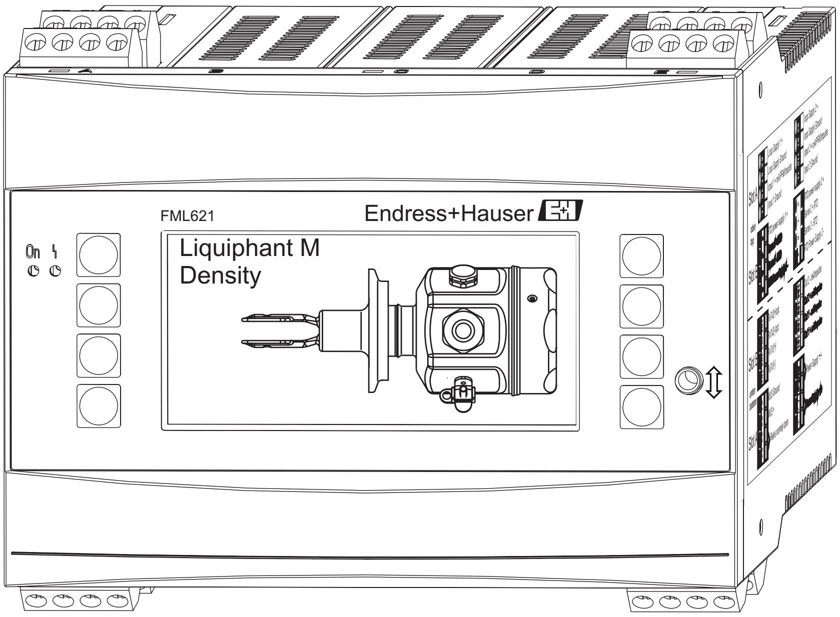
Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Operating Instructions

Density Computer FML621

Liquiphant M Density



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SW version
V1.02.xx

Endress+Hauser

People for Process Automation

Brief operating instructions

For quick and easy commissioning:

Safety instructions	→ Page 6
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Display and operating elements	→ Page 34
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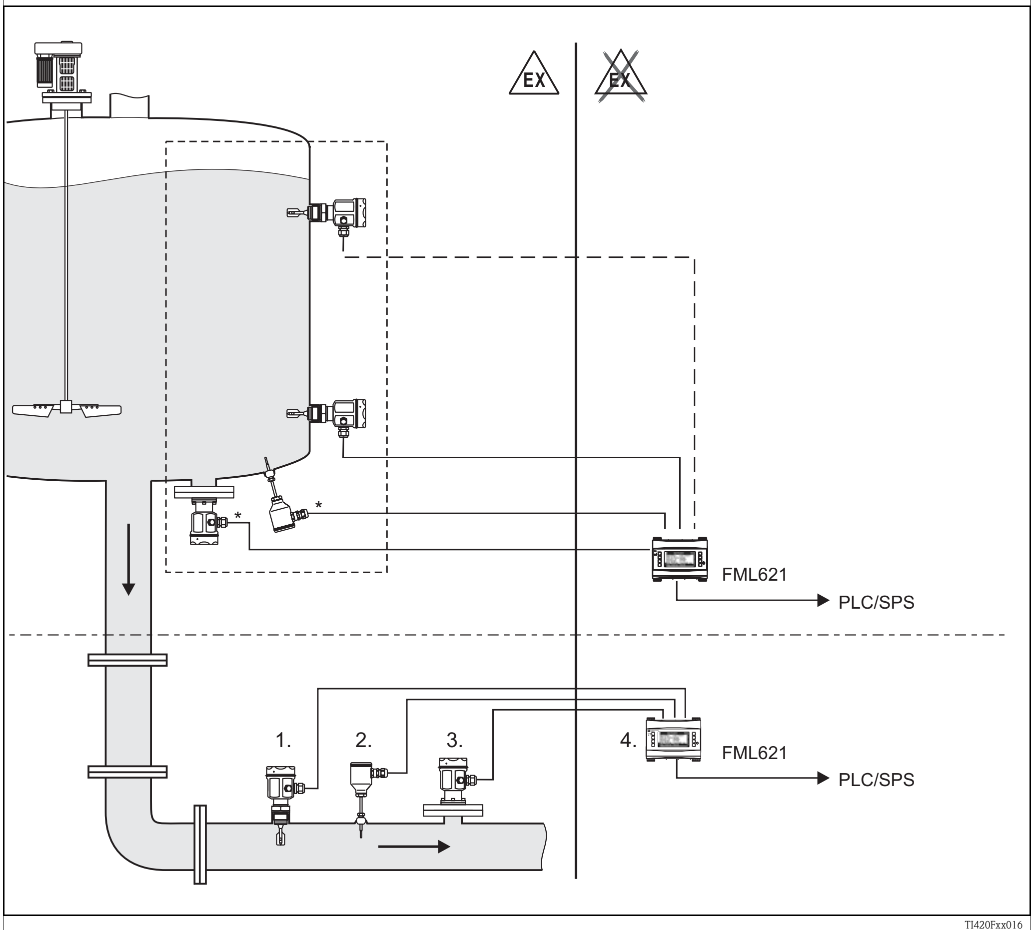
Quick start via the navigator to device configuration for standard operation. Device configuration – explanation and use of all configurable device functions with the associated value ranges and settings. Application example – configuration of the device.	

Application: density measurement	
Measuring the density of a liquid medium in pipes and tanks. Also suitable for use in hazardous areas, and preferably for applications in the chemical and food industry.	



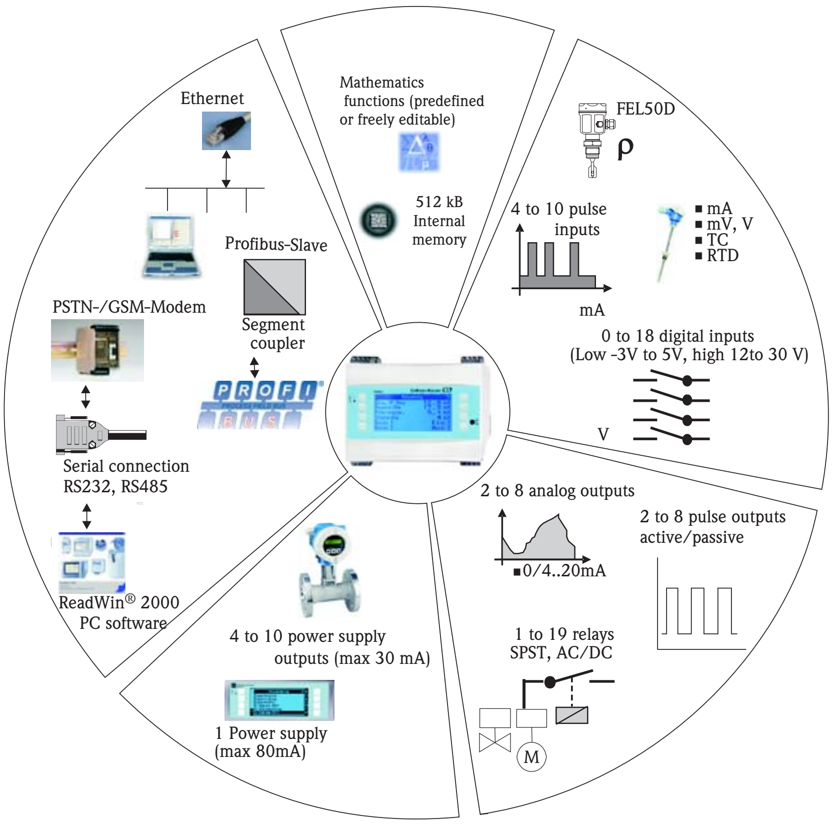
** Pressure and temperature information required depending on the application.*
1. Liquiphant M sensor with electronic insert FEL50D (pulse output);
2. Temperature sensor (e.g. 4 to 20 mA output);
3. Pressure transmitter (4 to 20 mA output) required for pressure changes > 6 bar;
4. Liquiphant Density Computer FML621 with display and operating unit

Applications for the Liquiphant M density computer

The density measuring line can be used in liquid media.
- for intelligent medium detection
- to calculate the specific density
- to calculate the concentration of liquid content
- to convert values to different units such as °Brix, °Baumé, °API etc.

In conjunction with Liquiphant M, the FML621 returns a continuous density measured value.
Furthermore, values can be converted to Baumé, °Brix etc.
The integrated mathematics functions make it possible to determine the specific density, perform intelligent medium differentiation and identify medium concentration. In this way, they play a decisive role in quality monitoring.
Up to five density measuring lines can be operated using Density Computer FML621. All slots must be fitted with plug-in cards.

FML621: Connection options



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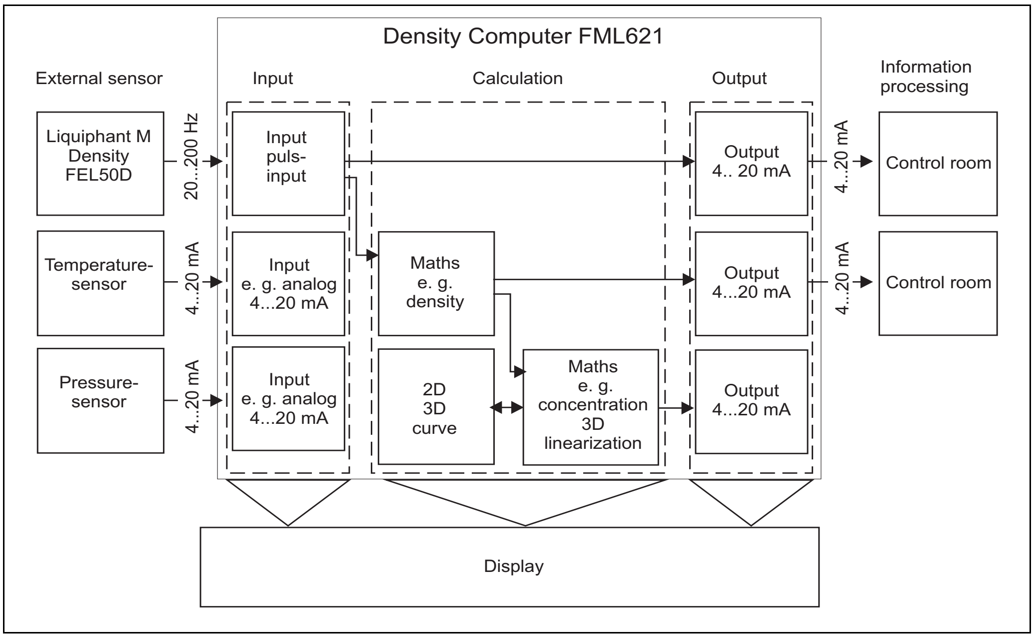
The device helps solve process measuring technology tasks with regard to the following:
- Data logging
- Telecontrol via various communication protocols and methods
- Control
- Presentation of scaled measured values (multichannel display)
- Calculations of mathematical and/or physical formulae, whose input values are delivered by connected sensors

The multichannel concept allows the simultaneous measurement and calculation of several applications. In this way, up to 5 density calculations can be performed in parallel and other conversions made at the same time.
A wide range of different sensors can be connected to the device, e.g. sensors for
- Flow
- Level
- Pressure
- Temperature
- Speeds
- Frequency or density
- Analytics

System design



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Specific density applications

Software modules are available which can calculate the density from the frequency, temperature and pressure input variables.

Additional modules can calculate the density at reference temperature, compute the concentrations or detect media.

Reference density

In this module, the system refers back to a reference temperature, such as 15 °C or 20 °C.
It must be known how the density of the medium changes at different temperatures.

Concentration

Using density and concentration curves already available or determined empirically, the concentration can be determined when substances are continuously dissolved in a medium, for example.

Medium detection

To be able to distinguish between two media, the density function – as a function of the temperature – can be stored for several media. In this way, the system can distinguish between two media or two different concentrations.

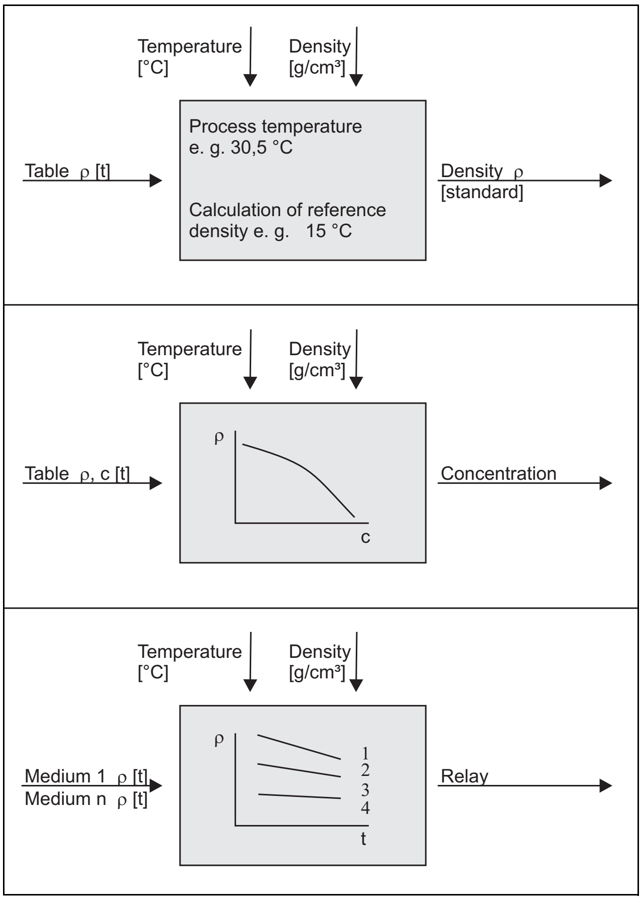

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Table of contents

1 Safety instructions

Safe operation of the density computer is only guaranteed if these Operating Instructions have been read and the safety instructions have been observed.

1.1 Designated use

The density computer is a device for calculating physical variables made available by connected sensors. Stored formulae and also formulae which can be defined and entered freely can be used for calculation. These formulae which can be entered freely can be edited either directly at the device or also on a PC (using ReadWin). The input values and calculated values can be stored in the device and evaluated at a later time either at the device or by means of an external system. There are various ways of establishing the connection to this external system: RS232/485, connection via Ethernet, OPC, M-Bus or Mod-Bus.

- The device is seen as accessory equipment and may not be installed in hazardous areas.
- The manufacturer does not accept liability for damage caused by improper or non-designated use. The device may not be converted or modified in any way.
- The device is designed for use in industrial environments and may only be operated in an installed state.

1.2 Installation, commissioning and operation

This device has been safely built with state-of-the-art technology and meets the applicable requirements and EU Directives. The device can be a source of application-related danger if used improperly or other than intended. Installation, wiring, commissioning and maintenance of the device must only be carried out by trained technical personnel. Technical personnel must have read and understood these Operating Instructions and must adhere to them. The information in the electrical wiring diagrams (see Section 4 'Wiring') must be observed closely.

1.3 Operational safety

Technical improvement
The manufacturer reserves the right to adapt technical details to the most up-to-date technical developments without any special announcement. Contact your local sales center for information about the current state of, and possible extensions to, the Operating Instructions.

1.4 Return

For a return, e.g. in case of repair, the device must be sent in protective packaging. The original packaging offers the best protection. Repairs must only be carried out by your supplier's service organization.

✎ Note!
- When sending in a device for repair, enclose a note with a description of the error and the application.
- Both devices have to be returned if the error cannot be clearly assigned to the Density Computer FML621 or Liquiphant M Density FTL5x during diagnostics.

1.5 Notes on safety conventions and icons

The safety instructions in these Operating Instructions are labeled with the following safety icons and symbols:

Warning!
This symbol draws attention to activities or procedures that can lead to injuries to persons, to a safety risk or to destruction of the device if not carried out properly.

Caution!
This symbol draws attention to activities or procedures that can lead to defective operation or to destruction of the device if not carried out properly.

Note!
This symbol draws attention to activities or procedures that have an indirect effect on operation, or can trigger an unforeseen device reaction if not carried out properly.

2 Identification

2.1 Device designation

2.1.1 Nameplate

The correct device?
Compare the order code on the nameplate of the device to the code on the delivery note.

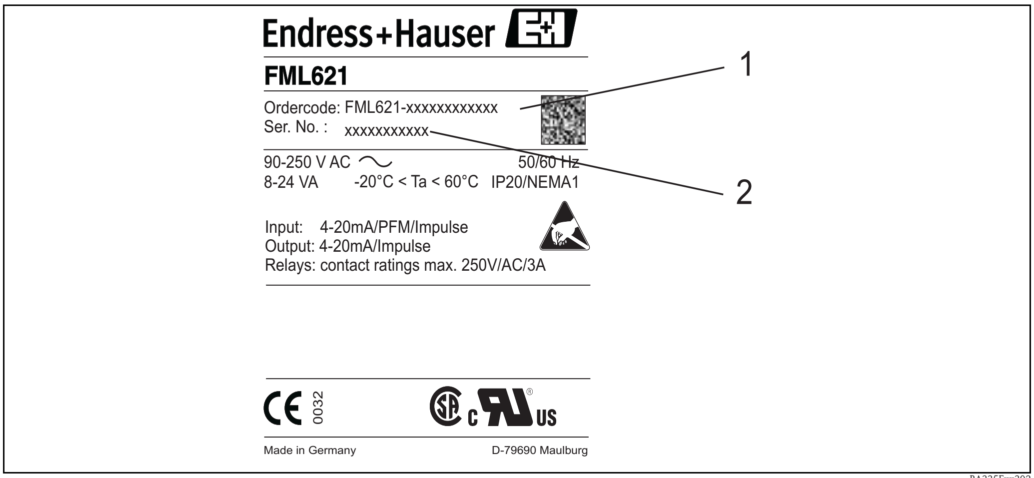

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Fig. 1: FML621 nameplate

1) Order code
2) Serial number

2.2 Scope of delivery

The scope of delivery of the device comprises:

- Density computer for top-hat rail mounting
- Hardcopy of Operating Instructions
- Operating Instructions on CD-ROM
- Delivery note
- CD-ROM with PC configuration software (ReadWin 2000)
- Interface cable RS232 (optional)
- Remote display for panel mounting (optional)
- Extension cards (optional)

✎ Note!
Please note the accessories of the device in the 'Accessories' section → Page 145 ff.

2.3 Certificates and approvals

CE mark, Declaration of Conformity

The device has been constructed and tested to state-of-the-art operational safety standards and left the factory in perfect condition as regards technical safety.
The device meets the relevant standards and directives as per IEC 61010 "Safety requirements for electrical equipment for measurement, control and laboratory use".
Thus, the device described in these Operating Instructions meets the legal requirements of the EU Directives. The manufacturer confirms successful testing of the device by affixing to it the CE mark.

2.4 Device identification

2.4.1 FML621 product structure

✎ Note!
Versions that mutually exclude one another are not marked.

10	**Approval:**			
	A	Non-hazardous area		
	B	ATEX II (1) GD	(EEx ia) IIC	
	C	FM	IS, Class I, II, III	Division 1, Group A-G
	D	CSA	IS, Class I, II, III	Division 1, Group A-G

20	**Display; operation:**		
	1	Not selected;	No keys
	2	Alphanumeric;	8 keys
	3	Separate	Panel 72 x 144 mm, 1 x RS485
	4	Separate	Panel 72 x 144 mm, 2 x RS485

30	**Power supply:**	
	1	90 to 250 V AC
	2	20 to 36 V DC, 20 to 28 V AC

40	**Slot B:**	
	A	Unused
	B	Input: 2 x FEL50D / 0/4 to 20 mA + transmitter power supply Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	C	Input: 2 x Pt100/500/1000 Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST
	D	Input: 2 x digital 20 kHz, 4 x digital 4 Hz Output: 6 x relay SPST
	E	Input: 2 x U, I, TC Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST
	G	Input: Ex i, 2 x FEL50D / 0/4 to 20 mA + transmitter power supply Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	H	Input: Ex i, 2 x Pt100/500/1000 Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	I	Input: Ex i, 4 x digital Output: 6 x relay SPST
	J	Input: Ex i, 2 x U, I, TC Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST

50	**Slot C:**	
	A	Unused
	B	Input: 2 x FEL50D / 0/4 to 20 mA + transmitter power supply Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	C	Input: 2 x Pt100/500/1000 Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST
	D	Input: 2 x digital 20 kHz, 4 x digital 4 Hz Output: 6 x relay SPST
	E	Input: 2 x U, I, TC Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST
	G	Input: Ex i, 2 x FEL50D / 0/4 to 20 mA + transmitter power supply Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	H	Input: Ex i, 2 x Pt100/500/1000 Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	I	Input: Ex i, 4 x digital Output: 6 x relay SPST
	J	Input: Ex i, 2 x U, I, TC Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST

60	**Slot D:**	
	A	Unused
	B	Input: 2 x FEL50D / 0/4 to 20 mA + transmitter power supply Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	C	Input: 2 x Pt100/500/1000 Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST

60		Slot D:
	D	Input: 2 x digital 20 kHz, 4 x digital 4 Hz Output: 6 x relay SPST
	E	Input: 2 x U, I, TC Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST
	G	Input: Ex i, 2 x FEL50D / 0/4 to 20 mA + transmitter power supply Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	H	Input: Ex i, 2 x Pt100/500/1000 Output: 2 x 0/4 to 20 mA, 2 x digital, 2 x relay SPST
	I	Input: Ex i, 4 x digital Output: 6 x relay SPST
	J	Input: Ex i, 2 x U, I, TC Output: 2 x 0/4 to 20 mA, pulse, 2 x digital, 2 x relay SPST

70		Software:
	AA	Mathematics, density module
	AB	Mathematics, density module and telealarm
	YY	Special version

80		Operating language:
	A	German
	B	English
	C	French
	D	Italian
	E	Spanish
	F	Dutch

90		Communication:
	1	1 x RS232, 1 x RS485
	2	1 x RS232, 1 x RS485 + cable
	3	1 x RS232 + Profibus DP slave module
	4	1 x RS232 + cable + Profibus DP, external slave module
	5	1 x RS232 + 2 x RS485
	6	1 x RS232 + 2 x RS485 + cable
	C	1 x RS232 + Profibus DP slave module + Ethernet
	D	1 x RS232 + Profibus DP slave module + Ethernet + cable
	E	1 x RS232 + 2 x RS485 + Ethernet
	F	1 x RS232 + 2 x RS485 + cable + Ethernet

100		Additional fittings:
	1	Not selected
	2	Factory calibration certificate

FML621 -											complete product designation

2.4.2 Application examples

Basic unit:

Application	Product structure	Number of inputs	Number of outputs	Comment
1 density measuring line Pressure- and temperature-compensated	FML621-xxxAAAxxxx	4x FEL50D / 0/4 to 20 mA	1x relay SPST, 2x 0/4 to 20 mA	1 Liquiphant with FEL50D 1 temperature transmitter 4 to 20 mA 1 pressure transmitter 4 to 20 mA 1 output: density 4 to 20 mA 1 output: temperature 4 to 20 mA
2 density measuring lines Temperature-compensated	FML621-xxxAAAxxxx	4x FEL50D / 0/4 to 20 mA	1x relay SPST, 2x 0/4 to 20 mA	2 Liquiphant with FEL50D 2 temperature transmitter 4 to 20 mA 1 output: density 4 to 20 mA 1 output: temperature 4 to 20 mA

Basic unit + 2 extension cards:

Application	Product structure	Number of inputs	Number of outputs	Comment
3 density measuring lines 2x temperature-compensated 1x pressure- and temperature-compensated	FML621-xxxBBAxxxx	8x FEL50D / 0/4 to 20 mA	1x relay SPST, 6x 0/4 to 20 mA	3 Liquiphant with FEL50D 3 temperature transmitter 4 to 20 mA 1 pressure transmitter 4 to 20 mA 3 outputs: density 4 to 20 mA 3 outputs: temperature 4 to 20 mA 1 relay for medium detection

Medium detection (e.g. with relay):

Application	Product structure	Use of inputs	Information content	Comment
Distinguish between 2 media	FML621-xxxAAAxxxx Basic unit	1x FEL50D 1x temperature 4 to 20 mA	1 output: density 4 to 20 mA 1 output: temperature 4 to 20 mA 1 relay to switch the storage tank, for example	The medium detection can refer to concentrations or phase transitions.
Distinguish between 3 media	FML621-xxxBAAxxxx Basic unit with additional relay card	1x FEL50D 1x temperature 4 to 20 mA	1 output: density 4 to 20 mA 1 output: temperature 4 to 20 mA 1 relay: display product 1 1 relay: display product 2 1 relay: display product 3	The relays can activate subsequent processes by triggering actuators.

Density:

Application	Product structure	Use of inputs	Information content	Comment
Density measurement or concentration calculation with pump protection	FML621-xxxAAAxxxx Basic unit	1x FEL50D 1x temperature 4 to 20 mA	1 output: density 4 to 20 mA 1 output: concentration 4 to 20 mA 1 relay to switch off the pump	In addition to determining the density and concentration, pump protection can also be implemented by setting the appropriate switching frequency.

Density in conjunction with other measuring principles:

Application	Product structure	Use of inputs	Information content	Comment
Determining the mass of the tank contents and monitoring the validity of the measurement	FML621-xxxBAAxxxx Basic unit with additional extension card, Analog	1x FEL50D 1x temperature 4 to 20 mA 1x Micropilot FMR240	1 output: mass 1 output: density 4 to 20 mA 1 output: level 4 to 20 mA Depending on the level information, 1 relay reports whether the measurement is valid	Thanks to the integrated mathematics function, the density measurement can calculate the mass of the medium with the level information.

3 Installation

3.1 FML621 installation

The permitted ambient temperature (see "Technical Data" Section) must be observed when installing and operating. The device must be protected against the effects of heat.

3.1.1 Dimensions

Observe the device length of 135 mm (5.31 in) (corresponds to 8TE). More dimensions can be found in the "Technical Data" Section.

3.1.2 Mounting location

Top-hat rail mounting as per IEC 60715 in the cabinet. The mounting location must be free from vibrations.

3.1.3 Orientation

No restrictions.

3.2 FML621 installation instructions

First remove the plug-in terminals from the device slots.
To fix the device to the top-hat rail, first hang it on the top-hat rail. Press down gently to engage the lower top-hat rail clamp. (see Fig. 2, item 1 and 2)

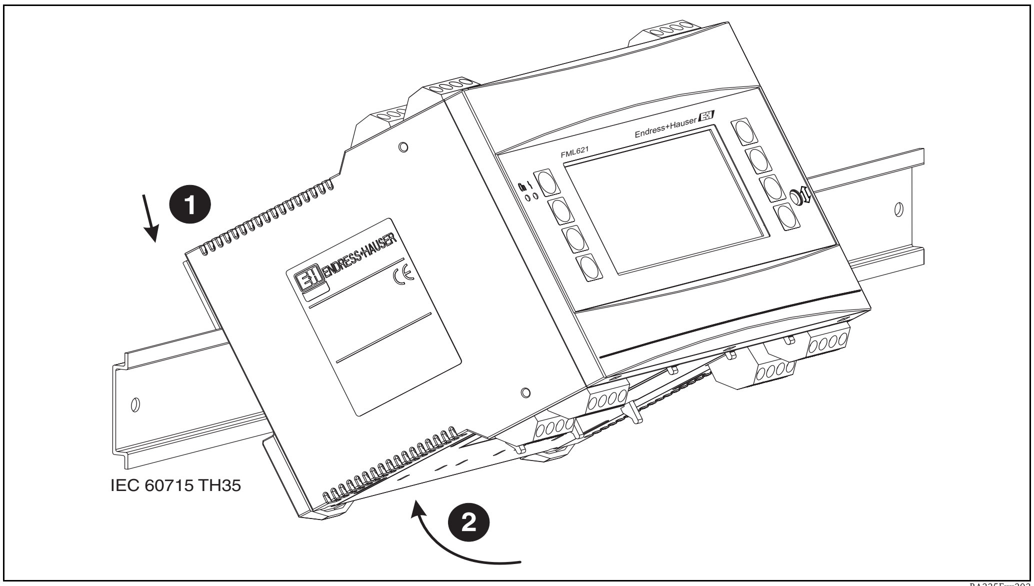


Fig. 2: Mounting device on top-hat rail

3.2.1 Installing extension cards

You can equip the device with various extension cards. A maximum of three slots are available in the device for this. The slots for the extension cards are marked with B, C and D (→ Fig. 3) on the device.

1. Make sure that the device is not connected to the power supply when installing and removing an extension card.

2. Remove the blanking cover from the slot (B, C or D) of the basic unit by pressing together the catches on the bottom of the device (see Fig. 3, item 2), while at the same time pressing in the catch on the rear of the housing (e.g. with a screwdriver) (see Fig. 3, item 1). Now you can pull the blanking cover up out of the basic unit.
3. Insert the extension card into the basic unit from above. The extension card is not correctly installed until the catches on the bottom and rear of the device (see Fig. 3, items 1 and 2) lock into place. Ensure that the input terminals of the extension card are on top and the connection terminals are pointing to the front, as with the basic unit.
4. The device automatically recognizes the new extension card once the device has been correctly wired and has been commissioned (see "Commissioning" Section).

Caution!
When using extension cards, venting with an air current of at least 0.5 m/s is necessary.

Note!
If you remove an extension card and do not replace it with another card, you must seal the empty slot with a blanking cover.

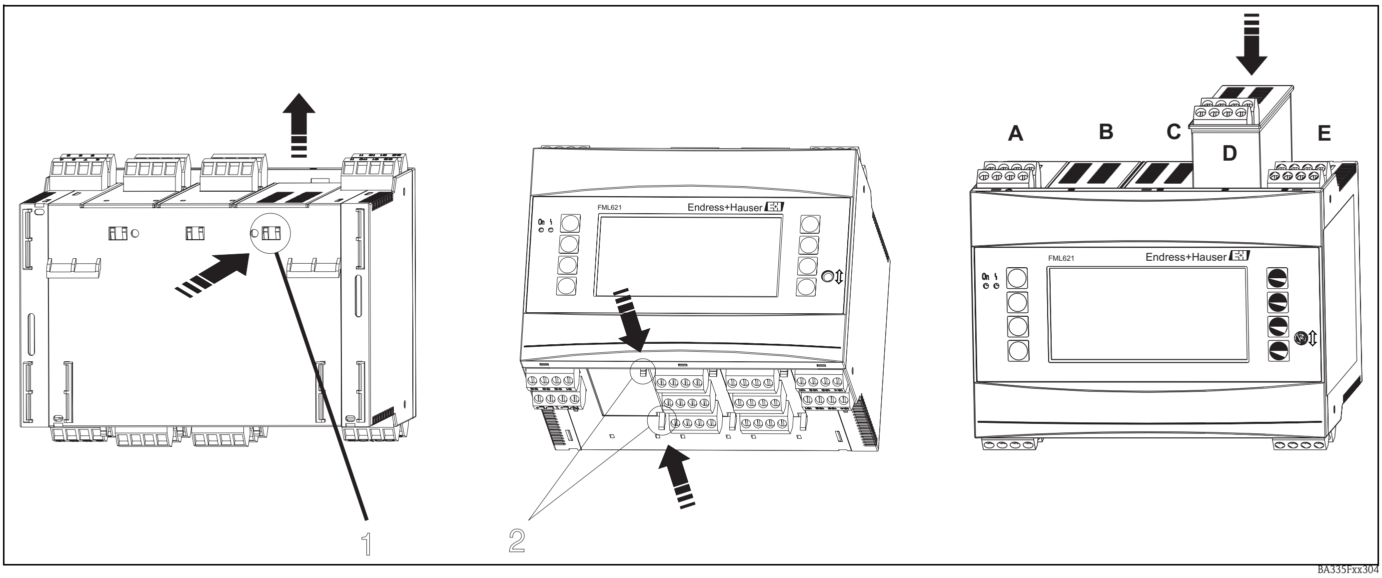


Fig. 3: Installing an extension card (example)

Item 1: catch on the rear of the device
Item 2: catches on the bottom of the device
Items A - E: identifier for slot assignment

3.3 Sensor-specific parameters

The Liquiphant M Density is supplied with a calibration report and sensor adjustments. The calibration report contains sensor-specific parameters which must be entered in the Density Computer FML621.
Alternatively, sensor-specific parameters can also be taken from the sensor adjustments, which are located in the Liquiphant M Density housing.

3.4 FML621 post-connection check

When using extension cards, ensure that the cards are correctly seated in the device slots.

3.5 Installation conditions for Liquiphant M Density

Note!
The following information is supplemented by additional documentation on Liquiphant M (see → Page 165 "Documentation").

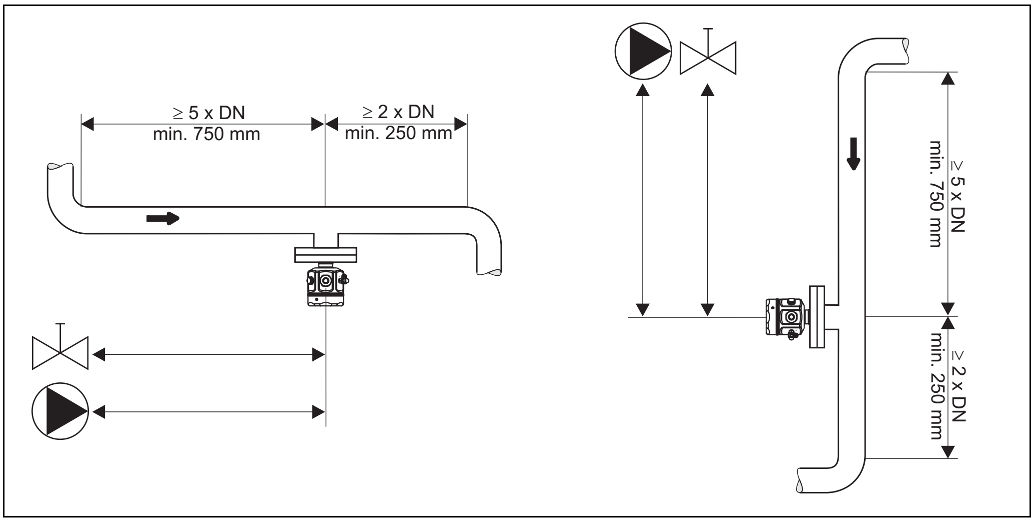
3.5.1 Orientation

The mounting location must be selected such that the fork tines and the membrane are always immersed in the medium.

Note!
To avoid air pockets in the pipes or nozzles, ensure suitable bleeding takes place.

3.5.2 Inlet and outlet run

Install the sensor as far as possible from fittings such as valves, T-sections, elbows, flange elbows etc. Compliance with the following requirements for the inlet and outlet runs is necessary in order to ensure measuring accuracy:
- Inlet run: ≥ 5 * DN (nominal diameter) minimum 750 mm
- Outlet run: ≥ 2 * DN (nominal diameter) minimum 250 mm



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Outlet runs for pressure and temperature measuring points

Pressure and temperature sensors must be installed downstream of the Liquiphant M Density (from the flow direction). When installing pressure and temperature measuring points downstream of the measuring device, make sure the distance between the measuring point and the measuring device is sufficient.

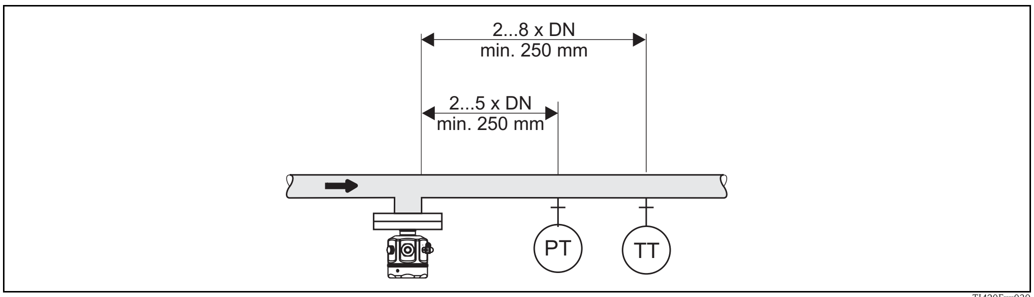

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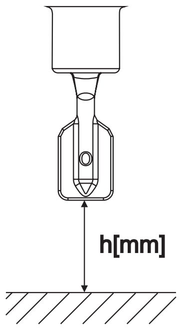
Fig. 4: PT = Pressure measuring point
TT = Temperature measuring point

3.5.3 Mounting location and correction factor (Correction r)

The Liquiphant M can be installed in containers, tanks or pipes, for example.

Note!
The following general conditions must be observed when selecting the correct mounting location:

- The vibrating tines of the Liquiphant M Density unit need room to vibrate at the mounting location. Even with this small deflection, the medium is displaced or medium has to flow around the fork. If the distance between the fork tines and the tank or pipe wall is very short, the measurement result is affected. This can be balanced by entering a correction factor (correction r).



h [mm]	*
12	1,0026
14	1,0016
16	1,0011
18	1,0008
20	1,0006
22	1,0005
24	1,0004
26	1,0004
28	1,0004
30	1,0003
32	1,0003
34	1,0002
36	1,0001
38	1,0001
40	1,0000

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*Fig. 5: * Correction factor (Correction r) with a distance of 12 to 40 mm between the tip of the fork tine and the tank floor, for example.*

- In pipe internal fittings, the fork tines of the Liquiphant M must be aligned with the direction of flow. Otherwise the measurement result can be distorted by vortexes and eddies.
  – A mark on the process connection indicates the position of the fork tines.
    Threaded connection = dot on the hexagon head; flange = two lines on the flange.
  – The flow velocity of the medium may not exceed 2 m/s during operation.
- In tanks with an agitator, the Liquiphant must be aligned in the direction of flow. Otherwise the measurement result can be distorted by vortexes and eddies.
- For Liquiphant pipe extensions > 1000 mm, the sensor must be laterally supported (against deforming) in tanks with agitators. Alternatively, install the Liquiphant laterally.

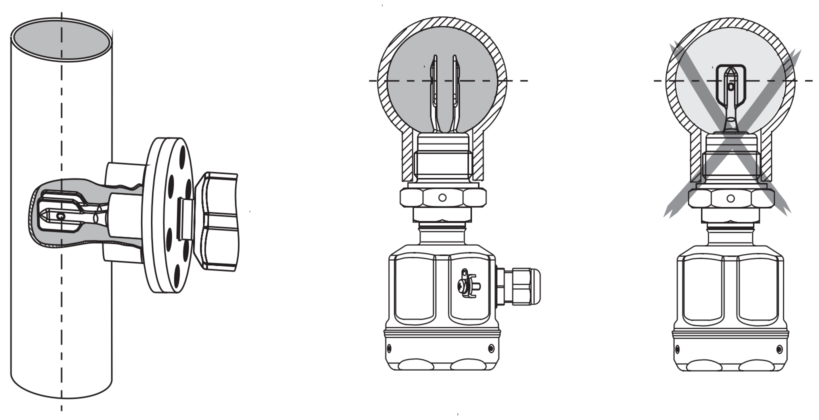

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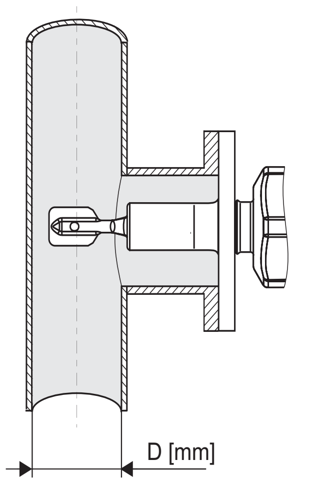
Fig. 6: Fork tine alignment in direction of flow (note the mark on the Liquiphant M Density)



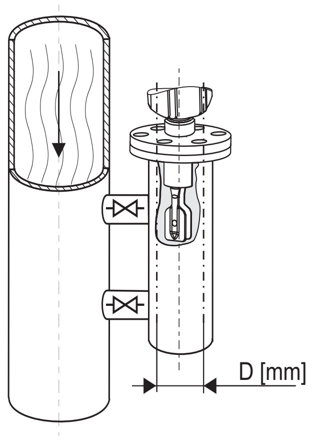
D [mm]	*
<44	–
44	1,0225
46	1,0167
48	1,0125
50	1,0096
52	1,0075
54	1,0061
56	1,0051
58	1,0044
60	1,0039
62	1,0035
64	1,0032
66	1,0028
68	1,0025
70	1,0022
72	1,0020
74	1,0017
76	1,0015
78	1,0012
80	1,0009
82	1,0007
84	1,0005
86	1,0004
88	1,0003
90	1,0002
92	1,0002
94	1,0001
96	1,0001
98	1,0001
100	1,0001
>100	1,0000

TI420Fxx042

*Fig. 7: * Correction factor (Correction r) with sensor immersed laterally. The mark on the fork should match the pipe axis.*

Note!
Pipe nominal diameters with internal measurements < 44 mm are not permitted!

If the flow in the pipes is strong (> 2 to < 5 m/s) or in the event of turbulent surfaces in tanks, construction-specific measures for the reduction of the turbulence at the sensor must be put in place. The Liquiphant M Density could be installed e.g. in a bypass or in a pipe with a larger diameter for this purpose.



D [mm]	*
<44	–
44	1,0191
46	1,0162
48	1,0137
50	1,0116
52	1,0098
54	1,0083
56	1,0070
58	1,0059
60	1,0050
62	1,0042
64	1,0035
66	1,0030
68	1,0025
70	1,0021
72	1,0017
74	1,0014
76	1,0012
78	1,0010
80	1,0008
82	1,0006
84	1,0005
86	1,0004
88	1,0003
90	1,0003
92	1,0002
94	1,0002
96	1,0001
98	1,0001
100	1,0001
>100	1,0000

TI420Fxx043

*Fig. 8: * Correction factor (Correction r) for pipe nominal diameters between DN50 and DN100. A correction for pipe nominal diameters > DN100 is not necessary.*

- The orientation must be selected such that the fork tines and the membrane are always covered by the medium during the measurement.

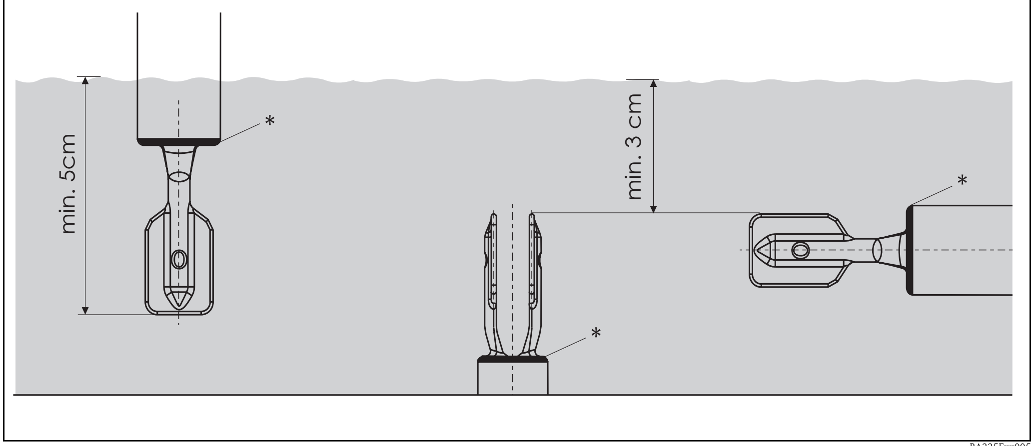


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Fig. 9: The fork tines and the "" membrane must be completely covered by the medium.*

3.6 Entering the correction factor (Correction r) in ReadWin

The correction factor can be entered in ReadWin as shown in Fig. 10.

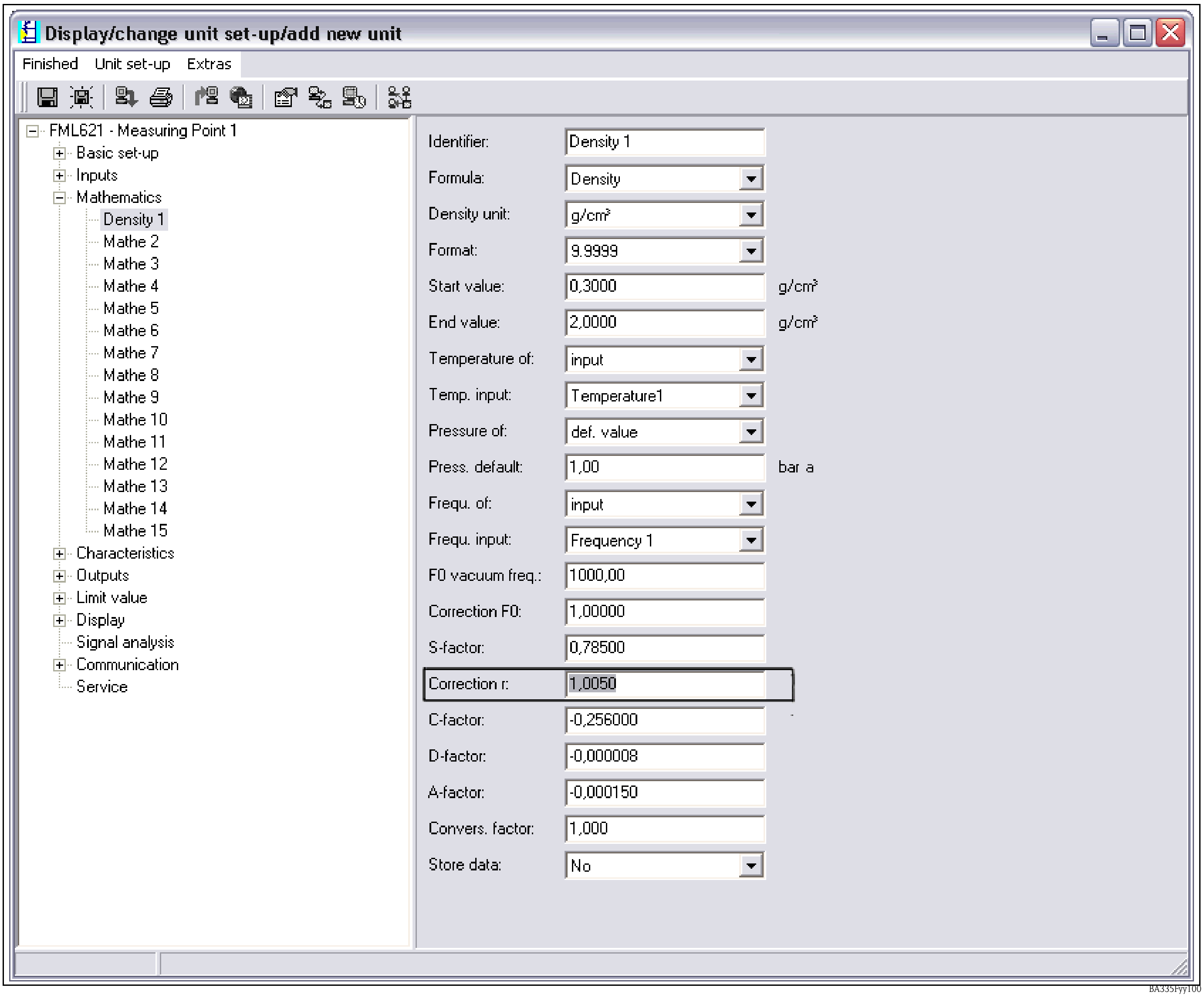


Fig. 10: Input box for the correction factor (Correction r)

4 Wiring

4.1 Quick wiring guide

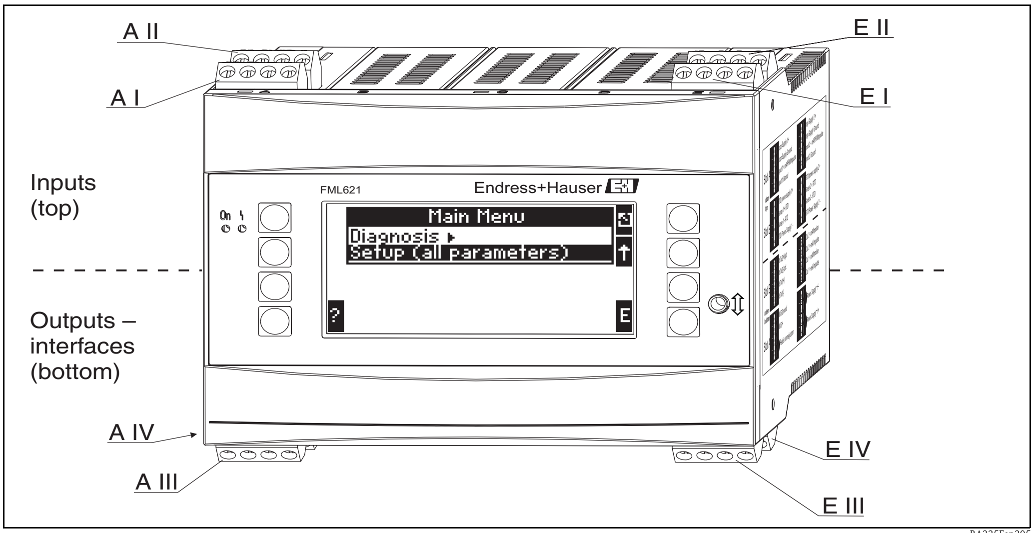


Fig. 11: Slot assignment (basic unit)

Terminal assignment

Terminal (item no.)	Terminal assignment	Slot	Input
10	+ 0/4 to 20 mA/PFM/pulse input 1	A top, front (**A I**)	Current/PFM/pulse input 1
11	Ground for 0/4 to 20 mA/PFM/pulse input		
81	Sensor power supply ground 1		
82	24 V sensor power supply 1		
110	+ 0/4 to 20 mA/PFM/pulse input 2	A top, rear (**A II**)	Current/PFM/pulse input 2
11	Ground for 0/4 to 20 mA/PFM/pulse input		
81	Sensor power supply ground 2		
83	24 V sensor power supply 2		
10	+ 0/4 to 20 mA/PFM/pulse input 1	E top, front (**E I**)	Current/PFM/pulse input 1
11	Ground for 0/4 to 20 mA/PFM/pulse input		
81	Sensor power supply ground 1		
82	24 V sensor power supply 1		
110	+ 0/4 to 20 mA/PFM/pulse input 2	E top, rear (**E II**)	Current/PFM/pulse input 2
11	Ground for 0/4 to 20 mA/PFM/pulse input		
81	Sensor power supply ground 2		
83	24 V sensor power supply 2		
Terminal (item no.)	**Terminal assignment**	**Slot**	**Output - interface**
101	+ RxTx 1	E bottom, front (**E III**)	RS485
102	- RxTx 1		
103	+ RxTx 2		RS485 (optional)
104	- RxTx 2		

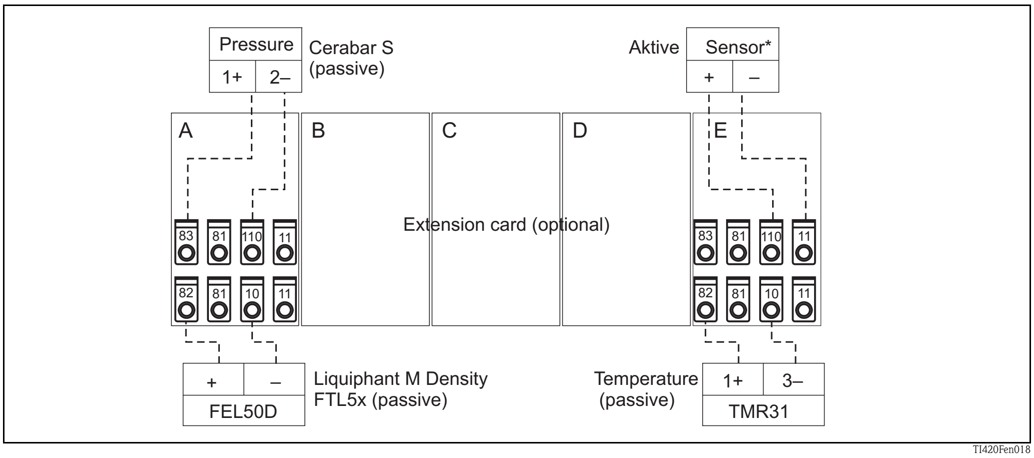
Terminal (item no.)	Terminal assignment	Slot	Input
131	+ 0/4 to 20 mA/pulse output 1	E bottom, rear (**E IV**)	Current/pulse output 1
132	- 0/4 to 20 mA/pulse output 1		
133	+ 0/4 to 20 mA/pulse output 2		Current/pulse output 2 Note! Ethernet, if the Ethernet option has been ordered.
134	- 0/4 to 20 mA/pulse output 2		
52	Relay Common (COM)	A bottom, front (**A III**)	Relay 1
53	Relay Normally Open (NO)		
91	Sensor power supply ground		Additional sensor power supply
92	+ 24 V sensor power supply		
L/L+	L for AC L+ for DC	A bottom, rear (**A IV**) Power supply	
N/L-	N for AC L- for DC		

Note!
The inputs in the same slot are not galvanically isolated. There is a separation voltage of 500 V between the aforementioned inputs and outputs in various slots. Terminals with the same second digit are jumpered internally (Terminals 11 and 81).

4.2 Connecting the measuring unit

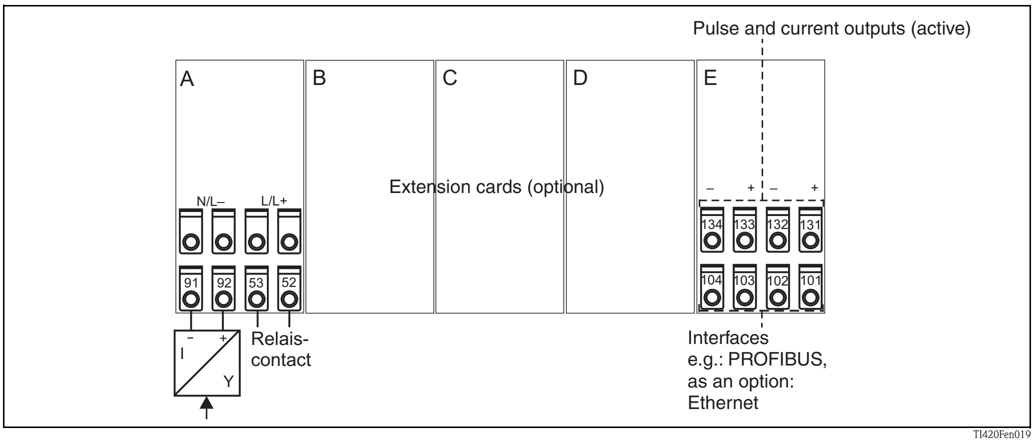
Caution!
Do not install or wire the device when it is connected to the power supply. Not conforming with this can lead to the destruction of electronic components.

