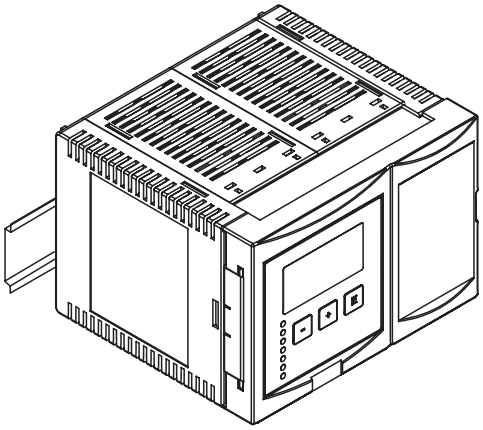
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

Prosonic S FMU90

Level Measurement
Alternating Pump Control
Rake Control

HART® FIELD COMMUNICATION PROTOCOL



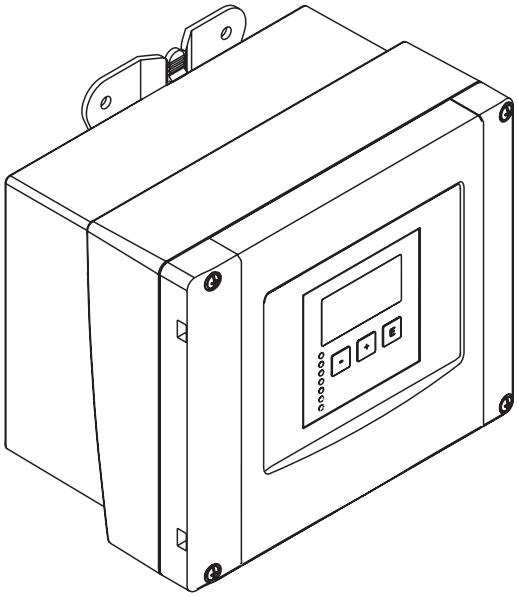


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Table of Contents

1 Safety Instructions

1.1 Designated use

The Prosonic S FMU90 is a transmitter for the ultrasonic sensors FDU91, FDU91F, FDU92, FDU93, FDU95 and FDU96. The sensors of the former class FDU8x can be connected as well.

The transmitter version for level measurements (product structure according to section 2.3: FMU90 - *1**********) can be applied for different measuring tasks, e.g.:

- level measurement in tanks and silos
- conveyor belt measurement
- level limit detection
- (alternating) pump control
- screen and rake control

The version for level and flow measurements (product structure according to section 2.3: FMU90 - *2**********) is usable for further measuring tasks, e.g.:

- flow measurement at open flumes and weirs
- (non-resettable) totalizers and (resettable) counters
- control of samplers by time or counting pulses
- backwater and dirt detection in flumes
- simultaneous measurement of level and flow in a stormwater overflow basin with only one sensor

1.2 Installation, commissioning, operation

The Prosonic S FMU90 is fail-safe and constructed to the state-of-the-art. It meets the appropriate standards and EC directives. However, if you use it improperly or other than for its designated use, it may pose application-specific hazards, e.g. product overflow due to incorrect installation or configuration. Installation, electrical connection, start-up, operation and maintenance of the measuring device must therefore be carried out exclusively by trained specialists authorised by the system operator. Technical personnel must have read and understood these operating instructions and must adhere to them. You may only undertake modifications or repair work to the device when it is expressly permitted by the operating instructions.

1.3 Hazardous area

Measuring systems for use in hazardous environments are accompanied by separate "Ex documentation", which is an integral part of this Operating Manual. Strict compliance with the installation instructions and ratings as stated in this supplementary documentation is mandatory.

- Ensure that all personnel are suitably qualified.
- Observe the specifications in the certificate as well as national and local standards and regulations.

The transmitter may only be installed in suitable areas.
Sensors with a certificate for hazardous areas may be connected to a transmitter without a certificate.

Warning!
The sensors FDU83, FDU84, FDU85 and FDU86 with an ATEX, FM or CSA certificate are not certified for connection to the FMU90 transmitter.

For installations in the USA:
Installation should be in accordance with the National Electrical Code NFPA 70 (NEC)

For installations in Canada:
Installation should be in accordance with the Canadian Electrical Code (CEC)

1.4 Notes on safety conventions and symbols

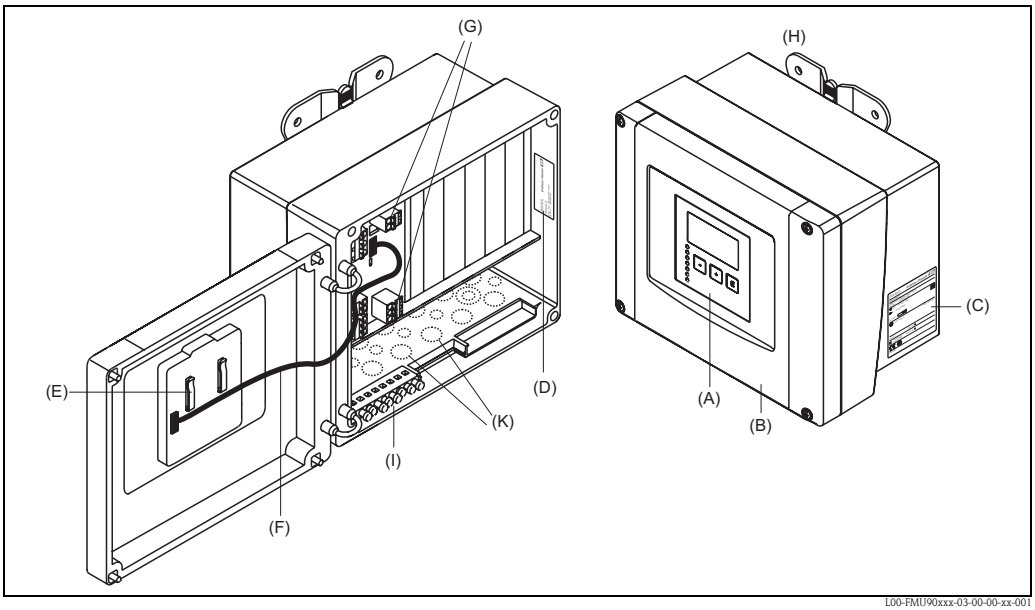
In order to highlight safety-relevant or alternative operating procedures in the manual, the following conventions have been used, each indicated by a corresponding symbol in the margin.

Safety conventions	
	**Warning!** A warning highlights actions or procedures which, if not performed correctly, will lead to personal injury, a safety hazard or destruction of the instrument
	**Caution!** Caution highlights actions or procedures which, if not performed correctly, may lead to personal injury or incorrect functioning of the instrument
	**Note!** A note highlights actions or procedures which, if not performed correctly, may indirectly affect operation or may lead to an instrument response which is not planned
Explosion protection	
	**Device certified for use in explosion hazardous area** If the device has this symbol embossed on its name plate it can be installed in an explosion hazardous area
	**Explosion hazardous area** Symbol used in drawings to indicate explosion hazardous areas. Devices located in and wiring entering areas with the designation “explosion hazardous areas” must conform with the stated type of protection.
	**Safe area (non-explosion hazardous area)** Symbol used in drawings to indicate, if necessary, non-explosion hazardous areas. Devices located in safe areas still require a certificate if their outputs run into explosion hazardous areas
Electrical symbols	
	Direct voltage A terminal to which or from which a direct current or voltage may be applied or supplied
	Alternating voltage A terminal to which or from which an alternating (sine-wave) current or voltage may be applied or supplied
	**Grounded terminal** A grounded terminal, which as far as the operator is concerned, is already grounded by means of an earth grounding system
	**Protective grounding (earth) terminal** A terminal which must be connected to earth ground prior to making any other connection to the equipment
	**Equipotential connection (earth bonding)** A connection made to the plant grounding system which may be of type e.g. neutral star or equipotential line according to national or company practice
	**Temperature resistance of the connection cables** States, that the connection cables must be resistant to a temperature of at least 85 °C.

2 Identification

2.1 Parts of the Prosonic S FMU90

2.1.1 FMU90 in the field housing



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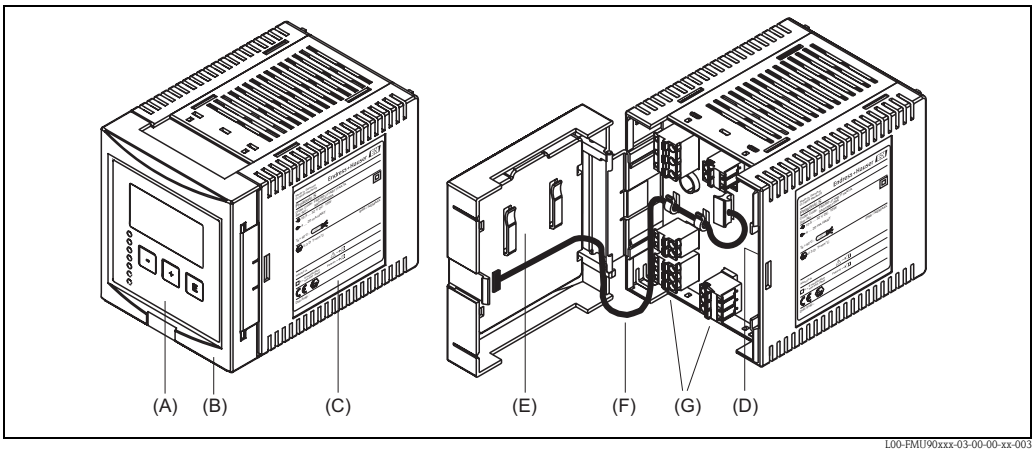
(A): *Display and operating module;* ***(B):*** *Cover of the terminal compartment;* ***(C):*** *Nameplate;* ***(D):*** *Instrument designation and identification;* ***(E):*** *Short instructions;* ***(F):*** *Display cable;* ***(G):*** *Terminals;* ***(H):*** *Mounting help;* ***(I):*** *Grounding terminals;* ***(K):*** *Prestamped openings for cable entries*

2.1.2 FMU90 in the DIN-rail housing



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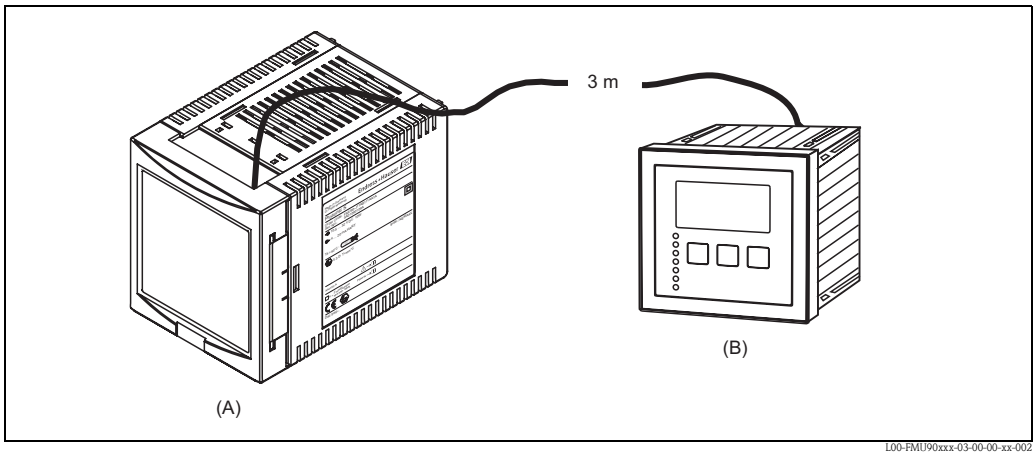
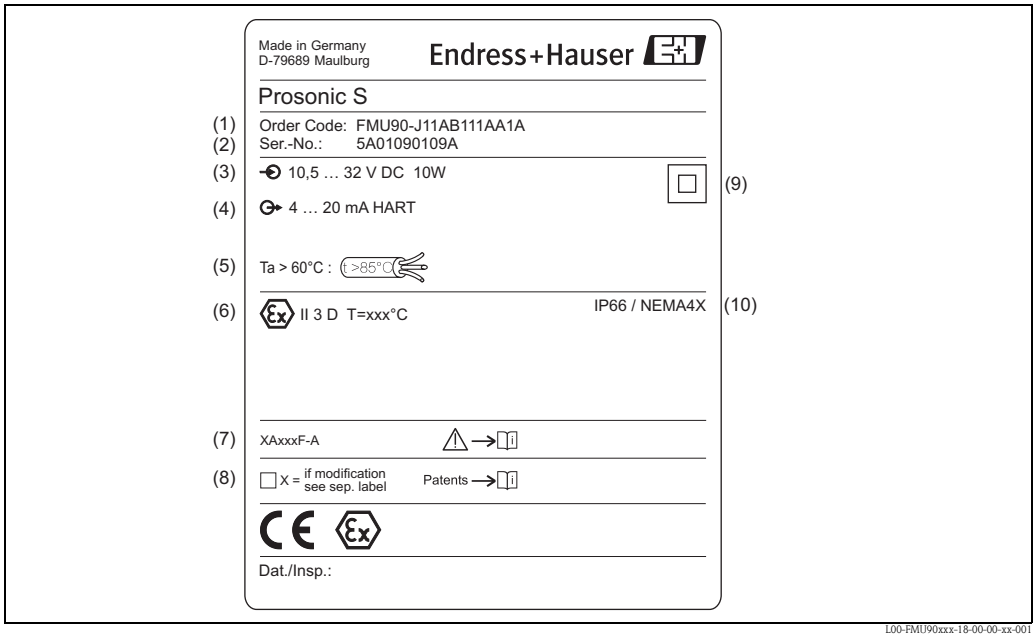
(A): *Display and operating module;* ***(B):*** *Cover of the terminal compartment;* ***(C):*** *Nameplate;* ***(D):*** *Instrument designation and identification;* ***(E):*** *Short instructions;* ***(F):*** *Display cable;* ***(G):*** *Terminals*

2.1.3 FMU90 with remote display and operating module for cabinet door and switchboard mounting (96x96 mm)



(A): DIN-rail housing without display; (B): Remote display and operating module for cabinet mounting; the cable (3 m) is supplied

2.2 Nameplate (Example)



(1): Order code (as defined by the product structure); (2): Serial number; (3): Power supply; (4): Output signal; (5): Specification of required temperature resistance of the connection cables; (6): Certificate-related data; (7): Reference to additional safety-relevant documentation; (8): Marked if a modification nameplate is present; (9): Specification of the electrical protection class (protective insulation); (10): Ingress protection

2.3 Product structure

10	**Approval**												
	R	Non-hazarous area											
	J	ATEX II 3D (in preparation)											
	N	CSA General Purpose											
20		**Application**											
		1	Level + pump control, alternating										
		2	Flow + totalizer + level + sample control + preprogrammed OCM flow curves										
30			**Housing, material**										
			1	Field mounting PC, IP66 NEMA 4x									
			2	DIN rail mounting PBT, IP20									
40				**Operation**									
				C	Illuminated display + keypad								
				E	Illuminated display + keypad, 96x96, panel mounting, front IP65								
				K	w/o display, via communication								
50					**Power supply**								
					A	90-253 VAC							
					B	10,5-32 VDC							
60						**Level input**							
						1	1x sensor FDU9x/8x						
						2	2x sensor FDU9x/8x						
70							**Switch output**						
							1	1x relay, SPDT					
							3	3x relay, SPDT					
							6	6x relay, SPDT					
80								**Output**					
								1	1x 0/4-20mA HART				
								2	2x 0/4-20mA HART				
								3	PROFIBUS DP				
90									**Additional input**				
									A	w/o additional input			
									B	4xlimit switch + 1xtemperature PT100/FMT131 (in preparation)			
100										**Datalog function**			
										A	Basic version		
110											**Languages**		
											1	de, en, nl, fr, es, it	
											3	en, zh, ja (in preparation)	
120												**Additional option**	
												A	Basic version
FMU90 –													complete product designation

2.4 Scope of delivery

- Instrument according to the version ordered
- ToF Tool – FieldTool Package
- for FMU90-***E********:
  remote display and operating module; retainers; connection cable (3 m)
- for FMU90-*21*********:
  2 slotted capstan screws (can be used to seal the housing)
- Accessories as ordered

2.5 Supplied documentation

2.5.1 Operating instructions (for transmitter FMU90)

Depending on the instrument version, the following operating instructions are supplied with the Prosonic S FMU90:

Operating instructions	Output	Application	Instrument version
BA 288F	HART	■ level measurement ■ alternating pump control ■ screen and rake control	FMU90 - *1*****1**** FMU90 - *2*****1**** FMU90 - *1*****2**** FMU90 - *2*****2****
BA 289F		■ flow measurement ■ backwater and dirt detection ■ totalizers and counters	FMU90 - *2*****1**** FMU90 - *2*****2****
BA 292F	PROFIBUS DP	■ level measurement ■ alternating pump control ■ screen and rake control	FMU90 - *1*****3**** FMU90 - *2*****3****
BA 293F		■ flow measurement ■ backwater and dirt detection ■ totalizers and counters	FMU90 - *2*****3****

These operating instructions describe installation and commissioning of the respective version of the Prosonic S. It contains those functions from the operating menu, which are required for a standard measuring task. Additional functions are contained in the "Descripiton of Instrument Functions" (BA 290F, see below).

2.5.2 Description of instrument functions

BA290F

contains a detailed description of **all** functions of the Prosonic S and is valid for all instrument versions. A PDF file of this document can be found
- on the CD-ROM of the "ToF-Tool - FieldTool Package", which is supplied together with the instrument
- in the internet at "www.endress.com"

2.5.3 Safety instructions

Additional safety instructions (XA, ZE, ZD) are supplied with certified device versions. Refer to the nameplate for the names of the safety instructions that apply to your device version.

2.6 Certificates and approvals

CE mark, declaration of conformity
The device is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The device complies with the applicable standards and regulations as listed in the EC declaration of conformity and thus complies with the statutory requirements of the EG directives. Endress+Hauser confirms the successful testing of the device by affixing to it the CE mark.

2.7 Registered trademarks

HART®
Registered trademark of HART Communication Foundation, Austin, USA

ToF®
Registered trademark of the company Endress+Hauser GmbH+Co. KG, Maulburg, Germany

3 Installation

3.1 Incoming acceptance, transport, storage

3.1.1 Incoming acceptance

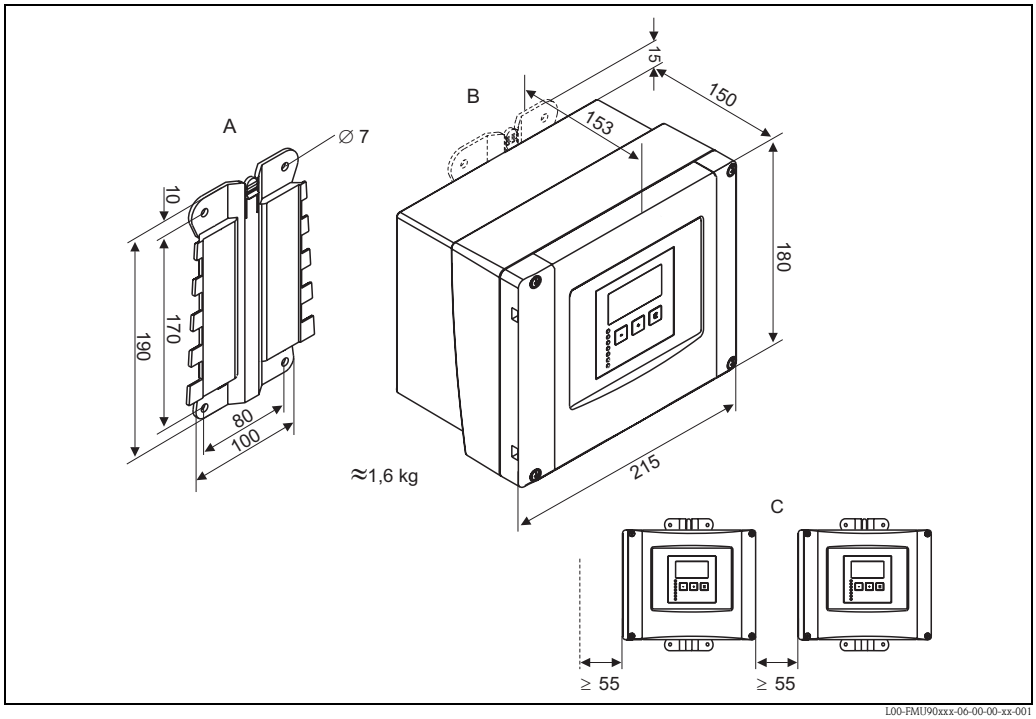
Check the packing and contents for any signs of damage.
Check the shipment, make sure nothing is missing and that the scope of supply matches your order.

3.1.2 Transport, storage

Pack the measuring instrument so that it is protected against impacts for storage and transport. The original packing material provides the optimum protection for this.
Permissible storage temperature: -40 ... +60 °C

3.2 Mounting the field housing

3.2.1 Dimensions of the field housing



Dimensions in mm
***A:** Mounting help (supplied); can also be used as drilling template ; **B:** Field housing; **C:** minimum mounting distance*

The dimensions of the field housing are the same for all instrument versions.
To open the housing, a minimum mounting distance of 55 mm is required on the left.

3.2.2 Installation conditions

Weather protection

In order to avoid excessive sunlight exposure, the instrument should be mounted in a position which is protected against direct sunlight or a protection cover should be applied (s. chapter "Accessories").

Overvoltage protection

In order to protect the Prosonic against overvoltages (especially if mounted outdoors), connection of an overvoltage protection is recommended (s. chapter "Accessories").

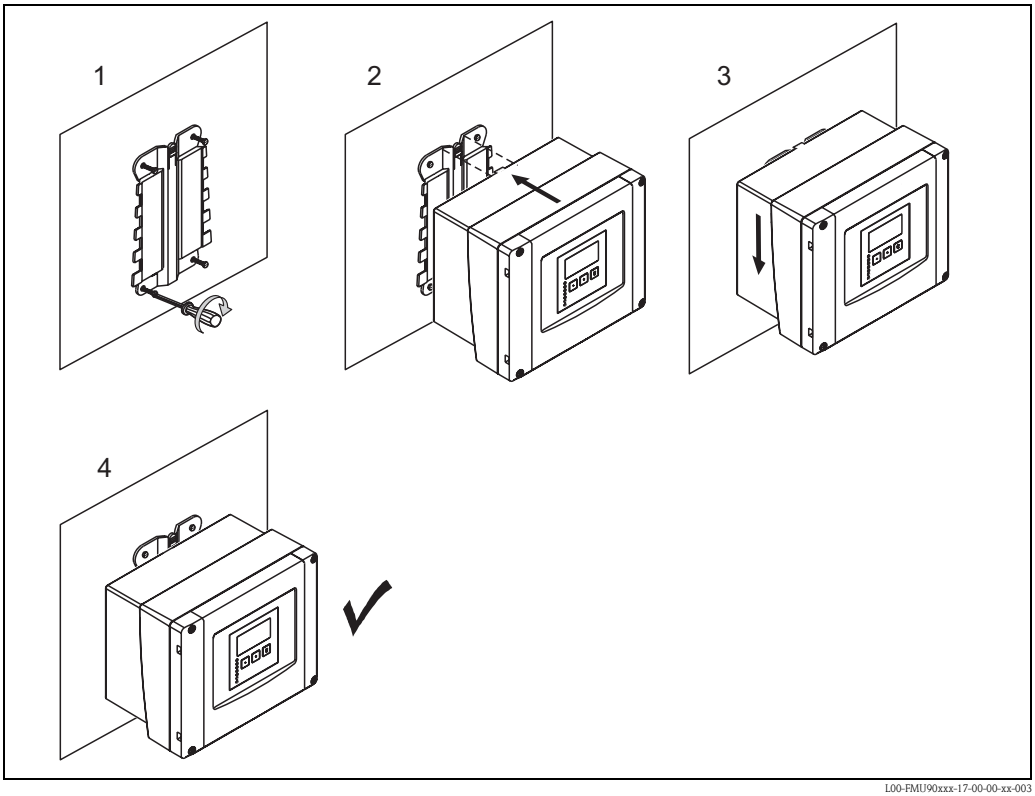
Wall mounting

A mounting help for wall mounting is supplied. It also serves as drilling template. The mounting help should be mounted on a flat surface and may not become distorted.

Pipe mounting

A mounting plate is available for mounting of the field housing to 1" – 2" pipes (s. chapter "Accessories").

3.2.3 Installation



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3.3 Mounting the DIN-rail housing

3.3.1 Dimensions of the DIN-rail housing

The dimensions of the DIN-rail housing depend on the instrument version. The version determines, which terminal areas the Prosonic S contains. The dimensions are influenced by the following features of the product structure (see chapter 2.3):

- 60: Level Input
- 70: Switch Output
- 80: Output

In order to determine the dimensions of a specific version, perform the following steps (see the example on page 15):

1. Using the product structure, determine the options of the features 60, 70 and 80 of the instrument version in question.

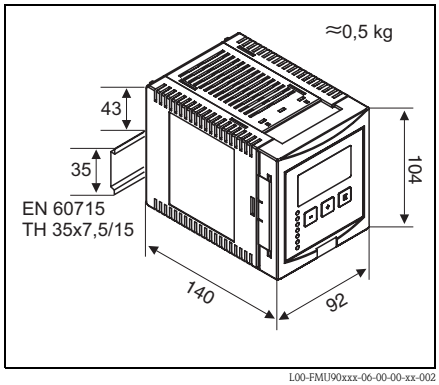
	10	20	30	40	50	**60**	**70**	**80**	90	100	110	120
FMU90 -												

2. Using the following table, determine how many optional terminal areas this instrument version contains.

Feature and option of the product structure	**corresponds to the following terminal area**	**present? yes = 1 no = 0**
feature 60; option 2 and/or feature 80, option 2	2 sensor inputs and/or 2 analogue outputs	
feature 70, option 3 or 6	3 o 6 relays	
feature 80, option 3	PROFIBUS DP interface	
	Sum =	

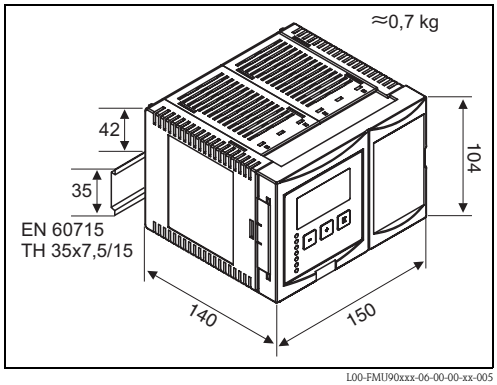
3. The appropriate dimensions are given in the following diagram:

Sum = 0
(only basic terminal area)



Dimensions in mm

Sum = 1, 2 or 3
(1-3 optional terminal areas)



Dimensions in mm

Example

	10	20	30	40	50	**60**	**70**	**80**	90	100	110	120
FMU90 -	R	1	2	A	A	2	3	2	A	A	1	A

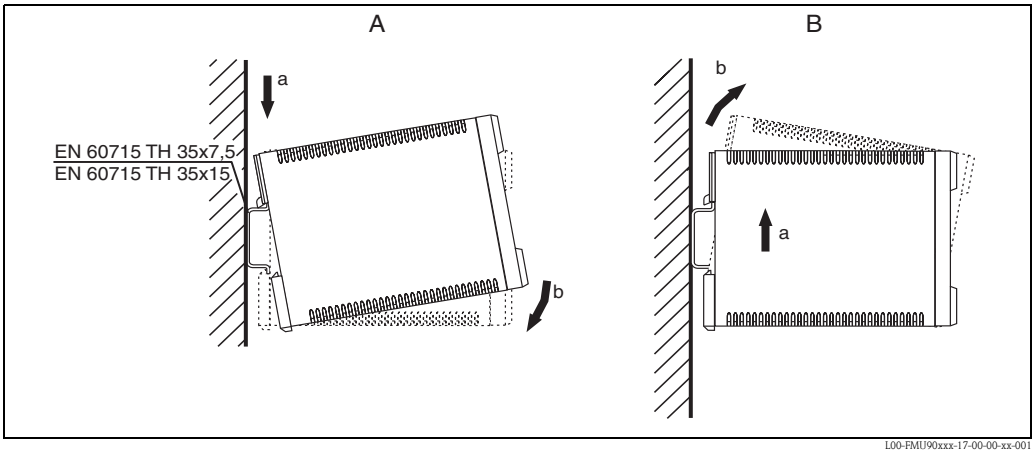
feature and option of the product structure	**corresponds to the following terminal area**	**present?**
feature 60; option 2 and/or feature 80, option 2	2 sensor inputs and/or 2 analogue outputs	1 (yes)
feature 70, option 3 or 6	3 or 6 relays	1 (yes)
feature 80, option 3	PROFIBUS DP interface	0 (no)
	Sum =	2

Sum = 2
=> 104 mm x 150 mm x 140 mm

3.3.2 Installation conditions

- The DIN-rail housing must be mounted outside hazardous areas in a cabinet.
- The housing is mounted on a DIN rail EN 60715 TH 35x7,5 or TH 37x15.
- Do not install the instrument in the vicinity of high-voltage lines, motor lines, contactors or frequency converters. The installation regulations for high-voltage lines, motor lines, contactors or frequency converters must be observed.
- To ensure easy mounting and opening of the housing, a distance of approx. 1 cm should be kept between the instruments.
- In order to avoid interference signals, the sensor cables should not be laid parallel to high voltage or electric power lines.
- The cables may not be laid in the proximity to frequnecy converters.

3.3.3 Mounting



***A:** Attaching the instrument to the rail; **B:** Detaching the instrument from the rail*

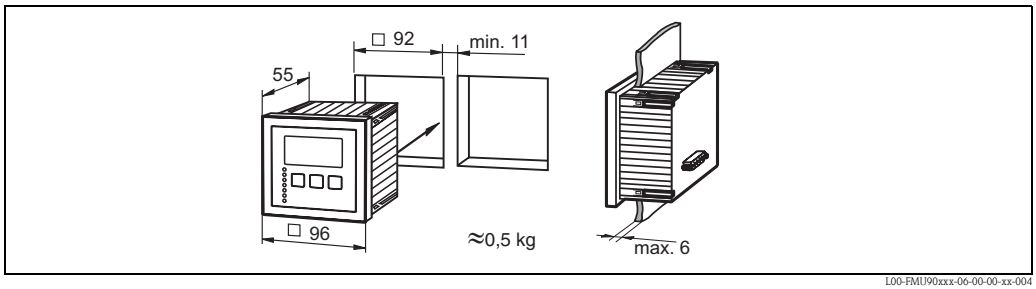
3.4 Mounting the remote display and operating module

3.4.1 Scope of delivery

If the Prosonic S is ordered with the display for cabinet door mounting, the following is contained in the scope of delivery:

- Display and operating module, 96x96 mm
- 4 retainers (with nuts and screws)
- Connection cable (3 m) for connection to the transmitter FMU90 (preassembled with suitable plugs; can not be extended).

3.4.2 Dimensions of the separate display and operating module

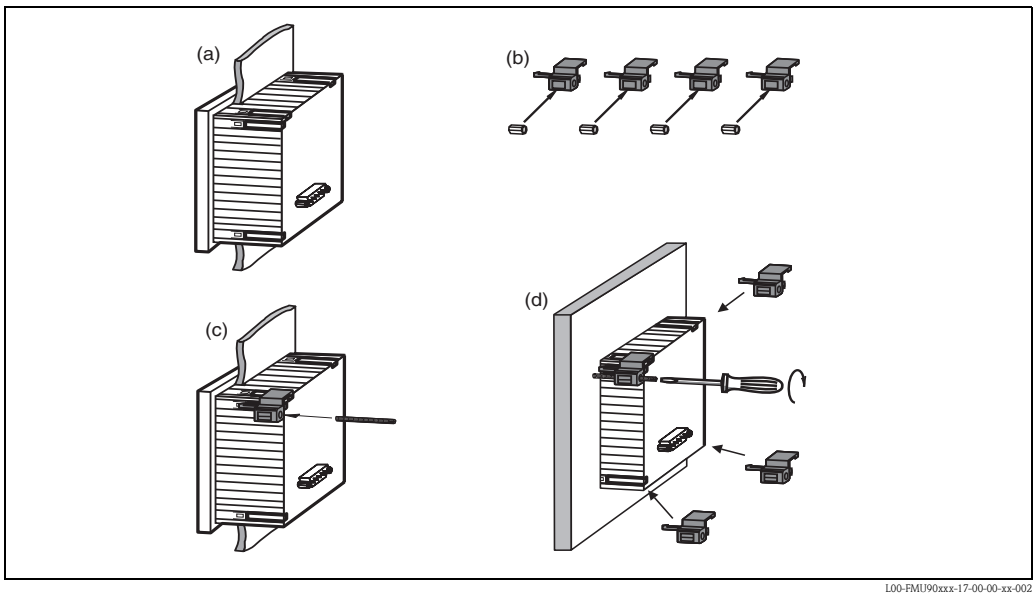


L00-FMU90xxx-06-00-00-xx-004

Dimensions in mm

3.4.3 Mounting

1. Cut an opening of 92 x 92 mm into the intended mounting position (e.g. cabinet door).
2. Insert the remote display module into the opening and fix the retainers as shown in the following figure:



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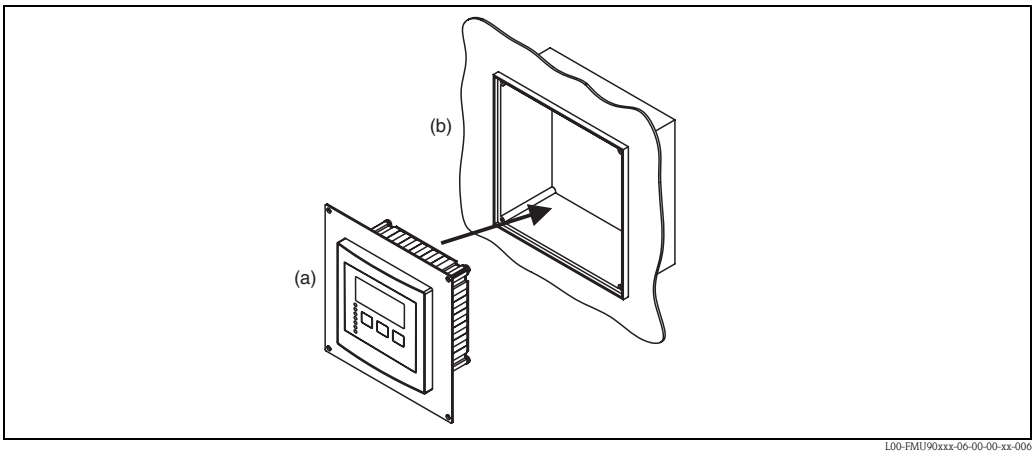
3.4.4 Adaption plate

If an opening of 138 mm x 138 mm and the remote display of the Prosonic FMU860/861/862 are already present, you can use the adaption plate (Order Code: 52027441, s. chapter "Accessories"). It is inserted into the remote display of the FMU860/861/862.



(a): *Remote display of the FMU90 with adaption plate;* ***(b):*** *Remote display of the FMU 860/861/862*

3.5 Mounting of the sensors

Information on the mounting of the sensors can be found in the following documents:

- Technical Information TI 189F (for FDU8x)
- Technical Information TI 396F (for FDU9x)

These documents are supplied with the sensors.

3.6 Installation check

After installing the device, carry out the following checks::

- Is the device damaged (visual inspection)?
- Does the device correspond to the meausring point specifications such as process temperature, process pressure, ambient temperature, measuring range etc?
- If available: Are the measuring point number and labelling correct?
- Is the instrument sufficiently protected against rainfall and direct sunlight?
- For the field housing: Are the cable glands tightened correctly?
- Is the instrument securely mounted to the DIN rail or the mounting help (visual inspection)?
- For the field housing: Are the screws of the terminal compartment cover securely tightened (visual inspection)?

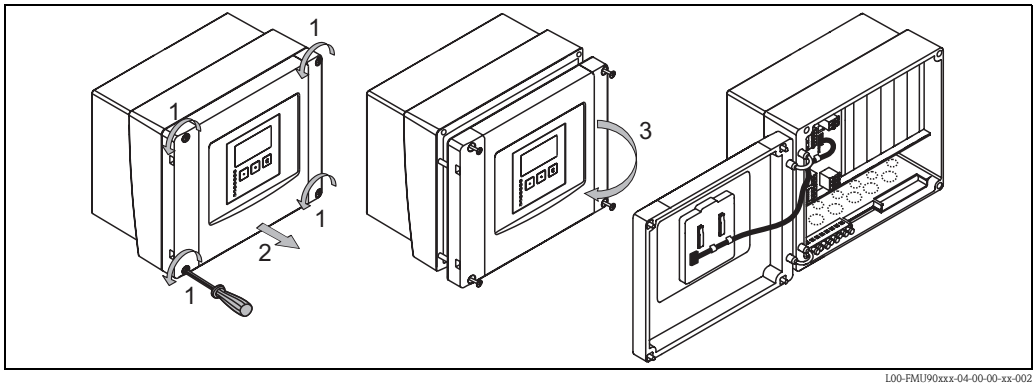
4 Wiring

Warning!
The instrument may only be installed if the supply voltage is switched off.

4.1 Terminal compartment

4.1.1 Terminal compartment of the field housing

The field housing has a separate terminal compartment. It can be opened after loosening the four screws of the lid.



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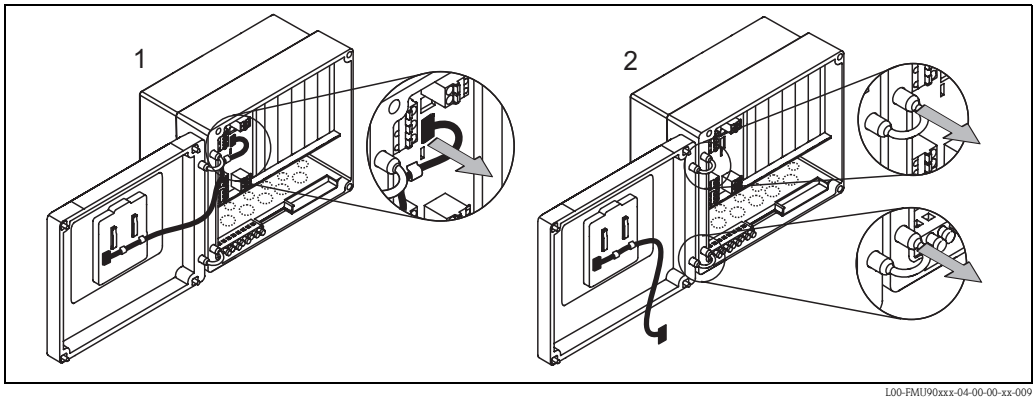
For easier wiring, the lid can be completely removed by unplugging the display plug (1) and pulling off the hinges (2):



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4.1.2 Cable entries of the field housing

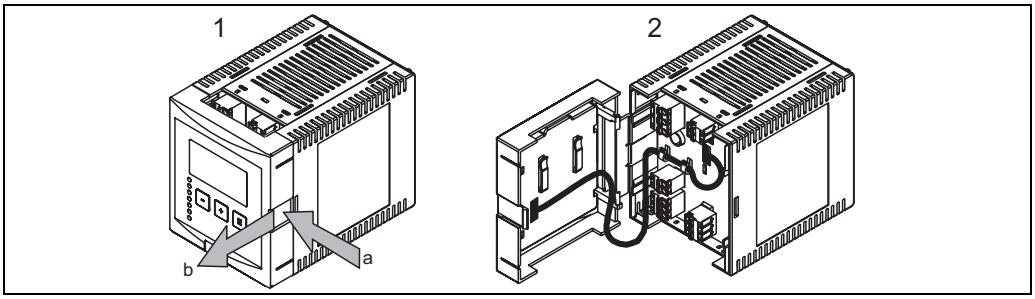
The following openings for cable entries are prestamped on the bottom of the housing :

- M20x1,5 (10 openings)
- M16x1,5 (5 openings)
- M25x1,5 (1 opening)

The required number and types of cable entries depend on the application at hand.
The prestamped openings can be removed by a suitable tool (e.g. knife or boring bit) or by punching them out cautiously.

4.1.3 Terminal compartment of the DIN-rail housing

Single instrument



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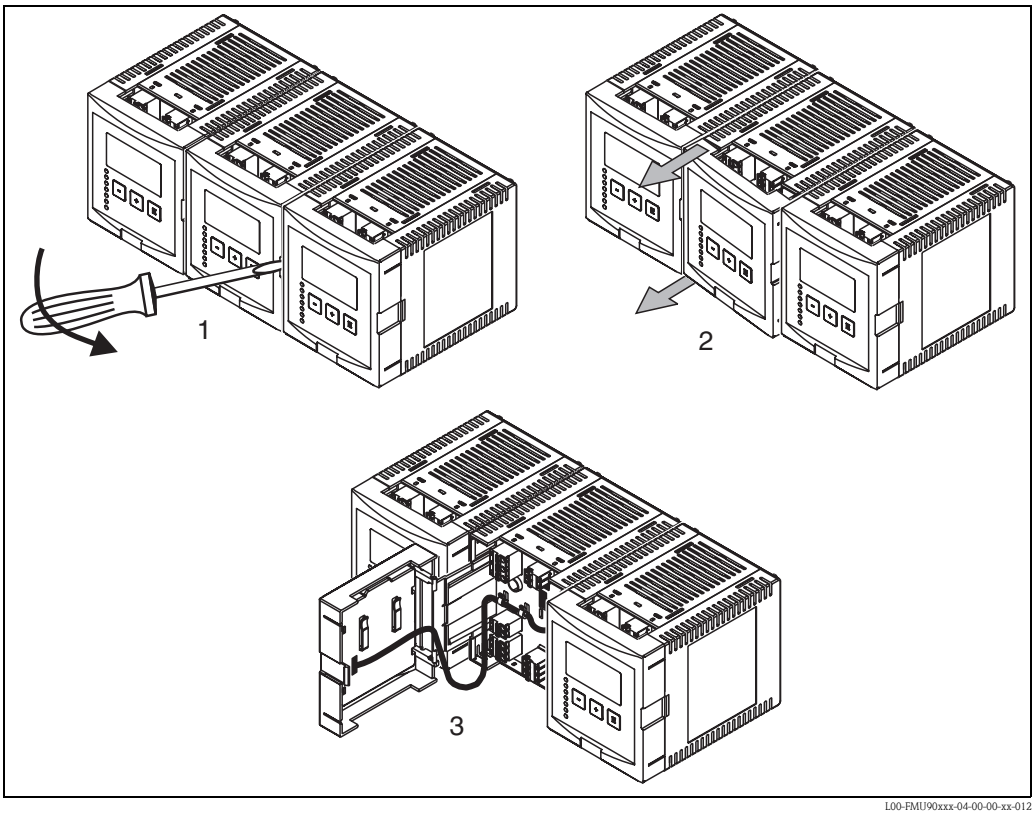
The catch can be unlocked by slightly pressing onto the clip. Then, the cover of the terminal compartment can be opened.

