32 Volt DC.

8.5.4 System Installation

The use of PROFIBUS-PA Profile B, V3.0 assures that the instrument is no only interoperable, i.e., instruments from, different manufacturers can be physically connected to the same bus and be communication capable, but are also interchangeable, i.e., instruments from different manufacturers can be exchanged with one another without requiring a reconfiguration in the process control system. In order to assure this exchangeability, ABB provides for system installation 3 different GSD-Files (GSD= Instrument Database). The user can decide at installation if he requires the complete functionality of the instrument or only a portion. The change is made using the parameter ID-number selector, which can only be changed acyclically.

The GSD-Files which are available are described in the following table. The manufacture specific GSD-File ABB_078C is on the CD included with the shipment. The standard-GSD-Files PA1397xx.gsd are available on the home webpage of Profibus International – http://www.profibus.com → Libraries → PA- Profiles for download. The GSD-File ABB_078C as well as the "Data Link Description PROFIBUS PA" for FSM4000 (Part No. D184B093U30) are also on the CD (Part No.: D699D002U01) included with the shipment. This CD can be reordered at any time at no charge.

The latest GSD-Files can also be downloaded from the ABB home webpage http://www.abb.com/Flow → Electromagnetic → read more → (select actual type) → Fieldbus & HART Files → read first: Version Matrix (Read first: all files and documentation for the product are listed here) → close Version Matrix → Download Software for the desired Communication Profibus.

Quantity and Type of Function Blocks	Ident Number	GSD File Name
1 x AI	0x9700	PA139700.GSD
1 x AI; 1 x TOT	0x9740	PA139740.GSD
1 x AI; 2 x TOT; and all manufacturer specific parameters	0x078C	ABB_078C.GSD

8.5.5 Block Diagram of the FSM4000 with PROFIBUS PA Communication

The diagram is presented as a function block diagram showing the blocks available in the FSM4000. Acyclically a communication tool or a SPC with Master Class 2 functionality can access all blocks for configuration.

Detailed Description of the Blocks:

Physical Block (Instrument characteristics and present status)	Contains general specifications about the fieldbus instrument, e.g., the manufacturer, the instrument type, version number, etc.
Transducer Block (Measurement parameters)	Contains all the instrument specific parameters and functions required for the flow measurements and calculations. The measured and described values are available in the Transducer-Block - Output Values and can be called by the AI-Block or the Totalizer-Blocks as channels.
Analog Input Block (Output of measured values and status)	The Channel-Selector is utilized by the user to select the relevant measured values (Q volume flowrate), internal flow totalizer (forward, reverse, difference). The values can be read acyclically from the Transducer-Block using the appropriate Index.
Totalizer Block 1+2	Here acyclically the totalizer value can be checked /changed using the PROFIBUS PA-DTM in SMART-VISION . The totalizer can be reset cyclically.

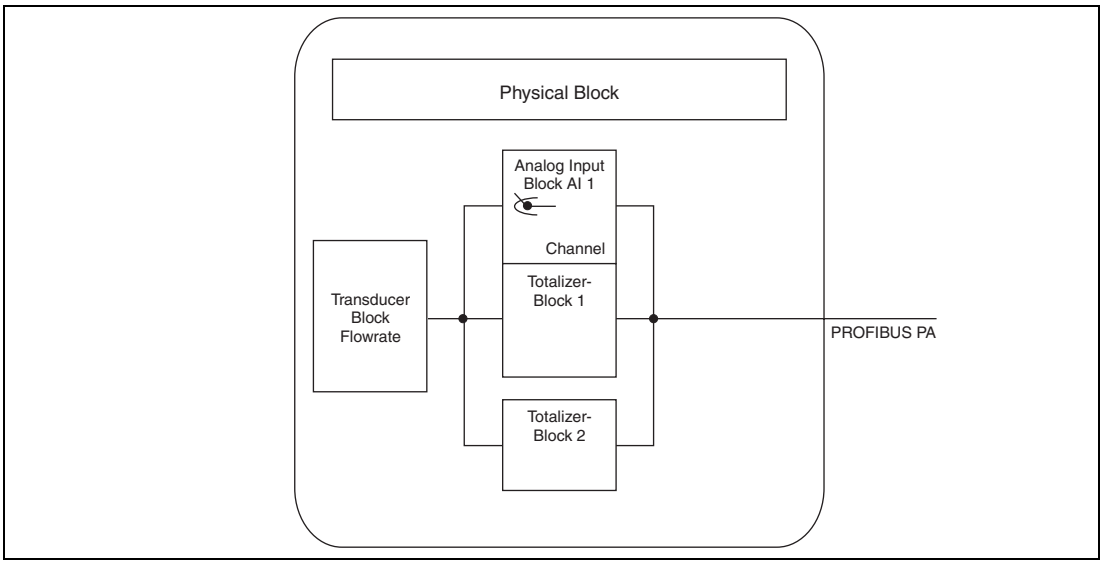


Fig. 21: Block Diagram PROFIBUS PA

Information!

1. A detailed description of the Blocks/Parameters may be found in the separate "Data Link Description PROFIBUS PA" for FSM4000 (Part No. D184B093U30). This is contained on the CD included with the shipment.

2. Configure acyclically over the PROFIBUS PA-DTM in the FSM4000.

8.6 Communication FOUNDATION Fieldbus

The Fieldbus-Converter is designed to be connected to special bus power supply instruments including the ABB Multibarrier FB900. The voltage on the bus must be in the range 9 - 32 V DC.

The FOUNDATION Fieldbus Interface Description is conforms to the Specifications FF-890/891 and FF-902/90. The transmission signal from the converter corresponds to IEC 61158-2. The FSM4000 is registered with the Fieldbus FOUNDATION. The Reg.-No. is: IT 027200 (with aktual ITK-Version).

The registration os the FSM4000 is listed with the Fieldbus FOUNDATION under the Manufacturer ID: 0x000320 and the Device ID 0x0017.

8.6.1 Project planning information

The following picture shows a typical FF-Network.

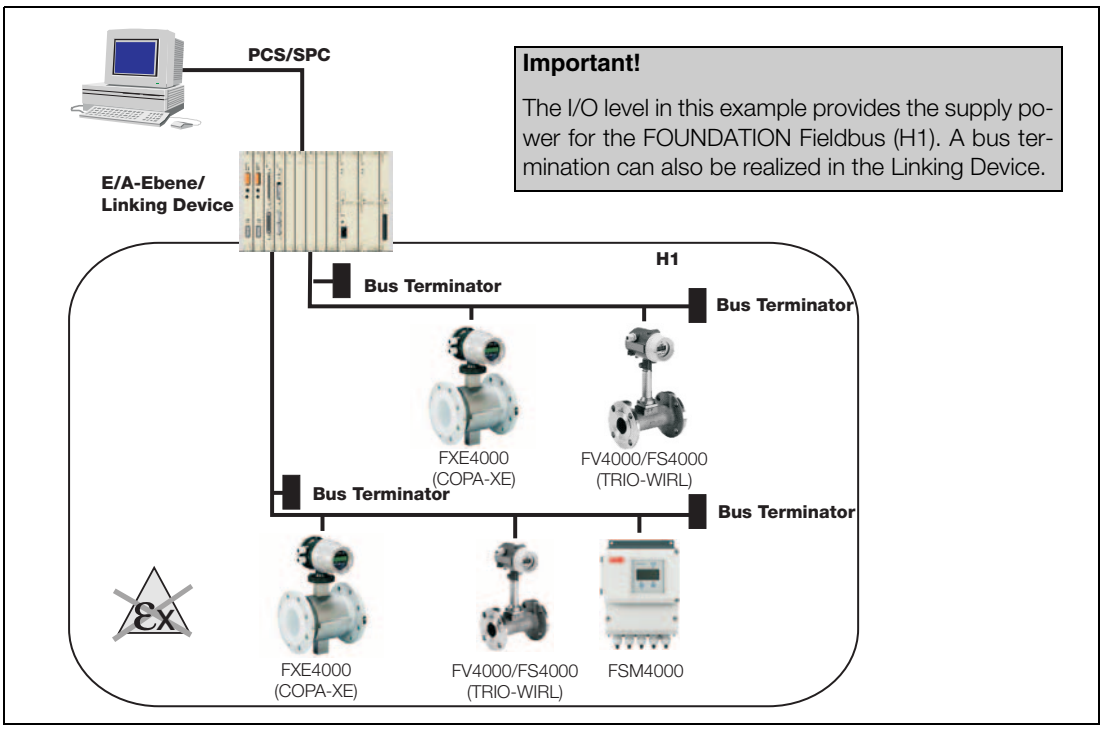


Fig. 22: Typical FF-Network

8.6.2 Cable

A twisted, shielded cable is recommended (as defined in IEC 61158-2, types A or B are preferred).

Additional detailed layout information may be found in the Brochure „FOUNDATION Fieldbus- Solutions from ABB" (No. 7592 FF Brochure). In addition, supplementary information is available on our Home Page at http://www.abb.de as well as on the Home Page of the Fieldbus FOUNDATION at http://www.fieldbus.org.

8.6.3 Setting the Bus-Address

The Bus-Address for FF is automatically assigned by the LAS (Link Active Scheduler). The Address-Recognition is made using a unique number (DEVICE_ID), which is made up of the Manufacturer-ID, Instrument-ID and Instrument Series-No.