Connection overview, top (inputs)



* *Active sensor: Passing on temperature information from a PLC can be taken as an example for connecting an active sensor.*

Connection overview, bottom (outputs, interfaces)



* *Active sensor: Passing on temperature information from a PLC can be taken as an example for connecting an active sensor.*

Note!
With the Ethernet option, no current output and no pulse output is available at slot E!

4.2.1 Power supply connection

Caution!
- Before wiring the device, ensure that the supply voltage corresponds to the specification on the nameplate.
- For the 90 to 250 V AC version (power supply connection), a switch marked as a separator, as well as a fuse (rated current = 10 A), must be fitted in the supply line near the device (easy to reach).

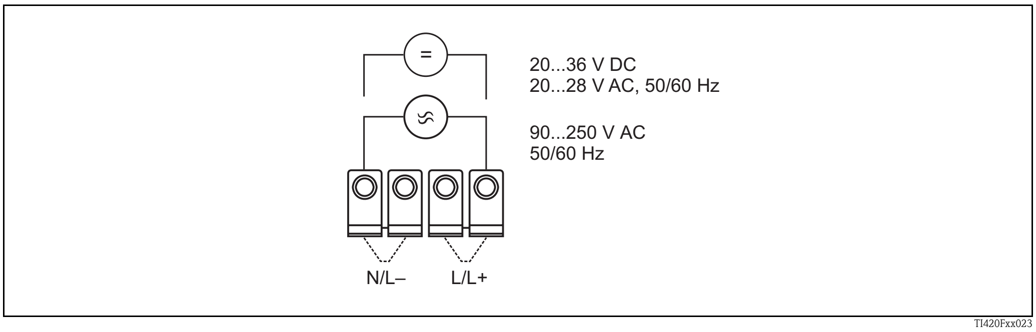


Fig. 12: Power supply connection

4.2.2 Connecting external sensors

Note!
Active and passive sensors with analog, PFM or pulse signals can be connected to the device.

Passive sensors

Connection diagram for sensors to which power is supplied via the sensor power supply integrated in the device, e.g. Liquiphant M FEL50D, temperature sensor 4 to 20 mA.

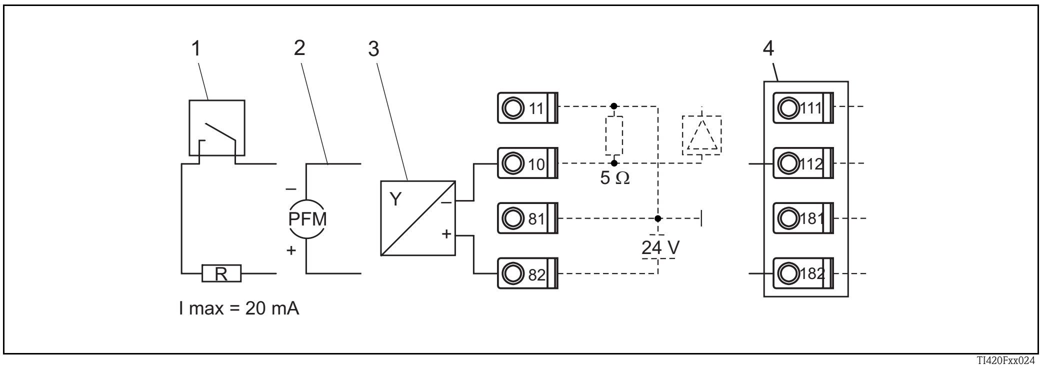


Fig. 13: Connecting a passive sensor, e.g. to input 1 (slot A I).

Item 1: pulse signal
Item 2: PFM signal
Item 3: 2-wire transmitter (4-20 mA), passive
Item 4: optional Universal extension card in slot B (slot B I, → Fig. 18)

Active sensors

Connection method for an active sensor (i.e. external power supply).

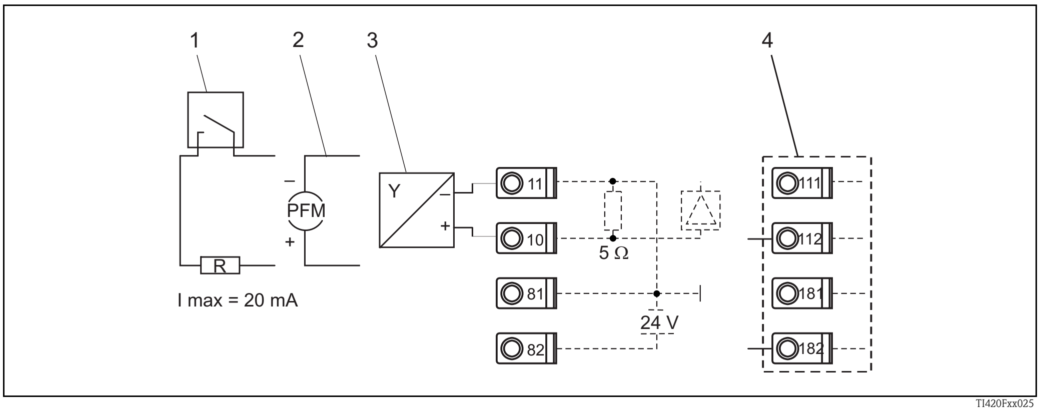


Fig. 14: Connecting an active sensor, e.g. to input 1 (Slot A I).

Item 1: pulse signal
Item 2: PFM signal
Item 3: 2-wire transmitter (4-20 mA), active
Item 4: optional Universal extension card in slot B (slot B I, → Fig. 18)

Liquiphant M Density with electronic insert FEL50D

Power supply

Frequency range: 300 to 1500 Hz
Signal level: 4 mA
Pulse height: 16 mA
Pulse width: 200 µs

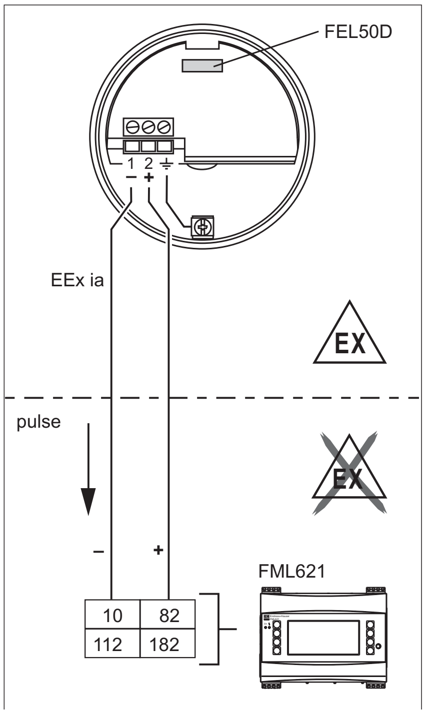
Electrical connection

Two-wire connection at Density Computer FML621
For connecting to Density Computer FML621.

The output signal is based on pulse technology. With the aid of this signal, the fork frequency is constantly forwarded to the switching unit.

Caution!
Operation with other switching units, such as FTL325P, is not permitted.

This electronic insert cannot be installed in devices that were originally used as a limit switch.



TI420Fen004

Signal on alarm

Output signal on power failure or in the event of damaged sensor: 0 Hz

Calibration

In the Liquiphant M modular system, the option of an extended calibration is also provided in addition to the electronics (special calibration, density H_2O) (see feature 60: "Accessories").

There are three types of calibration:

Standard calibration (see TI328F, ordering information for additional fittings, basic version A)
- In order to describe the sensor characteristics, two fork parameters are measured at the factory, presented in the calibration report and sensor adjustments and supplied with the device. These parameters must be transmitted to the Density Computer FML621.

Special calibration (see TI328F, ordering information for additional fittings, special calibration, density H_2O (K) or special calibration, density H_2O with 3.1 certificate (L))
- In order to describe the sensor characteristics, three fork parameters are measured at the factory, presented in the calibration report and sensor adjustments and supplied with the device. These parameters must be transmitted to the Density Computer FML621.
  This type of calibration achieves an even greater level of accuracy (see also "Performance characteristics").

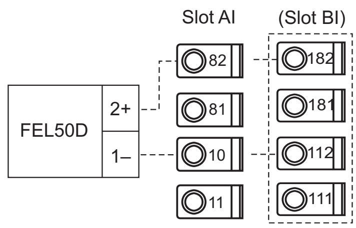
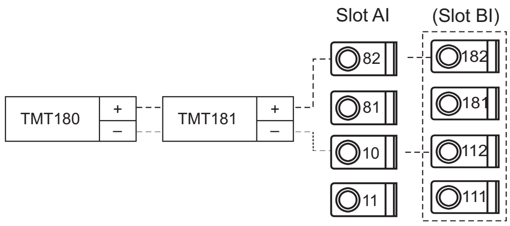
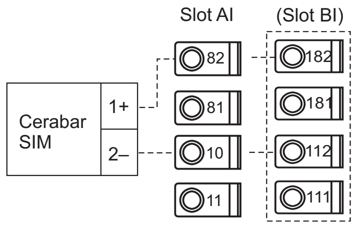
Field calibration
- During field calibration, a density value actually determined by the customer is entered and the system is automatically calibrated to this value (wet calibration). A display/operating unit is needed for wet calibration.

Note!
More information on Liquiphant M is provided in the following documents (Technical Information):
- Liquiphant M FTL50, FTL51 (for standard applications): TI328F/00
- Liquiphant M FTL50H, FTL51H (for hygiene applications): TI328F/00
- Liquiphant M FTL51C (with highly corrosion-resistant coating): TI347F/00

✎ Note!
All of the sensor-specific parameters of the Liquiphant M Density are documented in the calibration report and sensor adjustments. Both documents are included in the scope of delivery.

E+H-specific devices

✎ Note!
In the basic version, Density Computer FML621 is fitted with slot A and E. The unit can be optionally extended to include slots B, C, D.

Density sensors with a pulse output	 TI420Fxx028
Temperature sensor via temperature head-mounted transmitter (4 to 20 mA)	 TI420Fxx029
Pressure sensor with passive current output (4 to 20 mA)	 TI420Fxx030

4.2.3 Connection of outputs

The device has two galvanically isolated outputs (or Ethernet connection), which can be configured as an analog output or active pulse output. In addition, an output for connecting a relay and transmitter power supply are available. The number of outputs increases accordingly when the extension cards are installed (see 'Extension card connection').

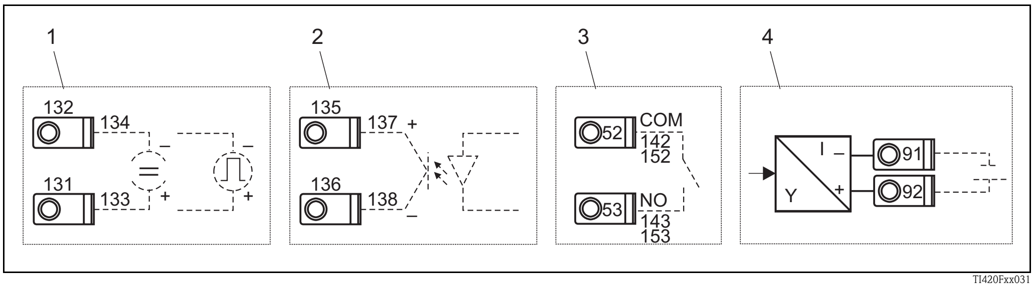


Fig. 15: Connection of outputs

Item 1: pulse and current outputs (active)
Item 2: passive pulse output (open collector)
Item 3: relay output (NO), e.g. slot A III (slot BIII, CIII, DIII on optional extension card)
Item 4: transmitter power supply (MUS) output

Interface connection

- **RS232 connection:** The RS232 is contacted by means of the interface cable and the jack socket on the front of the housing.
- **RS485 connection**
- **Optional: additional RS485 interface**
- **PROFIBUS connection:**
  Optional connection of the density computer to PROFIBUS DP via the serial RS485 interface with the external module HMS AnyBus Communicator for Profibus (see "Accessories").
- **Optional: Ethernet connection**

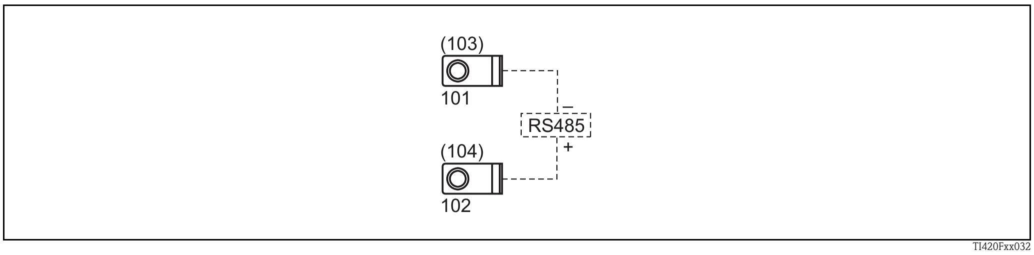


Fig. 16: Interface connection

4.2.4 Ethernet option

Ethernet connection

An IEEE 802.3-compatible connection is available on a shielded RJ45 plug connector on the device underside as the network connection. This can be used to connect the device to devices in the office environment with a hub or switch. The office equipment standard EN 60950 must be taken into consideration for safe distances between equipment. The assignment corresponds to an MDI-interface (AT&T258) conforming to standards so that a shielded 1:1 cable with a maximum length of 100 meters (328 ft) can be used here. The Ethernet interface is designed as a 10 and 100-BASE-T. Direct connection to a PC is possible with a crossover cable. Half-duplex and full-duplex data transmission is supported.

Note!
If the FML621 has an Ethernet interface, no analog outputs are available on the base unit (slot E)!

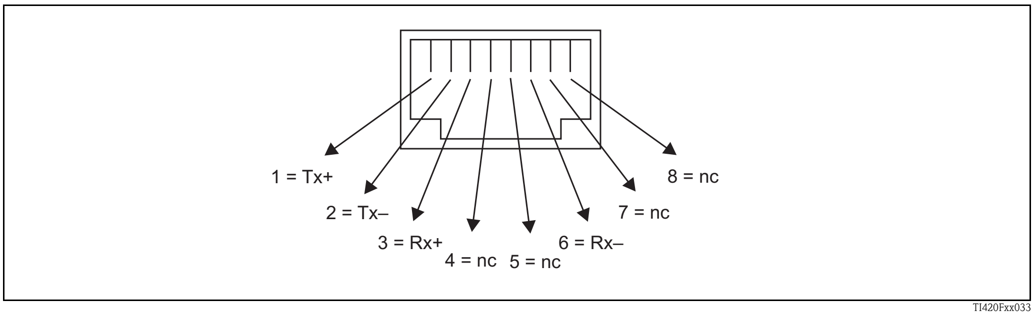


Fig. 17: RJ45 socket (assignment AT&T256)

Meaning of the LEDs

Two light-emitting diodes are located under the Ethernet connection (on the device underside) which indicate the status of the Ethernet interface.

- **Yellow LED**: link signal; is lit when the device is connected to a network. If this LED is not lit, communication is not possible.
- **Green LED**: Tx/Rx; flashes irregularly when the device is sending or receiving data. Otherwise it is lit constantly.

4.2.5 Extension card connection

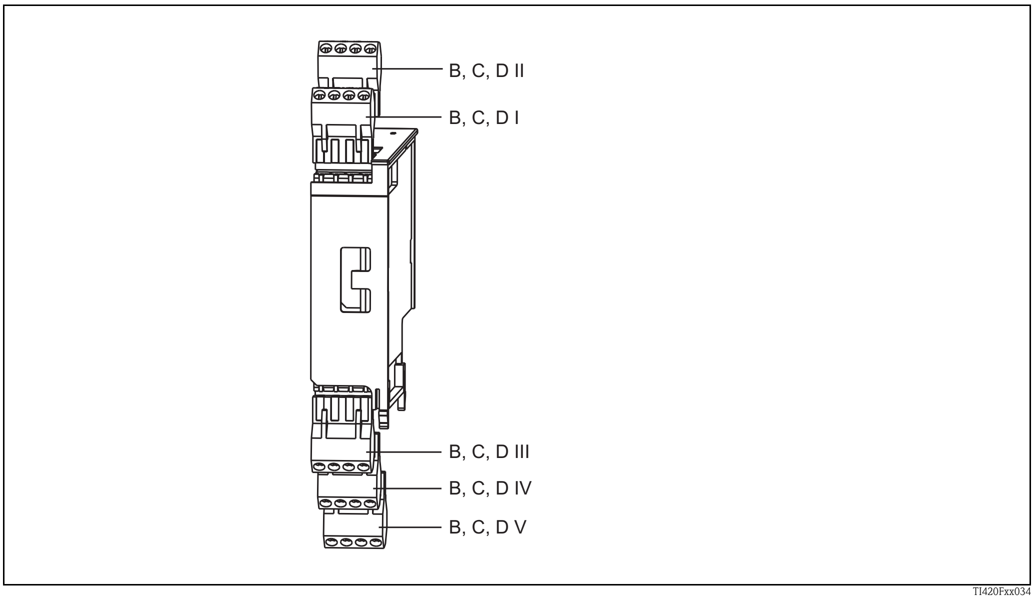


Fig. 18: Extension card with terminals

Terminal assignment of "Universal extension card (FML621A-UA)"; with intrinsically safe inputs (FML621A-UB)

Terminal (item no.)	Terminal assignment	Slot	Input and output
182	24 V sensor power supply 1	B, C, D top, front (**B I, C I, D I**)	Current/PFM/pulse input 1
181	Sensor power supply ground 1		
112	+ 0/4 to 20 mA/PFM/pulse input 1		
111	Ground for 0/4 to 20 mA/PFM/pulse input		

Terminal (item no.)	Terminal assignment	Slot	Input and output
183	24 V sensor power supply 2	B, C, D top, rear (**B II, C II, D II**)	Current/PFM/pulse input 2
181	Sensor power supply ground 2		
113	+ 0/4 to 20 mA/PFM/pulse input 2		
111	Ground for 0/4 to 20 mA/PFM/pulse input		
142	Relay 1 Common (COM)	B, C, D bottom, front (**B III, C III, D III**)	Relay 1
143	Relay 1 Normally Open (NO)		
152	Relay 2 Common (COM)		Relay 2
153	Relay 2 Normally Open (NO)		
131	+ 0/4 to 20 mA/pulse output 1	B, C, D bottom, center (**B IV, C IV, D IV**)	Current/pulse output 1 active
132	- 0/4 to 20 mA/pulse output 1		
133	+ 0/4 to 20 mA/pulse output 2		Current/pulse output 2 active
134	- 0/4 to 20 mA/pulse output 2		
135	+ pulse output 3 (open collector)	B, C, D bottom, rear (**B V, C V, D V**)	Passive pulse output
136	- pulse output 3		
137	+ pulse output 4 (open collector)		Passive pulse output
138	- pulse output 4		

Terminal assignment of "Temperature extension card (FML621A-TA)"; with intrinsically safe inputs (FML621A-TB)

Temperature sensors

Connection for Pt100, Pt500 and Pt1000

✎ Note!
Terminals 116 and 117 must be jumpered when connecting 3-wire sensors (see Fig. 19).

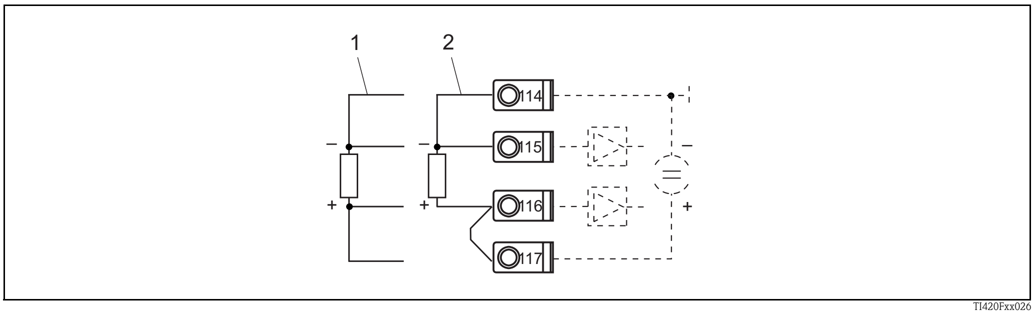


Fig. 19: Temperature sensor connection, optional temperature extension card e.g. in slot B (slot B I)

Item 1: 4-wire input
Item 2: 3-wire input

Terminal (item no.)	Terminal assignment	Slot	Input and output
117	+ RTD power supply 1	B, C, D top, front (**B I, C I, D I**)	RTD input 1
116	+ RTD sensor 1		
115	- RTD sensor 1		
114	- RTD power supply 1		

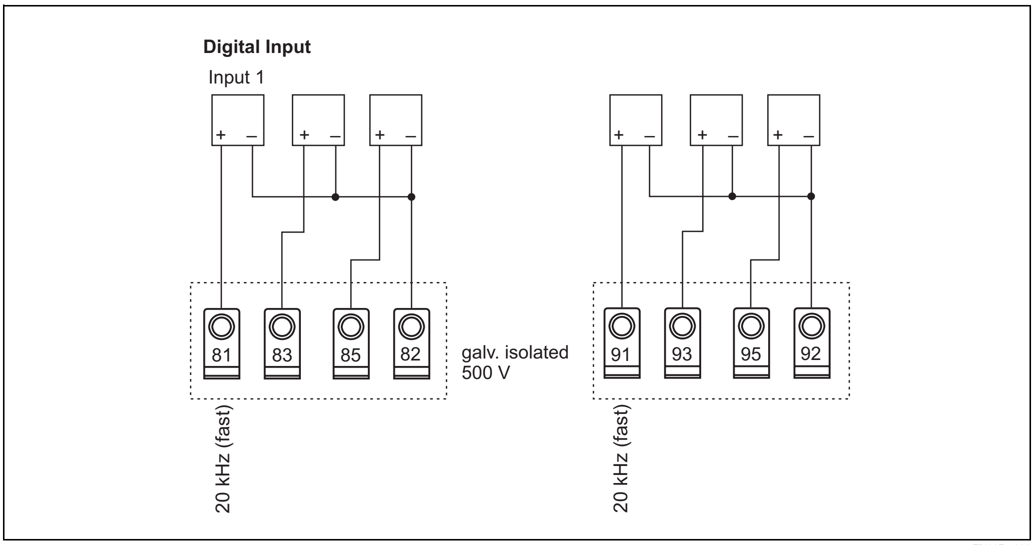
Terminal (item no.)	Terminal assignment	Slot	Input and output
121	+ RTD power supply 2	B, C, D top, rear (**B II, C II, D II**)	RTD input 2
120	+ RTD sensor 2		
119	- RTD sensor 2		
118	- RTD power supply 2		
142	Relay 1 Common (COM)	B, C, D bottom, front (**B III, C III, D III**)	Relay 1
143	Relay 1 Normally Open (NO)		
152	Relay 2 Common (COM)		Relay 2
153	Relay 2 Normally Open (NO)		
131	+ 0/4 to 20 mA/pulse output 1	B, C, D bottom, center (**B IV, C IV, D IV**)	Current/pulse output 1 active
132	- 0/4 to 20 mA/pulse output 1		
133	+ 0/4 to 20 mA/pulse output 2		Current/pulse output 2 active
134	- 0/4 to 20 mA/pulse output 2		
135	+ pulse output 3 (open collector)	B, C, D bottom, rear (**B V, C V, D V**)	Passive pulse output
136	- pulse output 3		
137	+ pulse output 4 (open collector)		Passive pulse output
138	- pulse output 4		

Terminal assignment of "Digital extension card (FML621A-DA)"; with intrinsically safe inputs (FML621A-DB)

Digital input

- Voltage level
  - low: -3 to 5 V
  - high: 12 to 30V (as per DIN 19240)
- Input current typically 3 mA with overload and reverse polarity protection
- Sampling frequency:
  - 4 x 4 Hz (terminal: 83, 85, 93, 95)
  - 2 x 20 kHz or 2 x 4 Hz (terminal: 81, 91)

The digital card has six intrinsically safe inputs. Two of these inputs (terminal assignment E1 and E4) can be defined as pulse inputs.



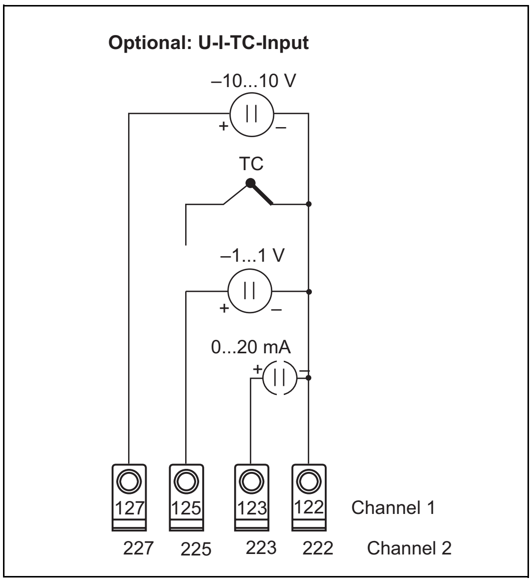
TI420Fen020

Terminal (item no.)	Terminal assignment	Slot	Input and output
81	E1 (20 kHz or 4 Hz as pulse input)	B, C, D top, front (**B I, C I, D I**)	Digital inputs E1 to 3
83	E2 (4 Hz)		
85	E3 (4 Hz)		
82	Signal ground E1 to 3		
91	E4 (20 kHz or 4 Hz as pulse input)	B, C, D top, rear (**B II, C II, D II**)	Digital inputs E4 to 6
93	E5 (4 Hz)		
95	E6 (4 Hz)		
92	Signal ground E4 to 6		
142	Relay 1 Common (COM)	B, C, D bottom, front (**B III, C III, D III**)	Relay 1
143	Relay 1 Normally Open (NO)		
152	Relay 2 Common (COM)		Relay 2
153	Relay 2 Normally Open (NO)		
145	Relay 3 Common (COM)	B, C, D bottom, center (**B IV, C IV, D IV**)	Relay 3
146	Relay 3 Normally Open (NO)		
155	Relay 4 Common (COM)		Relay 4
156	Relay 4 Normally Open (NO)		
242	Relay 5 Common (COM)	B, C, D bottom, rear (**B V, C V, D V**)	Relay 5
243	Relay 5 Normally Open (NO)		
252	Relay 6 Common (COM)		Relay 6
253	Relay 6 Normally Open (NO)		

Note!
The current/PFM/pulse inputs or the RTD inputs in the same slot are not galvanically isolated. There is a separation voltage of 500 V between the aforementioned inputs and outputs in various slots. Terminals with the same second digit are jumpered internally. (Terminals 111 and 181)

U-I-TC card (input)

- 0/4 to 20 mA +10% overrange
- Max. input current 80 mA
- Input impedance = 10 Ω
- Accuracy 0.1% of full scale value
- Temperature drift 0.01%/ K (0.0056%/ °F)



TI420Fen021

Terminal assignment of "U-I-TC extension card (FML621A-CA)"; with intrinsically safe inputs (FML621A-CB)

Terminal (item no.)	Terminal assignment	Slot	Input and output
127	-10 to +10 V Input 1	B, C, D top, front (**B I, C I, D I**)	U-I-TC Input 1
125	-1 to +1 V, TC Input 1		
123	0 to 20 mA Input 1		
122	Signal ground Input 1		
227	-10 to +10 V Input 2	B, C, D top, rear (**B II, C II, D II**)	U-I-TC Input 2
225	-1 to +1 V, TC Input 2		
223	0 to 20 mA Input 2		
222	Signal ground Input 2		
142	Relay 1 Common (COM)	B, C, D bottom, front (**B III, C III, D III**)	Relay 1
143	Relay 1 Normally Open (NO)		
152	Relay 2 Common (COM)		Relay 2
153	Relay 2 Normally Open (NO)		
131	+ 0/4 to 20 mA/pulse output 1	B, C, D bottom, center (**B IV, C IV, D IV**)	Current/pulse output 1 active
132	- 0/4 to 20 mA/pulse output 1		
133	+ 0/4 to 20 mA/pulse output 2		Current/pulse output 2 active
134	- 0/4 to 20 mA/pulse output 2		
135	+ pulse output 3 (open collector)	B, C, D bottom, rear (**B V, C V, D V**)	Passive pulse output
136	- pulse output 3		
137	+ pulse output 4 (open collector)		Passive pulse output
138	- pulse output 4		

4.2.6 Connecting remote display/operating unit

Functional description

Note!

- A display/operating unit is absolutely essential to be able to use all instrument functions. Operation using ReadWin is possible to a limited extent (no field calibration).
- Only one display/operating element can be attached to a top-hat rail device and vice versa (point-to-point).
- A remote display can also be used for commissioning density computer FML621. If necessary, it can also be used for commissioning several Density Computers FML621.

The remote display is an innovative addition to the powerful FML621 top-hat rail device. The user has the opportunity to optimally install the arithmetic unit to suit the installation and mount the display and operating unit in a user-friendly way at easily accessible locations. The display can be connected to both a top-hat rail device without, as well as a top-hat rail device with, an integrated display/operating unit. A 4-pin cable is supplied to connect the remote display with the basic unit; other components are not necessary.

Installation/dimensions

Mounting instructions:
- The mounting location must be free from vibrations.
- The permitted ambient temperature during operation is -20 to +60°C.
- Protect the device against the effects of heat.

Procedure for panel mounting:
1. Provide a panel cutout of 138+1.0 x 68+0.7 mm (as per DIN 43700), the installation depth is 45 mm.
2. Push the device with the sealing ring through the panel cutout from the front.
3. Hold the device horizontal and, applying uniform pressure, push the securing frame over the rear of the housing against the panel until the retaining clips engage.
   Make sure the securing frame is seated symmetrically.

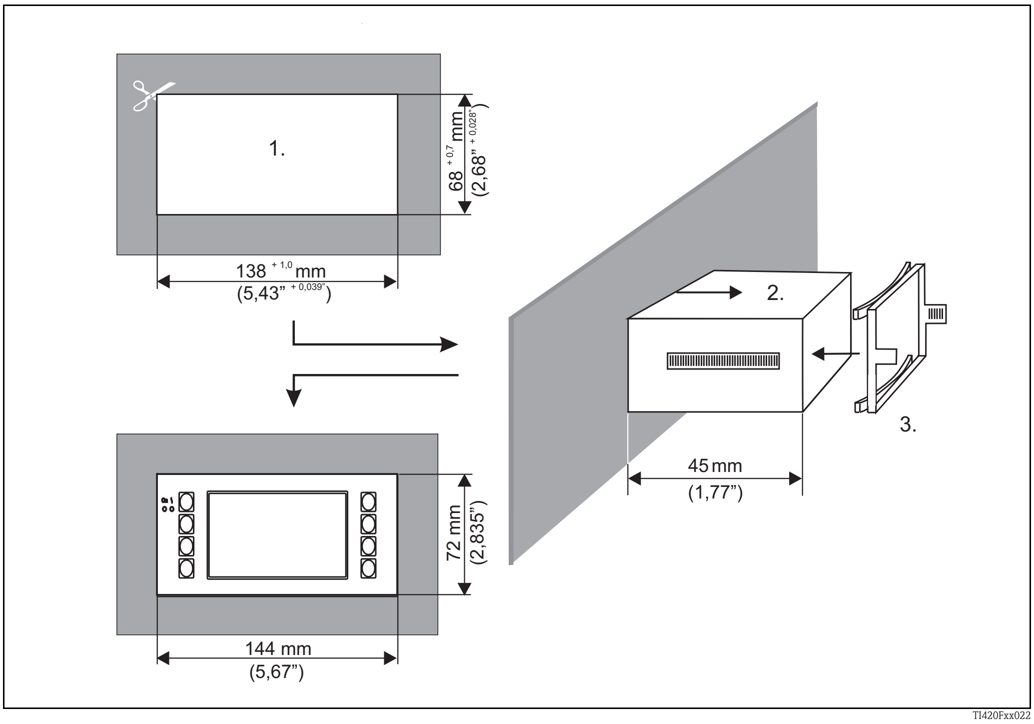


Fig. 20: Panel mounting

Wiring

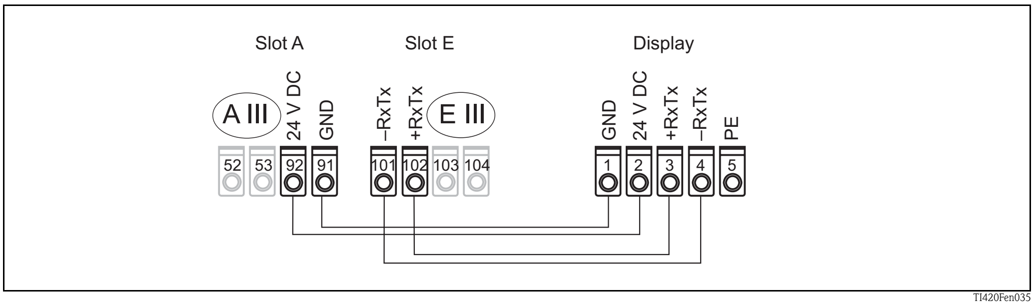


Fig. 21: Terminal plan of remote display/operating unit

The remote display/operating unit is connected directly to the basic unit with the cable supplied.

4.3 Post-connection check

After completing the device's electrical installation, carry out the following checks:

Device status and specifications	Notes
Is the device or cable damaged (visual inspection)?	–
Electrical connection	**Notes**
Does the supply voltage match the information on the nameplate?	90 to 250 V AC (50/60 Hz) 18 to 36 V DC 20 to 28 V AC (50/60 Hz)
Are all of the terminals firmly engaged in their correct slots? Is the coding on the individual terminals correct?	–
Are the mounted cables relieved of tension?	–
Are the power supply and signal cables connected correctly?	See wiring diagram on the housing
Are all of the screw terminals well-tightened?	–

5 Operation

5.1 Display and operating elements

Note!
Depending on the application and version, the density computer offers a wide range of configuration options and software functions. When programming the device, help is available for most operating items. The help is activated with the "?" key.
The configuration options described below refer to a basic unit (without extension cards).

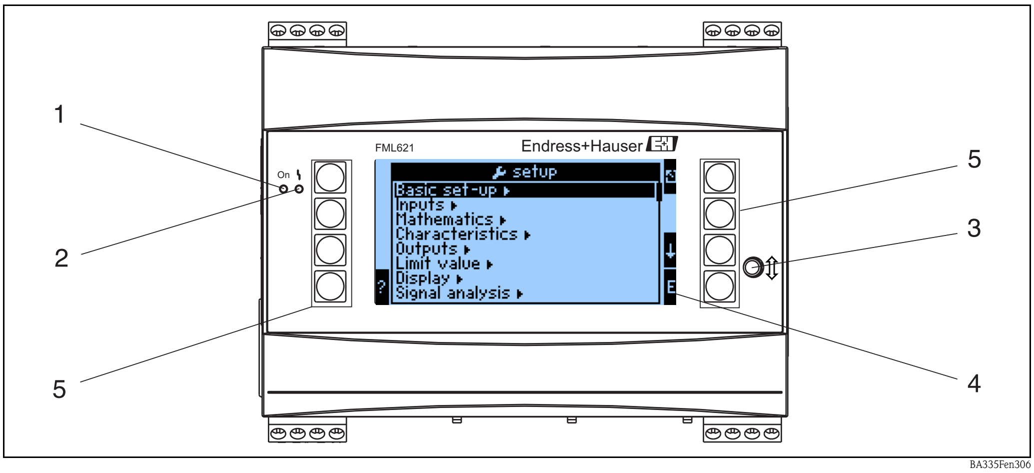


Fig. 22: Display and operating elements

Item 1: operating display: LED green, lights up when supply voltage applied.
Item 2: fault indicator: LED red, operating status as per NAMUR NE 44
Item 3: serial interface connection: jack socket for PC connection for device configuration and measured value read-out with the PC software including the connection cable
Item 4: display 160x80 dot-matrix display with dialog text for configuring as well as measured value, limit value and fault message display. Should a fault occur, the background lighting changes from blue to red. The size of the characters displayed depends on the number of measured values to be displayed (see Section 6.3.3 'Display configuration').
Item 5: input keys; eight soft keys which have different functions, depending on the menu item. The current function of the keys is indicated on the display. Only the keys which are required in the operating menu in question are assigned with functions or can be used.

5.1.1 Display

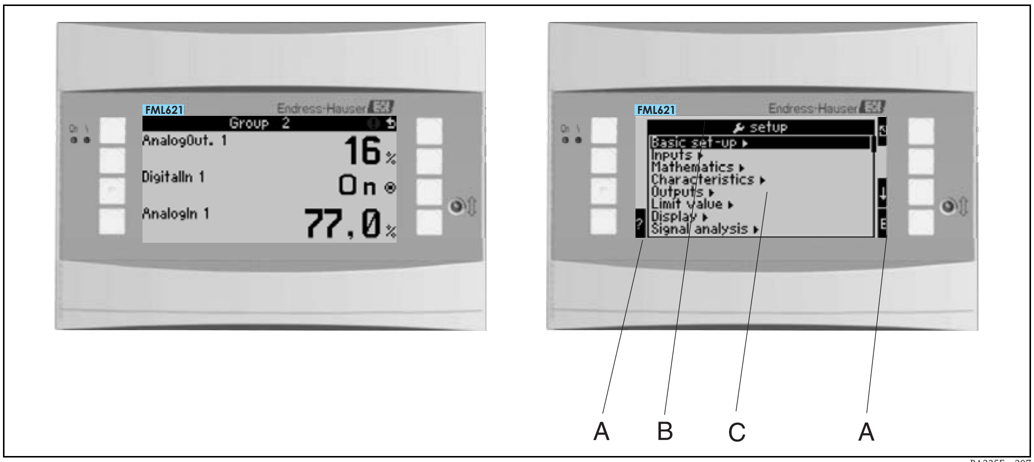


Fig. 23: Display of the density computer

Item 1: measured value display
Item 2: display of Configuration menu item – A: row of key icons – B: Current Configuration menu – C: Configuration menu activated for selection (highlighted in black).

5.1.2 Key icons

Key icon	Function
E	Change to submenus and select operating items. Edit and confirm configured values.
	Exit the current editing mask or the menu item currently active without saving any changes.
↑	Move the cursor up a line or a character. Depending on the menu item, this key is also used for increasing values.
↓	Move the cursor down a line or a character. Depending on the menu item, this key is also used for decreasing values.
→	Move the cursor a character to the right.
←	Move the cursor a character to the left.
?	If Help text is available on an operating item, this is indicated with the question mark. The Help is called up by actuating this function key.
AB	Changes to the editing mode of the Palm keyboard.
ij/IJ	Key field for upper case/lower case (only with Palm).
1/2	Key field for numerical entries (only with Palm).
F_x	This key can be used to display the various available functions in the formula editor.
↶	Switches from the display mode to the navigation mode

5.2 Local operation

5.2.1 Entering text

There are two ways of entering text in the operating items (see: **Setup** → **Basic Setup** → **Text Entry**):

a) Standard: individual characters (letters, numbers, etc.) are defined in the text field by scrolling through the entire row of characters with the up/down cursors until the desired character is displayed.
b) Palm: a visual key field appears for entering text. The characters on this keyboard are selected with the cursors. (See "Setup ➠ Basic Setup")

Using the Palm keyboard:

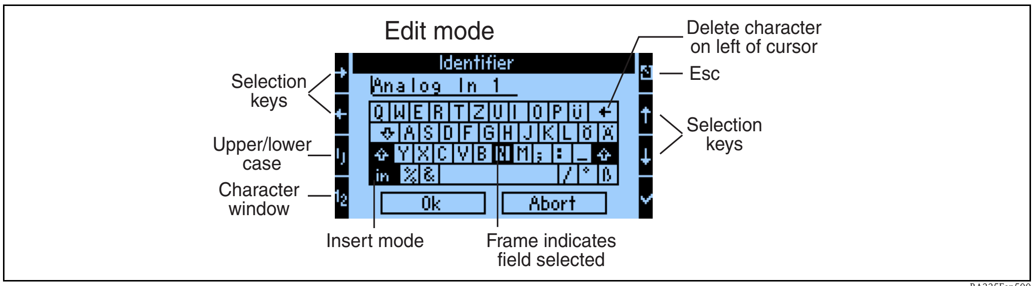


Fig. 24: Example: editing an identifier with the Palm keyboard

1. Using the cursor keys, move the cursor to the position where you wish to enter a character. If a character should be deleted, place the cursor to the right of the character to be deleted, select the "Delete character to the left of cursor" key and confirm with the tick sign.
2. Use the ij/IJ and ½ key to select upper/lower case or numerals.
3. Use the cursors to select the key required and use the tick sign to confirm. If you want to delete text, select the key in the top right.
4. Edit other characters in this way until the desired text has been entered.
5. Select "OK" and confirm with the tick sign to accept the entry. Select "Cancel" and confirm with the tick sign to discard the entries.

Notes
- Special key functions:
  "in" key: change to overwrite mode
  "←" key (top right): delete character to the left of the cursor

5.2.2 Locking configuration

The entire configuration can be protected against unintentional access by means of a four-digit code. This code is assigned in the submenu: **Basic Setup ➔ Code**. All the parameters remain visible. If the value of a parameter should be changed, you are first asked for the user code.

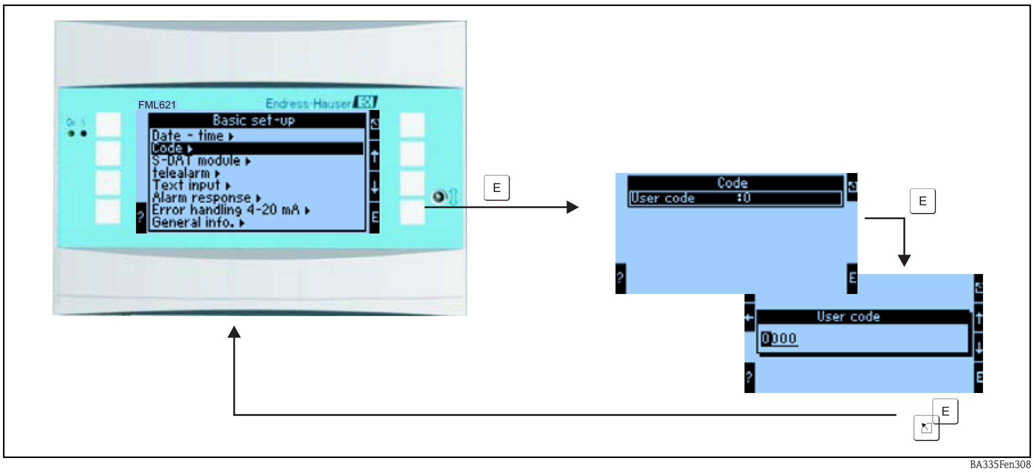


Fig. 25: Configuring the user code

5.2.3 Operating example

A detailed description of onsite operation with an application as an example can be found in → Chap. 6.5, 'User-specific applications'.

5.3 Error message display

The device differentiates between two types of errors:
- **System error:** this group comprises all the device errors, e.g. communication errors, hardware errors, etc. System errors are always signaled by fault messages.
- **Process error:** this group comprises all the application errors, e.g. "range overshoot", including limit value alarms, etc.

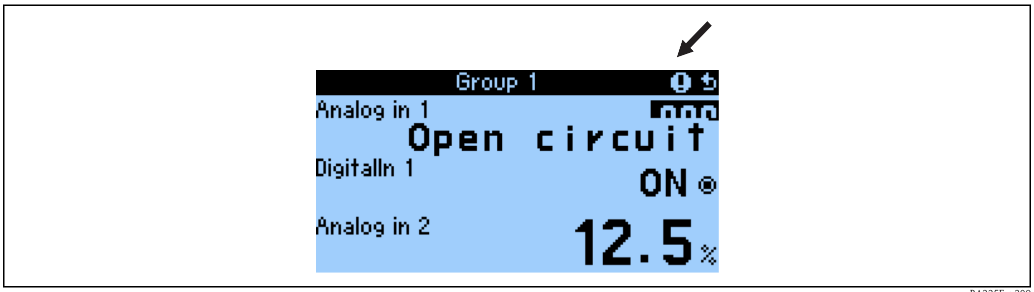
For process errors, you can configure how the device reacts in the event of an error. Here you can choose between the "Fault" or "Notice" alarm types. In addition, for both alarm types you can also choose whether a color change should take place and whether an error text should be displayed. On leaving the factory, all process errors are preset as faults with a color change but without error text display.

Fault messages ("Fault" alarm type)

A "fault" is signaled by an **exclamation mark (!)** on the display. It can also be signaled (as an option) by a color change and by displaying an error text message on the display. The exclamation mark is along the top edge of the display. In addition, some errors are signaled by an icon beside the corresponding measured values.
Operation is interrupted when a "fault" alarm occurs. Subsequent channels and outputs are given an alarm message and react in accordance with the defined alarm response.
Press a key (v) to acknowledge an error text message displayed. Via the Navigator menu, you can get to the diagnosis and the Setup to rectify the error if necessary. The fault causing the problem first has to be rectified before the device resumes normal operation, the color changes back to blue and the exclamation mark (!) disappears from the header.

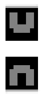
Notice messages ("Notice" alarm type)

A "notice" is signaled by an **exclamation mark (!)** on the display. It can also be signaled (as an option) by a color change and by displaying an error text message on the display. The exclamation mark is along the top edge of the display. In addition, some errors are signaled by an icon beside the corresponding measured values.
When a "notice" alarm occurs, operation continues with the defined "Notice Behavior". Subsequent channels, counters and outputs use the "Notice Value".
Press a key (v) to acknowledge an error text message displayed. The color change and **exclamation mark (!)** in the header remain until the cause of the error is rectified.



BA335Fen309

Fig. 26: Display of notice messages

Icons appear along the top edge of the display or next to the display parameter affected by the error which has occurred.	
	Signal overshoot (e.g. x > 20.5 mA) or signal undershoot (e.g. x < 3.8 mA)
	Error: fault or notice pending; → error list

Configuring the error type for process errors

Process errors are defined as notice messages in the factory setting. The alarm response of process errors can be changed, i.e. process errors are indicated by fault messages.

1. **Configure as Setup ➔ Basic Setup ➔ Alarm Response ➔ User-defined**
2. Individual alarm responses for the inputs can then be defined in the device menu for inputs, applications and outputs.

The following process errors can be configured:
- Inputs:
  Open circuit, sensor signal range violation
- Outputs:
  Range violation

Event Buffer

Navigator ➔ Diagnosis ➔ Event Buffer
In the event buffer, the last 100 events, i.e. fault messages, notices, limit values, power failure etc. are recorded in chronological order with the time of occurrence and counter reading.

Error List

Navigator ➔ Diagnosis ➔ Error List
The error list provides assistance in quickly localizing current device errors. Up to ten alarms are listed in the error list in chronological order. In contrast to the event buffer, only the errors currently pending are displayed, i.e. rectified errors are cleared from the list.

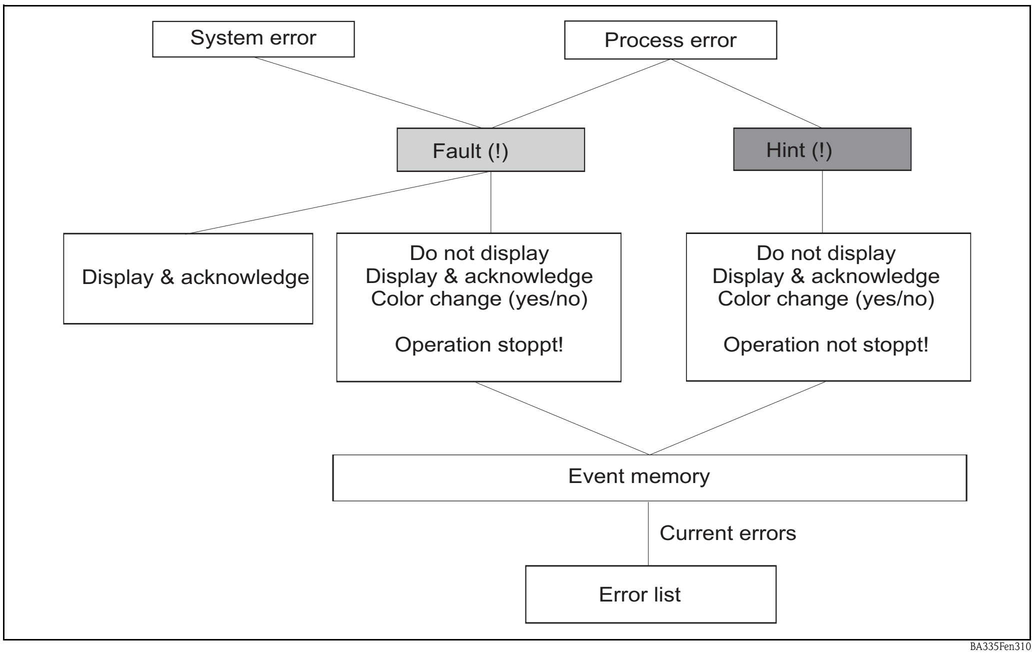


Fig. 27: Quick overview of the error concept

5.4 Communication

In all devices and device versions, the parameters can be configured, altered and read out via the standard interface with the aid of PC operating software and an interface cable (see 'Accessories' Section). This is recommended in particular if extensive settings are to be made (e.g. when commissioning). There is the additional option of reading out all the process and display values via the RS485 interface with an external PROFIBUS module (HMS AnyBus Communicator for PROFIBUS-DP) (see 'Accessories' Section). In addition, you can also communicate with the device via modem (landline and mobile network). The device can be configured in combination with the PC operating software. If an alarm occurs, this can be sent to a cellular phone via text message, for example, or a counter reading can be communicated.

✎ Note!
Detailed information for configuring the device using the PC operating software can be found in the accompanying Operating Instructions which are also located on the data carrier.

5.4.1 Communication via Ethernet (TCP/IP)

Every device that is equipped with an internal Ethernet interface can be integrated into a PC network (TCP/IP Ethernet).
The device(s) can be accessed from any PC in the network using the PC software supplied.
The system parameters "IP address", "Subnetmask" and "Gateway" are entered directly at the device or via ReadWin® 2000 and serial communication. Changes to the system parameters are not activated until the SETUP menu has been exited and the settings have been adopted. Only then does the device work with the new settings.

✎ Note!
Multiple clients (PC) cannot communicate with a server (device) at one time. If a second client (PC) tries to establish a connection, an error message is output.

Ethernet commissioning

The system parameters have to be configured in the device "Setup – Communication – Ethernet" before a connection can be established via the PC network.

✎ Note!
Your network administrator can provide you with the system parameters.

The following system parameters have to be configured:

1. IP address
2. Subnet mask
3. Gateway

✎ Note!
This menu only appears if the device is fitted with an internal Ethernet interface.

5.4.2 Communication in the network using the PC software supplied

Once the device has been configured and connected to the PC network, a connection can be established to a PC in the network.

The following steps are needed for this:

1. Install the PC software supplied on the PC via which communication should take place.
2. A new device now has to be created in the database. After entering the device description, select how the device settings should be transmitted. Select Ethernet (TCP/IP) in this case.
3. Now enter the IP address. The port address is 8000.

   ✎ Note!
   The device address set at the device and the release code must also be configured correctly here.
4. Click "Next" to confirm your entry and start transmission with OK.
   The connection is now established and the device is saved in the device database.

6 Commissioning

6.1 Function check

Make sure that all post-connection checks have been carried out before you commission your device:

- See Section 3.3 'Post-installation check'
- Checklist Section 4.3 'Post-connection check'

6.2 Switching on the measuring device

6.2.1 Basic unit

Once the operating voltage is applied, the green LED (= device operating) lights up if no fault is present.

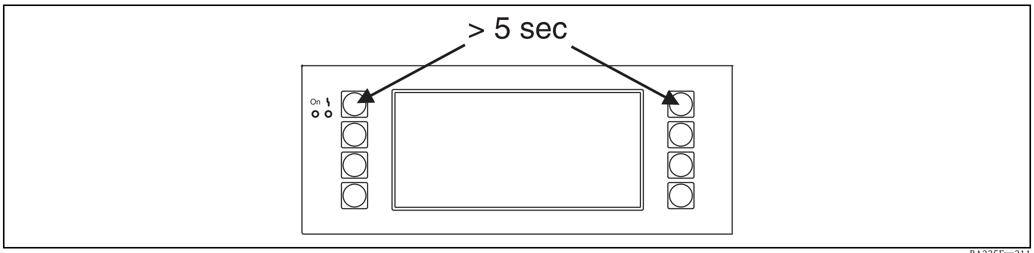
- When the device is first commissioned, the prompt "Please set up device" appears on the display. Program the device as per description → Section 6.3.
- When commissioning a device already configured or preset, measuring is immediately started as per the settings. The values of the display group currently set appear on the display. By pressing any key, you get to the navigator (quick start) and from there to the main menu (see Section 6.3).

6.2.2 Extension cards

When the operating voltage is applied, the device automatically recognizes the installed and wired extension cards. You can now follow the prompt to configure the new connections or perform the configuration at a later date.

6.2.3 Remote operating unit

The remote display/operating unit is preconfigured at the factory - unit address 01, baudrate 57.6k, RS485-Master. Once the supply voltage has been applied and after a short initialization period, the display automatically starts communication to the connected basic unit. Make sure that the unit address of the basic unit and of the remote display match.