Several instrument mounted side by side



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1. Open the catch of the cover (e.g. by a screwdriver).
2. Pull the cover out by approx. 2 cm.
3. The cover can now be opened.

Note!
The cables can be inserted into the housing from above or from below.

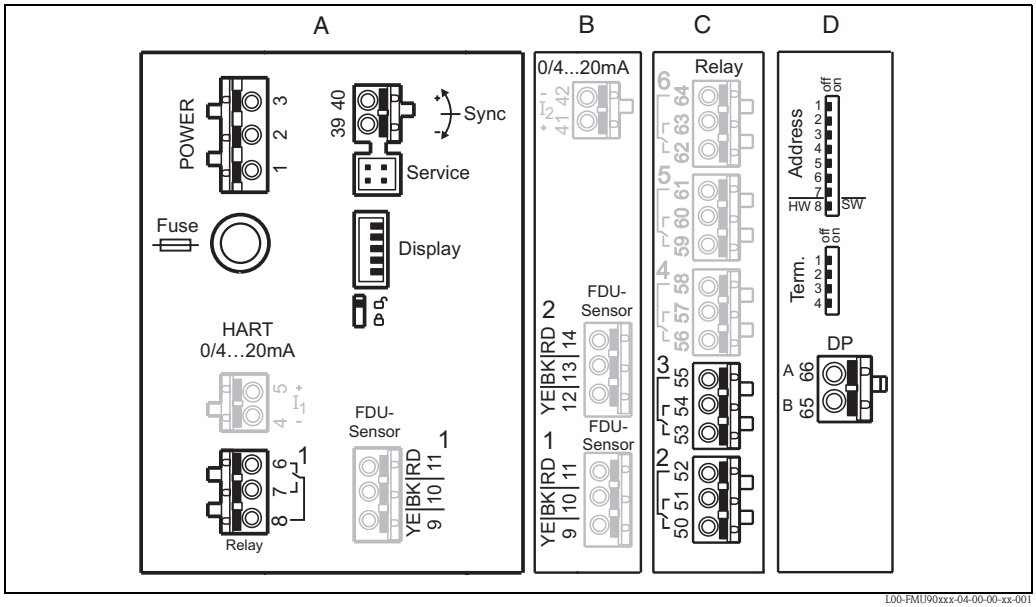
4.2 Terminal assignment

Pluggable spring-force terminals for connection of the cables are supplied in the terminal compartment. Rigid conductors or flexible conductors with cable sleeve can directly be inserted and are contacted automatically.

Conductor cross section	0,2 mm² - 2,5 mm²
Cable and sleeve cross section	0,25 mm² - 2,5 mm²
min. stripping length	10 mm

The terminal configuration depends on the instrument version ordered. There is a basic terminal area, which is present in every instrument version. Additonal optional terminal areas are only present if the respective option has been selected in the product structure.

Terminal area		**present for the following instrument versions**
Basic area	A	for all versions
Optional areas	B	for instrument versions with 2 sensor inputs and/or 2 analogue outputs (FMU90 - *****2****** and/or FMU90 - *******2****)
	C	for instrument versions with 3 or 6 relays (FMU90 - ******3***** oder FMU90 - ******6*****)
	D	for instrument versions with PROFIBUS DP interface (FMU90 - *******3****)



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Terminals of the Prosonic S; the terminals depicted in grey are not present in every instrument version.
***A:** Basic terminal area; **B-D:** Optional terminal areas (present if the respective option has been selected in the product structure)*

Note!
The depticted switching states of the relays refer to the de-energized state.

Terminals	Meaning	Terminal area	Remarks
Auxiliary energy			
1, 2	Auxiliary energy	A	depending on instrument version: ■ 90 ... 253 V_{AC} ■ 10,5 ... 32 V_{DC}
3	Potential equalization	A	
Analog outputs (not available for Profibus DP instruments)			
4, 5	Analog output 1; 4 ... 20 mA with HART/ 0 ... 20 mA w/o HART	A	**not** present for the PROFIBUS DP version
41, 42	Analog output 2 (optional); 4 ... 20 mA/ 0 ... 20 mA	B	only for the version with two analog outputs; no HART signal at this output
Relay outputs			
6, 7, 8	Relay 1	A	
50, 51, 52	Relay 2 (optional)	C	only for the versions with 3 or 6 relays
53, 54, 55	Relay 3 (optional)	C	only for the versions with 3 or 6 relays
56, 57, 58	Relay 4 (optional)	C	only for the version with 6 relays
59, 60, 61	Relay 5 (optional)	C	only for the version with 6 relays
62, 63, 64	Relay 6 (optional)	C	only for the version with 6 relays
Bus communication (only available for Profibus DP instruments)			
65	PROFIBUS B (RxT/TxD - P)	D	only for the PROFIBUS DP version
66	PROFIBUS A (RxT/TxD - N)	D	
Synchronization			
39, 40	Synchronization	A	see section 4.6, "Synchronization line"
Level inputs			
9 (YE), 10 (BK), 11 (RD)	Sensor 1 (FDU8x/9x) YE: yellow strand BK: black strand RD: red strand	■ A: for versions with 1 sensor input ■ B: for versions with 2 sensor inputs[1)]	
12 (YE), 13 (BK), 14 (RD)	Sensor 2 (FDU8x/9x) (optional) YE: yellow strand BK: black strand RD: red strand	B	only for the version with 2 sensor inputs

1) In this case, terminals 9/10/11 are not present on terminal area A.

Warning!
When using the public supply mains, an easily accesible power switch must be installed in the proximity of the device. The power switch must be marked as a disconnector for the device (IEC/EN 61010)

Note!
- In order to avoid interference signals, the sensor cables should not be laid parallel to high voltage or electric power lines.
- The cables may not be laid in the proximity to frequnecy converters.

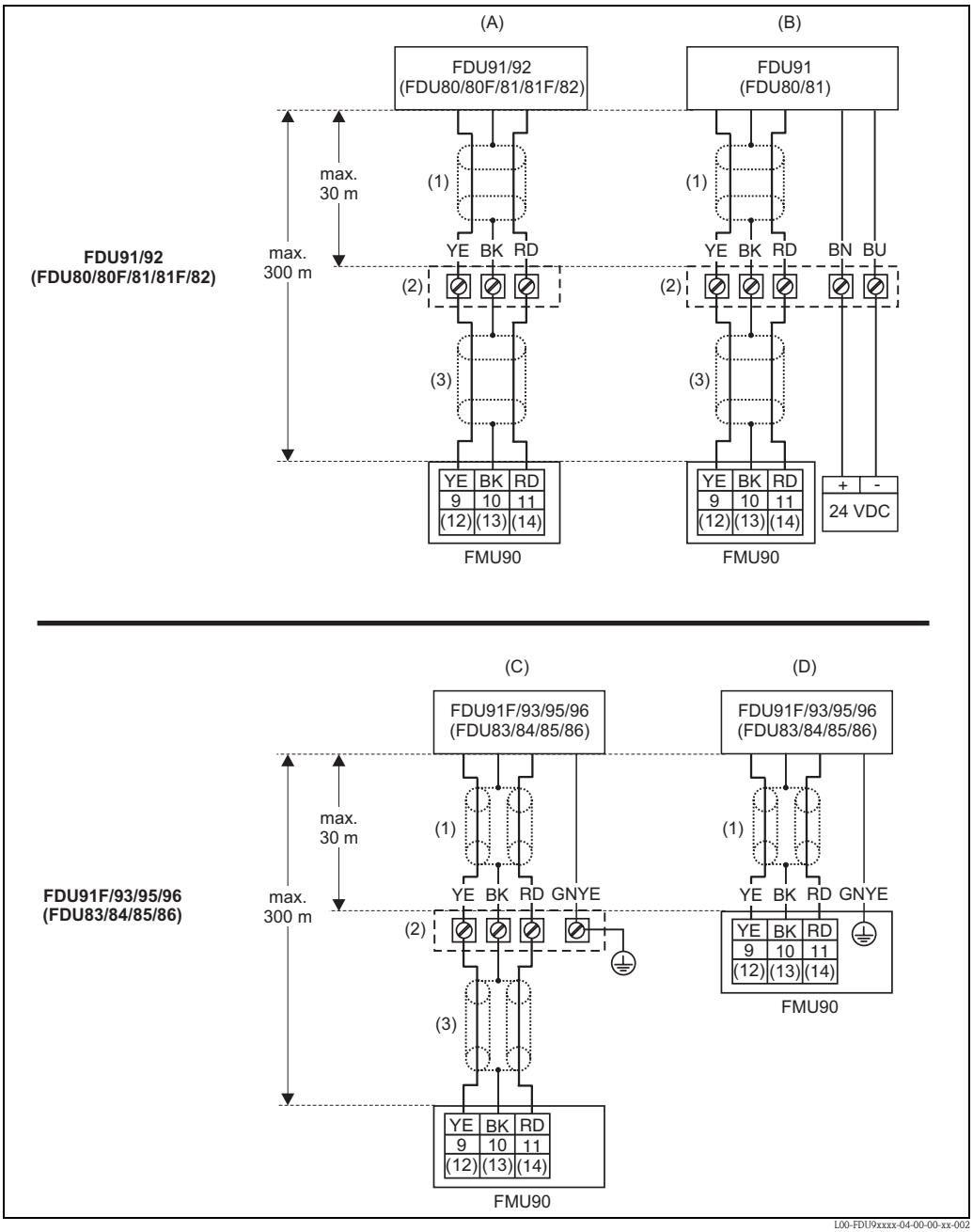
Additional elements on the terminal areas

Designation	Meaning/Remarks
Fuse	Fuse: 2 A T /DC or 400 mA T/AC
Display	Connection of the display or the remote display and operating module (see chap. 4.7)
Service	Service interface for connection of a PC/Notebook via Commubox FXA291 (see chap. 5.1)
	Locking switch, see chap. 5.5.3
Term.	Bus termination (only applicable for instruments with PROFIBUS interface)
Address	Bus address (only applicable for instruments with PROFIBUS interface)

Warning!
On wiring, the supply voltage must be switched off.

4.3 Sensor connection

4.3.1 Connection diagram



(A): without sensor heater;
(B): with sensor heater;
(C): grounding at the terminal box;
(D): grounding at the transmitter FMU90;
(1): Screen of the sensor cable;
(2): Terminal box;
(3): Screen of the extension cable;
Colours of the strands: YE = yellow; BK = black; RD = red; BU = blue; BN = brown; GNYE = green-yellow

4.3.2 Connection hints

Caution!
In order to avoid interference signals, the sensor cables should not be laid parallel to high voltage electric power lines. The cables may not be laid in the proximity to frequency converters.

Caution!
The cable screen serves as a return cable and must be connected to the transmitter without any electrical break. With the pre-assembled cables, the screen ends in a black strand (BK). With the extension cable, the screen must be twisted together and connected to the "BK" terminal.

Warning!
The sensors FDU83, FDU84, FDU85 and FDU86 with an ATEX, FM or CSA certificate are not certified for connection to the FMU90 transmitter.

Warning!
for the sensors FDU91F/93/95/96 and FDU83/84/85/86:
The ground lead (GNYE) must be connected to the local potential equalization **after a maximum distance of 30 m**. This can be done
- either at the terminal box
- or at the transmitter FMU90 or in the cabinet (if the distance to the sensor does not exceed 30 m).

Note!
For easier mounting it is advisable to use the sensors FDU91/92 and FDU80/80F/81/81F/82 with a maximum cable length of 30 m as well. For longer distances an extension cable should be used.

4.3.3 Extenxion cables for the sensors

For distances up to 30 m the sensor can be directly connected by the sensor cable. For longer distances, it is recommended to use an extension cable. The extension cable is connected via a terminal box. The total length (sensor cable + extension cable) may be up to 300 m.

Caution!
If the terminal box is installed in explosion hazardous areas, all applicable national guidelines must be observed.

Suitable extension cables can be obtained from Endress+Hauser (s. chapter "Accessories")
Alternatively, cables with the following properties can be used:

- Number of cores according to the connection diagram (see above)
- braided wire screen for the yellow (YE) and red (RD) core (no foil screen)
- Length: up to 300 m (sensor cable + extension cable)
- Cross section: 0,75 mm^2 to 2,5 mm^2
- up to 6 Ω per core
- max. 60 nF
- for FDU91F/93/95/96 and FDU 83/84/85/86:
  The earth lead must not be within the screening.

4.4 Connection of the sensor heater (for FDU91)

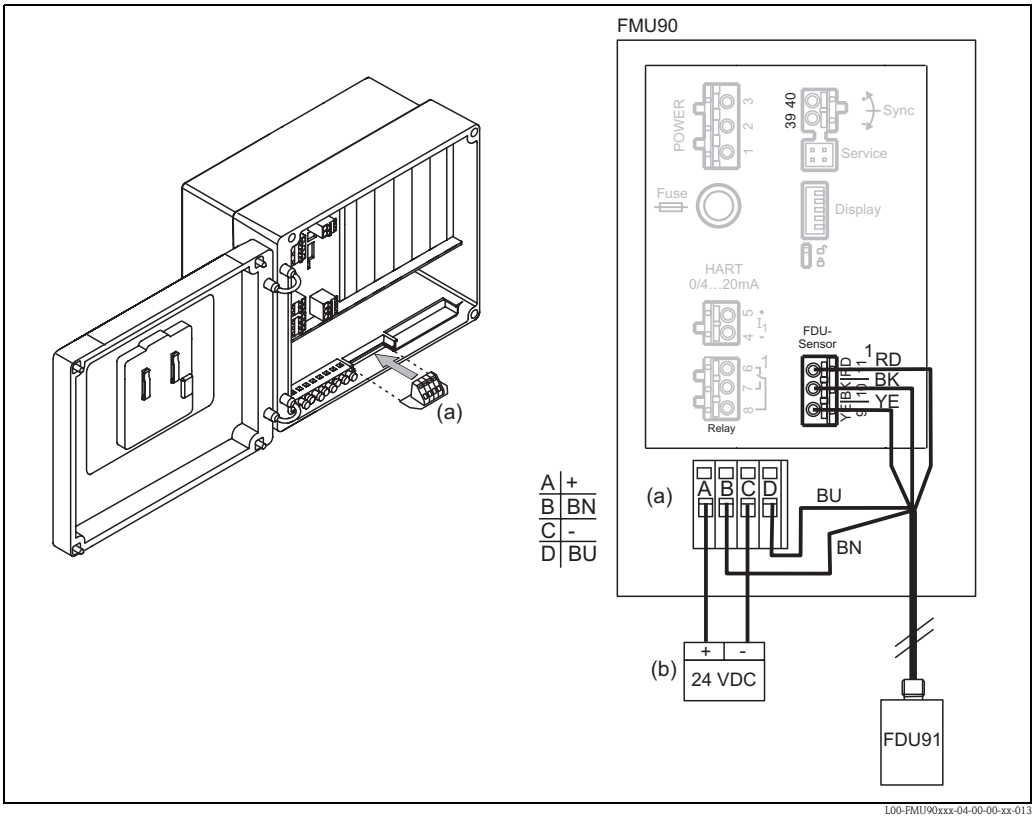
The FDU91 sensor is available in a version with heater. The power for this heater must be provided by an external power supply unit. The supply voltage is connected to the brown (BN) and blue (BU) strands of the sensor cable.

Technical Data

- 24 VDC ± 10%; residual ripple < 100 mV
- 250 mA per sensor

4.4.1 Connection in the field housing

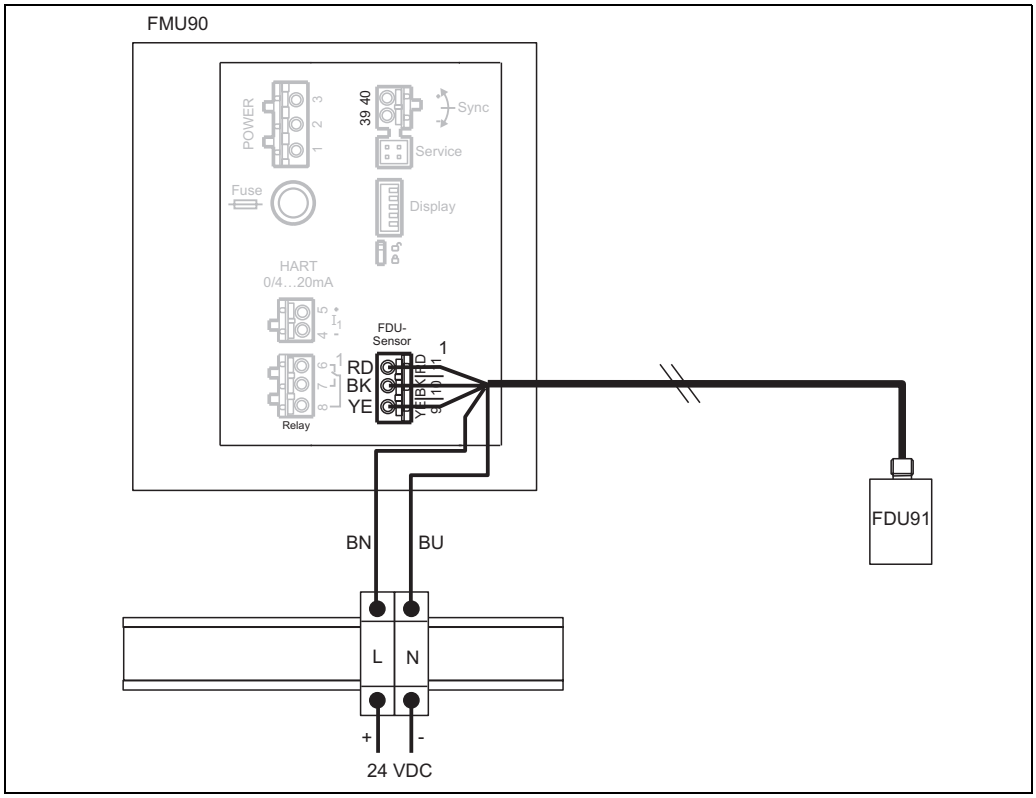
For the sensor with heater, a special terminal module is supplied for the connection of the supply voltage. This terminal module can be inserted into the field housing:



(a): *Terminal module for the sensor heater;* ***(b):*** *External power supply unit;*
BN: *Brown strand;* ***BU:*** *Blue strand*

4.4.2 Connection in the DIN-rail housing

The supply voltage must be provided in the cabinet, e.g. by a terminal on the DIN-rail:



L00-FMU90xxx-04-00-00-xx-014

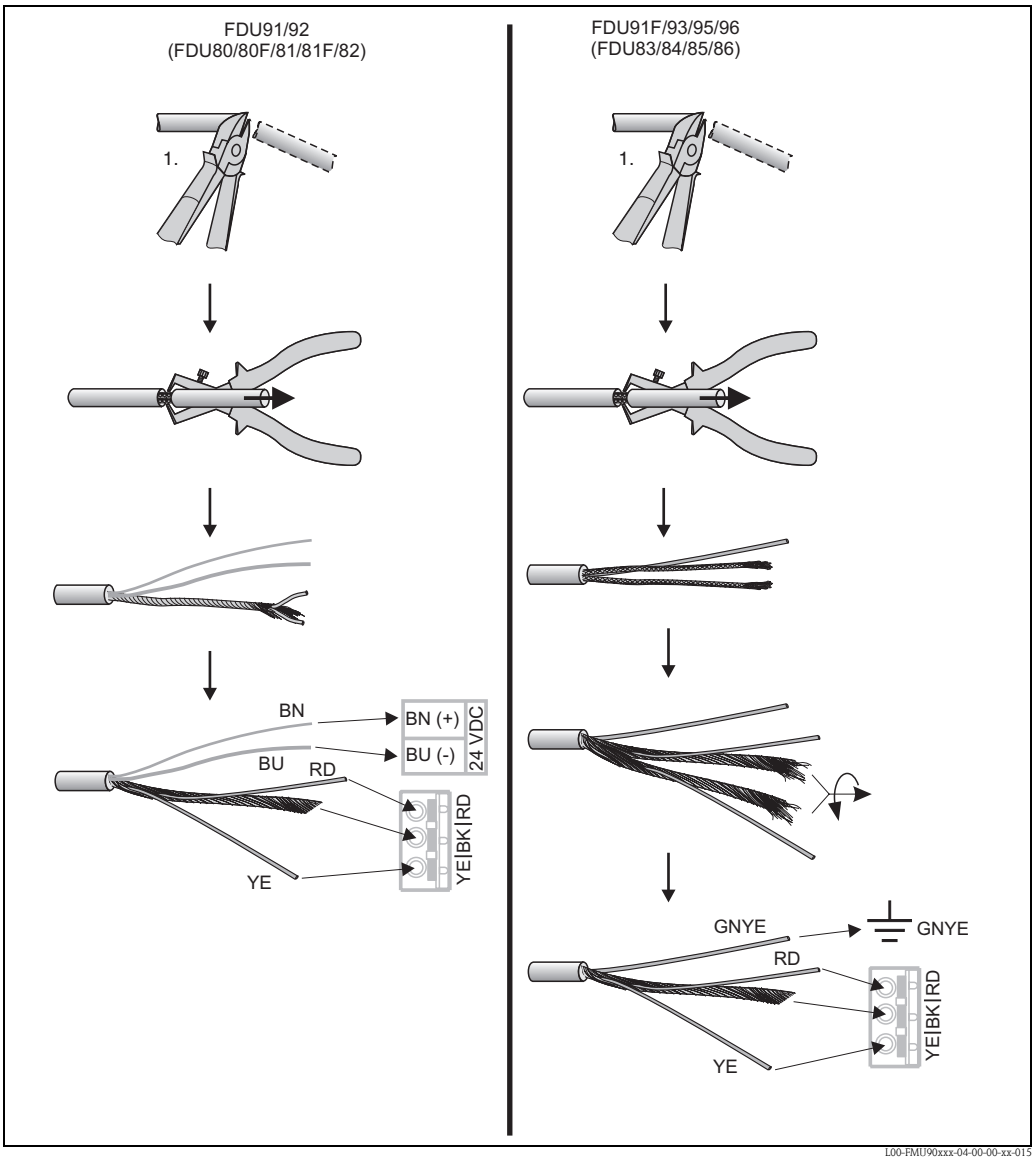
Note!
The terminal module supplied with the sensor can also be used for connection of the supply voltage. For the terminal assignment on this module see page 25.

4.5 Shortening the sensor cable

If required, the sensor cable can be shortened. Please note:

- Do not damage the cores when removing the insulation.
- The cable is shielded by a metallic braiding. This shielding serves as a return cable and corresponds to the black (BK) strand of the unshortened cable. After shortening the cable, loosen the metallic braiding, twist it together securely and connect it to the "BK" terminal.

Caution!
The protective earth conductor (GNYE), which is present in some of the sensor cables, may not be electrically connected to the cable shield.

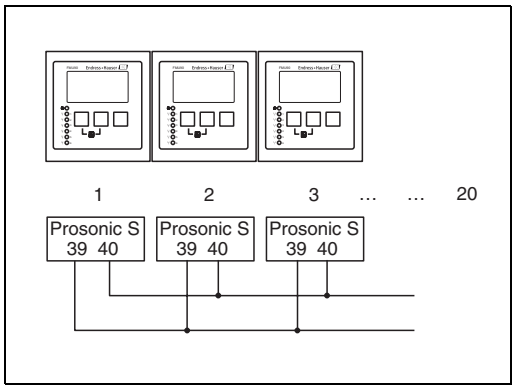


Colours of the strands: YE = yellow; BK = black; RD = red; BU = blue; BN = brown; GNYE = green-yellow

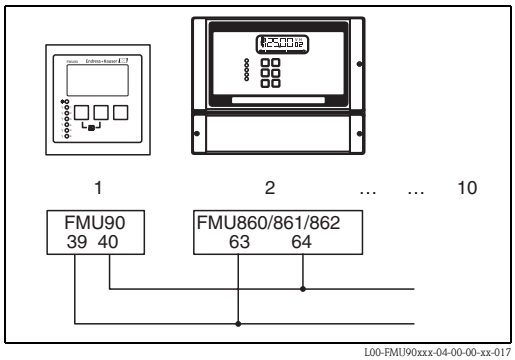
Note!
The blue (BU) and brown (BN) strands are only present for sensors with heater.

4.6 Synchronization line

- If wiring several Prosonic S, which are mounted in a common cabinet and if the sensor cables run in parallel, the synchronization terminals (39 and 40) must be interconnected.
- Up to 20 instruments can be synchronized in this way.
- If there are more than 20 instruments, groups must be formed, each containing a maximum of 20 instruments. For the instruments within each group, the sensor cables may run in parallel. The sensor cables of different groups must be seperated from each other.
- Usual commercial screened cable can be used for synchronization
  - max. length: 10 m between the individual instruments
  - cross section: 2 x (0.75 - 2.5 mm^2)
  - for lengths up to 1 m, an unscreened cable can be used; for lenghts exceeding 1 m, screening is required. The screen must be connected to ground
- Instruments of the Prosonic FMU86x family can be connected to the synchronization line as well. In this case a maximum of 10 instruments can be connected to each synchronisation line.

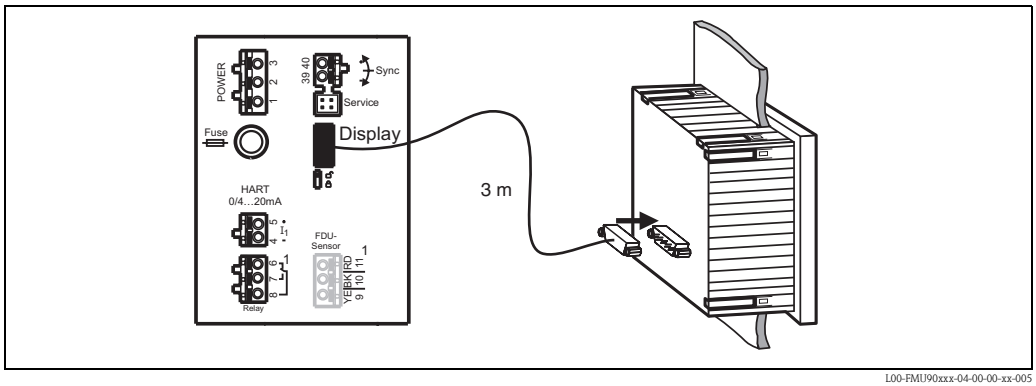


L00-FMU90xxx-04-00-00-xx-004



L00-FMU90xxx-04-00-00-xx-017

4.7 Connection of the separate display and operating module



L00-FMU90xxx-04-00-00-xx-005

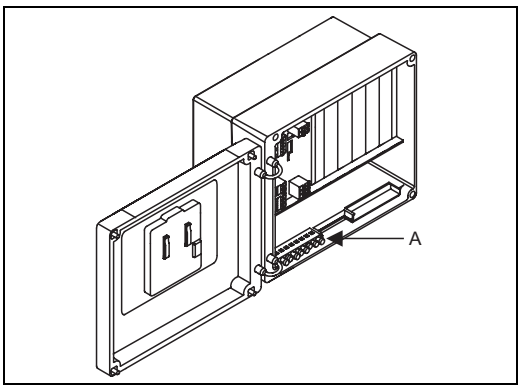
For the version of the Prosonic S with a separate display for panel mounting, a pre-assembled connecting cable (3 m) is supplied. The cable must be connected to the display plug of the Prosonic S.

Note!
Minimum diameter for cable bushing: 2 cm

4.8 Potential equalization

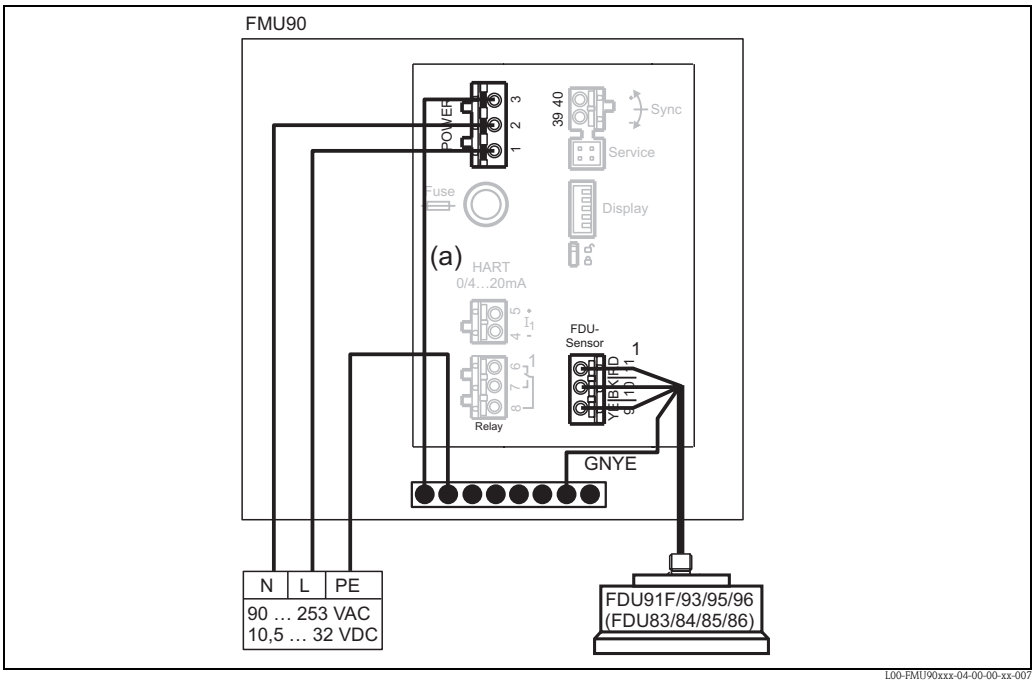
4.8.1 Potential equalization in the field housing

⚠ Warning!
The grounding line of the sensors FDU91F/93/95/96 and FDU83/84/85/86 must be connected to the local potential equalization system **after a maximum of 30 m** (see section 4.3.1). The metallic terminal block (A) in the field housing can be used for this.



L00-FMU90xxx-04-00-00-xx-006

Example



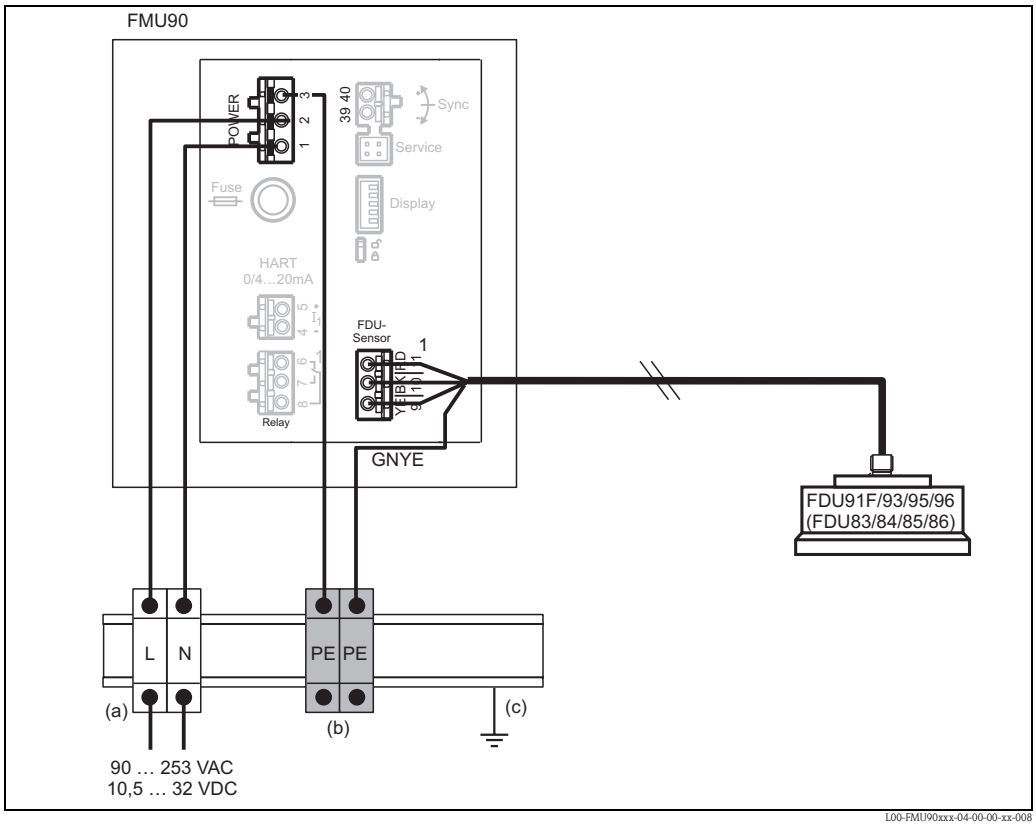
L00-FMU90xxx-04-00-00-xx-007

*The wire **(a)** is already connected on delivery.*

4.8.2 Potential equalization for the DIN-rail hosuing

If the DIN-rail housing is used, the potential equalization must be connected in the cabinet, e.g. at a metallic DIN rail:

Warning!
The grounding line of the sensors FDU91F/93/95/96 and FDU83/84/85/86 must be connected to the local potential equalization system **after a maximum of 30 m** (see section 4.3.1).



(a): *Terminal (isolated from the DIN rail);* ***(b):*** *Protective earth terminal (with contact to the DIN rail);* ***(c):*** *Protective ground via DIN rail*

Caution!
The signal evaluation electronics and its direct connections (display/service interface, CDI interface etc.) are galvanically isolated from the supply voltage and the communication signals. Their electric potential is identiacal to the potential of the sensor electronics.
Pay attention to the potential difference if the sensors are connected to ground!

Note!
- The longest required distance has to be taken into account when removing the jacket of the sensor cable (GNYE in the above example).
- When shortening the sensor cable, comply to the notes in section 4.5, "Shortening the sensor cable".

4.9 Post-connection check

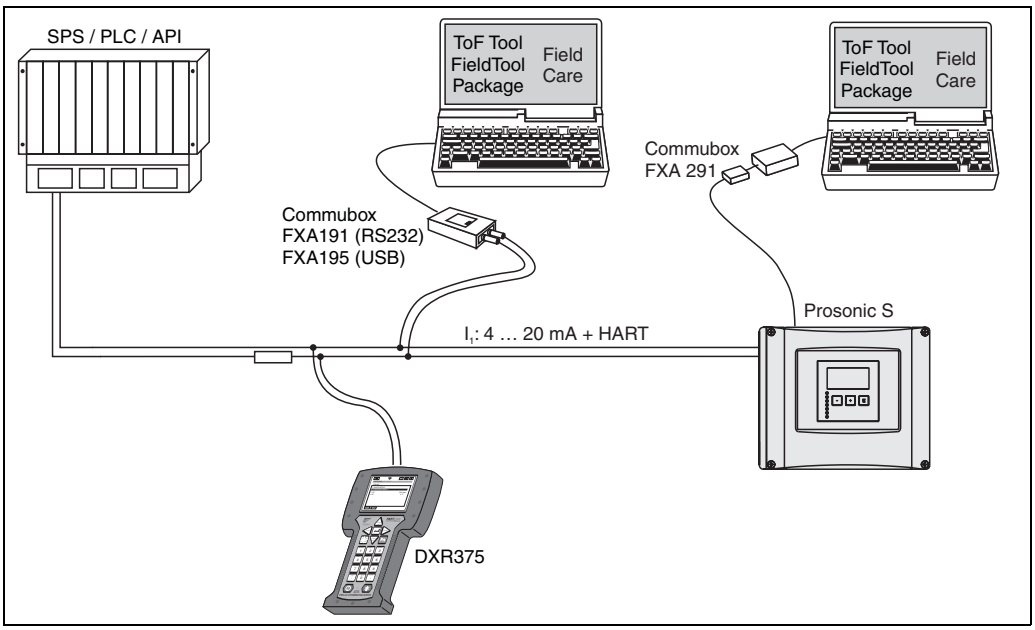
After wiring the transmitter, carry out the following checks:

- Is the terminal assignment correct?
- For the field housing: Are the cable glands tight and is the cover of the terminal compartment securely closed?
- If auxiliary energy is switched on: Does a display appear on the display module (if available) and does the green LED light up?

5 Operation

5.1 Operating options

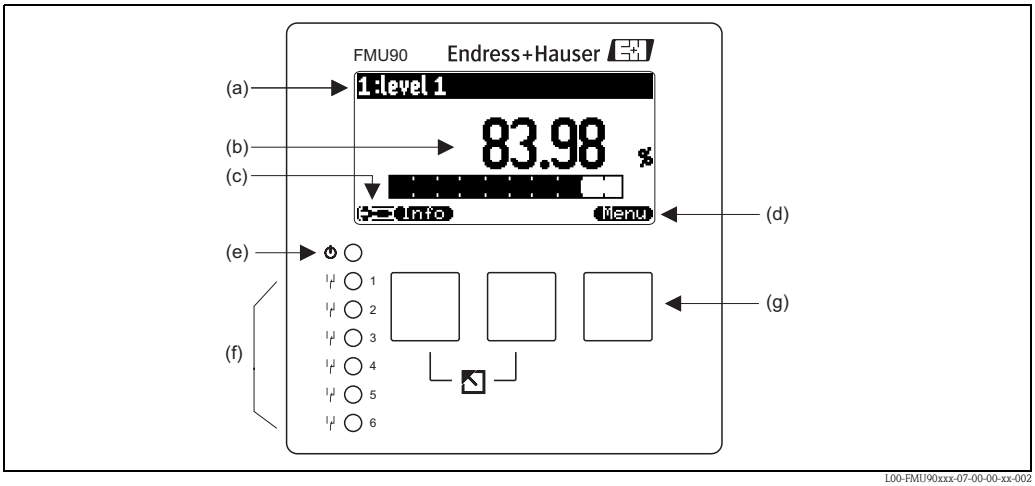
- via the operating and display module at the Prosonic S (if present)
- via the service interface of the Prosonic S with the Commubox FXA291 and the operating program "ToF Tool – FieldTool Package" or "FieldCare"
- via the HART protocol, e.g. with the Commubox FXA191 or FXA195 and the operating program "ToF Tool – FieldTool Package" or "FieldCare"
- via the HART handheld terminal DXR375



L00-FMU90xxx-14-00-00-xx-009

5.2 Operation via the display and operating module

5.2.1 Display and operating elements



L00-FMU90xxx-07-00-00-xx-002

(a): name of the parameter; (b): value of the parameter, including unit; (c): display symbols; (d): softkey symbol; (e): LED indicating the operating state; (f): LEDs indicating the switching states of the relays; (g): keys

Display symbols

Symbol	Meaning
Operating mode of the instrument	
	**User** User parameters can be edited. Service parameters are locked.
	**Diagnosis** The service interface is connected.
	**Service** User and service parameters can be edited.
	**Locked** All parameters are locked.
Locking state of the currently displayed parameter	
	**Display parameter** The parameter can **not** be edited in the current operating mode of the instrument.
	**Editable parameter** The parameter can be edited.
Scroll symbols	
	**Scroll list available** Indicates that the list contains more parameters than can be represented on the display. By pressing ↑ or ↓ repeatedly, all parameters of the list can be accessed.
Navigation in the envelope curve display	
	**Move left**
	**Move right**
	**Zoom in**
	**Zoom out**

LEDs

LED indicating the operating state (pos. (e) in the figure)	
green	normal measuring mode; no error detected
red (flashing)	Warning: An error is detected but the measurement continues. Reliability of the measured value is no longer ensured.
red	Alarm: An error is detected. The measurement is interrupted. The measured value assumes the value specified by the user (parameter "output on alarm").
off	supply voltage missing

LEDs for the relays (pos. (f) in the figure)	
yellow	The relay is activated.
off	The relay is de-activated (idle state).

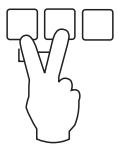
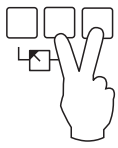
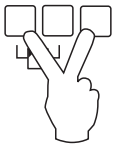
Keys (softkey operation)

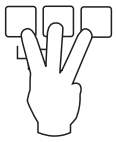
The function of the keys depends on the current position within the operating menu (softkey functionality). The key functions are indicated by softkey symbols in the bottom line of the display.