8.6.4 Information for Voltage / Current Requirements

The average current draw of the FSM4000 on the bus is 10 mA. During an error condition the FDE-Function (= Fault Disconnection Electronic) integrated in the instrument assures that the current cannot exceed 13 mA.

The upper limit of the current is electronically limited. The value of the voltage on the bus must be in the range 9 - 32 V DC.

8.6.5 System integration

For integrating in a process control system a DD-File (Device Description), which contains the instrument description and a CFF-File (Common File Format) are required. The CFF-File is required for engineering the segment. The engineering can be completed on- or offline.

A description of the function blocks may be found in the separate document „Data Link Description FOUNDATION Fieldbus for FSM4000 " (Part No. D184B093U32).

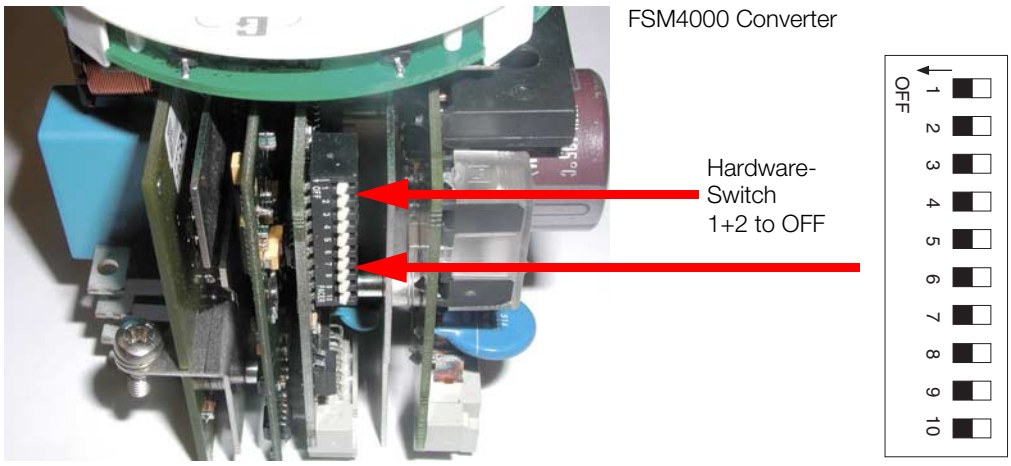
Both files, as well as the data link description are contained on the CD (Part No.: D699D002U01) included with the shipment. This CD may be obtained without cost at anytime from ABB. The files required for operation can also be downloaded at http://www.fieldbus.org.

Attention!

Check for correct DIP-Switch settings in the instrument.

DIP-Switch 2 must be set to OFF. Otherwise it will not be possible for process control system to write data to the instrument (hardware write protect).

DIP-Switch 1 must also be set to OFF.



Switch	1	2	3-10
Status	Simulation Mode	Write Protect	No Function
OFF ON	Disabled Enabled	Disabled Enabled	No Function

Fig. 23: Switch Settings for FOUNDATION Fieldbus

8.6.6 Bus Topology

Tree and/or linear structure Passive at both ends of the main bus cable (RC-component R = 100 Ω, C = 1 µF). Close hook switches on terminal board for bus termination.

8.6.7 Block Descriptions for the FSM4000 with FOUNDATION Fieldbus

The function diagram shows the blocks available. Acyclically a communication tool such as a NI-Configurator, System Tools or a SPC with appropriate functionality can access all blocks for configuration.

Detailed Description of the Blocks:

Resource Block	Contains general specifications about the fieldbus instrument, e.g., software version, TAG-No. etc.
Transducer Block	Contains the data for the flowmeter primary, e.g., meter size, flow ranges, etc. and all manufacturer specific parameters which are not included in the AI-Block. Also included are the parameters for the totalizers.
Analog Input Block	AI 1 Contains the current instantaneous value of the flowrate, its engineering units and status. AI 2 Contains the totalizer value for the forward flow direction, its units and status. AI 3 Contains the totalizer value for the reverse flow direction, its units and status.
PID Block	The PID-Function block contains a Proportional-Integral-Differential-Controller plus all the components required for scaling, noise value override, cascades, etc..

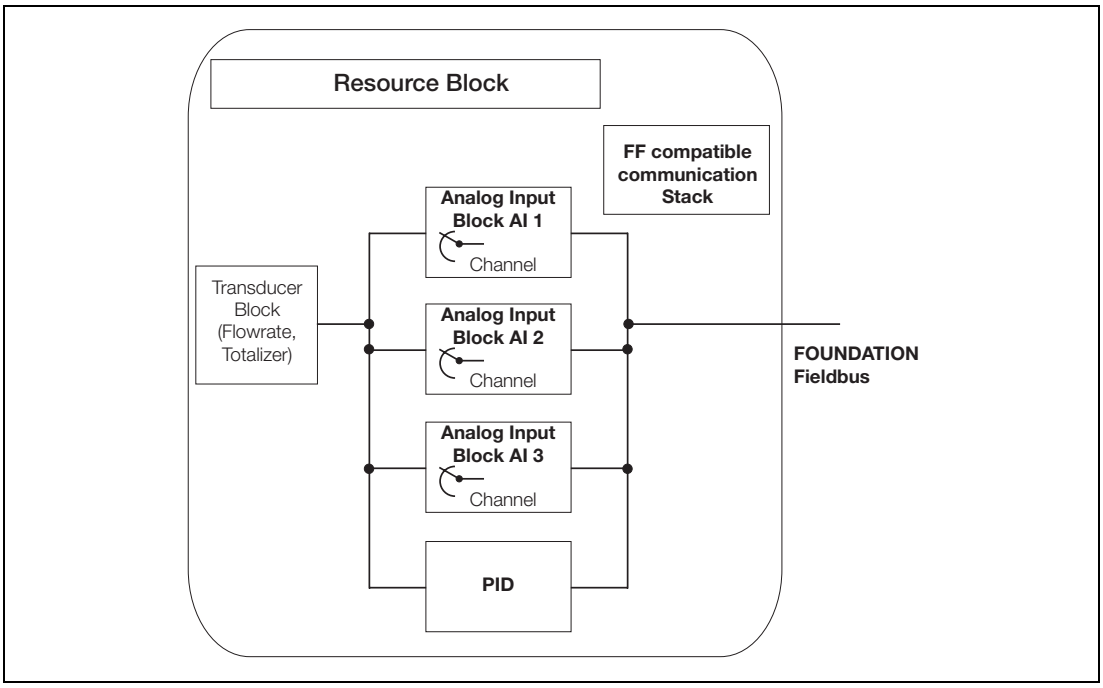


Fig. 24: Block representation at FOUNDATION Fieldbus

The Resource-Block, the AI-Blocks and the PID-Block are "Standard"-FF-Blocks.
The correspond exactly to FF-Specification FF-891-1.4
The measurement value calculations are made in the Transducer-Block. The Transducer-Block provides the measured values internally. The cyclical output of the measured values externally occurs over the AI-Block. The selection, which parameter is to by outputted from the AI-Block, is made using the Channel-Parameter.The PID-Function-Block contains a Proportional-Integral-Differential-Controller.
Details may be found in the FF-Specification FF-891.

A detailed description of the Blocks/Parameters may be found in a separate document Data Link Description FOUNDATION Fieldbus for FSM4000 (Part No. D184B093U32). This is contained on the CD included with the shipment.

9 Maintenance

9.1 General



Attention!

The are electrostatic sensitive parts on the circuit boards (observe EGB-Directives). Be sure that you are electrostatically discharged before touching the electronic components.

9.2 Information about the Exchangeability of the Converter S4

The converter module is identical in function for all Meter Sizes DN 1 to DN 1000 [1/25" to 40"] and can be easily exchanged. When exchanging a converter the following items should be considered for a FRAM calibrated flowmeter primary (can be recognized by the Cs and Cz values on the type tag):

1. That the replacement converter has the same supply power.
2. That the replacement converter has the same contact in- and output functions.
3. Before installing the replacement converter the supply power is to be turned off. After a wait time of 40 min the housing cover of the field mount housing can be unscrewed. Loosen the two mounting screws from the spacer studs, the converter can now be pulled up out of its connection plugs. Reinstall the replacement converter in the reverse manner.
4. Turn on the supply power, the model number of the converter is displayed and the present software version. Then the flowmeter primary and system data are loaded from the external FRAM.

a) The following message is displayed:
– **Warning 7 – Primary data loaded**
During this procedure, all the flowmeter and meter location specific parameters are loaded into the replacement converter. Approx. 30 seconds after a successful data transfer, the message disappears.

b) The converter and flowmeter primary return to normal operation (e.g. after a supply power interruption): No warning message is displayed, converter automatically operates using the data from the internal and external FRAM.

c) Only the converter is exchanged, Order Numbers are different. The external flowmeter primary and process data are loaded. The following message is displayed:
– Warning 7 – Primary data loaded

d) If the Order Number, Instrument Number, Cs, Cz and the Meter Size are the same (e.g. if a converter from the same shipment with identical parameter settings is used), then the process data are loaded from the internal to the external FRAM. The flowmeter primary data, however, continue to be loaded from the internal to the external FRAM. The following message is displayed:
– Warning 8b – (Update external FRAM) the external data in cases a) to d) cannot be loaded, the program attempts to repair the defective data, and the following messages may be displayed:
– Warning 8a – (Update internal FRAM) - for data flow direction external → **internal**
– Warning 8b – (Update external FRAM) - for data flow direction internal → **external**
It is possible that both messages may occur simultaneously.
If this occurs, the following error is displayed:
– Error C – for the external FRAM, then the FRAM must be replaced
– Error 5 – for the internal FRAM, the converter started automatically with the default values. In some instances it may be possible by turning the supply power off and on to eliminate the error. If it does not, then the converter must be replaced.