BA335Fxx311

Fig. 28: Start Setup menu

You can get to the Setup menu of the display/operating unit by pressing the left and right top key at the same time for 5 seconds. Here, the baudrate and unit address for communication, as well as the contrast and display viewing angle can be configured. Press ESC to exit the Setup menu of the display/operating unit and to get to the display window and the Main menu to configure the device.

Note!
The Setup menu for configuring the basic settings of the display/operating unit is only available in English.

Error messages

After switching on or configuring the device, the message **"Communication Problem"** appears briefly on the remote display/operating unit until a stable connection has been established.
If this error message is displayed during operation, please check the wiring and ensure that the baudrate and the unit address match the device.

6.3 Quick start

Note!
This chapter refers to commissioning the device and describes the necessary basic settings.

6.3.1 Objective

The following section describes the process for commissioning the device. The individual components of the measuring system are shown in a sample scenario in Fig. 29.

The scenario for "measuring point 1", for density measurement, consists of the following components:

1. Liquiphant M sensor with electronic insert FEL50D (pulse output 20 to 200 Hz, 200 μs)
2. Temperature sensor (e.g. 4 to 20 mA output)
3. Pressure transmitter (4 to 20 mA output)
4. Liquiphant Density Computer FML621

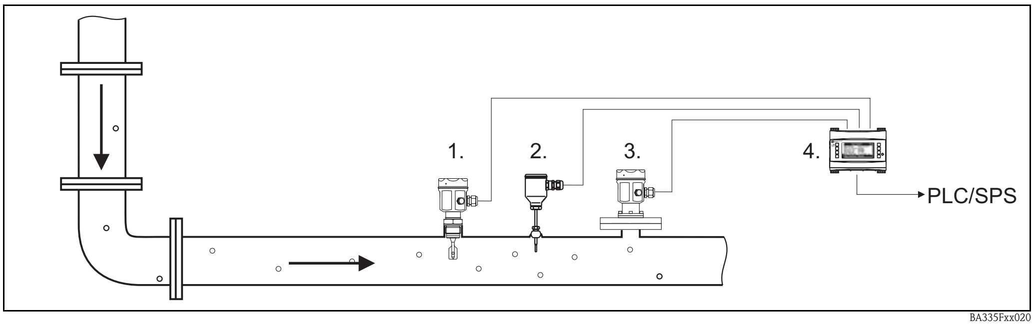
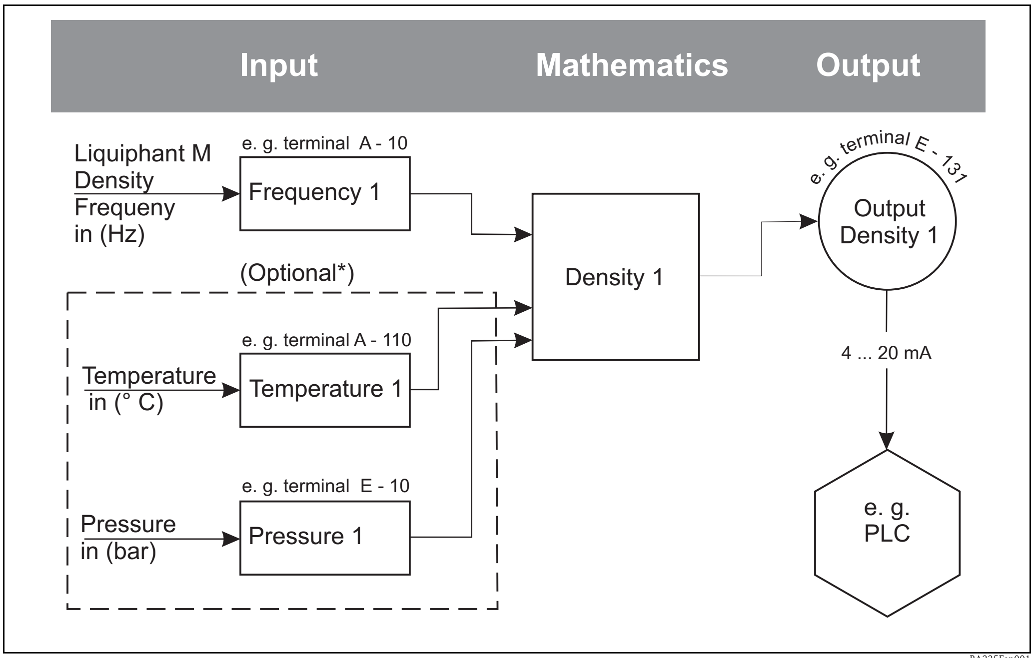


Fig. 29: Scenario for measuring point 1

The following block diagram illustrates the interrelations for calculating the medium density in FML621.



BA335Fen001

*Fig. 30: * If the application so requires. A temperature sensor is required if temperature-compensated density information is required. If the process pressure fluctuates by more than +/- 6 bar, a pressure sensor is required for compensation.*

6.3.2 Making basic settings

The "Setup" menu must be activated to make the basic settings.

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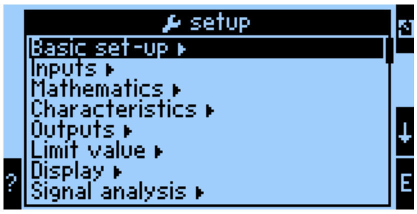
➔



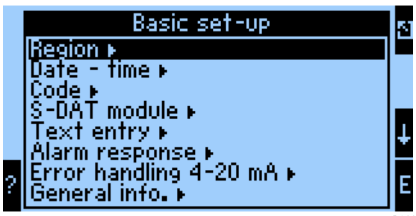
BA335Fen014

Region

The "Region" function is used to make special basic settings for calculations and displaying properties that depend on the region (e.g. Europe). These affect the following for example:

- Temperature calculation and display (° C or ° F)
- The density unit (g/cm^3 or lb/ft^3)
- The changeover from summer time to normal time

Note!
The same units must be used when configuring the input channels.



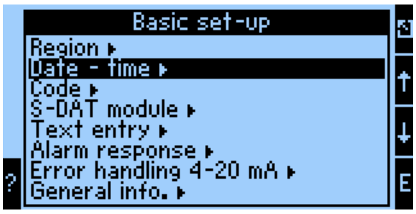
BA335Fen015

➔

BA335Fen016

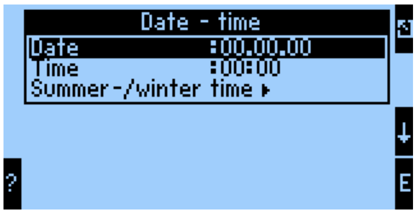
Date-Time

The time is set with the "Date-Time" function. This is needed for certain reports and calculations. The "Date-Time" can only be set at the device itself or via Readwin 2000 Menu -> Device Settings -> Online Settings.
The country-specific changeover from summer time to normal time (winter time) is configured in a subsequent step.



BA335Fen017

➔



BA335Fen018

Code

The device is supplied with a standard code "0000". If this code is changed, users are prompted to enter a code each time they want to change device settings in the future. The code must first be entered before users can access the device settings.

Alarm Response

The "Alarm Response" is used to specify how the device should react when process errors occur. As per the factory setting, all process errors are signaled by a notice message. If "User-defined" is selected in the menu, additional submenus are displayed in the menus for the inputs and outputs. These additional functions can be used to make settings defining how to handle process errors from the input or output signals.
Please refer to Section 5.3 "Error message display" for information on how to assign a different error category (fault message) to the individual process errors.

Error Handling 4 to 20 mA

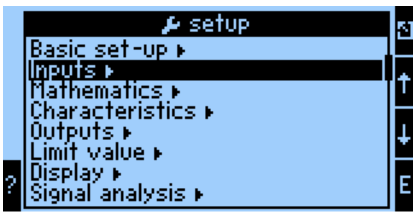
- No: no NAMUR failsafe mode is used. The error limits are freely adjustable.
- Yes: the device responds to an error as per the NAMUR standard: >
  21 mA: output at the output: 21 mA
  20.5 mA < x < 21 mA: unit continues to use last valid value.

Gen. Info

This function is used to specify a unit ID or a tag number for clearly assigning the device. In addition, this function also contains information on the software version and serial number of the device.

6.3.3 Inputs

Depending on the version, there are 4 (basic device, always available) to 10 (device extended with 3 analog cards) current, PFM and pulse inputs available in the density computer for recording sensor signals.



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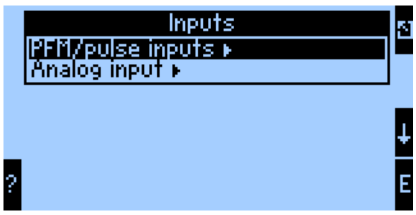
➔

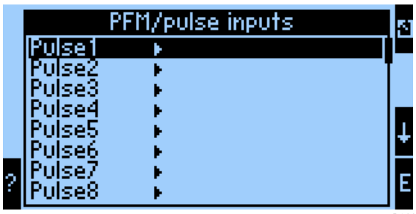


BA335Fen020

PFM/Pulse Inputs

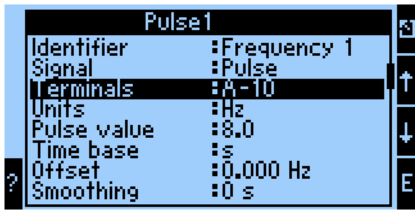
For Liquiphant M density sensors for example.
Proceed as follows to configure an input channel:

- Select the PFM/Pulse Inputs function.
- To configure the parameters of an input channel, select a channel from the list displayed.



BA335Fen021

➔



BA335Fen022

Identifier

To provide greater transparency, a name (e.g. Frequency 1) can be assigned to the input channel selected. This name may only be given once in the system.

Signal

The "Signal" is used to specify what type of input information is available. The "Pulse" type of signal is selected for Liquiphant M Density.

Terminals

Use this menu item to select the terminal to which the sensor should be connected, e.g. A–10.

Unit

Use the Unit menu item to define the unit of the measured variable e.g. Hz.

Pulse Value

The pulse value valuates the measured variable and is assigned 8 for Liquiphant Density. It is not necessary to change this value.

Note!
This value is needed for signal processing between Liquiphant and the pulse input on FML621. If devices other than the Liquiphant are connected to the pulse input, this value (evaluation) has to be adjusted specific to the device or set to 1 if necessary.

Time Base

Evaluation of the input signal for the integration – The integrated value is calculated depending on the selected value: e.g. if an input is evaluated /min, then the measured input signal is scaled and integrated accordingly. Select "s" for FEL50D.

Offset

The offset is used to adjust or calibrate sensors. This affects the scaling. The factory setting is 0.0 Hz. It is not necessary to adjust this value during initial commissioning.

Smoothing

If necessary, you can use this function to specify a time during which an average value should be calculated. This can be required if turbulences, for example, are expected in the application.

Format

This function is used to specify the number of decimal places for displaying the frequency value, e.g. 9.99 for two decimal places.

Store Data

If this function is confirmed with "Yes", the values of the input channel are stored in the device memory. This is necessary to allow input channel monitoring. In a separate "Signal Analysis" step, you also have to specify the cycles for saving the value of the input channel.

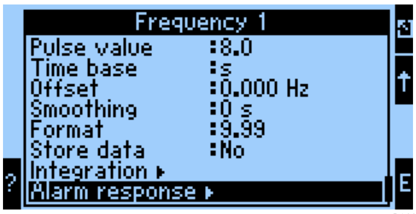
Integration

If the pulse input is used as a counter, e.g. a flow counter with a pulse output, the evaluation of the pulse must be specified. These settings are not required for the current scenario.

Alarm Response

Note!
This function is not available unless "User-defined" was selected in the menu Basic Setup -> Alarm Response.

This menu function is used to specify how the device should react if the input channel is no longer available e.g. in the event of a cable open circuit or if the values of the input channel are outside the specified value range.



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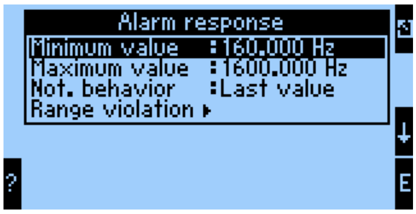


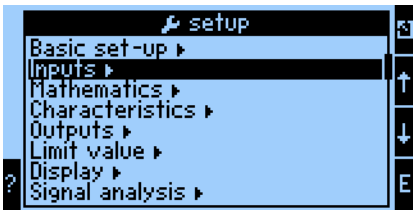
BA335Fen024

The "Alarm Response" function specifies how the input channel should behave in the event of a fault. The following settings are possible:

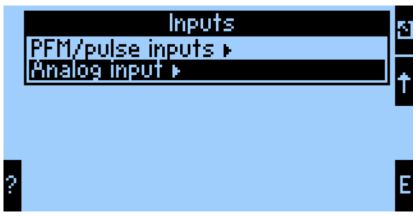
- Last Value:
  The last measured value is output in the event of a fault.
- Constant:
  A defined fault value is output in the event of a fault.

Analog Inputs

For temperature and pressure sensors, for example, if so required by the application.



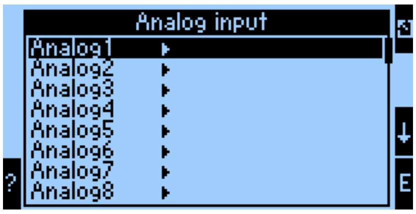
BA335Fen019



BA335Fen025

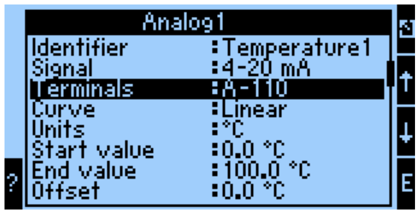
Identifier

To provide greater transparency, a name (e.g. Temperature 1) can be assigned to the input channel selected.



BA335Fen026

➔



BA335Fen027

Signal

The "Signal" specifies what type of input information is available. For a temperature transmitter with a 4 to 20 mA output signal, this type of signal can be selected.

Terminals

Use this menu item to select the terminal to which the sensor is connected.

Curve

The type of characteristic is specified by the device manufacturer. It can be linear or squared.

Units

The Units menu item is used to define the unit of the measured variable e.g. °C or bar (absolute pressure).

Start Value

Here you can specify which physical value, e.g. process temperature or process pressure corresponds to the minimum current value (0 or 4 mA) of the current signal.

End Value

Here you can specify which physical value, e.g. process temperature or process pressure corresponds to the maximum current value (20 mA) of the current signal.

Offset

The offset is used to adjust or calibrate sensors. This affects the scaling. The factory setting is 0 with reference to the process temperature or the process pressure. It is not necessary to adjust this value during initial commissioning.

Signal Damping

Setting the signal damping prevents fluctuations in the display caused by highly fluctuating input signals.

Format

Here, you can specify the number of decimal places with which the signal value should be displayed.

Store Data

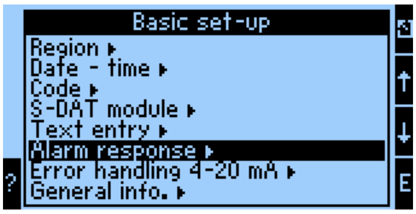
If this function is confirmed with "Yes", the values of the input channel are stored in the device memory. This is necessary to allow input channel monitoring. In a separate step (see PFM/Pulse Inputs), you can then specify the cycles for saving the value of the input channel.

Integration

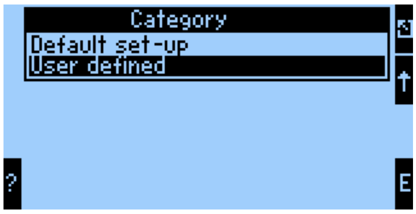
The integration function refers to flow variables and is not relevant for density measurement.

Alarm Response

Note!
This function is not available unless "User-defined" was selected in the menu Basic Setup -> Alarm Response.

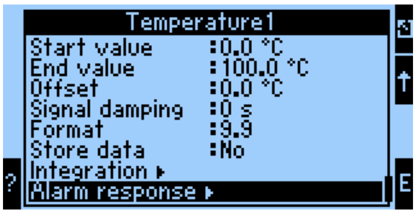


BA335Fen028

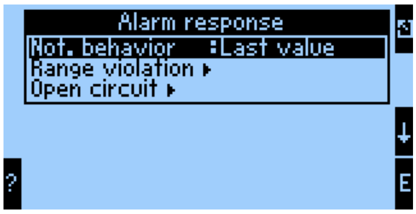


BA335Fen029

This menu function is used to specify how the device should react if the input channel is no longer available e.g. in the event of a cable open circuit or if the input channel is outside the specified value range.



BA335Fen030



BA335Fen031

The "Not. Behavior" function specifies how the input channel should behave in the event of an alarm, e.g. range violation. The following settings are possible:

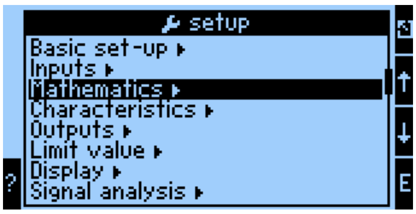
- Last Value:
  The last measured value is output if an alarm occurs.
- Constant:
  A defined value is output if an alarm occurs.

6.3.4 Mathematics

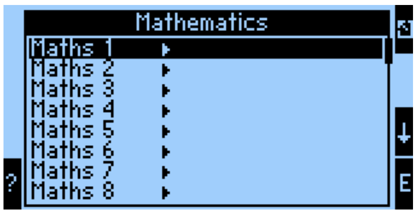
A total of 15 mathematics channels are available which can be used to make calculations on the basis of the available values, e.g. from the input channels or from previous calculations.

The following example illustrates the procedure for calculating the density of the liquid medium from the relevant input information (frequency 1, temperature 1 and pressure 1).

Once you select the mathematics channel, the following settings can be made.



BA335Fen032



BA335Fen033

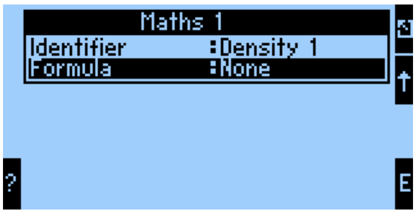
Identifier

To provide greater transparency, a name (e.g. Density 1) can be assigned to the mathematics channel selected. This name may only occur once in the system.

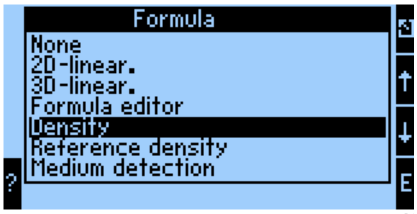
Formula

The "Formula" menu is used to specify whether a specific program module, e.g. "Density", is used or whether a general mathematic interrelation should be established between the input and output channels.

This quick start guide will only describe the settings in relation to the "Density" formula.



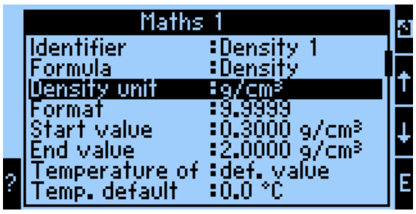
BA335Fen035



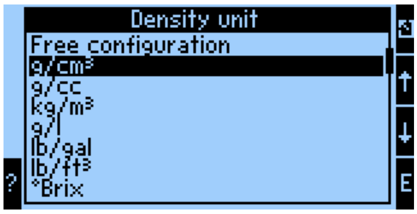
BA335Fen036

Density Unit

Use this menu item to select the unit for displaying the density e.g. g/cm³ or lb/ft³.



BA335Fen039



BA335Fen041

Note!
The units and interdependencies with regard to °Brix, °Baumé, °API and °Twad are explained in the section on calculating the concentration.

Format

Here, you can specify the number of decimal places with which the calculated value should be displayed.

Start Value

The Start Value is used for scaling a graphic illustration on the display unit. This specifies the lower value range e.g. 0.5 g/cm³.

End Value

The End Value is used for scaling a graphic illustration on the display unit. This specifies the upper value range e.g. 1.5 g/cm³.

"Temperature of", "Pressure of" and "Frequency"

The following input information now has to be assigned to the Density 1 module.

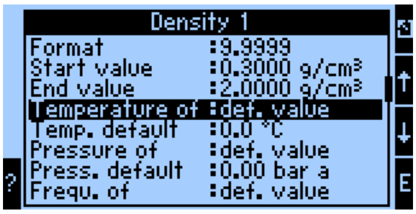
A distinction is made between two types of input, namely the physical input or a default value. The default value is used for simulation purposes and can display a value that corresponds to the process conditions if a process sensor, such as a temperature sensor, is not available.

Example:
A process temperature of 20 °C could be specified for an application which is operated at a constant temperature.

Assigning temperature information

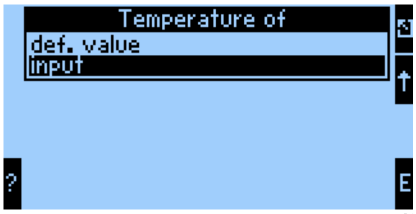
Note!
By specifying the region under Setup -> Basic Setup -> Region, the corresponding unit is automatically specified. This unit must be taken into consideration in all subsequent settings, e.g. scaling the temperature input.

Temperature 1 must be scaled:
- Region: Europe -> °C
- Region: USA -> °F

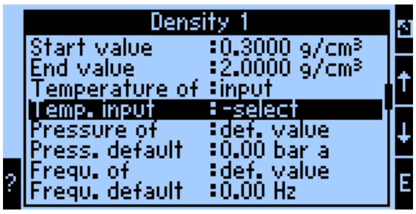


BA335Fen042

→

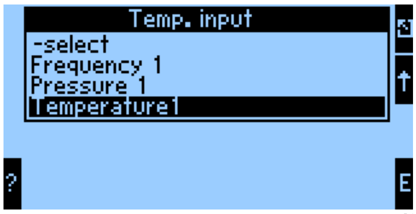


BA335Fen043



BA335Fen044

→

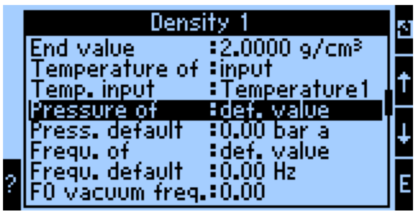


BA335Fen045

Assigning pressure information

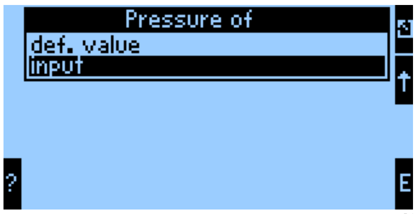
Note!
By specifying the region under Setup -> Basic Setup -> Region, the corresponding unit is automatically specified. This unit must be taken into consideration in all subsequent settings, e.g. scaling the pressure input.

- Region: Europe -> bar (absolute pressure)
- Region: USA -> psi (absolute pressure)

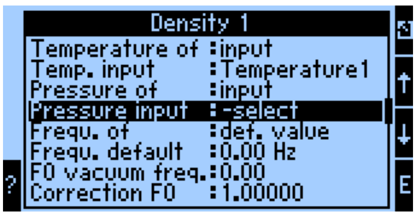


BA335Fen046

→

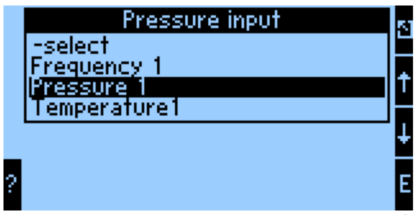


BA335Fen047



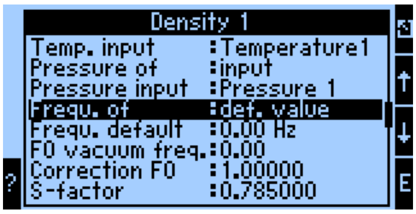
BA335Fen048

→



BA335Fen049

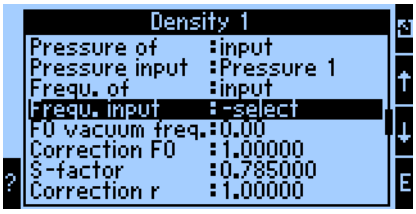
Assigning frequency information



BA335Fen050

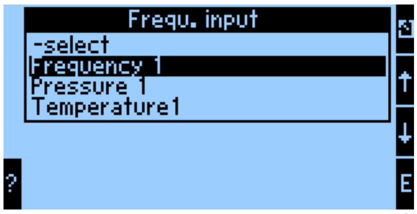
➔

BA335Fen051



BA335Fen052

➔



BA335Fen053

Once all the input information has been specified, the sensor-specific parameters now have to be entered.

Sensor-specific parameters

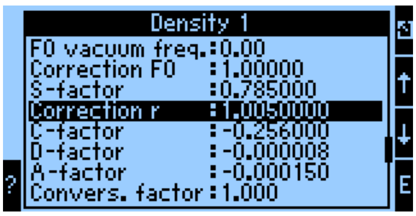
Note!
When you order a Liquiphant M for density measurement, a special sensor calibration report and sensor adjustments are enclosed and contain the following fork-specific parameters:

- F0-Vacuum Frequency: vibration frequency of the fork in a vacuum at 0 °C (Hz)
- S-Factor: density sensitivity of the tuning fork (cm^3/g)
- C-Factor: linear temperature coefficient of the fork (Hz/°C)
- D-Factor: pressure coefficient (1/bar)
- A-Factor: quadratic temperature coefficient of the fork ($Hz/[°C]^2$)

If necessary, the calibration report can be ordered by quoting the serial number.

Correction Factors

- Correction F0: correction value (multiplier) for F0 vacuum frequencies. This value is calculated during field calibration but can also be changed manually and reset to 1 for example.
- Correction r: the S-Factor is multiplied by this value. This value depends on the installation (see Section 3).
- *Conversion Fact.:* the conversion factor is a multiplier (offset) for the calculated density value.



BA335Fen054

On leaving the factory, the S, C, D and A factors are assigned average values for the material 316L. The vacuum frequency is assigned 0.00 to ensure that these values are entered. If the fork-specific values (see calibration report supplied) are not entered correctly, the measuring line cannot measure accurately.

Store Data

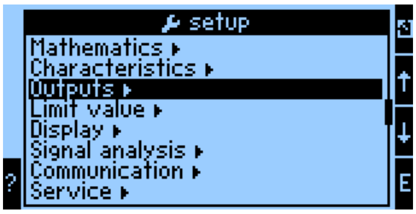
If this function is confirmed with "Yes", the calculated and measured density values are stored in the device memory. This is necessary to allow density information monitoring. In a separate step (see Pulse Inputs), you can then specify the cycles for saving the value.

6.3.5 Outputs

In accordance with the objective set out in → Chap. 6.3.1, this example will only look at assigning the calculated density value to an analog output.

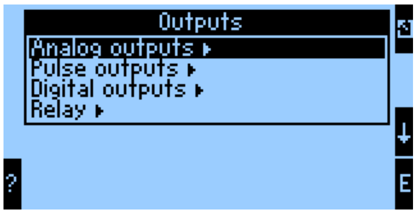
Analog outputs

Please note that these outputs can be used as both analog and pulse outputs; the desired signal type can be selected for each setting. Depending on the version (extension cards), 2 to 8 outputs are available.

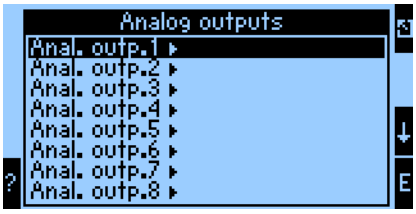


BA335Fen055

→

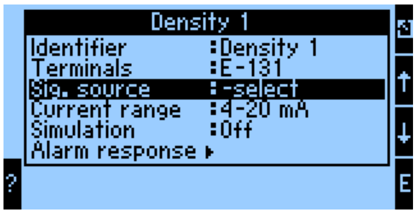


BA335Fen056



BA335Fen057

→



BA335Fen058

Identifier

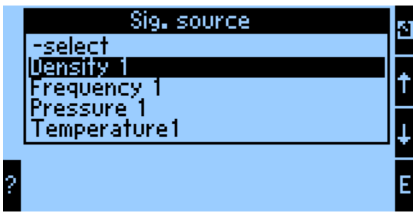
To provide greater transparency, a name (e.g. Density 1) can be assigned to the analog output selected. This name may only occur once in the system.

Terminals

Use this menu item to select the terminal at which the density value should be output, e.g. B-131.

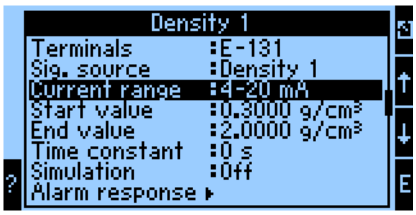
Sig. Source

With the aid of the signal source, the calculated density value can be linked to a specific output.



BA335Fen059

→



BA335Fen060

Current Range

The Current Range function can be used to specify the operating mode of the analog output e.g. 4 to 20 mA.

Start Value

Here you can specify which physical value, e.g. the minimum density, corresponds to the minimum current value (0 or 4 mA) of the current signal.

End Value

Here you can specify which physical value, e.g. the maximum density, corresponds to the maximum current value (20 mA) of the current signal. Scale the start value + end value e.g. 4 to 20 mA to 0.5 to 2 g/cm³ for example.

Time Constant

The time constant specifies how many seconds the output signal is smoothened.

Simulation

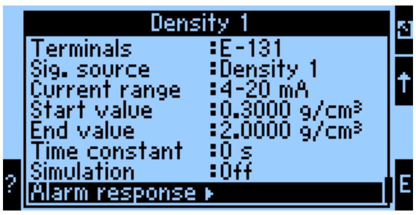
This function can be used to assign a current value to the analog output. You can choose from default values.

Note!
Simulation ends as soon as you leave the input field.

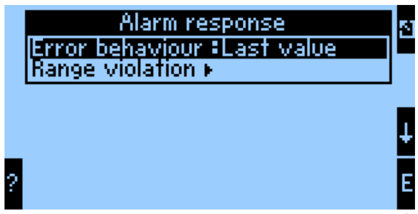
Alarm Response

Note!
This function is not available unless "User-defined" was selected in the menu Basic Setup -> Alarm Response.

This menu function is used to specify how the device should react if the value range is violated when calculating the density information.



BA335Fen061



BA335Fen062

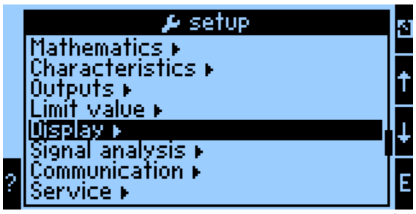
Failure Behavior:
The following settings can be made:

- Last Value:
  The last measured value is output in the event of a fault.
- Constant:
  A defined fault value is output in the event of a fault.

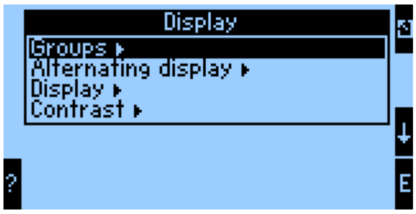
Range Violation:
For the range violation, you can specify whether a notice or fault should be signaled.

6.3.6 Configuring the measured value display

In the previous chapters we defined what information is used to calculate the density value. These values can be shown on the display as defined by the user.



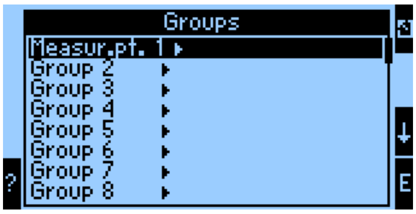
BA335Fen063



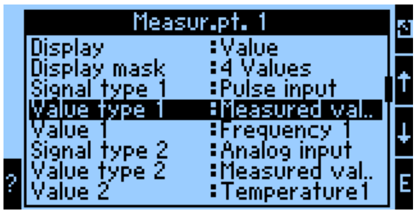
BA335Fen064

Groups

Similar to the example given, "Measuring Point 1" can be defined as a group.



BA335Fen065



BA335Fen066

Identifier

To provide greater transparency, a name (e.g. Measuring Point 1) can be assigned to the group selected.

Display

In this submenu, you can specify whether the information should be displayed as:

- Value (1 – 8 values)
- Horizontal Bargraph [1] (1 – 2 values)
- Vertical Bargraph [1] (1 – 2 values)
- Line Graph[2] (1 value)

Note!
1) Only available if "1 value" or "2 values" has been selected for Display mask.
2) Only available if "1 value" has been selected for Display mask.

Display Mask

Use this submenu to specify how many values should be shown on the display.

Signal Type (n)

Use this submenu to specify the type of signal that is present e.g. analog input or mathematics channel.

Value Type (n)

Use this submenu to specify the value type that is present e.g. measured value.

Value (n)

Use this submenu to select the value to be displayed from the list of all the process values available.

Alternating Display

If multiple groups have been defined, this function can be used to make these groups alternate on the display.
You can configure the switchover time and the particular groups that should alternate on the display.

Display

Counter Mode: sums are displayed with max. 10 positions up to overflow.
Exponential: exponential display is used for large values.

Contrast

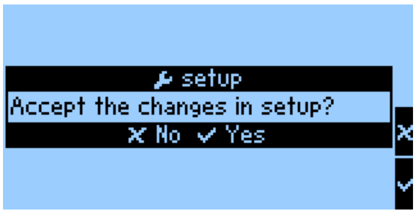
For configuring the display contrast. This setting takes effect immediately.
The contrast value is not saved until the setup is exited. The value range is between 0 and 99. The factory setting is 46 (see also "Setup -> Display" Page 80 ff.).

6.3.7 Concluding the quick start

When the outputs are assigned, all the necessary steps and settings have been performed.

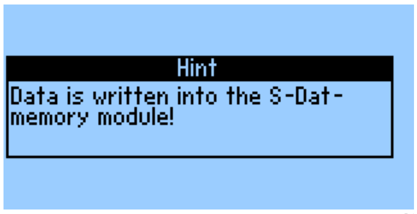
Note!
The device is now able to calculate a density value from the input information (frequency 1, temperature 1 and pressure 1) and forward this information to an output.

To save the settings, you must select "Yes" when asked to" Accept Changes in Setup" when returning to the main menu. The data are saved to the DAT module in the next step. The device is then restarted.



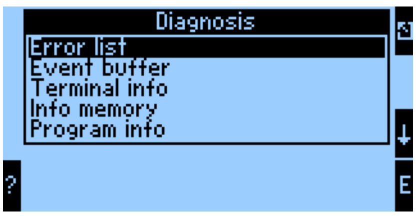
BA335Fen067

➔



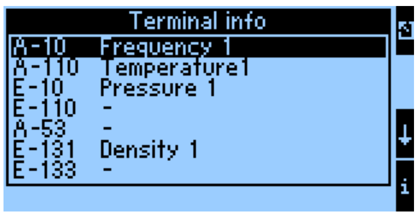
BA335Fen161

With regard to our example, the terminals are shown in the "Terminal Info" submenu in the "Diagnostics" main menu as follows:



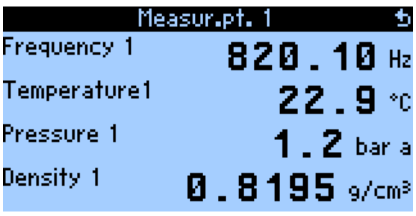
BA335Fen068

➔



BA335Fen071

Once all the settings have been made, the following information is shown on the display.



BA335Fen070

6.4 Device configuration

This section describes all the configurable device parameters with the associated value ranges and factory settings (default values).
Please note that the parameters available for selection, e.g. the number of terminals, depend on the device version (see 'Extension cards' section).

Function matrix

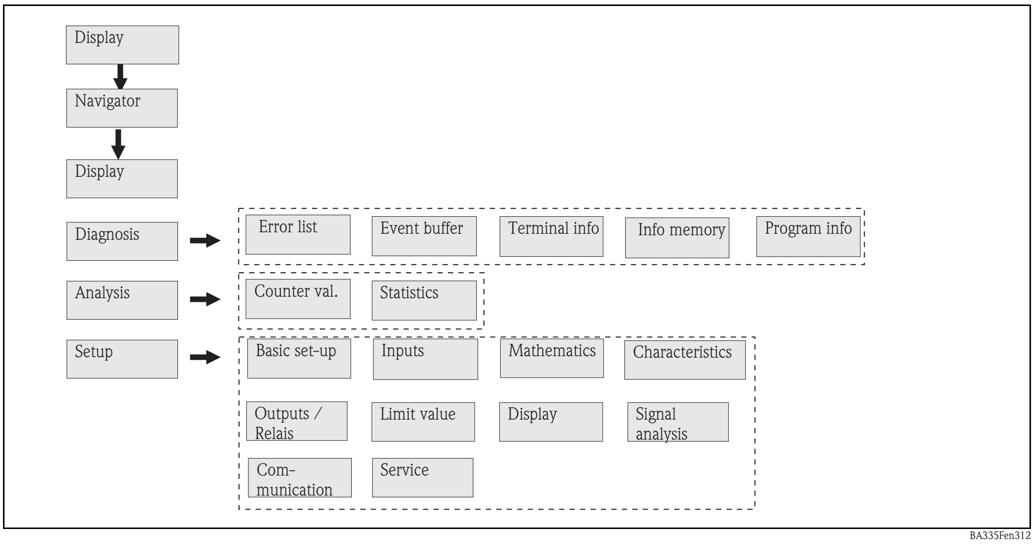


Fig. 31: Function matrix (extract) for onsite density computer configuration. A detailed function matrix can be found in the Appendix.

6.4.1 Navigator (quick start)

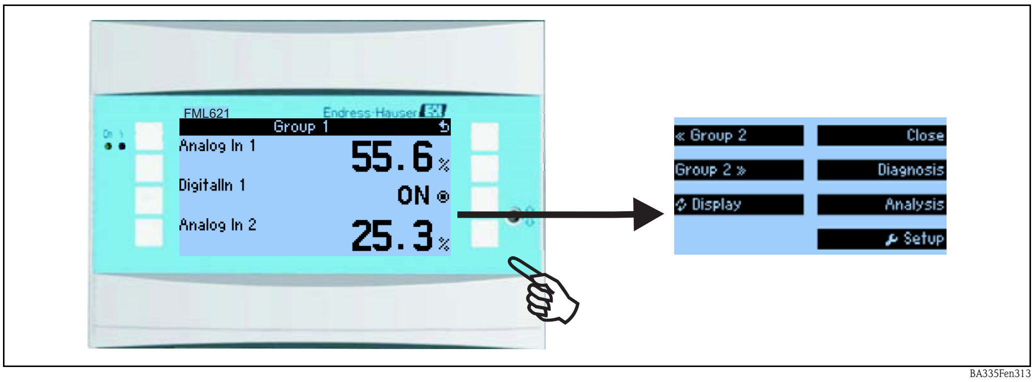


Fig. 32: Quick start to configuration via the Navigator menu of the density computer.

In the operating mode of the density computer (measured value displayed), the operating window "**Navigator**" opens up by pressing any key: the Navigator menu offers quick access to important information and parameters. Pressing one of the keys available takes you directly to the following items:

Function (menu item)	Description
Group Selection	For selecting individual groups with display values.
Diagnosis	Quickly locate current device errors; terminal info, prog. info. (→ Page 57)
Analysis	Counter readings and statistics. (→ Page 58)
Setup	Main menu for configuring the device. (→ Page 59)

The contents of the group with display values can only be defined in the **Setup ➔ Display** menu. A group comprises a maximum of eight process variables which are displayed in a window in the display.
The settings for the display functionalities, e.g. contrast, alternating display, special groups with display values, etc. are also made in the **Setup ➔ Display** menu.

✎ Note!
- When commissioning, the prompt "**Please Set Up Device**" is displayed. Confirming this message takes you further through the Navigator menu. Then select '**Setup**' to get to the main menu.
- During initial commissioning, you are automatically guided through the device setup. (See also Section 6.3 (quick start). The device is not operational until all the necessary settings have been made.
- A device already configured is in the display mode as standard. The device changes to the Navigator menu as soon as one of the eight operating keys is pressed. From here, you get to the main menu by selecting '**Menu**'.

✎ Note!
If you continue navigating through the Main menu, the message "**If you change the application, the respective counters will be reset**" is displayed. Confirming this message takes you to the Main menu.

6.4.2 Main menu - Diagnosis

The Diagnosis menu is used to analyze the device functionality, such as locating device malfunctions.

Function (menu item)	Description
Error list	List of the current pending errors. Entries are deleted when the errors are rectified.
Info Memory	Provides information on how long values can be stored in the memory before they are overwritten.

6.4.3 Main menu - Analysis

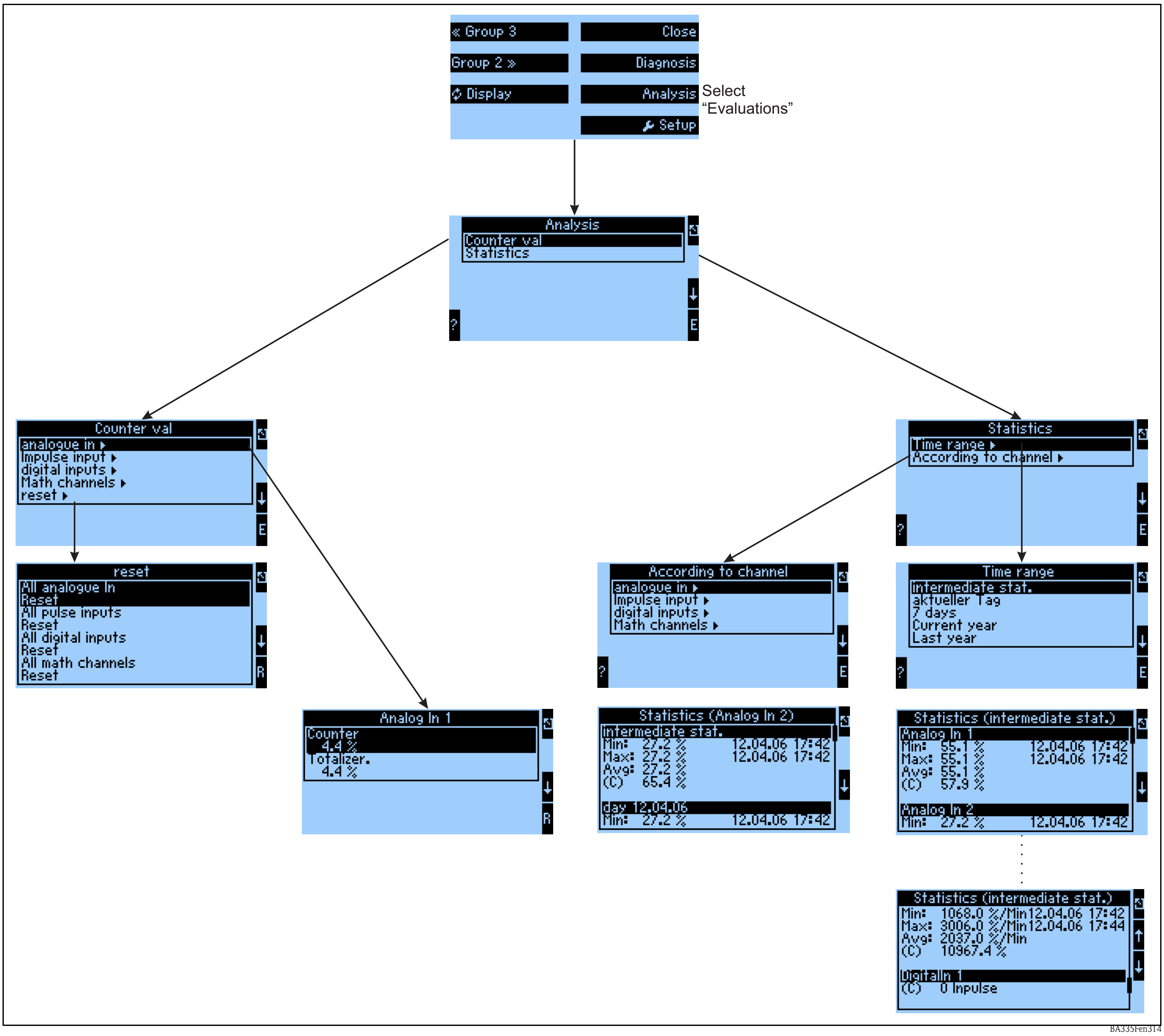


Fig. 33: Configuration of the FML621 statistics

The Analysis can be called up from the Navigator.
This is divided into the display of the counter readings and into the statistics functions.

Counter readings

The input counters, which have been configured as Integration ➔ No in the individual inputs are output here.
This output is useful when, for example, the counter readings of all analog inputs are to be checked, or when a certain type of counter is to be reset, while other counters are to remain unaffected.

Statistics

In this menu, evaluation is performed based on an individual input or channel, or on a period of time (all inputs and all channels during the defined period of time).
Here, the Intermediate Analysis is the period of time that has been configured in the "Signal Analysis➔Interm. Anal" menu item, e.g. if analysis is to be performed hourly, based on one hour.

This type of analysis is useful when analysis is to be performed based on time.
The analysis according to channel is used if an individual channel is to be evaluated in detail, e.g. when monitoring a flowrate.

6.4.4 Main menu - Setup

Note!
- The Setup menu is used for configuring the device.
- Menu items displayed in bold indicate functions that have submenus.
- Parameters displayed in bold indicate default values.

Menu items:

- Basic Setup
- Inputs
- Mathematics
- Characteristics
- Outputs
- Limit Values
- Display
- Signal Analysis
- Communication
- Service

Setup ➔ Basic setup

Function (menu item)	Parameter setting	Description
Region		
Europe	**Europe** - USA	Displays the changeover date from normal time (NT) to summertime (ST) and vice versa. This function depends on the region selected.
Date-Time		
Date	**DD.MM.YY**	For setting the current date. Note! Important for summertime/wintertime changeover
Time	SS:MM	Current time for the real time clock of the device.
Summertime/winter time		
Changeover	Off - Manual - **Auto.**	Kind of time changeover.
WT→ST - Date - Time ST→WT - Date - Time	Example: **25.03.07** (Europe) 11.03.07 (USA) **28.10.07** (Europe) 04.11.07 (USA) 02:00	Takes into consideration the summertime/normal time changeover in Europe and USA at different times. This can only be selected if summertime/normal time changeover is not set to 'Off'. Time of changeover. This can only be selected if summertime/normal time changeover is not set to 'Off'.
Code		
User Code	0000 - 9999	Device operation is only enabled once the previously defined code has been entered.
S-DAT Module		
Op. Data		
End Setup	**Automatic** On Request	Saves the settings automatically when you exit the setup or confirm a prompt/question.
Save	Press the E-key	Write counter readings and operating data to the S-DAT module.
Date	Editing field for entering the date	Date of last save.

Function (menu item)	Parameter setting	Description
Time	Editing field for entering the time	Time of last save.
Read Out	Press the E-key	Transfer counter readings and operating data from the module to the device.
Counter Val.		
Date		Editing field for entering the date.
Time		Editing field for entering the time.
Read Out	Press the E-key	Transfer counter readings from the module to the device.
Data S-DAT Module		
Prog. Name	Input field	Program name of the device the data in the S-DAT module come from.
Prog. Ver.	Input field	Program version of the device the data in the S-DAT module come from.
CPU Number	Input field	CPU number of the device the data in the S-DAT module come from.
Telealarm		Note! This function is only available if the Telealarm function has also been ordered.
Active	Active **Not Active**	Telealarm activated / not activated: If activated, then enabled (in the appropriate operating positions) messages are transmitted via telealarm to the specified receiver
Modem	**Modem (Tone)** Modem (Pulse) GSM Terminal	Landline modem has been connected either in tone dialing method or in pulse dialing method, or a GSM modem is connected
Interface	**RS232** RS485 (1) RS485 (2)	Depending on the device configuration, a 2nd RS485 is optionally available at the FML621 interface the modem is connected to.
Signal Display	Active **Not active**	GSM signal field strength. Signal display is shown in the Navigator menu Diagnosis -> Info Telealarm. Note! This function is not available unless "GSM Terminal" was selected under Telealarm -> Modem.
Dial Prefix	0 to 999	If the modem is connected to an extension of a telephone system, then the digit for the exchange line seizure, e.g. 0, is entered here. Note! Only available for landline modem.
GSM PIN	0000 to 9999	Input field for the GSM Personal Identification Number (PIN), which belongs to the SIM-card of the GSM modem used
SMS Service-No.	20-digit service number	If a GSM modem is connected to the FML621, then an SMS message can be sent directly via the SMS Service Center. The service number has to be obtained from your mobile network provider and entered here (e.g. +491722270333 for Vodafone). Configuration example, see Section 6 Note! Only available for GSM terminal.
Time betw. Call	0 to 999 **60 s**	Telealarm activated / not activated: If activated, then enabled (in the appropriate operating positions) messages are transmitted via telealarm to the specified receiver
Dial All Nos.	**Yes** No	Telealarm activated / not activated: If activated, then enabled (in the appropriate operating positions) messages are transmitted via telealarm to the specified receiver
SMS Error to Relay	**None** List of available relays	Telealarm activated / not activated: If activated, then enabled (in the appropriate operating positions) messages are transmitted via telealarm to the specified receiver

Function (menu item)	Parameter setting	Description
Receiver 1		
SMS Receiver 1	**- Please select** PC Software Cellular phone D1 (D) D2 (D) E-plus (D)	Should the SMS be sent to a receiver with mobile network number or should the SMS be forwarded to the receiver via a service exchange
Telephone Number 1	12-digit telephone number	Telephone number to which a telealarm message should be sent.
Number of Attempts 1	**1**-9	Number of attempts until the system switches to the next specified receiver
Receiver 2		
SMS Receiver 2	**- Please select** PC Software Cellular phone D1 (D) D2 (D) E-plus (D)	Should the SMS be sent to a receiver with mobile network number or should the SMS be forwarded to the receiver via a service exchange
Telephone Number 2	12-digit telephone number	Telephone number to which a telealarm message should be sent.
Number of Attempts 2	**1**-9	Number of attempts until the system switches to the next specified receiver
Receiver 3		
SMS Receiver 3	**- Please select** PC Software Cellular phone D1 (D) D2 (D) E-plus (D)	Should the SMS be sent to a receiver with mobile network number or should the SMS be forwarded to the receiver via a service exchange
Telephone Number 3	12-digit telephone number	Telephone number to which a telealarm message should be sent.
Number of Attempts 3	**1**-9	Number of attempts until the system switches to the next specified receiver
Text Input		
Text Input	Standard **Palm**	Selects the way of entering text: ▪ Standard: Per parameter item, runs up or down the row of characters until the desired character appears. ▪ Palm: The desired character can be selected from the visual key field with the cursors.
Alarm Response		
Category	**Default Setup** User-defined	Alarm response when process errors occur. As per the factory setting, all process errors are signaled by a notice message. By selecting "Random", additional operating items appear in the inputs and the application to assign a different fault category (fault message) to the individual process errors (see Section 5.3 'Error message display').
Error Handling 4-20 mA		
Acc. to Namur	**Yes** No – NAMUR 3.6 mA – NAMUR 3.8 mA – NAMUR 20.5 mA – NAMUR 21.0 mA	▪ Yes: the device responds to an error as per the Namur standard: > 21 mA: output at the output: 21 mA 20.5 mA < x < 21 mA: unit continues to use last valid value. ▪ No: no Namur failsafe mode is used. The error limits are freely adjustable.

Function (menu item)	Parameter setting	Description
Gen. Info		
Unit ID	Input field	Assigns a device name (max. 12 characters long).
Tag Number	Input field	Assigns a TAG number, as in wiring diagrams for example (max. 12 characters long).
Prog. Name	Input field	Name which is saved in the PC operating software along with all the settings.
SW version	Input field	Software version of your device.
SW Options	Input field	Information as to which extension cards are installed.
CPU No.:	Input field	The CPU number of the device is used as an identifier. It is saved with all the parameters.
Serial No.:	Input field	This is the serial number of the device.
Order code:	Input field	Order code of the device: first delivery status

Setup ➔ Inputs

✎ Note!
Depending on the version, there are 4 (basic device, always available) to 10 (device extended with 3 analog or U-I-TC cards) current, PFM and pulse inputs available in the Application Manager for recording sensor signals.
The number of possible digital inputs is dependent on the number of extension cards used: there are 6 additional digital inputs available per extension card used.
If voltage signals (also thermocouple) are to be processed, then the device has to be extended with a U-I-TC card; an RTD card ("Temperature" card) has to be used for RTD signals.