Symbol	Meaning
	**Move downwards** Moves the marking bar downwards within a selection list.
	**Move upwards** Moves the marking bar upwards within a selection list.
	**Enter** ■ Opens the marked submenu, the marked parameter set or the marked parameter ■ Confirms the edited parameter value
	**Previous parameter set** Reopens the previous parameter set within the submenu.
	**Next parameter set** Opens the next parameter set within the submenu.
	**Confirm selection** Selects the option of a selection list which is currently marked by the bar.
	**Increase value** Increases the active digit of an alphanumeric parameter.
	**Decrease value** Decreases the active digit of an alphanumeric parameter
	**Error list** Opens the list of all errors which are currently detected. If a warning is present, this symbol flashes. If an alarm is present, the symbol is displayed continuously.
	**Change Display** Change to the next page of measured values (only available if more than one pages of measured values have been defined; see chapter 7)
	**Info** Opens the Shortcut Menu, which contains the most important information about the current state of the instrument
	**Menu** Opens the Main Menu, which contains **all** parameters of the Prosonic S

General key combinations

The following key combinations do not depend on the menu position:

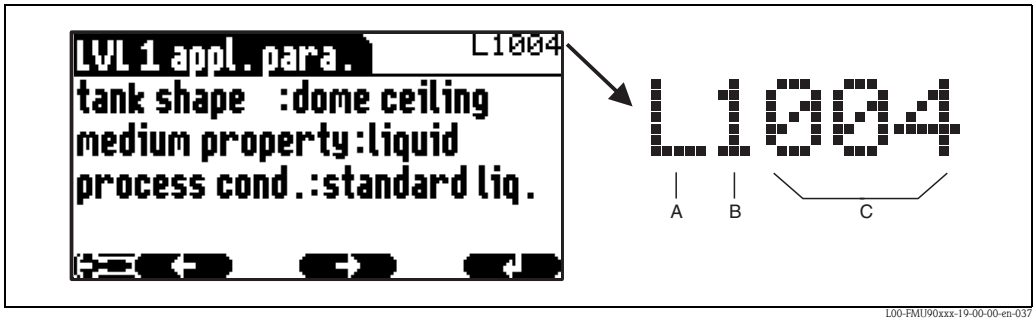
Key combination	Meaning
	**Escape** ■ While editing a parameter: Exit the editing mode without accepting the changes. ■ Within the navigation: Move upwards to the previous layer of the menu.
	**Increase contrast** Increases the contrast of the display module.
	**Decrease contrast** Decreases the contrast of the display module.

Key combination	Meaning
	**Locking** Locks the instrument against parameter changes. The isntrument can only be unlocked again by the keys (see 5.5.2).

5.2.2 The operating menu

Structure of the menu

The parameters of the Prosonic S are organized in an operating menu (consisting of a main menu and several submenus). Parameters which are related to each other are comprised in a common parameter set. To simplify the navigation within the menu, a five-digit position code is displayed with each parameter set.



*Identification of the parameter sets; **A:** submenu; **B:** number of the associated input or output; **C:** number of the parameter set within the submenu*

- The **first digit (A)** specifies the submenu[1]:
  - **L:** "level"
  - **F:** "flow"
  - **A:** "safety settings"
  - **R:** "relay/controls"
  - **O:** "output/calculations"
  - **D:** "device properties", "calibr. display" and "sensor management"
  - **I:** "system information"
  - **S:** "service" (only available if the service password has been entered)

  Diagrams of the submenus can be found in chapter 14.

- The **second digit (B)** is used if the parameter set occurs several times within the Prosonic S (e.g. for different inputs or outputs).

  Example:
  – O1201: "allocation current" for output 1
  – O2201: "allocation current" for output 2

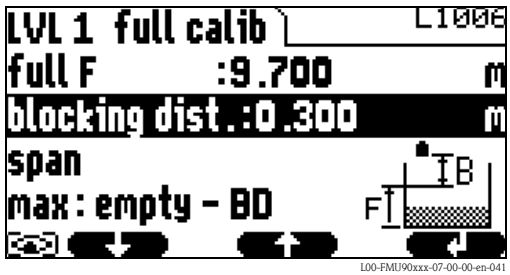
  If the parameter set occurs only once wihtin the Prosonic S, "X" is indicated at this position.

- The **last three digits (C)** specify the individual parameter sets within the submenu.

1) Depending on the instrument version, the installation environment and the selected operating mode, some of the submenus may not be present.

Parameter types

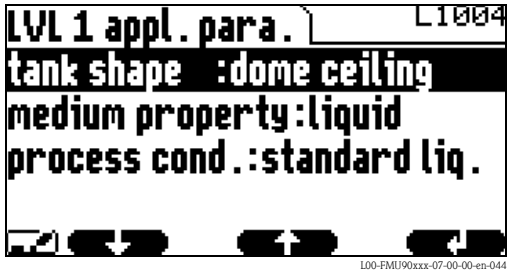
Display parameters



L00-FMU90xxx-07-00-00-en-041

Parameters for which the symbol is displayed in the left bottom corner of the display module, are either locked or display-only parameters.

Editable parameters



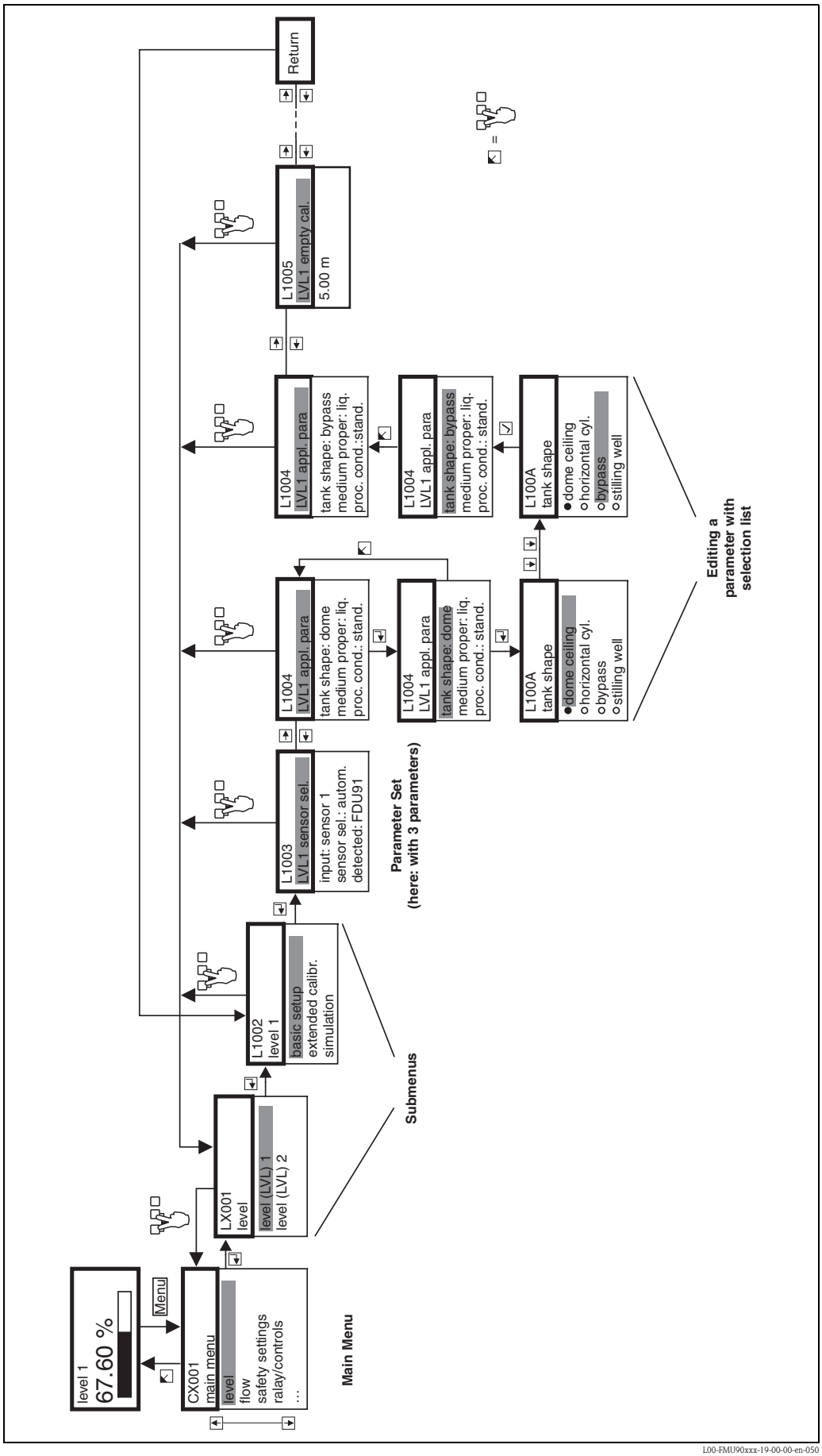
L00-FMU90xxx-07-00-00-en-044

Parameters, for which the symbol is displayed in the left bottom corner of the display module, can be entered for editing by pressing .

The editing procedure depends on the type of parameter:

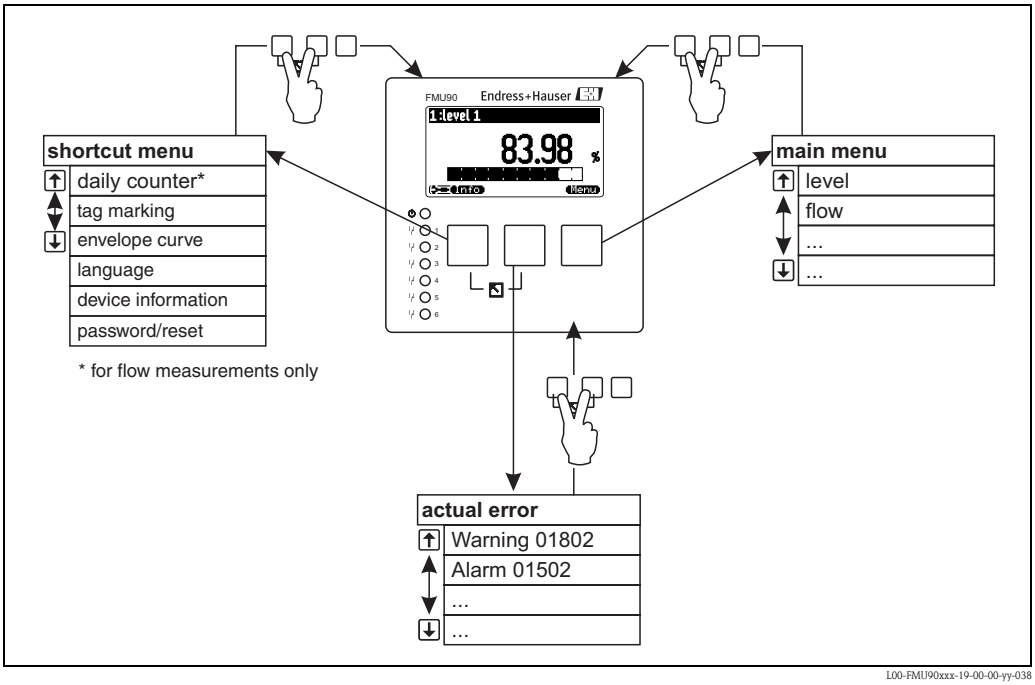
- when entering a **selection parameter**, the associated selection list appears (see below: "Editing a parameter with selection list").
- when entering a **numerical or alphanumerical parameter**, the text and number editor appears (see below: "Entering numbers and characters").

Navigation within the menu (Example)



Entering the menu

The navigation always starts from the main screen (measured value display[2]). From there, the following menus can be opened by the keys:

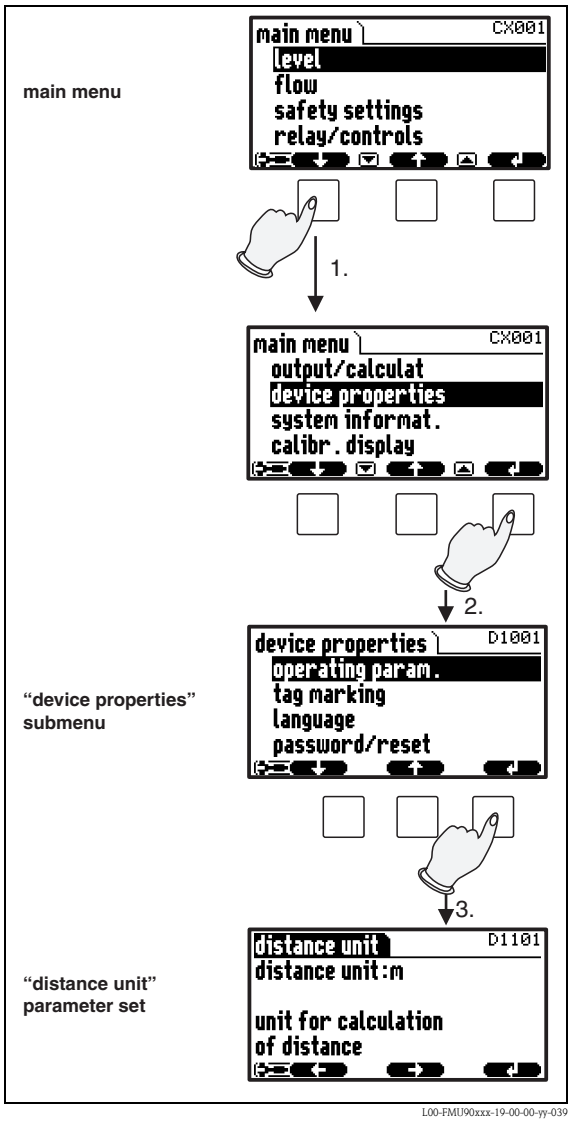


L00-FMU90xxx-19-00-00-yy-038

- **shortcut menu**
  The shortcut menu is accessed via the **"Info"** key. It allows quick access to device information:
  – daily counter (for flow measurements)
  – tag marking
  – envelope curve: used to check the signal quality
  – language: sets the display language
  – device information: serial number, versions of software and hardware
  – password/reset: used to enter the password or reset code
  All parameters of the shortcut menu are contained in the main menu as well.
- **main menu**
  The main menu is accessed via the **"Menu"** key. It contains all parameters of the Prosonic S. It is divided into submenus. Some of the submenus consist of further submenus. Which submenus are actually present, depends on the instrument version and the installation environment.
  An overview of all submenus and parameters is given in chapter 14.
- **actual error**
  If the self-monitoring of the Prosonic S detects an error, the [redacted] softkey symbol appears above the middle key.
  If the softkey symbol flashes, only "warnings[3]" are present.
  If the softkey symbol is displayed permanently, at least one "alarm[3]" is present.
  After pressing the key, a list of all currently present errors appears.

2) Note: Depending on the configuration, the appearance of the measured value display may be differemt from the example in the figure.
3) For the difference between "warning" and "alarm" refer to section 10.1.

Selecting a submenu



1. In the main menu press ↓ or ↑ until the required submenu is marked by the bar.

   Note!
   The symbols ▼ ▲ indicate that the selection list contains more items than can be displayed on the module. Press ↓ or ↑ several times, to mark one of the hidden items.

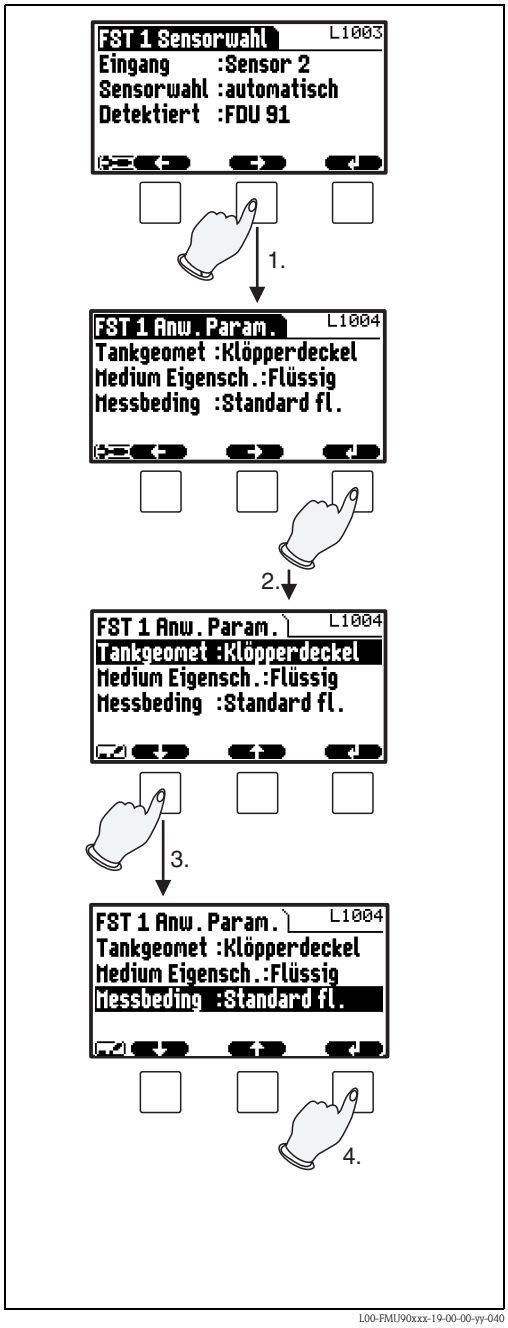
2. Press ↵, in order to enter the marked submenu.

3. If the submenu contains further submenus, continue until you reach the level of the parameter sets. This level is reached if the softkey symbols ← and → appear.

Note!
If necessary, you can return to the previous level of the menu by pressing. .

Selecting a parameter

By pressing → or ← you can switch between the parameter sets of the current submenu. For each parameter set the values of all its parameters are displayed. In order to change one of the values, proceed as follows:

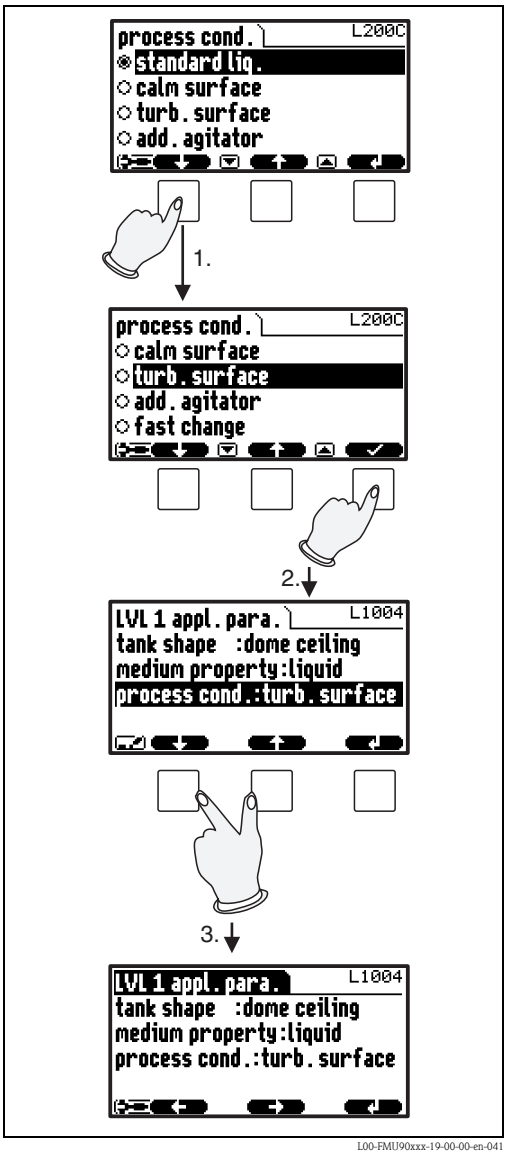


L00-FMU90xxx-19-00-00-yy-040

1. Press → or ←, until you have reached the required parameter set.
2. Press ↵, in order to enter the parameter set.
3. Select the required parameter by pressing ↓ or ↑.
   (This step is not required if the set contains only one parameter.)
4. Press ↵, in order to enter the editing mode of the parameter.
   The editing method depends on the type of parameter (selection list, numeric or alphanumeric parameter). For details refer to the following sections.

Note!
If necessary, you can exit the parameter and parameter set by pressing  .

Editing a parameter with selection list



L00-FMU90xxx-19-00-00-en-041

1. Press ⊡ or ⊡, until the required option is marked by the bar (in the example: "turb. surface").

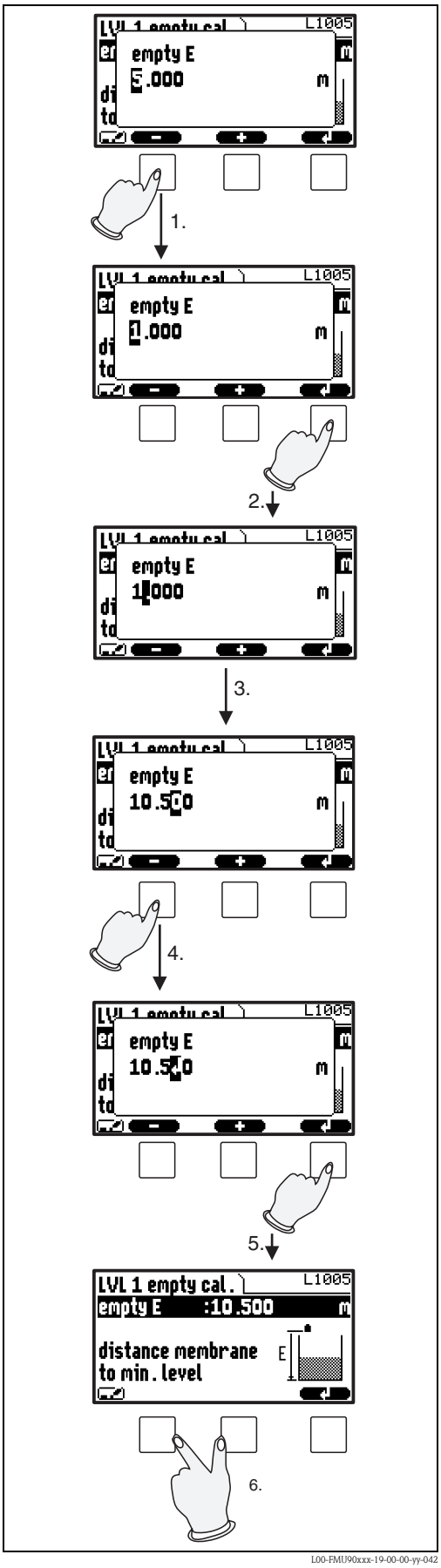
   Note!
   The symbols ▼ ▲ indicate that the selection list contains more items than can be displayed on the module. Press ⊡ or ⊡ several times, to mark one of the hidden items.

2. Press ✓, in order to select the marked option. It is then stored in the instrument.

3. Press the left and middle keys simultaneously in order to quit the parameter set.
   The software key symbols ⊡ and ⊡ reappear and you can switch to the next parameter set.

Note!
By pressing before ✓ you can quit the parameter without accepting your changes.

Entering numbers and characters



L00-FMU90xxx-19-00-00-yy-042

When you select a numeric parameter ("empty calibration", "full calibration" etc.) or an alphanumeric parameter ("device marking" etc.), the editor for numbers and text strings appears. Enter the desired value in the following way:

1. The cursor is at the first digit. Press − or + until this digit has the required value.

2. Press ↵ in order to confirm the value and to jump to the next digit.

3. Repeat the procedure for all relevant digits.

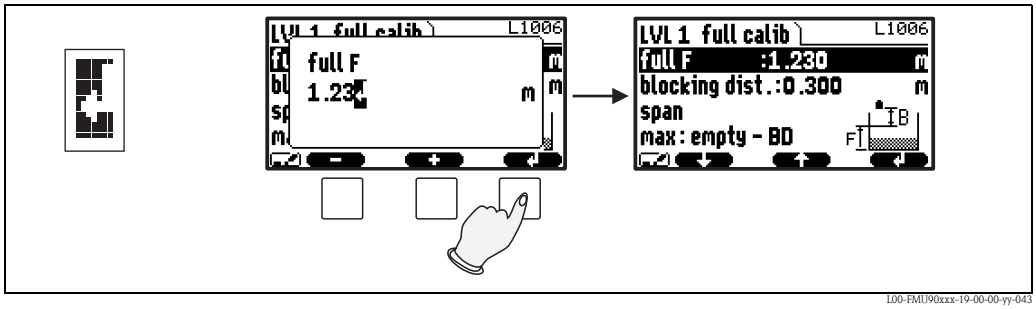
4. If all relevant digits have been entered: Press − or +, until ↵ appears at the cursor.

5. Press ↵ to store the complete value in the device.

6. Press the left and middle keys simultaneously in order to quit the parameter.

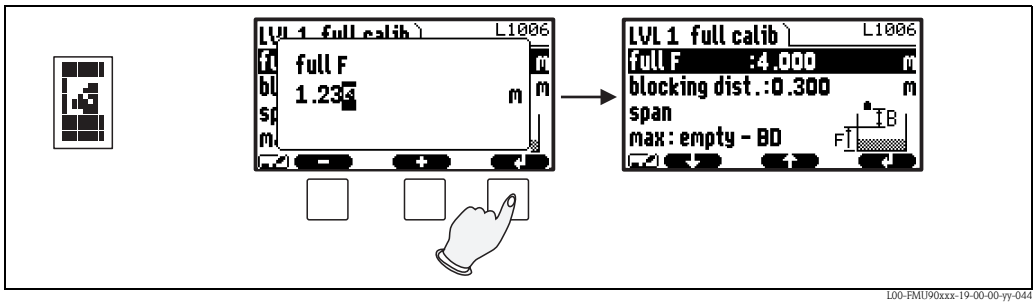
Special editing functions

Within the editor for alphanumeric characters, pressing − or + does not only lead to numbers and characters but also to the following symbols for special editing functions. They simplify the editing procedure.



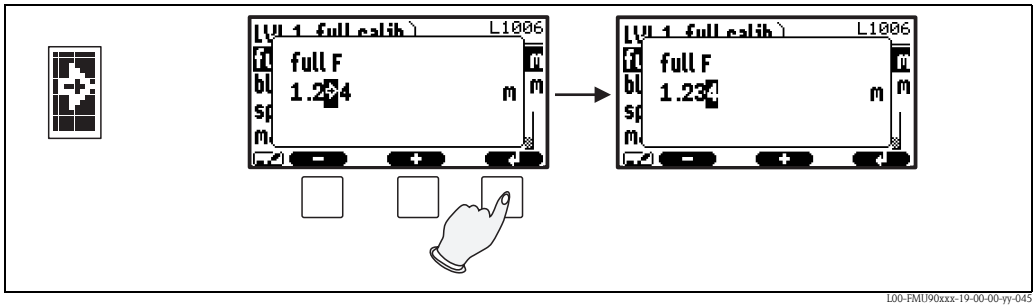
L00-FMU90xxx-19-00-00-yy-043

Enter: *The number left of the cursor is transferred to the instrument.*



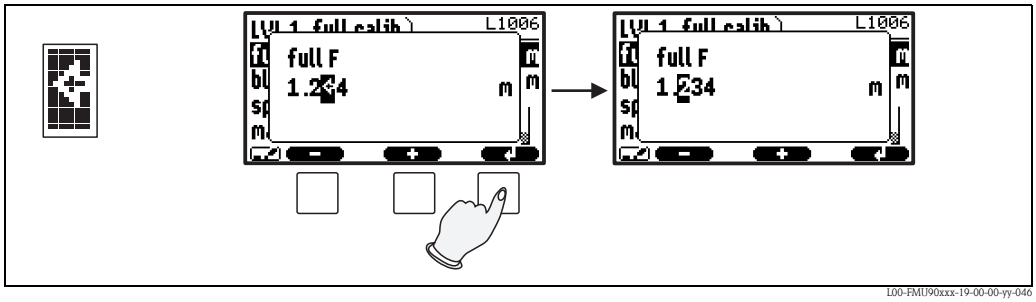
L00-FMU90xxx-19-00-00-yy-044

Escape: *The editor is closed. The parameter maintains its former value. The same behavior can be achieved by pressing the left and the middle key simultaneously (⇖).*



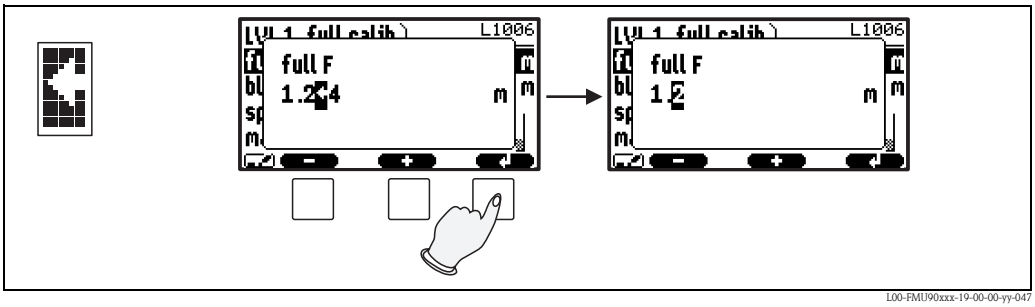
L00-FMU90xxx-19-00-00-yy-045

Next digit: *The cursor moves on to the next digit.*



L00-FMU90xxx-19-00-00-yy-046

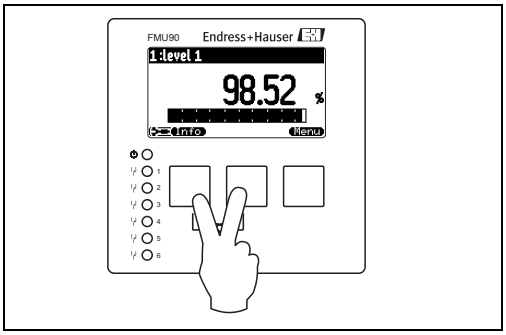
Previous digit: *The cursor moves back to the previous digit.*



L00-FMU90xxx-19-00-00-yy-047

Delete: *The current digit and all digits to its right are deleted.*

Return to the measured value display

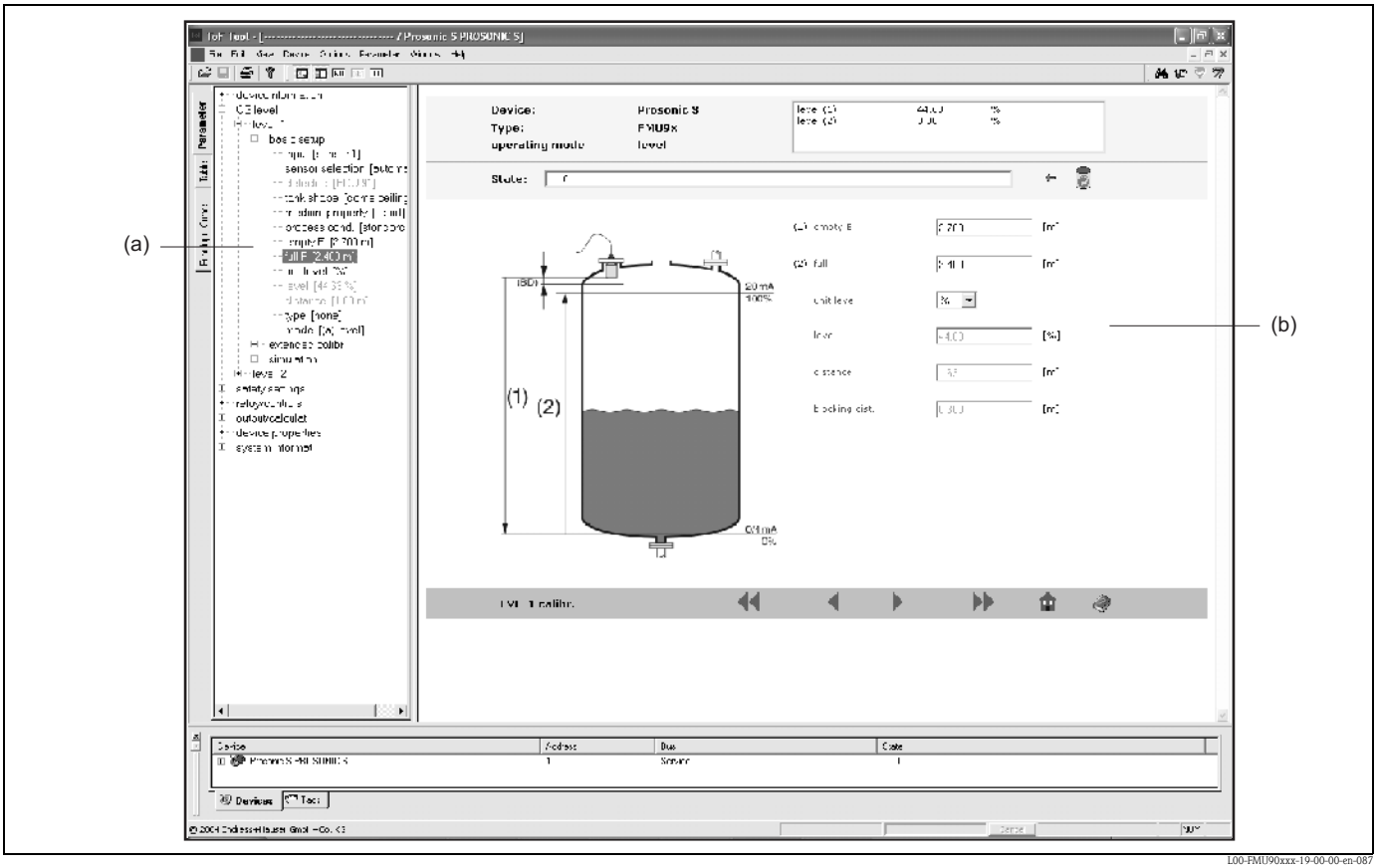


L00-FMU90xxx-19-00-00-en-048

By pressing the left and middle keys simultaneously you can return

- from a parameter to the parameter set
- from the parameter set to the submenu
- from the submenu to the main menu
- from the main menu to the measured value display

5.3 Operation via ToF Tool – Fieldtool Package



L00-FMU90xxx-19-00-00-en-087

Operation via the ToF Tool – Fieldtool Package is similar to the operation via the display module.

- The operating menu can be found in the **navigation bar (a)**.
- Input fields for the parameters can be found in the **parameter editor (b)**.
- When you click on a parameter name, the **help pages** appear. They contain a detailed description of the respective parameter.

5.4 Operation via HART handheld DXR375

in preparation

5.5 Lock/unlock configuration

5.5.1 Software locking

Locking

Go to the parameter "device properties/passoword-reset/code" and enter a value ≠100. The instrument is locked against parameter changes.
The (O-M) symbol appears on the display.

Unlocking

If you try to change a parameter, the "password-reset" parameter set appears. Select the "code" parameter and enter "100". Parameters can be changed again.

5.5.2 Locking by key combination

Locking

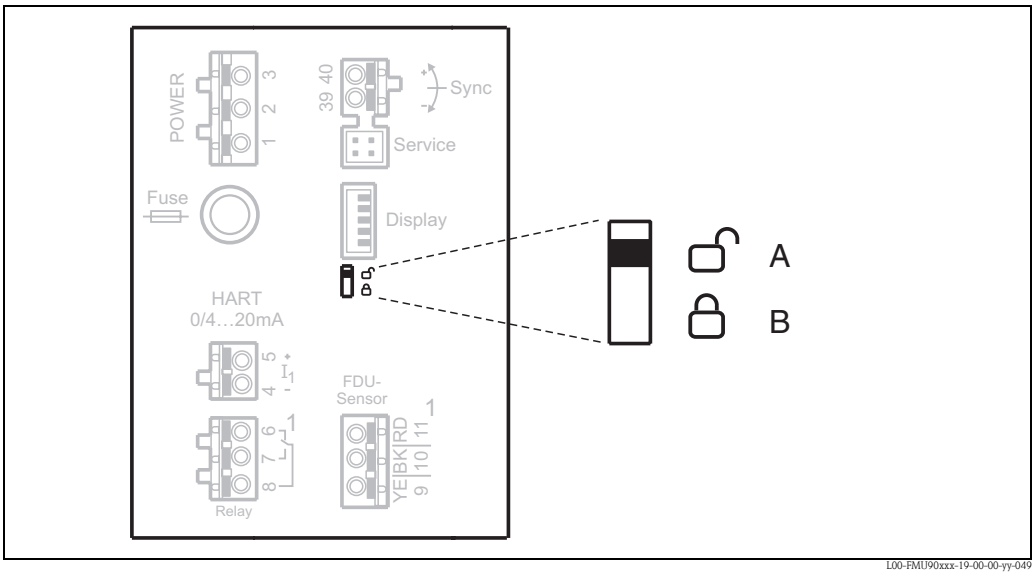
Press all three keys simultaneously. The instrument is locked against parameter changes.
The (O-M) symbol appears on the display.

Unlocking

If you try to change a parameter, the "password/reset" parameter set appears. "key locked" is displayed in the "status" parameter. Press all three keys simultaneously. Parameters can be changed again.

5.5.3 Hardware locking

The instrument can be locked against parameter changes by the locking switch in the terminal compartment of the Prosonic S.



*Switch position **A**: unlocked; parameters can be changed*
*Switch position **B**: locked; parameters can not be changed.*

If the switch is in position B, (O-M) appears on the display and parameters can not be changed. The instrument can only be unlocked by the switch.

5.5.4 Indication of the locking state

The current locking state of the instrument is displayed in the parameter "device properties/ password-reset/status". The following states may occur:

- **unlocked**
  All parameters (except of service parameters) can be changed.
- **code locked**
  The instrument has been locked via the operating menu. It can be unlocked by entering the unlocking code into the "code" parameter.
- **key locked**
  The key has been locked by a key combination. It can only be unlocked by pressing all three keys simultaneously.
- **switch locked**
  The instrument has been locked by the switch in the terminal compartment. It can only be unlocked by this switch.

5.6 Reset to the default configuration

Caution!
A reset may lead to impairment of the measurement. As a rule, a basic calibration is required after a reset.

Application of the Reset
It is advisable to reset the customer parameters if you want to use a device with an unknown history.

Effects of the Reset
- All parameters are reset to their default values.
- The linearisation type is switched to "none". If a linearisation table is present, it is not deleted. If required, it can be reactivated at a later point of time.
- An interference echo curve is deleted. After the reset, a new interference echo suppression has to be recorded.

Note!
In the menu diagrams (see chapter 14, "Operating Menu") the default values of the parameters are printed in bold.

Performing a Reset
In order to perform a reset, enter "333" into the parameter "device properties/password-reset/ reset".

Note!
- To **delete a linearisation table**, use the parameter "basic setup/linearisation", see chapter. 6.4.7
- To **delete a interference echo mapping**, use the parameter "extended calibration/distance mapping/status", see chapter 6.4.11

6 Commissioning

Warning!
For the version with field housing: The instrument may only be operated if the field housing is closed.

6.1 Structure and Functions of the Prosonic S

6.1.1 Function blocks

The Prosonic S contains various function blocks. During the commissioning procedure the blocks are linked to each other in order to perform the desired measuring task. Depending on the instrument version and installation environment, the following function blocks may occur:

Signal inputs
- Sensor 1
- Sensor 2 (if selected in the product structure)

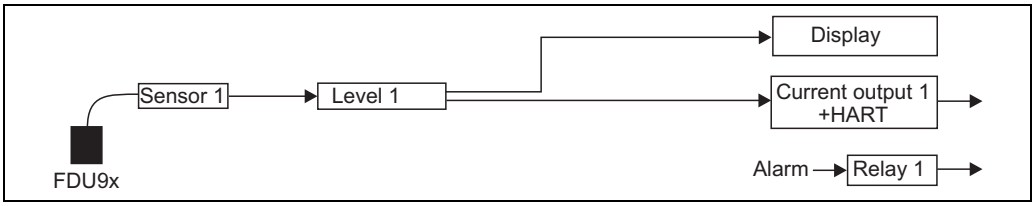
Signal evaluation (calculation of the measured value)
- Level 1
- Level 2 (for instruments with 2 current outputs)
- Flow 1 (for flow instruments)
- Flow 2 (for flow instruments)

Controls
- Pump control
- Rake control
- Backwater detection

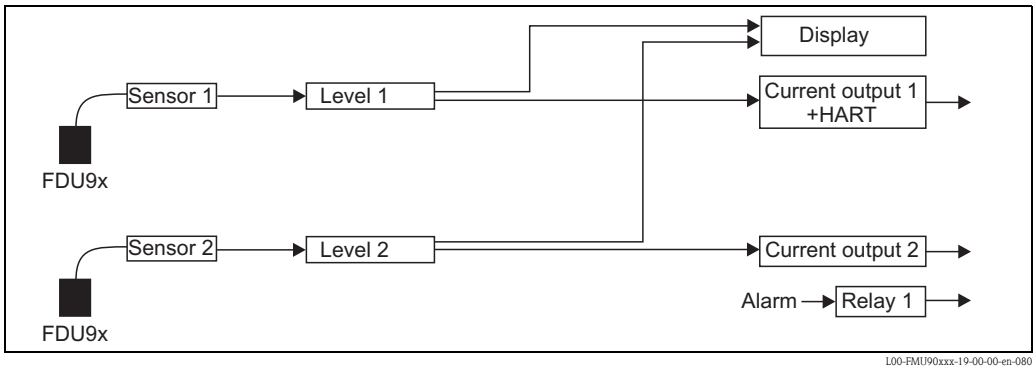
Signal output
- Display
- Current output 1 with HART
- Current output 2 (if selected in the product structure)
- Relay 1
- Relay 2 (for instruments with 3 or 6 relays)
- Relay 3 (for instruments with 3 or 6 relays)
- Relay 4 (for instruments with 6 relays)
- Relay 5 (for instruments with 6 relays)
- Relay 6 (for instruments with 6 relays)

6.1.2 Typical block configurations

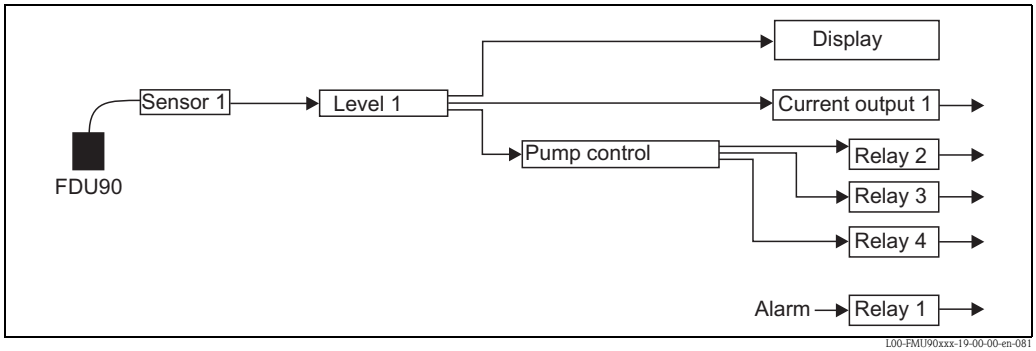
1-channel level measurement



2-channel level measurement

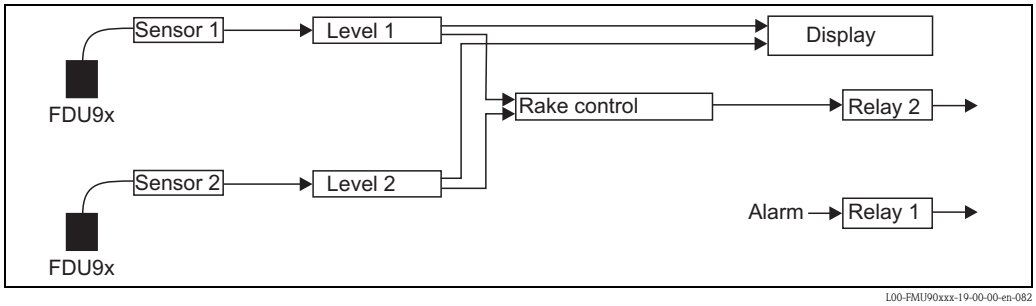


Pump control



The relays must be linked to the pump control by the user. By default, no relay is linked to the pump control.