5. Check if the Language, Display format, flow range, alarm settings and the flowmeter primary data agree with the values listed on the type tag on the flowmeter primary.
6. If parameters are subsequently changed, then these are automatically stored in the external FRAM.
7. The metering system is operational.

9.3 Converter Exchange with PROFIBUS PA or FOUNDATION Fieldbus

If a converter is connected at the end of a bus and both hook switches were set to provide the bus termination, then the bus termination is lost when the converter module is removed. The bus is then no longer properly terminated. To assure correct operation it is necessary to install a bus termination at a different location. Once the converter module is reinstalled, the old bus termination can be used again.

9.4 Exchange of a Defective Memory Module

If the start-up cannot be completed because of a missing or defective FRAM (or after a parameter change during operation), Error C is displayed. A new FRAM can be ordered from the Service Dept. at the factory at Göttingen, Germany. The ABB Order Number and Instrument Number of the flowmeter primary must be included with the order. The following replacement procedure should be followed:

1. Error C is displayed, missing or bad FRAM
2. Order replacement FRAM and include the Order Number and Instrument Number with the order
3. Turn off supply power
4. After the FRAM is installed and the supply power turned on the system start-up can be completed. All flowmeter data and parameter settings should be checked and changed as required.

9.5 Checking the Converter with the Flowmeter Primary Simulator 55XC4000

An additional simulator adapter board is required to test the converter S4 with the 55XC4000 simulator. This can be ordered after the flowmeter has been shipped by providing the Flowmeter Primary Simulator Ordering Number code. The test procedure is described in the Flowmeter Primary Simulator Operating Instruction, Part No. D184B049U02. The test should only be conducted by authorized technicians.

Information!

There are a number of training sessions conducted annually at the main ABB plant covering installation, start-up, error search, and all parameter functions. For additional information please contact us.

9.6 Maintenance

The converter is maintenance free.

Information!

When replacing or repairing individual parts, only original replacement parts should be used.

9.7 Gaskets

Assure that the housing gaskets are seated properly, defective or crushed gaskets should be replaced. Only then will the Protection Class IP67 is assured.

9.8 Messages and Tests

9.8.1 Overview of the Error Conditions and Alarms

Error Code and Clear Text Message	Flowrate Display	Messages While Simulating Current Output	Current Output	Pulse Output	Contact Output					Message with HART
					General Alarm	Min-Alarm	Max-Alarm	Max/Min-Alarm	Empty Pipe	
0 =„Empty pipe“	0 %	–	Prog.Al. DLR	0 %	Alarm				Alarm	More Stat avai.
1 =„AD-Converter/DSP“	0 %	–	Prog.Al.	0 %	Alarm					Trans Mal F.
2 =„Driver“	0 %	–	Prog.Al.	0 %	Alarm					Trans Mal F.
3 =„Flowrate >105 %“	105 %	Yes	High.Al	105 %	Alarm					PV out Limits
4 =„Ext. Zero Return“	0 %	–	0 %	0 %	Alarm					More Stat avai.
5 =„Database“	0 %	Yes	Prog.Al.	0 %	Alarm					Trans Mal F.
6 =„Totalizer“	–	Yes	–	–	Alarm					More Stat avai.
A =„Max-Alarm“	–	Yes	–	–	Alarm		Alarm	Alarm		More Stat avai.
B =„Min-Alarm“	–	Yes	–	–	Alarm	Alarm		Alarm		More Stat avai.
C =„ext. Database“	0 %	Yes	Prog.Al.	0 %	Alarm					Trans Mal F.
F =„FRAM in Pri.“	0 %	Yes	Prog.Al.	0 %	Alarm					Trans Mal F.
D =„OLD PRIMARY“	0 %	Yes	Prog.Al.	0 %	Alarm					Trans Mal F.

9.8.2 Error Messages During Operation and When Entering Data

The Error Messages listed below include explanations of the Error Codes shown in the display.
During data entry Error Codes 0 to 6, A, B, C, D will not occur.

Error Code & Clear Text Message	Priority	Description	Possible Cause	Corrective Measures
Error: 0 Empty Pipe	5	The meter pipe is not full	The pipeline is empty and the electrodes do not contact the fluid	Refill meter pipe. Detector empty pipe is turned on, an adjustment has not been conducted. Adjust DEP.
Error: 1 AD-Converter/DSP	4	The AD-Converter is saturated or does not respond	Input signal is too large	Check grounds (flowmeter primary). Check signal cable, check flow range setting, possibly the flow range is set too low
			AD-Converter/DSP is defective	Exchange DSP-Board
Error: 2 Driver	7	Positive or negative reference too small	Check wiring, no reference voltage. Current limiter has responded because the driver current is insufficient	Check connection board and converter
Error: 3 Flowrate > 105%	6	The max. range setting was exceeded by more than 5 %	Flowrate is too high or the range setting is too low	Increase flow range, decrease flowrate
Error: 4 Ext. Zero Return	8	Flowrate is set to zero; totalization was stopped	The external contact is closed	Reopen the external contact
Error: 5 Int. Database	2	Loss of the internal database	Data memory module is defective	Turn instrument off and on again, access the Self Check functions and test the converter
Error: 6 Totalizer	9	Error Totalizer >F Error Totalizer <R Error Totalizer	The forward totalizer is damaged The reverse totalizer is damaged The forward, reverse or difference totalizer is damaged	Reset forward/reverse totalizer or preset totalizer by entering a new value Forward/reverse totalizer defective. Check converter and wiring .
Error: A Max. Alarm Error: B Min. Alarm	10 11	Max-Alarm limit Min-Alarm limit	The flowrate exceeded the Max-Alarm setting The flowrate was below the Min-Alarm setting	Reduce flowrate Increase flowrate
Error: C External Database	3	External database FRAM corrupted or not installed	Missing or damaged FRAM 1)	Plug the FRAM from the associated flowmeter primary in the connection board in the field mounthousing. See Chapter 6. The FRAM cannot be read, it must be replaced.
Error: E DC to high	13	Increased analog reset, measuring signal with over-ranged DC signal	Air bubbles, deposits at the electrodes, too big interfering signal	Insert air separator, electrode cleaning please contact factory service personnel.
Error: F Ext. FRAM plugged in	1	Data from the external FRAM missing	FRAM is still plugged in the flowmeter primary connection box	Plug the FRAM from the associated flowmeter primary in the connection board in the field mount housing and secure. See Chapter 6.
Error: D OLD PRIMARY	12	Primary type of a older model Series was selected	The setting in the parameter „Primary Setup“ is incomplete	Complete entries in „Primary Setup“ . See Chapter 10.

1) Exchanging a Defective FRAM

If the start-up cannot be completed because of a missing or defective FRAM then a new FRAM can be ordered from the Service Dept. at the factory at Göttingen, Germany. The ABB Order Number and Instrument Number of the flowmeter primary must be included with the order. After the FRAM is installed and the supply power turned on the system start-up can be completed. All flowmeter data and parameter settings should be checked and changed as required.

9.8.3 Warning Messages During Operation

Warning Code & Clear Text Message	Priority	Description	Possible Causes	Corrective Measures
Warning: 1 Q Simulation	2	Before starting the flowrate, a flowrate value can be simulated. The outputs correspond to the simulated value set.	Simulation Mode turned on	After the Simulation program has been completed, the parameter „Simulation Mode“ should be turned off.
Warning: 2 Totalizer reset	1	All totalizers (forward/reverse, difference and overflow counters) were reset	External totalizer reset was initiated	Open switch at contact input (terminals 81, 82)
Warning: 3 Test Mode	3	Only for testing a converter with Simulator 55XC4000.	Test Mode turned on	After completing the Simulation test with the Simulator the parameter „Test Mode“ is to be turned off.
Warning: 4 Self Check	4	If with HART-Communication a contact output or contact input test was initiated, Warning "4" is displayed	Function test running	After completing the self check test, exit the routine.
Warning: 7[1)] Warning primary data loaded	9	Converter has recognized different flowmeter primary data and loaded it in the internal FRAM. Loaded are the system and flowmeter primary data	Defective FRAM, Repair instrument, replace instrument	Record old totalizer values, totalizer should be reset.
Warning: 8a[1)] Update internal FRAM	10	Converter has recognized an error in the internal FRAM and has repaired the contents and data from the external FRAM	Defective FRAM, Repair instrument, replace instrument	Check the entry settings and correct, if required.
Warning: 8b[1)] Update external FRAM	11	Converter has recognized an error in the external FRAM and has repaired the contents and data from the internal FRAM	Defective FRAM or data was changed.	Check the entry settings and correct, if required.
Warning: 9a Overflow > Forward	5	The forward totalizer has reached the maximum count limit and has initiated a reset and incremented the overflow counter.	Max. count value exceeded, 1 overflow is counted.	Reset totalizer if necessary.
Warning: 9b Overflow < Reverse	6	The reverse totalizer has reached the maximum count limit and has initiated a reset and incremented the overflow counter.	Max. count value exceeded, 1 overflow is counted.	Reset totalizer if necessary.
Overflow: 9c Difference totalizer	7	The difference totalizer has reached the maximum count limit and has initiated a reset and incremented the overflow counter.	Max. count value exceeded, 1 overflow is counted.	Reset totalizer if necessary.
Warning: 10 Reverse Q	8	If the forward flow direction is set and reverse flow occurs, this Warning is displayed	Flow direction is reverse, possibly a defective check valve.	Prevent reverse flow of change flow direction setting to forward/ reverse.
Warning: 11[2)] Instrument Address not zero	12	The HART Instrument Address was changed from 0. Current output is frozen at 4 mA	Address 1-15 selected. Therefore the current output frozen at 4 mA .	Select Address 0, if a 4-40 mA output is required.
Warning. 12a[2)3)] Simulation Iout	13	Self Check current output. Check the value of the current at the connection terminals with a digital voltmeter or the process instrumentation.	Function test, enter current output directly in mA for simulation.	Exit function test current output
Warning. 12b[2)3)] Simulation pulse output	14	Self Check pulse output. Check the value of output frequency with a counter.	Pulse output simulation turned on	Exit function test pulse output
Warning. 13[2)3)] Automatic adjustment running	15	Warning displayed only in Service Code section when an adjustment has been initiated (only accessible to ABB Service).	Only for ABB Service Personnel	Only for ABB Service Personnel
Warning. 14 Measurement value halted	16	Warning is only displayed when the function "Noise reduction" has been activated (only accessible to ABB Service)	Noisy measurement signal	Please contact factory Service