PFM/Pulse Inputs

Function (menu item)	Parameter setting	Description
Pulse 1 to 10		
Identifier	**Pulse 1 to 10**	Name of the PFM/pulse sensor (max. 12 characters).
Signal	**Pulse** PFM	Is the input signal interpreted as a PFM or as a pulse signal
Terminals	**None** List of the PFM/pulse input terminals available.	Defines the terminal to which the analog input in question is connected. It is possible to use one sensor for several applications. For this, in the application in question, select the terminal where the transmitter is located (multiple selection possible).
Units	Input field	Free text, manual entry of a unit
Pulse Value	0.0001 to 999999.9	Evaluation of an input pulse, i.e. how a pulse is evaluated, e.g. pulse value = 0.1 m^3: therefore corresponds to a pulse of 0.1 m^3; this is also calculated when the value is integrated.
K-Factor	**0.125**	✎ Note! Only visible if the "PFM" signal type was selected.
Time Base	Off **s (second)** min (minute) h (hour) d (day)	Evaluation of the input signal for the integration - The integrated value is calculated depending on the selected value: e.g. if an input is evaluated /min, then the measured input signal is scaled and integrated accordingly
Offset	**0.0**	Configuring the offset value in % (-999999.9 to +999999.9)
Smoothing	0.0	The measured value is smoothened over the set time period. The average value over the period is thus used as the measured value.
Format	9 9.9 **9.99** 9.999 9.9999 9.99999	Presentation format (decimal places) on the display of the device and when transferring on the serial interface
Store Data	Yes **No**	Storage of the input value in the nonvolatile memory of the device
Integration		
Integration	**Off** On	
Factor	**1.0**	Configuring the factor (-999999.9 to 999999.99)
Units	**%**	Free text, manual entry of a unit
Format	9 **9.9** 9.99 9.999 9.9999 9.99999	Presentation format (decimal places) on the display of the device and when transferring on the serial interface

Function (menu item)	Parameter setting	Description
Actual Value	-999999.9 to 999999.99	Current counter value: counter reading of the associated counter, resettable/ changeable
Alarm Response		✎ Note! Only visible if "User-defined" was selected for the alarm response in the Basic Setup.
Minimum Value	160.00	Lowest measured value permitted.
Maximum Value	1600.00	Largest measured value permitted.
Not. Behavior	**Last Value** Constant	Failure Behavior: response of the output in the event of a fault in the value that is to be output, or specification of the value with which the system continues calculation in an alarm condition.
Not. Value	-999999.9 to 999999.99	✎ Note! Only visible if "Constant" has been selected for the response in the event of a fault.
Range Violation		Define individually for this input which alarms should be displayed when errors occur: range violation (minimum value, maximum value).
Alarm Type	**Fault** Hint	Fault message, counter stop, color change (red) and message in plain text. **Channel affected continues to work with the last measured value or notice value** **- Color Change** **- Fault Text**
Color Change	**Yes** No	Select whether the alarm should be signaled by a color change from blue to red.
Fault Text	**Do Not Display** Display+Confirm SMS Disp.+Ackn.+SMS	Select whether in the event of an error an alarm should be shown to describe the error, which is hidden (acknowledged) by pressing a button or/and whether an SMS should be sent to the telealarm receiver.

Analog inputs

Function (menu item)	Parameter setting	Description
AnalogIn 1 to 10		Configuration of individual analog inputs
Identifier	**AnalogIn x**	Name of the analog input (max. 12 characters).
Signal	**Please select** 4-20 mA 0-20 mA 0-100 mV 0-1 V 0-5 V 0-10 V +/- 1 V +/-10 V Type B Type J Type K Type L IEC Type L (G) Type N Type R Type S Type T Type U Type D Type C PT 100 PT 100 (J) PT 100 (G) PT 500 PT 500 (J) PT 500 (G) PT 1000 PT 1000 (J) PT 1000 (G)	Selects the signal of the analog input.
Terminals	**None** List of the analog input terminals available.	Defines the terminal to which the analog input in question is connected. It is possible to use one sensor for several applications. For this, in the application in question, select the terminal where the transmitter is located (multiple selection possible).
Type of Connection	**2-wire** 3-wire 4-wire	Note! Only visible if the "PTxxxx" signal type is selected.
Curve	**Linear** Squared	For selecting the characteristic of the signal generator used with regard to the sensor e.g. squared characteristic.
Unit	e.g. %	Free text, manual entry of a unit Note! For PTxxxx and thermocouples: ■ °C (Region: Europe) ■ °F (Region: USA)
Start Value	-999999.9 to 999999.99 **0.0**	Start value for the beginning of the measuring interval Note! Can only be selected for the current/voltage signal type.
End Value	-999999.9 to 999999.99 **100.0**	End value for the end of the measuring interval Note! Can only be selected for the current/voltage signal type.
Offset	-9999.99 to 9999.99 **0.0**	Shifts the zero point of the response curve. This function is used to adjust sensors. Note! This can only be selected for the 0/4 to 20 mA signal.

Function (menu item)	Parameter setting	Description
Signal Damping	**0** to 99 s	Time constant of the first order low pass for the input signal. This function is used to reduce display fluctuations in the event of severely fluctuating signals. Note! This can only be selected for the 0/4 to 20 mA signal.
Format	9 **9.9** 9.99 9.999 9.9999 9.99999	Number of places after the decimal point Note! Only visible if the "User-defined" system unit has been selected.
Store Data	Yes **No**	Storage of the input value in the nonvolatile memory of the device
Temperature Correction		Note! Only visible if a TC-type has been selected.
Comparison Temperature	**Internal** Constant	For selecting the internal comparison measurement point or constant value.
Fixed Temp.	–99999.9 to 99999.9	Can only be selected if "Comparison Temperature" = "Constant"
Integration		Note! Not visible if a TC-type or Pt-type has been selected as the type of input.
Integration	**Off** s (second) min (minute) h (hour) d (day)	Evaluation of the input signal for the integration - The integrated value is calculated depending on the selected value: e.g. if an input is evaluated /min, then the measured input signal is scaled and integrated accordingly
Factor	-999999.9 to 999999.99	
Unit	**(%)**	Free text, manual entry of a unit, initial setting "%"
Format	9 **9.9** 9.99 9.999 9.9999 9.99999	Presentation format (decimal places) on the display of the device and when transferring on the serial interface
Curr. Counter Value	-999999.9 to 999999.99	
Alarm Response		Note! Only visible if "User-defined" was selected for the alarm response in the Basic Setup.
Not. Behavior	**Last Value** Constant	Response of the output in the event of a fault in the value that is to be output, or specification of the value with which the system continues calculation in an alarm condition.
Not. Value	-999999.9 to 999999.99	Note! Only visible if "Constant" has been selected for "Not. Behavior".
Range Violation		
Alarm Type	**Fault** Notice	**Fault message, counter stop, color change (red) and message in plain text.** Channel affected continues to work with the last measured value or notice value - Color Change - Fault Text
Color Change	**Yes** No	Select whether the alarm should be signaled by a color change from blue to red.
Fault Text	**Do Not Display** Display+Confirm SMS Disp.+Ackn.+SMS	Select whether in the event of an error an alarm should be shown to describe the error, which is hidden (acknowledged) by pressing a button or/and whether an SMS should be sent to the telealarm receiver.

Function (menu item)	Parameter setting	Description
Open Circuit		
Alarm Type	**Fault** Notice	Define individually for this input which alarms should be displayed when errors occur: range violation (as per NAMUR43 or freely selectable limits) or circuit break.
Color Change	**Yes** No	Select whether the alarm should be signaled by a color change from blue to red.
Display Text	**Do Not Display** Display+Confirm SMS Disp.+Ackn.+SMS	Select whether in the event of an error an alarm should be shown to describe the error, which is hidden (acknowledged) by pressing a button or/and whether an SMS should be sent to the telealarm receiver.

Digital Inputs

Function (menu item)	Parameter setting	Description
DigitalIn 1 to 18		
Identifier	**DigitalIn 1 to 18**	Name of the digital input, e.g. 'Pump On' (max. 12 characters).
Terminals	**None** List of the digital input terminals available.	Defines the terminal for connecting the digital signal.
Function	**None** On/Off Message Display Group Synch. Time Set Time Limit Value Monitoring Active Counter Start/Stop Reset Counter Counter Operating Time	Function of the considered digital input ▪ On/Off Message: when the status is changed, a defined message should be output on the screen / entered in the event buffer ▪ Display Group: should a display group, which is to be defined, be output ▪ Synch. Time: synchronization of the time when a flank occurs: the seconds of the time are set to 0 - if the time value is currently in the range of 0-29, then the seconds time is reset (minutes value stays the same), otherwise the minutes value is increased by 1 ▪ Set Time: when a flank occurs, the value of the internal clock is changed to the specified value. The date is retained if the internal clock is < 1/2 period fast, otherwise the date is increased by 1, if necessary. (If the date is to be changed in the meantime) ▪ Limit Value Monitoring Active: should the limit values of the entire device be deactivated? ▪ Counter Start/Stop: should the counters including totalizers be stopped? ▪ Reset Counter: should the counters including totalizers be reset? ▪ Operating Time: displays the accumulated current operating time
Active Level	Active Low **Active High**	What should be reacted to? ✎ Note! Only visible if "Operating Time", "Counter Start/Stop" or "Display Group" has been selected.
Active Flank	**Low→High** High→Low Both	When should the reaction take place (which change in status is reacted to) ✎ Note! Not visible if "Operating Time", "Counter Start/Stop" or "Display Group" has been selected.
Designation of statuses		
-Low	Text (**off**)	Text that is output when the digital input is at low
-High	Text (**on**)	Text that is output when the digital input is at high
Display Group	Group 1 ... Group 10	Selection of the group that is to be displayed. ✎ Note! Only visible if "Display Group" has been selected for the function.
Counter	**Select** List of the counters available in the device	✎ Note! Only visible if "Counter Start/Stop" or "Reset Counter" has been selected for the function.

Function (menu item)		Parameter setting	Description
	Set Time	(**00:00**)	Time in hh:mm format) ✎ Note! Only visible if "Set Time" has been selected for the function.
	Actual Value		✎ Note! Only visible if "Counter" has been selected for the function.
	Store Data	Yes **No**	Storage of the input value in the nonvolatile memory of the device. ✎ Note! Only visible if "Pulse Counter" has been selected for the function.

Setup ➔ Mathematics

Up to 15 different mathematical calculations can be calculated simultaneously. The configuration of an application is possible without restricting the applications available up to now in the operating status. Please note that when you have successfully configured a new application or changed the settings of an already existing application, the data are not accepted until the user enables the application at the end (question before exiting the setup).

Function (menu item)	Parameter setting	Description
Maths 1 to 15		
Identifier	**Maths 1 to 15**	Name of the mathematics channel, e.g. 'Density calc.' (max. 12 characters).
Formula	**None** 2D Linear. 3D Linear. Formula editor Density Reference Density Medium Detection	✎ Note! A definition of the possible parameter settings is described in the Mathematics Section on → Page 94 ff.. Other interrelations are indicated in supplementary chapters. **2D Linearization**: P. 94, reference density section P. 136 or concentration calculation section P. 126 **3D Linearization**: P. 95 and concentration calculation section P. 126 **Formula Editor**: P. 97 and formula editor section P. 114 **Density**: P. 98 and quick start section P. 42 **Reference Density**: P. 101 **Medium Detection**: P. 104
Linearization	Characteristic 1 to 5	Which of the five characteristics should be used for the linearization? ✎ Note! Display depends on the formula selected.
Calculation of	**Z-Value** Y-value	Should the Y-value or the Z-value be calculated? ✎ Note! Is displayed if Formula = "3D Linear."
Signal X-Value	List of the input or mathematics channels available.	Input signal, i.e. a signal input of the device which is then used as the X-value for further processing in the linearization. ✎ Note! Is displayed if Formula = "2D Linear." or "3D Linear."
Signal Y-Value	List of the input or mathematics channels available.	Input signal, i.e. a signal input of the device which is then used as the Y-value for further processing in the linearization. ✎ Note! Is displayed if Formula = "3D Linear." and "Calculation of" = Z-Value.
Signal Z-Value	List of the input or mathematics channels available.	Input signal, i.e. a signal input of the device which is then used as the Z-value for further processing in the linearization. ✎ Note! Is displayed if Formula = "3D Linear." and "Calculation of" = Y-Value.
Formula editor		Enables the formula editor.
Result is	Logic Operation **Scalable Value** Counter Operating time	The result can be a logical operation, a scalable value, a counter or an operating time. The difference affects what is shown on the measured value display and the further usability of the channel (cascaded mathematics channels). ✎ Note! Is displayed if Formula = "Formula Editor."
Density Unit	Free Configuration **g/cm³** g/cc kg/m³ g/l lb/gal lb/ft³ °Brix °Baumé °API °Twad	Use this menu item to select the unit for displaying the density e.g. g/cm³ or lb/ft³. ✎ Note! The units and interdependencies with regard to °Brix, °Baumé, °API and °Twad are explained in the section on calculating the concentration. See also Setup -> Basic Setup -> Region. ✎ Note! Is displayed if Formula = "Density", "Reference Density" or "Medium Detection".

Function (menu item)	Parameter setting	Description
Unit	g/cm³	Enter the desired unit in this menu item. Note! Is displayed if Formula = "2D Linear.", "3D Linear." or "Formula Editor".
Format	9 9.9 9.99 9.999 **9.9999** 9.99999	Presentation format (decimal places) on the display of the device and when transferring on the serial interface Factory setting: bold
Start Value	0.3000	The Start Value is used for scaling a graphic illustration on the display unit. This specifies the lower value range e.g. 0.5 g/cm³.
End Value	2.0000	The End Value is used for scaling a graphic illustration on the display unit. This specifies the upper value range e.g. 1.5 g/cm³.
Temperature of	**Def. Value** Input	Note! Is displayed if Formula = "Density", "Reference Density" or "Medium Detection".
Temp. Input	List of the input or mathematics channels available.	
Temp. Default		Note! This display depends on the option selected under "Temp. Input".
Pressure of	**Def. Value** Input	The following input information now has to be assigned to the Density 1 module. A distinction is made between two types of input, namely the physical input or a default value. The default value is used for simulation purposes and can display a value that corresponds to the process conditions if a process sensor, such as a temperature sensor, is not available.
Pressure Input	List of the input or mathematics channels available.	
Press. Default		Note! This display depends on the option selected under "Pressure Input".
Frequ. of	**Def. Value** Input	
Frequ. Input	List of the input or mathematics channels available.	Input via which the frequency should be measured.
Frequ. Default		Note! This display depends on the option selected under "Frequ. Input".

Function (menu item)	Parameter setting	Description
F0 Vacuum Frequ. Correction F0 S-Factor Correction r C-Factor D-Factor A-Factor Convers. Factor		Sensor-specific parameters Note! When you order a Liquiphant M for density measurement, a special sensor calibration report is enclosed and contains the following fork-specific parameters: ■ F0-Vacuum Frequency: vibration frequency of the fork in a vacuum at 0 °C (Hz) ■ S-Factor: density sensitivity of the tuning fork (cm^3/g) at 20 °C. ■ C-Factor: linear temperature coefficient of the fork (Hz/°C) ■ D-Factor: pressure coefficient (1/bar) ■ A-Factor: quadratic temperature coefficient of the fork (Hz/°C²) Correction Factors ■ Correction F0: correction value (multiplier) for F0 vacuum frequencies. This value is calculated during field calibration but can also be changed manually and reset to 1 for example. ■ Correction r: the S-Factor is multiplied by this value. This value depends on the installation (see Section 3). ■ Convers. Fact.: the conversion factor is a multiplier for the calculated density value. On leaving the factory, the S, C, D and A factors are assigned average values for the material 316L. The vacuum frequency is assigned 0.00 to ensure that these values are entered. Note! Is displayed if Formula = "Density", "Reference Density" or "Medium Detection".
Hysteresis	-99999 to 99999 (**0.00 %**)	Specify set point switch-back threshold to suppress set point bounce. Note! Only visible if Formula = "Medium Detection".
Store Data	Yes **No**	If this function is confirmed with "Yes", the calculated density values are stored in the device memory. This is necessary to allow density information monitoring. In a separate step (see Pulse Inputs), you can then specify the cycles for saving the value.
Field Calibration	Density Set Point Start Calibration	The field calibration is used to adapt the display information to the actual density measured value or in accordance with the requirements of the customer (offset). By entering a target density value in the device and executing the routine, a correction factor is determined which is multiplied by the vacuum frequency. If the correction does not prove to be helpful, the "Correction F0" factor can be reset to 1.0 in the Setup. Note! Is displayed if Formula = "Density."
Medium 1	Curve ■ Not active ■ **Active**	Enable/disable characteristic.
	Identifier Temperature 1 Density Value 1 Temperature 2 Density Value 2 Transmit by	Enter name of the characteristic? Temperature 1 of the 1st characteristic. Density value 1 of the 1st characteristic. Temperature 2 of the 1st characteristic. Density value 2 of the 1st characteristic. This output switches as long as the system detects medium 1.
Medium 2	Curve ■ Not active ■ **Active**	Enable/disable characteristic.
	Identifier Temperature 1 Density Value 1 Temperature 2 Density Value 2 Transmit by	Enter name of the characteristic? Temperature 1 of the 2nd characteristic. Density value 1 of the 2nd characteristic. Temperature 2 of the 2nd characteristic. Density value 2 of the 2nd characteristic. This output switches as long as the system detects medium 2.

Function (menu item)	Parameter setting	Description
Medium 3	Curve ■ **Not active** ■ Active	Enable/disable characteristic.
	Identifier Temperature 1 Density Value 1 Temperature 2 Density Value 2 Transmit by	Enter name of the characteristic? Temperature 1 of the 3rd characteristic. Density value 1 of the 3rd characteristic. Temperature 2 of the 3rd characteristic. Density value 2 of the 3rd characteristic. This output switches as long as the system detects medium 3.
Medium 4	Curve ■ **Not active** ■ Active	Enable/disable characteristic.
	Identifier Temperature 1 Density Value 1 Temperature 2 Density Value 2 Transmit by	Enter identifier of the characteristic? Temperature 1 of the 4th characteristic. Density value 1 of the 4th characteristic. Temperature 2 of the 4th characteristic. Density value 2 of the 4th characteristic. This output switches as long as the system detects medium 4.
Ref. Density Curves	Number of Lin. Pnts	Number of points on which the curve is based. Note! Is displayed if Formula = "Reference Density."
	Ref. Temp. T0	Reference temperature for the reference density characteristic.
	Modify Table	Edit the table.
Edit table		
Line Function	Temperature	Column for temperature values.
	Density	Column for density values.
Integration	**Off** s min h d	Evaluation of the input signal for the integration - The integrated value is calculated depending on the selected value: e.g. if an input is evaluated / min, then the measured input signal is scaled and integrated accordingly. Note! Is displayed if Formula = "2D Linear.", "3D Linear." or "Formula Editor".
	Factor	Value by which the input value should be multiplied.
	Unit	Here, you can specify the unit with which the calculated value should be displayed.
	Format	Here, you can specify the number of decimal places with which the calculated value should be displayed.
	Curr. Counter Value ■ -999999.9 to 999999.99 ■ (**0.0**)	Contains the counter reading, it changes

Setup ➔ Characteristics

✎ Note!
The 2D or 3D characteristic can be easily processed using the "ReadWin 2000" software supplied.

Function (menu item)	Parameter setting	Description
Characteristic 1 to 5		
Identifier		Name of the characteristic (max. 12 characters).
Linearization	**2D-Linear.** 3D-Linear.	Should the characteristic be 2-dimensional or 3-dimensional?
No. Points X	**2**	Number of points (X-values) needed for displaying the characteristic.
No. Points Y	**2**	Number of points (Y-values) needed for displaying the characteristic. ✎ Note! Is displayed if Formula = "3D Linear."

Setup ➔ Outputs

Analog outputs

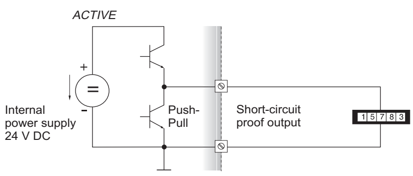
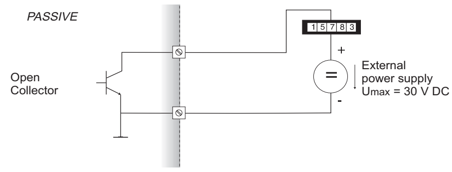
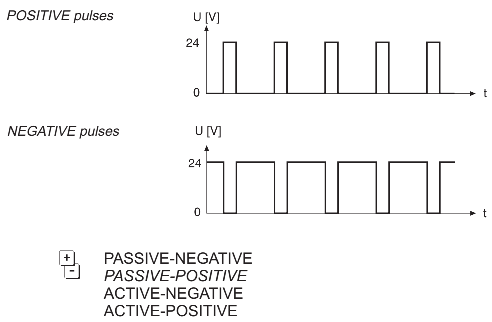
Please note that these outputs can be used as both analog and pulse outputs; the desired signal type can be selected for each setting. Depending on the version (extension cards), 2 to 8 outputs are available.

Function (menu item)	Parameter setting	Description
Analog Outp. 1 to 8		
Identifier	Analog Outp. 1 to 8	A name can be given to the analog output in question for a better overview (max. 12 characters).
Terminals	**None** List of the analog output terminals available.	Defines the terminal at which the analog signal should be output.
Sig. Source	**- Please select** List of the values that can be output as an analog signal (inputs, calculated values)	Setting as to which calculated or measured variable should be output at the analog output. The number of signal sources depends on the number of configured applications and inputs.
Current Range	**4 to 20 mA** 0 to 20 mA	Specifies the mode of operation of the analog output.
Start Value	-999999 to 999999	Smallest output value of the analog output. ✎ Note! Is displayed if Signal Source has been selected.
End Value	-999999 to 999999	Largest output value of the analog output. ✎ Note! Is displayed if Signal Source has been selected.
Time Constant	0 to 99 s (**0 s**)	Time constant of the first order low pass for the input signal. This is used to prevent large fluctuations in the output signal (can only be selected for the signal type 0/4 and 20 mA). ✎ Note! Is displayed if Signal Source has been selected.
Simulation	**Off** 0 3.6 4.0 10.0 12.0 20.0 21.0	The function of the current output is simulated. Simulation is active if the setting is not 'off'. Simulation ends as soon as you leave this item. ✎ Note! Is displayed if Signal Source has been selected.

Function (menu item)	Parameter setting	Description
Alarm response		✎ Note! Only visible if "User-defined" was selected for the alarm response in the Basic Setup.
Failure Behavior	**Last Value** Constant	Defines the behavior of the output in the event of a fault, e.g. if a sensor in the measurement fails.
Fault Value	-999999 to 999999 (**3.6 mA**)	Fixed current value which should be output at the analog output in the event of a fault. ✎ Note! Only for the fault response setting → "Constant" can be selected.
Range violation		
Alarm Type	**Fault** Notice	Depending on the configuration of the fault ('fault message, counter stop, color change (red) and message in plain text) or notice ('here the user can determine the response of the device according to his requirements), the device reacts to exceptional behavior of this output
Color Change	**Yes** No	Select whether the alarm should be signaled by a color change from blue to red.
Fault Text	**Do Not Display** Display+Confirm SMS Disp.+Ackn.+SMS	Select whether in the event of an error an alarm should be shown to describe the error, which is hidden (acknowledged) by pressing a button or/and whether an SMS should be sent to the telealarm receiver.

Pulse outputs

The pulse output function can be configured with active, passive output or relay. Depending on the version, 2 to 8 pulse outputs are available.

Function (menu item)	Parameter setting	Description
Pulse 1 to 8		
Identifier	Pulse 1 to 8	A name can be given to the pulse output in question for a better overview (max. 12 characters).
Signal	**Select** Relay DO Active DO Passive	Assign the pulse output. **Relay:** The pulses are output on a relay. (The frequency is max. 5Hz) **DO Active:** active voltage pulses are output. Power is supplied from the device. **DO Passive:** passive open collectors are available in this operating mode. Power must be supplied externally.  For continuous currents up to 15 mA  For continuous currents up to 25 mA Note! "DO passive" can only be selected when extension cards are used.
Terminals	**None** List of the pulse output terminals available.	Defines the terminal at which pulses should be output.
Sig. Source	**Select** List of signals that can be output	Setting as to which variable should be output at the pulse output.
Pulse		Note! Is displayed if a suitable input has been defined, e.g. analog with output damping.
-type	Negative **Positive**	 Note! Pulse unit depends on the signal source selected.

Function (menu item)	Parameter setting	Description
-value	0.001 to 10000.0 (**1.0**)	Setting as to which value a pulse corresponds to (unit/pulse). ✎ Note! The max. possible output frequency is 12.5 Hz. The suitable pulse value can be determined as follows: $\text{Pulse value} > \frac{\text{Estimated max. input value (end value)}}{\text{Desired max. output frequency}}$
-width	User-def. **Dynamic (max. 120 ms)**	The pulse width limits the max. possible output frequency of the pulse output.
-value	0.04 to 1000.00 s	Configuration of the pulse width suiting the external totalizer. The maximum permitted pulse width can be calculated as follows: $\text{Pulse width} < \frac{1}{2 \text{ x max. output frequency [Hz]}}$ ✎ Note! Only visible if "User-def." has been selected for **-width**.
Simulation	**Off** 0.1 Hz 1.0 Hz 5.0 Hz 10.0 Hz 50.0 Hz 100.0 Hz 200.0 Hz 500.0 Hz 1 kHz 2 kHz	The function of the pulse output is simulated with this setting. Simulation is active if the setting is not "off". Simulation ends if you leave this item.

Digital outputs

The digital output function can be configured with active, passive output or relay. Depending on the version, 2 to 6 digital outputs are available.

Function (menu item)	Parameter setting	Description
Dig.Out 1 to 6		
Identifier	Dig.Out 1 to 6	A name can be given to the digital output in question for a better overview (max. 12 characters).
Type	**Active** Passive	Level is positive = "Active" or negative = "Passive".
Active level	Active Low **Active High**	Operating mode of the digital output.
Terminals	**None** List of the digital output terminals available.	Defines the terminal at which pulses should be output.

Relay

Depending on the version, 1 to 19 relays are available in the device for limit value functions or regulation functions.

Function (menu item)	Parameter setting	Description
Relay 1 to 19		
Identifier	Relay 1 to 19	A name can be assigned to the relay in question for a better overview (max. 12 characters).
Op. Mode	Norm. Closed **Norm. Open**	Is the relay operated as a normally closed contact or as a normally open contact when not activated Note! Only visible if a terminal has been selected.
Terminals	**None** List of the relay terminals available.	Defines the terminal of the set point selected.

Setup ➔ Limit values

Depending on the version, 1 to 30 limit values are available in the device for limit value functions or regulation functions.

Function (menu item)	Parameter setting	Description
Limit value 1 to 30		
Identifier	Limit value 1 to 30	A name can be assigned to the limit value in question for a better overview (max. 12 characters).
Transmit by	**Select** List of configured relays and digital outputs Display	Where should the limit function be output?
Type	**Min+Alarm** Max+Alarm Grad.+Alarm Alarm Min Max Gradient Unit Failure	Definition of the event which should activate the set point. ■ Min+Alarm Minimum safety, event report if the limit value is undershot with simultaneous monitoring of the signal source as per NAMUR NE 43 (or freely selectable limits). ■ Max+Alarm Maximum safety, event report if the limit value is overshot with simultaneous monitoring of the signal source as per NAMUR NE 43 (or freely selectable limits). ■ Grad.+Alarm Gradient analysis, event report when set signal change is overshot per time unit of the signal source with simultaneous signal source monitoring as per NAMUR NE 43. ■ Alarm Monitoring of the signal source as per NAMUR NE 43 (or freely selectable limits), no limit function. ■ Min Event report when limit value is undershot without taking NAMUR NE 43 into consideration. ■ Max Event report when limit value is overshot without taking NAMUR NE 43 into consideration. ■ Gradient Gradient analysis, event report when set signal change is overshot per time unit of the signal source without taking NAMUR NE 43 into account. ■ Unit Failure Relay (output) switches if a device fault is present (fault message).
Sig. Source	**Select** List of values that can be monitored	Signal sources for the selected set point. Note! The number of signal sources depends on the number of configured applications and inputs.
Unit	Free Configuration	The physical unit is suggested depending on the signal and can be edited.
Swit. Point	-99999 to 99999 (**0.00**)	Smallest output value of the analog output. Note! Only visible if "Min+Alarm", "Max+Alarm", "Min" or "Max" has been selected for **Type**.
Hysteresis	-99999 to 99999 (**0.00**)	Specify set point switch-back threshold to suppress set point bounce. Note! Only visible if "Min+Alarm", "Max+Alarm", "Min" or "Max" has been selected for **Type**.
Time Delay	0 to 99 s (**0 s**)	How long does the limit value have to be present before a reaction takes place. Note! Only visible if "Min+Alarm", "Max+Alarm", "Min" or "Max" has been selected for **Type**.
Gradient		
Delta x	-19999 to 99999 (**0.00**)	Value of signal change for gradient analysis (inclination function). Note! Only visible if "Grad.+Alarm" or "Gradient" has been selected for **Type**.

Function (menu item)		Parameter setting	Description
	Delta -t	0 to 60 s (**0 s**)	Time interval for the signal change of the gradient analysis. Note! Only visible if "Grad.+Alarm" or "Gradient" has been selected for **Type**.
	Reset Value	-19999 to 99999 (**0.00**)	Switch-back threshold for gradient analysis. Note! Only visible if "Grad.+Alarm" or "Gradient" has been selected for **Type**.
	Event Text		
	Setp. Off→On		You can write a message for when the limit value (set point) is overshot. Depending on the setting, this appears in the event buffer and the display (see 'Lim. display') Note! Not visible if "Unit Failure" has been selected.
	Setp. On→Off		You can write a message for when the limit value (set point) is undershot. Depending on the setting, this appears in the event buffer and the display (see 'Lim. display') Note! Not visible if "Unit Failure" has been selected.
	Message Text	**Do Not Display** Disp.+Confirm SMS Disp.+Ackn.+SMS	Definition of the way of reporting the limit value. **Do Not Display:** limit value violation or violated limit value undershooting is recorded in the event buffer. **Disp.+Ackn.:** entered in the event buffer and shown on the display. The message does not disappear until it is acknowledged with a key. Note! Not visible if "Unit Failure" has been selected.
	Telealarm	**Deactivated** With Priority	Note! Not visible if "Unit Failure" has been selected.
	SMS Receiver	**All** Receiver 1 Receiver 2 Receiver 3	Note! Not visible if "Unit Failure" has been selected.

Setup ➔ Display

The device display can be freely configured. Up to ten groups, each with 1 to 8 freely definable process values, can be displayed individually or alternately.

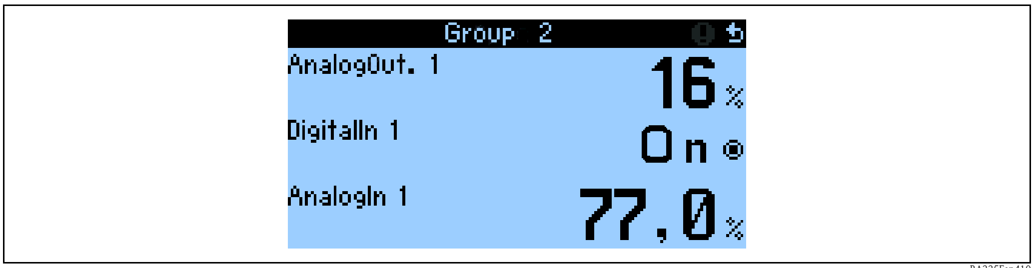


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Fig. 34: Display with 3 values

When displaying numerical values, up to 8 values can be displayed in a group with a name and associated physical unit.

Note!
In Setup "**Display**", the display functionality is configured. In "**Navigator**" then select which group(s) appear(s) with process values on the display.

Function (menu item)	Parameter setting	Description
Groups		
Group 1 to 10		Combine process values to groups here for showing on the display
Identifier	Free text	A name (max. 12 characters) can be given to the groups for a better overview.
Display	**Value** Horizontal Bargraph[1)] Vertical Bargraph[1)] Line Graph[2)]	Note! [1)] Only available if "1 value" or "2 values" has been selected for Display mask. [2)] Only available if **"1 value"** has been selected for Display mask.
Display Mask	**Select** 1 Value 2 Values ... 8 Values	Here, set the number of process values which should be displayed underneath one another in a window (as a group). The way the value is displayed depends on the number of selected values. The more values in a group, the smaller the display.
Signal Type 1	**All** Analog Input Pulse Input Digital Input Mathematics Channels Relay Miscellaneous	The display values can be selected from 6 categories (types).
Value Type 1	**All** Measured Values Statuses Counter Totalizer Miscellaneous	Selection criterion for output in the measured value display: the displayed values can be selected from 5 categories (types).
Value 1 to 8	**Select** List of all available process values	Selects which process values should be displayed. Note! The extent of this list depends on the defined process values.
Alternating Display		Alternating display of individual groups on the display.
Swit. Time	0 to 99 **0 s**	Seconds until the next group is displayed.
Group 1 to 10	Yes **No**	Select the groups that should be displayed alternately. The alternating display is activated in the "**Navigator**" / "**Display**" (see 6.3.1).

Function (menu item)	Parameter setting	Description
Display		
No. of Sums	**Counter Mode** Exponential	Sum display Counter Mode: sums are displayed with max. 10 positions up to overflow. Exponential: exponential display is used for large values.
Contrast		
Main Device	0 to 99 **46**	For configuring the display contrast. This setting takes effect immediately. The contrast value is not saved until the setup is exited.

Setup ➔ Signal Analysis

Function (menu item)	Parameter setting	Description
Interm. Anal.	No 1 min 2 min 3 min 4 min **5 min** 10 min 15 min 30 min 1 h 2 h 3 h 4 h 6 h 8 h 12 h	Determines at the time intervals specified here the Min., Max., Mean values (applies to the entire device) for those channels whose storage has been set to "Yes"
Day	Yes **No**	Determines once a day the Min., Max., Mean values (applies to the entire device) for those channels whose storage has been set to "Yes"
Month	Yes **No**	Determines once a month the Min., Max., Mean values (applies to the entire device) for those channels whose storage has been set to "Yes"
Year	Yes **No**	Determines once a year the Min., Max., Mean values (applies to the entire device) for those channels whose storage has been set to "Yes"
Synch. Time	00:00	The synchronization time is used for the analysis and defines the start of the analysis intervals. ✎ Note! Only available if "Intermediate Analysis", "Day", "Month" or "Year" has been activated.
Reset	**No** Intermediate Analysis Daily Counter Monthly Counter Yearly Counter All Counters	✎ Note! Only available if "Intermediate Analysis", "Day", "Month" or "Year" has been activated.
Memory Info		The space still available in the device is displayed (in units of time).

Setup ➔ Communication

An RS232 interface at the front and an RS485 interface at terminals 101/102 can be selected as standard. In addition, all process values can be read out via the PROFIBUS DP protocol.

Function (menu item)	Parameter setting	Description
Unit Addr.	0 to 99 **1**	Device address for communicating via the interface.
RS485 (1)		
Baudrate	9600, 19200, 38400 **57600**	Baudrate for the RS485 interface
RS232		
Baudrate	9600, 19200, 38400 **57600**	Baudrate for the RS232 interface
PROFIBUS-DP		
Number	0 to 48 **0**	Number of values which should be read out via the PROFIBUS-DP protocol (max. 48 values).
Adr. 0...4	e.g. density x	Assigns the values to be read out to the addresses. ✎ Note! Is only displayed if "Number" > 0.
Adr. 5...9 ... Adr. 235...239	e.g. temp. diff. x	48 values can be read out via an address. Addresses in bytes (0...4, ... 235...239) in numerical order. ✎ Note! Is only displayed if "Number" > 1.
RS485 (2)		
Baudrate	9600 19200 38400 **57600**	Baudrate for the second RS485 interface
Ethernet		
MAC	xx-xx-xx-xx-xx-xx	Configuring the unique MAC address (HW address, specified by E+H Preset)
IP	e.g. 192.168.100.5	IP address, specified by network administrator
Subnet Mask	255.255.255.0	Enter the subnet mask (you can obtain this from your network administrator). The subnet mask must be entered if the device is intended to establish connections into another partial network. Specify the subnet mask of the partial network, in which the device is located (e.g. 255.255.255.000). Please note: the class of network is determined by the IP address. This results in a default subnet mask (e.g. 255.255.000.000 for a Class B network).
Gateway	000.000.000.000	Enter the gateway (you can obtain this from the network administrator). Enter the address of the gateway here if connections into other networks are to be established. ✎ Note! Changes to the system parameters are not activated until the SETUP menu has been exited and the settings have been adopted. Only then does the device work with the changed settings.

✎ Note!
A detailed description about integrating the device into a PROFIBUS system can be found in the Operating Instructions of the accessory (see Section 9 'Accessories'): **PROFIBUS interface module HMS AnyBus Communicator for PROFIBUS**

Setup ➔ Service

Service menu: **Setup (all parameters) ➔ Service**

Note!
In the Service menu, parameter settings can only be made by Endress+Hauser service technicians.

Function (menu item)	Parameter setting	Description
Preset	Yes **No**	Resetting the device to the delivery status with the factory default settings.
Counter Stop	Yes **No**	Should the counters (all counters) be stopped? Yes/No
Reset Op. Time	Yes **No**	If a reset terminal is defined and the Reset Op. Time operating item is set to "Yes", then all operation hour counters are also to be reset to 0 when the reset terminal flank is changed from Low->High. This then always applies when a flank is changed. If Reset Op. Time is set to "No", then the operation hour counters remain at their value when a flank is changed.
Reset Term.	**None** List of the available digital inputs	Reset Term.; the counters can be reset via a digital signal. To do this, an available digital input must be selected
Counter		
Analog Input		
Analog Input 1 to 10		Note! Only the analog inputs that have actually been configured are displayed.
Sum x	-999999.9 to 999999.9	The "Integration = Yes" operating item can be used to determine per channel whether the current values are to be integrated. These integrated values can then be displayed in the service level in an overview. When doing so, the resettable counters (comparable with the trip-distance counters of a car) are displayed.
Totalizer x	-999999.9 to 999999.9	The "Integration = Yes" operating item can be used to determine per channel whether the current values are to be integrated. These integrated values can then be displayed in the service level in an overview. The total sums correspond to the mileometer of a car.
Pulse Input		
Pulse Input 1 to 10		Note! Only the pulse inputs that have actually been configured are displayed.
Sum x	-999999.9 to 999999.9	The "Integration = Yes" operating item can be used to determine per channel whether the current values are to be integrated. These integrated values can then be displayed in the service level in an overview. When doing so, the resettable counters (comparable with the trip-distance counters of a car) are displayed.
Totalizer x	-999999.9 to 999999.9	The "Integration = Yes" operating item can be used to determine per channel whether the current values are to be integrated. These integrated values can then be displayed in the service level in an overview. The total sums correspond to the mileometer of a car.
Digital Input		
Digital Input 1 to 18		Note! Only the digital inputs that have actually been configured are displayed.
Sum x	-999999.9 to 999999.9	The "Integration = Yes" operating item can be used to determine per channel whether the current values are to be integrated. These integrated values can then be displayed in the service level in an overview. When doing so, the resettable counters (comparable with the trip-distance counters of a car) are displayed.
Totalizer x	-999999.9 to 999999.9	The "Integration = Yes" operating item can be used to determine per channel whether the current values are to be integrated. These integrated values can then be displayed in the service level in an overview. The total sums correspond to the mileometer of a car.

Function (menu item)	Parameter setting	Description
Mathematics Channels		
Mathematics Channel 1 to 15		Note! Only the mathematics channels that have actually been configured are displayed.
Sum x	-999999.9 to 999999.9	The "Integration = Yes" operating item can be used to determine per channel whether the current values are to be integrated. These integrated values can then be displayed in the service level in an overview. When doing so, the resettable counters (comparable with the trip-distance counters of a car) are displayed.
Totalizer x	-999999.9 to 999999.9	The "Integration = Yes" operating item can be used to determine per channel whether the current values are to be integrated. These integrated values can then be displayed in the service level in an overview. The total sums correspond to the mileometer of a car.

6.5 User-specific applications

6.5.1 Application examples

Display

In the Setup -> Display menu, you can create value groups which should be shown on the display. Up to 10 groups can be defined. With the "Alternating Display" function you can then define which groups should be shown on the display at specific intervals.
If a fault occurs, the display changes color (blue/red). See Section 5.3 'Error message display' for information on how to eliminate the error.

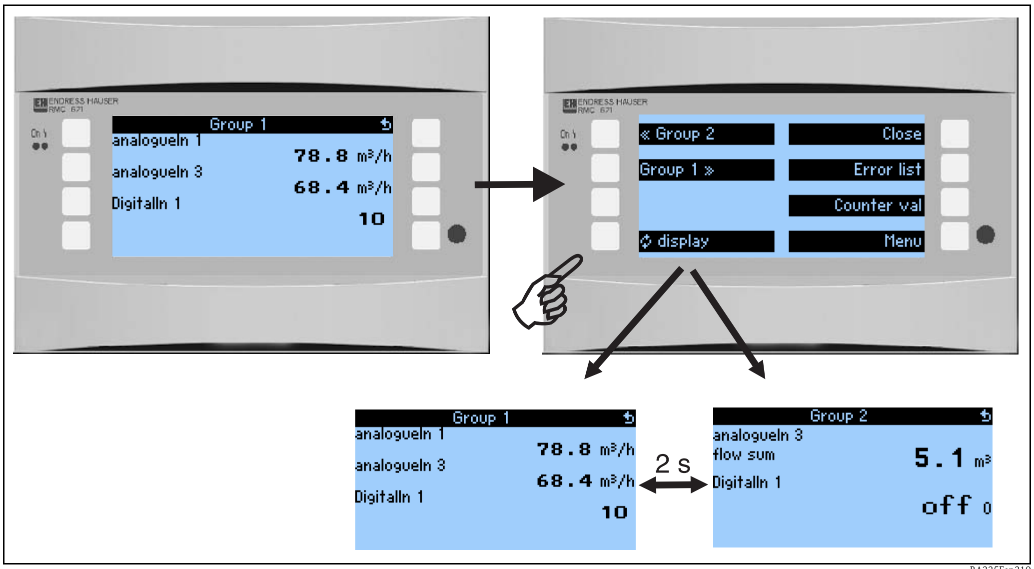

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Fig. 35: Automatic changing of various display groups (alternating display)

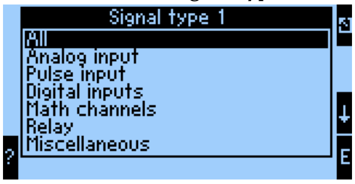
If one value is displayed, then there are the following display possibilities:
- Value
- Horizontal Bargraph
- Vertical Bargraph
- Line Graph

If 2 values are to be displayed, then you can choose between
- Value
- Horizontal Bargraph
- Vertical Bargraph

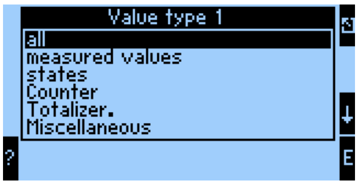
If 3 or more values are displayed, only values (and statuses, e.g. circuit break) are displayed.

To facilitate greater transparency, the display is configured in **Navigator → Setup → Display → Groups → Group X** in 3 steps per value:

1. Selection of the signal type



2. Selection of the value type



3. The actual value can then be selected based on the preselections made above.

Note!
For better transparency, groups can be given their own identifier, so that the user can identify e.g. the measuring point to which the displayed values are assigned, for example "Tank East" or "Density Input".

Up to 10 display groups can be set up, which can each comprise up to 8 values. This means that you can map up to 80 measured values in one display cycle (i.e. in the specified alternation).

Different possibilities for measured value display and their configuration

Navigator → Setup → Display → Groups → Group X

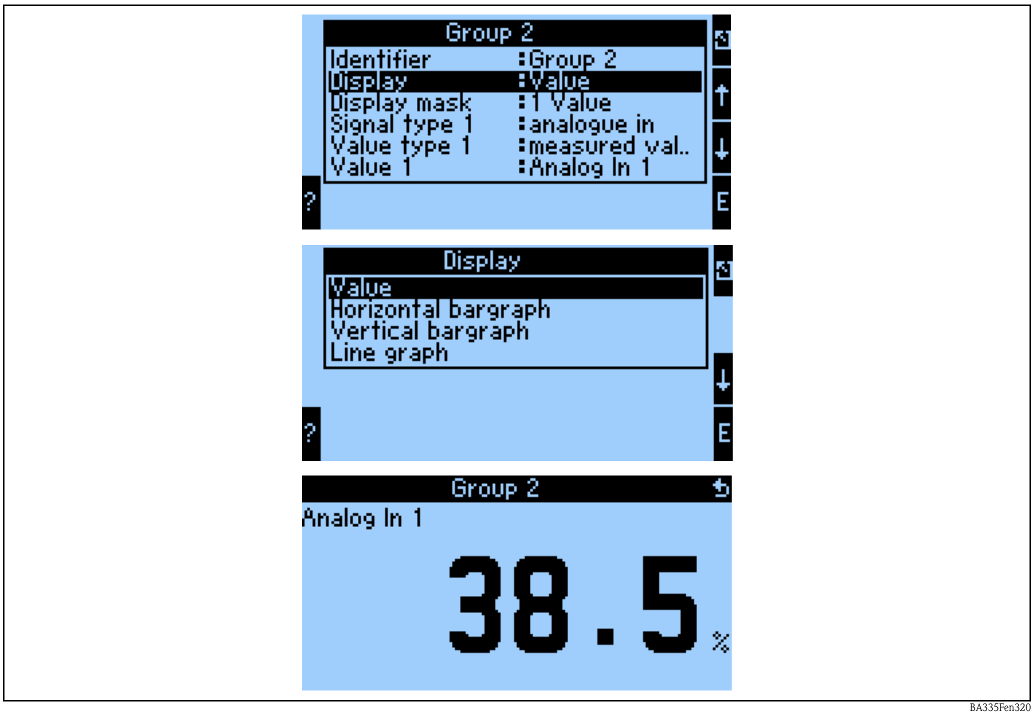


Fig. 36: Display of a measured value

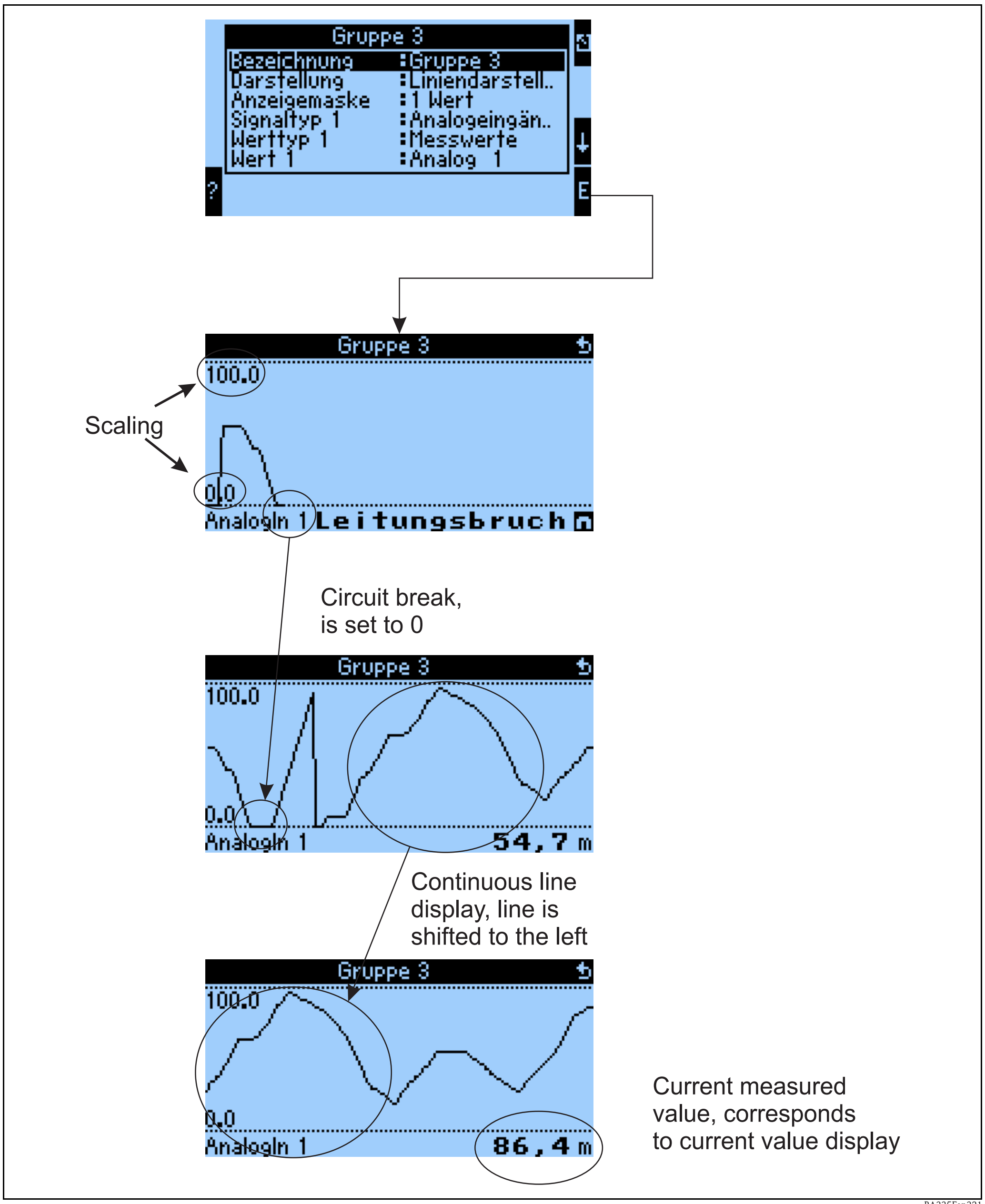


Fig. 37: *Line display of a measured value*

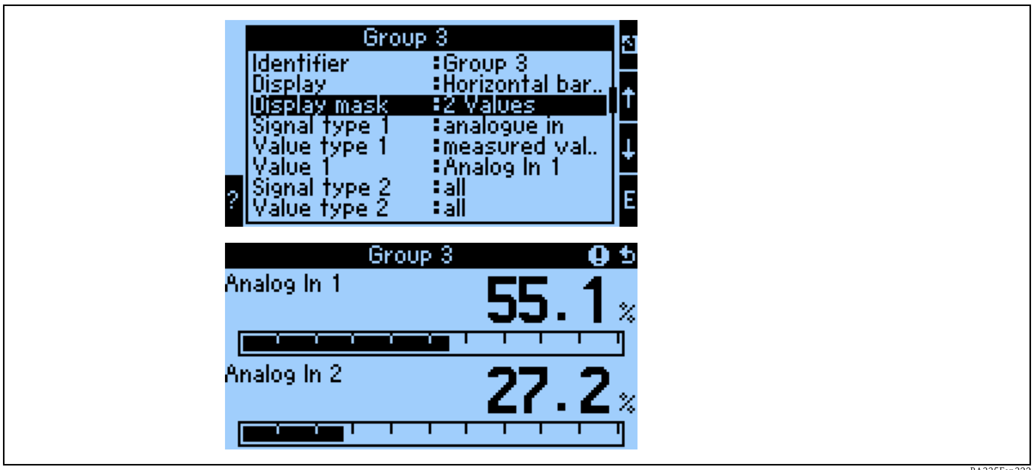


Fig. 38: *Value + horizontal bargraph display*

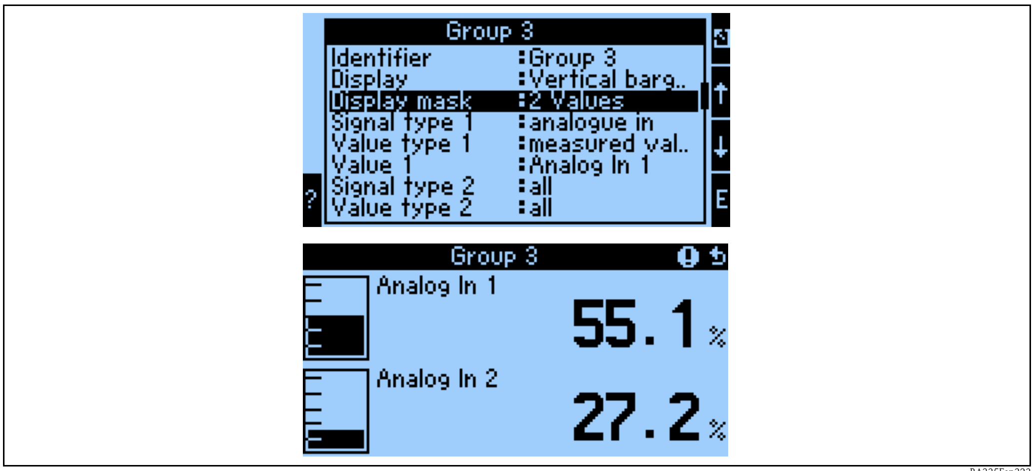


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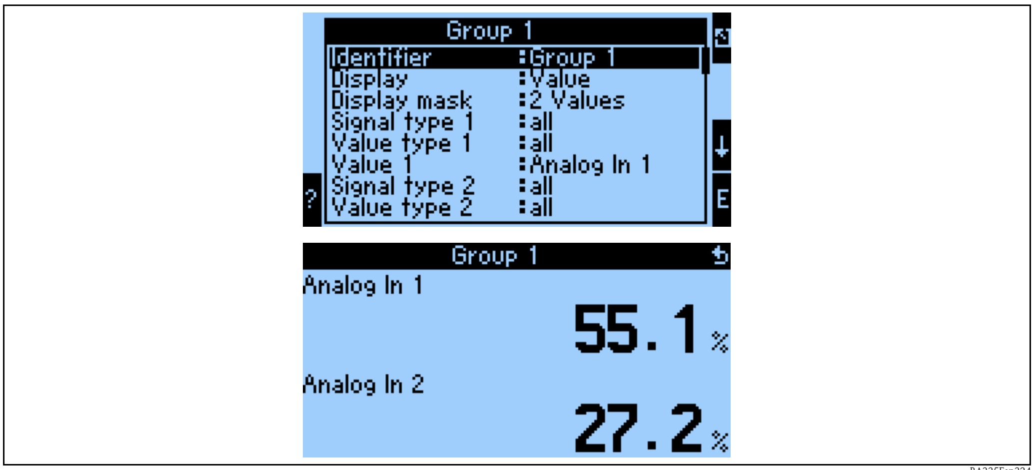
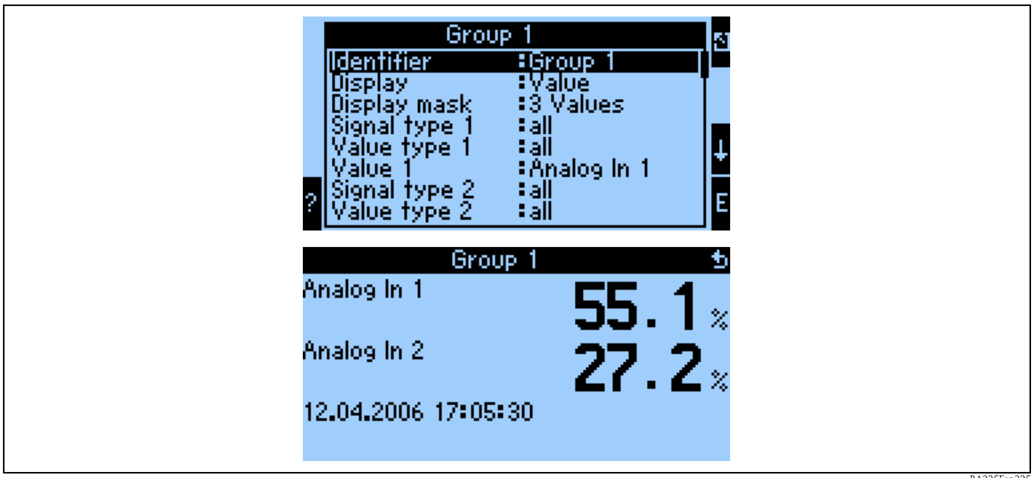
Fig. 39: *Value + vertical bargraph display*



BA335Fen324

Fig. 40: *Purely value display*



BA335Fen325

Fig. 41: *Display of three measured values, only value display possible*

Inputs

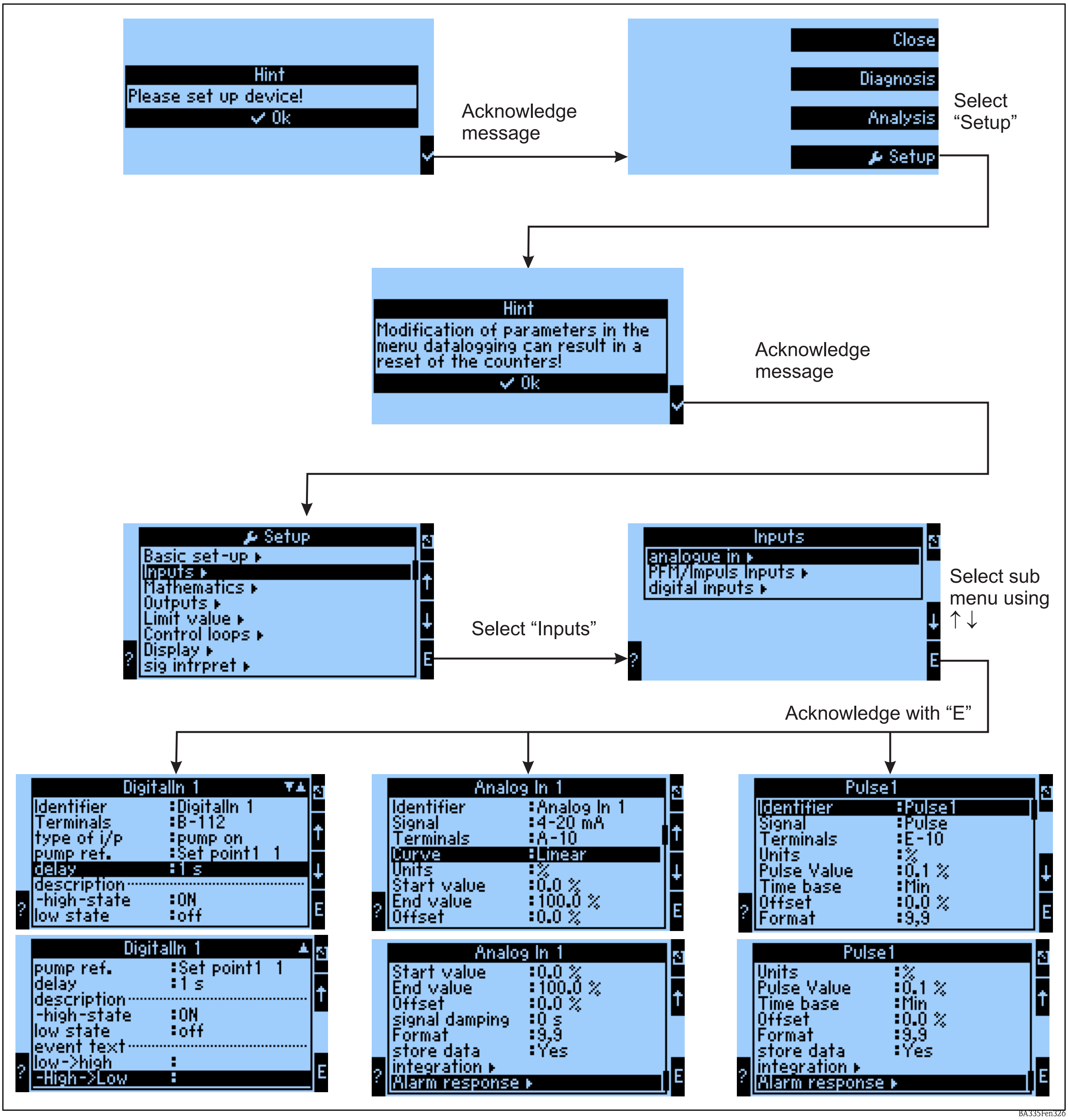


Fig. 42: Configuration of the inputs: Overview

Configuration of the analog input

- Identifier: give the analog input a name
- Select the signal type of the terminal to which the sensor is connected.
- Terminal: select A10(+) and connect transmitter to terminal A10(-)/A82(+).
- Curve: Linear: should the characteristic curve of the sensor be assumed as linear or as squared (relevant above all for flow sensors).
- Unit: free text entry, is used for displaying the measured value.
- Start/End Value: for 0/4 to 20mA: entry of the scaling, upper and lower limits of the physical value range.