Rake control



Note!
By default, relay 1 is alway configured to be the alarm relay.

6.2 First setup

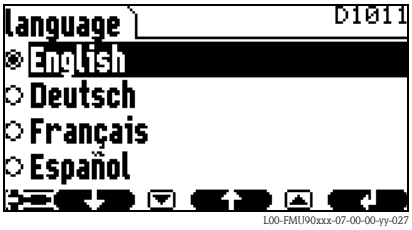
Note!
This chapter describes the commissioning of the Prosonic S via the display and operating module. Commissioning via ToF Tool, FieldCare or the HART handheld terminal DXR375 is similar. For further instructions refer to the ToF Tool Operating Instructions, the FieldCare Online Help or the Operating Instructions supplied with the DXR375.

After switching on the power supply for the first time, the instrument asks for a number of operating parameters:

1. Select the display language.

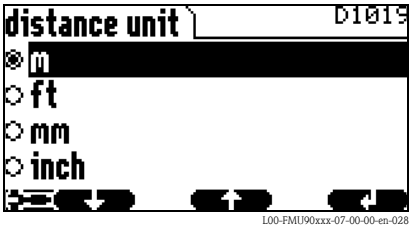
   a. Press ↓ or ↑ to move the marking bar to the desired language.

   b. Press ↵ to confirm your selection.



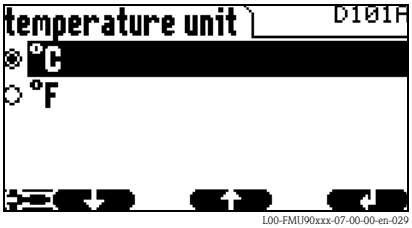
L00-FMU90xxx-07-00-00-yy-027

2. Select the unit for distance measurements.



L00-FMU90xxx-07-00-00-en-028

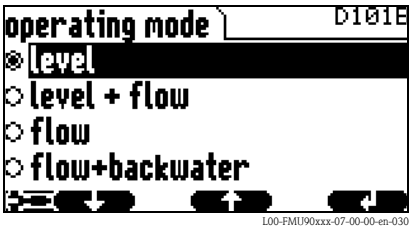
3. Select the temperature unit.



L00-FMU90xxx-07-00-00-en-029

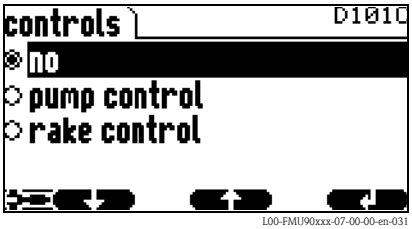
4. Select the operating mode.

   Note!
   The available options depend on the instrument version and the installation environment.



L00-FMU90xxx-07-00-00-en-030

5. For level measurements:
   Select the control functions, which you are going to use.

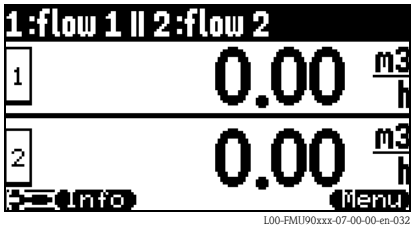


L00-FMU90xxx-07-00-00-en-031

Note!
By pressing **you can return to the previous parameter** (e.g. in order to correct the value).
All these parameters can also be changed at a later point of time in the "device properties/operating parameters" and "device properties/language" parameter sets.

6.3 Preparing the basic setup

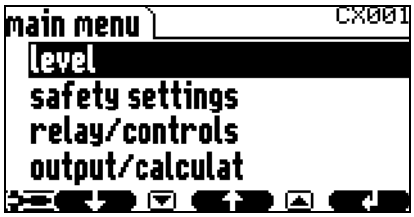
1. After the first setup the main screen appears. However, the displayed value does not correspond to the real level before you have performed the basic setup. To do so, enter the main menu by pressing "Menu" (right key).



L00-FMU90xxx-07-00-00-en-032

✎ Note!
In the "calibr. display" menu you can adjust the display to your requirements (displayed values, display format). The figure shows an example for a 2-channel instrument.

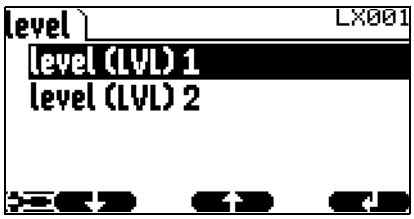
2. Select the "level" submenu.



L00-FMU90xxx-07-00-00-en-033

– Select by ↓ and ↑
– Confirm by ↵

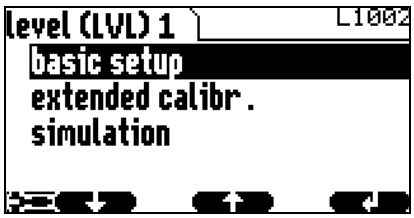
3. In the following submenu select the level channel you are going to calibrate.



L00-FMU90xxx-07-00-00-en-034

✎ Note!
The selection "level (LVL) 2" is only available for instruments with 2 sensor inputs or 2 current outputs.

4. In the following submenu select "basic setup". This submenu contains all parameters needed for the basic setup.



L00-FMU90xxx-07-00-00-en-035

6.4 Basic setup

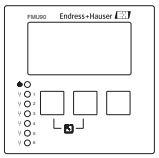
6.4.1 Overview

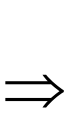
The following table gives an overview of the basic setup for level measurements. Detailed information on the parameters can be found in the sections 6.4.2. to 6.4.11.

Step	Parameter Set	Parameter	Remarks	s. section
Configuring the sensor				
1	LVL N sensor selection (N = 1 or 2)	input	Allocate a sensor to the channel.	6.4.2
		sensor selection	Specify the type of sensor ("automatic" for FDU9x)	
		detected	only available for "sensor selection" = "automatic"; indicates the detected type of sensor.	
2	application parameter	tank shape	Select the appropriate values for your application	6.4.3
		medium property		
		process conditions		
3	empty calibration	empty E	Specify the distance between the sensor membrane and the minimum level (0%).	6.4.4
4	full calibration	full F	Specify the distance between the minimum (0%) and maximum (100%) level.	6.4.5
		blocking distance (BD)	Display parameter; the maximum value for the full calibration is: F_{max} = E - BD	
5	unit level	unit level	Select the unit for the level measurement.	6.4.6
		level	Displays the currently measured level.	
		Distanz	Displays the currently measured distance between the sensor membrane and the product level.	
Linearisation (if no linearisation is required: continue by step 7: "distance correction")				
6	linearisation	type	Select type of linearisation	6.4.7
		mode	Specify, to which value the measurement refers: "level" or "ullage"	
		customer unit	Specify the unit for the linearized value; (not available for "type" = "none")	
		max. scale	Specify the maximum contents of the vessel (in customer units); (not availablefor "type" = "none")	
		diameter	Specify the diameter of the tank; (only availablefor "type" = "horizontal cylinder" or "sphere")	
		intermediate height	Specify the intermediate height of the tank or silo; (only availablefor "type" = "pyramid bottom", "conical bottom" oder "angled bottom")	
		edit	Used to enter, change or delete a linearisation table; (only availablefor "type" = "table")	
		status table	Enables or disables the linearisation table; (only availablefor "type" = "table")	

Step	Parameter Set	Parameter	Remarks	s. section
Interference echo suppression				
7	distance correction	act. distance 1 act. distance 2	Indicates the currently measured distance between the sensor membrane and the product surface.	6.4.8 6.4.9
		Check distance	Compare the indicated distance with the real value: ■ "distance = ok" → "distance mapping" (see below) ■ "distance too small" → "distance mapping" (see below) ■ "distance too big" → Basic setup completed ■ "distance unknown" → Basic setup completed ■ "manual" → "distance mapping" (see below)	
8	distance mapping	act. distance 1 act. distance 2	Indicates the currently measured distance between the sensor membrane and the product surface.	6.4.10
		range of mapping	Determines the range over which the mapping is recorded; confirm the predefined value or enter your own value.	
		start mapping	Select: ■ no: the mapping is not recorded ■ yes: the mapping is recorded; after completion the "LVL 1(2) state" function appears (see below)	
9	LVL 1(2) state	level 1(2)	Indicates the currently measured level.	6.4.11
		act. distance	Indicates the currently measured distance between the sensor membrane and the product surface. Check the value: ■ Value correct: → Basic setup completed. Return to the measured value display by pressing  several times ■ Value not incorrect: → go back to step 7 ("distance correction")	
		status	Used to enable, disable or delete a mapping	

6.4.2 "LVL N sensor selection" (N = 1 or 2)





LVL1 sensor sel. L1003
input:
sensor selection:
detected:

"input"

Use this parameter to assign a sensor to the channel.

Selection:
- no sensor
- sensor 1
- sensor 2 (only for 2-channel instruments)

"sensor selection"

Use this parameter to specify the type of the connected ultrasonic sensor.

Note!
- For the sensors **FDU9x** the option "automatic" is recommended (default setting). With this setting the Prosonic S recognizes the type of sensor automatically.
- For the sensors **FDU8x** the type has to be assigned explicitly. The automatic sensor recognition does not work for these sensors.

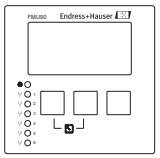
Caution!
After **exchanging a sensor**, observe the following:
The automatic sensor recognition is also active after a sensor has been exchanged[4]. The Prosonic S recognizes the type of the new sensor automatically and changes the "detected" parameter if required. The measurement continues without a break.
Nevertheless, in order to ensure perfect measurement, the following checks are required:
- Check the **"empty calibration"** and **"full calibration"** parameters. Adjust these values if required. Take into account the blocking distance of the new sensor.
- Go to the **"distance correction"** parameter set and check the displayed distance. If required, perform a new interference echo suppression.

"detected" (only available for "sensor selection" = "automatic")

Indicates the type of the automatically detected sensor.

4) if the new sensor is of the type FDU9x

6.4.3 "LVL N application parameters" (N = 1 or 2)

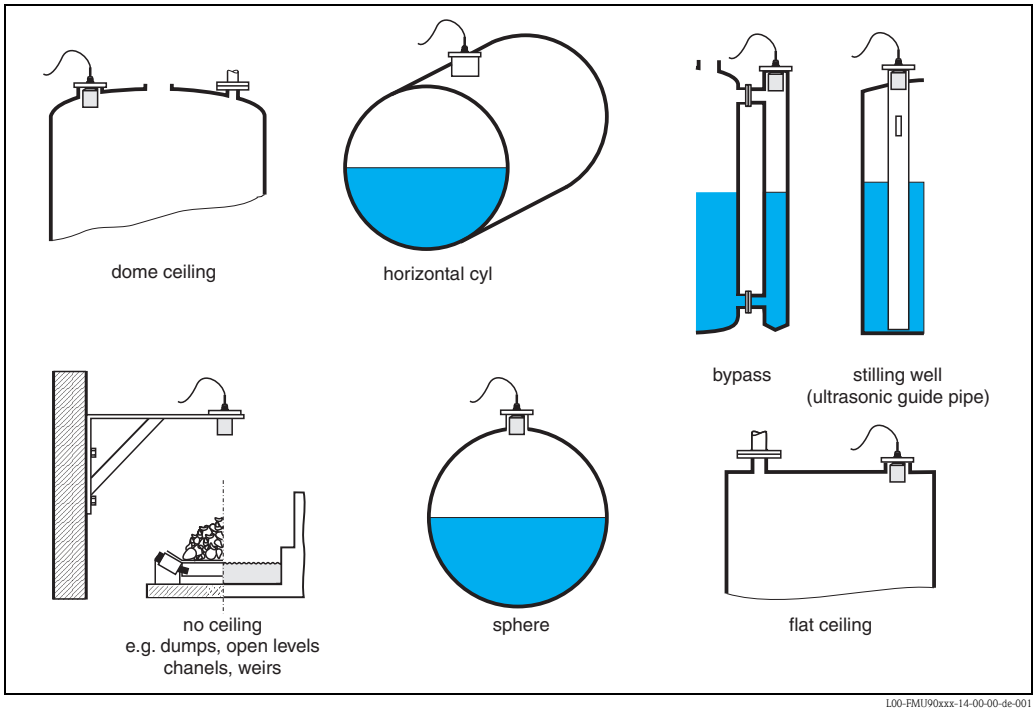


LVL1 appl. para. L1004
tank shape:
medium property:
process cond.:

"tank shape"

Use this parameter to specify the tank shape of your application.

Selection:



"medium property"

Use this parameter to specify the type of medium.

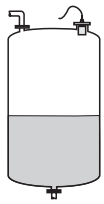
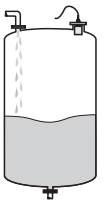
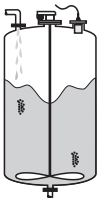
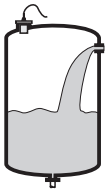
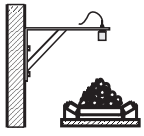
Selection:

- liquid
- pastelike
- solid < 4 mm
- solid > 4 mm
- unknown

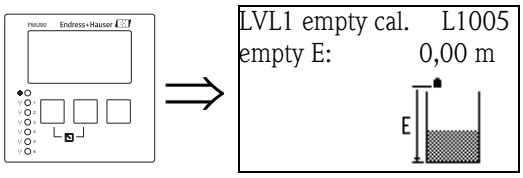
Note!
If the medium does not fit into one of the groups, select "unknown".

"process conditions"

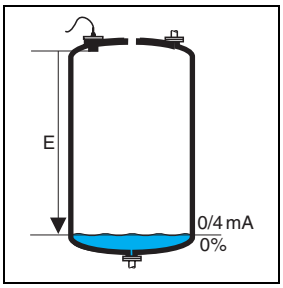
Use this parameter to specify the process conditions of your application. The filters of the signal evaluation are automatically adjusted to the selected conditions.

"process conditions"	for the following situations	Example	filter settings
standard liquid	for all fluid applications which do not fit in any of the following groups		The filters and output damping are set to average values.
calm surface	Storage tanks with immersion tube or bottom filling		The averaging filters and output damping are set to large values. -> stable measured value -> accurate measurement -> slow reaction time
turbulent surface	Storage/accumulation tanks with uneven surface due to free filling, mixing nozzles or small bottom stirrers		Special filters for stabilizing the input signal are activated. -> stable measured value -> medium reaction time
additional agitator	Moving surfaces (possibly with vortex formation) due to agitators		Special filters for stabilizing the input signal are set to large values. -> stable measured value -> medium reaction time
fast change	Rapid level change, particularly in small tanks		The averaging filters are set to small values. -> rapid reaction time -> possibly unstable measured value
standard solid	For all bulk solid applications which do not fit in any of the following groups.		The filter and output damping are set to average values.
solid dusty	Dusty bulk solids		The averaging filters are set to detect even relatively weak signals.
conveyor belt	Bulk solids with rapid level change		The averaging filters are set to small values. -> rapid reaction time -> possibly unstable measured value
test: no filter	For service and diagnosis only		All filters are switched off.

6.4.4 "LVL N empty calibration" (N = 1 or 2)



"empty E"



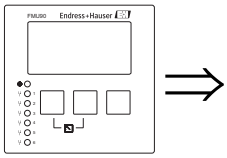
L00-FMU90xxx-19-00-00-yy-007

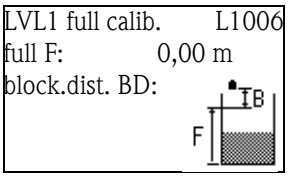
Use this parameter to specify the empty distance E, i.e. the distance between the sensor membrane and the minimum level (zero point).

– Default: max. measuring range of the respective sensor
– Range of values: depending on sensor type

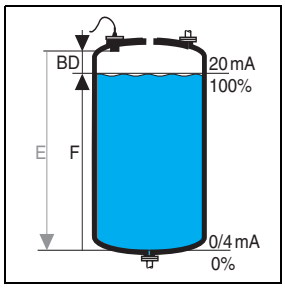
☝ Caution!
The zero point should not be deeper than the point at which the ultrasonic wave impinges on the tank bottom

6.4.5 "LVL N full calibration" (N = 1 or 2)





"full F"



Use this parameter to specify the span F, i.e. the distance from the minimum level to the maximum level.

– Default setting: depending on sensor type
– Range of values: depending on sensor type
– blocking distance BD: depending on sensor type (see table)

Achtung!
The maximum level may not project into the blocking distance:

$F_{max} = E - BD$

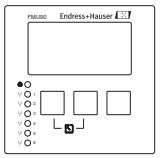
"blocking distance"

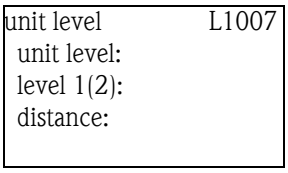
Indicates the blocking distance of the respective sensor. The blocking distance is measured from the sensor membrane.

Type of sensor	blocking distance (BD)	maximum measuring distance[1)]
FDU91/FDU91F	0,3 m	10 m (for liquids)
FDU92	0,4 m	20 m (for liquids)
FDU93	0,6 m	25 m (for liquids)
FDU95 - *1*** (low temperature version)	0,7 m	45 m (for solids)
FDU95 - *2*** (high temperature version)	0,9 m	45 m (for solids)
FDU96	1,6 m	70 m (for solids)
FDU80/FDU80F	0,3 m	5 m (for liquids)
FDU81/81F	0,5 m	10 m (for liquids)
FDU82	0,8 m	20 m (for liquids)
FDU83	1 m	25 m (for liquids)
FDU84	0,8 m	25 m (for solids)
FDU85	0,8 m	45 m (for solids)
FDU86	1,6 m	70 m (for solids)

1) valid for optimum process conditions

6.4.6 "unit level"





"unit level"

Use this parameter to select the distance unit.
If no linearization is performed, the level is displayed in this unit.

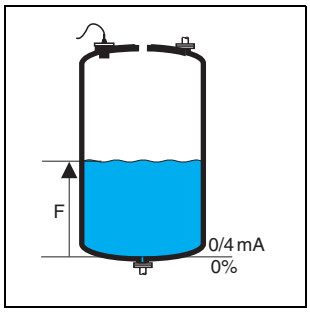
Selection:

- m
- ft
- inch
- mm
- **% (Default)**

Achtung!
After a change o f the level unit, the switching points of the limit and pump control relays have to be checked and to be adjusted if required.

"level N" (N = 1 or 2)

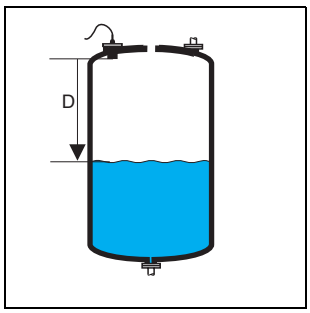
Displays the currently measured level F (from the zero point to the product surface) in the selected unit.



L00-FMU90xxx-19-00-00-yy-021

"distance"

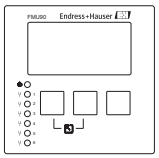
Displays the currently measured distance D (from the sensor membrane to the product surface) in the distance unit. If the display value does not match the real distance, an interference echo suppression must be performed prior to linearization (see section 6.4.8)



L00-FMU90xxx-19-00-00-yy-022

Note!
The distance unit is defined during the first setup of the instrument. If required, it can be changed in the "device properties/operating params" menu.

6.4.7 "LVL N linearisation" (N = 1 or 2)



linearisat.	L1008
type:	
mode:	

Note!
Number and type of the parameters in this set depend on the selected linearization type.
Only the parameters "type" and "mode" are always present.

The "linearization" is used to convert the level into other quantities. Especially, it can calculate the volume or mass within a vessel of arbitrary shape. The Prosonic S provides different linearization modes for the most common types of vessels. Additionally, a linearization table for arbitrarily shaped vessels can be entered.

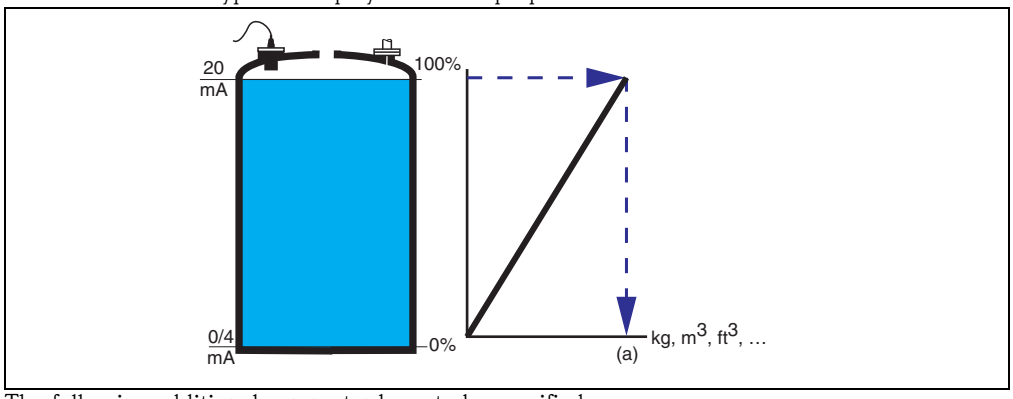
"type"

Use this parameter to select the type of linearisation.

Selection:

- **none**
  In this linearization type the measured level is not converted but displayed in the selected level unit (see above, "unit level").

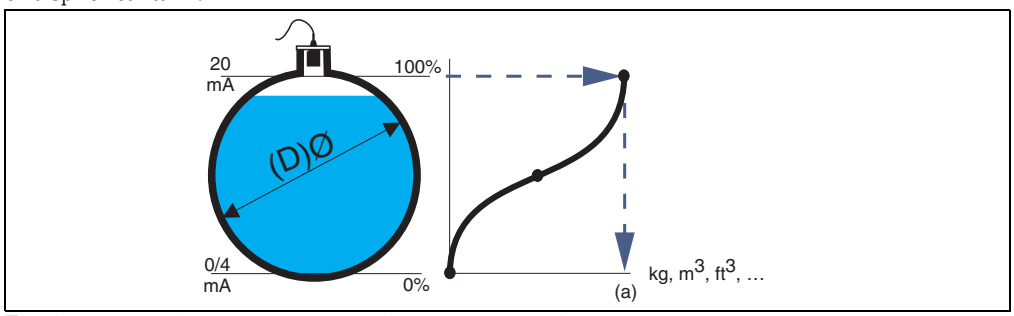
- **linear**
  In this linearization type the displayed value is proportional to the measured level.



The following additional parameter have to be specified:
– the unit for the linearized value, e.g. kg, m^3, ft^3, ... (**"customer unit"**)
– the maximum capacity (a) of the vessel, measured in the customer unit (**"maximum scale"**).

- **horizontal cylinder**
- **sphere**

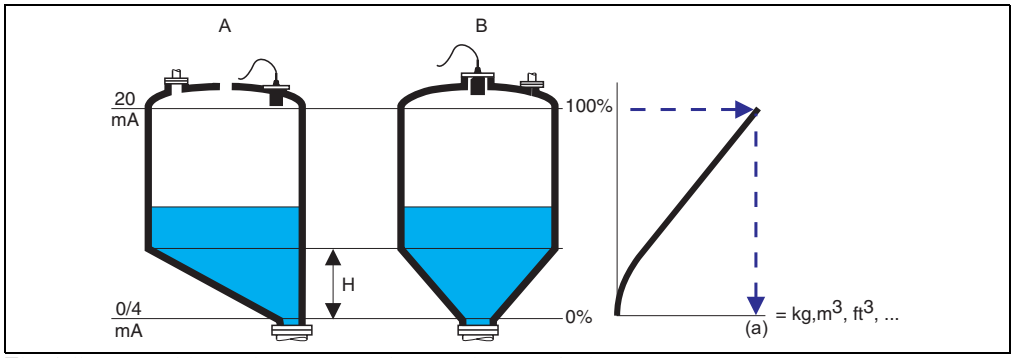
In these linearization types the measured level is convertet to the volume in a horizontal cylinder or a spherical tank.



The following additional parameters have to be specified:
– the unit of the linearized value, e.g. kg, m^3, ft^3, ... (**"customer unit"**)
– the diameter (D) of the tank (**"diameter"**)
– the maximum capacity (a) of the tank, measured in the customer unit (**"maximum scale"**).

- **angled bottom (A)**
- **pyramid bottom (B)**
- **conical bottom (B)**

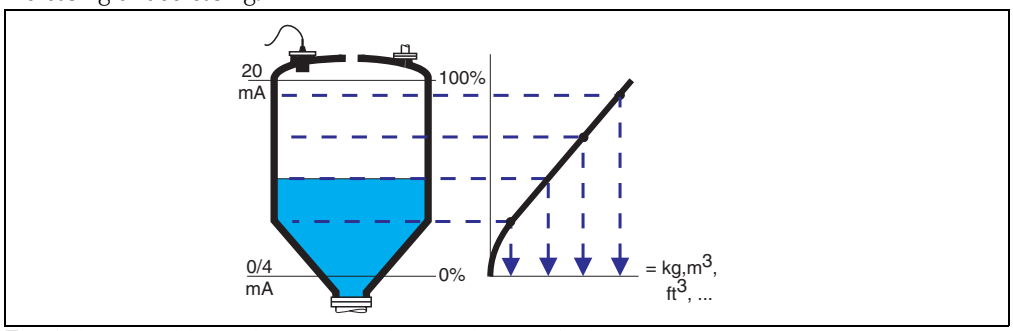
In these linearisation modes the measured level is converted to the volume in the respective type of vessel.



The following additional parameters have to be specified:
– the unit for the linearized value, e.g. kg, m^3, ft^3, ... (**"customer unit"**)
– the intermediate height H according to the diagram (**"intermediate height"**)
– the maximum capacity (a) of the tank, measured in the customer unit (**"maximum scale"**).

■ **table**

In this linearization mode the measured value is calculated from a linearization table. The table may consist of up to 32 pairs of values (level – volume). The table must be monotonically increasing or decreasing.



The following additional parameters have to be specified:
– the unit of the linearized value, e.g. kg, m^3, ft^3, ... (**"customer unit"**)
– the linearization table (**"edit"**)

"customer unit"

Use this parameter to select the desired unit for the linearized values (e.g. kg, m^3, ft^3, ...). This unit is only indicated on the display. It does not cause a conversion of the measured value.

Note!
After selecting the option "customer specific", the parameter "customized text" appears. An arbitrary string (consisting of up to 5 alphanumeric characters) can be entered into this parameter.

"maximum scale"

Use this parameter to specify the maximum content of the vessel in the customer unit.

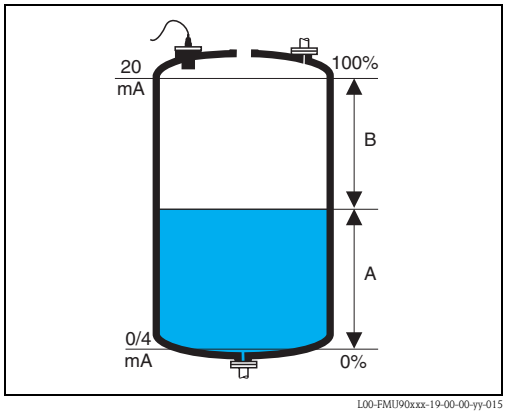
"diameter"

Use this parameter to specify the diamter of the horizontal cylinder or the spherical tank respecitvely.

"intermediate height"

Use this parameter to specify the intermediate height of the vessel.

"mode"



L00-FMU90xxx-19-00-00-yy-015

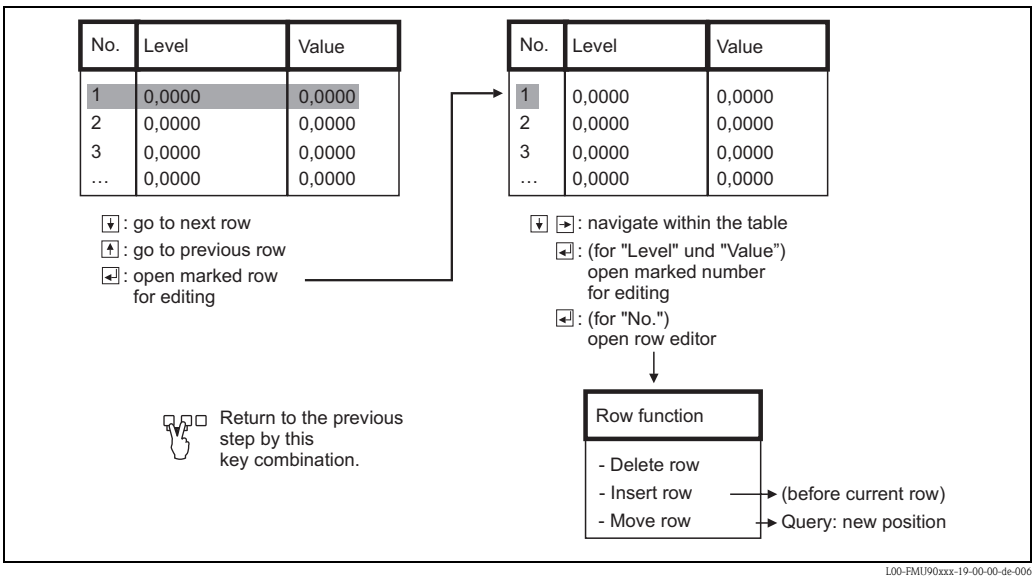
Use this parameter to specify if the measurement refers to the **"level"** (A) or to the **"ullage"** (B).

"edit"

Use this parameter to enter, change or read a linearization table. There are the following options:

- **read:**
  The table editor is opened. The existing table can be read but not changed.
- **manual:**
  The table editor is opened. Table values can be entered and changed.
- **semi-automatic:**
  The table editor is opened. The level is automatically read by the Prosonic S. The measured value (volume, weight or flow) must be entered by the user.
- **delete:**
  The linearization table is deleted.

The table editor



"status table"

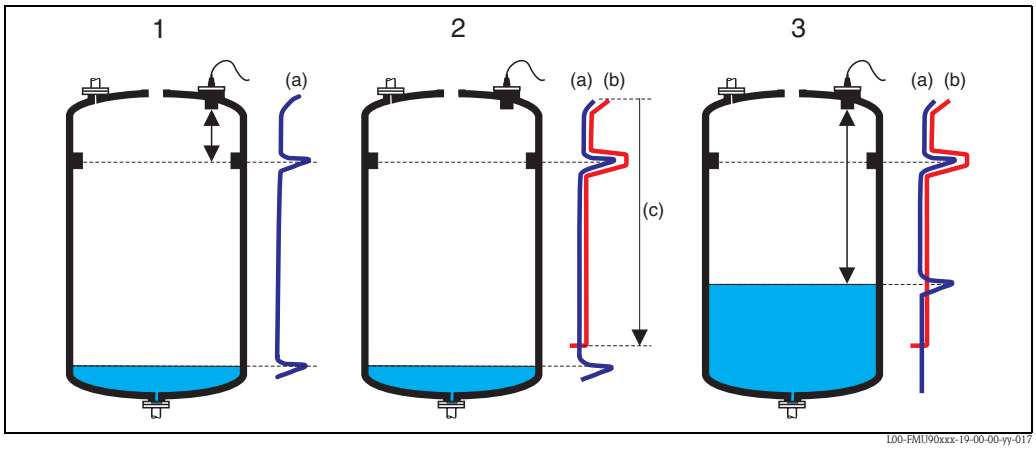
Use this parameter to enable or disable the linearization table.

Selection:

- **enabled**
  The table is used.
- **disabled**
  The table is **not** used. The measured values is transferred to the output without linearization.

6.4.8 Interference echo suppression: Basic principles

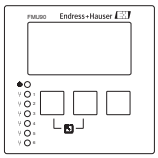
The **"check value"** and **"distance mapping"** parameters are used to configure the interference echo suppression of the Prosonic S.
The following picture shows the operating principle of the interference echo suppression:



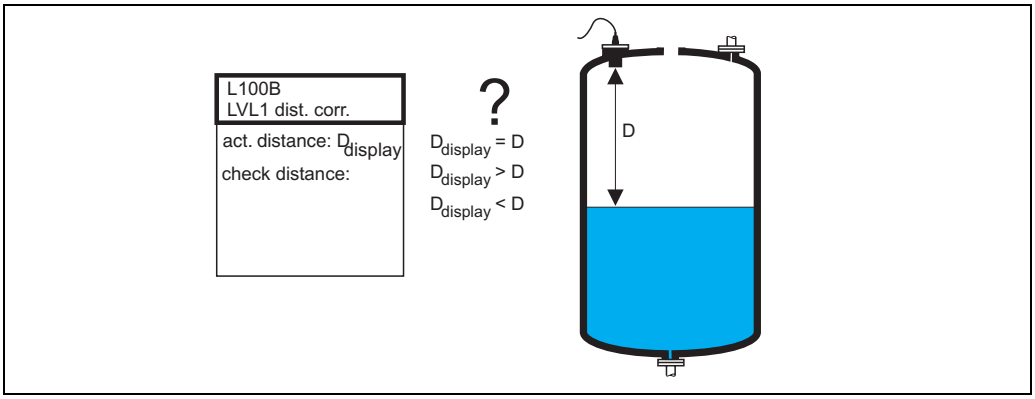
1: *The envelope curve* ***(a)*** *contains the level echo and an interference echo. Without interference echo suppression, the interference echo is evaluated.*
2: *The interference echo suppression generates the mapping curve* ***(b)****. This curve suppresses all echos within the range of mapping* ***(c)****.*
3: *From now on, only those echos are evaluated, which are higher than the mapping curve. The interference echo is lower thanthe mapping curve and is therefore ignored.*

Note!
In order to include all interference echos, the interference echo suppression should be performed with the level as low as possible. If during commissioning the vessel can not be sufficiently emptied, it is advisable to repeat the interference echo suppression at a later point of time (as soon as the level reaches nearly 0%).

6.4.9 "LVL N check value" (N = 1 or 2)



LVL1 check value L100B
act. distance 1:
check distance:



"actual distance N" (N = 1 or 2)

Displays the currently measured distance $D_{display}$.

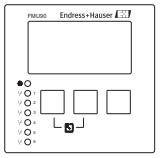
"check distance"

Use this parameter to state if the displayed distance $D_{display}$ matches the real distance D (measured by a rule for example). Based on your selection, the Prosonic S automatically proposes a suitable range of mapping.
You have got the following options:

- **distance = ok**
  Choose this option if the displayed value $D_{display}$ matches the real distance D.
  After selecting this option, the Prosonic S changes to the **"distance mapping"** parameter set. The preset range of mapping is identical to D. That means: all interference echos above the current product surface will be suppressed by the mapping curve.
- **distance too small**
  Choose this option if the displayed value $D_{display}$ is smaller than the real distance D.
  In this case the currently evaluated echo is an interference echo.
  After selecting this option, the Prosonic S changes to the **"distance mapping"** parameter set. The preset range of mapping is slightly larger than $D_{display}$. Therefore, the currently evaluated interference echo is suppressed by the mapping curve.
  If after the mapping $D_{display}$ still is too small, repeat the mapping until $D_{display}$ matches the real distance D.
- **distance too big**
  Choose this option if the displayed value $D_{display}$ exceeds the real distance D.
  This error is not caused by interference echos. Therefore, no interference echo suppression is performed and the Prosonic S returns to the "level 1(2)" submenu. Check the calibration parameters, especially the **"empty calibration"** and the **"application parameters"**.
- **distance unknown**
  Choose this option if you do not know the real distance D.
  In this case, an interference echo suppression can not be performed and the Prosonic S returns to the "level 1(2)" submenu.
- **manual**
  Choose this option if you want to define the range of mapping manually.

The Prosonic S changes to the **"distance mapping"** function, where you can define the required range of mapping.

6.4.10 "distance mapping"




```
LVL1 dist.map.     L100B
 act. distance 1:
 range of mapping:
 start mapping:
 status:
```

"actual distance N" (N = 1 or 2)

Displays the currently measured distance between the sensor membrane and the product surface. Compare this value to the real distance in order to find out if currently an interference echo is evaluated.

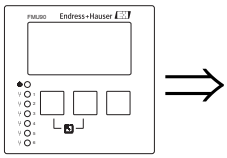
"range of mapping"

Use this parameter to specify the range of the mapping curve. Normally, a suitable value has already been entered automatically. Nevertheless, you can change this value if required.

"start mapping"

Select **"yes"** in this parameter in order to start the mapping. When the mapping is finished, the state is automatically changed to **"enable map"**.
The **"state"** parameter appears, in which the currently mesaured level and distance are displayed. Compare the displayed distance to the real distance in order to decide if a further mapping is necessary.
If yes: Press the left-arrow key (←) in order to return to the **"dist. map"** parameter set.
If no: Press the right-arrow key (→), in order to return to the **"level (LVL) N"** submenu.

6.4.11 "LVL N state" (N = 1 or 2)



LVL1 state L100C
level 1:
act. distance 1:
status:

"level N" (N = 1 or 2)

Displays the currently measured level.

"act. distance N" (N = 1 or 2)

Dispalys the currently measured distance.

"status"

Use this parameter to define the status of the interference echo suppression.

- **enable map**
  Choose this option in order activate the interference echo suppression. The mapping is then used for signal evaluation.
- **disable map**
  Choose this option in order to deactivate the interference echo suppression. The mapping is then no longer used for signal evaluation but it can be reactivated if required.
- **delete map**
  Choose this option in order to delete the mapping. It can not be reactivated again and the instrument uses the preprogrammed default mapping.

6.5 Envelope curve display

After the basic setup an evaluation of the measurement with the aid of the envelope curve is recommended, see chapter 10.3.

6.6 After the basic setup

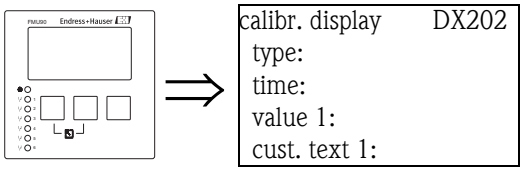
After the basic setup the Prosonic S transmitts the measured value via
- the display module
- the current output
  (by default the complete measuring range (0% – 100%) is mapped to the current range [4 – 20mA])
- the HART signal

Additional parameters are available for optimization of the measuring point. They can be parametrized as required. A detailed description of all instrument functions is given in the operating manual BA290F, "Prosonic S FMU90 – Description of Instrument Functions". A PDF-file of this document is available from
- the supplied CD-ROM of the "ToF Tool – FieldTool Package"
- the internet at "www.endress.com"

The following chapters describe the function groups "calibration display", "relay/controls" and "output/calculations".

7 The "display" menu

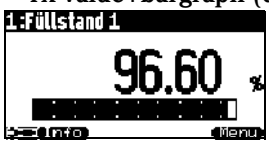
7.1 "display"



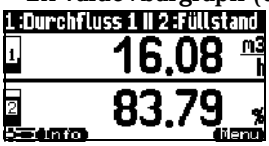
"type"
Use this parameter to select the format of the measured value display.

Selection:

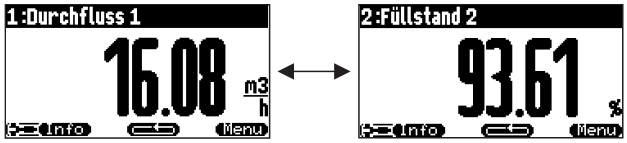
- **1x value+bargraph (default for instruments with 1 current output)**



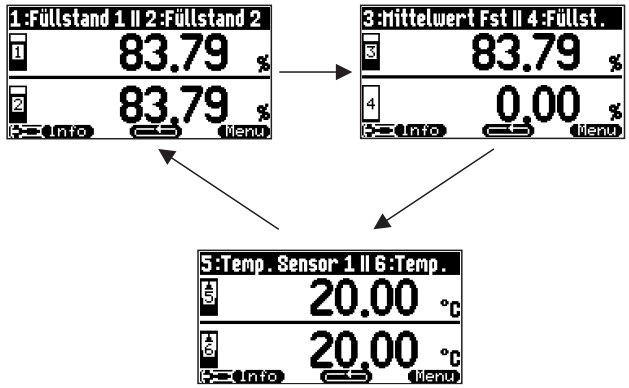
- **2x value+bargraph (default for instruments with 2 current outputs)**



- **value max. size**
  Up to two values are displayed alternately using the entire display:



- **alter 3x2 values**
  Up to 6 values can be displayed on three alternating pages. Each pages contains two values.



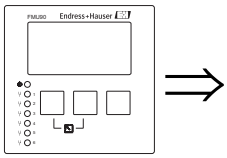
"time"
This parameter is used for the options "value max. size" and "alter 3x2 values". It specifies the time after which the next page appears.

Note!
To change to the next page immediately, press  .

"value 1" ... "value 6"
Use these parameters to allocate a measured or calculated value to each of the display values. The selection depends on the instrument version and installation environment.

"cust. text 1" ... "cust. text 6"
These parameters can be used to allocate a text string to each of the display values. This text is displayed together with the value if **"customized text"** (in the "display format" parameter set) has been set to **"yes"**.

7.2 "display format"



display format	DX201
format:	
no. of decimals:	
sep. character:	
customized text:	

"format"
Use this parameter to select the display format for numbers.