1) Warning is displayed for 30s

2) Converter must include the communication "HART-Protocol" option

3) Warning is only displayed when the function is called using a HART-Command

9.8.4 Checking the Metering System



Warning!

When the housing cover is open and the supply power is turned on the personnel contact protection is no longer provided!

The check of the metering system follows the assembly and installation the flowmeter primary and converter.

Are the flowmeter primary and converter installed at the correct location? (is the coordination correct, Tag-No., Instrument Nos, FRAM, is the FRAM-type tag identical to the data on the flowmeter primary?). Do the ambient conditions Protection Class, temperature, vibration, cables used and cable type comply with the specifications limits for the instrument?	No	Allowable installation requirements: check temperature, Protection Class, vibration, connections per Interconnection Diagram (see Page 14). Compare the Instrument Number on the type tag, coordination based on the Instrument Numbers (only for designs with factory entered data). In the high temperature design insulate the flowmeter primary and the pipeline (see Flowmeter Primary OM).
Yes		
Does the supply power correspond with the value on the type tag on the converter?	No	Provide correct supply power.
Yes		
Is the supply power within the limits for the nominal voltage at the terminals? Terminals — Supply Power — (Limits) L, N, (PE) — AC 100–230 V — (-15%/+10%) 1+,2-,(PE) — AC 20.4-26.4 V — (-15%/+30%) DC 20.4-31.2 V [1] — (-15%/+10%)	No	Provide correct supply power.
Yes		
Is the supply power frequency within the limits 50/60 Hz ± 6% ?	No	Provide correct supply power frequency.
Yes		
Were the flowmeter primary and converter earthed correctly?	No	Check the earth connections per the Interconnection Diagram. See Page 14-17
Yes		
Is the flowmeter primary filled with fluid?	No	Fill pipeline.
Yes		
Turn on supply power. With flow, does the actual flow direction agree with the flow direction indicators → F for forward, ← R for reverse? Does the flowrate indication agree with the actual flowrate in percent or direct reading units?	No	1) Check if the flow direction indicators in the display agree with the actual flow direction. 2) Is the conductivity too low? Check.
Yes		
Is the operating mode Standard selected for continuous flowrate metering ? For pulsating flows is the operating mode Piston Pump selected?	No	Enter parameter Operating Mode Standard or Operating Mode Piston Pump.
Yes		
Does the meter size in the submenu Primary agree with the size on the type tag on the flowmeter primary?	No	Incorrect FRAM in converter, the meter size can only be entered for older model flowmeter primaries.
Yes		
Have the flow range, current output, pulse factor, pulse width etc. been entered?	No	Enter units and flow range. Enter the current output range and the pulse values.
Yes		
Does the actual flowrate correspond to the display and output values?[2]	No	Initiate function test, check converter with flowmeter primary simulator.
Yes		
Metering system operational. The entry settings can also be recorded on the Overview Sheet on the last page.		

1) Ripple ≤ 5%

2) If the flow direction does not agree with the flow direction indicators in the display, the flow direction indicators should be changed. In the submenu Operating Mode call the parameter Flow Direction and change to Inverse or Standard as required.

9.9 Pulse Output, Change Active/Passive

The factory setting for the pulse output is noted on the type tag on the converter can be obtained from the Ordering Information (Model Number). Use the following procedure if a change is required:

- Turn off supply power
- After a wait time of 40 minutes, unscrew the housing cover of the field mount housing
- Loosen the two screws on the opposite sides and remove the converter module (see Fig. 25)
- The jumper for changing the settings may be found on the underside of the module (Fig. 25). Install jumper in the desired location:
  - Active = outside see Fig. 26
  - Passive = inside see Fig. 27
- Reinstall the converter in the housing and tighten the screws
- Close the cover and tighten the screws