- Pulse Value (only for flow input signal and pulse signal type): value of an (electrical) pulse in relation to the measured variable.
- Offset: constant value, which is taken into consideration for each measured value.
- Signal Damping: entry of the time constants for the integrated low-pass filter; this filters out undesired, high-frequency interferences.
- Format: format of the value display, number of decimal places.
- Store Data: measured values are stored and are available for reading out by means of ReadWin.
- Integration: configuration of the integration, if this is required.
- Alarm Response: how should the analog input react to a current value > 20.5 mA and < 21 mA (range violation) as with a current value > 21 mA

✎ Note!
This function is not available unless "User-defined" was selected in the menu Basic Setup -> Alarm Response.

Configuration of the digital input
- Identifier: give the digital input a name
- Terminal = selection of the terminal that is to be used for the digital input
- Function: which task is assigned to the digital input – what should be brought about at the device by the digital input? e.g. synchronization of the time (for more details, see parameter table)
- Active Flank (optional: active level): initiates the low ➔ high, or high ➔ low flank function in the device (optional high level or low level)
- Description of High stat.: On – displayed text in the measured value display (display group) when digital input is set to High.
- Description of Low stat.: Off – displayed text in the measured value display (display group) when digital input is set to Low.
- Event Text –Low ➔ High: text that is to be output when a rising flank occurs.
- Event Text – High ➔ Low: text that is to be output when a falling flank occurs.
- Store Data: only visible and can only be selected for pulse counters.

Configuration of the pulse input
- Identifier: give the pulse input a name
- Select the signal type of the terminal to which the sensor is connected.
- Terminal: select E10(+) and connect transmitter to terminal E10(-)/E82(+).
- Unit: free text entry, is used for displaying the measured value.
- Pulse Value: how much of the evaluated variable corresponds to a pulse.
- Time Basis: time reference of the signal, e.g. for flow: 1 pulse corresponds to 10 l/sec.
- Offset: constant value, which is taken into consideration for each measured value.
- Smoothing: the measured value is smoothened over the set time period. As a result, the measured value determined is used as the measured value during this period.
- Unit: format of the value display, number of decimal places.
- Format: display format in the measured value display
- Store Data: measured values are stored and are available for reading out by means of ReadWin.
- Integration: configuration of the integration, if this is required.
- Alarm Response: how should the analog input react to a current value > 20.5 mA and < 21 mA (range violation) as with a current value > 21 mA

Outputs

Analog output

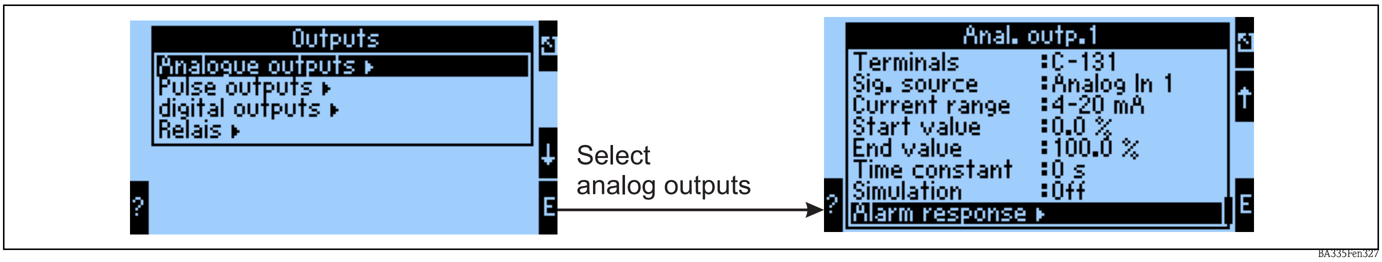


Fig. 43: Configuration of the analog output

- Identifier: give the analog output a name
- Terminal at which the analog signal is to be output (selection possibilities dependent on the device configuration).
- Signal Source: the input / mathematics channel that is to be output.
- Current Range: 0 to 20mA or 4 to 20mA
- Start/End Value: scaling of the current value that is to be output.
- Time Constant: used for filtering high-frequency interference signals.
- Simulation: off = output is not operated in the simulation mode. A constant current value is output if the device is operated in the simulation mode. (For example, the simulation of a connected device.)
- Alarm Response: how should the device respond in the event of an error (range overshooting, etc.).

Pulse output

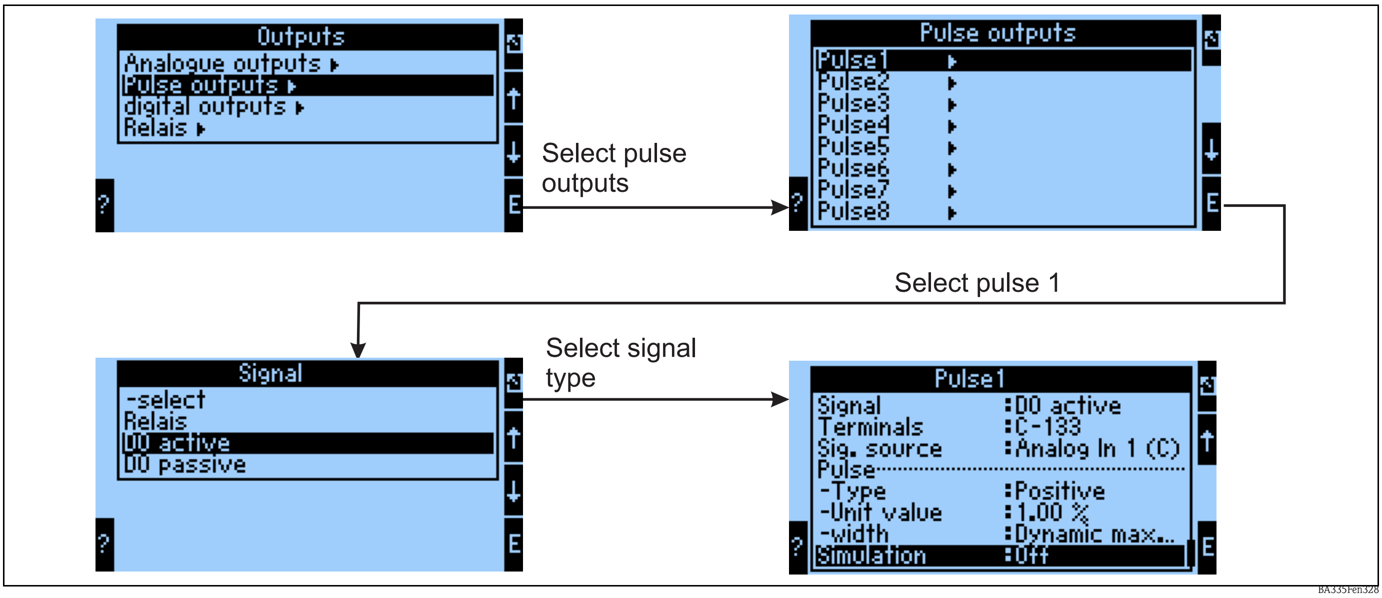


Fig. 44: Configuration of the pulse outputs

- Signal Type: how should the signal be output? Relay: max. 5 switching operations per sec., digital output active or passive
- Terminal at which the digital signal is to be output (selection possibilities dependent on the device configuration).
- Signal Source: which signal should be output as a pulse – reference to an integrated input (e.g: flow) or a counter.
- Pulse Type: positive/negative
- Pulse Value: if, for example, a pulse is output per 10 liters, then "10" has to be set at this operating item.

- Pulse Width: dynamic max. 120 ms: the pulse width is adapted to the update time of 250 ms; if, for example, 3 pulses are to be output per update time, then the pulse is approx. 40 ms high and 40 ms low.
- Simulation: off = output is not operated in the simulation mode. A constant current value is output if the device is operated in the simulation mode. (For example, the simulation of a connected device.)

Digital outputs

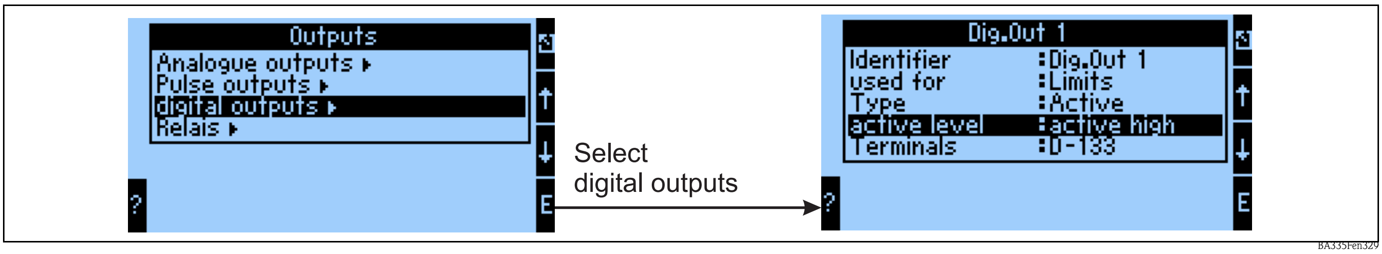


Fig. 45: Configuration of the digital outputs

- Selection of the output type (how should the device be used, e.g. as control outlet for a pump, as limit value, etc.)
- Transmit by: relay (e.g. if a pump is to be switched via a relay)

Relay

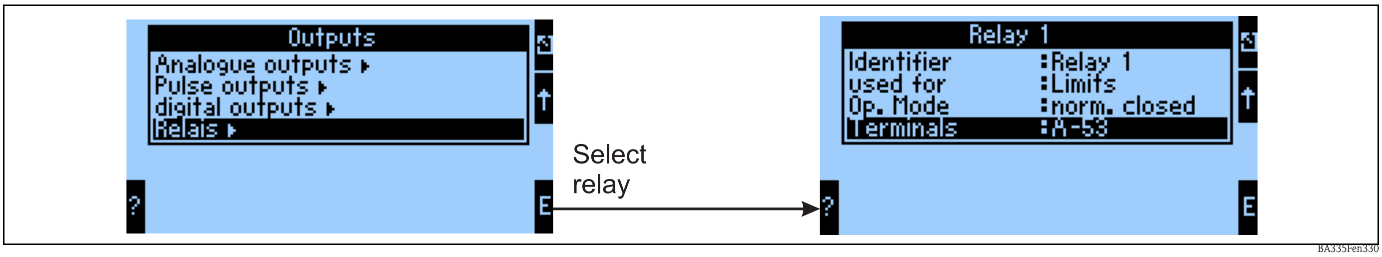


Fig. 46: Configuration of the relays

Limit values

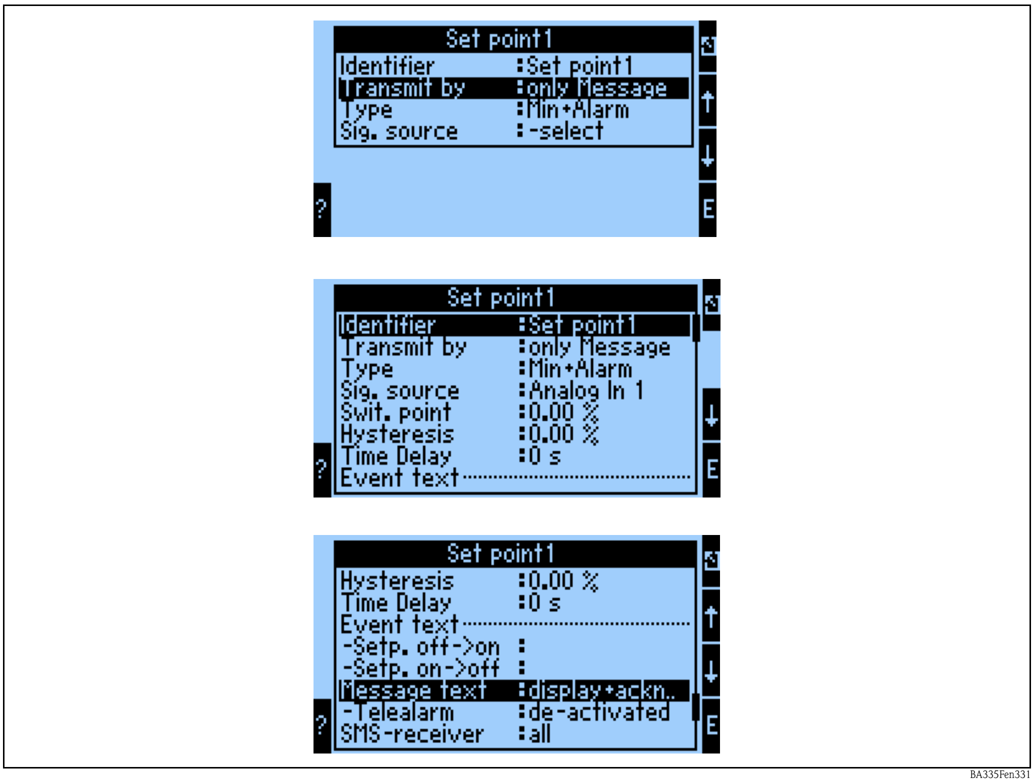


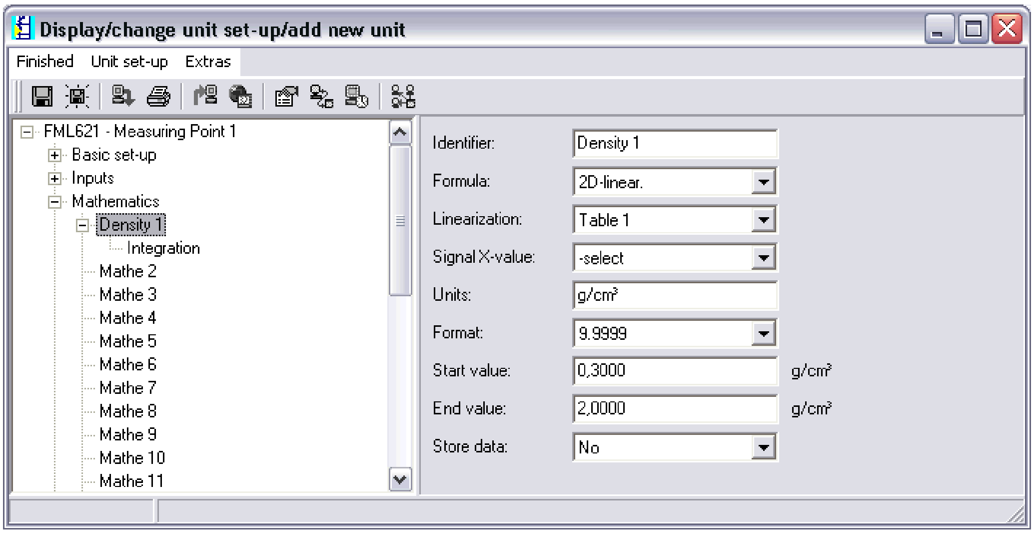
Fig. 47: Configuration of the limit values

- Identifier: give the limit value a name
- Transmit by: only on the display (purely message display, no issuing on an output)
- Type: the limit value is set when the minimum is undershot and when an alarm occurs
- Signal Source: link to the signal that is to be monitored
- Dimension: dimension of the value to be monitored
- Switch Point: when should the limit value be set (scaled value)
- Hysteresis: specify set point switch-back threshold to suppress set point bounce.
- Time Del.: after what length of time, in which the limit value has been violated for a sustained length of time, should the limit value be set.
- Setp. Off/On: text that is displayed in the respective status in the measured value display of the device
- Setp. Off ➔ On / On ➔ Off: text that is output in a message box when the respective change in status takes place (if no text has been entered, then no message box is displayed).
- Event Text: if a message box appears, the user is prompted to confirm it. (Alternatively, a telealarm (send SMS) can be configured here)

Mathematics

Formula: 2D-Linear

2D linearization gives users the possibility of taking simple reference density tasks into account (see Section 8.3). Here, the user specifies the curve (i.e. 1 to 5) which should be used and which input variable e.g. temperature or density – as the output of another mathematics channel – should be used to calculate the result.



BA335Fen310

Identifier
To provide greater transparency, this function can be given a name.

Formula (2D-Linear.)
The type of calculation is specified when a formula is selected.

Linearization
Here, you can specify the curve which should be used for calculating. The contents of the 2D table must be entered beforehand. (See Section 8.3)

Signal X-Value
Here, the user specifies which input information, e.g. temperature or density, should be used as the output of another mathematics channel to calculate the result.

Unit
The unit of the output is specified here. This can be a density or also °Brix, for example, for simpler applications.

Format
Here, you can specify the number of decimal places with which the signal value should be displayed.

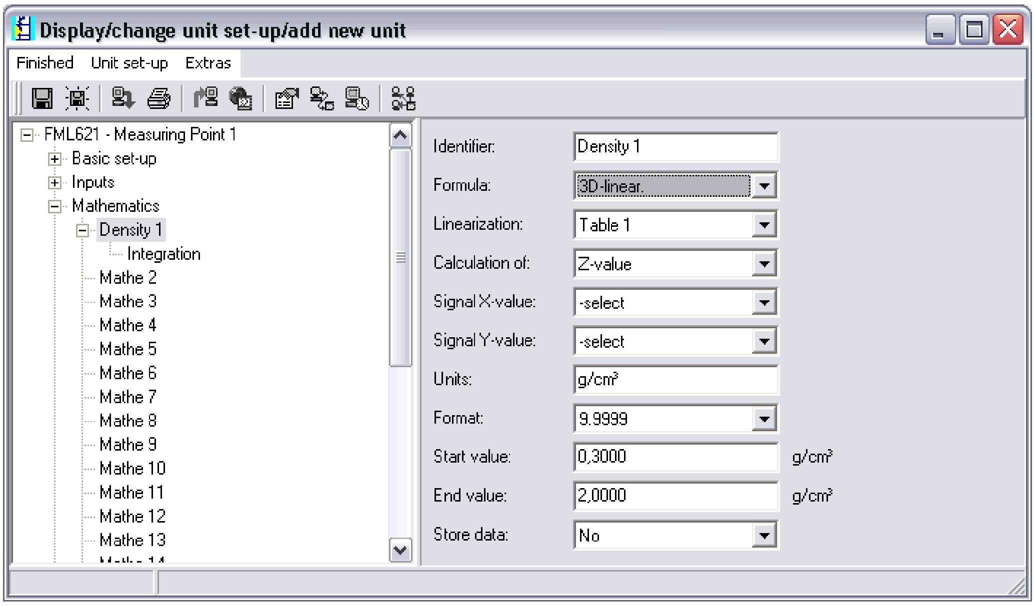
Start Value
Here you can specify which physical value, i.e. the variable specified under "Unit", corresponds to the minimum current value (0 or 4 mA) of the current signal.

End Value
Here you can specify which physical value, i.e. the variable specified under "Unit", corresponds to the maximum current value (20 mA) of the current signal.

Store Data
If this function is confirmed with "Yes", the values of the input channel are stored in the device memory. This is necessary to allow input channel monitoring.
In a separate step (see PFM/Pulse Inputs, for example), you can then specify the cycles for saving the value of the input channel.

Formula: 3D-Linear

3D linearization gives users the possibility of processing extensive concentration calculations (see Section 8.2). Here, the user specifies the curve (i.e. 1 to 5) which should be used and which input variables e.g. temperature and density should be used to calculate the result, e.g. °Brix.



BA335Fen101

Identifier
To provide greater transparency, this function can be given a name.

Formula (3D-Linear.)
The type of calculation is specified when a formula is selected.

Linearization
Here, you can specify the curve which should be used for calculating. The contents of the 3D table must be entered beforehand under "Curve". (See Page 126 ff.)

Calculation of
Depending on the application, a Z-axis or Y-axis breakdown can make sense. See Section 8.2.5 or 8.2.6.

Signal X-Value
Here, the user specifies the input information – e.g. temperature – which should be used to calculate the result.

Signal Y-Value
Here, the user specifies the input information – e.g. density – which should be used to calculate the result.

Unit
The unit of the output is specified here. This can be a density or also °Brix, for example, for simpler applications.

Format
Here, you can specify the number of decimal places with which the signal value should be displayed.

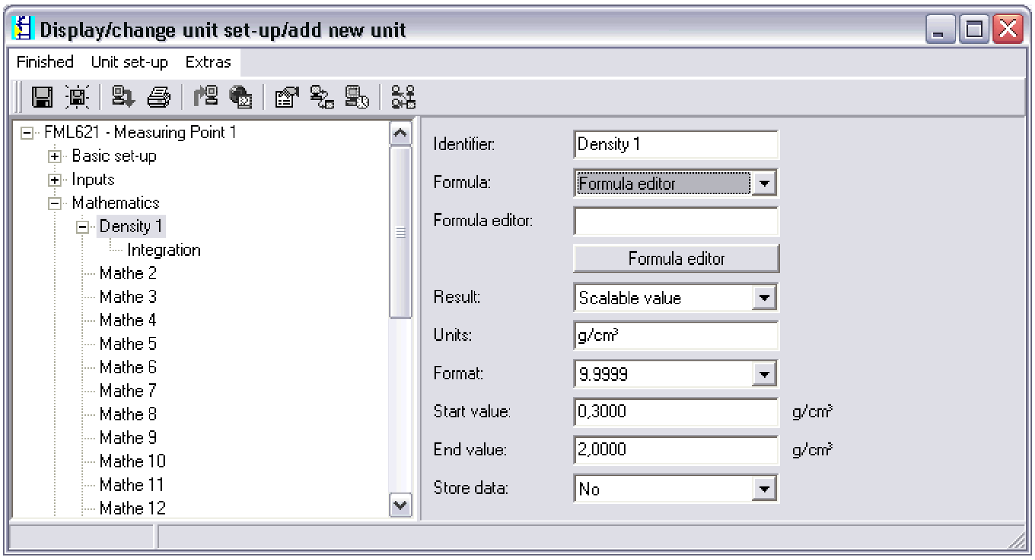
Start Value
Here you can specify which physical value, i.e. the variable specified under "Unit", corresponds to the minimum current value (0 or 4 mA) of the current signal.

End Value
Here you can specify which physical value, i.e. the variable specified under "Unit", corresponds to the maximum current value (20 mA) of the current signal.

Store Data
If this function is confirmed with "Yes", the values of the input channel are stored in the device memory. This is necessary to allow input channel monitoring.
In a separate step (see PFM/Pulse Inputs, for example), you can then specify the cycles for saving the value of the input channel.

Formula: Formula editor

The formula editor gives users the possibility of analyzing or calculating inputs mathematically. This can be useful if, for example, the mass of the medium is to be calculated from the level information and the density, or if a mass flow should be displayed in Kg for large mass flowmeters. (See also Section 7)



BA335Fen102

Identifier
To provide greater transparency, this function can be given a name.

Formula (Formula Editor)
With the Formula Editor button, an application is started with which mathematic formulae can be created.

Result is
Here you can specify whether this is a logical operation, a scalable value or a counter reading, or whether the hours of operation should be displayed. (See Section 7).

Unit
The unit of the output is specified here. This can be a density or also °Brix, for example, for simpler applications.

Format
Here, you can specify the number of decimal places with which the signal value should be displayed.

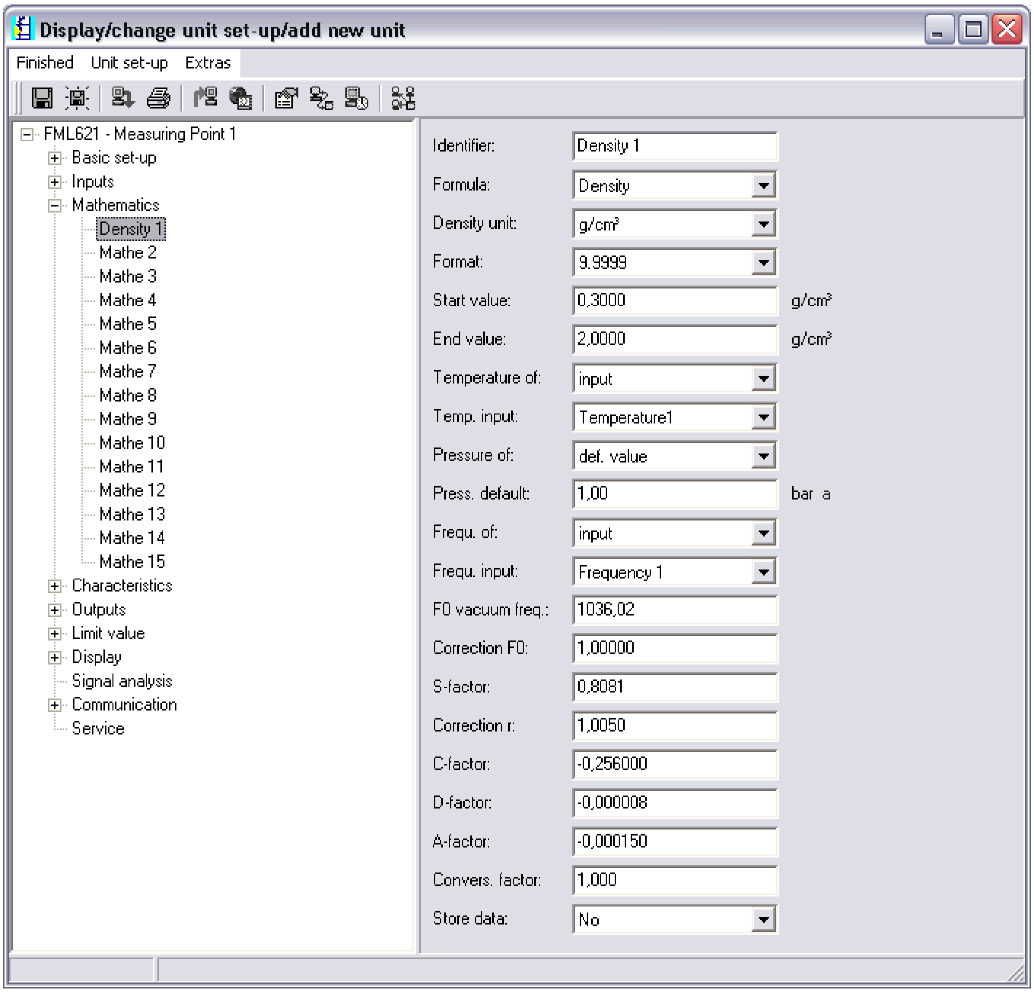
Start Value
Here you can specify which physical value, i.e. the variable specified under "Unit", corresponds to the minimum current value (0 or 4 mA) of the current signal.

End Value
Here you can specify which physical value, i.e. the variable specified under "Unit", corresponds to the maximum current value (20 mA) of the current signal.

Store Data
If this function is confirmed with "Yes", the values of the input channel are stored in the device memory. This is necessary to allow input channel monitoring.
In a separate step (see PFM/Pulse Inputs, for example), you can then specify the cycles for saving the value of the input channel.

Formula: Density

This module gives users the possibility of calculating a density from the input information "Frequency or Pulse" i.e. Liquiphant, temperature information (non-isothermal applications) and optional pressure information (application with a pressure fluctuation >+/-6bar). See Section "8.1 Density" or "6.3 Quick Start".



BA335Fen104

Identifier
To provide greater transparency, a name (e.g. Density 1) can be assigned to the mathematics channel selected. This name may only occur once in the system.

Formula (density)
The "Formula" menu is used to specify whether a specific program module, e.g. "Density", is used or whether a general mathematic interrelation should be established between the input and output channels.

Density Unit
Use this menu item to select the unit for displaying the density e.g. g/cm³ or lb/ft³.

Note!
The units and interdependencies with regard to °Brix, °Baumé, °API and °Twad are explained in the section on calculating the concentration. → Page 128 ff.

Format
Here, you can specify the number of decimal places with which the calculated value should be displayed.

Start Value
The Start Value is used for scaling a graphic illustration on the display unit. This specifies the lower value range e.g. 0.5 g/cm³.

End Value
The End Value is used for scaling a graphic illustration on the display unit. This specifies the upper value range e.g. 1.5 g/cm³.

"Temperature of", "Pressure of" and "Frequency"
The following input information now has to be assigned to the Density 1 module.

A distinction is made between two types of input, namely the physical input or a default value. The default value is used for simulation purposes and can display a value that corresponds to the process conditions if a process sensor, such as a temperature sensor, is not available.

Example:
A process temperature of 20 °C could be specified for an application which is operated at a constant temperature.

Assigning temperature information

✎ Note!
By specifying the region under Setup -> Basic Setup -> Region, the corresponding unit is automatically specified. This unit must be taken into consideration in all subsequent settings, e.g. scaling the temperature input.

Temperature 1 must be scaled:
- Region: Europe -> °C
- Region: USA -> °F

Assigning pressure information

✎ Note!
By specifying the region under Setup -> Basic Setup -> Region, the corresponding unit is automatically specified. This unit must be taken into consideration in all subsequent settings, e.g. scaling the pressure input.

- Region: Europe -> bar (absolute pressure)
- Region: USA -> psi (absolute pressure)

Assigning frequency information
The frequency input can be assigned in this function.

Correction factors (sensor-specific parameters)
Once all the input information has been specified, the sensor-specific parameters now have to be entered.

✎ Note!
When you order a Liquiphant M for density measurement, a special sensor calibration report is enclosed and contains the following fork-specific parameters:

- **F0 Vacuum Frequency:** vibration frequency of the fork in a vacuum at 0 °C (Hz)
- **Correction F0:** correction value (multiplier) for F0 vacuum frequencies. This value is calculated during field calibration but can also be changed manually and reset to 1 for example.
- **S-Factor:** density sensitivity of the tuning fork (cm^3/g)
- **Correction r:** the S-Factor is multiplied by this value. This value depends on the installation (see Section 3).
- **C-Factor:** linear temperature coefficient of the fork (Hz/°C)
- **D-Factor:** pressure coefficient (1/bar)
- **A-Factor:** quadratic temperature coefficient of the fork ($Hz/[°C]^2$)

- **Convers. fact.:** the conversion factor is a multiplier (offset) for the calculated density value.

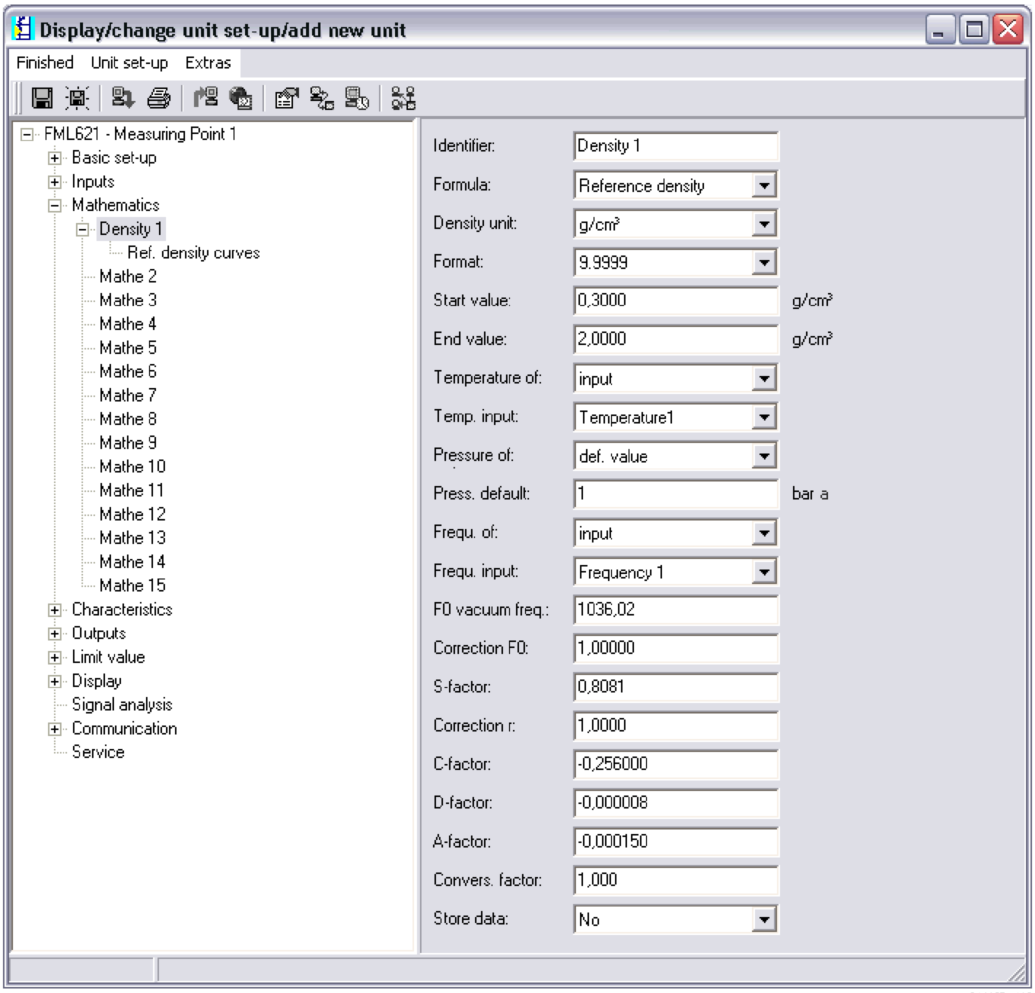
On leaving the factory, the S, C, D and A factors are assigned average values for the material 316L. The vacuum frequency is assigned 0.00 to ensure that these values are entered.

Note!
The measuring system does not achieve the specified level of accuracy until the individual sensor-specific parameters have been entered!
The measuring system does not achieve the specified level of accuracy until the sensor-specific parameters have been entered. These parameters are contained in the sensor adjustments of the Liquiphant M Density (in the housing).

Store Data
If this function is confirmed with "Yes", the calculated density values are stored in the device memory. This is necessary to allow density information monitoring. In a separate step (see Pulse Inputs), you can then specify the cycles for saving the value.

Formula: Reference Density

Definition: the reference density is a medium density at standard conditions.
The density of a liquid depends on the temperature since it increases in volume with increasing temperature.
Thus, measured density values can only be compared with one another at the same temperature.
This module gives users the possibility to display at reference conditions, i.e. using a table, even though the process is not running under reference conditions.
See also Section "see Section 8.3 Reference density"



BA335Fen105

Identifier
To provide greater transparency, a name (e.g. Density 1) can be assigned to the mathematics channel selected. This name may only occur once in the system.

Formula (Reference Density)
The "Formula" menu is used to specify whether a specific program module, e.g. "Density", is used or whether a general mathematic interrelation should be established between the input and output channels.

- **Ref. Density Curves:** In contrast to 2D linearization, the 2D curve can be entered directly in this module. This is carried out with the aid of up to 15 points that can be saved.

Density Unit
Use this menu item to select the unit for displaying the density e.g. g/cm³ or lb/ft³.

Note!
The units and interdependencies with regard to °Brix, °Baumé, °API and °Twad are explained in the section on calculating the concentration. → Page 128 ff.

Format
Here, you can specify the number of decimal places with which the calculated value should be displayed.

Start Value
The Start Value is used for scaling a graphic illustration on the display unit. This specifies the lower value range e.g. 0.5 g/cm^3.

End Value
The End Value is used for scaling a graphic illustration on the display unit. This specifies the upper value range e.g. 1.5 g/cm^3.

"Temperature of", "Pressure of" and "Frequency"
The following input information now has to be assigned to the Density 1 module.

A distinction is made between two types of input, namely the physical input or a default value. The default value is used for simulation purposes and can display a value that corresponds to the process conditions if a process sensor, such as a temperature sensor, is not available.

Example:
A process temperature of 20 °C could be specified for an application which is operated at a constant temperature.

Assigning temperature information

✎ Note!
By specifying the region under Setup -> Basic Setup -> Region, the corresponding unit is automatically specified. This unit must be taken into consideration in all subsequent settings, e.g. scaling the temperature input.

Temperature 1 must be scaled:
- Region: Europe -> °C
- Region: USA -> °F

Assigning pressure information

✎ Note!
By specifying the region under Setup -> Basic Setup -> Region, the corresponding unit is automatically specified. This unit must be taken into consideration in all subsequent settings, e.g. scaling the pressure input.

- Region: Europe -> bar (absolute pressure)
- Region: USA -> psi (absolute pressure)

Assigning frequency information
The frequency input can be assigned in this function.

Correction factors (sensor-specific parameters)
Once all the input information has been specified, the sensor-specific parameters now have to be entered.

✎ Note!
When you order a Liquiphant M for density measurement, a special sensor calibration report is enclosed and contains the following fork-specific parameters:

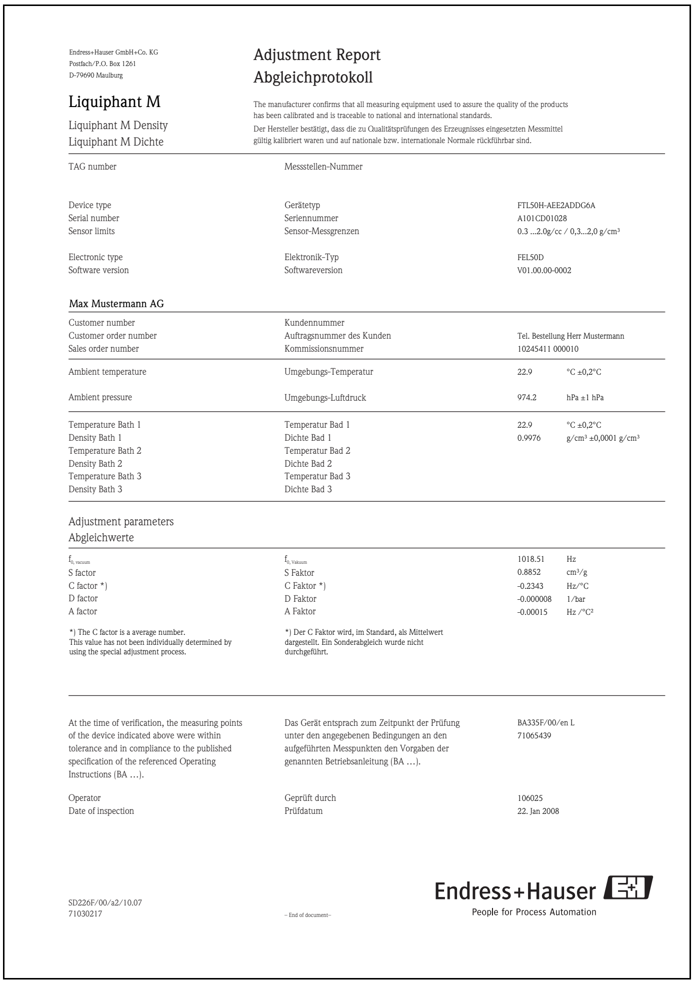
- **F0 Vacuum Frequency:** vibration frequency of the fork in a vacuum at 0 °C (Hz)
- **Correction F0:** correction value (multiplier) for F0 vacuum frequencies.
- **S-Factor:** density sensitivity of the tuning fork (cm^3/g)
- **Correction r:** the S-Factor is multiplied by this value. This value depends on the installation (see Section 3).
- **C-Factor:** linear temperature coefficient of the fork (Hz/°C)

- **D-Factor:** pressure coefficient (1/bar)
- **A-Factor:** quadratic temperature coefficient of the fork (Hz/[°C]²)
- **Convers. Fact.:** the conversion factor is a multiplier (offset) for the calculated density value.

On leaving the factory, the S, C, D and A factors are assigned values for the different sensors (316L, Alloy C4, coatings, etc.). The vacuum frequency is assigned 0.00 to ensure that these values are entered.

Note!
The measuring system does not achieve the specified level of accuracy until the individual sensor-specific parameters have been entered in the Density Computer FML621! The sensor-specific parameters are printed in the calibration report and in the "sensor adjustments".

Calibration report (example)



Endress+Hauser GmbH+Co. KG
Postfach/P.O. Box 1261
D-79690 Maulburg

Adjustment Report
Abgleichprotokoll

Liquiphant M
Liquiphant M Density
Liquiphant M Dichte

The manufacturer confirms that all measuring equipment used to assure the quality of the products has been calibrated and is traceable to national and international standards.
Der Hersteller bestätigt, dass die zu Qualitätsprüfungen des Erzeugnisses eingesetzten Messmittel gültig kalibriert waren und auf nationale bzw. internationale Normale rückführbar sind.

TAG number	Messstellen-Nummer		
Device type	Gerätetyp	FTL50H-AEE2ADDG6A	
Serial number	Seriennummer	A101CD01028	
Sensor limits	Sensor-Messgrenzen	0.3 ...2.0g/cc / 0,3...2,0 g/cm³	
Electronic type	Elektronik-Typ	FEL50D	
Software version	Softwareversion	V01.00.00-0002	

Max Mustermann AG

Customer number	Kundennummer		
Customer order number	Auftragsnummer des Kunden	Tel. Bestellung Herr Mustermann	
Sales order number	Kommissionsnummer	10245411 000010	
Ambient temperature	Umgebungs-Temperatur	22.9	°C ±0,2°C
Ambient pressure	Umgebungs-Luftdruck	974.2	hPa ±1 hPa
Temperature Bath 1	Temperatur Bad 1	22.9	°C ±0,2°C
Density Bath 1	Dichte Bad 1	0.9976	g/cm³ ±0,0001 g/cm³
Temperature Bath 2	Temperatur Bad 2		
Density Bath 2	Dichte Bad 2		
Temperature Bath 3	Temperatur Bad 3		
Density Bath 3	Dichte Bad 3		

Adjustment parameters
Abgleichwerte

$f_{0, vacuum}$	$f_{0, Vakuum}$	1018.51	Hz
S factor	S Faktor	0.8852	cm³/g
C factor *)	C Faktor *)	-0.2343	Hz/°C
D factor	D Faktor	-0.000008	1/bar
A factor	A Faktor	-0.00015	Hz /°C²

*) The C factor is a average number. This value has not been individually determined by using the special adjustment process.
*) Der C Faktor wird, im Standard, als Mittelwert dargestellt. Ein Sonderabgleich wurde nicht durchgeführt.

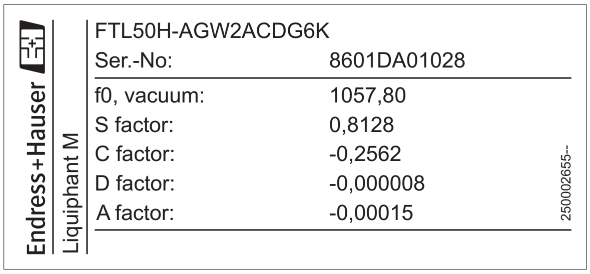
At the time of verification, the measuring points of the device indicated above were within tolerance and in compliance to the published specification of the referenced Operating Instructions (BA ...).
Das Gerät entsprach zum Zeitpunkt der Prüfung unter den angegebenen Bedingungen an den aufgeführten Messpunkten den Vorgaben der genannten Betriebsanleitung (BA ...).
BA335F/00/en L
71065439

Operator	Geprüft durch	106025
Date of inspection	Prüfdatum	22. Jan 2008

SD226F/00/a2/10.07
71030217
– End of document–
Endress+Hauser
People for Process Automation

Adjustment protocol

Sensor adjustments (example)



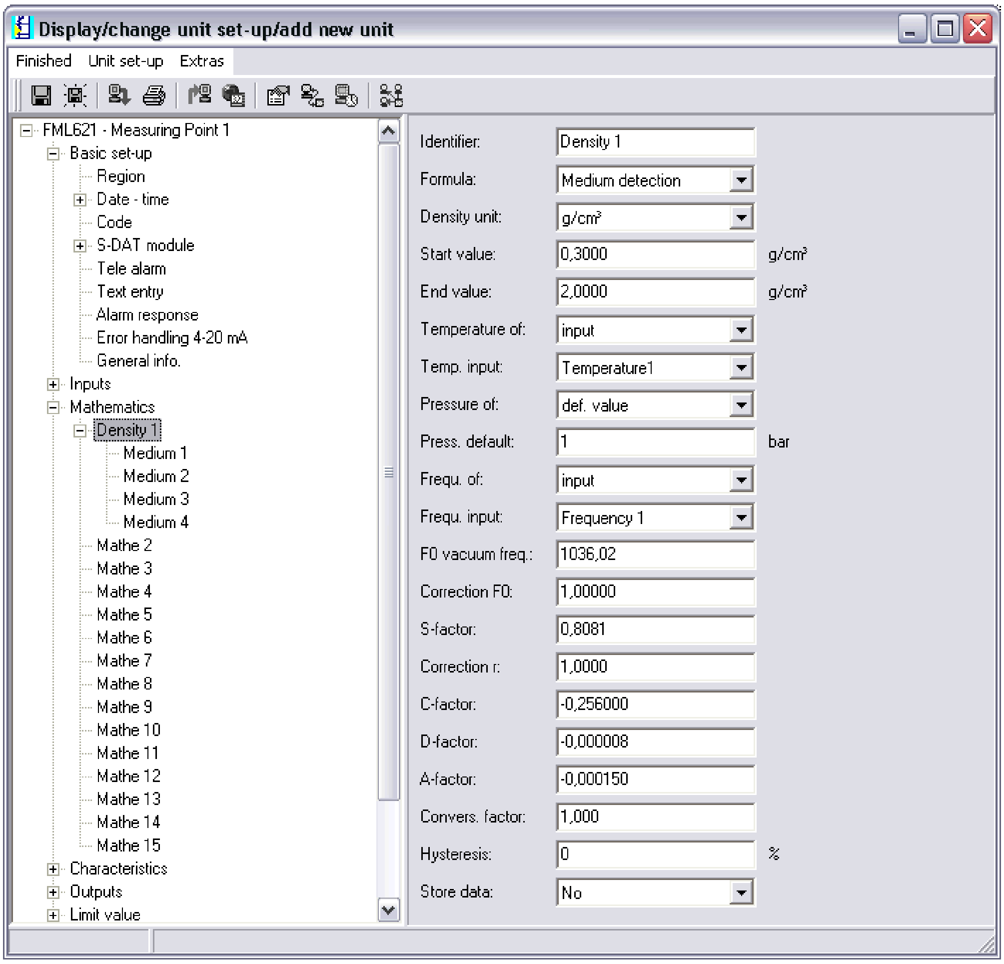
Sensorpass

Store Data

If this function is confirmed with "Yes", the calculated density values are stored in the device memory. This is necessary to allow density information monitoring. In a separate step (see Pulse Inputs), you can then specify the cycles for saving the value.

Formula: Medium Detection

The medium detection section allows users to distinguish between oil and water, for example. As only one straight line is taken into account for the effect between the temperature and density of the medium, this application is only recommended for simple applications. To distinguish media more precisely, use 2D or 3D linearization.
See also Section 8.4 "Medium detection" or 8.2 "Concentration".



BA335Fen106

Identifier
To provide greater transparency, a name (e.g. Density 1) can be assigned to the mathematics channel selected. This name may only occur once in the system.

Formula (Medium Detection)
The "Formula" menu is used to specify whether a specific program module, e.g. "Density", is used or whether a general mathematic interrelation should be established between the input and output channels.

- **Medium 1 - 4:** The media data can be stored directly here. These are illustrated simply only using a line function with regard to the change in density compared to the temperature.

Density Unit
Use this menu item to select the unit for displaying the density e.g. g/cm³ or lb/ft³.

Note!
The units and interdependencies with regard to °Brix, °Baumé, °API and °Twad are explained in the section on calculating the concentration. → Page 128 ff.

Format
Here, you can specify the number of decimal places with which the calculated value should be displayed.

Start Value
The Start Value is used for scaling a graphic illustration on the display unit. This specifies the lower value range e.g. 0.5 g/cm³.

End Value
The End Value is used for scaling a graphic illustration on the display unit. This specifies the upper value range e.g. 1.5 g/cm³.

"Temperature of", "Pressure of" and "Frequency"
The following input information now has to be assigned to the Density 1 module.

A distinction is made between two types of input, namely the physical input or a default value. The default value is used for simulation purposes and can display a value that corresponds to the process conditions if a process sensor, such as a temperature sensor, is not available.

Example:
A process temperature of 20 °C could be specified for an application which is operated at a constant temperature.

Assigning temperature information

✎ Note!
By specifying the region under Setup -> Basic Setup -> Region, the corresponding unit is automatically specified. This unit must be taken into consideration in all subsequent settings, e.g. scaling the temperature input.

Temperature 1 must be scaled:
- Region: Europe -> °C
- Region: USA -> °F

Assigning pressure information

✎ Note!
By specifying the region under Setup -> Basic Setup -> Region, the corresponding unit is automatically specified. This unit must be taken into consideration in all subsequent settings, e.g. scaling the pressure input.