Selection:
- decimal (Default)
- ft-in-1/16"

"no. of decimals"
Use this parameter to select the number of decimals for the representation of numbers.

Selection:
- x
- x.x
- x.xx (Default)
- x.xxx

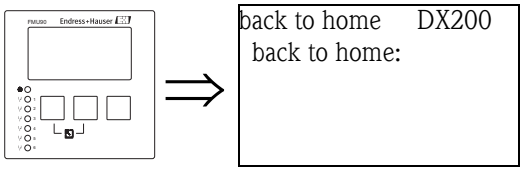
"sep. character"
Use this parameter to select the separation character for the representation of decimal numbers.

Selection:
- point (.) (Default)
- comma (,)

"customized text"
Determines if "text 1" to "text 6" from the "calibration display" parameter set are displayed.

Selection:
- no (Default)
- yes

7.3 "back to home"



"back to home"
Use this parameter to specify the return time. If no entry is made during the specified time, the display returns to the measured value display.

- Range of values: 3 ... 9999 s
- Default: 100 s

8 The "Relay/Controls" menu

The "relay/controls" menu is used to configure the relays and control functions of the Prosonic S. The following relay functions are available for level measurements:

- Limit relay
- Alarm and diagnostics relay
- (Alternating) pump control
- Rake control

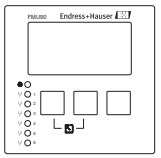
The configuration of these functions is described in the following sections.

8.1 Configuration of a limit relay

8.1.1 Overview

Step	Parameter set or submenu	Parameter	Remarks	see section
1	"relay/controls" menu		Select "relay configuration".	
2	relay allocation		Select a relay.	8.1.2
3	relay N (N= 1 -6)	function	1. Select "limit" 2. Select the measured or calculated value to which the limit refers.	8.1.3
4	relay N (N = 1 - 6)	limit type	Select a limit type.	8.1.4
		switch on point	Define the switch on point. (only available for "limit type" = "standard" or "tendency/speed")	
		switch off point	Define the switch off point. (only available for "limit type" = "standard" or "tendency/speed")	
		upper switch point	Define the upper switch point. (only available for "limit type" = "inband" or "out of band")	
		lower switch point	Define the lower switch point. (only available for "limit type" = "inband" or "out of band")	
		hysteresis	Define the hysteresis. (only available for "limit type" = "inband" or "out of band")	
5	relay N (N = 1 - 6)	switch delay	Define the switch delay (Default: 0s).	8.1.5
		invert	Select if the relay signal is to be inverted (default: no)	
		error handling	Define the reaction of the relay in the case of an error.	

8.1.2 "relay allocation"



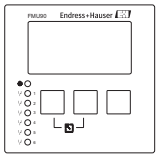
relay allocation RX101
relay 1
relay 2
relay 3
relay 4

Use this parameter to select the relay you are going to configure.

Selection:
- All relays of the instrument version at hand

Note!
If a function has already been allocated to one of the relays, the name of this function is displayed next to the relay number.

8.1.3 "relay N" (N = 1 - 6) (Part 1: relay function)

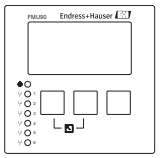


relay 1 R1103
function:

After selecting a relay, the parameter set **"relay N"** (N =1 - 6) appears, which is used to configure the relay. Initially, it contains the "function" parameter only. To configure a limit relay, proceed according to the following steps:

1. Select the **"function"** parameter. The **"select function"** screen appears.
2. Select **"limit"**. The **"function"** selection list appears.
3. Select the measured or calculated value to which the limit relay refers. The selection depends on the instrument version and the parametrization.

8.1.4 "relay N" (N = 1 - 6) (Part 2: Limit type and switching points)



relayN RX101
function: limit
limit type:
switch on point:
switch off point:

"Limit type"

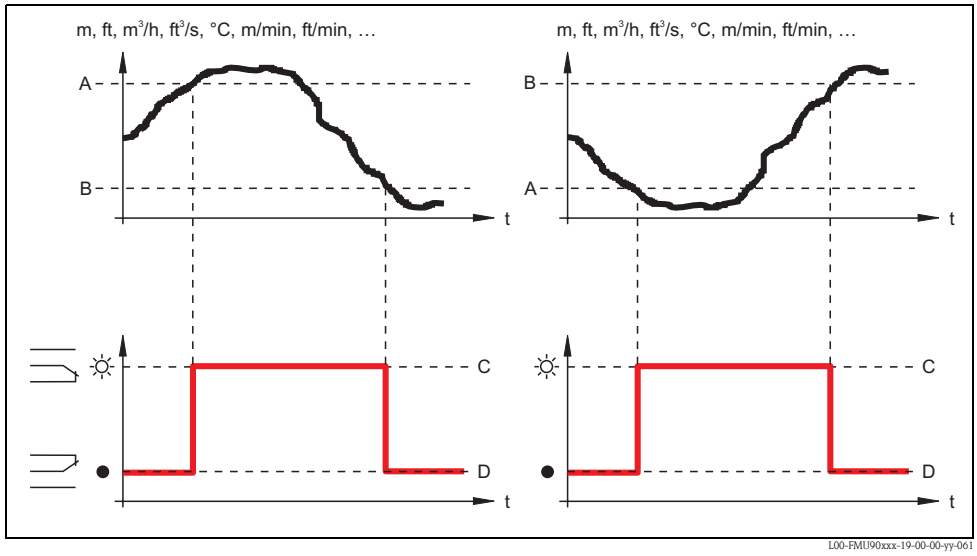
Use this parameter to define the type of limit.

Selection:
- **standard**
  For this limit type, a switch on point and a switch off point have to be defined. The switching behaviour depends on the relative position of these switching points.

  a. **switch on point > switch off point**
     The relay is energized if the measured value rises above the switch on point.

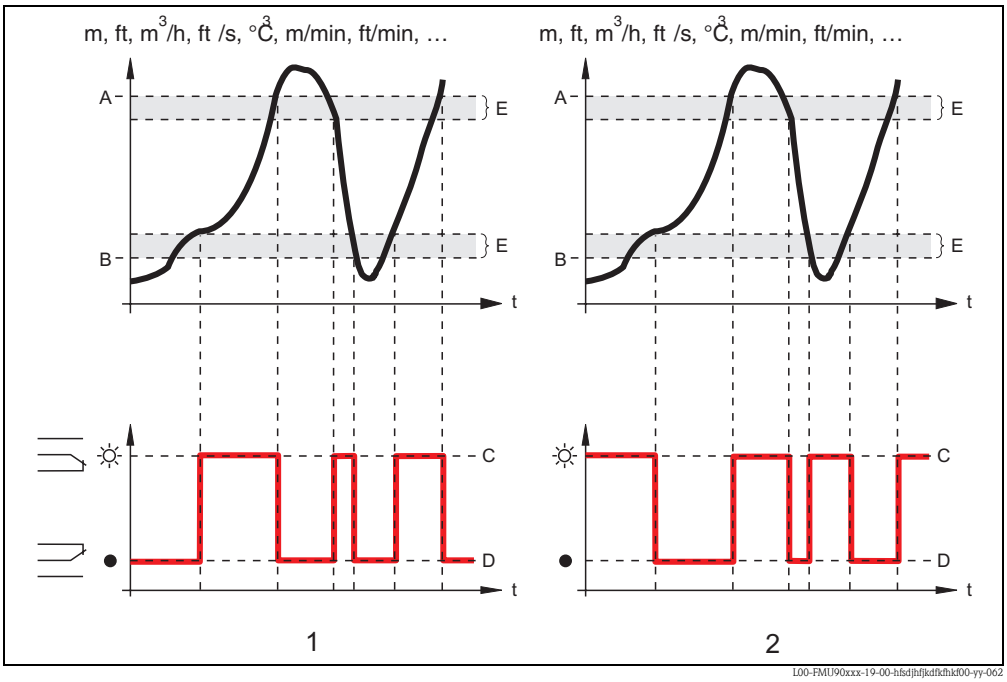
The relay is de-energized if the measured value falls below the switch off point.

b. **switch on point < switch off point**
The relay is energized if the measured value falls below the switch on point.
The relay is de-energized if the measured value rises above the switch off point.



***A:** switch on point; **B:** switch off point; **C:** relay energized; **D:** relay de-energized*

- **tendency/speed**
  This limit type is similar to the "standard" type. . The only difference is that variations with time of the measured value are examined instead of the measured value itself. Therefore, the unit for the switching points is "measuring value unit per minute".
- **inband**
  For this limit type, an upper and a lower switching point have to be defined.
  The relay is energized if the measured value is between the two switching points.
  The relay is de-energized if the measured value is above the upper or below the lower switching point.
  Additionally, a hystersis can be defined, which affects both switching points.
- **out of band**
  For this limit type, an upper and a lower switching point have to be defined.
  The relay is energized if the measured value is above the upper or below the lower switching point.
  The relay is de-energized if the measured value is between the two switching points.
  Additionally, a hystersis can be defined, which affects both switching points.



1: *"inband" limit relay;* ***2:*** *"out of band" limit relay*
A: *upper switching point;* ***B:*** *lower switching point;* ***C:*** *relay energized;* ***D:*** *relay de-energized;* ***E:*** *hysteresis*

"switch on point" and "switch off point"
(for the "standard" limit type)

Define the switching points in these parameters.
They have the same unit as the measured value.

Caution!
After a change of the "unit level" or "flow unit" the switchinp points have to be checked and adjusted if required.

"switch on /min" and "switch off /min"
(for the "tendency/speed" limit type)

Define the switching points in these parameters.
Their unit is the measured value unit per minute.

Caution!
After a change of the "unit level" or "flow unit" the switchinp points have to be checked and adjusted if required.

"upper switching point" and "lower switching point"
(for the "inband" and "out of band" limit types)

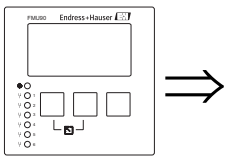
Define the switching points in these parameters.
They have the same unit as the measured value.

Caution!
After a change of the "unit level" or "flow unit" the switchinp points have to be checked and adjusted if required.

"hysteresis"
(for the "inband" and "out of band" limit types)

Define the hysteresis in this parameter. It has the same unit as the measured value.
The hysteresis affects the upper and the lower swtiching point.

8.1.5 "relay N (N = 1 - 6)" (Part 3: Relay behavior)



relay X RX104
switch delay:
invert:
error handling:

"switch delay"

Use this parameter to specify the switch delay (in seconds).

The relay does not switch immediately after the switch on point has been exceeded but only after the specified delay.
The measured value must exceed the switch-on point during the entire delay time.

"invert"

Use this parameter to specify if the switching direction of the relay is to be inverted.

Selection:
- **no (default)**
  The switching direction of the relay is **not** inverted. The relay switches as described in the above sections.
- **yes**
  The switching direction of the relay **is** inverted. The states "energized" and "de-energized" are interchanged.

"error handling"

Use this parameter to specify the reaction of the relay in the case of an error.

Selection:
- **actual value**
  The relay switches according the the currently measured value (although its reliability is not ensured).
- **hold (default)**
  The current switching state of the relay is maintained.
- **switch on**
  The relay is energized.
- **switch off**
  The relay is de-energized.

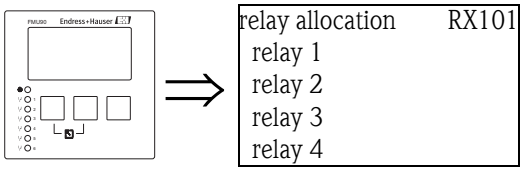
8.2 Configuration of an alarm or diagnostic relay

8.2.1 Overview

Step	Parameter set or submenu	Parameter	Remark	see section
1	"relay controls" menu		Select "relay configuration"	
2	relay allocation		Select a relay	8.2.2
3	relay N (N= 1 -6)	function	1. Select "alarm/diagnostics" 2. Select – "alarm relay", if the relay is to indicate an alarm state of the Prosonic S.[1)] – "diagnostics", if the relay is to indicate one or two user selectable states of the instrument.	8.2.3
4	relay N (N = 1 - 6)	allocation 1	Select the first instrument state which is to be indicated by the relay. (only available if "diagnostics" has been selected in the previous function)	8.2.4
		allocation 2	Select the seccond instrument state which is to be indicated by the relay. (only available if "diagnsotics" has been selected in the previous function)	
5	relay N (N = 1 - 6)	invert	Select if the relay signal is to be inverted (default: no)	8.2.5

1) This is the default setting for relay 1.

8.2.2 "relay allocation"

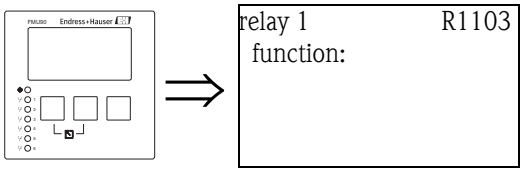


Use this parameter to select the relay you are going to configure.

Selection:
- All relays of the instrument version at hand

Note!
If a function has already been allocated to one of the relays, the name of this function is displayed next to the relay number.

8.2.3 "relay N" (N = 1 - 6) (Part 1: relay function)

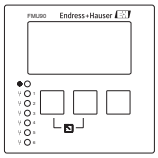


After selecting a relay, the parameter set **"relay N"** (N =1 - 6) appears, which is used to configure the relay. Initially, it contains only the "function" parameter. To configure an alarm relay or diagnostic relay, proceed according to the following steps:

1. Select the **"function"** parameter. The **"select function"** screen appears.
2. Select **"alarm/diagnostics"**. The **"function"** selection list appears.

3. Select
   – "alarm relay", if the relay si to indicate an alarm state of the Prosonic S[5].
   – "diagnostics" if the relay is to indicate one or two user selectable states of the instrument.

8.2.4 "relay N" (N = 1 - 6) (Part 2: Allocation of the switching condition)



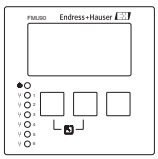
relay N RN103
function: diagnostics
allocation 1:
allocation 2:

"allocation 1/2"

A specific instrument state or event can be allocated to each of these parameters. The relay is de-energized as soon as one of these states or events occurs.

Selection:
- echoloss sensor 1/2/1+2
- defective temperature sensor1/2
- defective external temperature sensor
- Accumulated alarm: defective temperature sensor
- overtemp. sensor 1/2
- Accumulated Alarm: overtemp.
- safety distance channel 1/2
- Accumulated Alarm: safety distance
- pump alarm
- pump operation

8.2.5 "relay N" (N = 1 - 6) (Part 3: Relay behavior)



relay N RN104
invert:

"invert" subfunction

Use this parameter to specify if the switching direction of the relay is to be inverted.

Selection:
- **no (default)**
  The switching direction of the relay is **not** inverted. The relay switches as described in the above sections.
- **yes**
  The switching direction of the relay **is** inverted. The states "energized" and "de-energized" are interchanged.

5) This is the default setting for relay 1.

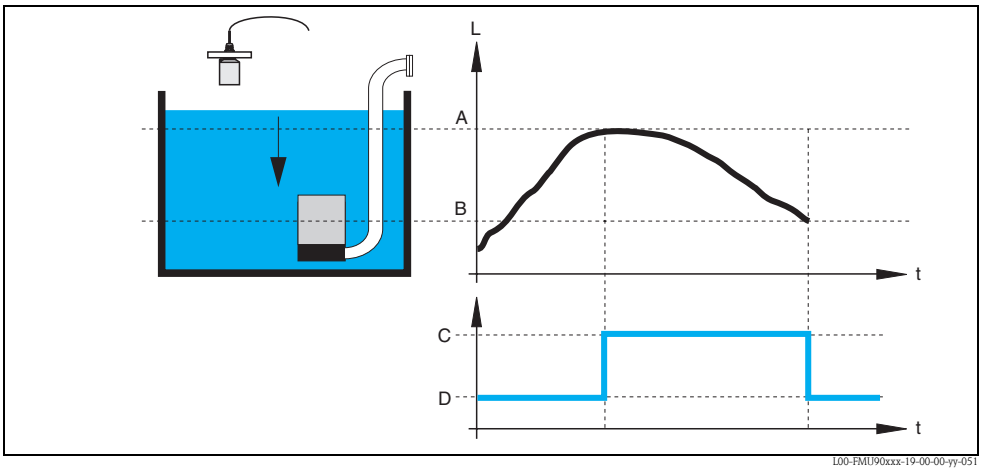
8.3 Configuration of a pump control

8.3.1 Basic principles

Switch points

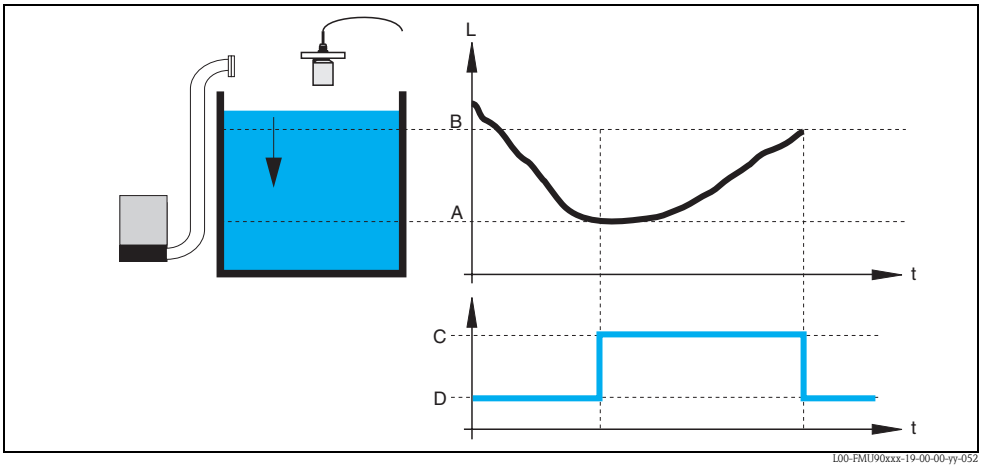
The pump control is used to start or stop pumps depending on the measured level. To do this, a switch-on point and a switch-off point is defined for each pump. Additionally, a relay is assigned to the pump and the switching is performed by this relay.
Two cases can be distinguished for the swichting behaviour of this relay:

a. **Switch-on point > Switch-off point**
The pump is switched on if the level rises above the switch-on point (A). It is switched off if the level drops below the switch-off point (B).
Example: Emptying of a flood control reservoir.



***A:** switch-on point; **B:** switch-off point; **C:** pump on; **D:** pump off*

b. **Switch-on point < Switch-off point**
The pump is switched on if the level drops below the switch-on point (A). It is switched off if the level rises above the switch-off point (B).
Example: Filling of a storage vessel



***A:** switch-on point; **B:** switch-off point; **C:** pump on; **D:** pump off*

Operating mode

The Prosonic S can control several pumps simultaneously – depending on the number of relays (s. feature 70 of the product structure). If two or more pumps are applied for one level channel, you can choose between two different operating modes:

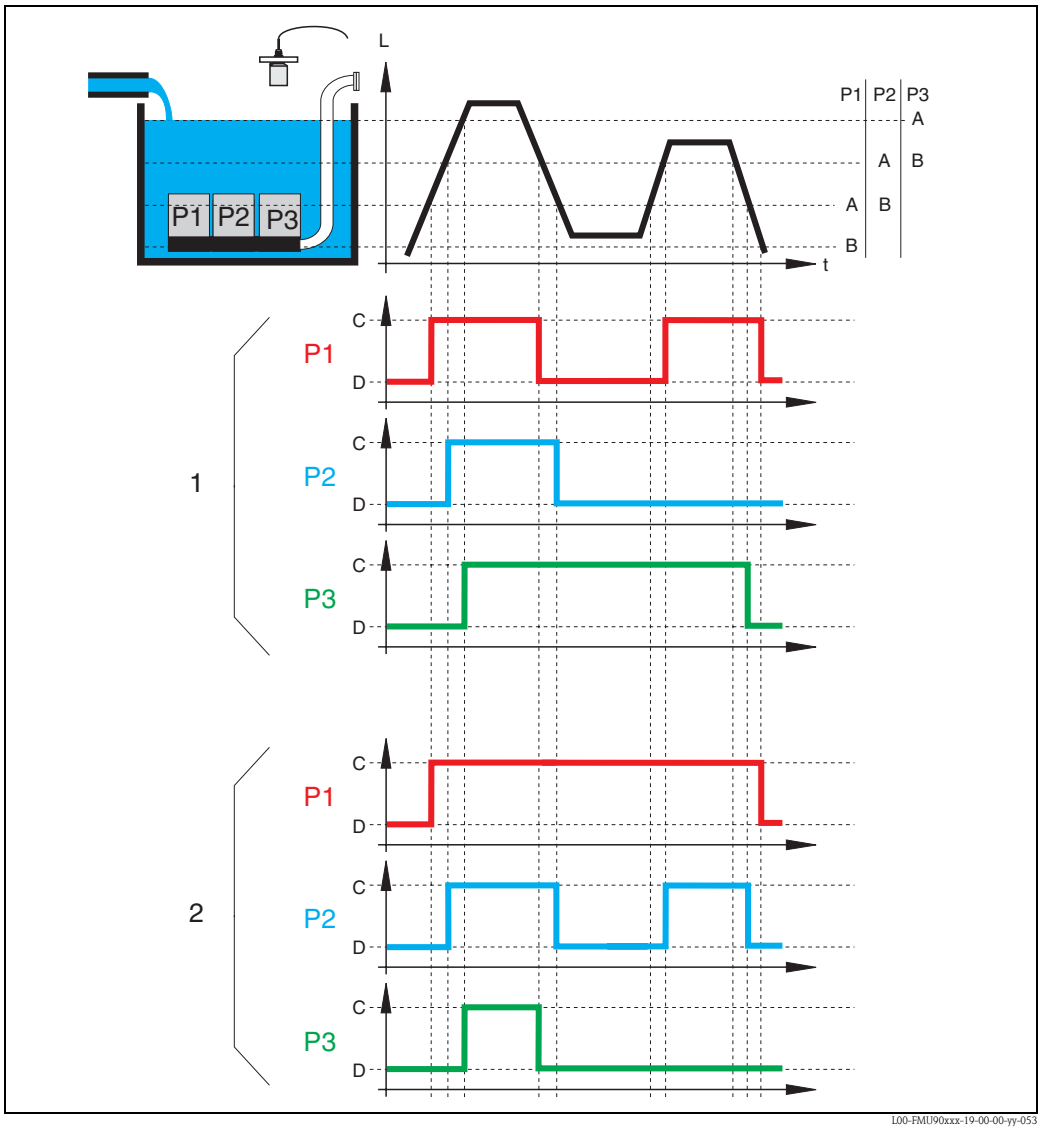
a. **Non-alternating pump control**
In this mode, each pump is switched according to the switching points allocated to it.

b. **Alternating pump control**
In this mode, the switching points are not allocated to the individual pumps. Instead, the relays are switched in a way that ensures uniform usage of all pumps. This is achieved by the following rules:

1. If the level rises above one of the switch-on points, that relay switches on, which at that moment has been switched off the longest time. This is not necessarily the relay to which the switch-on point belongs.
2. If the level drops below one of the switch-off points, that relay switches off, which at that moment has been switched on the longest time. This is not necessarily the relay to which the switch-off point belongs.

However, there are two restrictions to these rules:

3. Rising of the level above a switch-on point effects switching on of a relay only if the corresponding switch-off point has been reached before.
4. Dropping of the level below a switch-off points effects switching-off of a relay only if the corresponding switch-on point has been reached before.



1: Alternating pump control; that pump is switched on (switched off), which has been switched off (switched on) the longest time.
2: Non-alternating pump control; each switching point is allocated to a different pump.
A: switch-on point of the pump; B: switch-off point of the pump; C: pump on; D: pump off;

Limit control versus pump rate control

If several pumps are connected, you can choose between limit control (as described above) and pump rate control.

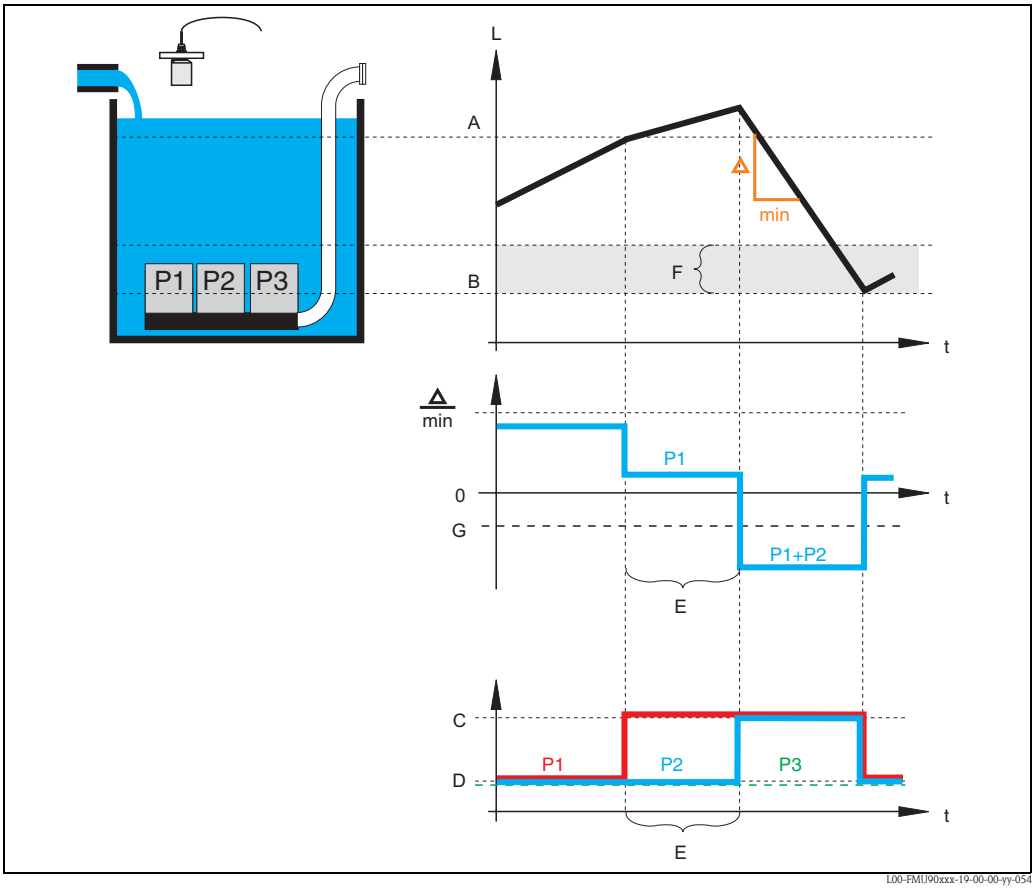
Limit control

If limit control has been selected, the relays are switched according to the swichting points as described above.

Pump rate control

If pump rate control has been selected, there is only one switch-on point and one switch-off point, which are valid for all relays. Additionally, a desired **pump rate** has to be specified.
If the level rises above (or falls below) the switch-on point, initially only one pump is switched on. If the desired pump rate has not been achieved after the selected **hook-up interval**, an additional pump is switched on. Similarly, further pumps are switched on in intervals until the desired pump rate has been achieved.

However, if the level is already near to the switch-off point (distance < **switch-on barrier**), no further pumps are swtiched on, even if the pump rate has not yet been achieved.



A: *switch-on point;* ***B:*** *switch-off point;* ***C:*** *pump on;* ***D:*** *pump off;* ***E:*** *hook-up interval;* ***F:*** *switch-on barrier*
G: *pump rate*

Note!
If both the alternating pump control and the pump rate contral are active, the pumps are alternately used as first pump.

8.3.2 Overview

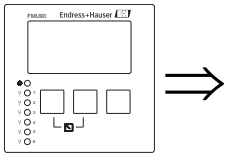
Parametrization of a pump control (type: limit control)

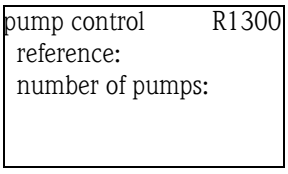
Step	Parameter set or submenu	Parameter	Remarks	see section
1	"relay/controls" menu		Select "pump control1" or "pump control 2".	
2	pump control N (N = 1 or 2)	reference	Select the level according to which the pumps are controlled.	8.3.3
		number of pumps	Select the number of pumps. Note: A relay must be available for each of the pumps.	
3	pump control N (N = 1 or 2)	function	Select "limit control".	8.3.4
4	pump control N (N = 1 or 2)		Select a pump. (Each pump must be configured individually.)	8.3.5
5	pumpe M control N (M = 1 - 6) (N = 1 or 2)	switch on point	Define the switch on point for this pump.	8.3.6
		switch off point	Define the switch off point for this pump.	
		switch on delay	Define the switch on delay for this pump.	
		alternate	Select if the pump is to take part in the alternating pump control (Default: no).	
		crust reduction	Define the inaccuracy of the switching points (to reduce crust formation).	
6	pumpe M control N (M = 1 - 6) (N = 1 or 2)	backlash interval	Define the backlash interval	8.3.7
		backlash time	Define the backlash time	
		error handling	Define the error handling	
7	relay allocation		Allocate a relay to the pump. Note: By default, relay 1 is configured as alarm relay.	8.3.8
8	relay N (N = 1 - 6)	function	Select "pump M/control N"	8.3.9
		invert	Select if the switching signal is inverted (default: no)	
9	pump control N		Select the next pump and continue with step 5 until all pumps have been configured. If all pumps are configured: Press  to return to the "relay/controls" menu.	

Parametrization of a pump control (type: pump rate control)

Step	Parameter set or submenu	Parameter	Remarks	see section
1	"relay/controls" submenu		Select "pump control 1" or "pump control 2".	
2	pump control N (N = 1 or 2)	refernece	Select the level according to which the pumps are controlled.	8.3.3
		number of pumps	Select the number of pumps. Note: A relay must be available for each of the pumps.	
3	pump control N (N = 1 or 2)	function	Select "rate control"	8.3.4
4	pump control N (N = 1 or 2)	switch on point	Define the switch on point.	8.3.10
		switch off point	Define the switch off point.	
		min. pumprate/min	Dfine the minimum pump rate.	
		crust reduction	Define the inaccuracy for the switching points (to reduce crust formation).	
		switch on border	Define the switch on border.	
		hook up interval	Define the hook-up interval.	
		alternate	Select if an alternating pump control is to be performed.	
5	pump control N (N = 1 or 2)		Select a pump. (The following parameters must be configured for each pump individually.)	8.3.5
6	pumpe M control N (M = 1 - 6) (N = 1 or 2)	switch on delay	Define the switch on delay.	8.3.11
		backlash interval	Define the backlash interval.	
		backlash time	Define the backlash time.	
		error handling	Define the error handling.	
7	relay allocation		Allocate a relay to the pump. Note: By default, relay 1 is configured as alarm relay.	8.3.8
8	relay N (N = 1 - 6)	function	Select "pump M/control N".	8.3.9
		invert	Select if the switching signal is inverted (default: no).	
9	pump control N		Select the next pump an continue by step 6 until all pumps have been configured. If all pumps are configured: Press  to return to the "relay/controls" menu.	

8.3.3 "pump control N" (N = 1 or 2)





"reference"

Defines the level channel to which the pump control refers.

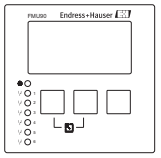
Selection:
- **none (default)**
- level 1
- level 2 (for instrument versions with 2 level inputs)

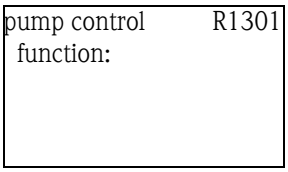
"number of pumps"

Defines the number of pumps participating in the pump control. At the end of the configuration procedure a relay must be allocated to each of the pumps ("relay allocation" parameter set).

- Range of values : 1 ... 6 (depending on the number of relays)
- Default: 1

8.3.4 "pump control N" (N = 1 or 2)



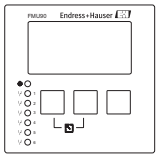


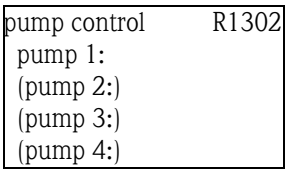
"function"

Determines the type of pump control.

Selection:
- **limit control (Default)**
  Each pump has its own switch-on point and switch-off point
- **rate control**
  There is only one switch-on point and one switch-off point for all pumps. If the switch-on point has been exceeded, several pumps are switched on in intervals until the defined pumprate is obained. For details refer to the chapter "Limit control and rate control".

8.3.5 "pump control N" (N = 1 or 2)

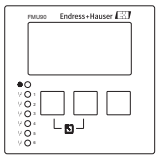


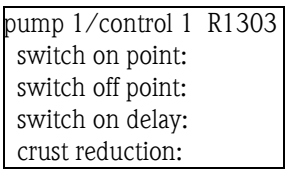


Determines, to which pump the following specifications refer.

Selection
- depending on the selected "number of pumps"

8.3.6 "pump M/control N" (M = 1 - 6; N = 1 or 2) (Part 1: Switching points for limit control)





"switch on point"

Specifies the switch-on point of the respective pump. Use the selected level unit.

Caution!
After a change of the "unit level" the switch on point has to be checked and adjusted if required.

"switch off point"

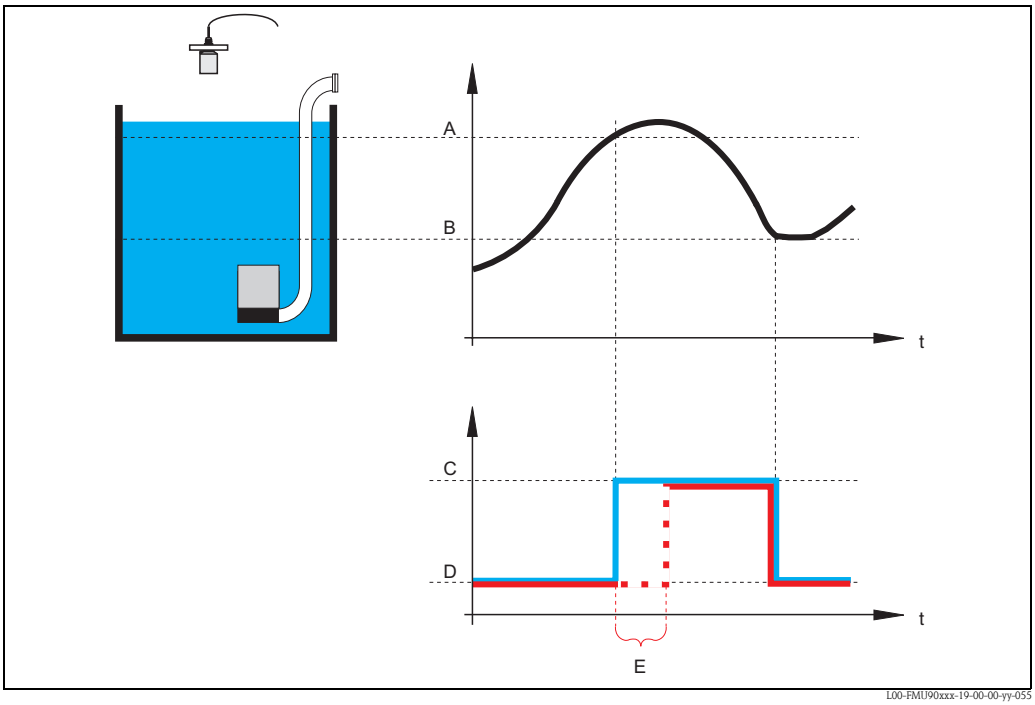
Specifies the switch-off point of the respective pump. Use the selected level unit.

Caution!
After a change of the "unit level" the switch off point has to be checked and adjusted if required.

"switch-on delay"

Specifies the switch-on delay of the respective pump (in seconds).

When the level has risen above the switch-on point, the relay does not switch immediately but only after the specified switch-on delay. Assign different delays to the individual pumps in order to avoid simultaneous switching-on of several pumps (which could cause an overload of the power supply system).



***A:** switch-on point; **B:** switch-off point; **C:** pump on; **D:** pump off; **E:** switch-on delay*

"alternate"

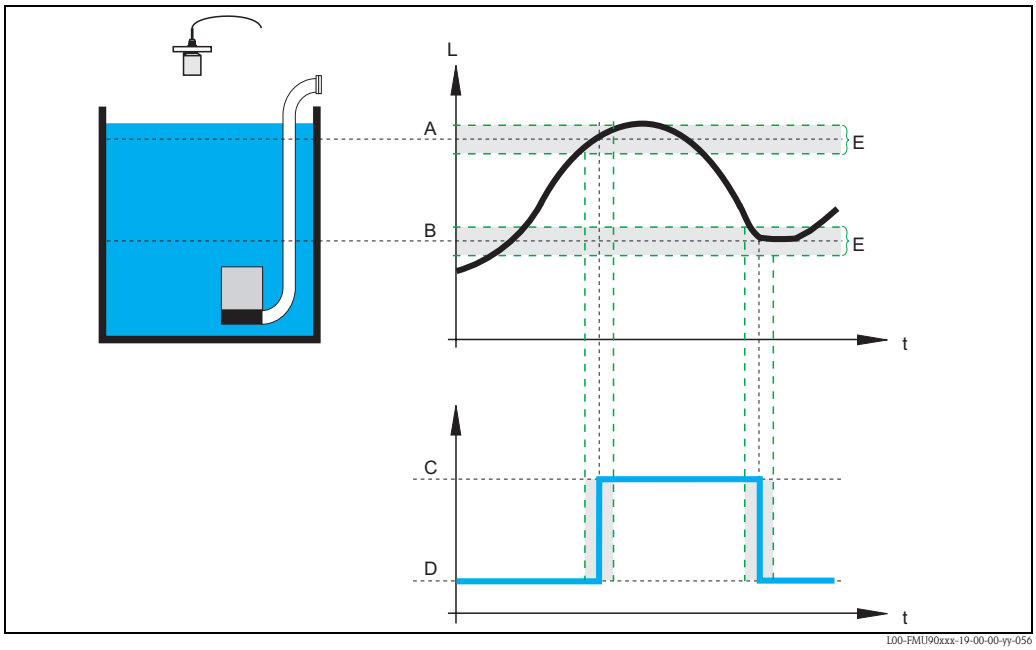
Specifies if the pump should be included in the alternating pump control.

Selection

- **no (default)**
  The pump is not included in the alternating pump control. Instead, it switches according to its own switch points.
- **yes**
  The pump is included in the alternating pump control.

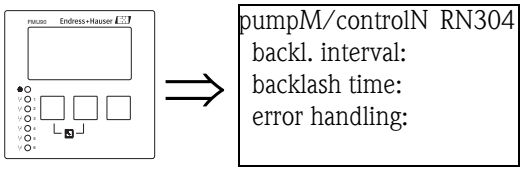
"crust reduction"

Specifies a range of inaccuracy (percentage of the measuring range) for the switching points of the pump. If this value is larger than "0", the switching points are not exactly constant. Instead, they vary within the specified range of inaccuracy.
This helps to avoid crust formation, which often occurs at fixed switching points.



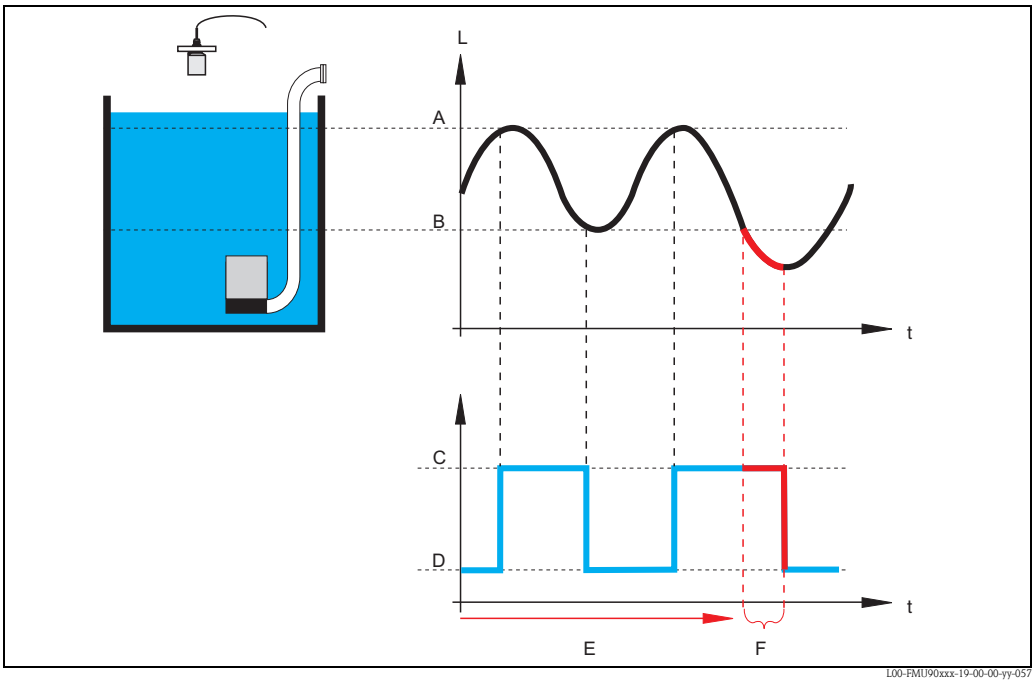
***A:** switch-on point; **B:** switch-off point; **C:** pump on; **D:** pump off; **E:** inaccuracy ("crust reduction")*

8.3.7 "pump M/control N" (M = 1 - 6, N = 1 or 2) (Part 2: Switching behavior for limit control)



"backlash interval" and "backlash time"

Use these parameters if, you want to empty a vessel beyond the switch-off point in regular intervals.
The **"backlash interval"** determines after which time this extended pumping will occur.
The **"backlash time"** determines how long this additional pumping lasts.



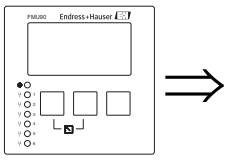
***A:** switch-on point; **B:** switch-off point; **C:** pump on; **D:** pump off*
***E:** backlash interval; **F:** backlash time*

"error handling"

This parameter defines the reaction of the relay in the case of an error.