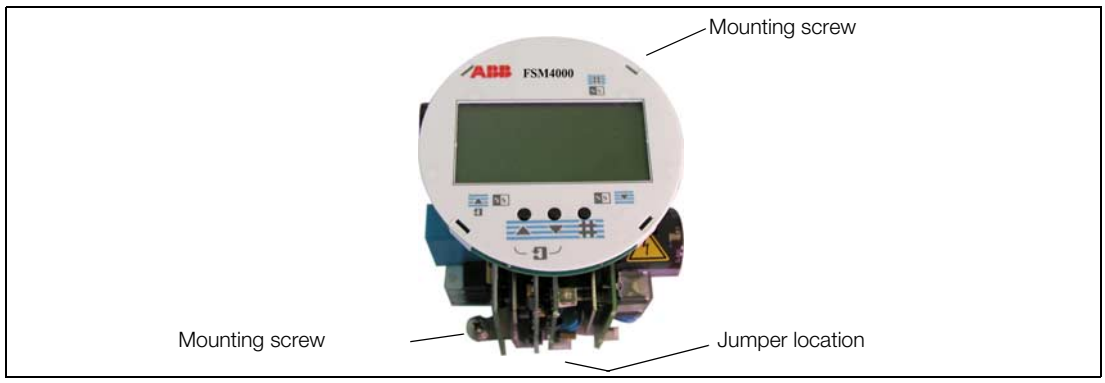


Fig. 25: Converter Module

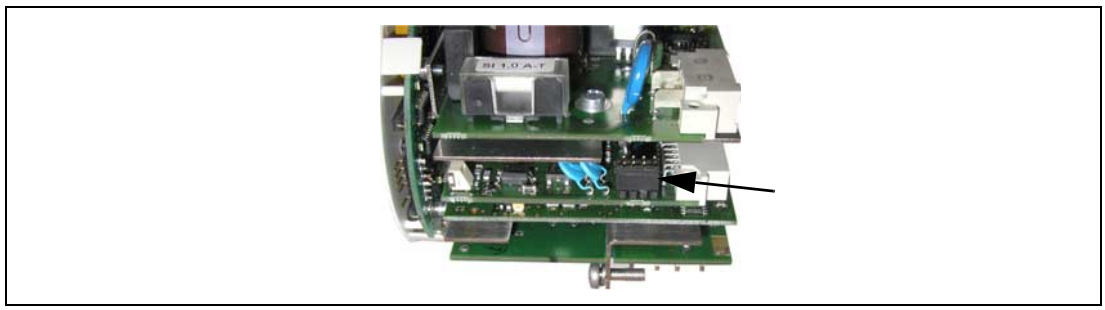


Fig. 26: Jumper Position „Active“

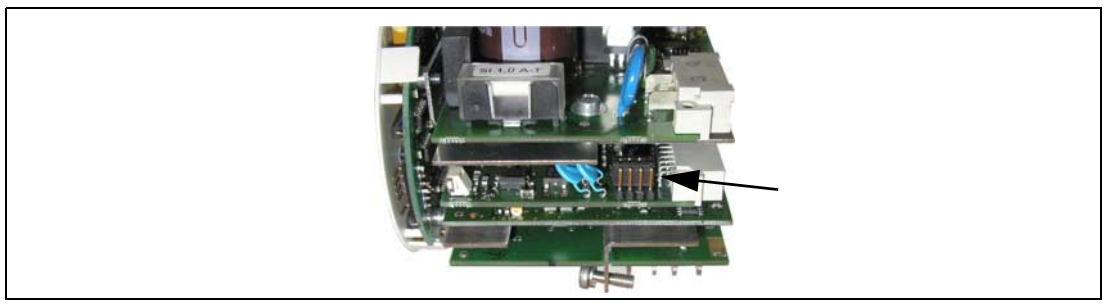
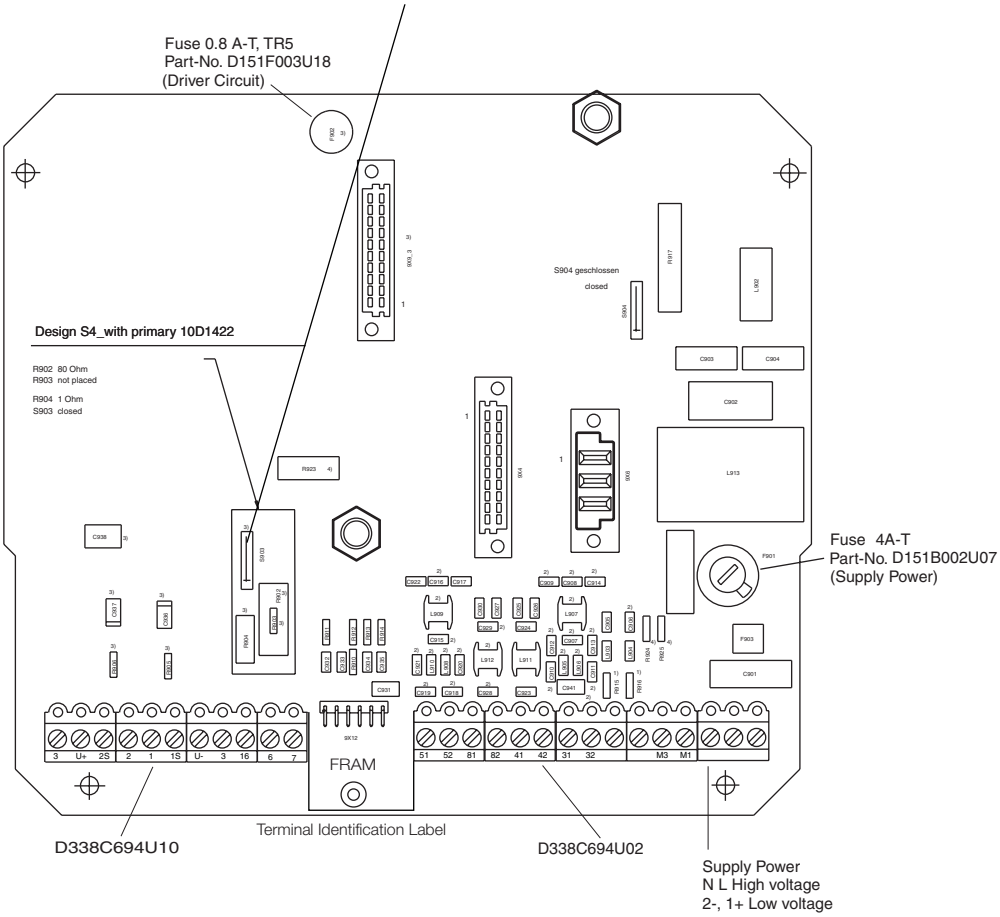


Fig. 27: Jumper Position „Passive“

9.10 Connection Board Field Mount Housing

The switch S903 is closed for the older model primaries 10D1422, [10DI1425, 10DS3111A-D (≥ DN 500 [20"]). Switch S903 is opened for all the other older model primaries, see Page 65, and for flow-meter primaries SE21_/SE41F, or the parts may not be installed for this models.



Connection Terminals for PROFIBUS PA / FOUNDATION Fieldbus

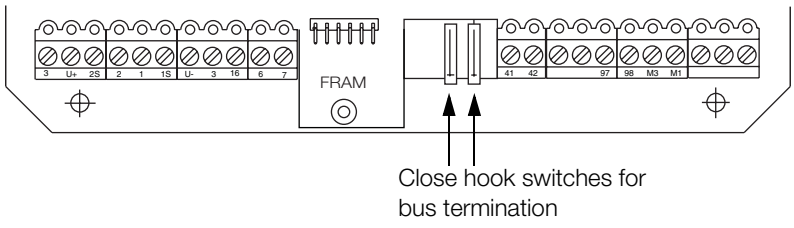


Fig. 28: Connection Board Field Mount Housing

Replacing the Instrument Fuses:



Warning!

When the housing cover is open EMC and personnel contact protection are no longer provided and the voltages on accessible components may be hazardous. Electrocution danger!

Replace the fuses as follows:

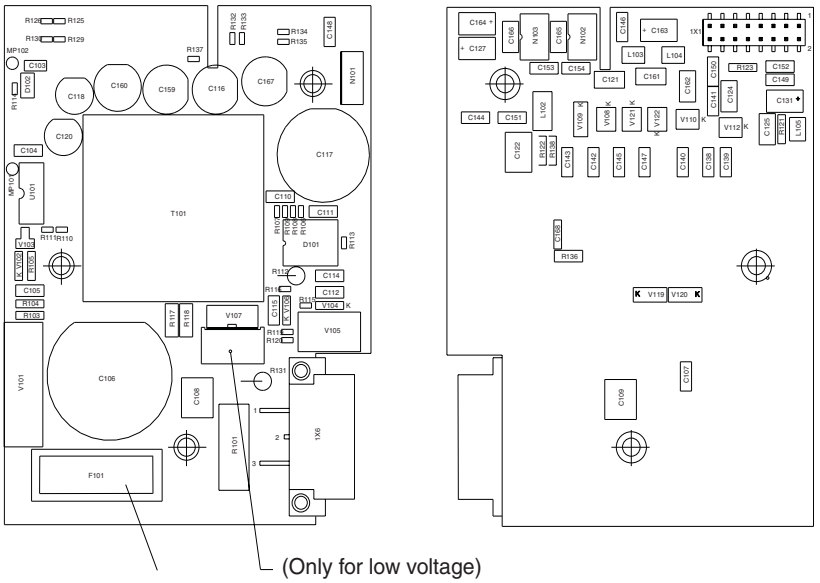
1. Turn off the supply power and wait 40 minutes
2. Unscrew the large cover
3. Remove the protection cap F101
4. Replace the defective fuse (4.0 A slo-blow) Replacement part No. D151B002U07
5. Reinstall protection cap F101
6. Press the large cover against the gaskets on the open side and tighten the cover screws
7. Turn on the supply power



Information!

Use only original ABB replacement parts!

9.11 Power Supply Board)



Fuse F101
High voltage: 1A-T, Part-No. D151B002U06
Low voltage: 4 A-T, Part-No. D151B002U07

Replace fuses as described on Page 61.