- Region: Europe -> bar (absolute pressure)
- Region: USA -> psi (absolute pressure)

Assigning frequency information
The frequency input can be assigned in this function.

Correction factors (sensor-specific parameters)
Once all the input information has been specified, the sensor-specific parameters now have to be entered.

✎ Note!
When you order a Liquiphant M for density measurement, a special sensor calibration report is enclosed and contains the following fork-specific parameters:

- **F0 Vacuum Frequency:** vibration frequency of the fork in a vacuum at 0 °C (Hz)
- **Correction F0:** correction value (multiplier) for F0 vacuum frequencies.
- **S-Factor:** density sensitivity of the tuning fork (cm^3/g)
- **Correction r:** the S-Factor is multiplied by this value. This value depends on the installation (see Section 3).
- **C-Factor:** linear temperature coefficient of the fork (Hz/°C)

- **D-Factor:** pressure coefficient (1/bar)
- **A-Factor:** quadratic temperature coefficient of the fork (Hz/[°C]²)
- **Convers. Fact.:** the conversion factor is a multiplier (offset) for the calculated density value.

On leaving the factory, the S, C, D and A factors are assigned average values for the material 316L. The vacuum frequency is assigned 0.00 to ensure that these values are entered.

Note!
The measuring system does not achieve the specified level of accuracy until the individual sensor-specific parameters have been entered!

Store Data
If this function is confirmed with "Yes", the calculated density values are stored in the device memory. This is necessary to allow density information monitoring. In a separate step (see Pulse Inputs), you can then specify the cycles for saving the value.

Storage

The FML621 has 3 different storage media for storing values:
- Flash memory (permanently built in to the device) - storage according to the specified storage interval
- S-Dat module (removable) - storage takes place 1x/hour
- FRAM (permanently built into the device) - storage according to the specified storage interval

	Op. Data	Continuous counters (statistics) Min./Max./Mean value	Event buffer	Default values (statistics) Min./Max./Mean value of the last interval
FRAM (permanently built in)		✓		
Flash memory (permanently built in)	✓		✓	✓
S-Dat module (removable)	✓	✓		

The "Store Data" option can be activated for analog inputs, pulse inputs, digital inputs and mathematics channels. This enables you to specify that values are stored for the respective input / channel (see the following table).
In addition, the integrated value can be stored for analog inputs and mathematics channels, i.e. the measured current values are integrated and stored in the device along with the Min./Max./Mean value.
These values can then be read out in the Navigator via the "Analysis" menu by "Counter Values" and "Statistics" (Min./Max./Mean values and current counter and preliminary counter directly at the device, archived values with ReadWin® 2000).
In the "Signal Analysis" menu item, interval-based intermediate evaluations, daily, monthly, yearly evaluations can then be activated:
- Intermediate Analysis: here you can configure at what interval the values are to be stored (no=no intermediate evaluation, 1, 2, 3, 4, 5, 10, 15, 30 min, 1, 2, 3, 4, 6, 8, 12h)
- Day: no, yes: daily values of the counters
- Month: no, yes: monthly values of the counters
- Year: no, yes: yearly values of the counters
- Synch. Time: hh:mm: daily evaluation at the time of synchronization (applies to intermediate evaluation, day, month, year)
- Reset: yes / no: when this operating item is selected, all counters are reset.
- Memory Info: the memory still available in the device is determined.

Note!
Reporting only takes place if "No" is selected for the "Interm. Anal." function.

Signal Analysis

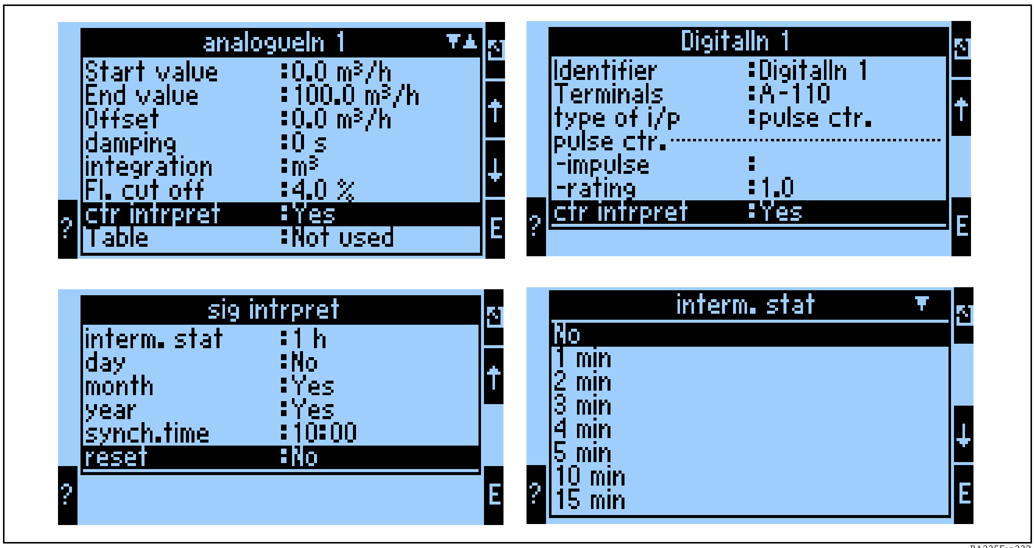


Fig. 48: Configuration of the signal analysis

Counter evaluation:
Yes: storage of the counter readings as per stored interval

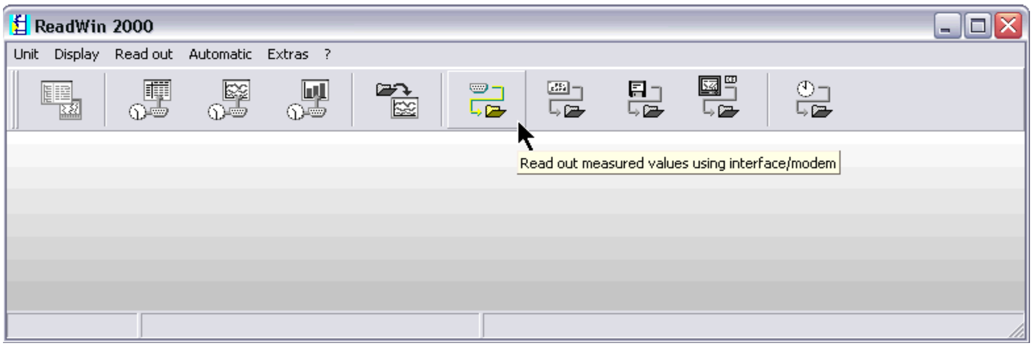
Signal Analysis:
Setting, which specifies how the signals are to be evaluated:
- Inter. Anal.: here you can specify at what interval the values are to be stored (no=no intermediate analysis, 1, 2, 3, 4, 5, 10, 15, 30 min, 1, 2, 3, 4, 6, 8, 12h)
- Day: no, yes
- Month: no, yes
- Year: no, yes
- Synch. Time: hh:mm: daily evaluation at the time of synchronization (applies to intermediate evaluation, day, month, year)
- Reset: no, intermediate evaluation, day, month, year, all counters are reset when ENTER is actuated
- Memory Info: how much memory is currently still available

With ReadWin® 2000 :

Note!
The ReadWin® 2000 operating program from Endress+Hauser forms part of the scope of delivery.

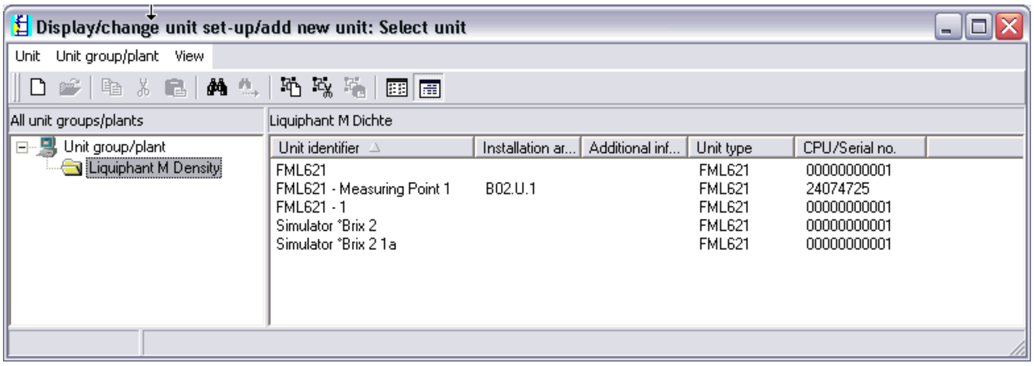
Read out measured values per interface/modem

Step 1: Start action



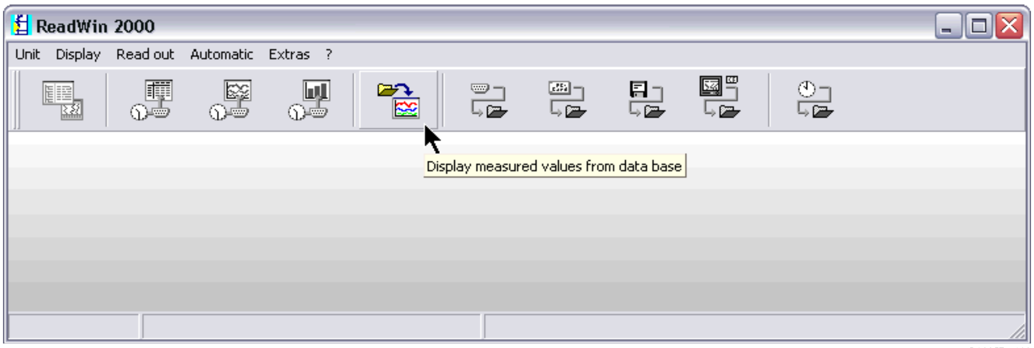
BA335Fen107

Step 2: selection of the configuration, whose archived measured values are to be read out



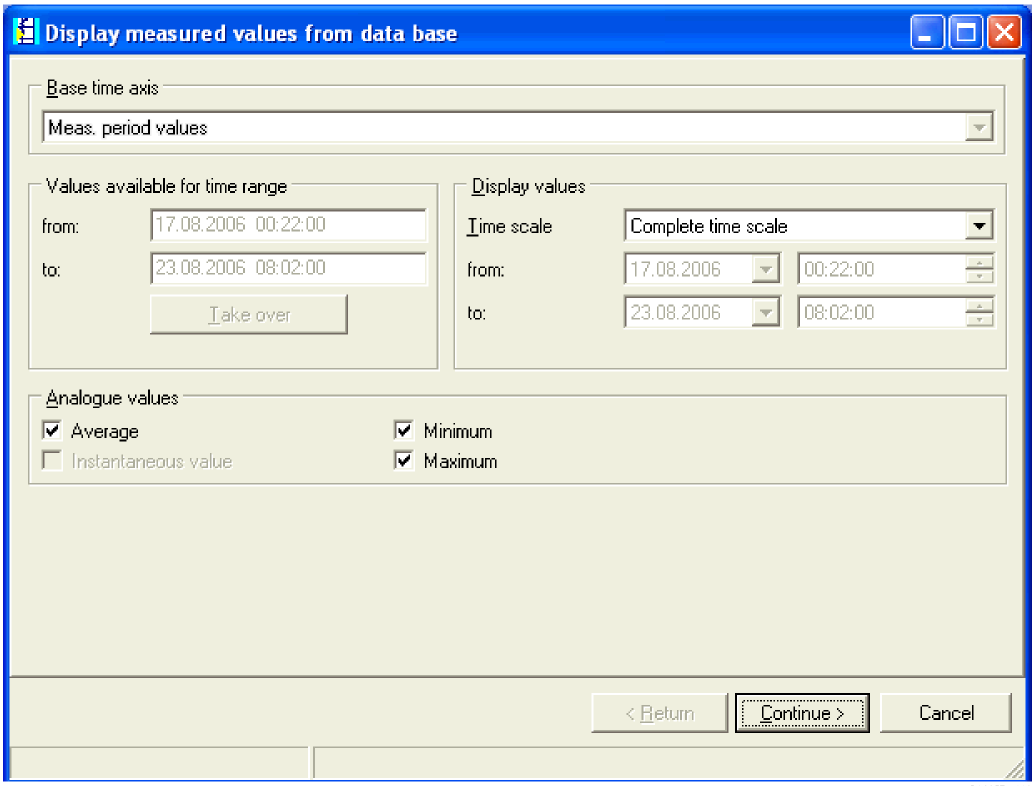
BA335Fen114

Step 3: display read-out measured values



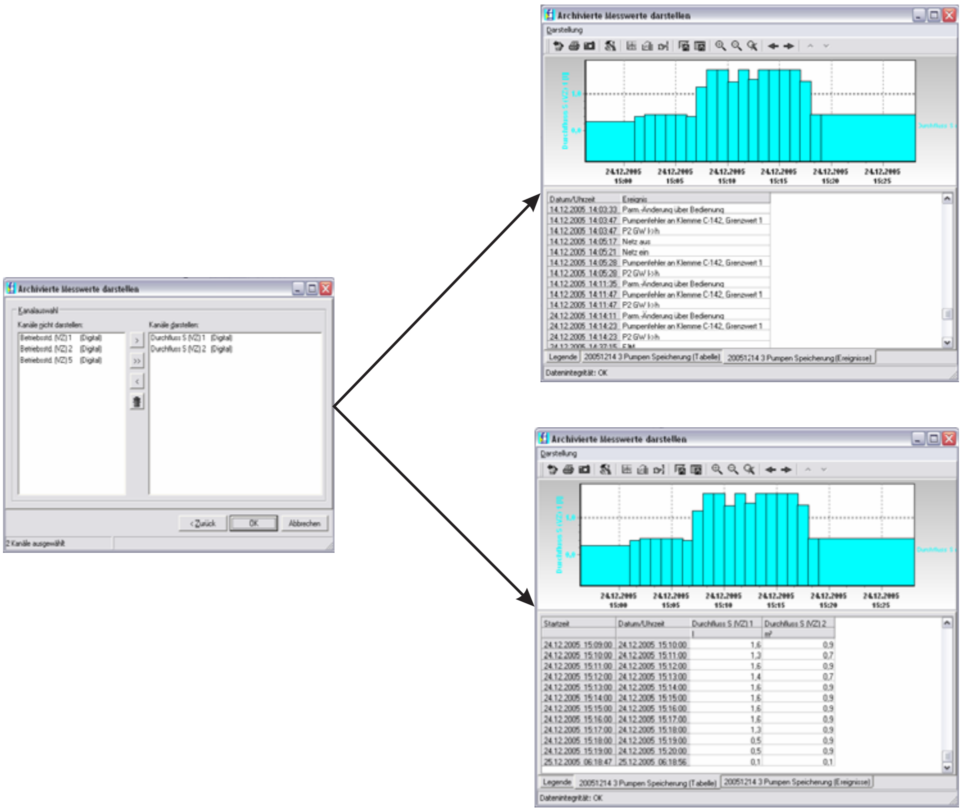
BA335Fen109

Step 4: configuration of the output and selection of the desired values



BA335Fen110

Step 5: display of the read-out values as bargraph, measured value table and the accumulated events



BA335Fen345

Telealarm configuration

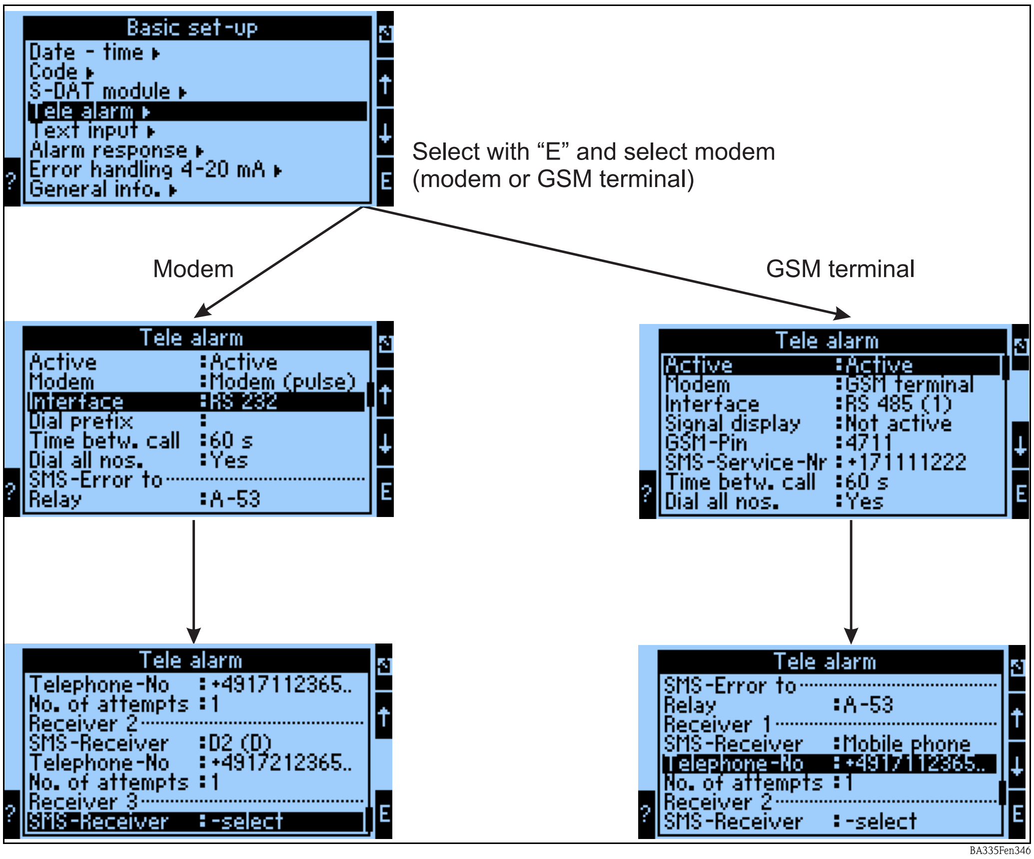


Fig. 49: Telealarm configuration at the FML621 onsite

The "Telealarm" function is used for forwarding alarms, e.g. to a cellular phone or to a PC; this function is configured in the basic setup. For example, the following are configured here:
- Which modem type
  - GSM terminal,
  - Modem (pulse dialing method) or
  - Modem (tone dialing method)

  is used,
- Which interface with which baudrate is used
- Whether a dial prefix is necessary (not for GSM)
- Signal Display.: display of the signal strength – above all for testing in the event of transmission difficulties (only for GSM)
- SMS Service No.: number of the SMS gateway of the mobile network operator (only for GSM)
- Pause: a defined waiting time is maintained between 2 transmission attempts
- Should all numbers defined in the sequence be dialed? i.e. if it was not possible to reach the first defined number, then the second number is used, etc.
- SMS-Err. Terminal: if it was not possible to transfer an SMS correctly to the modem, then a relay can be switched to activate an external system to display the problem.
- Receiver 1: cellular phone or PC software (for GSM), or D1 (D) or cellular phone (for modem)
- Telephone No. 1: "+"country code, followed by the telephone number of the desired participant
- Number of attempts before the next participant is to be dialed.

The same configuration using ReadWin® 2000 is displayed below; the individual steps correspond to those of the "Telealarm configuration: at FML621 on site" (see Fig. 49)

Telealarm configuration in ReadWin® 2000

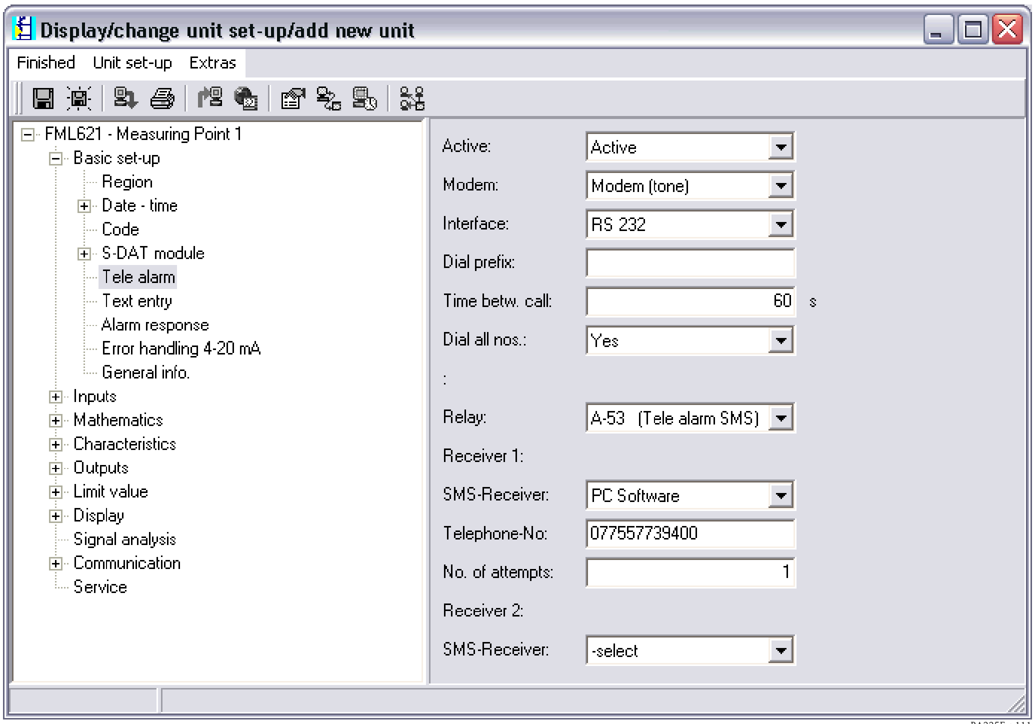


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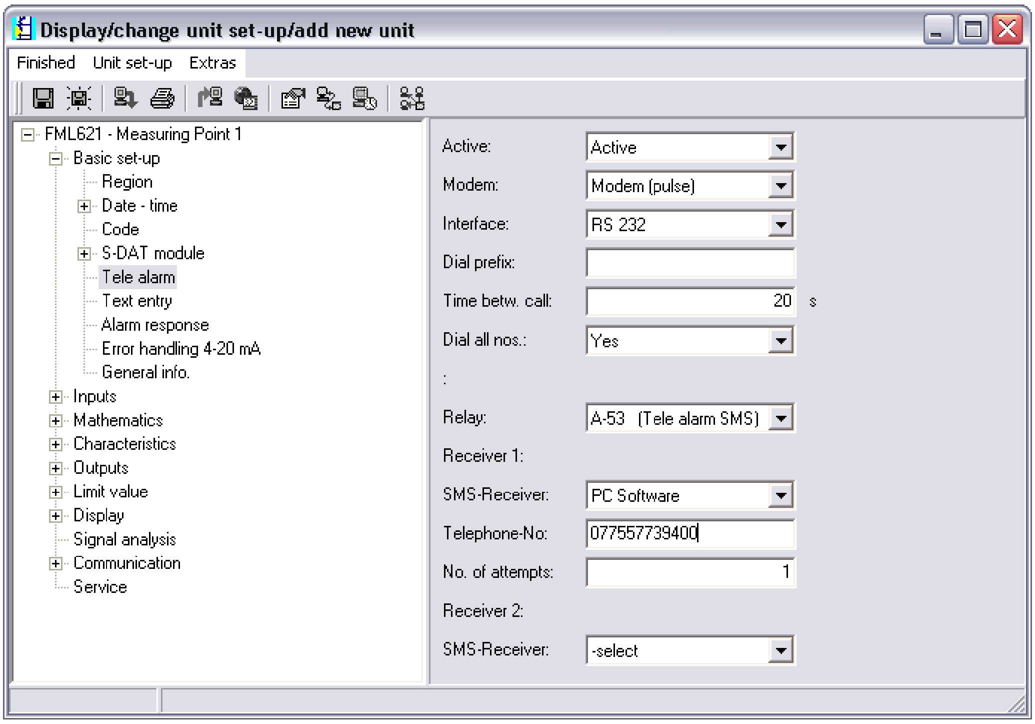
Fig. 50: Configuration of Telealarm for modem with tone dialing in ReadWin® 2000



BA335Fen112

Fig. 51: Configuration of Telealarm for modem with pulse dialing in ReadWin® 2000

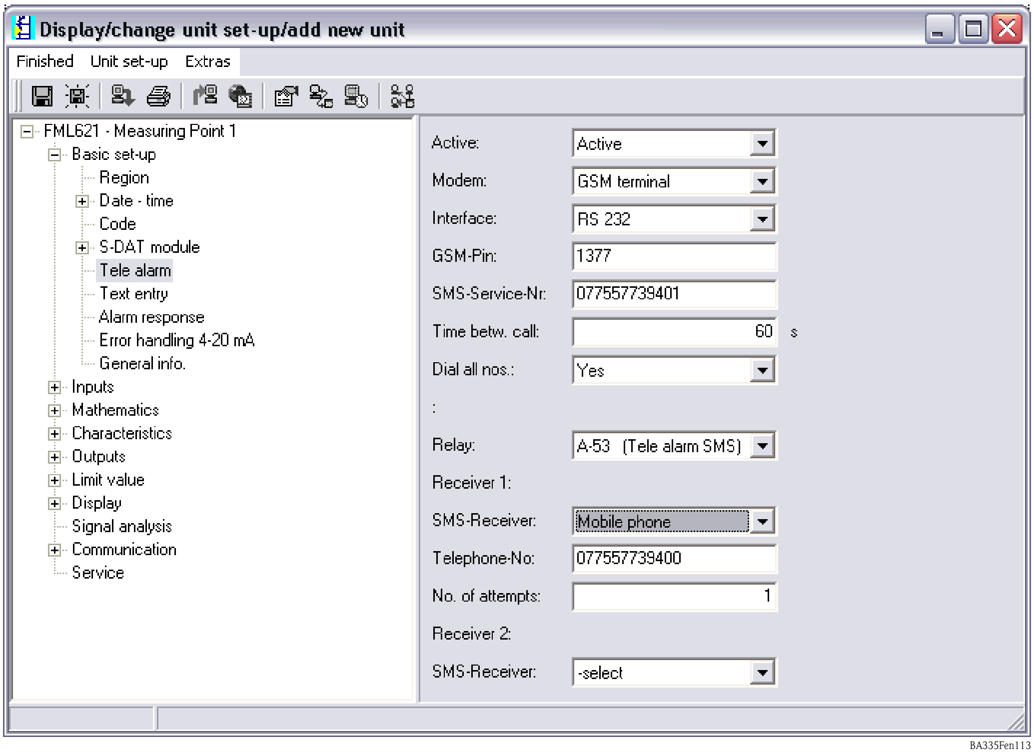


Fig. 52: Configuration of Telealarm for GSM terminal in ReadWin® 2000

The following illustrations describe how the connection is established:

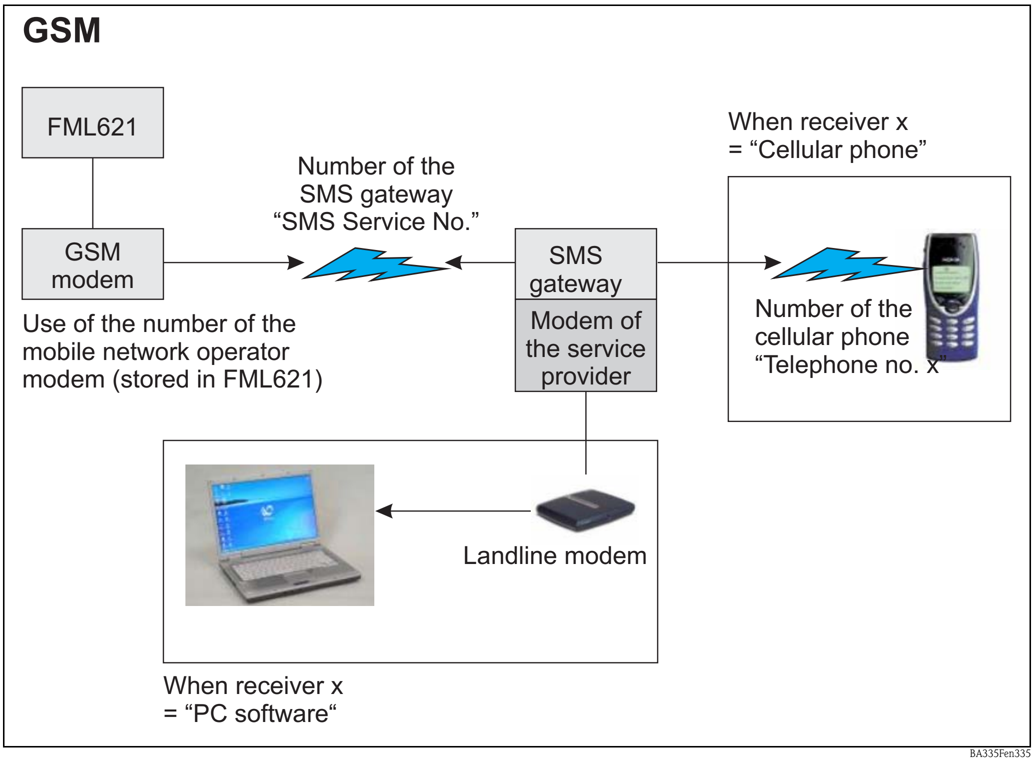


Fig. 53: Communication with cellular phone (SMS) via GSM modem (at FML621) and SMS gateway, or modem of the service provider

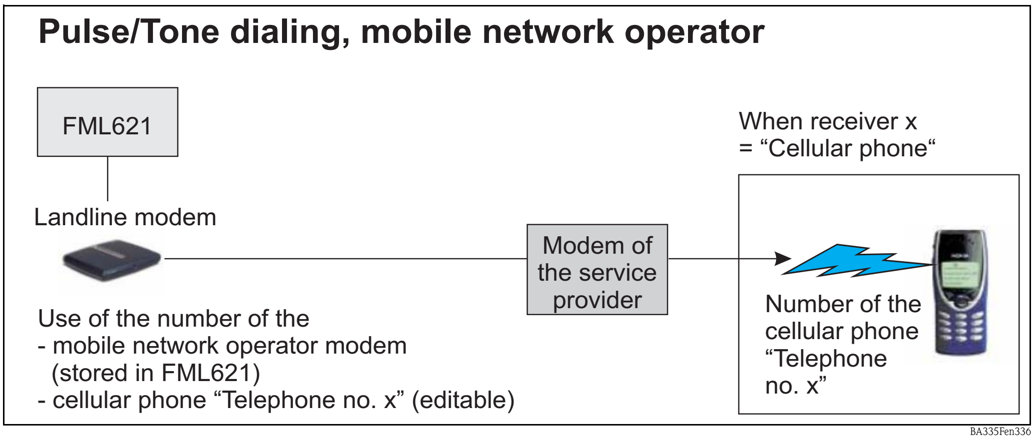


Fig. 54: Communication with cellular phone (SMS) via modem of the service provider

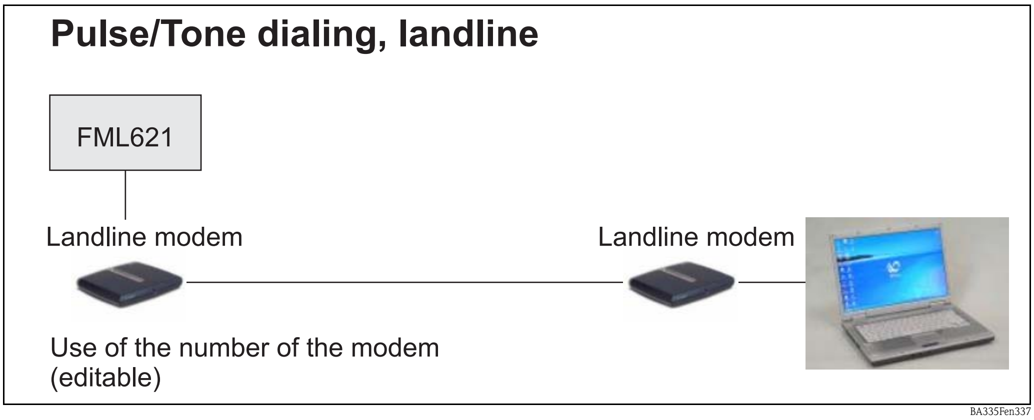


Fig. 55: Communication with PC (e.g. ReadWin® 2000)

Communication

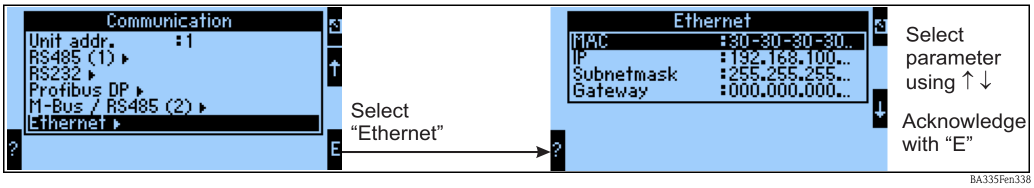


Fig. 56: Configuration of the Ethernet interface

- Configuration of the MAC address: is already permanently stored in the delivery status of the device, cannot be changed, is uniquely assigned to the device
- IP address: configuration of the IP address – is usually issued by the system administrator of the local network
- Subnet mask: Enter the subnet mask (you can obtain this from your network administrator). The subnet mask must be entered if the device is intended to establish connections into another partial network. Specify the subnet mask of the partial network, in which the device is located (e.g. 255.255.255.000). Please note: the class of network is determined by the IP address. This results in a default subnet mask (e.g. 255.255.000.000 for a Class B network).
- Gateway: enter the gateway (you can obtain this from the network administrator). Enter the address of the gateway here if connections into other networks are to be established.

7 Formula editor

7.1 General information

- The formula can consist of "analog" and "digital" parts. The following operators and functions are available.
- Mathematics channels can be cascaded one below the other, i.e. the result of the first calculation can continue to be used for the next calculation. However, it is only possible to use the calculated values of a "previous" channel (e.g. maths channel 3 can access the results of maths channels 1 and 2, but not maths channels 4 to 8).
- The formula entered can be max. 200 characters long.

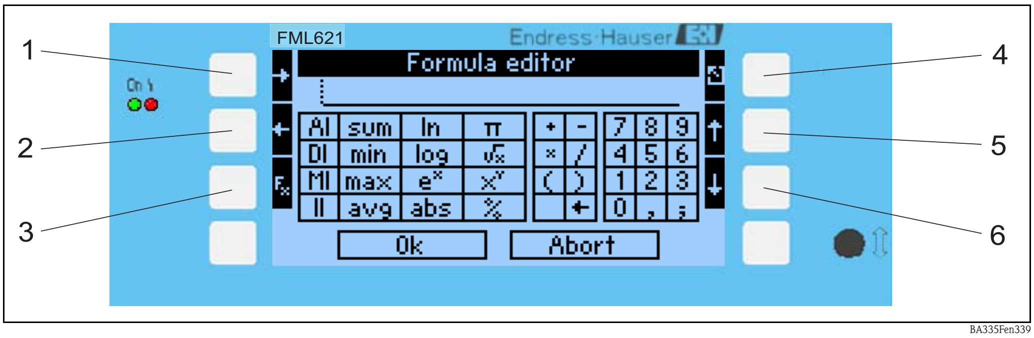


Fig. 57: FML621 formula editor

1) Move cursor to the right
2) Move cursor to the left
3) Switch between the available mathematics functions
4) Back to the menu of the mathematics channel
5) Move cursor upwards
6) Move cursor downwards

7.1.1 The formula editor in the PC operating software

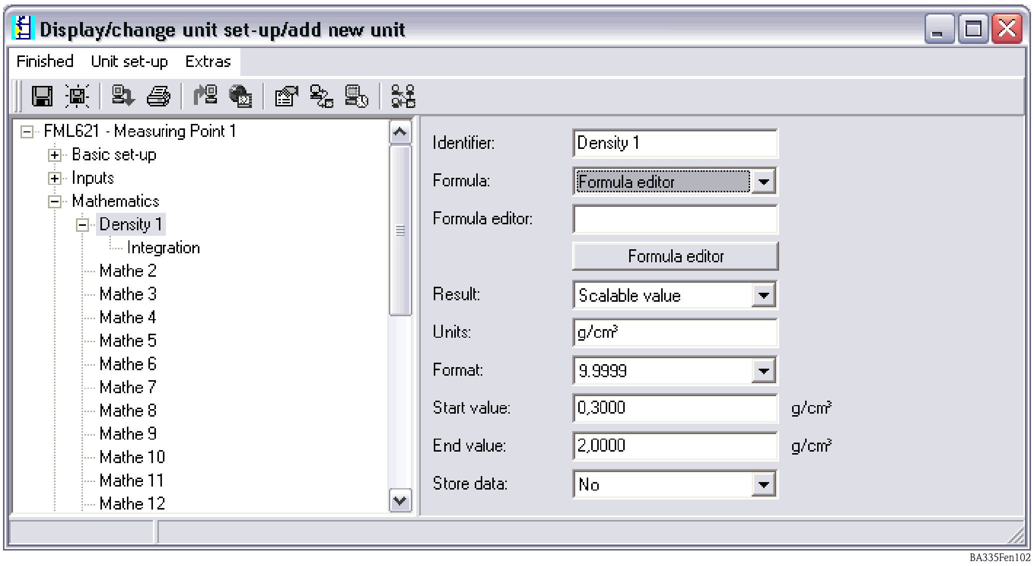


Fig. 58: Call the formula editor in the PC operating software

If the entry "Formula Editor" was selected in the Formula menu item, a row appears with the formula currently used. If the field is empty, no formula has yet been defined for the mathematics channel. The button for opening the formula editor appears beneath this row. Clicking this button opens the following window.

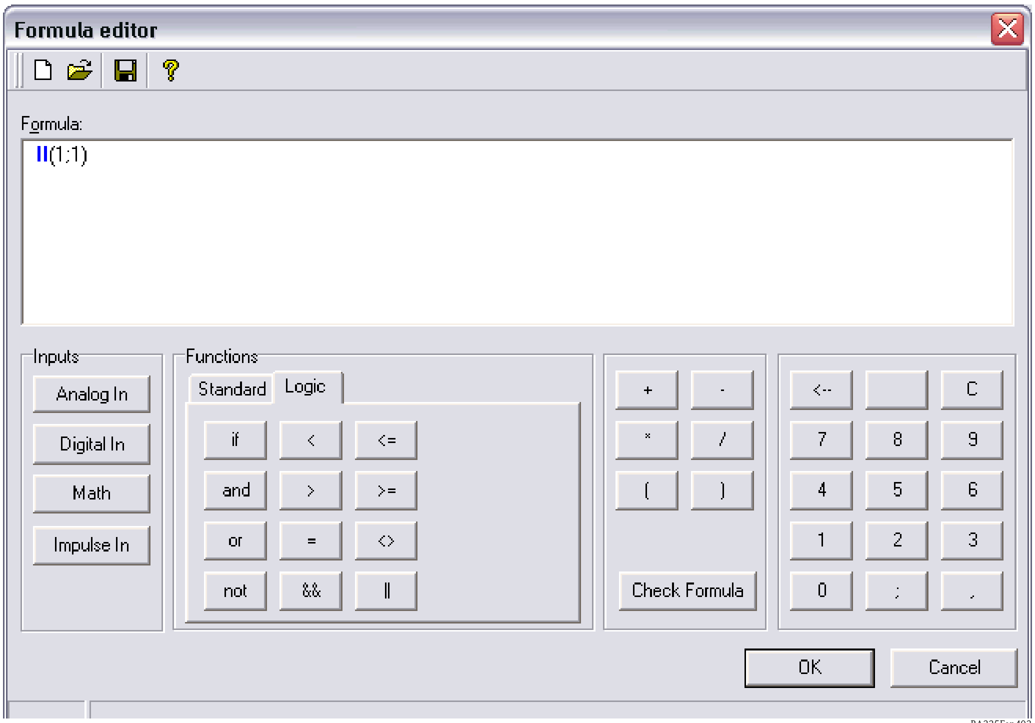


Fig. 59: Formula editor in the PC operating software

A formula with up to 200 characters can be created with the aid of this editor. Once the formula is ready, the "Test Formula" button can be used to check whether the formula entered is correct. If this test is positive, the editor can be exited with OK and the formula entered is accepted.

7.2 Inputs

Inputs are described within the formula using the following syntax:
Type of input (signal type ; channel number)

Types of input:

Type	Description
AI	Analog inputs
DI	Digital inputs (*)
MI	Mathematics channels
II	Pulse inputs (*)

(*): The "Liquiphant density computer" differentiates between digital inputs and pulse inputs. These inputs are combined in other devices.

Note!
If the scaling for an input has been changed and if this input is then used in the formula editor, an error message can occur.
Proceed as follows here:
- First configure the inputs
- Then exit the Setup (-> the inputs are configured as per the setting)
- Then start Setup again and enter the formula.

✎ Note!
The available types are device-dependent (i.e. not available for all devices) or dependent on the device options.

Signal type:

Type	Description
1	Current value (measured value)
2	Status
3	Counter/operating time

✎ Note!
The available signal types are device-dependent, i.e. not available for all devices.

Channel number: Analog channel 1 = 1, Analog channel 2 = 2, Digital channel 1 = 1, …

Examples:
DI(2;4) → status of digital channel 4
AI(1;1) → the current value of analog channel 1

7.3 Priority of operators/functions

The formulae are processed according to the universally valid mathematical rules:
- Brackets first
- Powers have precedence over multiplications
- Point has precedence over dash
- Calculate from left to right.

7.4 Operators

7.4.1 Arithmetic operators

Operator	Function
+	Addition
-	Subtraction / negative algebraic sign
*	Multiplication
/	Division
%	Modulo (remainder of the division x/y) see also "mod" function
^	x to the power of y

7.4.2 Relational operators

Operator	Function
>	greater than
>=	greater than or equal to
<	less than
<=	less than or equal to
=	equal to
<>	unequal to

7.4.3 Linking operators

Function	Syntax	Description	Example
||	Value1 || Value2	logic "or" (see also "or" function)	DI(2;1) || DI(2;2)
&&	Value1 && Value2	logic "and" (see also "and" function)	DI(2;1) && DI(2;2)

7.5 Functions

7.5.1 Standard functions

Function	Syntax	Description	Example
ln	ln(number)	Returns the natural logarithm of a number. Natural logarithms have the constant e (2.71828182845904) as their basis. For values ≤ 0, the result is undefined. The device continues to work with 0.	ln (86) = 4.454347
log	log(number)	Calculates the logarithm of the argument to a basis of 10. For values ≤ 0, the result is undefined. The device continues to work with 0.	log (10) = 1
exp	exp(number)	Exponentiates the basis e with the number specified as the argument. The constant e is the basis of the natural logarithm and has the value 2.71828182845904.	exp (2.00) = 7.389056
abs	abs(number)	Returns the absolute value of a number. The absolute value of a number is the number without its algebraic sign.	abs (-1.23) = 1.23
pi	pi()	Delivers the value of the number PI (3.14159265358979323846264)	
sqrt	sqrt(number)	sqrt calculates the positive square root of the "number" argument. For negative values, the result is undefined. The device continues to work with 0.	sqrt (4) = 2
mod	mod(number;divisor)	Returns the remainder of a division. The result has the same algebraic sign as the divisor. If the divisor has the value 0, the result is undefined. The device continues to work with 0.	mod (5; 2) = 1
x^y	pow(number;power)	Returns an exponentiated number as the result.	pow (2, 3) = 2^3 = 8

7.5.2 Trigonometric functions

Function	Syntax	Description	Examples
rad	rad(number)	Conversion of degrees to radians	rad (270) = 4.712389
degrees	degrees(number)	Conversion of radians to degrees	degrees (pi()) = 180

The following functions expect an angle in radians as the argument. If the angle is specified in degrees, it has to be converted to radians by multiplying it by pi()/180. Alternatively, the "rad" function can also be used.

Function	Syntax	Description	Examples
sin	sin(number)	Returns the sinus of a number.	sin(pi()) → Sinus of pi radians sin(30*pi()/180) → Sinus of 30 degrees (0.5)
cos	cos(number)	Returns the cosine of a number.	cos(1.047) = 0.500171
tan	tan(number)	Returns the tangent of a number.	tan(0.785) = 0.99920

The following functions output the returned angle in radians with a value between -pi/2 and pi/2. If the result is to be expressed in degrees, the respective result must be multiplied by 180/pi() or the "degrees" function must be used.

Function	Syntax	Description	Examples
asin	asin(number)	Returns the arc sine or reversed sinus of a number (inverse function). The arc sine expects a real argument in a range of -1 to +1. When values outside of this range are used, the device continues to work with 0.	arcsin(-0.5) = -0.5236 arcsin(-0.5)*180/pi() = -30°
acos	acos(number)	Delivers the arc cosine or reversed cosine of a number (inverse function. Arc cosine expects a real argument in a range of -1 to +1. When values outside of this range are used, the device continues to work with 0.	arccos(-0.5) = 2.094395
atan	atan(number)	Returns the arc tangent or reversed tangent of a number. (inverse function)	atan (1) = 0.785398

7.5.3 Logic functions

Function	Syntax	Description	Example
if	if(Check; Then_Value; Otherwise_Value)	Check is any value or expression, the result can be TRUE or FALSE. This argument can adopt any relational calculating operator. Then_Value is the value that is returned when the check is TRUE. Otherwise_Value is the value that is returned when the check is FALSE.	if(x>10;1;0) If the value x is greater than 10, the function returns 1; otherwise 0.
or	or(true1;true2)	Returns TRUE if an argument is TRUE. Returns FALSE if all arguments are FALSE. Note! see also Operator "||";	or(2>1;3>2) = true or(2<1;3>2) = true or(2<1;3<2) = false
and	and(true1;true2)	Returns TRUE if both arguments are TRUE. If one of the arguments is FALSE, this function returns the value FALSE. Note! see also Operator "&&"	and(2>1;3>2) = true and(2<1;3<2) =false
not	not(logical value)	Inverts the value of an argument. NOT can be used prevent a value from matching a certain value.	not(false) = true

7.5.4 Range functions

The XX in the following functions stands for one of the types of input described under Section 7.2 "Inputs". Range functions can only ever be executed via a type of input.

Function	Syntax	Description	Example
sumXX	sumXX(Type;From;To)	Adds up the values for the specified range of the input signals. Type: Signal type (see Inputs) From: channel number from which adding up is to begin ;(0 = Channel 1) To: channel number up to which adding up is to be performed (0 = Channel 1)	sumXX (1;2;5) = sum of all current values from channel 2 to 5
avgXX	avgXX(Type;From;To)	Calculates the mean value for the specified range of the input signals.	avgXX(1;1;6)
minXX	minXX(Type;From;To)	Delivers the smallest value for the specified range of the input signals.	minXX(1;1;6)
maxXX	maxXX(Type;From;To)	Delivers the largest value for the specified range of the input signals.	maxXX (1;1;6)

7.6 Decimal point

Both the decimal comma and the decimal point can be used in the formula editor. Symbols indicating thousands are not supported.

7.7 Inspecting the validity of a formula / failsafe mode

Before the entered formula is used, its validity is checked. A formula is invalid, for example, if:
- The channels used are not switched on or they are in the wrong operating mode (is not checked during entry because the user may switch on the channel later)
- It contains invalid characters/formulae/functions/operators
- Syntax errors (e.g. wrong number of parameters) occur in the formulae
- Invalid brackets are set (number of open brackets <> number of closed brackets)
- Division is performed by zero
- A channel refers to itself (infinite recursion)

Invalid formulae are switched off when the setup is adopted or the device is started.

7.7.1 Unrecognizable errors

Where possible, errors in the formula are reported directly during entry. However, due to the possible complexity of the formula entered (e.g. multiple connected formulae, which access different input variables via "if" condition), it is not possible to detect all errors.

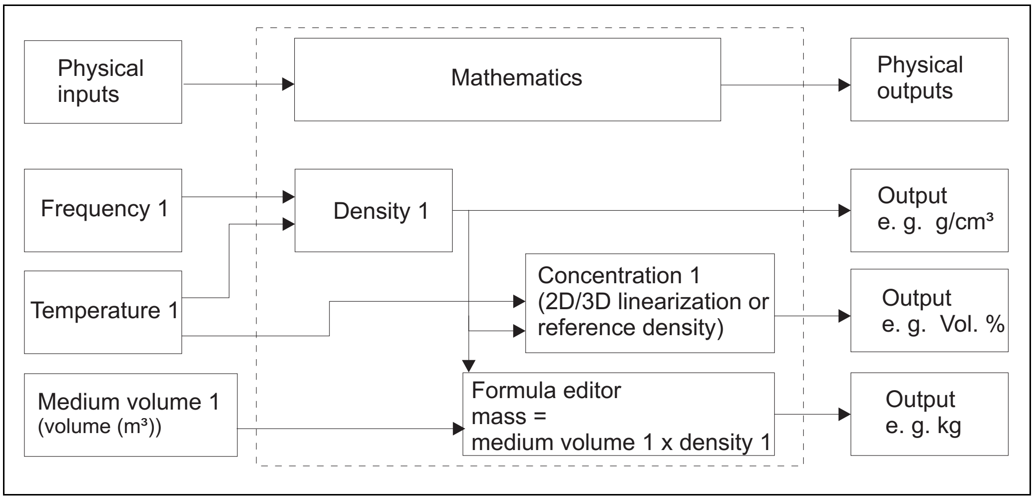
7.8 Examples

Formula	Description
AI(1;1)+AI(1;2)	Analog channel 1 + Analog channel 2
avgAI(1;1;4)	Mean values of all analog channels 1 to 4
if(DI(2;1);AI(1;1)+AI(1;2);AI(1;1)+AI(1;3))	If digital input 1 is "on", analog channel 1 + analog channel 2 is calculated. Otherwise, analog channel 1 + analog channel 3 is calculated

8 Applications

This section explains functions open to the user with regard to additional calculation and conversion options of the FML621.

The graphic below illustrates the interdependencies between input variables and output variables. The example shows a typical temperature-compensated density calculation. In addition, the graphic also illustrates how a variable, for example the medium density, which was calculated beforehand, is combined with other physical input information - here the temperature - and converted to calculate the concentration.
In addition, it is also possible to show other input variables, such as the level in a process tank together with the medium density determined, as the mass in kg at the output.



BA335Fen080

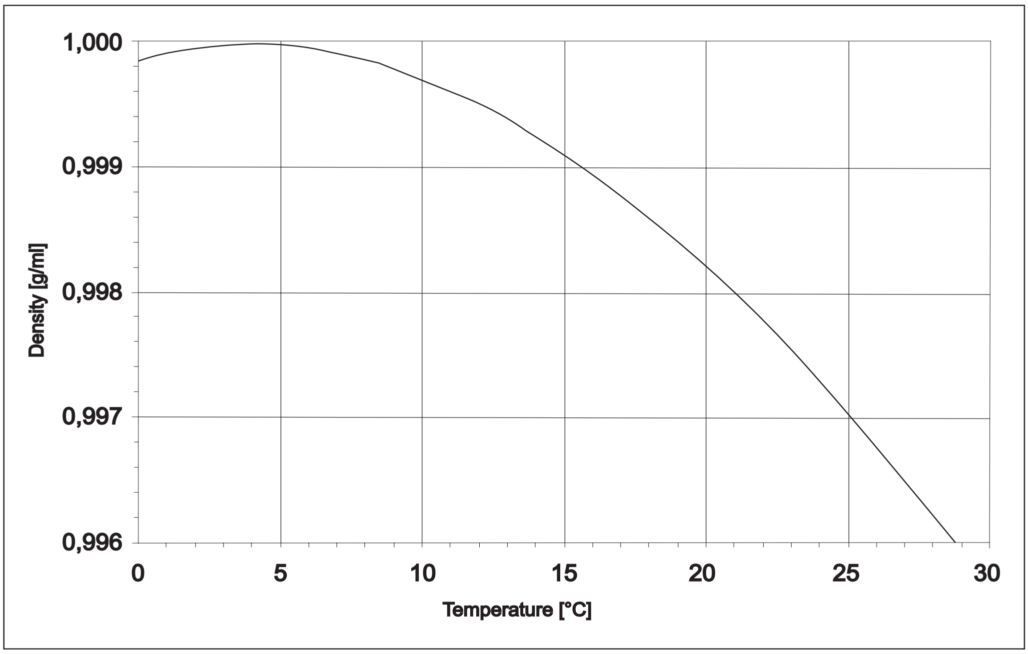
8.1 Density

The density (room density, mass density, specific mass, density), formula symbol ρ (rho), is the quotient from mass m and volume V ($\rho = m / V$), i.e. "mass per volume". The density is the numerical value of the mass concentration. The international SI unit is kg/m^3; g/cm^3 is also common. The reciprocal value of the density $1/\rho$ is called the specific volume.

The density is important as an analytical characteristic quantity because, as a sum parameter, it can provide overall information on the mass of a substance. Liquid density is used for the following measuring tasks, for example:
- Measuring the content and determining the concentration (sulfuric acid, sugar, alcohol)
- Quality information (petroleum, milk etc.)
- As an indicator of purity
- For identification purposes
- As a variable indicating the changing turnover for kinetic information (reaction speed)
- As a base variable in physical calculations or simulations
- For clarifying how much material a volume contains

Note on the influence of temperature

With the exception of water between freezing and 4 °C, [(for the anomaly of water, see graphic)], the volume of a liquid increases with increasing temperature. A liquid expands when it heats and thus the density decreases. The thermal expansion is caused by the molecules' increasing need for space with increasing temperatures.