Selection:
- **hold (default)**
  The current switching state of the relay is held.
- **switch on**
  The relay is energized (i.e. the pump is switched on).
- **switch off**
  The relay is de-energized (i.e. the pump is switched off).
- **actual value**
  The relay switches according to the current measuring value (although its reliability is not ensured).

8.3.8 "relay allocation"

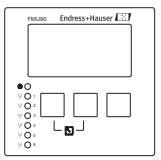


relay allocation	RN305
relay 1	
relay 2	
relay 3	
relay 4	

Allocates a relay to the pump.

Selection:
- All relays of the instrument version at hand

8.3.9 "relay N" (N = 1 - 6)



RelaisN RN306
function:
invert:

"function"

Allocates the desired function to the relay.

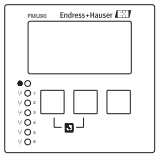
Selection:
- none (default)
- pump M/control N

"invert"

Determines if the switching behavior of the relay is inverted.

Selection:
- **no (default)**
  The switching behavior of the relay is **not** inverted. The relay is energized if the pump should be switched on.
- **yes**
  The switching behavior of the relay **is** inverted. The relay is energized if the pump should be switched off.

8.3.10 "pump control N" (N = 1 or 2) (Switching points for rate control)



pump control R13A3
switch on point:
switch off point:
min pump rate:
alternate:

"switch on point"

Specifies the switch-on point. Use the selected level unit.

Caution!
After a change of the "unit level", the switch on point has to be checked and adjusted if required.

"switch off point"

Specifies the switch-off point. Use the selected level unit.

Caution!
After a change of the "unit level", the switch off point has to be checked and adjusted if required.

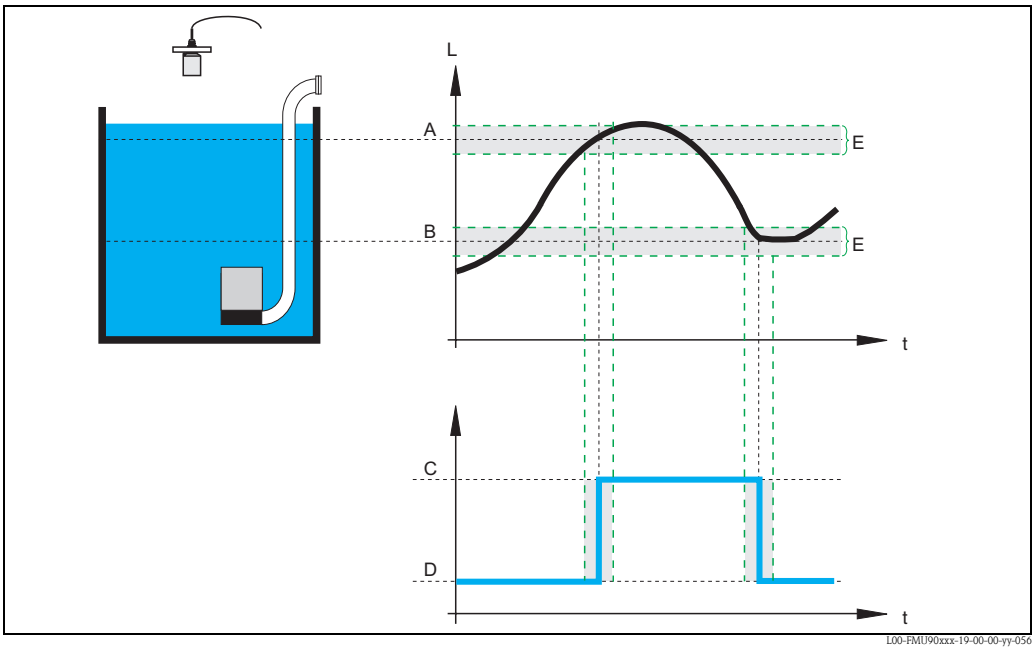
"min pump rate"

Specifies the desired minimum pump rate (for details see section "limit control and rate control").

Note!
If the vessel is to be emptied, a negative pump rate has to specified.

"crust reduction" subfunction

Specifies a range of inaccuracy (percentage of the measuring range) for the switching points. If this value is larger then "0", the switching points are not exactly constant. Instead, they vary within the specified range of inaccuracy.
This helps to avoid crust formation, which often occurs at fixed switching points.



A: *switch-on point;* ***B:*** *switch-off point;* ***C:*** *pump on****D:*** *pump off;* ***E:*** *inaccuracy ("crust reduction")*

"switch on border"

Specifies the switch-on border for the rate control (for details see section "limit control and rate control").

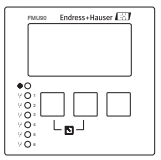
"hook up interval"

Specifies the time interval between the switching-on of the different pumps (for details see section "limit control and rate control").

"alternate"

Determines if an alternating pump control is to be performed.

8.3.11 "pump M/control N (M = 1 - 6, N = 1 or 2) (Switching behavior for rate control)



pump control RN304
switch-on delay:
backlash interval:
backlash time:
error handling:

"switch-on delay"

see page 85

"backlash interval" and "backlash time"

see page

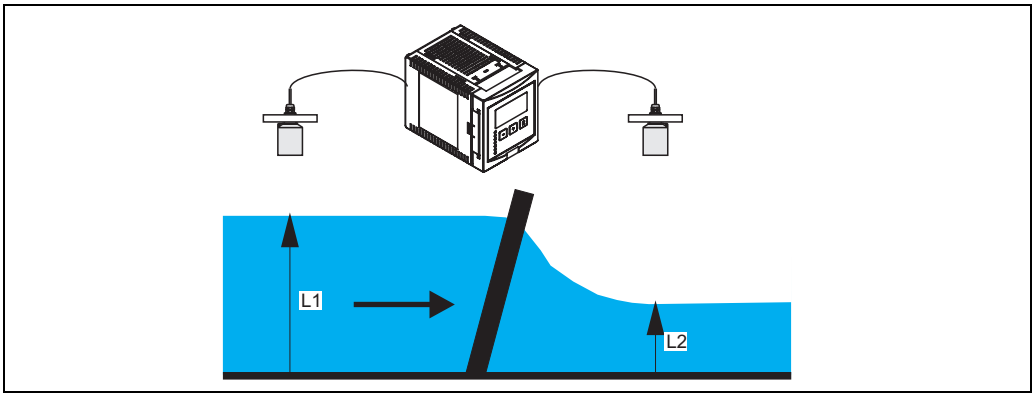
"error handling"

see page

8.4 Configuration of a rake control

8.4.1 Basics

In order to detect clogging of a rake, the Prosonic S measures the upstream level L1 and the downstream leve L2. Rake clogging causes L2 to become much lower than L1. Therefore, the rake control function evaluates either the difference L1 - L2 or the ratio L2/L1.



L00-FMU90xxx-19-00-00-yy-058

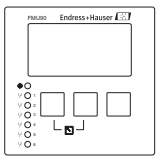
Rake clogging is indicated by a relay, which can be used, for example, to trigger a rake cleaning device.

8.4.2 Overview

Step	Parameter set or submenu	Parameter	Remarks	see section
1	"relay/controls" menu		Select "rake control"	
2	rake control	upstream water	Select the upstream water level signal (L1)	8.4.3
		downstream water	Select the downstream water level signal (L2)	
		function	Select the criterion for rake clogging: ■ difference: L1 - L2 ■ ratio: L2/L1	
3	rake control	switch on point	Define the switch on point	8.4.4
		switch off point	Define the switch off point	
4	rake control	switch delay	Define the switch delay.	8.4.5
		error handling	Define the error handling	
5	relay allocation		Select the relay for rake control	8.4.6
6	relay N (N = 1 - 6)	function	Select "rake control"	8.4.7
		invert	Select if the switching delay is to be inverted (default: no)	

Note!
In the "output/calculations" and "calibrate display" menus it is possible to define, that the difference L1-L2 or the ratio L2/L1 is displayed by the analog output and/or the display.

8.4.3 "rake control" (Part 1: Allocation)



```
rake control          R1200
 upstream water:
 downstream water:
 function:
```

"upstream water"

Specifies, which signal refers to the upstream level.

Selection:
- level 1 (default)
- level 2

"downstream water"

Specifies, which signal refers to the downstream level.

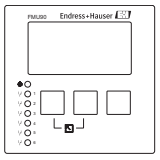
Selection:
- level 1
- level 2 (default)

"function"

Used to select the criterion for the detection of rake clogging.

Selection:
- **difference (default)**
  Rake clogging is indicated if the difference L1 – L2 exceeds a critical value.
- **ratio**
  Rake clogging is indicated if the ratio L2/L1 falls below a critical value.

8.4.4 "rake control" (Part 2: Switching points)



```
rake control          R1201
 switch on point:
 switch off point:
```

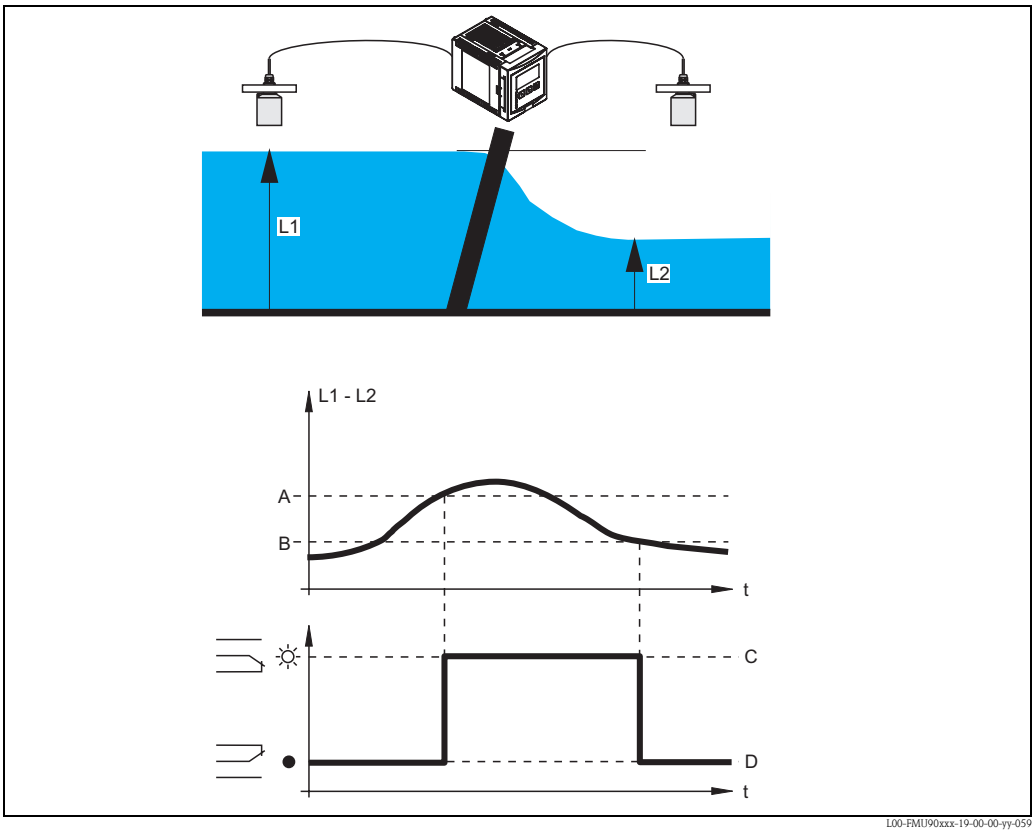
"switch on point" and "switch off point"

Used to specify the limit values for detection of rake clogging. The meaning of these limit values depends on the selected function.

Caution!
After a change of the "unit level" the switching points have to be checked an adjusted if required.

function = "difference"

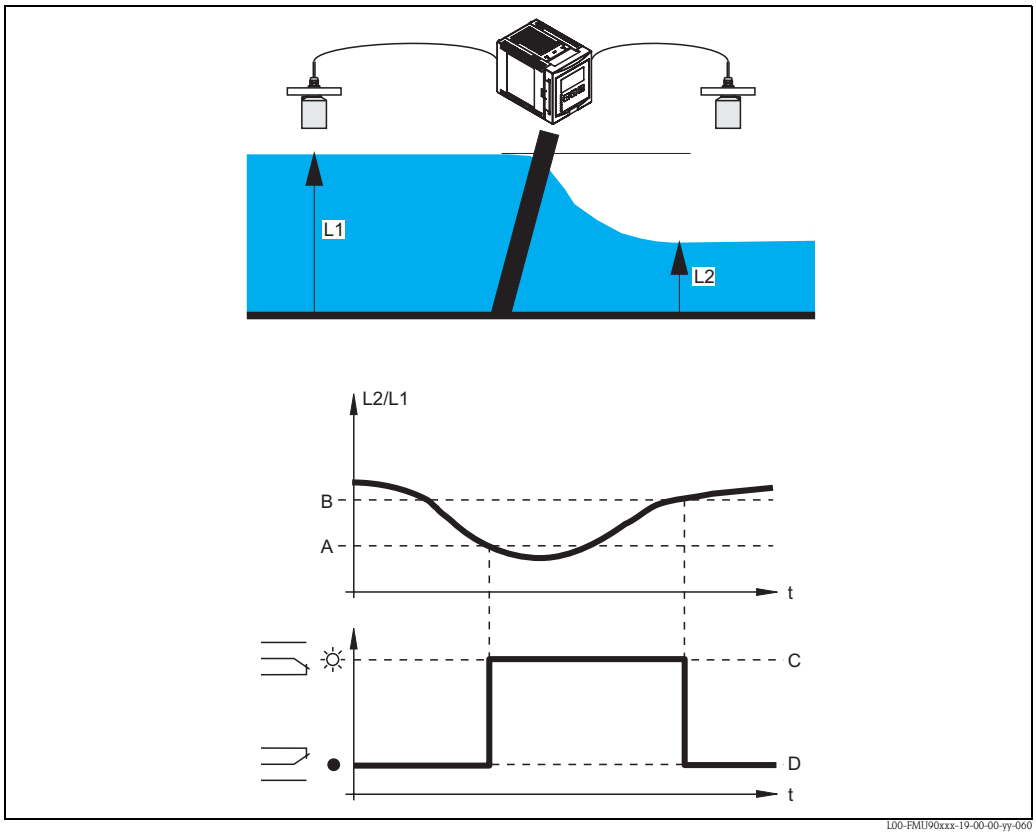
In this case, the switch on and switch off points have to be specified in the level unit. The switch on point must be larger than the switch off point.
The rake control relay is energized if the difference L1 – L2 rises above the switch on point. It is de-energized if the difference falls below the switch off point.



A: *switch on point;* ***B:*** *switch off point;*
C: *relay energized (i.e. rake cleaning on);* ***D:*** *relay de-energized (i.e. rake cleaning off)*

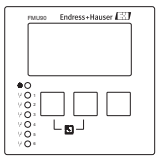
function = "ratio"

In this case, the switch on and switch off points are numbers between 0 and 1. The switch on point must be smaller than the switch off point.
The rake control relay is energized if the ratio L2/L1 falls below the switch on point. It is de-energized if the ratio rises above the switch off point.



***A:** switch on point; **B:** switch off point;*
***C:** relay energized (i.e. rake cleaning on); **D:** relay de-energized (i.e. rake cleaning off)*

8.4.5 "rake control" (Part 3: Switching parameters)



rake control	R1202
switch delay:	
error handling:	

"switch delay"

Specifies the switch delay for the rake control.

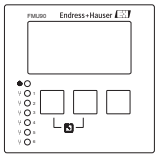
The relay does not switch immediately after the switch on point has been exceeded but only after the specified switch delay. This is to prevent that random fluctuations of L1 or L2 activate the rake cleaning unnecessarily.

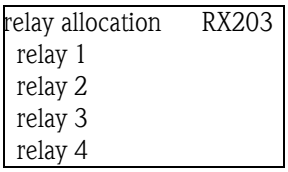
"error handling"

Specifies the behavior of the rake control relay in case of an error.

Selection:
- **actual value (default)**
  The relay switches according to the current measuring value (although its reliability is not ensured).
- **hold**
  The current switching state of the relay is held.
- **switch on**
  The relay is energized.
- **switch off**
  The relay is de-energized.

8.4.6 "relay allocation"

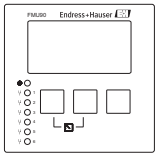


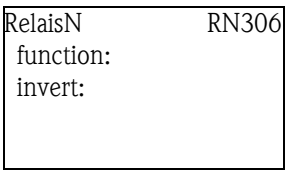


Allocates a relay to the rake control function.

Selection:
- All relays of the instrument version at hand.

8.4.7 "relay N" (N = 1 - 6)





"function"

Allocates the desired function to the relay.

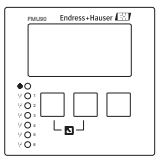
Selection:
- none (default)
- rake control

"invert"

Determines if the switching behavior of the relay is to be inverted.

Selection:
- **no (default)**
  The switching behavior of the relay is **not** inverted. The relay is energized if the rake cleaner should be switched on.
- **yes**
  The switching behavior of the relay **is** inverted. The relay is energized if the rake cleaner should be switched off.

9 The "output/calculations" menu

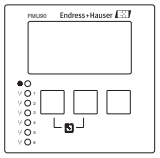


main menu CX001
output/calculat
device properties
system informat.

The "output/calculations" menu can be used to

- configure calculations such as averaging and subtraction
- configure the current outputs and the HART interface.

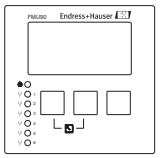
After entering the "output/calculations" menu, a selection screen appears in which you must choose the output you are going to configure.



output/calculat OX001
current output 1
(current output 2)

✎ Note!
Current output 2 is available only for 2-channel instruments.

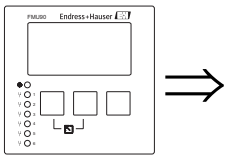
After this selection, additional submenus appear, which can be used to configure the output:

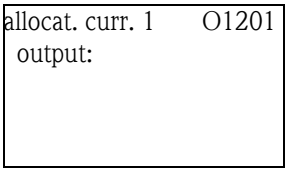


current output 1 O1302
allocat./calculat
extended calibr.
HART settings
simulation

9.1 The "allocation/calculations" submenu

9.1.1 "allocation current N " (N = 1 or 2)





"output"

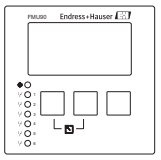
Allocates a measured or calculated value to the current output.

Selection:
The available options depend on the instrument version, the connected sensors and the instrument configuration. The following measured and calculated values may occur:

- level 1
- level 2
- flow 1
- flow 2
- average level: (level1 + level2)/2
- level 1-2
- level 2-1
- level 1+2
- average flow
- flow 1-2
- flow 2-1
- flow 1+2
- backwater ratio downstream/upstream
- rake control ratio downstream/upstream

9.2 The "extended calibration" submenu

9.2.1 "mode current N" (N = 1 or 2)



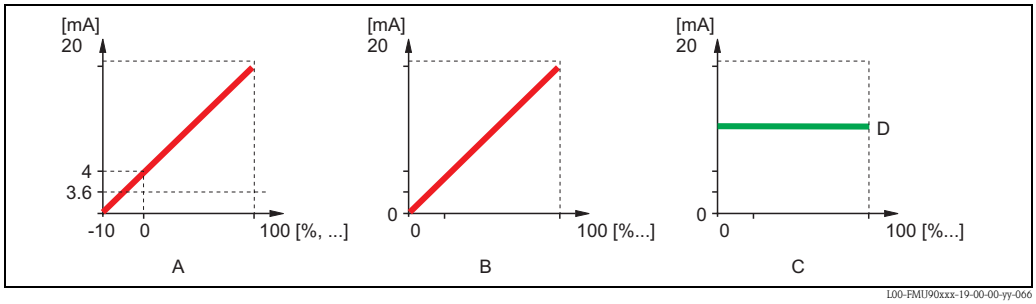
mode current 1	OX202
current span:	
output damping:	
4mA threshold:	
curr. turn down:	

"current span"

Used to select the current span to which the measuring range is mapped.

Selection:

- **4-20 mA (default)**
  The measuring range (0%–100%) is mapped to the current range 4-20 mA.
- **0-20 mA**
  The measuring range (0%–100%) is mapped to the current range 0-20 mA.
- **fixed current HART**
  A fixed current is output. The value can be defined in the "mA value" parameter. The measured value is transmitted by the HART signal.



A: *current span = 4-20 mA;* ***B:*** *current span = 0-20 mA;* ***C:*** *current span = fixed current HART;*
D: *mA value*

"mA value" (only available for "current span" = "fixed current HART")

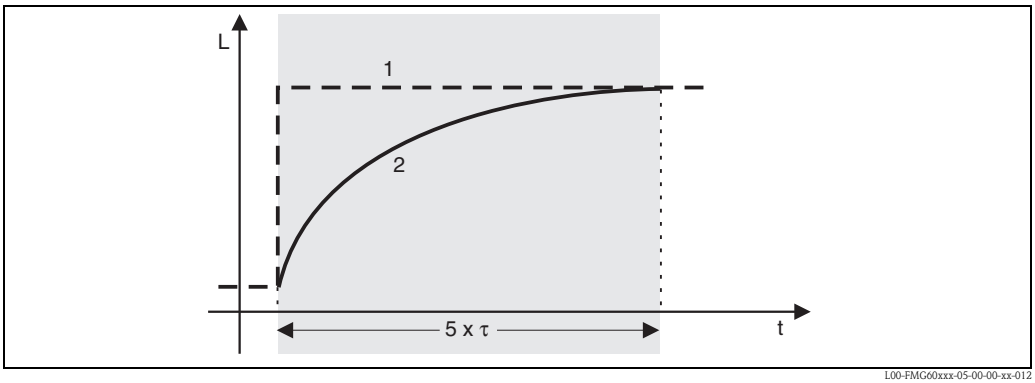
Specifies the value of the fixed current.

- range of values: 3,6 - 22 mA
- default: 4 mA

"output damping"

Specifies the output damping τ by which changes of the measured value are attenuated. After a surge in the level it takes 5 x τ until the new measured value is reached.

- range of values: in preparation
- default: 0 s



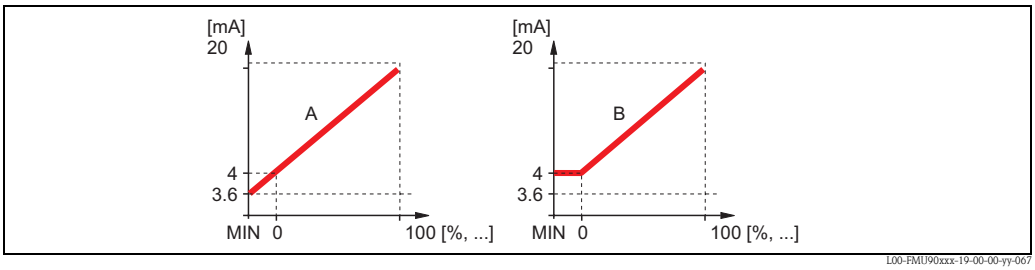
1: *measured value;* ***2:*** *output current*

"4 mA threshold" (only available for "current span" = "4-20mA")

Used to switch on the 4mA threshold. The 4-mA threshold makes sure that the current never falls below 4 mA, even if the measured value is negative.

Selection:

- **off (default)**
  The threshold is switched off. Currents less than 4 mA may occur.
- **on**
  The threshold is switched on. The current never falls below 4 mA.



A: *4mA threshold off;* ***B:*** *4mA threshold on*

"current turn down" (not present for "current span" = "fixed current HART")

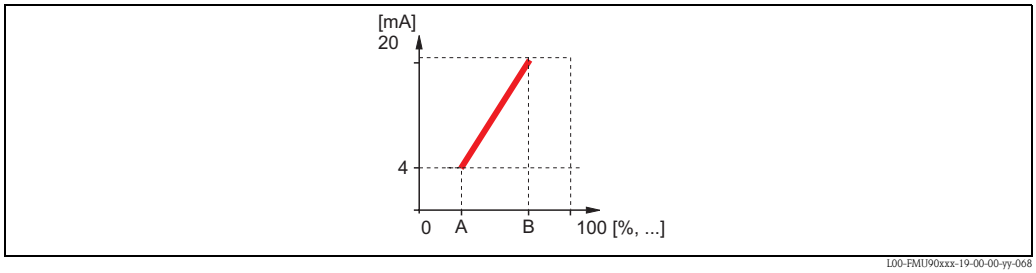
Used to map only a part of the measuring range to the current output. The selected part is enlarged by this mapping.

"turn down 0/4 mA" (only for "current turn down" = "on")

Specifies the measured value for which the current is 0 or 4 mA (depending on the selected current span).

"turn down 20 mA" (only for "current turn down" = "on")

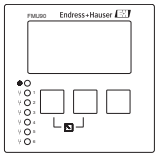
Specifies the measured value for which the current is 20 mA.



A: *turn down 4mA ;* ***B:*** *turn down 20 mA*

9.3 "HART settings" submenu (only for current output 1)

9.3.1 "HART settings"



HART settings O1203
HART address:
no. of preambles:
short TAG HART:

"HART address"

Defines the communication address for the instrument.

Range of values:
- for standard operation: **0 (default)**
- for multidrop operation: **1 - 15**

Note!
In multidrop operation, the ouptput current is 4 mA by default. However, it can be adjusted in the "mA value" parameter of the "mode current" parameter set (see above).

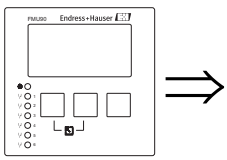
"no. of preambles"

Specifies the number of preambles for the HART protocol. For lines with communication problems a slight increase of this value is recommended.

"short TAG HART"

in preparation

9.3.2 "additional HART value 2/3/4"



add. HART value2 O2205
measured value 2:
output 2:
output damping:

Use these parameter sets to configure the additional values transmitted by the HART protocol:

- measured value 2
- measured value 3
- measured value 4

The paramneters are the same for all three measured values.

Note!
"measured value 1" is identical to the main value, which is linked to current output 1.

"measured value 2/3/4"

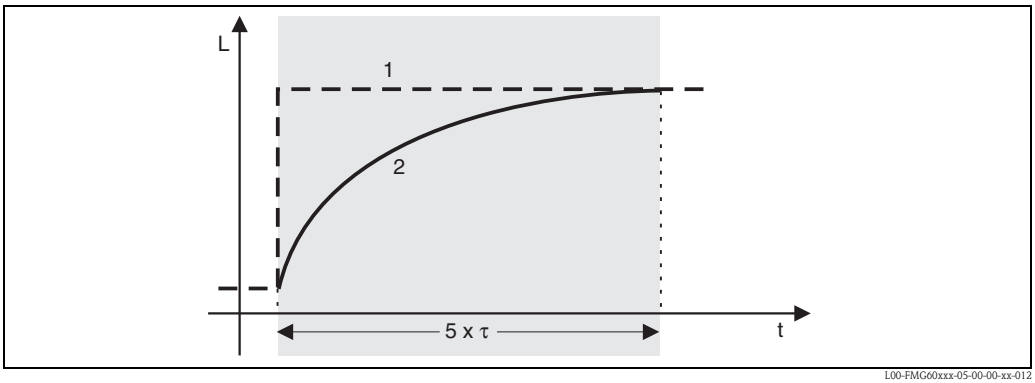
Specifies which measured value is transmitted.

Selection:
The selection depends on the instrument version, the connected sensors and the configuration. The following options may occur:
- none (default)
- level 1/2
- flow 1/2
- average level
- level 1-2 / 2-1 / 1+2
- rake control ratio
- backwater ratio
- temperature external sensor
- temperature Sensor 1/2
- counter 1/2/3
- totalizer 1/2/3
- average flow
- flow 1-2 / 2-1 / 1+2
- distance sensor 1/2

"output damping"

Specifies the output damping τ by which a change of the measured value is attenuated.
After a surge of the measured value it takes 5 x τ till the HART value has adoptet the new value.

- range of values: in preparation
- default: 0 s

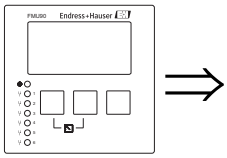


L00-FMG60xxx-05-00-00-xx-012

1: measured value; 2: HART output value

9.4 "Simulation" submenu

9.4.1 "simulation"



simulation O1204
simulation:
simulation value:

"simulation"

Used to switch on the simulation of the current.

Selection:
- **off (default)**
  No simulation is performed. The instrument is in the measuring mode.
- **on**
  The instrument is in the simulation mode. No measured value is transmitted to the output. Instead, the current output assumes the value specified in the "simulation value" subfunction.

"simulation value" (only for "simulation" = "on")

Specifies the value of the simulated output current (in mA).

10 Troubleshooting

10.1 System error messages

10.1.1 Error signal

Errors occuring during commissioning or operation are signalled in the following way:

- Error symbol, error code and error description on the display and operating module
- Current output, configurable ("output on alarm" function).
  - MAX, 110%, 22mA
  - MIN, -10%, 3,6mA
  - HOLD (the last value is held)
  - user-specific value
- In the menu: "system information/error list/actual error"

10.1.2 Last error

To access a list of the last errors which have been cleared, go to "system information/error list/last error".

10.1.3 Types of errors

Type of error	Display symbol	Meaning
Alarm (A)	 continuous	The output signal assumes a value which can be defined by the "output on alarm" function: ■ MAX: 100%, 22mA ■ MIN: -10%, 3,8mA ■ Hold: last value is held ■ user-specific value Additionaly, an error message appears on the display.
Warning (W)	 flashing	The instrument continues to measure. An error message is displayed.

10.1.4 Error codes

The error code consists of 6 digits with the following meaning:

- Digit 1: Type of error
  - A: alarm
  - W: warning
  - E: error (the user can define if the error behaves like an alarm or a warning.)
- Digits 2 and 3:
  indicate the input channel, output channel or the relay to which the error refers. "00" means that the error does not refer to a specific channel or relay.
- Digits 4-6:
  indicate the error according to the following table.

Example:

W 01 641	■ W: Warning ■ 01: sensor input 1 ■ 641: loss of echo

Code	Description of error	Remedy
A 00 100	software version does not fit to hardware version	
A 00 101	checksum error	full reset and recalibration required
A 00 102	checksum error	full reset and recalibration required
W 00 103	initializing - please wait	if the message does not disappear after a couple of seconds: replace electronics
A 00 106	downloading - please wait	wait for completion of the download
A 00 110	checksum error	full reset and recalibration required
A 00 111 A 00 112 A 00 114 A 00 115	electronics defective	switch instrument off/on; if the error persists: call Endress+Hauser service
A 00 116	download error	repeat download
A 00 117	hardware not recognised after exchange	
A 01 121 A 02 121	current output 01 or 02 not calibrated	call Endress+Hauser service
A 00 125	electronics defective	replace electronics
A 00 152	checksum error	full reset and recalibration required
W 00 153	initializing	if the message does not disappear after a couple of seconds: replace electronics
A 00 155	electronics defective	replace electronics
A 00 164	electronics defective	replace electronics
A 00 171	electronics defective	replace electronics
A 00 180	synchronization faulty	check synchronization wiring (s. chapter "Wiring")
A 00 183	hardware not supported	check if the installed board complies with the order code of the instrument; call Endress+Hauser service
A 01 231 A 02 231	sensor 01 or 02 defective - check connection	check for correct connection of the sensor (s. chapter "Wiring")
A 01 281 A 02 281	temperature measurement 01 or 02 defective - check connection	check for correct connection of the sensor (s. chapter "Wiring")

Code	Description of error	Remedy
W 01 501 W 02 501	no sensor selected for channel 01 or 02	allocate sensor (s. "level" or "flow" menu)
A 01 502 A 02 502	Sensor 01 or 02 not recognized	Enter type of sensor manually ("level" or "flow" menu, submenu "basic calibration".
A 00 511	no factory calibration present	
A 01 512 A 02 512	mapping in process	wait for completion of mapping
W01 521 W02 521	new sensor 01 or 02 detected	
W01 601 W02 601	non-monotonic linearisation curve for level 01 or 02	re-enter linearisation (s. "level" menu")
W 01 602 W 02 602 W 01 603 W 02 603	non-monotonic linearisation for flow 01 or 02	re-enter linearisation (s. "flow" menu)
A 01 604 A 02 604	faulty calibration for level 01 or 02	adjust calibration (s. "level" menu
A 01 605 A 02 605 A 01 606 A 02 606	faulty calibration flow 01 or 02	adjust calibration (s. "flow" menu)
W01 611 W02 611	linearisation points level 01 or 02: number < 2	enter further linearisation points (s. "level" menu)
W01 612 W02 612 W01 613 W02 613	linearisation points flow 01 or 02: number < 2	enter further linearisation points (s. "flow" menu)
W 01 620 ... W 06 620	pulse value too low for relay 01 - 06	check counting unit (see "flow" menu, "flow counter" submenu)
E 01 641 E 02 641	no usable echo sensor 01 or 02	check basic calibration for the respective sensor (s. "level" or "flow" menu)
A 01 651 A 02 651	Safety distane reached for sensor 01 or 02 - danger of overfilling	Error disappears if the level is out of the safety distance again. Possibly, the function "acknowledge alarm" must be used (s. "safety settings" menu)
E 01 661 E 02 661	temperature sensor 01 or 02 too high	
W 01 681 W 02 681	Current 01 or 02 out of measuring range	Perform basic calibration; check linearisation
A 01 682 A 02682	calibration current 01 or 02 faulty; "current turn down" faulty	correct "current turn down" (s. "output/calculations" menu
W01 691 W02 691	filling noise detected sensor 01 or 02	
W00 692	backwater detected (if backwater detection is active)	
W00 693	dirt detected (if dirt detection is active)	
W00 801	simulation level swichted on	switch off level simulation (s. "level" menu)
W01 802 W02 802	simulation sensor 01 or 02 switched on	switch off simulation
W01 803 W02 803 W01 804 W02 804	simulation flow switched on	switch off simulation (see "flow" menu)

Code	Description of error	Remedy
W01 805	simulation current 01 switched on	switch off simulation (s. "output/calculations" menu)
W02 806	simulation current 02 switched on	switch off simulation (see "output/calculations" menu)
W01 807 ... W06 807	simulation relay 01 - 06 switched on	switch off simulation
W01 808 W02 808	sensor 01 or 02 switched off	switch on sensor (see "device properties/sensor management" menu)
W01 809 W02 809	current calibration D/A active	
A 00 820 ... A 00 832	Different units for calculation of average value, sum, difference or rake control	Check the units of the respective basic calibrations (s. "level" or "flow" menu)

10.2 Possible calibration errors

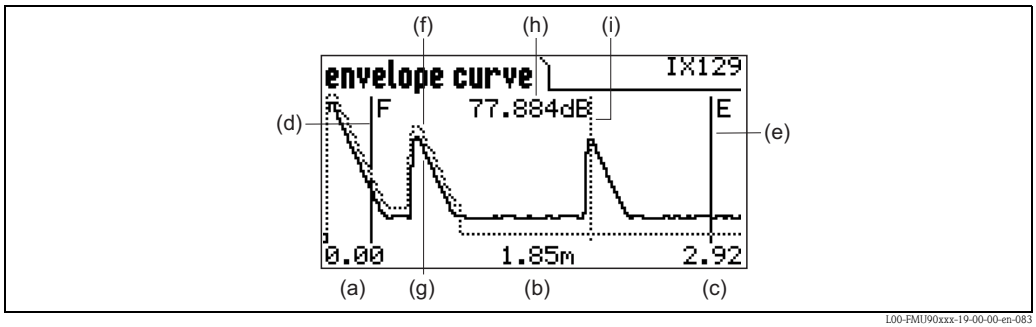
Error	Remedy
Incorrect measured value	Check "actual distance" a. **"Actual distance" is incorrect** – For measurements in bypasses or ultrasound guide pipes: Select the appropriate option in the "application parameters" parameter set. – Perform tank map ("distance mapping") b. **"Actual distance" is correct** – Check "empty calibration" and "full calibration" – Check the linearization
Measured value does not change when filling or emptying a vessel	a. Perform tank map (interference echo suppression) b. clean sensor if necessary c. choose better mounting position of the sensor (to avoid interference echos)
With an uneven surface the measured value jumps sporadically to higher levels	a. Perform tank map (interference echo suppression) b. Select "turbulent surface" or "additional agitator" in the "process conditions" parameter c. Increase "output damping" d. if possible: choose better mounting position and/or larger sensor
When filling the vessel, the measured value sporadically drops to lower levels	a. Change the "tank geometry" to "dome ceiling" or "horizontal cylinder" ("application parameters" parameter set) b. If possible: avoid central mounting position of the sensor. c. if possible: install sensor in bypass or ultrasound guide pipe.
Echo loss (Error E@@641)	a. Check all settings in the "application parameters" parameter set. b. if possible: choose better mounting position and/or larger sensor. c. Align the sensor membrane parallely to the product surface (especially for solid applications).

10.3 Envelope curve display

The measuring signal can be checked by the envelope curve display. From the envelope curve it is possible to see if there are interference echos and if they are completely suppressed by the interference echo suppression.
The envelope curve can be displayed on the display and operating module of the Prosonic S or in the ToF Tool - Fieldtool Package.

10.3.1 Envelope curve on the display module

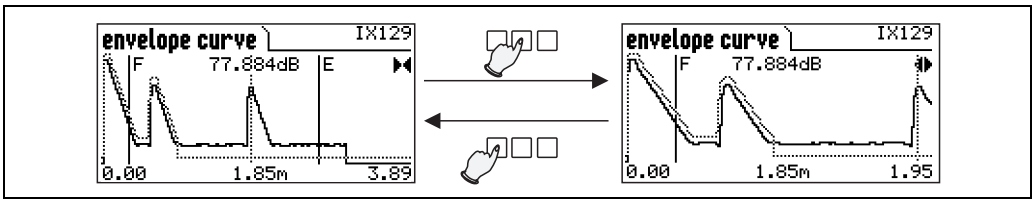
1. Go to the "system information" submenu.
2. Select the "envelope curve" submenu.
3. (only relevant for instruments with two sensor inputs): Select the sensor whose envelope curve you want to check.
4. Select the curves to be displayed:
   – **Envelope curve**: Only the envelope curve is displayed.
   – **Env. curve + FAC**: The envelope curve and the Floating Average Curve (FAC) are displayed.
   – **Env. curve + cust. map**: The envelope curve and the customer mapping curve (for interference echo suppression) are displayed.
5. Select the plot setting:
   – **single curve**
   – **cyclic**
6. Now, the envelope curve display appears:



(a): *lower limit of the display range;* ***(b):*** *distance of the evaluated echo (measured from the sensor membrane);* ***(c):*** *upper limit of the display range;* ***(d):*** *marking of the full calibration F;* ***(e):*** *marking of the empty calibration E;* ***(f):*** *customer mapping curve (dotted line[6]);* ***(g):*** *envelope curve (solid line);* ***(h):*** *echo quality of the evaluated echo[7];* ***(i):*** *Marking of the evaluated echo.*

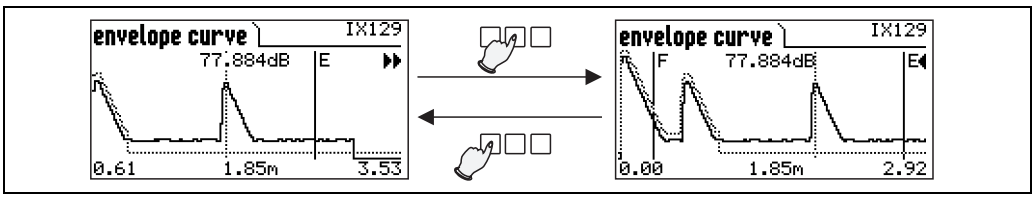
7. **Scaling of the envelope curve display**
   To display a part of the envelope curve in more detail, the curve can be scaled horizontically. To do so, press the right key. The ◀▶ or ▶◀ symbol appears in the upper right corner of the display. You have got the following options:
   – Press the **middle key** to **zoom in** the envelope curve.
   – Press the **left key** to **zoom out** the envelope curve.

6) The Floating Average Curve (FAC) is represented by a dotted line as well.
7) The echo quality is the distance (in dB) between the peak of the echo and the Floating Average Curve (FAC).