Fig. 29: Power Supply Board

9.12 Digital-I/O Board

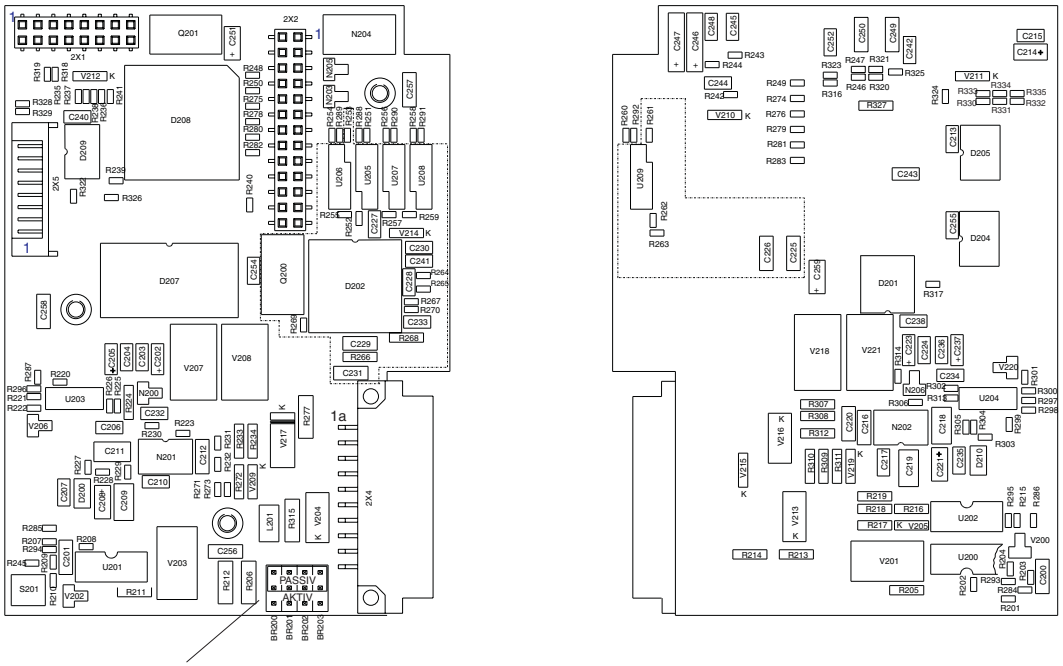


Fig. 30: Digital I/O Board

9.13 Replaceable Parts List Converter Field Mount Housing

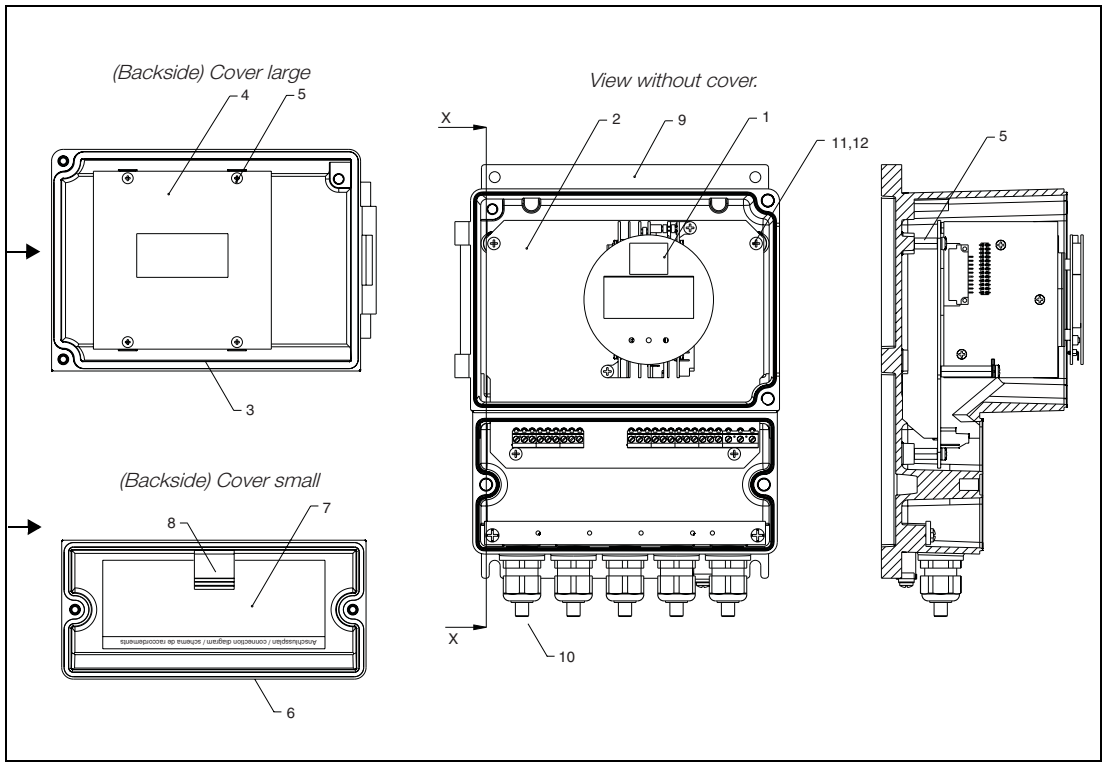


Fig. 31: Replaceable Parts Converter Field Mount Housing

No.	Description	Part No.
1	Converter U high voltage without HART	D674A859U01
	Converter U high voltage with HART	D674A859U02
	Converter U high voltage with PROFIBUS PA/FF 1)	D674A859U03
	Converter U low voltage with HART	D674A860U01
	Converter U low voltage with PROFIBUS PA/FF 1)	D674A860U02
2	Connection board Standard	D685A1020U03
	Connection board for PA/FF	D685A1020U02
3	Cover large, complete	D641A030U01
4	PVC protection cover	D626A005U01
5	Mach. screw, Phillps, phillister head M 3x5 DIN 7985 SS	D004F105AU20
6	Cover, small	D641A029U01
7	Interconnection diagram	D338D311U01
8	Flat cable clamp	D174D002U03
9	Field Mount Housing empty	D641A033U01
10	Cable connector M 20x1.5	D150A008U15
11	Mach. screw, Phillps, phillister head M4x10 steel galv.	D004G108AU01
12	Spring washer A 4.0 DIN 137 SS	D085D020AU20

1) For spare part ordering please indicate the communication-variant for software choice

9.14Replaceable Parts List Converter

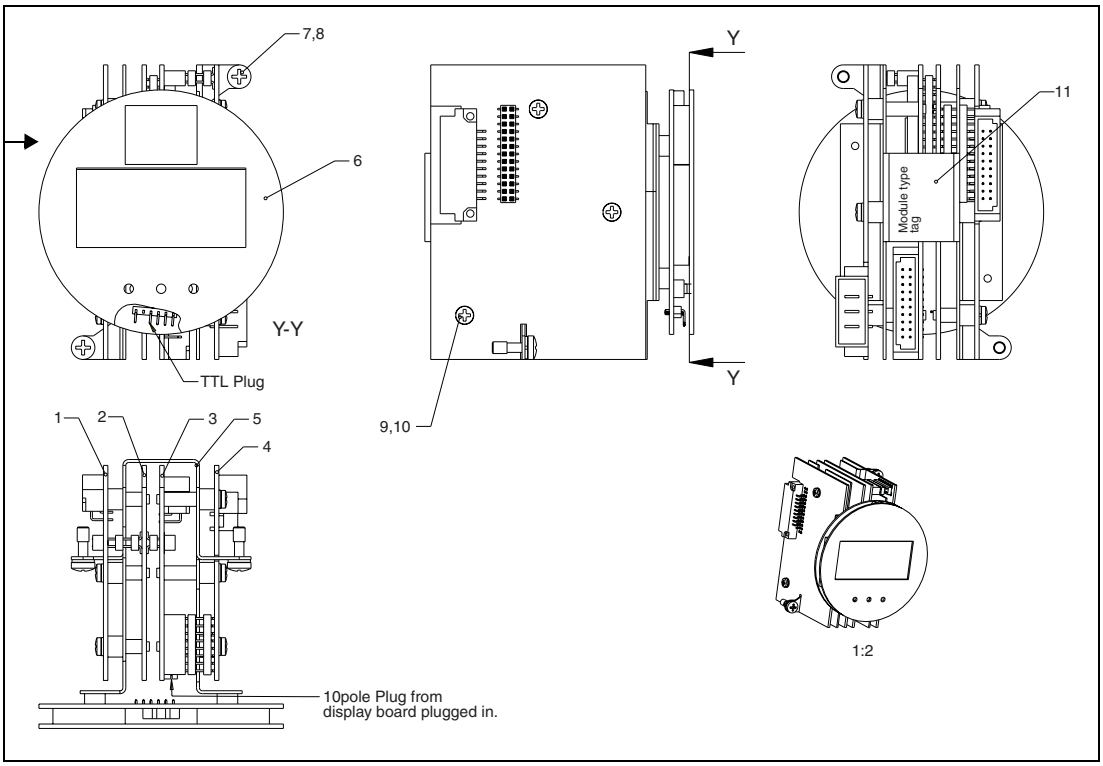


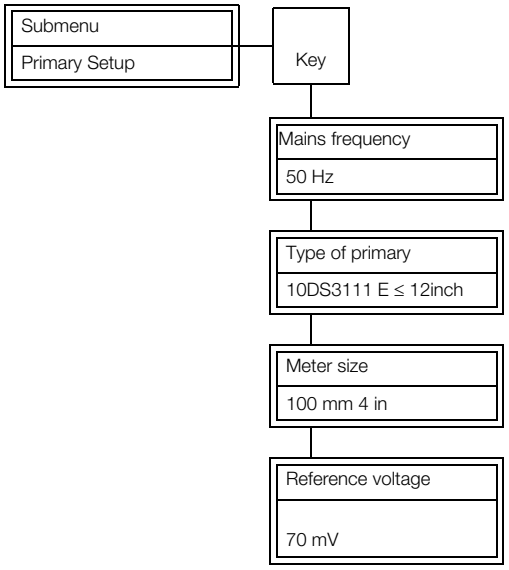
Fig. 32: Replaceable Parts Converter

No.	Description	Part No.
1	Driver Board	D685A1016U01
2	Front End Board	D685A1017U01
3	Digital-I/O Board Standard	D685A1018U01
	Digital-I/O Board HART	D685A1018U02
	Digital-I/O Board PROFIBUS PA/FF	D685A1032U01
4	Power Supply Board Standard $U_{High\ voltage}$	D685A1019U01
	Power Supply Board Standard $U_{Low\ voltage}$	D685A1019U02
5	Bracket	D353F151U01
6	Display board	D685A1015U01
7	Mach. screw, Phillps, phillister head DIN 7985 M4x12 SS	D396A014U02
8	Spring washer B 4.0 DIN 127 SS	D004F109AU20
9	Mach. screw, Phillps, phillister head DIN 7985 M3x12 SS	D004F109AU20
10	Spring washer B 3.0 DIN 127 SS	D085C016BU20
11	Converter module type tag	D338C706U01

10 Supplementary Information, Operating S4 with an Older Models

Older Models, selections for operating with converter S4
Procedure:

If a converter is to be operated with an older model flowmeter primary then a FRAM with the values Cs=100 % and Cz=0 % must be used. If this FRAM is installed in the converter and the converter was connected according to the Interconnection Diagrams on Page 14 or 17, then when the power is turned on the menu „Primary Setup“ is displayed. After pressing any key the following entries must be made. If later it is determined that an incorrect entry was made, corrections can be made in the submenu Systemdata „Primary“ . See Page 29.



Entries can be made one after the other. In the submenu Primary Setup select the Mains Frequency at which the flowmeter primary was calibrated. See type tag. Select the appropriate flowmeter primary type from the list in the table. Important is the letter after the model number and the meter size, otherwise the converter will not access the correct reference data.

Enter the appropriate meter size. The values are listed for ANSI and DN sizes. The reference voltage, see type tag on the flowmeter primary, is entered numerically. Then select the flow range and the remaining process parameters (damping, low flow cutoff, current/ pulse outputs, display format etc.). Then a system zero adjustment must be made with a full pipeline at zero flowrate.

If no values are listed for the reference voltage on the type tag, they can be requested from the Service Dept. at the factory in Göttingen, Germany by supplying the Order Number of the flowmeter primary.

Information!

See also Page 60 for adapting an older flowmeter primary model.