BA335Fen081

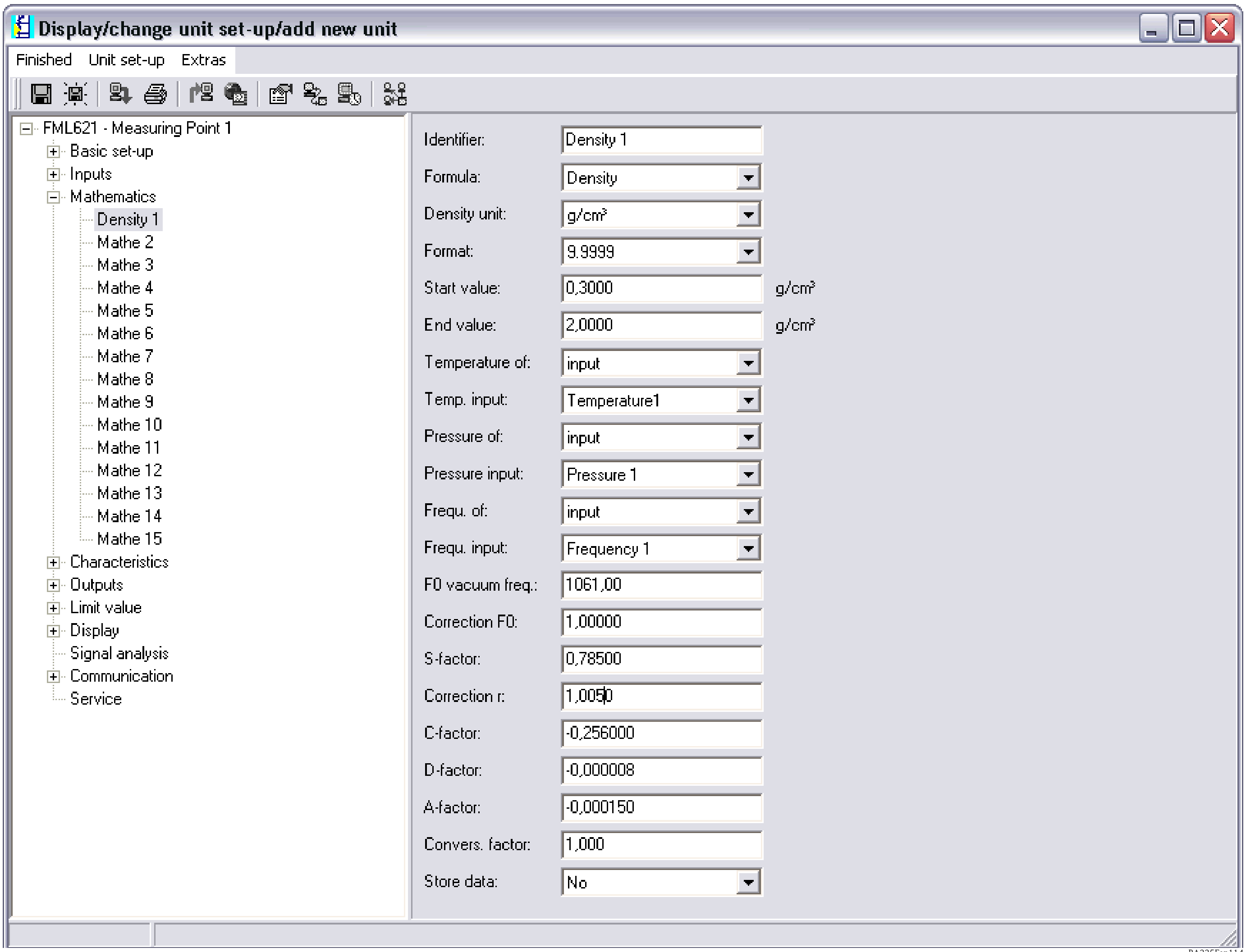
8.1.1 Reference to the measuring line

The measuring line calculates the medium density from the input variables "temperature", "oscillator frequency" and a "process pressure".

ρ [g/cm³ or lb/ft³] = f (frequency [Hz], temperature [°C or °F], pressure [bar, absolute pressure or psi, absolute pressure])

The following table indicates what process variables have to be available to comply with various application requirements.

Application	Process information	Comment
Phase transition for isothermal applications. The density usually does not have to be calculated here.	Frequency	This works in applications where the difference in the density between two media is large enough to ensure they can be differentiated.
All applications requiring temperature compensation.	Frequency and temperature	The accuracy values shown always refer to these two versions.
Applications with a pressure fluctuation > +/-6 bar	Frequency, temperature and pressure	



BA335Fen114

Identifier

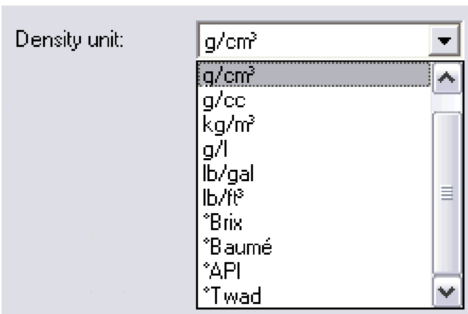
The name selected here for the calculation is needed later for other calculations. This name can only occur once in the system. For this reason, consecutive numbering is provided e.g. Density 1.

Formula

By specifying "Density", the specific options needed to calculate the medium density are shown on the display.

Unit

The corresponding unit can be configured here or a unit can be defined freely.



BA335Fen115

Format

Specifies the number of places after the decimal point.

Start Value/End Value

To specify a validity range and scaling for the graphic display, a start value (e.g. 0.5g/cm³) and an end value (e.g. 1.5g/cm³) have to be entered.

The three input data items that follow can be physically present at the inputs or can be preset.

Temperature

Process temperature e.g. temperature 1

Pressure

Pressure transmitter e.g. default value

Frequency

Liquiphant e.g. frequency 1

The common situation that no pressure sensor is needed is used as an example to set the default value. In such instances, the process pressure of 20bar, for example, can be configured. This adequately compensates for the effect of the process pressure for determining the medium density. This can be performed for all three input variables if this makes sense for error analysis.

In addition to the relevant process variables, each fork has its own individual geometry. When the forks are manufactured, the corresponding differences in mass are illustrated and listed in a calibration report specifically for the sensor.

In the event of standard calibration, the frequency in vacuum $f_{0,\ vac}$ and density sensitivity are determined individually. An optional "Special calibration H_2O" can be performed to achieve the highest accuracy class. This feature must be indicated as an accessory when ordering the Liquiphant M Density. Here, all the sensor-specific constants $f_{0,\ vac}$, S and C are determined individually.

	Formula symbol	Meaning	Unit
Sensor-specific constants	$f_{0,\ vac}$	Vibration frequency of the fork in a vacuum at 0 °C	Hz
	S	Density sensitivity of the tuning fork	cm³/g
	C	Linear temperature coefficient of the fork	Hz/°C
	A	Quadratic temperature coefficient of the fork	Hz/°C²
	D	Pressure coefficient	1/bar
Process variables	t	Process temperature	°C
	P	Process pressure (only relevant if pressure > 6 bar)	bar (absolute)
Measured value of fork electronics	$f_{T,P,med}$	Vibration frequency of the fork in the medium at process temperature t and pressure p	Hz
Result	ρ_{med}	Density of the medium	g/cm³

Sensor-specific parameters

The average values are as follows for the sensor-specific patameters.

This is accumulative information since a separate calibration report is supplied when delivered. The average values have already been stored in the device for the Bimorph 316L version. The vacuum frequency of "0" Hz has been stored in the device for it to be possible to enter values here. If no information is entered, an error message is displayed.

Note!
The following parameters are examples.

Fork	$f_{0, vac,}$ Hz	**S,** cm³/g	**C,** 1/°C	**A,** 1/°C²	**D,** 1/bar.
FTL50, FTL51 316L	1059	0.794	-0.253	-0.00015	-0.000008
FTL50, FTL51 Hastelloy C4	1115	0.692	-0.191	-0.0001	-0.000007
FTL51C ECTFE	984	0.829	-0.251	-0.00045	+0.000034
FTL51C RubyRed/PFA	944	0.795	-0.246	0.00006	+0.000034
FTL51C PFA/EDLON	946	0.819	-0.257	-0.0001	+0.000034
FTL51C Enamel	1000	0.706	-0.092	-0.00008	+0.000034
FTL50H, FTL51H polished Ra 0.3 µ	1016	0.893	-0.234	-0.00015	-0.000008

Convers. Factor

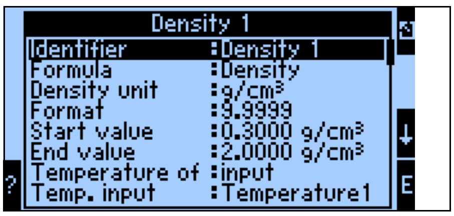
The conversion factor can be used if a free unit was selected which is the result of multiplying by the basic unit.
For Europe and USA regions this means:
[g/cm³ * conversion factor = free unit]

Store Data

By selecting "Yes", this calculated value is written to the data logger. (See also Setup -> Signal Analysis -> Interm. Anal. (Intermediate Analysis).

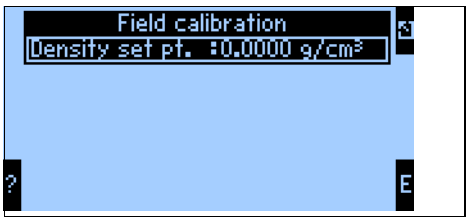
Field Calibration

This function is only available at the FML621 display. This function is not available in ReadWin. The field calibration can only be selected in the "Density" operating mode. The field calibration cannot be selected in the "Reference density" operating mode.



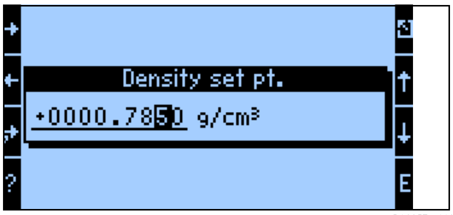
BA335Fen116

→



BA335Fen117

The field calibration is used to adapt the density measured value to the actual density value (offset). By entering a target density value in the device and executing the routine, a correction factor is determined which is multiplied by the vacuum frequency.



BA335Fen118

If the correction does not prove to be helpful, the "Correction F0" factor can be reset to 1.0 in the Setup.

8.2 Calculating the concentration after evaluating the density

General observation of the concentration as a function of the density and temperature.

Note!
The density <=> concentration conversion tables are dependent on the medium and must be provided by the customer.

8.2.1 Definition of concentration

Concentration is an important variable in the food and chemical industry. This variable indicates how much pure substance a mixture or solution involves. The concentration is always a relative quantity. The quantity can be measured in mass or volume units. For this reason, the concentration is based on the following:

- "The ratio between the mass of the pure substance $m_{substance}$ and the total mass of the solution

  $m_{substance} + m_{solvent} = m_{solution}$

  $C_{M/M} = m_{substance} / m_{solution}$

- "The ratio between the mass of the pure substance and the volume of the solution $V_{solution}$:

  $C_{M/V} = m_{substance} / V_{solution}$

- "The ratio between the volume of the pure substance and the volume of the solution $V_{solution}$:

  $C_{V/V} = V_{substance} / V_{solution}$

Depending on the definition, typical concentration units are: mass.%, g/l, vol.%, molality (M), normality (N), per mil (parts per thousand), °Brix, °Plato, °Baume. If a mixture or a solution comprises several pure components, the concentration can be defined for each component (e.g. the concentration of the cations and anions in mineral water). On the other hand, the concentration can be assessed as a quantity of the minerals that remains after water evaporation.

8.2.2 Identifier

Degrees Brix, also °Brix, Brix, %Brix, is an engineering unit for the specific density of liquids. It is used in the food industry particularly for determining the percentage of sugar in fruit juices and beverages.
Definition of °Brix:

$°Brix = (m_{sucrose} / m_{solution}) * 100$

From this definition it follows that the °Brix concentration only refers to the sucrose content. For aqueous sucrose solutions, the ratio between the density and °Brix is known and is published in official tables.

Degrees Baumé or °Bé is a hydrometric scale for determining the density of liquids. The Baumé scale refers to 15.6°C and has been defined as follows:

Water: 0 °Bé
10 Mass. % saline solution: 10 °Bé
(a concentrated saline solution has 24 °Bé)

Today's highly concentrated sulfuric acid is defined as a new fixed point for the Baumé scale (66 °Bé). Thus, 66 °Bé correspond to a density of 1.8427 g/cm³ at 15.6 °C.

Definition of °Baume:

- For density less than 1 g/cm³
  °Baumé = K_B (1 / $\rho_{15.6\,°C}$ – 1)
  This is a concentration that is adapted to the relative density of the saline solution at 60°F (15.6°C).
- For density greater than 1 g/cm³
  °Baumé = K_B (1 – 1 / $\rho_{15.6\,°C}$)
  K_B = 144.3 (rational)

General
Temperature is a disturbance variable that has to be taken into consideration when calculating the concentration. Liquids expand differently over temperature. → Fig. 60 illustrates the density of water and silicone oil AK5 over different temperatures. The temperature-dependency of the density of the solution causes temperature-dependency of the volumetric concentration as the ratio of mass in the solution remains constant over temperature.

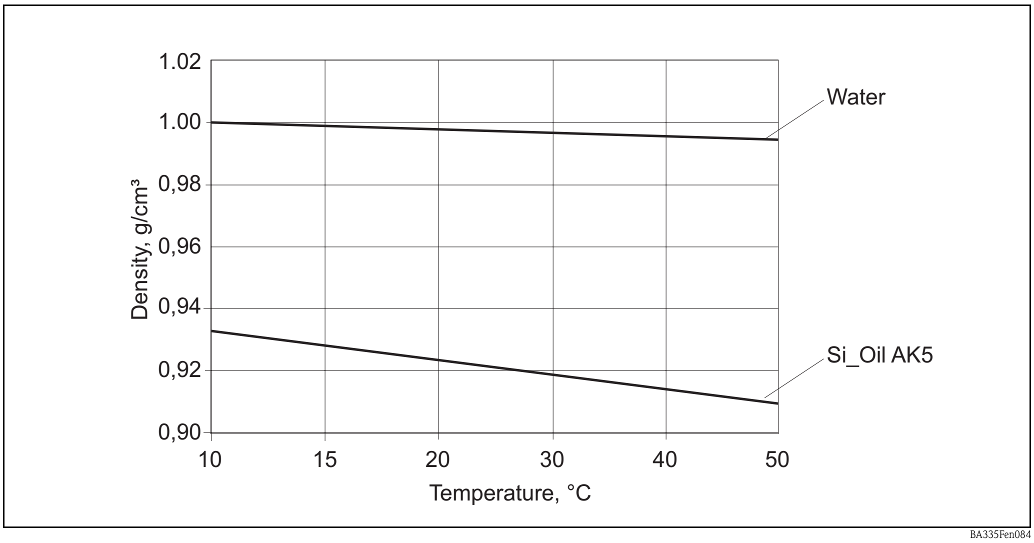


Fig. 60: Density of water and silicone oil AK5 depending on the temperature

For further observation it is important that:

- "The concentration always corresponds to the ratio between two quantities (in units of mass or volume)
- "It has to be specifically defined for each case
- "As the ratio of two masses, the concentration does not depend on the temperature
- "As the ratio between one mass and one volume or between two volumes, the concentration always depends on the temperature

8.2.3 Evaluating the concentration at a constant temperature

The change in the concentration density is not linear. Due to chemical bonds between the solvent and the dissolved substance, the volume of the solution is not necessarily the sum of the component volumes.
Fig. 63 illustrates how the concentration depends on the density for two infinitely mixable liquids that form an association (curve 2). Due to the chemical effect, the density exhibits a deviation from the linear ratio (line 1). In such instances, the concentration must be determined with accurate density-concentration characteristics at the known temperature.
In some instances, the concentration can be calculated from known densities for mixed components A and B and the solution density. This calculation is valid with the approach that the solution does not exhibit any associations or chemical bonds (line 1 in Fig. 63). Fig. 64 illustrates the linear dependency of the density on the volumetric ratio of two liquids A and B. If the densities ρ_A and ρ_B are known, the solution density ρ_M is measured, the following applies to the volumetric concentration A ($C_{A(Vol)}$):

Formula (1):

$$C_{A(Vol)} = \frac{V_A}{V_0} = \frac{\rho_M - \rho_B}{\rho_A - \rho_B}$$

Fig. 61: $C_{A(Vol)}$

The volumetric concentration can be converted to mass concentration with formula (2):

$$C_{A(Masse)} = \frac{V_A \cdot \rho_A}{V_0 \cdot \rho_M} = \frac{\rho_A}{\rho_M} \cdot \frac{\rho_M - \rho_B}{\rho_A - \rho_B}$$

Fig. 62: $C_{A(mass)}$

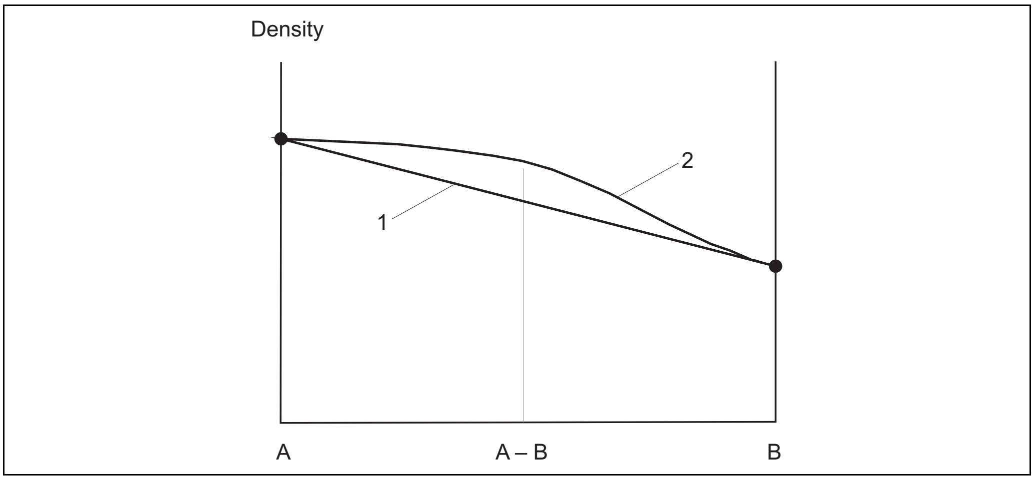


Fig. 63: Two liquids A and B form an association A-B (curve 2)

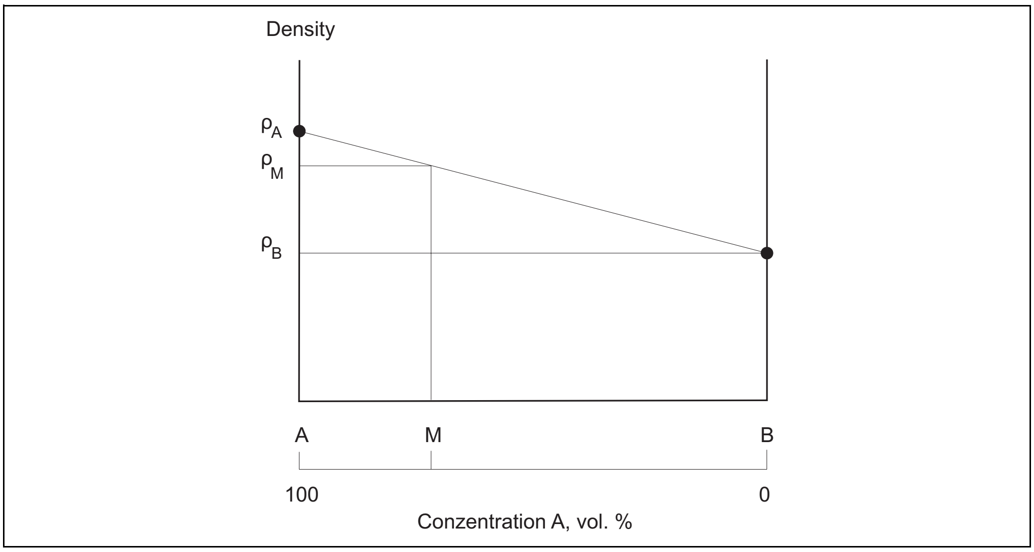
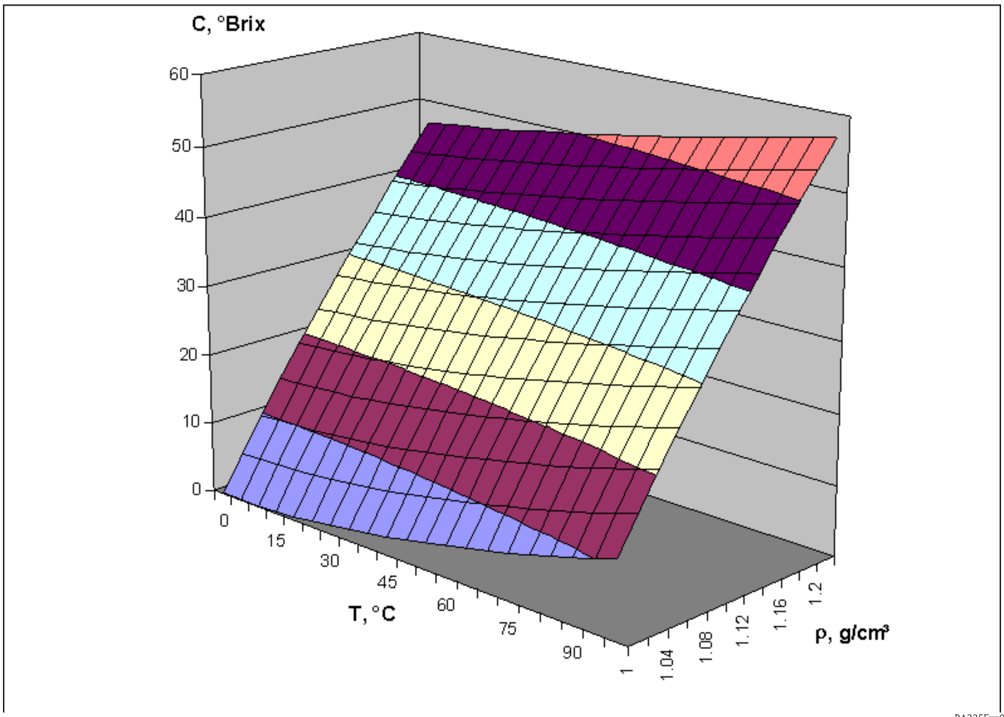


Fig. 64: Determining the vol. concentration using the density

These formulae (1) and (2) can only be used to a certain extent. Most of the time, they apply to heterogeneous mixtures such as lime milk or oil emulsions. However, for pure solutions the calculated concentration can deviate greatly from the actual value. One such example is an ethanol solution in water. The 40.0 vol.% ethanol solution has a density of 0.94805 g/cm³ at 20 °C. It corresponds to the calculated concentration (formula (1)) of 24.0 vol.%. The unacceptable deviation of 16.0 vol.% is caused by the chemical interaction in the solution. Formulae (1) and (2) are not suitable for such applications.

8.2.4 Evaluating the concentration at different temperatures

When calculating the concentration, temperature is a disturbance variable that has to be taken into consideration. If the process temperature and the process concentration can change at random, use a suitable reference table or empirical dependencies. Such tables or dependencies can have different arguments and functions since these are 3D areas in temperature-density-concentration coordinates. To evaluate the concentration, a suitable table is used which shows the concentration as a function of the density and the temperature. A graphic example of such a function can be seen in → Fig. 65. A concentration value is assigned for every temperature and measured density.



BA335Fxx089

Fig. 65: Concentration in °Brix as a function of the temperature and density

Based on the table C=F(T, ρ), the concentration C_A at the temperature T_A can be determined for the solution with the density ρ_A. Since the mass concentration (e.g. in mass.%) is independent of the temperature, the measured C_A value applies as the reference concentration. The reference concentration is the concentration under reference operating conditions, for example at 20 °C. If the concentration is a volumetric concentration (e.g. in vol.%), the reference concentration cannot be determined from such tables. This is due to the fact that the volumetric concentration and the density (both as a function of temperature) act independently.

The tables C = F (T, ρ) are known for uncommon solutions. For example, the chemical industry uses the tables with density as a function of the temperature and concentration ρ = F (T,C). For such tables, the density values of the solutions with a certain reference concentration are measured at different temperatures. This process is best suited to a typical laboratory setup to determine density. Another advantage is that these tables can be used to evaluate the reference concentration for the mass concentration and for the volumetric concentration since this table refers to the reference concentration.

For further observation, note the following:

- "There are two types of table for concentration evaluation. Type C = F (T, ρ) is known for calculating the concentration in °Brix. Type ρ = F (T,C) is more widely used in the chemical industry and is based on simple laboratory measurements.
- "The tables C = F (T, ρ) can only be used to evaluate the reference concentration for mass units. The reference concentration in volumetric units cannot be evaluated.
- "The tables ρ = F (T,C) can be used to evaluate the reference concentration for mass units and for volumetric units since the reference concentration is an argument in the table.

8.2.5 Calculating the concentration with table C = F (T, ρ)

The table has the following structure:

	t_1	t_2	t_3	...	t_m
ρ_1	C_{11}	C_{12}	C_{13}	...	C_{1m}
ρ_2	C_{21}	C_{22}	C_{23}	...	C_{2m}
ρ_3	C_{31}	C_{32}	C_{33}	...	C_{3m}
ρ_4	C_{41}	C_{42}	C_{43}	...	C_{4m}
...	...	...	...	...	...
ρ_m	C_{n1}	C_{n2}	C_{n3}	...	C_{nm}

The current density ρ_a and temperature t_a are known and the concentration C_a should be calculated.

Example:
The table below shows a °Brix table.

°Brix table:
It shows the relevant °Brix value as a function of the density and the temperature.

Temperature °C	10	20	30	50
Density g/cm³				
1.030	7.58	8.02	8.71	10.71
1.050	12.38	12.84	13.56	15.55
1.070	16.99	17.50	18.24	20.23
...				
1.310	63.25	63.95	64.80	66.65
1.320	64.91	65.60	66.45	68.29
1.330	66.55	67.23	68.08	69.91

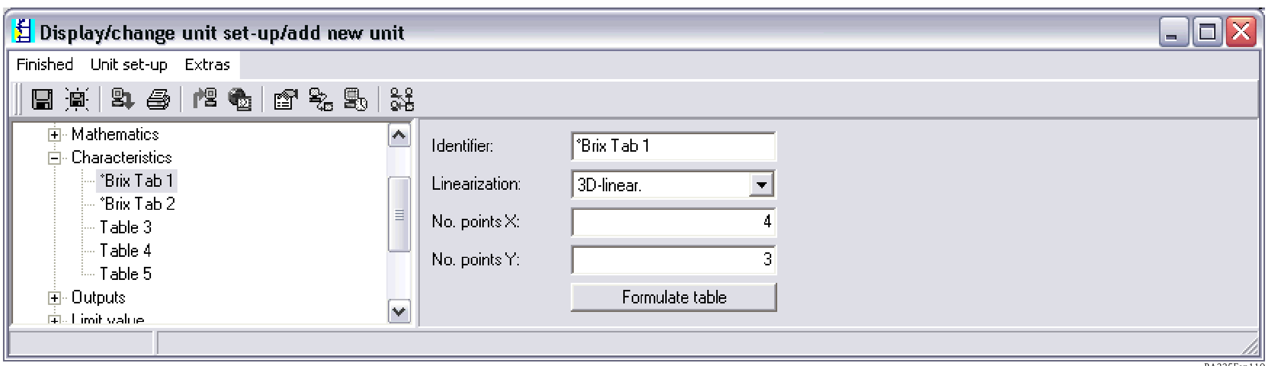
Such a table can only be entered via ReadWin 2000. By selecting the Curve menu item, you are able to define 5 independent characteristic curves. These curves can be referenced to one another in the mathematics channel.

The characteristic can be entered as two-dimensional or three-dimensional, as shown in the example. Two-dimensional curves are used in applications where the temperature remains constant for the most part and the level of accuracy required is correspondingly low.

Depending on the application, up to 15 points can be stored in the 3D field.

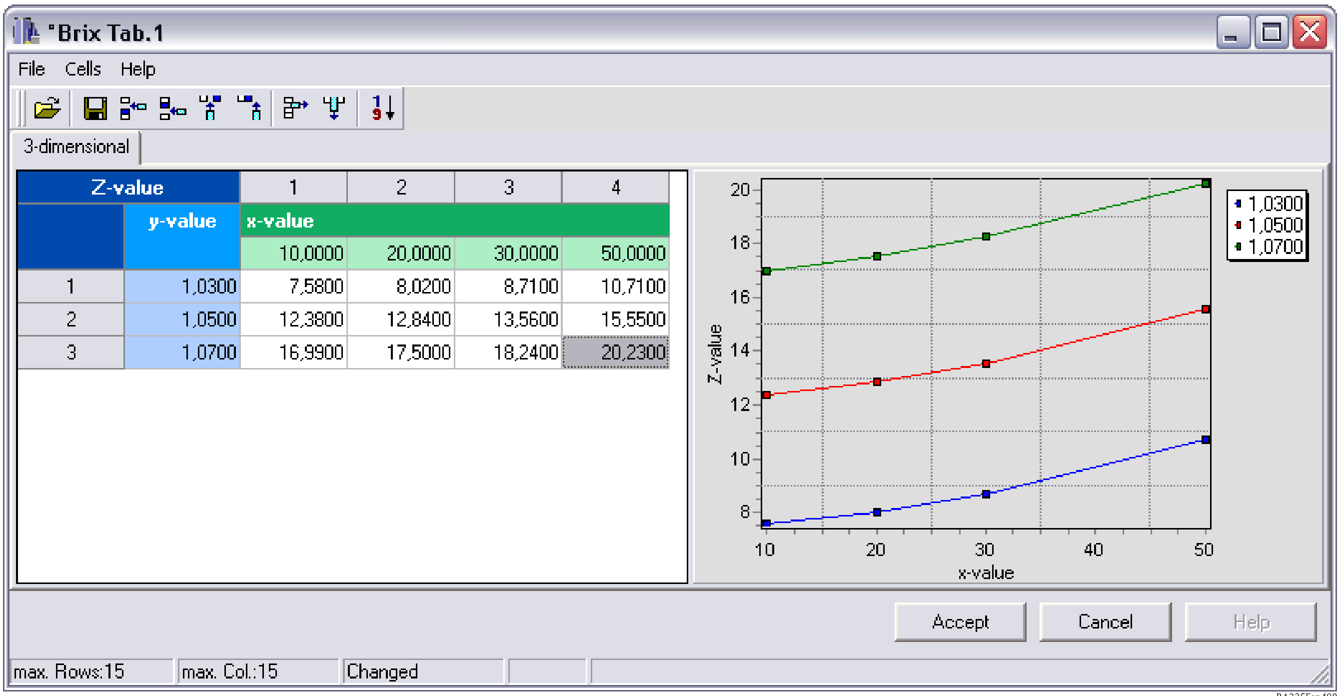
The number of Z values to be entered is derived from multiplying the X points by the Y points.

Note!
The family of characteristics must cover the entire concentration and temperature range to be expected. Measured values outside the family of characteristics trigger an error message in the mathematics channel.



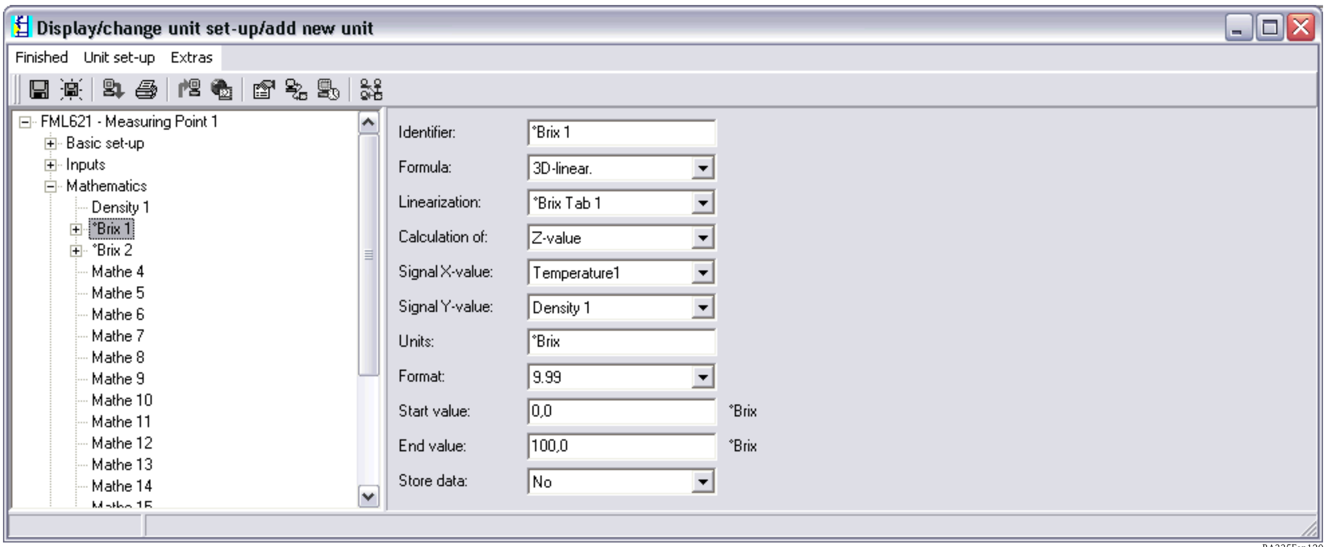
BA335Fen119

Clicking the "Edit Table" button calls up a separate window which allows you to enter the values.



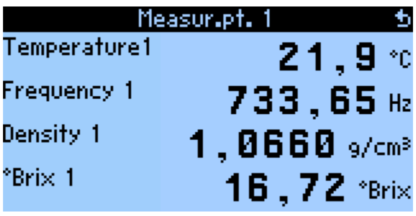
BA335Fen408

The characteristic now has to be selected in the mathematics channel.



BA335Fen120

Once the display options have been configured, a result – based on the table entered above – could be displayed as follows.



BA335Fen121

8.2.6 Calculating the concentration with table ρ =F(T,C)

The table has the following structure:

	t_1	t_2	t_3	...	t_m
C_1	ρ_{11}	ρ_{12}	ρ_{13}	...	ρ_{1m}
C_2	ρ_{21}	ρ_{22}	ρ_{23}	...	ρ_{2m}
C_3	ρ_{31}	ρ_{32}	ρ_{33}	...	ρ_{3m}
C_4	ρ_{41}	ρ_{42}	ρ_{43}	...	ρ_{4m}
...	...	...	...	...	...
C_n	ρ_{n1}	ρ_{n2}	ρ_{n3}	...	ρ_{nm}

The current density ρ_a and temperature t_a are known and the concentration C_a should be calculated.

This type of table is frequently used in laboratory situations since a concentration or a mixture ratio can be created at a certain temperature (e.g. the reference temperature). The changes in density can be determined relatively easily for all solutions with a known reference concentration by varying the temperature.

A sample table with °Brix concentration is provided below.
°Brix table:
It shows the relevant density value as a function of the concentration and temperature.

Temperature °C	10	20	30	50
°Brix				
10.0	1.0401	1.0381	1.0351	1.027
15.0	1.0615	1.0592	1.056	1.0475
20.0	1.0836	1.081	1.0776	1.0688
...				
70.0	1.3526	1.3475	1.3422	1.3308
75.0	1.3846	1.3794	1.3739	1.3625
80.0	1.4175	1.4122	1.4067	1.3952

Such a table can only be entered via ReadWin 2000. By selecting the Curve menu item, you are able to define 5 independent characteristic curves. Reference can then be made to these curves in the mathematics channel.

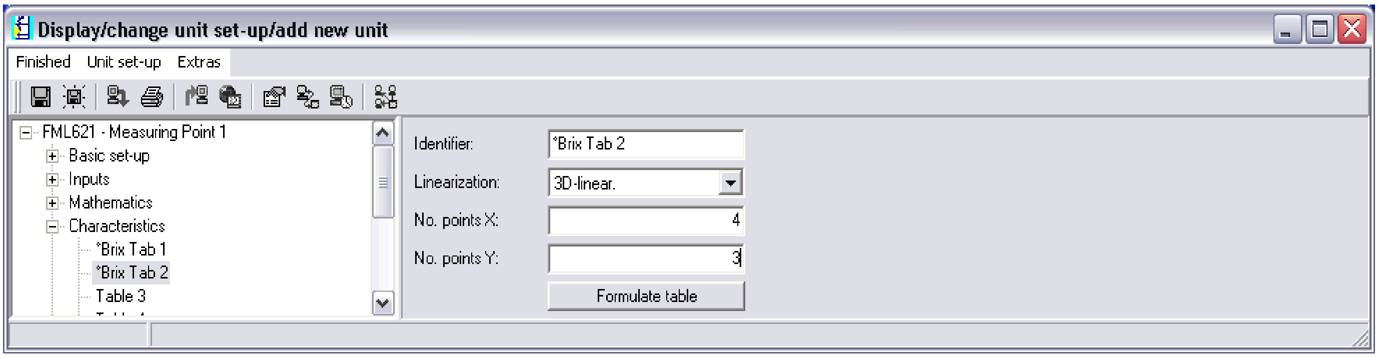
The characteristic can be entered as two-dimensional or three-dimensional, as shown in the example. Two-dimensional curves are used in applications where the temperature remains constant for the most part and the level of accuracy required is correspondingly low.

Depending on the application, up to 15 points can be stored in the 3D field.

The number of Z values to be entered is derived from multiplying the X points by the Y points.

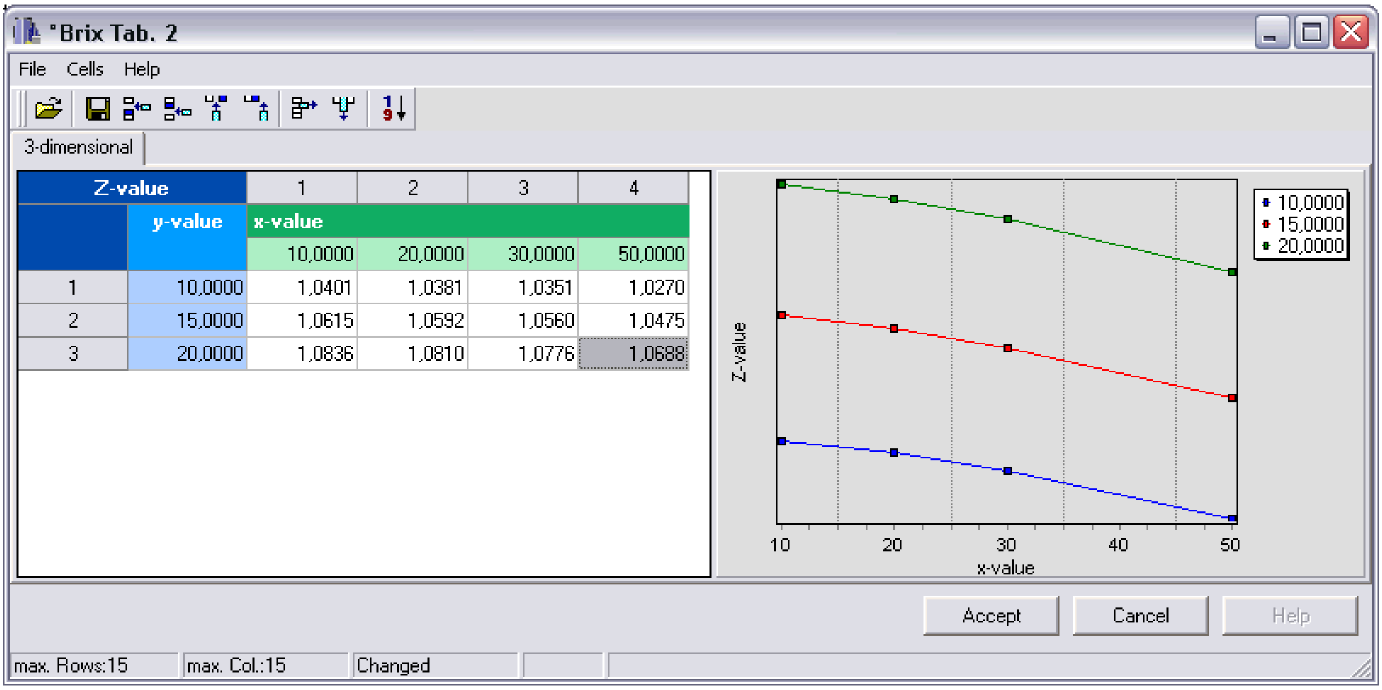
✎ Note!
The family of characteristics must cover the entire concentration and temperature range to be expected. Measured values outside the family of characteristics trigger an error message in the mathematics channel.

As shown in the previous example, a new curve can be entered using the "Curve" submenu.



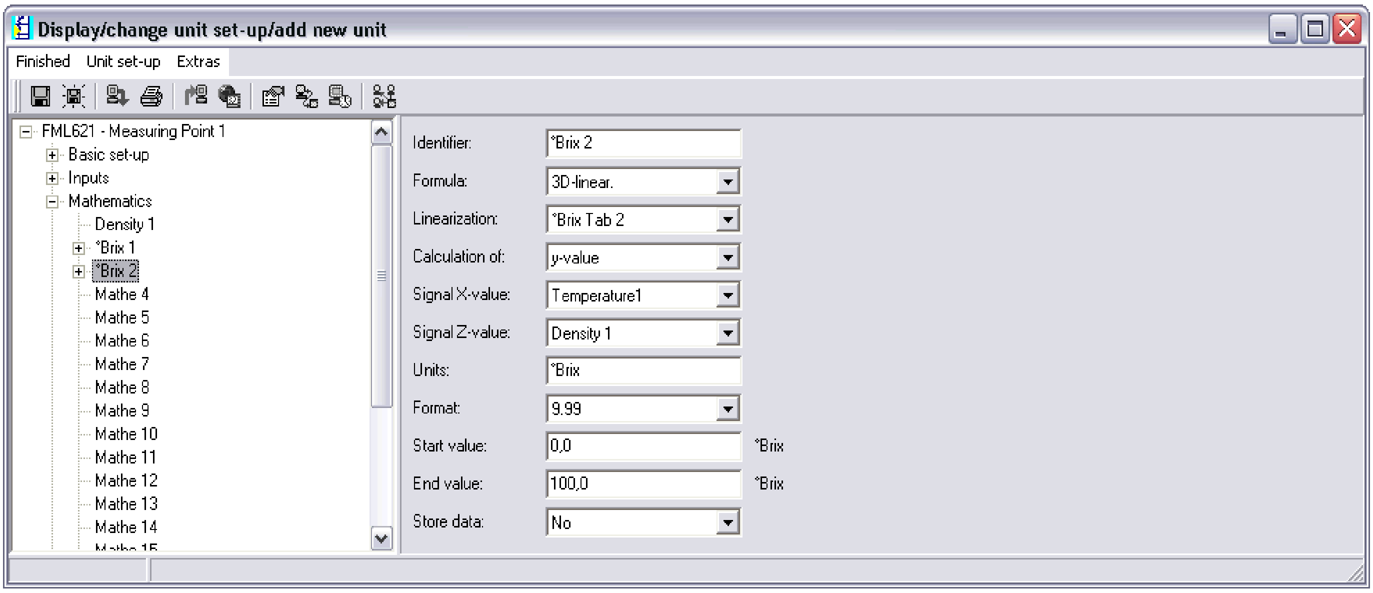
BA335Fen122

Clicking the "Edit Table" button calls up a separate window which allows you to enter the values.



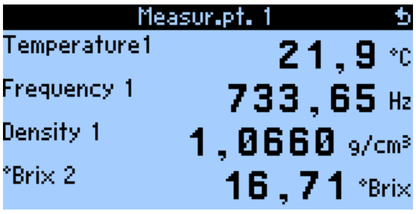
BA335Fen409

The characteristic now has to be selected in the mathematics channel.



BA335Fen123

Once the display options have been configured, a result – based on the table entered above – could be displayed as follows.



BA335Fen124

Alcohol solution example

Another example refers to calculating the concentration of ethanol solution. The measured density of an unknown solution, alcohol in water, at 25.0 °C is 0.9430 g/cm³. This value is present in the concentration table for ethanol as follows.

Reference concentration	Measured temperature	
Vol. %	20.0 °C	30.0 °C
35.7	0.9546	0.9482
46.2	0.9373	0.9298

The calculated result C_a is 40.6 vol.% ethanol in water. The reference concentration of the solution determined directly is 40.9 vol.%. The measuring error is 0.7 % or 0.3 vol. % ethanol. This measuring error depends on the non-linearity of the density-concentration ratio and can be reduced with a finer concentration table breakdown.

8.2.7 Notes and summary

1. The best way to determine the concentration is by using density-concentration-temperature tables. Two types of concentration table have to be taken into account:
   – With concentration as a function of the temperature and density
   – With density as a function of the temperature and concentration
2. The concentration formula (see below) can only be used to a certain extent since it refers to a specific temperature. The concentration formula is used to give a rough estimate of the concentration value.

After selecting the unit in the mathematics channel (e.g. after selecting the "Density" module), the relations can be configured directly and without entering the table values. ρ_t refers to the density in g/cm^3 at the temperature t.

$$°Brix = 270.4\ (1 - 1/\rho_{15\ °C})$$

(at 15 °C)

This formula applies to the °Brix range from 0 to 80 and is based on the tables:
"Brix Measurement" Technical inspection procedures. For use of USDA processed foods inspectors. US Department of Agriculture, Agricultural Marketing Service, Fruit and Vegetable Division, Processed Products Standardization and Inspection Branch, Washington, D.C., April 1960", file code 135-A-3.

The following units (all at 15.6 °C) illustrate additional interrelations:

$$°Baumé = 144.3\ (1 - 1/\rho_{15.6\ °C})$$

$$°API = 141.5/\rho_{15.6\ °C} - 131.5$$

$$°Twad = 200\ (\rho_{15.6\ °C} - 1)$$

8.3 Reference density

Definition: the reference density is a medium density at standard conditions.

The density of a liquid depends on the temperature since it increases in volume with increasing temperature. Thus, measured density values can only be compared with one another at the same temperature.
The density specifications of liquids refer to specific temperature conditions and are thus often called reference conditions.

The reference conditions depend on the industry and country and can be specified at temperatures of 0 °C, 15 °C, 18 °C, 20 °C, for example. DIN1343, for example, specifies the standard condition for gases at a temperature of 273.15 **K**elvin (0 °C) and a pressure of 101325 **Pa**scal (1.01325 bar, absolute pressure).
If the medium density is measured at a temperature that deviates from the reference temperature, this value has to be converted to the reference density. This can only be performed if the temperature dependency of the volume (volume expansion coefficient) or the density (density temperature coefficient) is known.

If the volume expansion coefficient of the liquid is known, the reference density can be calculated as follows:

Υ	Volume expansion coefficient	1/°C
ρ_0	Reference density	g/cm^3
ρ_t	Operating density/process density	g/cm^3
t_0	Reference temperature	°C
t	Operating temperature/process temperature	°C

$$\boldsymbol{\rho_0 = \rho_t\ [1 + \Upsilon(t - t_0)]}$$

The reference density has the same unit as the measured process density e.g. kg/dm^3 or g/cm^3.

Example:
The density of 0.9467 g/cm^3 was measured in silicone oil AK20 at 25.0 °C with the density measuring device. The laboratory density measurement at a reference temperature of 20.0°C returns a density of 0.9513 g/cm^3. Silicone oil AK20 has a volume expansion coefficient of 9.7 * 10^{-4} 1/°C. Do the measured density values match?

The following conversion can be entered in the formula editor (Density Computer FML621).

$\rho_t = 0.9467\ g/cm^3$
$\Upsilon = 9.7 * 10^{-4}\ 1/°C$
$t = 25.0\ °C$
$t_0 = 20\ °C$

$$\boldsymbol{\rho_0 = 0.9467 * [1 + 0.00097 * (25.0 - 20.0)] = 0.9513\ g/cm^3}$$

The two measurement results match since the calculated reference density corresponds to the laboratory value at the reference temperature.

If the temperature coefficient of the density (density TC) is known, the reference density can be calculated as follows:

ρ_0	Reference density	g/cm^3
ρ_t	Operating density/process density	g/cm^3
δ	Temperature coefficient of the density	1/°C
t	Operating temperature/process temperature	°C
t_0	Reference temperature	°C

$$\boldsymbol{\rho_0 = \rho_t / [1 + \delta(t_0 - t)]}$$

Example:
The density of 1.1056 g/cm^3 was measured in ethylene glycol at 30.0 °C with the density measuring device. The laboratory density measurement at a reference temperature of 20.0 °C returns a density of 1.1126 g/cm^3. Ethylene glycol has a density TC of $6.29 * 10^{-4}$ 1/°C.
Do the measured density values match?

$\rho_t = 1.1056\ g/cm^3$
$\delta = 6.29 * 10^{-4}\ 1/°C$
$t = 30.0\ °C$
$t_0 = 20.0\ °C$

$$\boldsymbol{\rho_0 = 1.1056 / [1 + 0.000629 * (20.0 - 30.0)] = 1.1126\ g/cm^3}$$

The two measurement results match since the calculated reference density corresponds to the laboratory value for the reference temperature.

8.3.1 Volume expansion coefficient

The volume-specific expansion coefficient indicates the value (in relation to the overall volume) by which the volume of a medium changes with a temperature change of one Kelvin (or °C).

Υ	Volume expansion coefficient	1/°C
V_1	Volume at temperature t_1	cm^3
V_2	Volume at temperature t_2	cm^3
t_1, t_2	Temperature	°C

$$\boldsymbol{\Upsilon = (V_2 - V_1) / [V_1 * (t_2 - t_1)]}$$

Note!
The volume expansion coefficient is known for many liquids and is listed in tables with medium properties.

8.3.2 Density temperature coefficient (density TC)

The density TC indicates the value (in relation to the overall density) by which the density of a medium changes with a temperature change of one Kelvin (or °C).

δ	Density temperature coefficient	1/°C
ρ_1	Density at temperature t_1	g/cm^3
ρ_2	Density at temperature t_2	g/cm^3
t_1, t_2	Temperature	°C

$$\delta = (\rho_2 - \rho_1) / [\rho_1 * (t_1 - t_2)]$$

The density information of liquids at different temperatures is known for many liquids and is listed in tables with medium properties.
In APPLICATOR[1], two density values at two different temperatures are stored for many liquids. These values can be used to calculate the density TC for these media in the known temperature range.

[1] APPLICATOR is a handy selection and configuration tool for determining and selecting the right product with regard to the measuring task. In the planning process, suitable products and solutions are determined for the application by querying specific application parameters. The APPLICATOR is available on www.endress.com.

Note!
The density temperature coefficient and the volume expansion coefficient are different indexes.

Example:
From the properties table for 1-propanol, it is clear that the density of 1-propanol is 0.8046 g/cm^3 at 20 °C and 0.7964 g/cm^3 at 30 °C. Thus the density TC for this liquid is:

$$\delta = (0.7964 - 0.8046) / [0.8046 * (20 - 30)] = 1.019 * 10^{-3}$$

8.3.3 Thermal expansion coefficient Υ

Substance	Reference temperature, °C	ρ_n, g/cm³	$\Upsilon * 10^3$, 1/K
Acetone	20	0.791	1.43
Benzene	20	0.879	1.21
Chloroform	20	1.483	1.27
Ethanol	20	0.789	1.09
Glycerine	20	1.261	0.49
Methanol	20	0.792	1.18
Essence of turpentine	20	0.855	0.96
Toulol	20	0.867	1.07
m-xylene	20	0.864	0.99

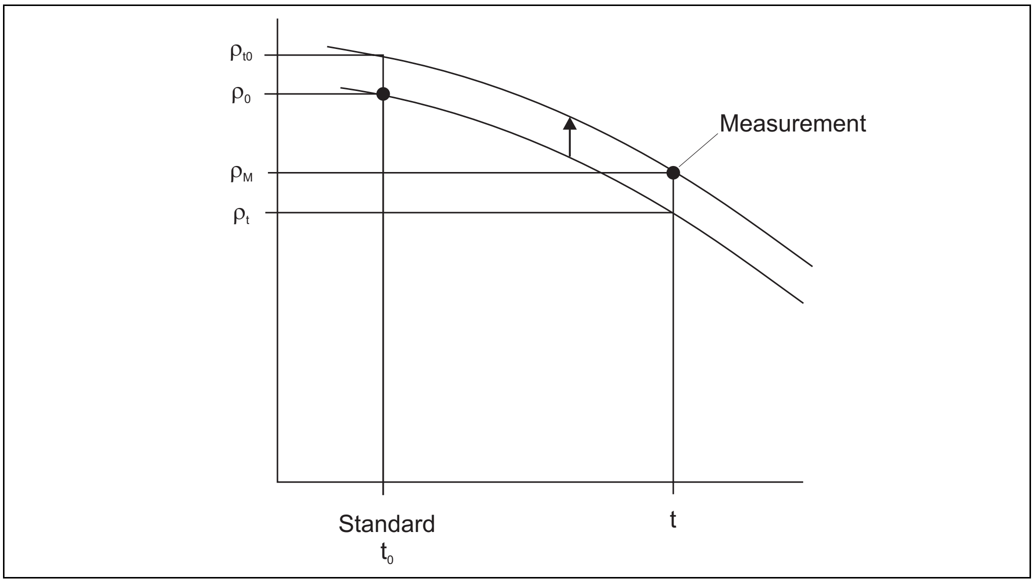
Source: Kaye & Laby, Tables of Physical and Chemical Constants.

8.3.4 Saving a characteristic curve

In contrast to the volume expansion coefficient, a curve can be stored here. This curve is mostly useful if values were determined in the laboratory for a new solution, for example, but no expansion coefficient was determined.

The reference density can be calculated more precisely with the density-temperature curve (table is entered by the customer) since the change in density over the temperature is not a linear function (generally speaking). Number of points: max. 15 value pairs.

The reference temperature t_0 is entered by the user. Density value (ρ_M) calculated from the measured frequency F_M.



BA335Fen089

Calculation:

- Firstly, ρ_t is determined from the curve at temperature t.
- Both ρ_0 and ρ_t are to be interpolated (or extrapolated if the marginal ranges of the table have been violated).
- With $\rho_0 / \rho_t \cong \rho_{t0} / \rho_M$, the value ρ_{t0} can be calculated.
- The value ρ_{t0} is then compared to ρ_0.