L00-FMU90xxx-19-00-00-en-084

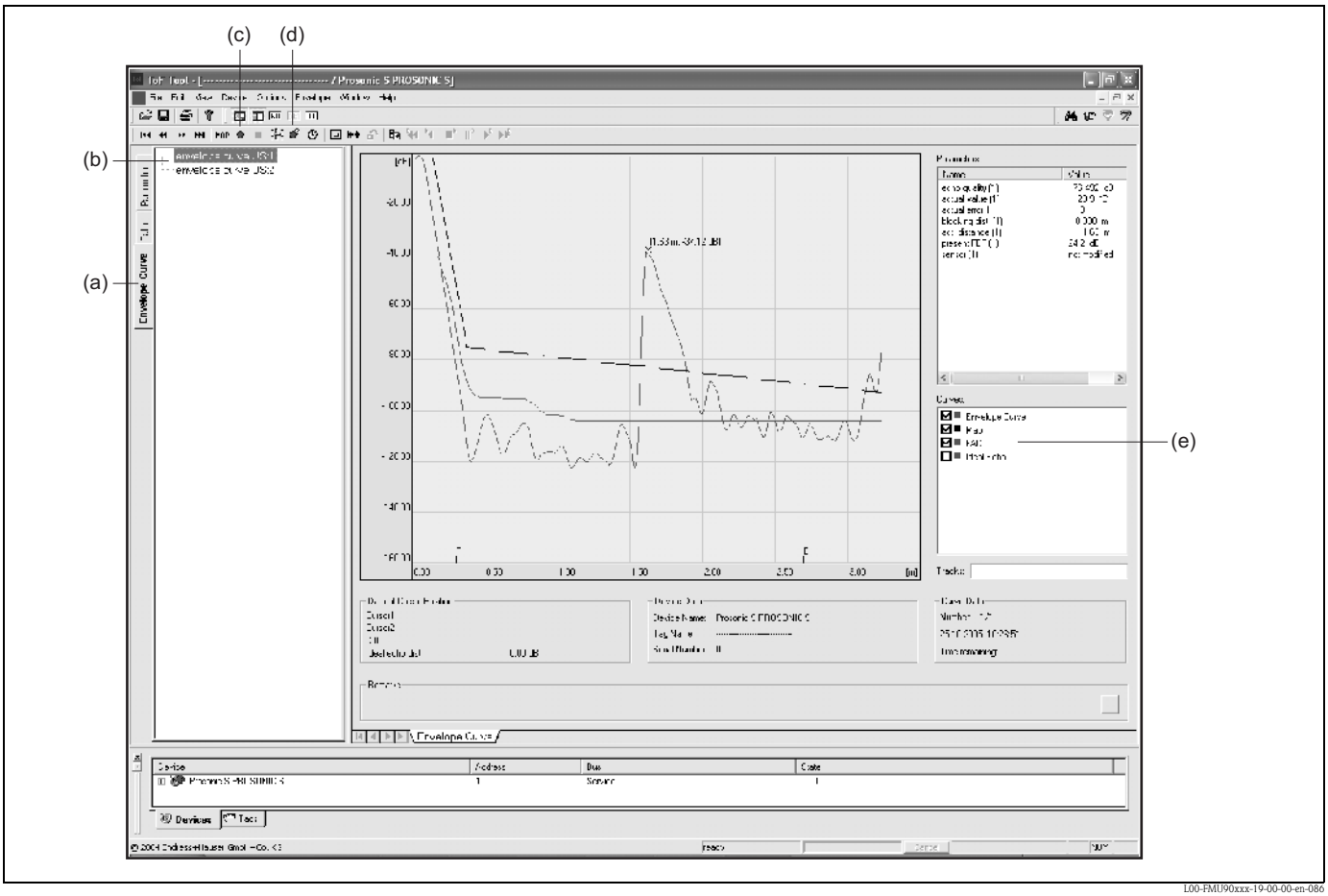
8. **Moving the envelope curve display**
   To move the envelope curve display, press the right key a second time. The ◀◀ or ▶▶ symbol appears in the upper right corner of the display. You have got the following options:
   – Press the **middle key** to move the envelope curve **to the right**.
   – Press the **left key** to move the envelope curve **to the left**.



L00-FMU90xxx-19-00-00-en-085

9. **Quitting the envelope curve display**
   Press  to quit the envelope curve display.

10.3.2 Envelope curve display in the ToF Tool - Fieldtool Package



L00-FMU90xxx-19-00-00-en-086

1. Klick on **"envelope curve" (a)**.
2. Select the **sensor (b)** whose envelope curve you want to check.
3. Click on
   – **"read curve" (c)** to display a **single curve**
   – **"cyclic read" (d)** to display the curves **cyclically**.
4. Select the curves you want to check in the "Curves" window (e):
   – Envelope Curve
   – Map (= mapping of the interference echo suppression)
   – FAC (= Floating Average Curve)

For details refer to the operating manual of the ToF Tool - Fieldtool Package (BA224F).

10.4 Software history

Software version/ Date	Changes to software	Changes to documentation
V 01.00.00	original software	original documentation: ■ for level measurements: BA288F/00/en/12.05 ■ for flow measurements: BA289F/00/en/12.05
V 01.00.02/16.06.06	Relay functions for limit detection revised. No updates of "ToF Tool - Fieldtool Package" or "Fieldcare" required	no changes

11 Maintenance and repairs

11.1 Exterior cleaning

When cleaning the exterior, always use cleaning agents that do not attack the surface of the housing and the seals.

11.2 Repairs

The Endress+Hauser repair concept assumes that the Prosonic S has a modular design and that repairs can be done by the Endress+Hauser service or specially trained customers.
Spare parts are contained in suitable kits. They contain the related replacement instructions.
All the spare parts kits which you can order from Endress+Hauser for repairs are listed with their order numbers in the section "Spare parts".
For more information on service and spare parts, contact the Service Department at Endress+Hauser.

11.3 Repairs to Ex-approved devices

When carrying out repairs to Ex-approved devices, please note the following:
- Repairs to Ex-approved devices may only be carried out by trained personnel or by the Endress+Hauser Service.
- Comply with the prevailing standards, national Ex-area regulations, safety instructions (XA) and certificates.
- Only use original spare parts from Endress+Hauser.
- When ordering a spare part, please note the device designation on the nameplate. Only replace parts with identical parts.
- Carry out repairs according to the instructions. On completion of repairs, carry our the specified routine test on the device.
- Only Endress+Hauser Service may convert a certified device into a different certified variant.
- Document all repair work and conversions.

11.4 Replacement

After a complete instrument or electronic module has been replaced, the parameters can be downloaded into the instrument again via the communication interface. Prerequisite to this is that the data were uploaded to the PC beforehand using the ToF Tool / Commuwin II. Measurement can continue without having to carry out a new setup. Only a linearisation and a tank map (interference echo suppression) have to be recorded again.

11.5 Replacing a sensor

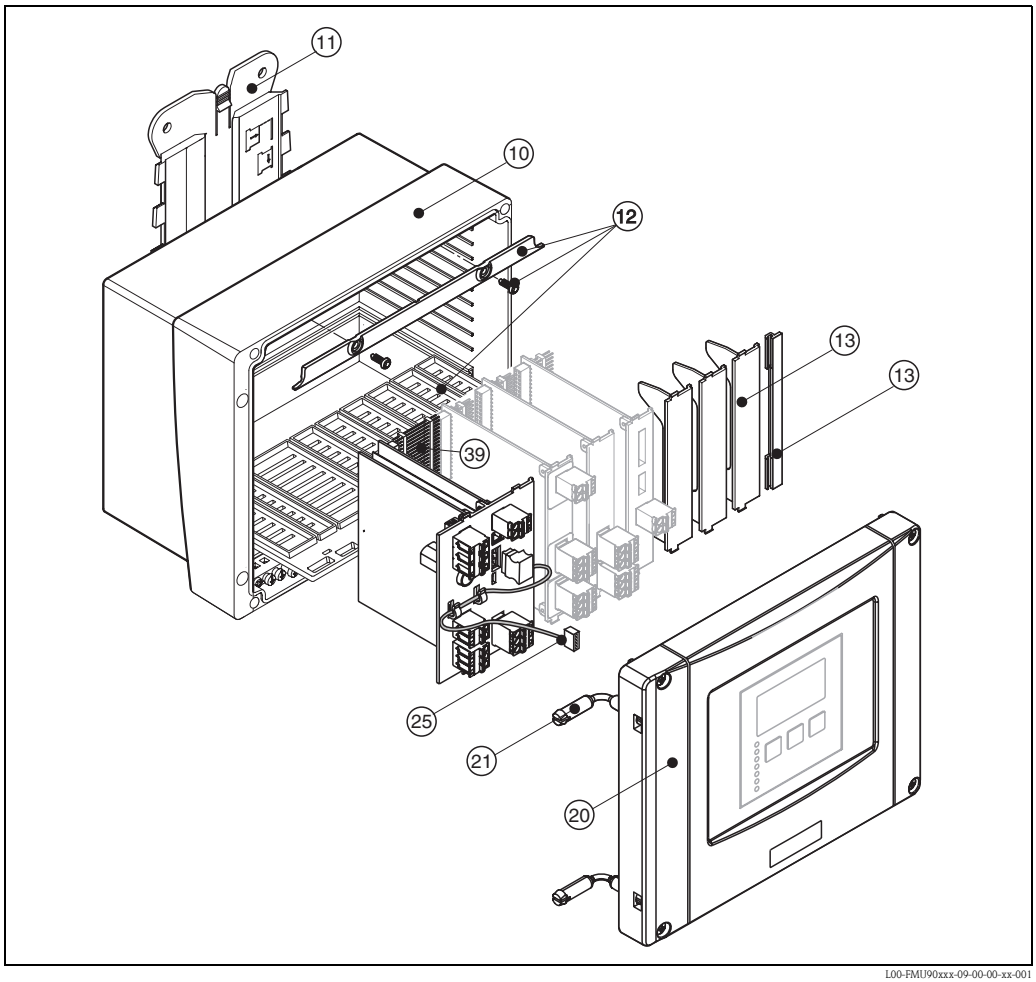
Sensors can be replaced if required.
After replacing a sensor, the following parameters of the "basic setup" submenu must be checked:

- for sensors FDU8x: sensor type
  (sensors of the type FDU9x are automatically detected by the Prosonic S)
- the empty calibration
- for level measurements: the full calibration
- the interference echo suppression

After that, the measurement can be continued without further restrictions.

11.6 Spare parts

11.6.1 Field housing



L00-FMU90xxx-09-00-00-xx-001

10 Housing

52025696 Field housing P3 PC, hinge

11 Mounting plate

52025695 Mounting plate FMU9x field housing, PC

12 Fastening

52025702 Seperating web + fixing PC board

13 Blind plate for PC board

52025712 Blind cover PC board, 6 pieces

20 Cover

52025699 Cover P3 + display field housing, PC

52025700 Cover P3 field housing, hinge

21 Fixing housing / cover

71024576 hinge + screws, field housing FMU90

25 Cable

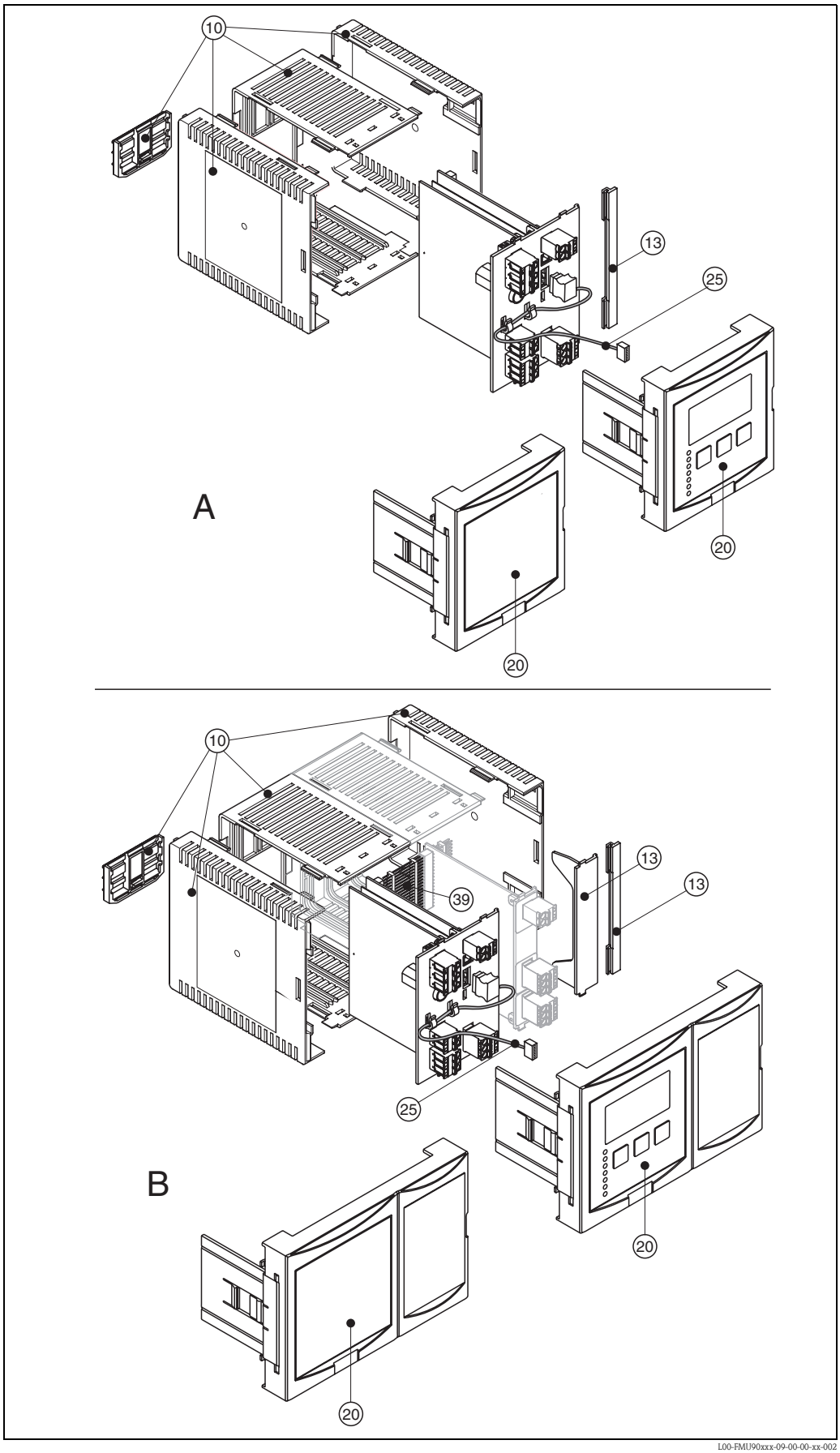
52025721 Cable display FMU90, L=260 mm

Miscellaneous

71024578 screw set FMU90, leaded, 2 pieces

71024579 fuse set FMU90, AC + DC

11.6.2 Housing for DIN rail



L00-FMU90xxx-09-00-00-xx-002

10 Housing

52025713 Housing DIN rail FMU9x (frame, 2 side frames and locking DIN rail)

13 Blind plate for PC board

52025712 Blind cover PC board, 6 pieces

20 Front panel

52025705 Front plate small FMU90

52025708 Front plate wide FMU90

52025703 Front plate small FMU90 + display

52025710 Front plate wide FMU90 + display

21 Blind plate for front panel

52025711 Front plate small FMU90, blind cover

25 Cable

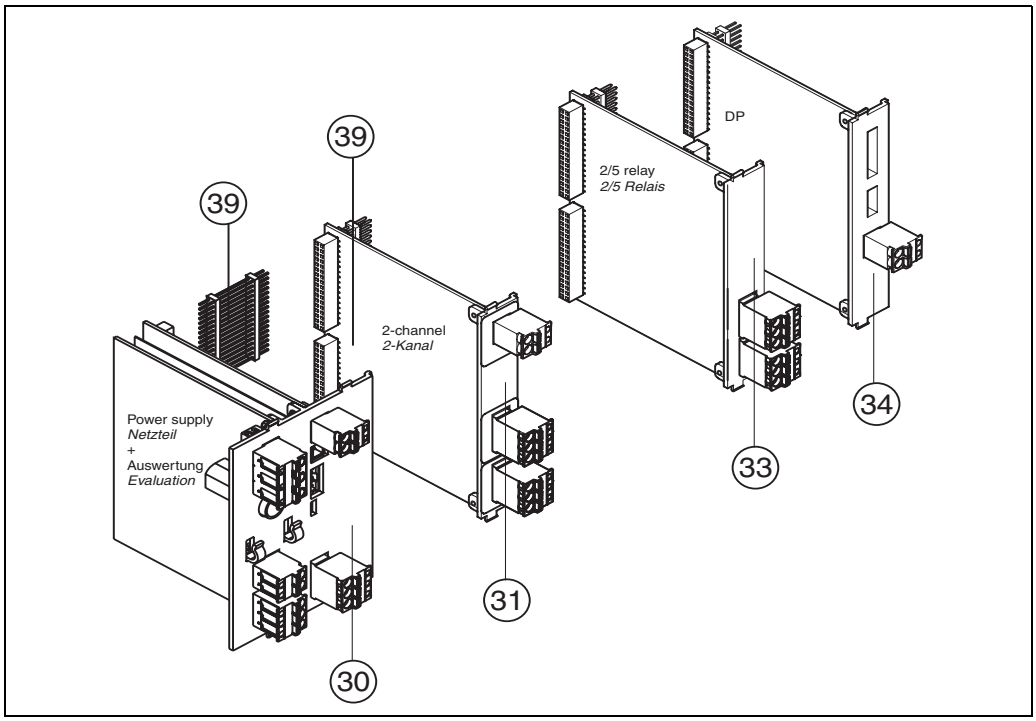
52025722 Cable display FMU90, L=200 mm

Remote display

71020896 remote display FMU90, lightened
with 3 m cable
DIN rail mounting

71020897 cable 3 m, remote display
connection cable between display and main electronics

11.6.3 PC boards



L00-FMU90xxx-09-00-00-xx-004

30 Electronics

Electronics basic version FMU90X

010	**Approval**								
	R	Non-hazardous area							
	J	ATEX II 3 D (in preparation)							
	N	CSA General Purpose (in preparation)							
	Y	Special version, to be specified							
020		**Application**							
	1	Level + pump control, alternating							
	2	Flow + totalizer + level + sample control + preprogrammed OCM flow curves							
	9	Special version, to be specified							
050			**Power supply**						
		A	90-253VAC						
		B	10,5-32VDC						
		Y	Special version, to be specified						
060				**Level input**					
			1	1x sensor FDU9x/8x					
			2	2x sensor FDU9x/8x (prepared for)					
			9	Special version, to be specified					
070					**Switch output**				
				1	1x relay, SPDT				
				9	Special version, to be specified				
080						**Output**			
					1	1x 0/4-20mA HART			
					2	2x 0/4-20mA HART (prepared for)			
					3	PROFIBUS DP (prepared for)			
					9	Special version, to be specified			
110							**Language**		
						1	de, en, nl, fr, es, it		
						9	Special version, to be specified		
FMU90X –									complete product designation

31 PC board 2-channel

52025714 PC board 2-channel, 1 current output

52025715 PC board 2-channel, w/o current output

52025716 PC board current output, no sensor input

33 PC board relay

52005718 PC board 2x relays SPDT, additional (1 relay included in electronics FMU90X)

52005719 PC board 5x relay SPDT, additional (1 relay included in electronics FMU90X)

34 PC board communication

52005720 PC board PROFIBUS DP FMU90

39 PCB connector

71024577 PCB connector set FMU90, 6 pieces

11.7 Return

The following procedures must be carried out before a transmitter is sent to Endress+Hauser e.g. for repair or calibration:

- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- Always enclose a duly completed "Declaration of contamination" form (a copy of the “Declaration of contamination” is included at the end of this operating manual). Only then can Endress +Hauser transport, examine and repair a returned device.
- Enclose special handling instructions if necessary, for example a safety data sheet as per EN 91/155/EEC.

Additionally specify:

- An exact description of the application.
- The chemical and physical characteristics of the product.
- A short description of the error that occurred (specify error code if possible)
- Operating time of the device.

11.8 Disposal

In case of disposal please seperate the different components according to their material consistence.

11.9 Contact addresses of Endress+Hauser

Contact addresses can be found on our homepage: www.endress.com/worldwide. If you have any questions, please do not hesitate to contact your Endress+Hauser representative.

12 Accessories

12.1 Commubox FXA191 HART

For intrinsically safe communication with ToF Tool/FieldCare via the RS232C interface. For details refer to TI237F/00/en.

12.2 Commubox FXA195 HART

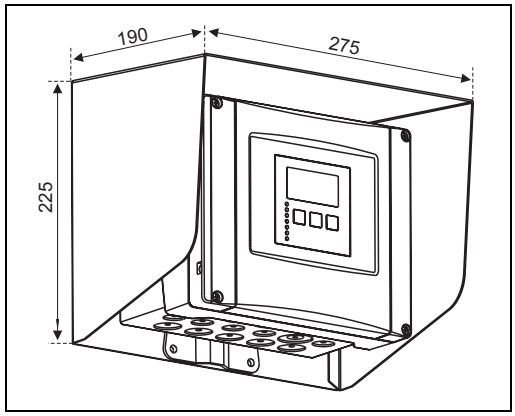
For intrinsically safe communication with ToF Tool/FieldCare via the USB interface. For details refer to TI404F/00/en.

12.3 Commubox FXA291 IPC

For intrinsically safe communication with ToF Tool/FieldCare via the service interface (IPC) of the instrument and the USB interface of a PC/Notebook.

12.4 Protection cover for the field housing

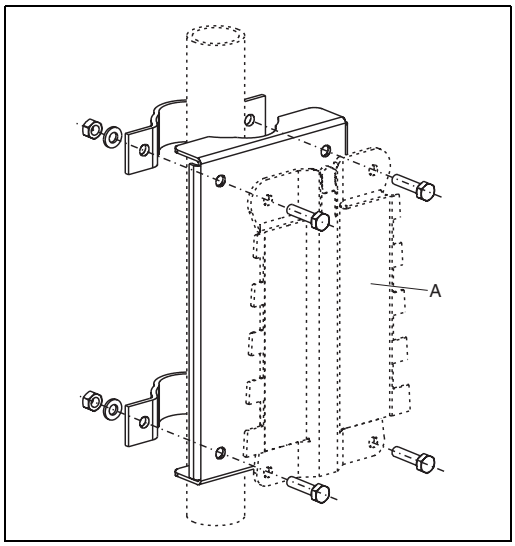
- Material: 316Ti/1.4571
- is mounted by the mounting help of the Prosonic S
- Order-Code: 52024477



L00-FMU90xxx-06-00-00-xx-003

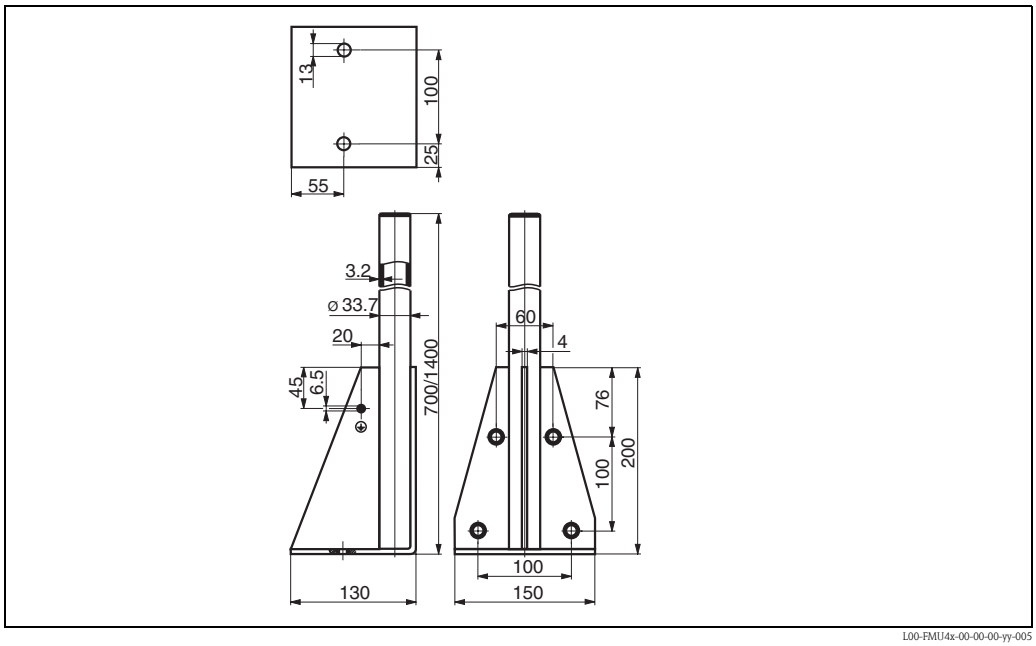
12.5 Mounting plate for the field housing

- suited for the mounting help of the Prosonic S
- for 1" - 2" tubes
- Dimensions: 210 mm x 110 mm
- Material: 316Ti/1.4571
- fixing clips, screws and nuts are supplied
- Order code: 52024478



A: *mounting help of the field housing*

12.6 Mounting bracket

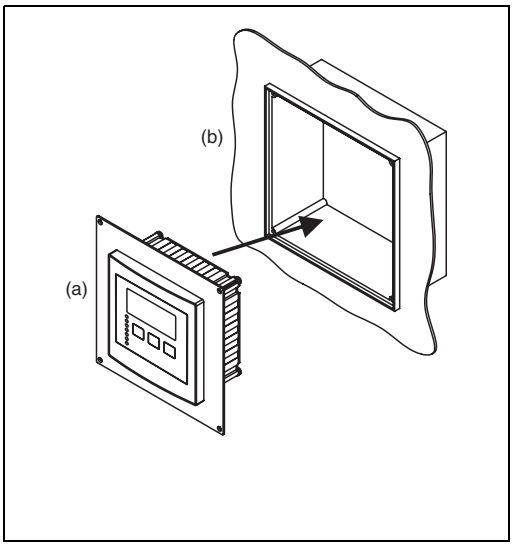


Height	Material	Order Code
700 mm	galv. steel	919791-0000
700 mm	316 Ti	919791-0001
1400 mm	galv. steel	919791-0002
1400 mm	316 Ti	919791-0003

12.7 Adaption plate for remote display

Used to mount the remote display into the opening (138 mm x 138 mm) of the remote display module of the Prosonic FMU860/861/862).

Order-Code: 52027441



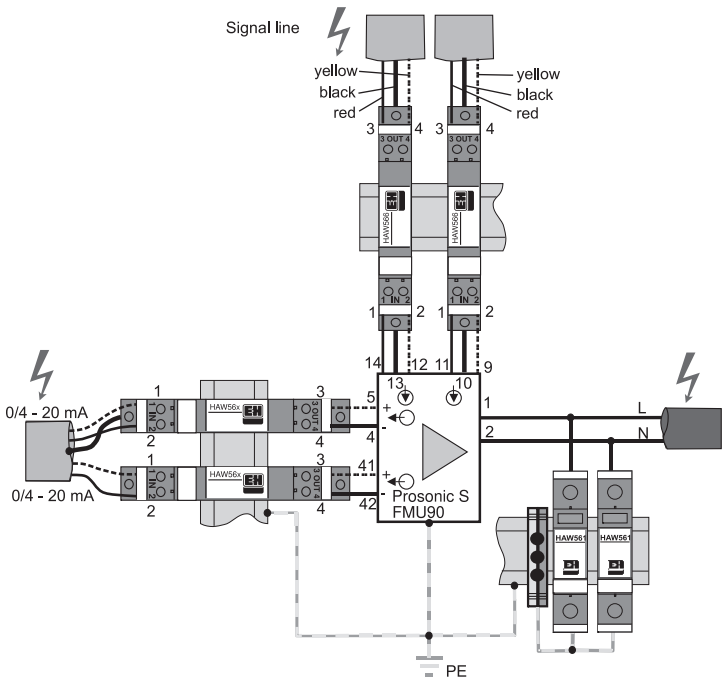
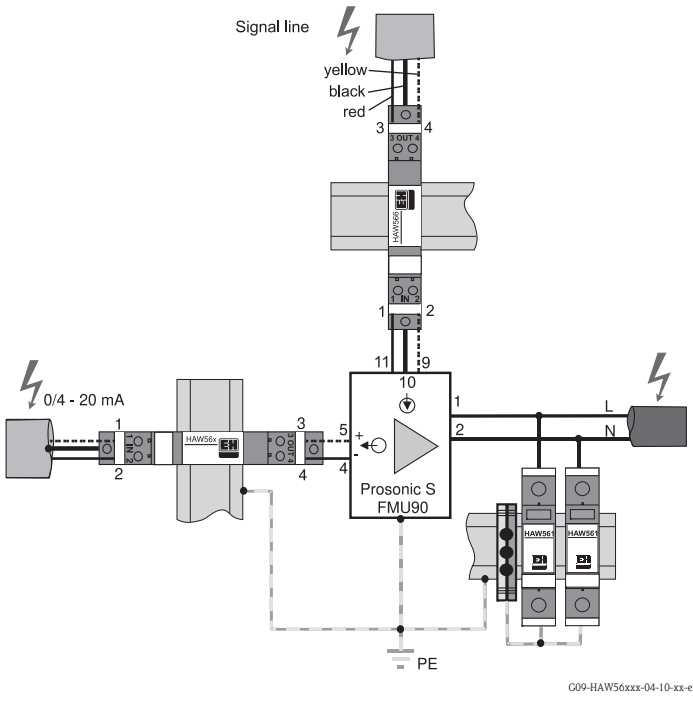
(a): *remote display of FMU90 with adaption plate;*
(b): *opening of the remote display FMU860/861/862*

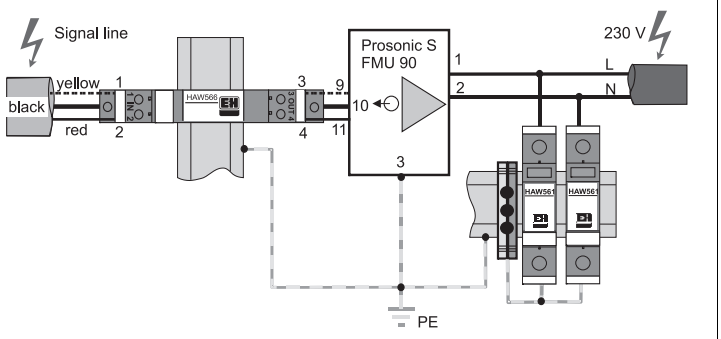
12.8 Overvoltage protection (in IP66 housing)

- Overvoltage protection for the mains voltage and up to 3 signal outputs
- Dimensions of housing: 292mm x 253 mm x 106 mm
- Order Code: 215095-0001

12.9 Overvoltage protection HAW56x

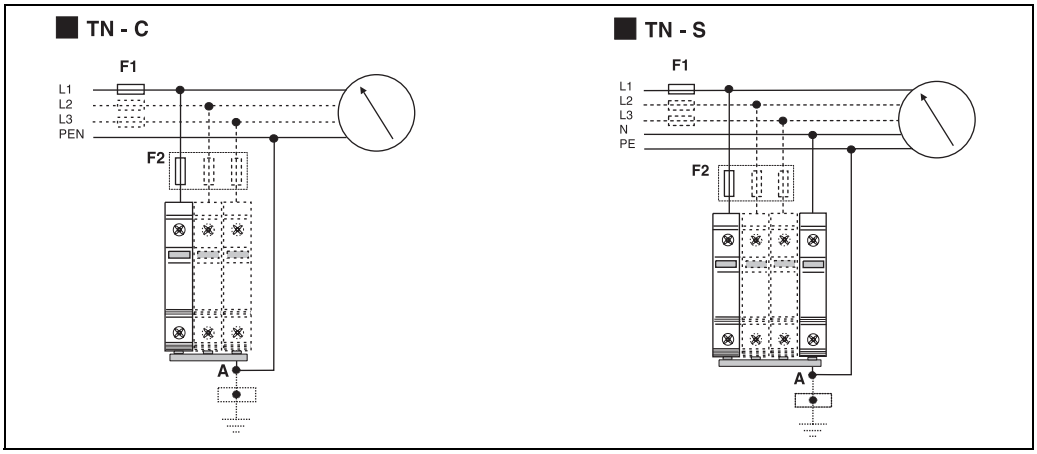
12.9.1 Application examples

Measurement signal	Measurement point requirements	Connection diagram
■ Current output 1 0/4 to 20 mA ■ Current output 2 0/4 bis 20 mA Transducer Prosonic S FMU90 with 2 Prosonic FDU9x sensors	■ 2 x HAW560 + 562 for 0/4 to 20 mA signals ■ 2 x HAW561 for power supply to the transducer ■ 2 x HAW560 + 566 for the sensor signal line	
■ Current output 0/4 to 20 mA Prosonic S FMU90 transducer with Prosonic FDU9x level measurement sensors	■ 1 x HAW560 + 562 for 0/4 to 20 mA signals ■ 2 x HAW561 for power supply to the transducers ■ 1 x HAW560 + 566 for the sensor signal line	

Measurement signal	Measurement point requirements	Connection diagram
■ no current output (only relay outputs) Prosonic S FMU90 transducer with Prosonic FDU9x level measurement sensor	■ 1 x HAW560 + 1 x HAW566 for signal line. Use gas discharge tube for indirect shield earthing. ■ 2 x HAW561 for power supply line	

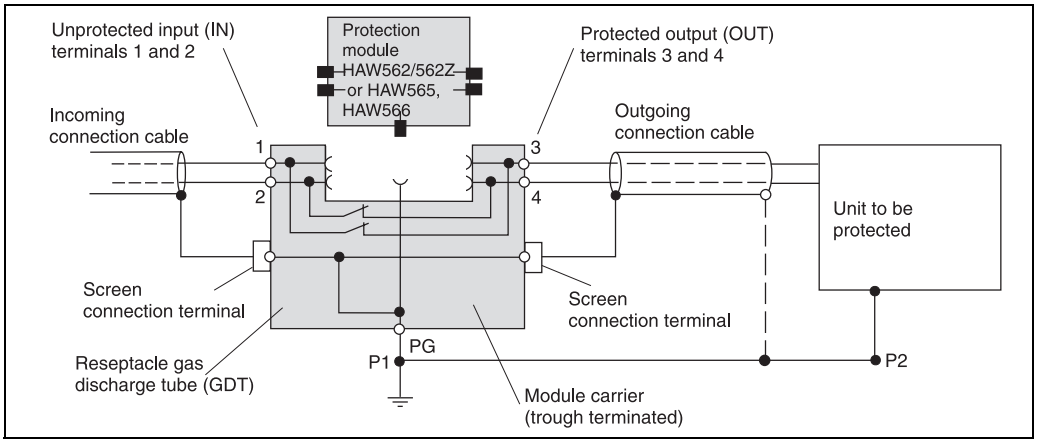
12.9.2 Electrical connection

HAW561 and 561K



A fixed allocation of the phase and ground terminal is not allocated (pole security). The unit is fitted on both ends with a multi function connection terminal. This gives the opportunity to simultaneously connect a cable as well as a fork ferrule from standard busbars.
Connection of the unit is as in the diagram above. Dependent on the cabling, up to four units will be required.

HAW562/562Z, HAW565 and HAW566



Connection of the unit as in the diagram. The ground connection is made using the DIN rail. For the signal cable screen connection on the HAW565 unit a special EMC spring terminal is supplied. For indirect screening (as required if connecting the Prosonic S signal line to an HAW566) a gas-discharge arrester is supplied. It must be inserted into the provided plug-in bay on the HAW560.

12.9.3 Product overview

Oreder code	Unit
51003569	**Surge arrester HAW561K** For low voltage users 24/48V, single pole, requirement class C, basic component with plugged in protection unit, defect display, 18 mm housing width
51003570	**Surge arrester HAW561** For standard voltage users 115/230 V, single pole, requirement class C, basic component with plugged in protection unit, defect display, 18 mm housing width
51003571	**Surge arrester module carrier HAW560** Two pole through terminated for fitting surge arrester modules for units in information technology, 12 mm housing width, colour grey
51003572	**Surge arrester module HAW562** For protection of 2 single lines, e.g. 2 asymmetrical single lines, e.g.: 0/4 to 20 mA, Profibus PA, 12 mm housing width, colour grey
51003573	**Surge arrester module HAW565** For protection of 2 single lines, e.g. 2 asymmetrical single lines with high frequency signal transmission, e.g.: Profibus DP, RS 485, 12 mm housing width, colour grey
51003574	**Surge arrester module carrier HAW560Z** Two pole through terminated for fitting surge arrester modules for units in information technology in Ex areas, 12 mm housing width, colour blue
51003575	**Surge arrester module HAW562** For protection of 2 single lines, e.g. 2 asymmetrical single lines in Ex areas, e.g.: 0/4 to 20 mA, Profibus PA, 12 mm housing width, colour blue
71028875	**Surge arrester module HAW566** Protection for 2 signal inputs, e.g. 2 asymmetrical inputs, e.g. Prosonic S signal 12 mm housing with, colour grey

For details see Technical Information TI093R.

12.10 Extension cable for sensors

for Sensor	Material	Cable type	Order code
■ FDU91 ■ FDU92	PVC	LiYCY/CUL 2x(0,75)	71027742
■ FDU91F ■ FDU93 ■ FDU95	PVC (-40 ... +105 °C)	LIYY/CUL 2x(0,75)D+1x0,75#	71027743
■ FDU95 ■ FDU96	Silicone (-40 ... +150 °C)	Li2G2G 2x(0,75)D+1x0,75#	71027745
■ FDU91 with heater	PVC	LIYY/CUL 2x(0,75)D+2x0,75#	71027746

Total length (sensor cable + extension cable): up to 300 m

13 Technical Data

13.1 Technical data at a glance

13.1.1 Input

Sensor inputs

Depending on the instrument version, 1 or 2 of the sensors FDU91, FDU92, FDU93, FDU95 and FDU96 can be connected. The Prosonic S identifies these sensors automatically.

Sensor	FDU91 FDU91F	FDU92	FDU93	FDU95	FDU96
max. range[1)] in liquids	10 m	20 m	25 m	-	-
max. range[1] in solids	5 m	10 m	15 m	45 m	70 m

1) This table gives the maximum range. The range depends on the measuring conditions. For an estimation see Technical Information TI 396F, chapter "Input".

In order to support existing installations, the sensors of the former series FDU8x can be connected as well. The type of sensor must be entered manually.

Sensor	FDU80 FDU80F	FDU81 FDU81F	FDU82	FDU83	FDU84	FDU85	FDU86
max. range[1)] in liquids	5 m	9 m	20 m	25 m	-	-	-
max. range[1] in solids	2 m	5 m	10 m	15 m	25 m	45 m	70 m

1) This table gives the maximum range. The range depends on the measuring conditions. For an estimation see Technical Information TI 189F, chapter "Planning Recommendations".

Warning!
The sensors FDU83, FDU84, FDU85 and FDU86 with an ATEX, FM or CSA certificate are not certified for connection to the transmitter FMU90 (certificate is pending).

13.1.2 Output

Analogue outputs

Number	1 or 2, depending on instrument version
Output signal	configurable at the instrument: ■ 4 ... 20 mA with HART[1)] ■ 0 ... 20 mA without HART
Signal on alarm	■ for setting 4 ... 20 mA, selectable: – -10% (3,6 mA) – 110% (22 mA) – HOLD (last current value is held) – user specific ■ for setting 0 ... 20 mA: – 110% (21,6 mA) – HOLD (last current value is held) – user specific
Output damping	freely selectable, 0 ... 1000 s
Load	max. 600 Ω, influence negligible
max. ripple	U_{SS} = 200 mV at 47 ... 125 Hz (measured at 500Ω)
max. noise	U_{eff} = 2,2 mV at 500 Hz... 10 kHz (measured at 500Ω)

1) The HART signal is assigned to the first analogue output. The second analogue output does not carry a HART signal.

Relay outputs

Number	1, 3 or 6; depending on the instrument version
Type	potential-free relay, SPDT, can be inverted
Assignable functions	■ limit (inband, out-of-band, trend, level limit) ■ counting pulse (pulse width adjustable) ■ time pulse (pulse width adjustable) ■ alarm/diagnosis (e.g. indication of backwater[1)], sludge[1], echo loss etc.) ■ pump control (alternating/fixed limit/pump rate) ■ rake control (difference or relative measurement) ■ fieldbus relay (to be switched direclty from the Profibus DP-bus)
Switching power	■ DC voltage: 35 V_{DC}, 100 W ■ AC voltage: 4 A, 250 V, 100 VA at cosφ = 0,7
State on error	selectable: ■ HOLD (last value is held) ■ energized ■ de-energized ■ present value is used
Behaviour after power failure	switch-on delay selectable
LEDs[2)]	A yellow LED on the front panel is allocated to each relay, which lights if the relay is energized. The LED of an alarm relay lights during normal operation. The LED for a pulse relay briefly flashes at every pulse.

1) for instrument versions with flow software (FMU90 - *2**********)

2) for instrument versions with display and operating module

PROFIBUS DP interface

Profile	3.0
Transmittable values	■ main value (level or flow, depending on the instrument version) ■ distances ■ counters ■ temperatures ■ average/difference/sum ■ relay states ■ rake control ■ pump control
Function blocks	■ 10 Analog Input Blocks (AI) ■ 10 Digital Input Blocks (DI) ■ 10 Digital Output Blocks (DO)
Supported baud rates	■ 9.6 kbaud ■ 19.2 kbaud ■ 45,45 kbuad ■ 93.75 kbaud ■ 187.5 kbaud ■ 500 kbaud ■ 1.5 Mbaud ■ 3 Mbaud ■ 6 Mbaud ■ 12 Mbaud
Addressing	via dip switches at the instrument or via software (e.g. ToF Tool)

13.1.3 Auxiliary energy

Supply voltage/ Power consumption/ Current consumption

Instrument version	Supply voltage	Power consumption	Current consumption
AC voltage (FMU90 - ****A*******)	90 ... 253 V_{AC} (50/60 Hz)	max. 23 VA	max. 100 mA at 230 V_{AC}
DC voltage (FMU90 - ****B*******)	10,5 ... 32 V_{DC}	max. 14 W (typically 8 W)	max. 580 mA at 24 V_{DC}

Galvanic isolation

The following terminals are galvanically isolated from each other:
- auxiliary energy
- sensor inputs
- analogue output 1
- analogue output 2
- relay outputs
- bus connection (PROFIBUS DP)

13.1.4 Performance characteristics

Reference operating conditions

- Temperature = 24±5 °C
- Pressure = 960±100 mbar
- Relative humidity = 60±15 %
- Ideally reflecting surface, sensor vertically aligned (e.g. calm, plane liquid surface of 1 m^2)
- No interference echoes within the signal beam
- Settings of the application parameters:
  - tank shape = flat ceiling
  - medium property = liquid
  - process condition = calm surface

Measuring uncertainty[8)]

±0,2 % of the maximum span of the sensor

Typical accuracy[9)]

±2 mm + 0,17 % of the measured distance

Measured value resolution

1 mm with FDU91

Measuring frequency

max. 3 Hz
The exact value depends on the settings of the application parameters and the instrument version (1- or 2-channel).

8) according to NAMUR EN 61298-2
9) after calibration

13.1.5 Ambient conditions

Ambient temperature

-40 ... 60 °C
The functionality of the LC display becomes restricted at T_U < -20 °C.
If the device is operated outdoors in strong sunlight, a protective cover should be used (s. chapter "Accessories").