EMF-Type Flowmeter Primary Model revision level	Meter size DN	Connection Board with Voltage Splitter, Switch S903 must be closed	FRAM-Design	Coil Supply Current from:
SE2_, SE4	3-1000 [1/10”-40”]	no	With primary calibration values Cs = see name plate Cz = see name plate	Converter S4
10DS2112 DS2_ DS4_ 10DS3111(A-D) 10DS3111(E) 10DI1425	3-100 [3/8”-4”] 1-100 [1/25”-4”] ≤ 300 [12”] ≤ 400 [16”] ≤ 300 [12”] ≤ 400 [16”]	no	Cs = 100 %; Cz = 0 %	Converter S4
DS4_ 10DS3111(E)	≥ 350-1000 [14”-40”] ≥ 350-400[14”-16”]	no	Cs = 100 %; Cz = 0 %	Converter S4
10DS3111(A-C) 10DS3111(D) 10DS3111(E)	≥ 500 [20”] ≥ 500 [20”] ≥ 500 [20”]	no	Cs = 100 %; Cz = 0 %	External supply power
10D1422, 10DI1425 10D1418 10D1430	3-1000 [1/10”-40”] ≥ 500 [20”] 3-100 [3/8”-4”] 150-1000 [6”-40”]	yes, 81 Ohm	Cs = 100 %; Cz = 0 %	External supply power
10DS3111A 10D1462 10D1472	350-600 [14”-24”] 150-900 [6”-36”] 15-100 [1/2”-4”]	no, Board 1000 Ohm must be used	Calculated	External supply power

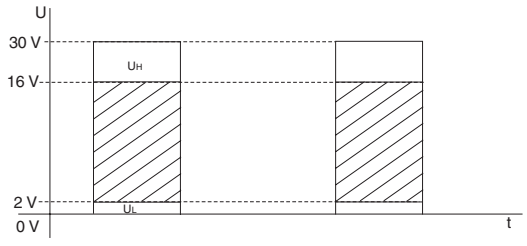
Information:

If the flow direction indicators in the display indicate the wrong flow direction after start-up, e.g., reverse flow instead of forward, corrections can be made in the submenu Operating Mode in the converter. First turn off the Program Protection („Prog. Level" -> „Specialist"). Then in the submenu „Operating Mode" select the parameter „Flow Direction". Select „Invers" instead of „Standard". Finally, turn the Program Protection on again by selecting „Prog. Level" -> „Locked".

11 Supplementary Configuration Information

11.1 Supplementary Information for Configuring the Pulse Output

The scaled pulse output uses 1-channel and can be configured as an active (24 V DC) or passive (optocoupler) pulse. To change mode after start-up, see Chapter 9.9. To configure the following parameter settings are to considered.

Parameter Entry	Comments
Pulse factor 1.0000 / l	**Pulse Factor** The limits for the pulse factor are dynamic and are dependent on the flow range (Qmax) setting as well as the totalizer units selection. The limits are calculated so the count frequency is between 5000 Hz and 0.01 Hz. If the flow range or totalizer units are changed, the selected pulse factor is checked for validity. If necessary, the pulse factor is changed so that the limits are not exceeded. If the pulse width is too large for the resultant frequency, it is also reduced. Example for high limit: Pulse factor high = max. frequency/(Qmax · units factor) If Qmax = 1 l/s then the units factor is = 1 max. Frequency = 5,000 Hz 5,000(1 · 1) = 5,000 pulses/liter min. Frequenz = 0.00016 Hz Example for low limit: Pulse factor low = Pulse factor high/min. pulse frequency Min. pulse frequency = 31 250 000 5,000/31 250 000 = 0.000016 pulses/liter The pulse factor can therefore be set within the limits from 0.01 to 5000 pulses per liter. In the sub-menu "Pulse Factor" the value displayed will be within these limits. If other entry changes are made, Qmax, totalizer units, the limits are recalculated and if required, the pulse factor changed, if it is outside of the limits. The pulse width is always set so that the above criteria are satisfied. If a change is required, then the Warning Pulse Width Changed is displayed.
Pulse width 50 ms	**Pulse Width** The pulse width (duration for the pulses) can be set within the range from 0.1ms to 2000 ms. The upper limit may be reduced based on the value of the pulse factor, in order to assure an on/off ratio of 1:1 and the maximum 5 kHz. Example for high limit: Width high = 500/(pulse factor · units factor · Qmax) Pulse factor = 5,000, Qmax = 1 l/s, units factor = 1 500/(5,000 · 1 · 1) = 0.1 ms Pulse factor = 10, Qmax = 1 l/s, units factor = 1 500/(10 · 1· 1) = 50 ms
Unit Totalizer l	If the pulse width is not sufficient for the application, then the totalizer units, flow range or pulse factor must be changed. Basically any changes made by the converter to the pulse factor or pulse width will be indicated by a Warning message in the display. When connecting an active or passive counter, the allowable current and pulse frequency limits must be considered. Example: A 24 V passive counter is connected: The maximum output frequency is 5 kHz.  **Voltage** **Current** „closed“ 16 V ≤ U_{CEH} ≤ 30 V, 2 mA ≤ I_{CEH} ≤ 220 mA „open“ 0 V ≤ U_{CEL} ≤ 2 V, 0 mA ≤ I_{CEL} ≤ 2 mA

11.2 Supplementary Information for Configuring Piston Pump/Pulsation

Parameter Entry	Comments
Submenu Operating mode Operating mode Piston Pump	The main application areas for the AC magnetic field instruments are where fast measurement processing is required for continuous flow metering of single or multi phase fluids. If pulsation dampeners are used in piston pump applications, then usually DC magnetic field instruments can be used. If the use for pulsation dampeners is not desired or impossible, then instruments with higher magnetic field excitation frequencies are required. When metering pulsating flows downstream from a simple, single stroke piston pump with a high or unsteady stroke frequency, hose or diaphragm pump, the converter must be in position to process the peak flowrates correctly. These peak values are often three times the average flowrate. As long as the converter can process high flowrate spikes linearly and a sufficient number of samples are measured, the basic accuracy of the measurement system for longer term measurements is maintained. Therefore the Piston Pump selection is made in the submenu Operating Mode. Especially for pulsating flow or very noisy signals a digital filter is incorporated in the converter. It smooths the instantaneous indications and provides a pulsation free current output. In the parameter Damping a selection can be made in the range from 0.2 to 20 sec (= 1 τ).

12 Specifications FSM4000

12.1 General Description

The Converter Model S4 converts the flowrate proportional flow signals from an electromagnetic flowmeter primary into the conventional output signals. These measurement values are shown on a full-graphic 4 line lighted display. In addition, the measurement values are also transmitted to a scaled pulse output, current output and using HART-Protocol communication. In the variant PROFIBUS PA, the measurement values are transmitted over the PROFIBUS and are also available at a contact output. The flow range end value of the converter can be set within the range from 0.5 m/s to 10 m/s. This metering system is especially suited for applications with fast changing or two phase flows.

The incorporation of a digital signal processing assures a high system reliability especially in interference environments, noise intensive fluids and for fast changing flows. Furthermore, standard are a pulsation free current output, pulse output (active or passive), fast response times, automatic empty pipe detection and much more. Therefore this EMF is especially suited for demanding applications and two phase flows.

12.2 Converter Model S4

Housing material	Fluidized bed powder coated Aluminum die casting
Coating	Epoxy powder
primer	None
surface preparation	Washed in a high alkaline bath; Alodine process applied as a corrosion layer to improve adhesion of coating
Coating thickness	80 µm
Color	RAL 9002 (light gray) RAL 7012 (basalt gray)
Protection Class per EN 60529	IP 67, NEMA 4X,
Ambient temperature	-20°C to + 60°C
Storage temperature	-20°C to + 80°C
Relative humidity	Acc. to IEC 60068-2-30 Classification of environmental conditions; Natural influences, temperature and air humidity. No influences within the following conditions: Temperature at 25 °C to 55 °C [77 °F to 131 °F] and relative humidity of 94 % to 97 %.
Shock and vibration resistance	Acc. to IEC 60068-2-6, grouping for instruments acc. to table C2 for general industry applications. No additional influences to the following levels of vibration: Frequency: 10 to 55 Hz, amplitude max.: 0.15 mm. **Note:** Avoid using the Field mount housing in an environment with constant vibration. Protective plug-in cover against vibration upon request.
Cable entries	M20x1.5; NPT ½" option; PF ½" option
Supply power U_{High}	AC 85–253 V, 47/63 Hz
U_{Low}	AC 20.4-26.4 V, 47/63 Hz DC 20.4-31.2 V (ripple < 5%)
Power	S ≤ 45 VA (flowmeter primary including converter)
Galvanic isolation	Current output, pulse output, contact input and contact output are galvanically isolated from the signal input and each other
Flow range setting	0 to 0.5 and 0 to 10 m/s
Response time	1 τ = 70 ms (0–63 % flowrate change) Operating Mode Fast 1 τ = 200 ms (0–63 % flowrate change) Operating Mode Standard, Piston Pump
Current output	0/4–20 mA; 0/2–10 mA selectable, galvanically isolated, R_L < 560 Ω, (for HART min. 250 Ω)

Pulse output		Active/passive switchable, galvanically isolated,
	active	Voltage pulse 24V rectangular, $R_L > 150\ \Omega$, Pulse width ≤ 50 ms, count frequency ≤ 3 Hz, $R_L > 500\ \Omega$, pulse width ≥ 0.1 ms count frequency max. 5 kHz
	passive	Apply external voltage, optocoupler specifications:
	„closed“	Voltage 16 V ≤ U_{CEH} ≤ 30 V; current 2 mA ≤ I_{CEH} ≤ 220 mA
	„open“	Voltage 0 V ≤ U_{CEL} ≤ 2 V; current 0 mA ≤ I_{CEL} ≤ 2 mA
	Pulse factor	Settable within dynamic limits in pulses/unit
	Pulse width	Settable within dynamic limits from 0.1 to 2000 ms
Contact input		Active as operating contact (normally open) optocoupler specifications: „On“ 16V ≤ U_{KL} ≤ 30 V DC, „Off“ 0V ≤ U_{KL} ≤ 2 V DC, R_i 0= 2 kΩ The following functions can be assigned: Ext. zero return, ext. totalizer reset
Contact output		Passive as operating contact (normally opened or closed) Optocoupler specifications: „Closed" 0 V ≤ U_{CEL} ≤ 2 V, 2 mA ≤ I_{CEL} ≤ 220 mA „Open“ 16V ≤ U_{CEL} ≤ 30 V DC, 0 mA ≤ I_{CEH} 2 mA The following functions can be assigned: Forward/reverse flow direction signal, limit alarms (max. or min.), general alarm, empty pipe
Communication		HART-Protocol over current output or PROFIBUS PA or FOUNDATION Fieldbus
Data security		Using FRAM, all data stored for a 10 year period without supplementary power when the power is turned off or interrupted. Additional security using a serial internal and external FRAM for data exchange for data storage of process information and instrument values.
Display		4-line lighted graphical display with a 4x16 character dot matrix display indication. User selectable values for display in each line. Standard is 2-line; 1st line „large“, 2nd line „small“.
Interference resistance (EMC)		Per EN 61326 and NAMUR NE21.
Retrofit		For older flowmeter primaries (Series DS2_, DS4_, 10DS3111, 10DI1425 and 10D1422) the system can be operated using Converter S4.

12.3 Accuracy Under Reference Conditions per EN29104

Pulse output	± < 0.5 % of rate > 0.5 m/s ± < 0.00025 % of max. < 0.5 m/s
Current output	plus ± < 0.1 % of rate + 0.01 mA
Reproducibility	≤ ± 0.2 % of rate

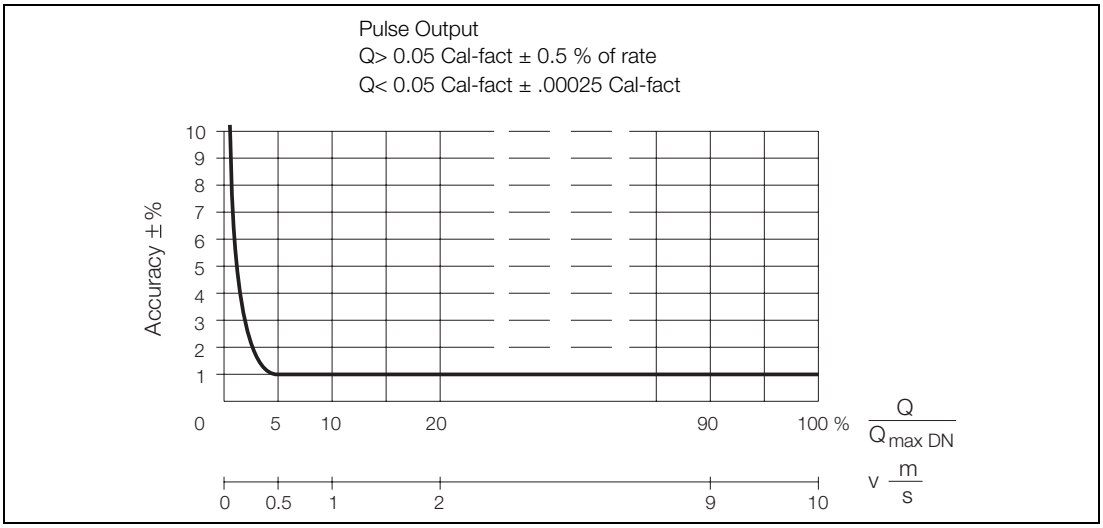


Fig. 33: Accuracy

12.4 Reference Conditions per EN 29104

Fluid temperature	20 °C ± 2 K
Ambient temperature	20 °C ± 2 K
Supply power	Unom ± 1 % At reference conditions the supply power is restricted to a fixed value U_{High} = 230 V AC U_{Low} = 24 V AC/DC.
Warm up phase	30 min
Installation requirements	Upstream > 10 x D
straight pipe sections	Downstream > 5 x D
	Flowmeter primary and converter are connected to earth.
	The flowmeter primary is to be installed concentrically in the pipeline.

13 Parameter Setting and Option Overview

Meter Location:		TAG-No.:			
Flowmeter Primary Type:		Converter Type:			
Order No.:	Instrument No.:	Order No.:	Instrument No.:		
Fluid Temp.:		Supply Power:		V	Hz
Liner:	Electrodes:	Excitation Frequency:			Hz
Cs:	Cz:	System Zero:			
Phase:	Reference Voltage:				

Parameter		Setting Range
Prog. Prot. Code:		0–9999 (0 = Factory setting)
Language:		German, English, French, Finish, Spanish, Italian, Dutch, Danish, Swedish, Turkish
Primary:		SE2_, SE4_; DS2_; DS4_ (≤DN300/12"); DS21/DS41, 10DS3111A-D (≤DN400/16"), 10DS3111E (≤DN300/12"), 10DI1425 (≤DN400/16"), DS4_ (≥DN350-400/14"-16"), 10DS3111E (≥DN350-400/14"-16"), 10DS3111A-D (≥DN500/20"),DS4_(≥DN500/20"), 10DS3111E (≥DN500/20"), 10D1422, 10DI1425 (≥ DN 500/20"),
Meter Size:		DN 1 – 1000 / 1/25" - 40"
Q_{max}:		0.05 Cal-fact to Cal-fact
Pulse Factor: 1)		pulses/unit (observe dynamic limits)
Pulse Width: 1)		ms (observe dynamic limits)
Low Flow Cutoff:		0–10 % of flow range end value
Damping:		0.2–20.0 seconds (= 1τ) Operating Mode: Standard, Piston Pump (0.2–3 sec) 0.07–20.0 seconds (= 1 τ) Operating Mode: Fast
Density:		0.01 g/cm^3 – 5.0 g/cm^3
Units Q_{max}:		l/s, l/min, l/g,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/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, igl, mgal, bbl, bls, kg, t, g, ml, Ml, lb, uton, kgal
Max. Alarm:		%
Min. Alarm:		%
Contact Output:		F/R Signal, General Alarm, Min-Alarm, Max-Alarm, Max-/Min-Alarm, Empty Pipe
Contact Input		Ext. Totalizer Reset, Ext. Zero Return
Current Output:		0/4–20 mA, 0/2–10 mA
I_{out} Low Alarm:		2-10 mA: 1.6-2 mA / 4-20 mA: 2-3.5 mA
I_{out} High Alarm:		0/4-20 mA: 20-26 mA / 0/2-10 mA: 10-12 mA
Detector e. Pipe:		ON/OFF
I_{out} at e. Pipe:		See I_{out} Low Alarm, I_{out} High Alarm
Threshold:		0–10000
Adjust e. Pipe:		
1st Display Line:		Q [%]; Q [Unit]; Q [mA]; Q [m/s]; Q [Bargraph]; Totalizer; Totalizer\→ F; Totalizer\← R; Tag Number; Blank Line
2nd Display Line:		same as above
3rd Display Line:		same as above
4th Display Line:		same as above
Operating Mode:		Standard/Piston Pump/Fast
Flow Indication:		Forward/Reverse, Forward
Flow Direction:		Standard, Invers

Pulse Output:	❑	Active	❑	Passive			
Communication:	❑	HART-Protocol	❑	PROFIBUS PA	❑	FOUNDATION Fieldbus	❑ No
Detector empty Pipe:	❑	Yes, activated	❑	No (Meter size too small, preamplifier)			
Alarm:	❑	Yes	❑	No			
Ext. Input:	❑	Yes Ext. Totalizer Reset	❑	Yes Ext. Zero Return	❑	No	

1) The maximum count frequency (5 kHz) may not be exceeded.

14 EU Certificate of Compliance

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:*	S4... SE21_ / SE21F SE41F	
Richtlinie: *Directive:*	EMV Richtlinie 89/336/EWG * EMC directive 89/336/EEC *	
Europäische Norm: *European Standard:*	EN 50081-1, 3/93 * EN 50082-1, 3/93 *	EN 50081-2, 3/94 * EN 61000-6-2, 3/00 *
Richtlinie: *Directive:*	Niederspannungsrichtlinie 73/23/EWG * Low voltage directive 73/23/EEC *	
Europäische Norm: *European Standard:*	EN 61010-1, 8/02 *	

* einschließlich Nachträge
including alterations

Göttingen, 06.09.2002

i.V.
.....
Unterschrift / Signature

BZ-13-5111, Rev.1, 5120

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The Company's policy is one of continuous product improvement and the right is reserved to modify the information contained herein without notice.

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