Storage temperature

-40 ... 60 °C

Climate class

- **Field housing:** according to DIN EN 60721-3 4K2/4K5/4K6/4Z2/4Z5/4C3/4S4/4M2 (DIN 60721-3 4K2 corresponds to DIN 60654-1 D1)
- **Housing for DIN rail mounting:** according to DIN EN 60721-3 3K3/3Z2/3Z5/3B1/3C2/3S3/3M1 (DIN 60721-3 3K3 corresponds to DIN 60654-1 B2)

Vibration resistance

- Housing for DIN rail: DIN EN 600068-2-64 / IEC 68-2-64; 20 ... 20000 Hz; 0,5 $(m/s^2)^2/Hz$
- Field housing: DIN EN 600068-2-64 / IEC 68-2-64; 20 ... 20000 Hz; 1,0 $(m/s^2)^2/Hz$

Ingress protection

- Field housing: IP66 / NEMA 4x
- Housing for DIN rail: IP20
- separate display:
  - IP65 / NEMA 4 (front panel , if mounted in cabinet door)
  - IP20 (rear panel, if mounted in cabinet door)

Electromagnetic compatibility (EMC)

- Interference emmission to EN 61326; Equipment class A
- Interference immunity to EN 61326; Annex A (Industrial) and NAMUR recommendation EMC (NE21)

13.1.6 Mechanical construction

Dimensions

s. chapter "Installation"

Weight

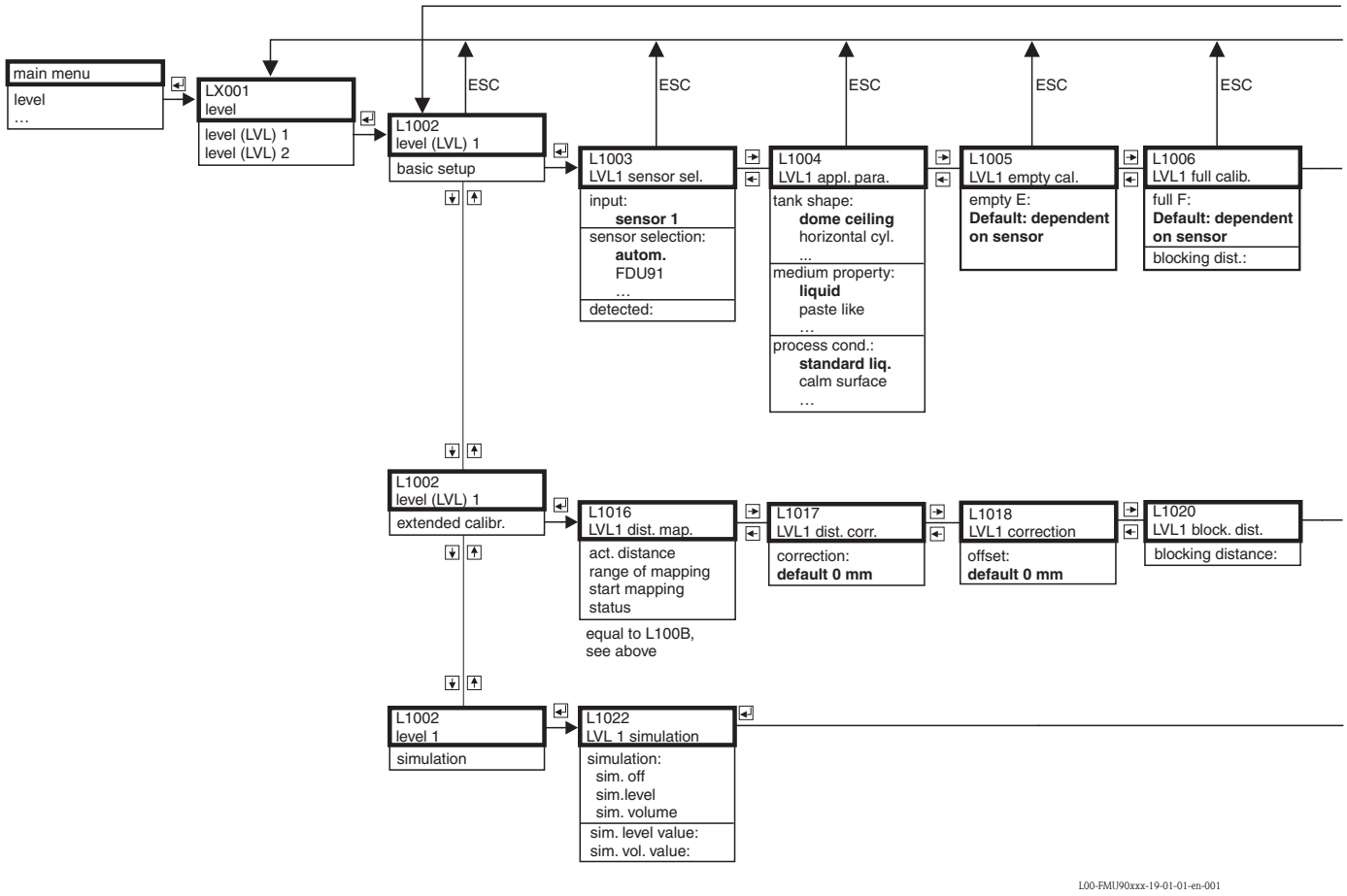
Housing version	Weight
Field housing	approx.. 1,6 ... 1,8 kg; depending on instrument version
Housing for DIN rail	approx. 0,5 ... 0,7 kg; depending on instrument version (s. section: "Dimensions of the DIN-rail housing")
separate display and operating module	approx. 0,5 kg

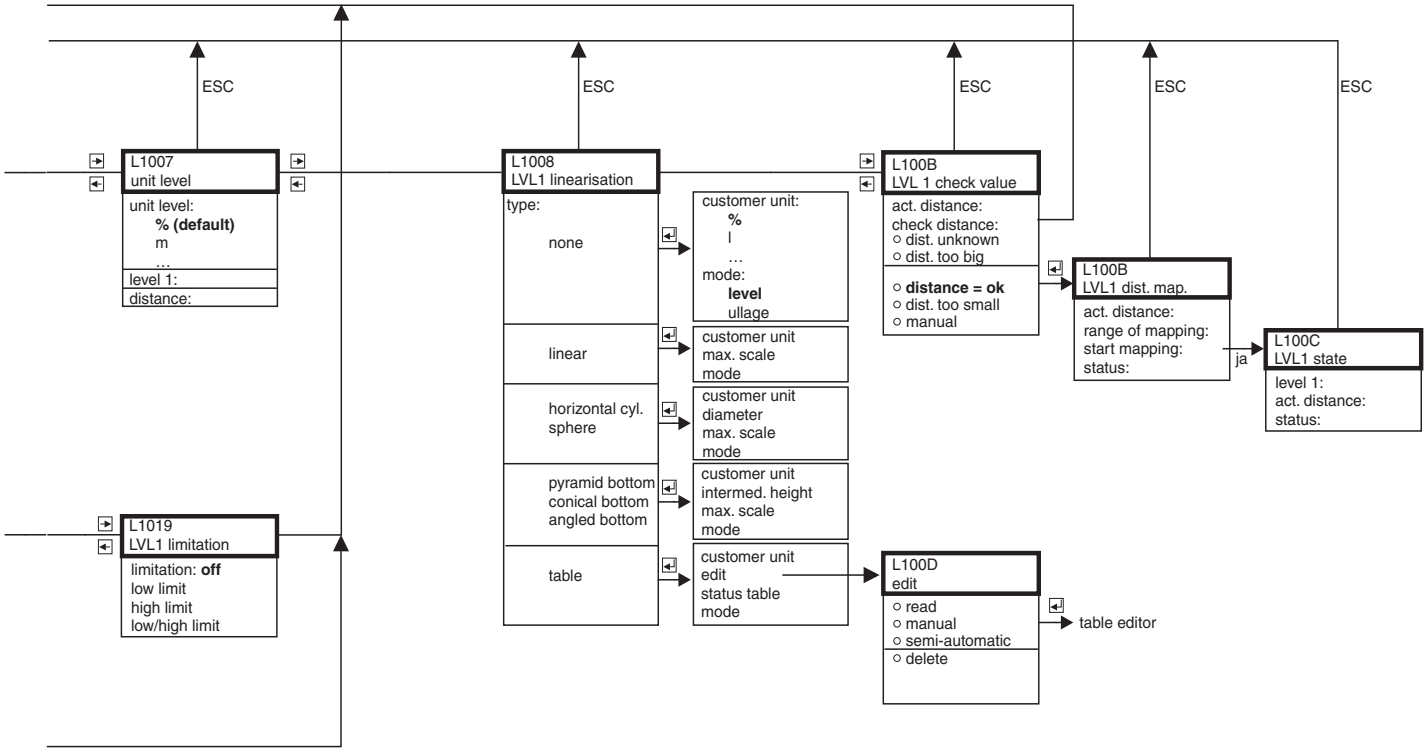
Materials

- Field housing: PC
- Housing for DIN rail: PBT

14 Operating menu

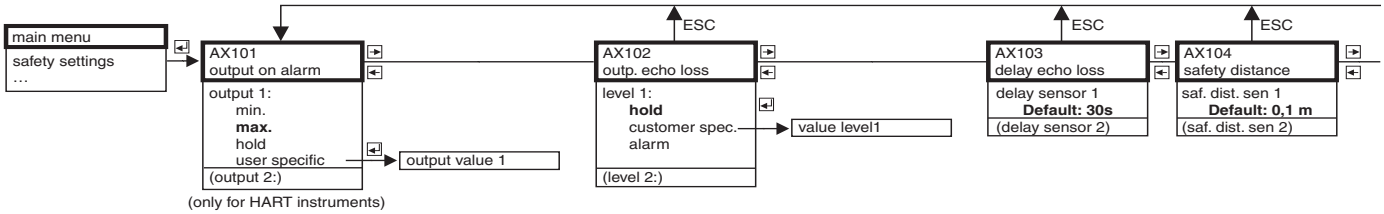
14.1 "Level"





L00-FMU90xxx-19-01-02-en-001

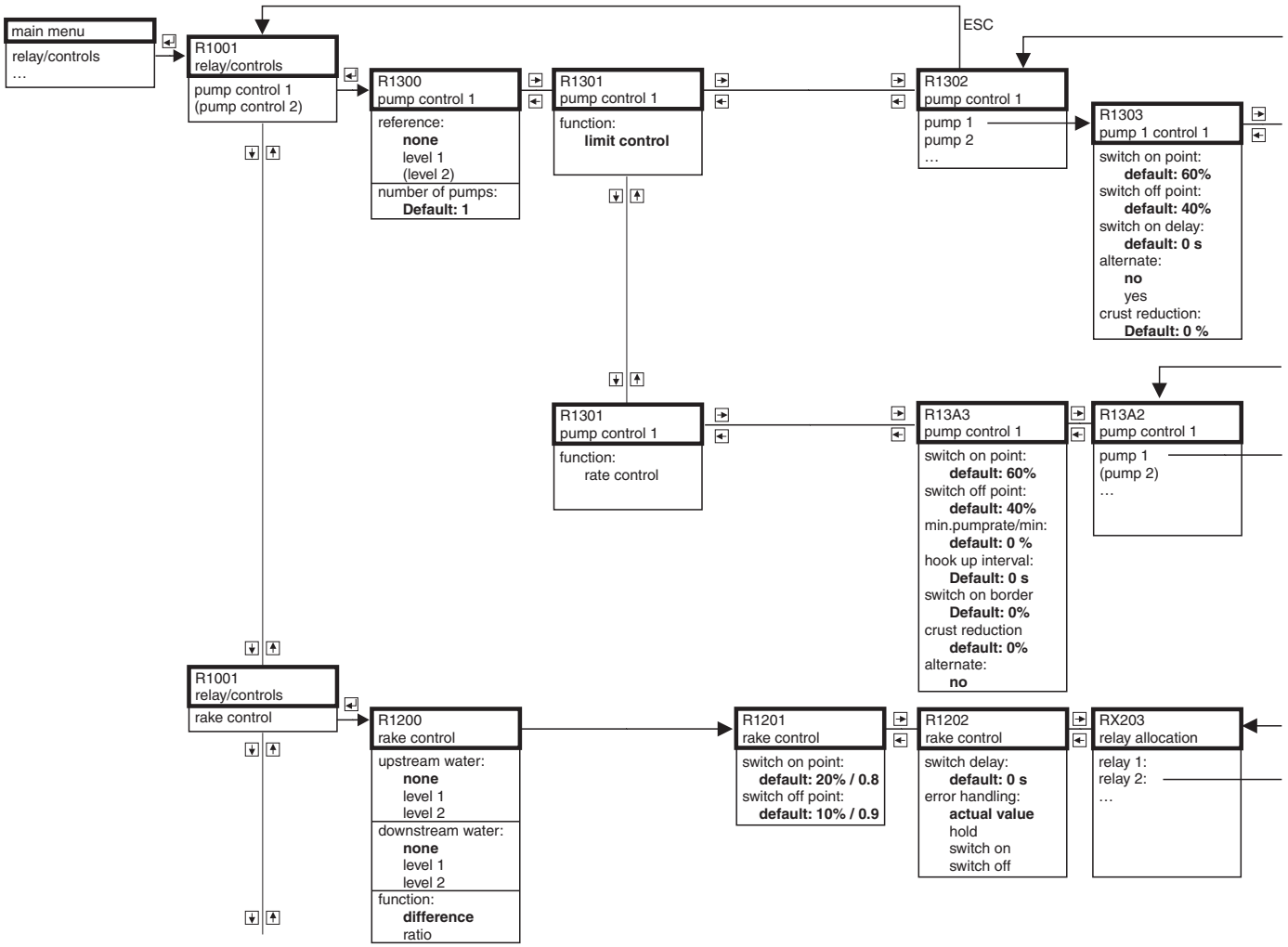
14.2 "Safety settings"



L00-FMU90xxx-19-03-01-en-001

14.3 "Relay/Controls"

14.3.1 Pump control/rake control



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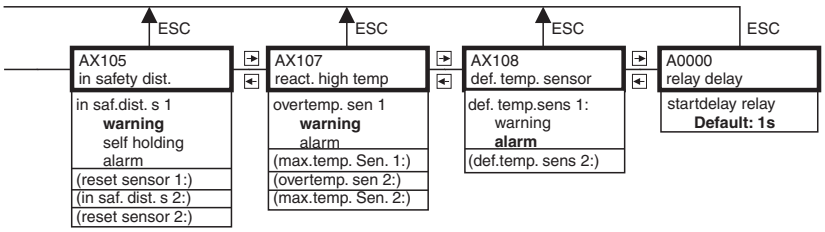

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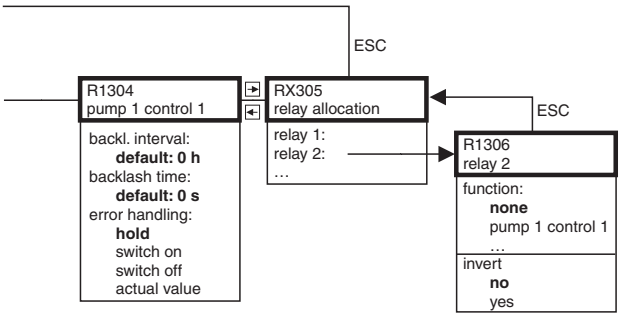
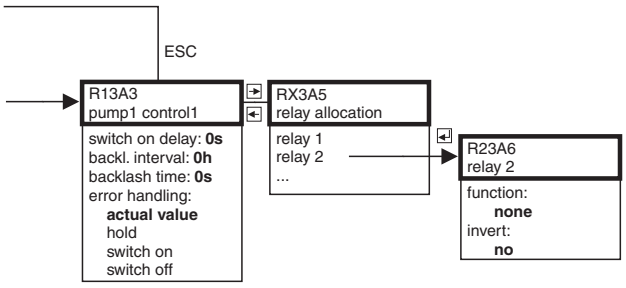
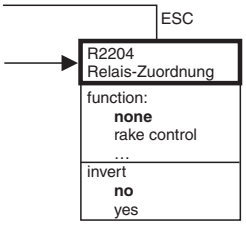
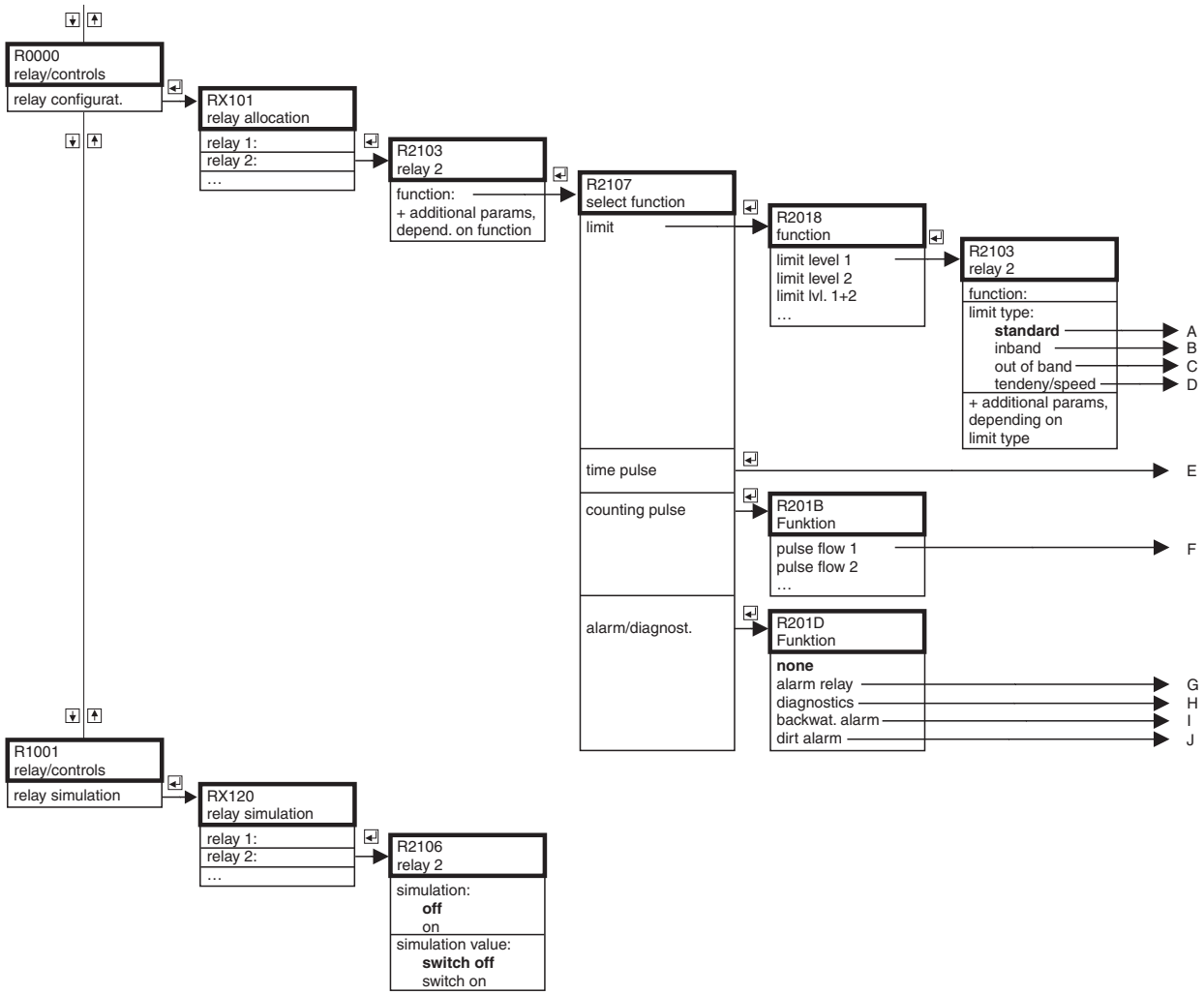




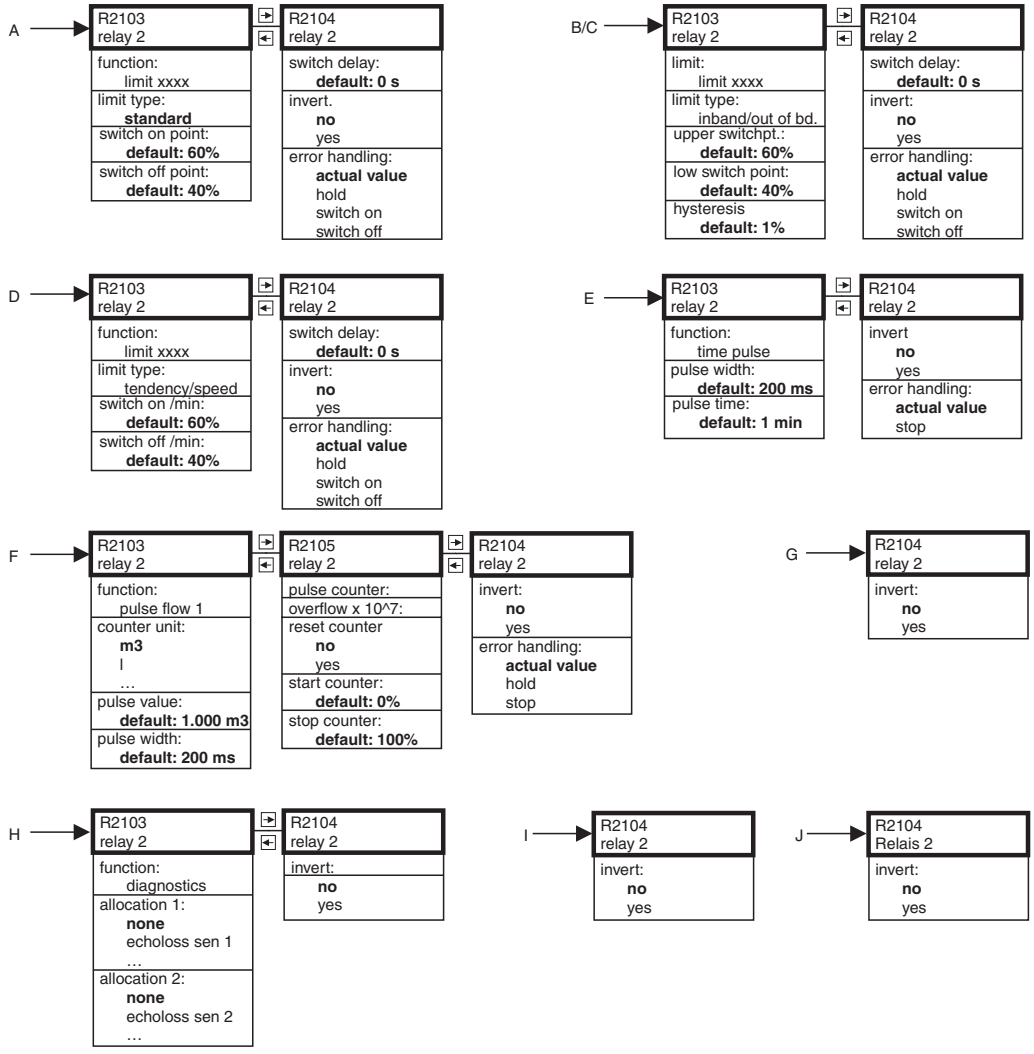


L00-FMU90xxx-19-04-02-en-001

14.3.2 Relay configuration

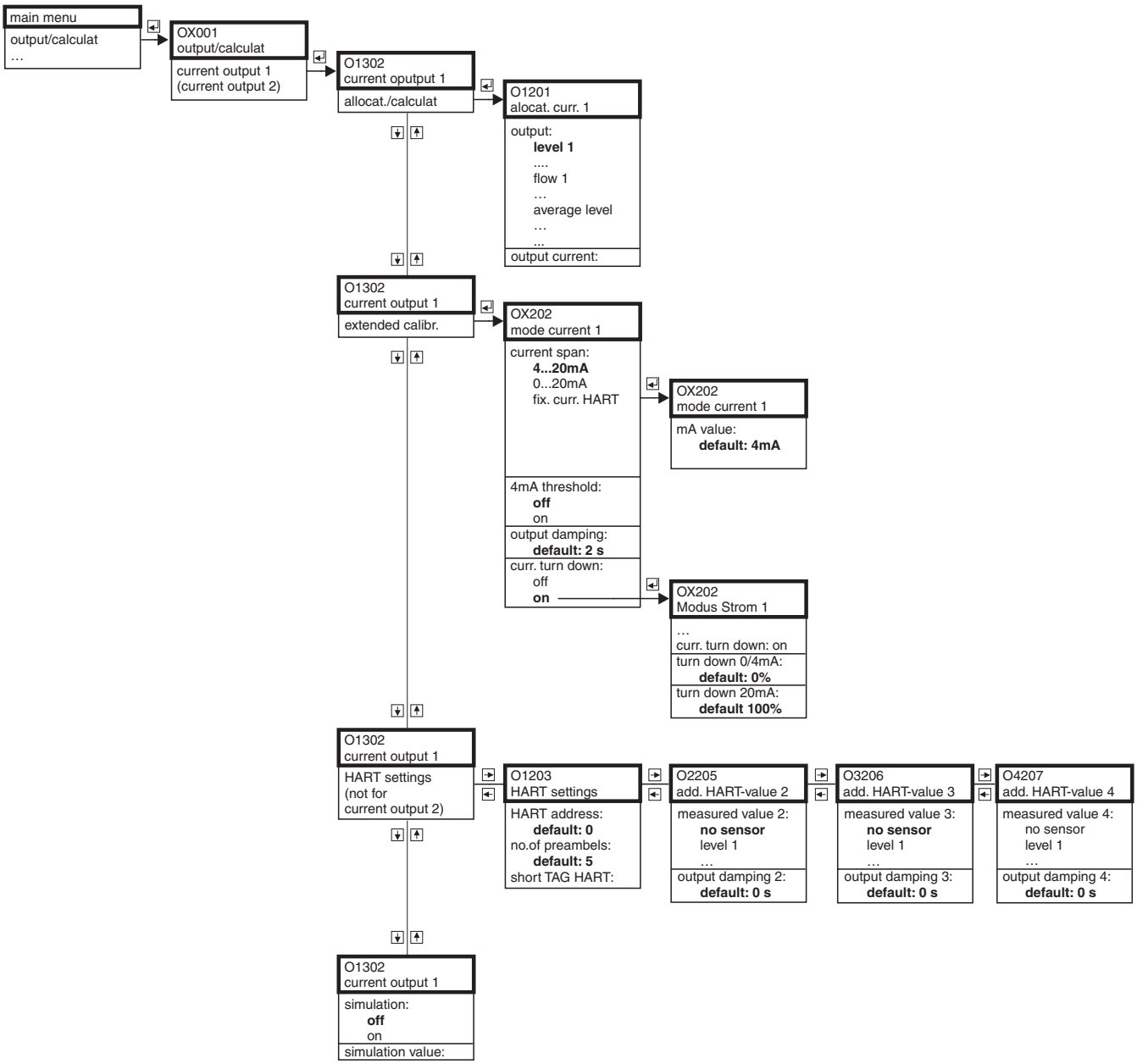


L00-FMU90xxx-19-08-01-en-001



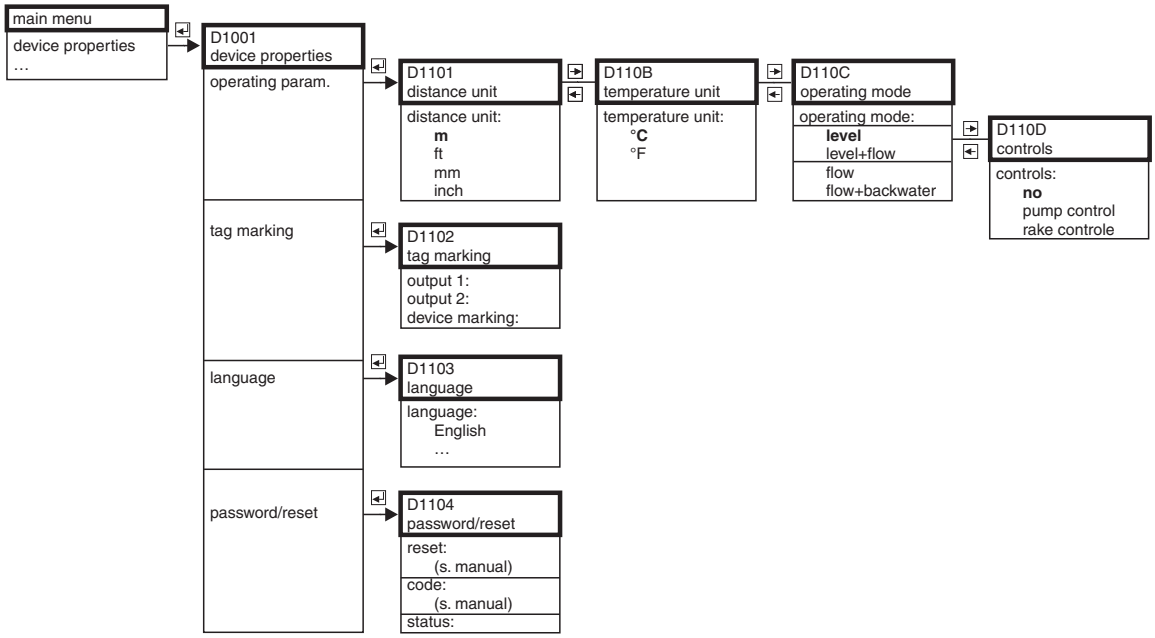
L00-FMU90xxx-19-08-02-en-001

14.4 "Output/calculations"



L00-FMU90xxx-19-05-01-en-001

14.5 "Device properties"



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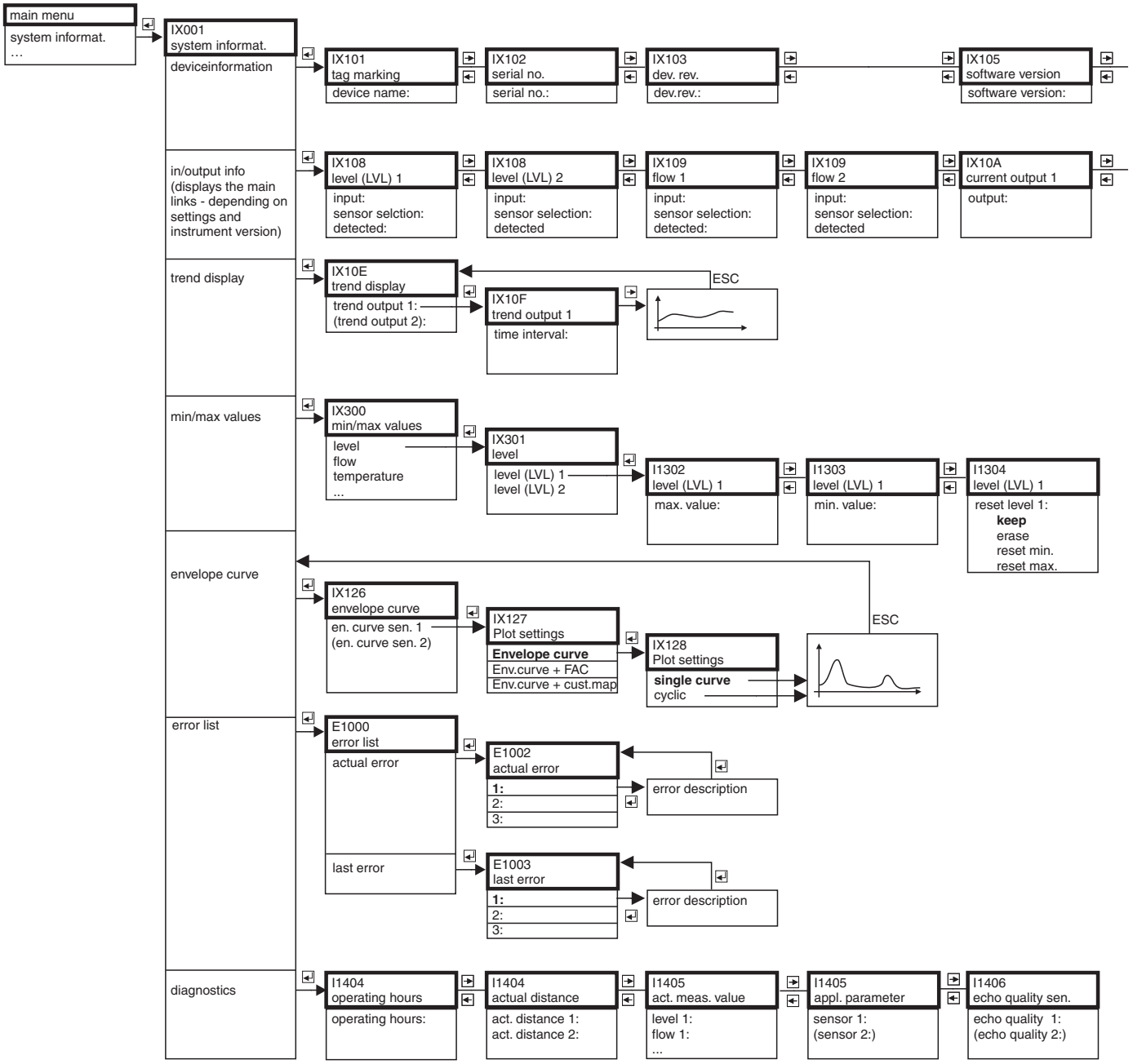
14.6 "System information"



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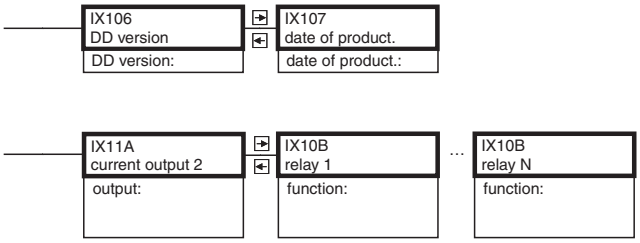
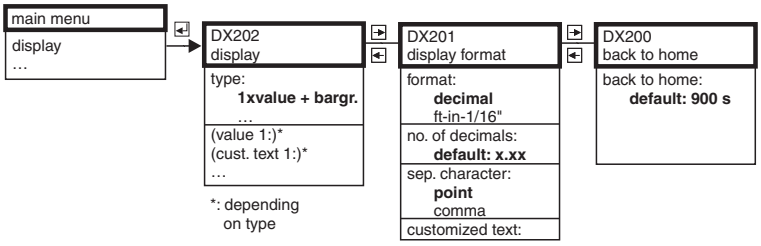


L00-FMU90xxx-19-07-02-de-001

14.7 "Display"



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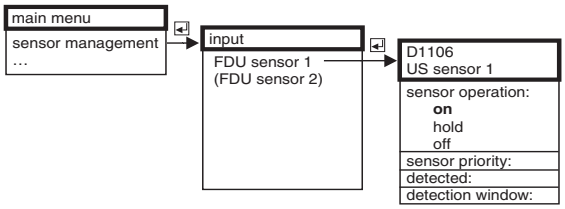
14.8 "Sensor management"



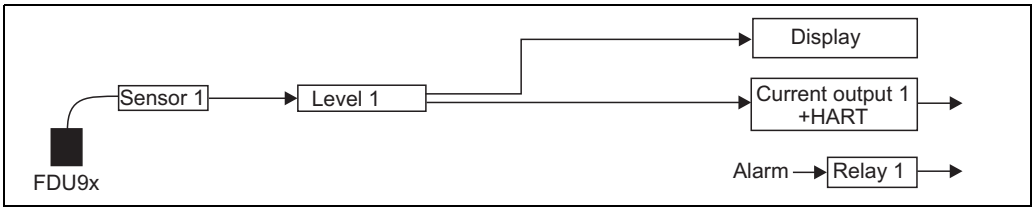
L00-FMU90xxx-19-10-01-en-001

15 Appendix

15.1 Default block configuration

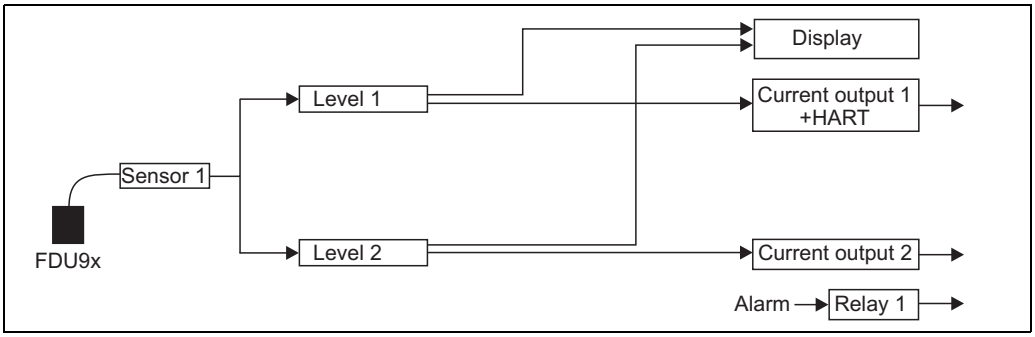
The block configuration on delivery depends on the instrument version:

15.1.1 1 Sensor input / 1 current output (FMU90 - *1***1*1****)



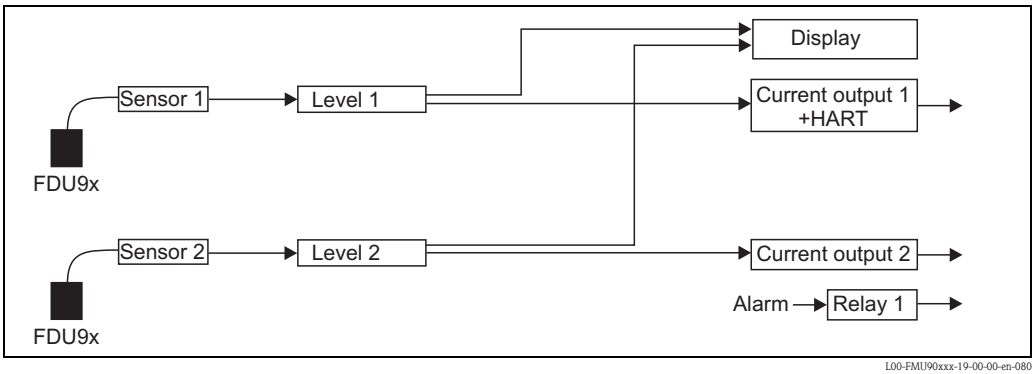
L00-FMU90xxx-19-00-00-en-079

15.1.2 1 sensor input / 2 current outputs (FMU90 - *1***1*2****)



L00-FMU90xxx-19-00-00-en-088

15.1.3 2 sensor inputs / 2 current outputs (FMU90 - *1***2*2****)



L00-FMU90xxx-19-00-00-en-080

Index

Parameter sets (on the display)

A

B

C

D

E

F

H

I

L

M

N

O

P

R

S

T

V

W

Endress+Hauser

People for Process Automation

Declaration of Hazardous Material and De-Contamination

Erklärung zur Kontamination und Reinigung

RA No. ☐☐☐☐☐☐☐☐

Please reference the Return Authorization Number (RA#), obtained from Endress+Hauser, on all paperwork and mark the RA# clearly on the outside of the box. If this procedure is not followed, it may result in the refusal of the package at our facility.

Bitte geben Sie die von E+H mitgeteilte Rücklieferungsnummer (RA#) auf allen Lieferpapieren an und vermerken Sie diese auch außen auf der Verpackung. Nichtbeachtung dieser Anweisung führt zur Ablehnung ihrer Lieferung.

Because of legal regulations and for the safety of our employees and operating equipment, we need the "Declaration of Hazardous Material and De-Contamination", with your signature, before your order can be handled. Please make absolutely sure to attach it to the outside of the packaging.

Aufgrund der gesetzlichen Vorschriften und zum Schutz unserer Mitarbeiter und Betriebseinrichtungen, benötigen wir die unterschriebene "Erklärung zur Kontamination und Reinigung", bevor Ihr Auftrag bearbeitet werden kann. Bringen Sie diese unbedingt außen an der Verpackung an.

Type of instrument / sensor
Geräte-/Sensortyp _____

Serial number
Seriennummer _____

☐ **Used as SIL device in a Safety Instrumented System /** *Einsatz als SIL Gerät in Schutzeinrichtungen*

Process data/ *Prozessdaten*

Temperature / *Temperatur* _____ [°F] _____ [°C]
Pressure / *Druck* _____ [psi] _____ [Pa]
Conductivity / *Leitfähigkeit* _____ [µS/cm]
Viscosity / *Viskosität* _____ [cp] _____ [mm^2/s]

Medium and warnings
Warnhinweise zum Medium

	Medium /concentration *Medium /Konzentration*	Identification CAS No.	 flammable *entzündlich*	 toxic *giftig*	 corrosive *ätzend*	 harmful/ irritant *gesundheits-schädlich/ reizend*	 other * *sonstiges**	 harmless *unbedenklich*
Process medium / *Medium im Prozess*								
Medium for process cleaning / *Medium zur Prozessreinigung*								
Returned part cleaned with / *Medium zur Endreinigung*								

* explosive; oxidising; dangerous for the environment; biological risk; radioactive
* *explosiv; brandfördernd; umweltgefährlich; biogefährlich; radioaktiv*

Please tick should one of the above be applicable, include safety data sheet and, if necessary, special handling instructions.
Zutreffendes ankreuzen; trifft einer der Warnhinweise zu, Sicherheitsdatenblatt und ggf. spezielle Handhabungsvorschriften beilegen.

Description of failure / *Fehlerbeschreibung* _____

_____

_____

Company data / *Angaben zum Absender*

Company / *Firma* _____

_____

Address / *Adresse*

_____

_____

Phone number of contact person / *Telefon-Nr. Ansprechpartner:*

_____

Fax / E-Mail _____

Your order No. / *Ihre Auftragsnr.* _____

"We hereby certify that this declaration is filled out truthfully and completely to the best of our knowledge.We further certify that the returned parts have been carefully cleaned. To the best of our knowledge they are free of any residues in dangerous quantities."

"Wir bestätigen, die vorliegende Erklärung nach unserem besten Wissen wahrheitsgetreu und vollständig ausgefüllt zu haben. Wir bestätigen weiter, dass die zurückgesandten Teile sorgfältig gereinigt wurden und nach unserem besten Wissen frei von Rückständen in gefahrbringender Menge sind."

(place, date / *Ort, Datum)*

Name, dept./ *Abt.* (please print / *bitte Druckschrift*)

Signature / *Unterschrift*

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