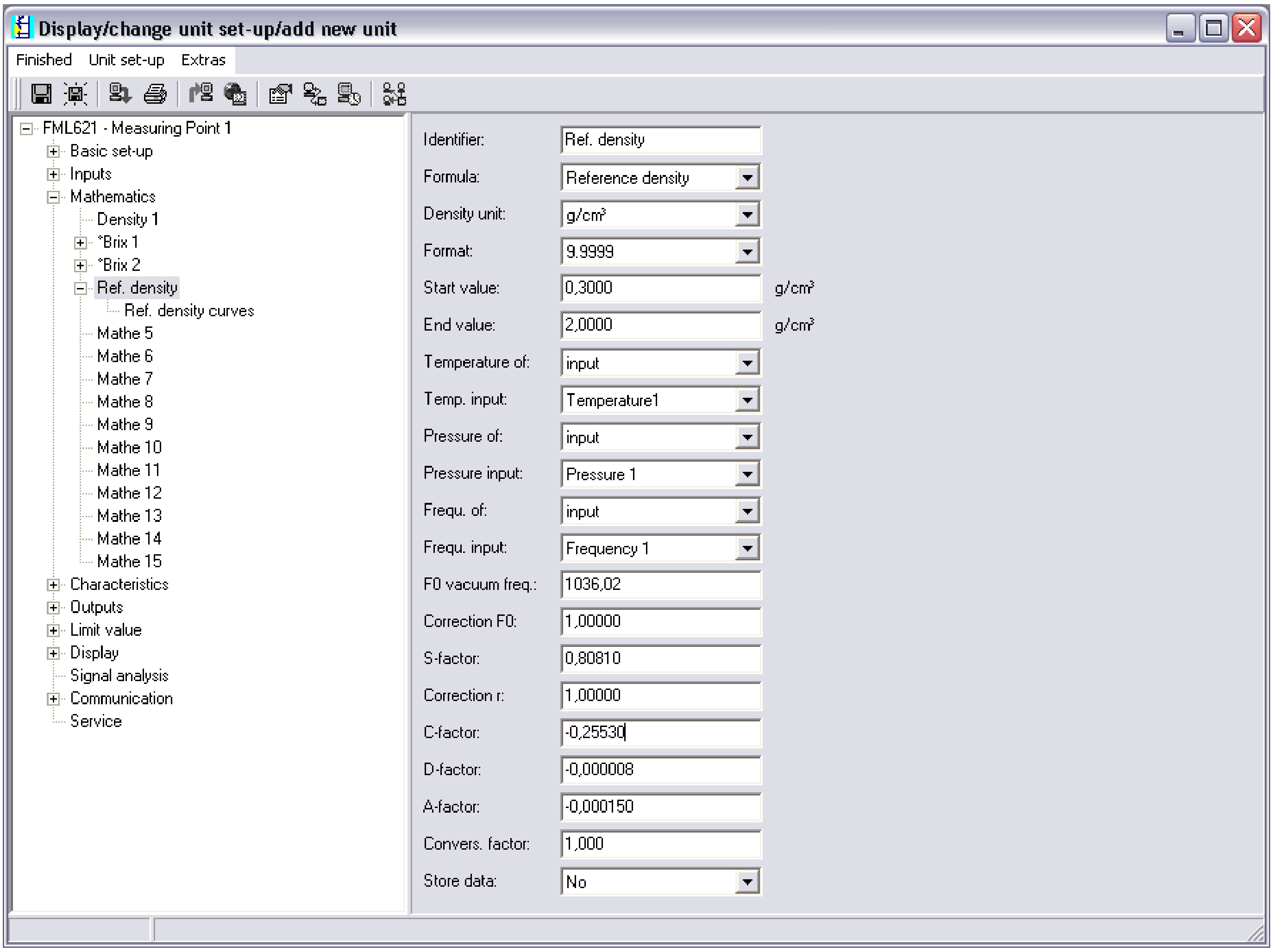
Output on display/at analog output:

- ρ_{t0}

The values for density in the table should not be < 0.

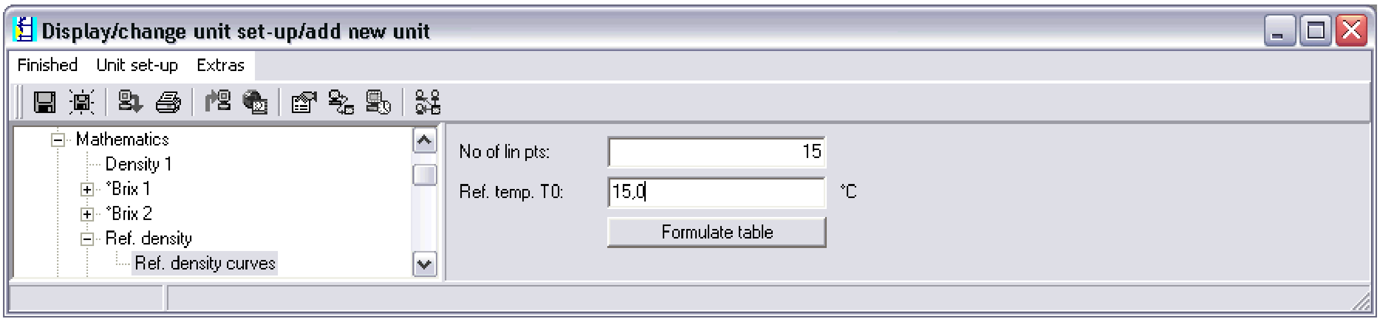
Example
If the density of water at a temperature of 15 °C is to be displayed, in contrast to the volume expansion coefficient, the user can avail of an independent calculation module.
In the "Mathematics" module, the specific data can be entered by selecting the "Reference Density" formula. Here, the density curve is a subitem in the mathematics module and not a separate curve.

Configuration of the module with the following contents:

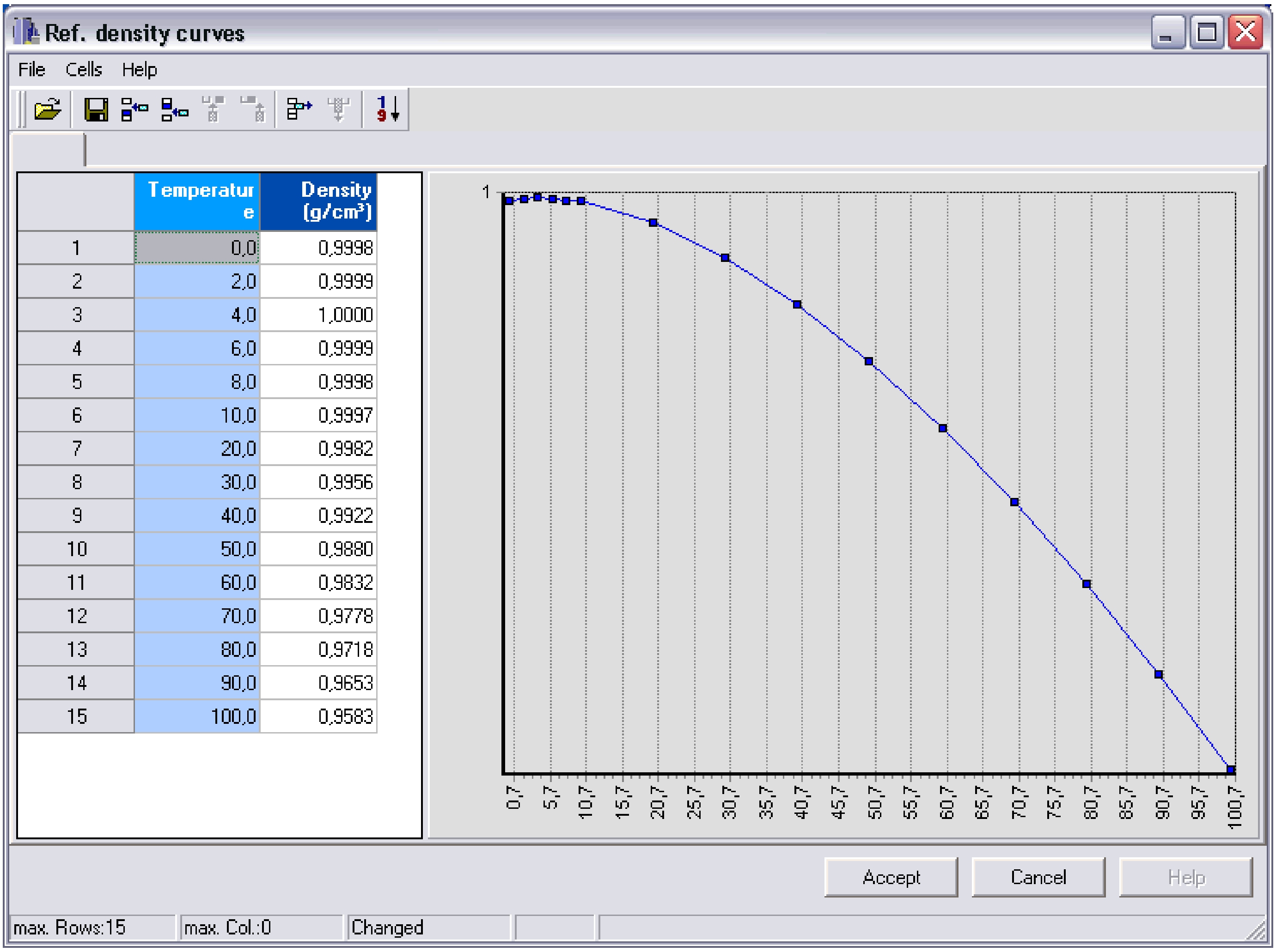


BA335Fen125

Saving the curve:
Here, you specify the number of points and the reference temperature to be displayed.



BA335Fen126



BA335Fen127

8.4 Medium detection

This module is aimed at giving users an easy way of distinguishing between different media. For this purpose, the user can enter 4 curves, each of which is described by two value pairs (temperature and density). In this way, temperature dependency can be taken into account accordingly.

The information can be output at a relay output with an appropriate hysteresis.

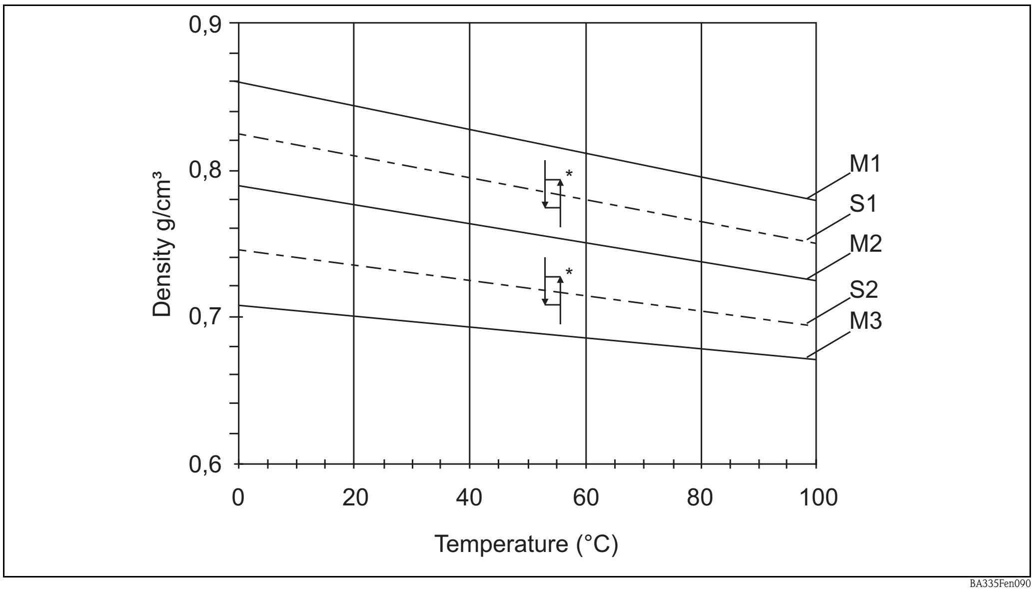


*Fig. 66: M1 = Medium1; M2 = Medium2; M3 = Medium3; S1 = Switch threshold1; S2 = Switch threshold2 * Hysteresis in %. The hysteresis can be entered in ReadWin for example.*

The corresponding input screen follows. The entries are shown in accordance with the determination of the medium density. The curves can be entered in the subsections.

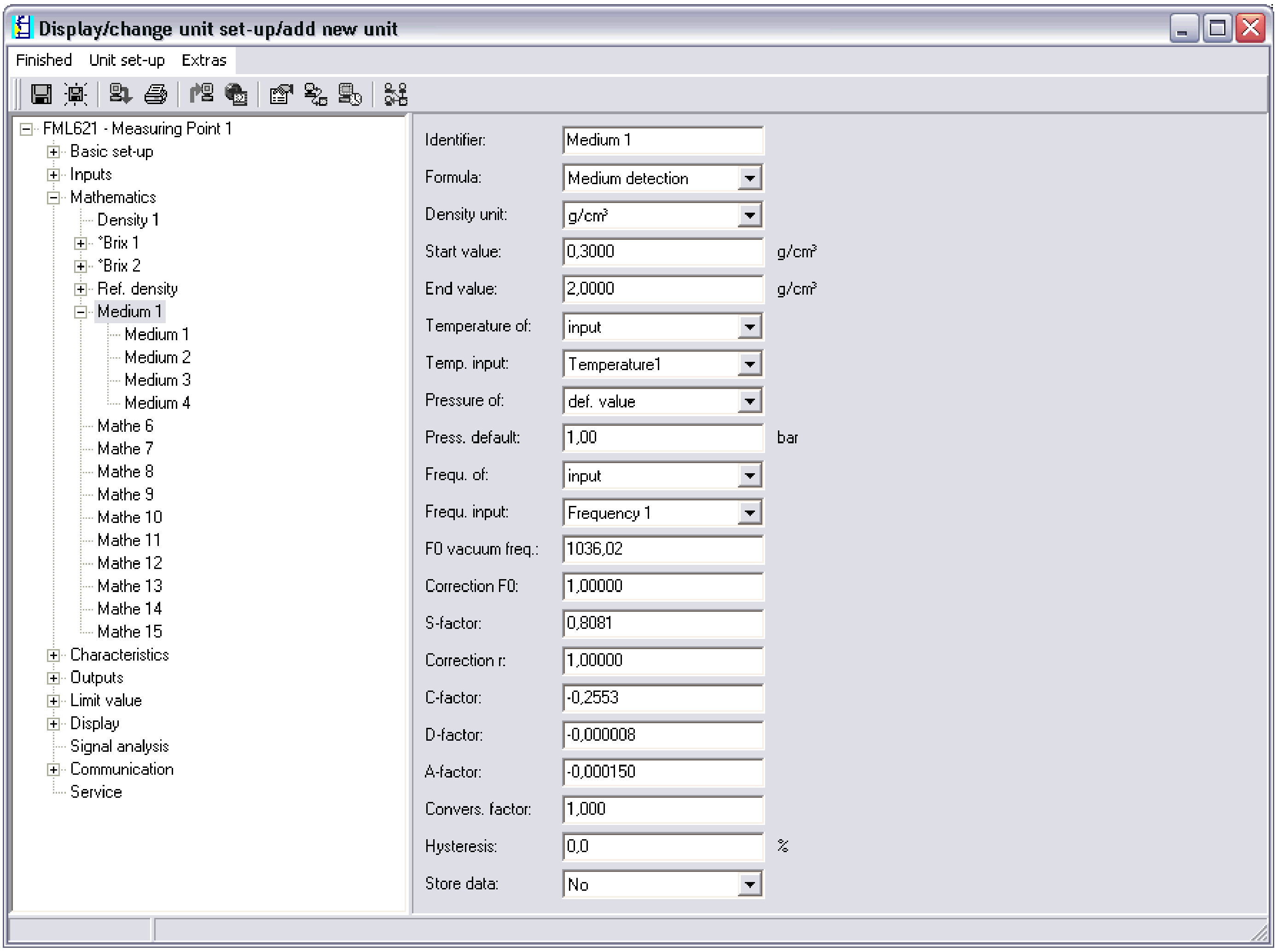
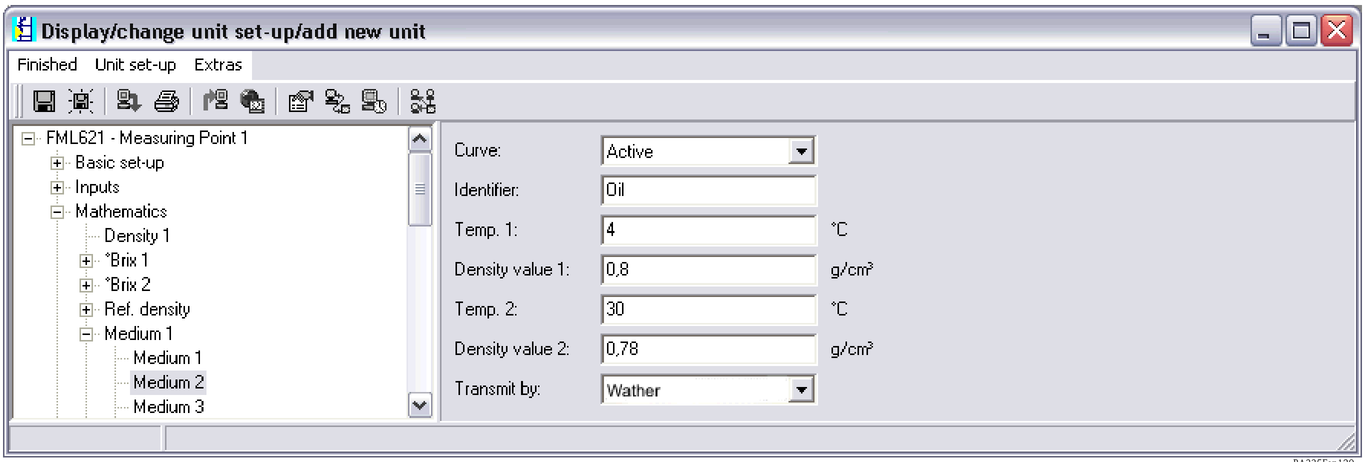
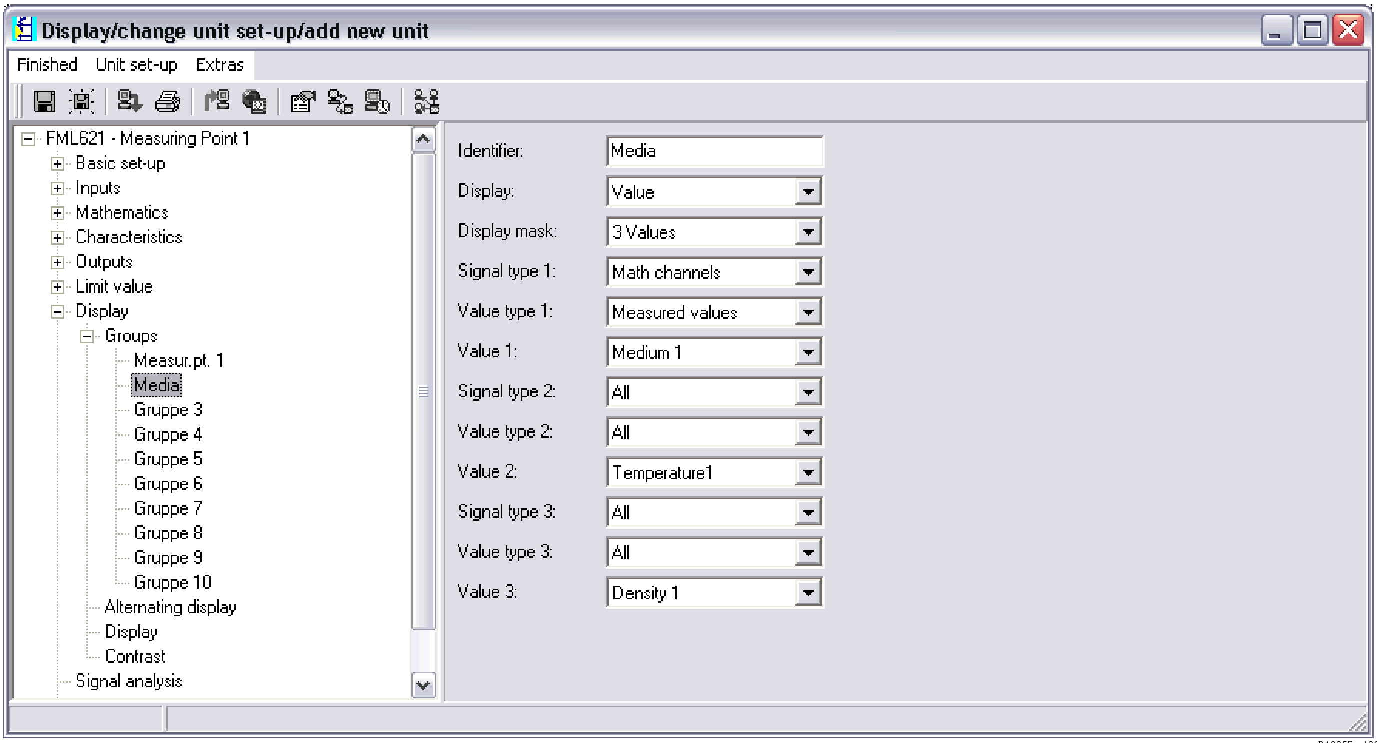


Fig. 67: Mathematics, formula: medium detection

The curves are specified in the submenus. If a relay has been assigned under the Outputs/Relay menu item, a relay can be selected here.



Once at least one curve has been entered, the display function can be configured.

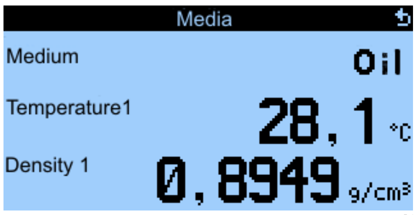


BA335Fen130

An example of what the display could then show is as follows:

BA335Fen131

➔



BA335Fen132

9 Maintenance

The device does not require any special maintenance and servicing work.

10 Accessories

General

Identifier	Order code
Cable set for FML621 for connecting to a PC or modem	RXU10-A1
Remote display for panel mounting 144 x 72 x 43 mm	FML621A-AA
Protective housing IP 66 for top-hat rail devices	52010132
PROFIBUS interface	RMS621A-P1
Adhesive label, printed (max. 2 x 16 char.)	51004148
Metal plate for TAG number	51002393
Plate, paper, TAG 3x16 characters	51010487

Extension cards

The device can be extended with a maximum of 3 universal and/or digital and/or current and/or Pt100 cards.

Identifier	Order code
Digital 6 x dig. in, 6 x rel. out, cpl. including terminals + fixing frame	FML621A-DA
Digital, ATEX approved 6 x dig. in, 6 x rel. out, cpl. including terminals	FML621A-DB
2 x U, I, TC outp. 2 x 0/4-20 mA/pul., 2 x dig., 2 x rel. SPST	FML621A-CA
Multifunction, 2 x U, I, TC ATEX outp. 2 x 0/4 mA/pul., 2 x dig., 2 x rel. SPST	FML621A-CB
Temperature (Pt100/Pt500/Pt1000) complete, including terminals + fixing frame	FML621A-TA
Temperature, ATEX approved (Pt100/PT500/PT1000) complete, including terminals	FML621A-TB
Universal (PFM/pulse/analog/transmitter power supply unit) complete, incl. terminals + fixing frame	FML621A-UA
Universal ATEX approved (PFM/pulse/analog/transmitter power supply unit) complete, incl. terminals	FML621A-UB

11 Troubleshooting

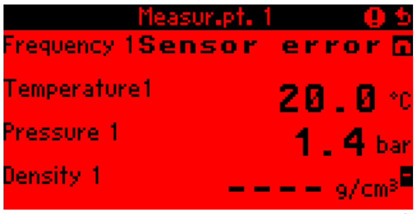
11.1 Diagnosis (error messages)

Error messages are indicated on the display by a change in color and an error text (optional). A list of the errors detected is shown in the main menu -> Diagnosis -> Error List.

11.1.1 Interpreting errors (example)

Note!
The user is only prompted to confirm process errors if this was configured in the Setup.
See Section 5.3 "Displaying error messages".

BA335Fen087



BA335Fen094

- View the error list e.g. signal range violation E-131, Density 1

Note!
Density 1 is calculated with the aid of input information (frequency 1, temperature 1 and pressure 1). If some of this information is missing or if the input or output information does not correspond to the defined value range, an error is output.

- An error list with the recorded process errors is shown in the Diagnosis menu.
  Main menu: Diagnosis -> Error List

BA335Fen089

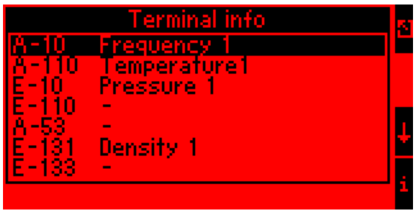
BA335Fen090

BA335Fen091

BA335Fen095

Additional information can be viewed by selecting the error list entry in question and scrolling horizontally.

Note!
Due to the range violation at terminal A-10 (frequency 1), an error was also output at terminal E-131 since this output information is the result of a mathematic calculation and is outside the defined value range.



BA335Fen092

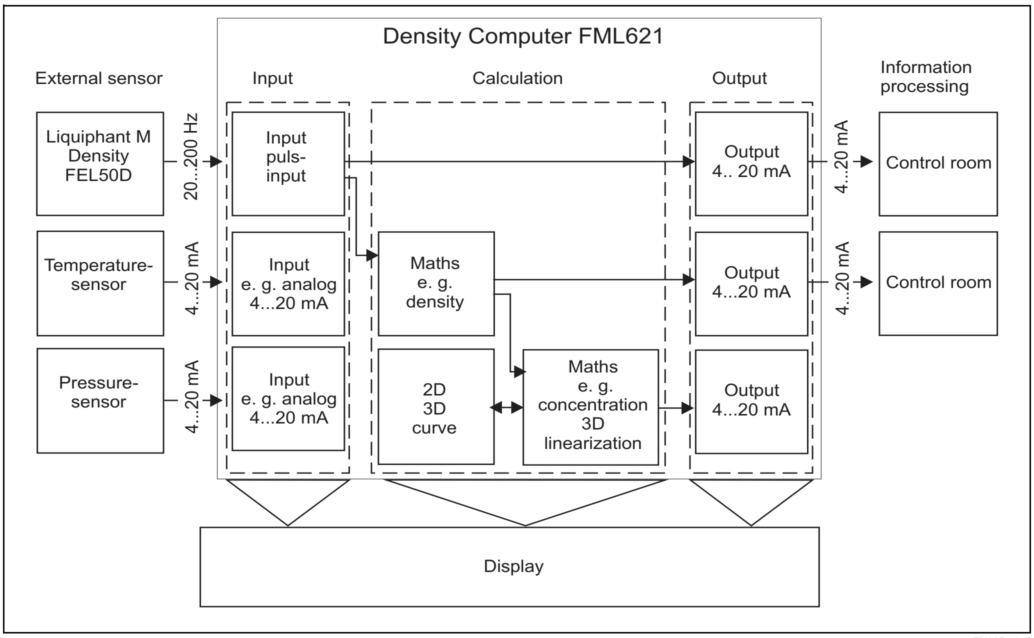
BA335Fen093

- The Terminal Info (Main Menu -> Diagnosis -> Terminal Info) shows the value that is pending at an input or output terminal.

In this example, the errors are output since the frequency information at Terminal A-10 is 0.0 Hz. The user then has to determine the reason for the loss of information at Terminal A-10. Possible causes include maintenance work, connection cable disconnected, sensor defective etc.

11.2 Troubleshooting instructions

Always begin troubleshooting using the following checklists if faults occur after commissioning or during operation. Different questions will guide you to the cause of the error and will suggest appropriate remedial action.



TI420Fen017

Measured error	Cause	Remedy
	Mechanical damage to the sensor	Replace the sensor.
	Incorrect sensor parameter entered	Compare the serial number of FTL5x with the calibration data (see calibration report)
	Bacteria buildup in stagnant media	Clean the sensor, cyclically if necessary

System error messages	Cause	Remedy
"Calibration data error slot %c"	Calibration data set at the factory faulty/cannot be read.	Remove card and insert it again (➔ Section 3.2.1 Installing extension cards). If the error message appears again, contact Endress+Hauser Service.

Ring memory error messages	Cause	Remedy
"Error reading curr. read item"	Event buffer faulty, read error	Contact Endress+Hauser Service, reset of the ring memory necessary.
"Error reading curr. write item"	Event buffer faulty, write error	
"Error reading curr. oldest value"		

General errors in inputs/outputs	Cause	Remedy
"Terminal not assigned!"	An unassigned terminal is to be displayed in the diagnosis menu.	Only select terminals that are being used.
"Circuit break:Slot, terminal"	Input current at current input smaller than 3.6 mA (with setting 4 to 20 mA) or larger than 21 mA. ■ Incorrect wiring ■ Sensor malfunction ■ Incorrectly configured end value for flow transmitter	■ Check sensor configuration. ■ Check function of the sensor. ■ Check end value of the connected flowmeter. ■ Check wiring.
"Range violation; Circuit break ok:Slot, terminal"	No error message! Information is entered in the event list after the error has been eliminated.	
"Pulse buffer overflow"	Too many pulses accumulated so the pulse counter overflows: pulses lost.	Increase pulse factor.
"Range violation: Slot, terminal"	3.6 mA < x < 3.8 mA (for setting 4 to 20 mA), 20.5 mA < x < 21 mA or 160 > x > 1600 Hz (for setting pulse/PFM) ■ Incorrect wiring ■ Sensor malfunction ■ Incorrectly configured end value for flow transmitter	■ Check sensor configuration. ■ Check function of the sensor. ■ Check end value of the connected flowmeter. ■ Check wiring.
"Signal range violation Slot, terminal"	Current output signal below 3.6 mA or above 21 mA.	■ Check whether the current output is scaled correctly. ■ Change the start and/or end value of the scaling

S-Dat module	Cause	Remedy
"Error when writing the counter readings and/or operating data to the S-DAT module!"	Error when reading data into or out of the S-Dat module	Detach S-Dat module and attach it again. If necessary, contact your local E+H Service organization.
"Error reading the operating data from the S-DAT module!"	Error when reading data into or out of the S-Dat module	Detach S-Dat module and attach it again. If necessary, contact your local E+H Service organization.
" S-DAT error"	No SDAT connected, no data on the SDAT or SDAT comes from another device	Check SDAT. If necessary, contact your local E+H Service organization.

Error messages during setup	Cause	Remedy
"Invalid date!"	Date entered is incorrect	Correction of the values entered
"Invalid time!"	Time entered is wrong	Correction of the values entered
"Delta t must lie between 0 and 60 s!"	When specifying the gradient, an incorrect time Δt has been entered.	Enter the value according to the value limits.
"It was not possible to read out the operating data. The standard values will be used."	The stored operating data cannot be read because format is different.	Reconfigure the device because the format the software is expecting does not match the actual present format. If the error also occurs after reconfiguration, please contact E+H Service.
"Start and end value must not be the same!"	The same value has been entered for the upper and lower limits of the scaling of an input/output.	Check the values of your scaling of inputs/outputs: have the same values been entered in the start/end value editing field? If this is the case, correct the values.

Table entry	Cause	Remedy
All the values must be unique in this column (duplicate values cannot occur). Correct entry!	Faulty table (e.g. for the linearization)	Check the values of your linearization table: are duplicate values contained in the first column? If this is the case, then correct one of the two values, or delete all of them that are contained a number of times in the table except for one line.
No more lines can be added since the max. number of lines (specified by the device) has already been reached! (Only in ReadWin2000)	An attempt has been made to enter more lines into a table than is intended for the table	Check whether all cells that have been entered so far are necessary; remove redundant lines, for example, if ▪ Line 1: 4mA –> 0m ▪ Line 2: 8mA –> 10m ▪ Line 3: 12mA –> 20m Then the line with the 8mA as input signal can be omitted because the FML621 automatically calculates the pair of values 8mA –> 10 due to the contained interpolation of intermediate values. This enables you to save on a line in the table and use it for another pair of values.
Each table has to contain at least 2 lines. No more lines can be deleted!	An attempt has been made to reduce the number of lines in a table to less than 2.	Since the FML621 can no longer perform the interpolation of intermediate values correctly when the number of lines < 2, this error message is output. Do not delete any more lines. Since there is no point in having a table with less than 2 lines, deactivate the table, so that the functions associated with it are no longer executed.

Error messages of the formula editor	Cause	Remedy
"Error in formula"	General error in a mathematical formula	Check the formulae that you have entered using the formula editor. When doing so, observe the guidelines described in the Section on configuration of the mathematics channels.
Too many parameters!	Too many parameters have been entered for the function.	Check the number of parameters that are transferred to a function, e.g. a decade logarithm can only contain one parameter
Invalid operator!	An operator has been specified, which is not permitted in the function	Check that the formula is correct.
Formula buffer has been destroyed!	The formula entered has been destroyed / is no longer correct	Restart the device and reenter the formula, if necessary. If the error occurs again, contact E+H Service.
Size estimate of the memory: insufficient memory!	The quantity of the data that is to be saved exceeds the memory capacity of the device	Check the formula. The size of the tables used (for max. size, see list of operating parameters) and the number of values to be saved are too high: is reduction/optimization possible, e.g. is a longer memory interval possible?
Missing operand	No operand has been specified in the stored formulae.	Add an operand.
Number of opening and closing brackets is not equal!	Too few / too many brackets have been closed in a formula	Check your formulae: does the number of opened brackets match the number of closed brackets? If necessary, correct the brackets in the equation.
Error in the syntax of the formula!	Syntax error in the formula entered	Check the formula: for example, if there is another summand after a "+", have the correct parameters been used?
Error in the function!	General error in the function	Check the formula.
Too few parameters!	Too few parameters have been entered for the function.	Check the number of parameters that are transferred to a function, e.g. a decade logarithm must contain a parameter.
Division by 0!	A value = 0 was the result for a denominator in an equation.	Check the configured error handling: if, for example, a constant value is to be used for further calculation in the event of a circuit break of an input whose value is contained in the denominator of a division, then set it to a value not equal to 0.
"The formula can be max. 200 characters long! " (Only in ReadWin2000!)	More than 200 characters have been entered.	Limit the formula to 200 characters.
Function not found.	No function found at the expected position in the formula.	Check the formula.

Telealarm error messages	Cause	Remedy
"SMS sent successfully"	Not an error message. Is only entered in the event list in event of OK.	
"'SMS could not be sent to all configured recipients"	The SMS-Service-Center/SMS recipient could not be reached, e.g. because an incorrect number is/ was set.	Check the telephone number configured and contact your Service Provider where necessary.

11.3 Spare parts

Note!
A calibration report is always supplied with the Liquiphant M Density (standard calibration or special calibration).
If necessary, this calibration report can be reordered by quoting the serial number.

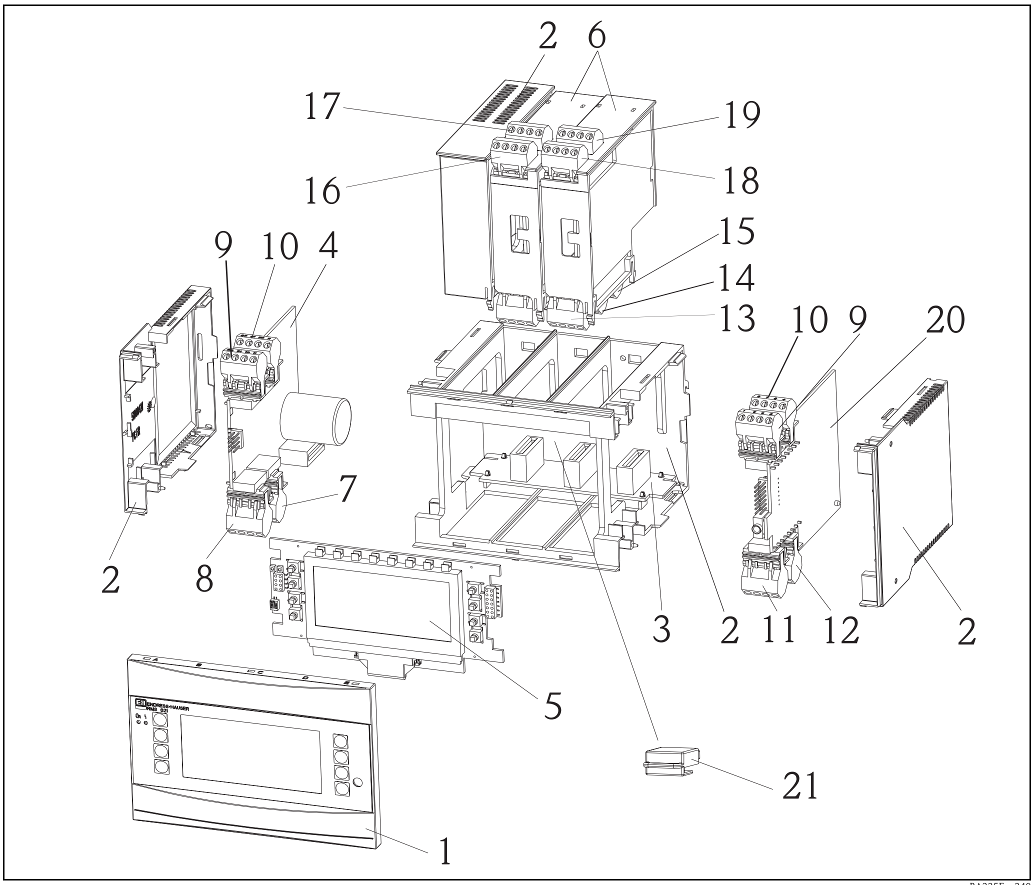


Fig. 68: FML621 spare parts

Item No..	Identifier	Description	Order number
1	Front	Front cover for version without display	FML621X-HA
		Front cover for version with display	FML621X-HB
2	Housing	Housing cpl.without front +3x dummy plug-in +3x plug-in frame for board	FML621X-HC
3	Bus board	Bus board	FML621X-BA
4	Power unit	Power unit 90-253VAC	FML621X-NA
		Power unit 18-36VDC/20-28VAC	FML621X-NB
		Power unit 90-253VAC/ATEX version	FML621X-NC
		Power unit 18-36VDC/20-28VAC/ATEX version	FML621X-ND
5	Display	Display cpl. non Ex	FML621X-DA
		Front board, version without display, non Ex	FML621X-DB
		Display + front cover, non Ex	FML621X-DC
		Display cpl. Ex	FML621X-DE
		Front board, version without display, Ex	FML621X-DF
		Display + front cover, Ex	FML621X-DG

Item No..	Identifier	Description	Order number
6	Extension cards	Extension card temperature (Pt100/Pt500/Pt1000) cpl. incl. terminals+fixing frame	FML621A-TA
		Extension card temp. ATEX approved (Pt100/500/ 1000) cpl. incl. terminals	FML621A-TB
		Extension card universal (PFM/pulse/analog/loop power) cpl. incl. terminals +fixing frame	FML621A-UA
		Extension card univ. ATEX approved (PFM/pulse/ analog/loop power) cpl. incl. terminals	FML621A-UB
		Extension card 2x U,I,TC, outp. 2x0/4-20mA/pul., 2xdig., 2x rel. SPST	FML621A-CA
		Extension card 2xU, I, TC, 2x U,I,TC ATEX, outp. 2x0/4mA/pul., 2xdig., 2x rel. SPST	FML621A-CB
		Extension card digital, 6x dig. in, 6x rel. out, cpl. incl. terminals + fixing frame	FML621A-DA
		Extension card dig., ATEX approved, 6x dig. in, 6x rel. out, cpl. incl. terminals	FML621A-DB
7	Supply terminal	Plug-in supply terminal, 4-pin	51000780
8	Relay terminal / loop power	Plug-in terminal, 4-pin SMSTB2,5 91/92/53/52 Relay terminal / loop power	51004062
9, 10	Analog terminal	Plug-in terminal, 4-pin SMSTB2,5 82/81/10/11 Analog terminal 1 (PFM/pulse/analog/loop power)	51004063
		Plug-in terminal, Ex, 4-pin SMSTB2,5 82/81/10/11 Analog terminal 1 (PFM/pulse/analog/loop power)	51005957
		Plug-in terminal, 4-pin SMSTB2,5 83/81/110/11 Analog terminal 2 (PFM/pulse/analog/loop power)	51004064
		Plug-in terminal, 4-pin Ex 83/81/110/11 Analog terminal 2 (PFM/pulse/analog/loop power)	51005954
11	Terminal RS485	Plug-in terminal, 4-pin SMSTB2,5 104 to 101 Terminal RS485	51004065
12	Output terminal	Plug-in terminal, 4-pin SMSTB2,5 134 to 131 Output terminal (analog/pulse)	51004066
13	Relay terminal/ extension card	Plug-in terminal, FML621 relay	51004912
14, 15	Extension card / output terminal	Plug-in terminal, FML621 dig./open collector	51004911
		Plug-in terminal, 4-pin SMSTB2,5 134 to 131 Output terminal (analog/pulse)	51004066
		Plug-in terminal, 4p FML621 dig. outp. I	51010524
		Plug-in terminal, 4p FML621 dig. outp. II	51010525
		Plug-in terminal, 4p FML621 dig. outp. III	51010519

Item No..	Identifier	Description	Order number
16, 17, 18, 19	Extension card / input terminal	Plug-in terminal, FML621, input 1, RTD (Pt100/Pt500/Pt1000)	51004907
		Plug-in terminal, Ex, FML621, input 1, RTD (Pt100/Pt500/Pt1000)	51005958
		Plug-in terminal, FML621, input 2, RTD (Pt100/Pt500/Pt1000)	51004908
		Plug-in terminal, Ex, FML621, input 2, RTD (Pt100/Pt500/Pt1000)	51005960
		Plug-in terminal, FML621, input 1, 4-20mA PFM, pulse, loop power	51004910
		Plug-in terminal, Ex, FML621, input 1, 4-20mA PFM, pulse, loop power	51005959
		Plug-in terminal, FML621, input 2, 4-20mA PFM, pulse, loop power	51004909
		Plug-in terminal, Ex, FML621, input 2, 4-20mA PFM, pulse, loop power	51005953
		Plug-in terminal, 4p FML621, dig. inp. blue	51010521
		Plug-in terminal, 4p FML621, dig. inp. gray	51010520
		Plug-in terminal, 4p FML621, inp. II blue	51010523
		Plug-in terminal, 4p FML621, inp. II gray	51010522
		Plug-in terminal, 4p FML621 UITC I blue	71005489
		Plug-in terminal, 4p FML621 UITC I gray	71005487
		Plug-in terminal, 4p FML621 UITC II blue	71005492
		Plug-in terminal, 4p FML621 UITC II gray	71005491
21	S-Dat module		

Item No. 20	CPU board	FML621C-		
	Version:			
	A	Non-hazardous area		
	B	ATEX approvals		
	C	FM ASI I, II, III/1/ABCDEFG		
	D	CSA (Ex ia) I, II, III/1/ABCDEFG		
		Operating language:		
		A	German	
		B	English	
		C	French	
		D	Italian	
		E	Spanish	
		F	Dutch	
			Device software:	
			AA	Mathematics
			AB	Mathematics + telealarm
			YY	Special version, to specify
FML621C-				⇐ Order code (part 1)

				Communication:		
				1	1x RS232+1x RS485	
				5	1xRS232+2xRS485	
				A	1x RS232+1x RS485+Ethernet Conversion to Ethernet only possible following consultation with E+H	
				E	1xRS232+2xRS485+Ethernet Conversion to Ethernet only possible following consultation with E+H	
					Version:	
					A	Standard
FML621C-						⇐ Order code (complete)

Item No. 21	S-Dat module	FML621S-	
	Software		
	1	Mathematics	
	2	Mathematics + telealarm	
		Version	
		A	Standard version
FML621S-			⇐ Order code

11.4 Return

For a return, e.g. in case of repair, the device must be sent in protective packaging. The original packaging offers the best protection. Repairs must only be carried out by your supplier's service organization. An overview of the service network can be found on the address page of these Operating Instructions.

✎ Note!
When sending in a device for repair, enclose a note with a description of the error and the application.

11.5 Disposal

The device contains electronic components and must, therefore, be disposed of as electronic waste in the event of disposal. Please also observe local regulations governing disposal.

11.6 Firmware history

Electronics	Release date	Software version	Software modification
FML621 -	11/2007	V 01.00.XX	Original software
FML621	04/2008	V 01.01.XX	Original software
FML621	03/2009	V 01.02.XX	Pressure units in absolute pressure Additional density unit kg/l

12 Technical data

12.1 Input

12.1.1 Measured variable

Voltage (analog and digital input), current (analog input), PFM, pulse input

✎ Note!
Only Endress+Hauser flow sensors can be connected to the PFM input.
Not suitable for level and pressure measuring instruments.

12.1.2 Input signal

Any measured variables (e.g. flow, level, pressure, temperature, density), implemented as an analog signal.

12.1.3 Measuring range

<table>
<tr><th>Measured variable</th><th colspan="3">Input</th></tr>
<tr><td>Current</td><td colspan="3">▪ 0/4 to 20 mA +10% overreach
▪ Max. input current 150 mA
▪ Input impedance < 10 Ω
▪ Accuracy 0.1% of full scale value
▪ Temperature drift 0.04% / K (0.022%/ °F)
▪ Signal damping low filter 1st order, filter constant adjustable 0 to 99 s
▪ Resolution 13 bit</td></tr>
<tr><td>Current (U-I-TC card)</td><td colspan="3">▪ 0/4 to 20 mA +10% overreach
▪ Max. input current 80 mA
▪ Input impedance = 10 Ω
▪ Accuracy 0.1% of full scale value
▪ Temperature drift 0.01%/ K (0.0056%/ °F)</td></tr>
<tr><td>PFM/pulse input</td><td colspan="3">▪ Frequency range 0.01 Hz to 18 kHz
▪ Signal level
– low: 2 to 7 mA;
– high: 13 to 19 mA
▪ Measurement method: period length/frequency measurement
▪ Accuracy 0.01% of measured value
▪ Temperature drift 0.01% over entire temperature range
▪ Signal level 2 to 7 mA low; 13 to 19 mA high with approx. 1.3 kΩ dropping resistor at max. 24 V voltage level</td></tr>
<tr><td>Voltage (digital input)</td><td colspan="3">▪ Voltage level
– low: -3 to 5 V
– high: 12 to 30V (as per IEC 61131-2)
▪ Input current typically 3 mA with overload and reverse polarity protection
▪ Sampling frequency:
– 4 x 4 Hz
– 2 x 20 kHz or 2 x 4 Hz</td></tr>
<tr><td>Voltage (analog input)</td><td colspan="3">▪ Voltage: 0 to 10 V, 0 to 5 V, ±10 V, measuring error ±0.1% of measuring range, input impedance > 400 kΩ
▪ Voltage: 0 to 100 mV, 0 to 1 V, ±1 V, ±100 mV; measuring error ±0.1% of measuring range, input impedance > 1 MΩ
▪ Temperature drift: 0.01% / K (0.0056% / °F)</td></tr>
<tr><td rowspan="5">Resistance thermometer (RTD) as per ITS 90</td><td>Identifier</td><td>Measuring range</td><td>Accuracy (4-wire connection)</td></tr>
<tr><td>Pt100</td><td>-200 to 800 °C (-328 to 1472 °F)</td><td>0.03% of full scale value</td></tr>
<tr><td>Pt500</td><td>-200 to 250 °C (-328 to 482 °F)</td><td>0.1% of full scale value</td></tr>
<tr><td>Pt1000</td><td>-200 to 250 °C (-328 to 482 °F)</td><td>0.08% of full scale value</td></tr>
<tr><td colspan="3">▪ Type of connection: 3-wire or 4-wire system
▪ Measuring current 500 µA
▪ Resolution 16 bit
▪ Temperature drift 0.01%/ K (0.0056%/ °F)</td></tr>
</table>

Measured variable	Input		
Thermocouples (TC)	Type	Measuring range	Accuracy
	J (Fe-CuNi), IEC 584	-210 to 999.9 °C (-346 to 1832 °F)	± (0.15% oMR +0.5 K) as of -100 °C ± (0.15% oMR +0.9 °F) as of -148 °F
	K (NiCr-Ni), IEC 584	-200 to 1372 °C (-328 to 2502 °F)	± (0.15% oMR +0.5 K) as of -130 °C ± (0.15% oMR +0.9 °F) as of -202 °F
	T (Cu-CuNi), IEC 584	-270 to 400 °C (-454 to 752 °F)	± (0.15% oMR +0.5 K) as of -200 °C ± (0.15% oMR +0.9 °F) as of -328 °F
	N (NiCrSi-NiSi), IEC 584	-270 to 1300 °C (-454 to 1386 °F)	± (0.15% oMR +0.5 K) as of -100 °C ± (0.15% oMR +0.9 °F) as of -148 °F
	B (Pt30Rh-Pt6Rh), IEC 584	0 to 1820 °C (32 to 3308 °F)	± (0.15% oMR +1.5 K) as of 600 °C ± (0.15% oMR +2.7 °F) as of 1112 °F
	D (W3Re/W25Re), ASTME 998	0 to 2315 °C (32 to 4199 °F)	± (0.15% oMR +1.5 K) as of 500 °C ± (0.15% oMR +2.7 °F) as of 932 °F
	C (W5Re/W26Re), ASTME 998	0 to 2315 °C (32 to 4199 °F)	± (0.15% oMR +1.5 K) as of 500 °C ± (0.15% oMR +2.7 °F) as of 932 °F
	L (Fe-CuNi), DIN 43710, GOST	-200 to 900 °C (-346 to 1652 °F)	± (0.15% oMR +0.5 K) as of -100 °C ± (0.15% oMR +0.9 °F) as of -148 °F
	U (Cu-CuNi), DIN 43710	-200 to 600 °C (-328 to 1112 °F)	± (0.15% oMR +0.5 K) as of -100 °C ± (0.15% oMR +0.9 °F) as of -148 °F
	S (Pt10Rh-Pt), IEC 584	0 to 1768 °C (32 to 3214 °F)	± (0.15% oMR +3.5 K) for 0 to 100 °C ± (0.15% oMR +1.5 K) for 100 to 1768 °C ± (0.15% oMR +6.3 °F) for 0 to 212 °F ± (0.15% oMR +2.7 °F) for 212 to 3214 °F
	R (Pt13Rh-Pt), IEC 584	-50 to 1768 °C (-58 to 3214 °F)	± (0.15% oMR +3.5 K) for 0 to 100 °C ± (0.15% oMR +1.5 K) for 100 to 1768 °C ± (0.15% oMR +6.3 °F) for 0 to 212 °F ± (0.15% oMR +2.7 °F) for 212 to 3214 °F
	Internal temperature compensation error: ≤ 3 °C (5.4 °F) Temperature drift: 0.01% / K (0.0056% / °F)		

12.1.4 Galvanic isolation

The inputs are galvanically isolated between the individual extension cards and the basic unit (see also 'Galvanic isolation' under Output.)

Note!
With digital inputs, every terminal block is galvanically isolated from one another.

12.2 Output

12.2.1 Output signal

Current, pulse, transmitter power supply (MUS) and switching output

12.2.2 Galvanic isolation

- The signal inputs and outputs are galvanically isolated towards the supply voltage (testing voltage 2.3 KV).
- All the signal inputs and outputs are galvanically isolated from one another (testing voltage 500 V).

Note!
The specified insulation voltage is the AC testing voltage U_{eff}, which is applied between the connections.
Basis for assessment: IEC 61010-1, protection class II, overvoltage category II

12.3 Output variable current - pulse

Measured variable	Output variables
Current	▪ 0/4 to 20 mA +10% overreach, invertible ▪ Max. loop current 22 mA (short-circuit current) ▪ Load max. 750 Ω at 20 mA ▪ Accuracy 0.1% of full scale value ▪ Temperature drift: 0.1% / 10 K (0.056% / 10°F) Ambient temperature ▪ Output ripple < 10 mV at 500 Ω for frequencies < 50 kHz ▪ Resolution 13 bit ▪ Error signals 3.6 mA or 21 mA limit as per NAMUR NE 43 (adjustable)
Pulse	Basic unit: ▪ Frequency range up to 12.5 kHz ▪ Voltage level 0 to 1 V low, 12 to 28 V high ▪ Load min. 1 kΩ ▪ Pulse width 0.04 to 1000 ms Extension cards (digital passive, open collector): ▪ Frequency range up to 12.5 kHz ▪ $I_{max.}$ = 200 mA ▪ $U_{max.}$ = 24 V ±15 % ▪ $U_{low/max.}$ = 1.3 V at 200 mA ▪ Pulse width 0.04 to 1000 ms
Number	Number: ▪ 2 x 0/4 to 20 mA/pulse (in basic unit) ▪ With Ethernet option: no current output present in the basic unit Max. number: ▪ 8 x 0/4 to 20 mA/pulse (depends on the number of extension cards) ▪ 6 x digital passive (depends on the number of extension cards)
Signal sources	All available multifunctional inputs (current, PFM or pulse inputs) and results from mathematic calculations can be freely allocated to the outputs.

12.4 Switching output

12.4.1 Function

Limit relay switches in the operating modes: minimum/maximum safety, gradient, alarm, frequency/pulse, device error

12.4.2 Switch behavior

Binary, switches when the limit value is reached (potential-free NO contact)

12.4.3 Relay switching capacity

Max. 250 V AC, 3 A / 30 V DC, 3 A

Note!
A combination of line voltage and protective extra low voltage is not permitted for extension card relays.

12.4.4 Switching frequency

Max. 5 Hz

12.4.5 Threshold

freely programmable

12.4.6 Hysteresis

0 to 99%

12.4.7 Sig. source

All available inputs and calculated variables can be allocated freely to the switching outputs.

12.4.8 Number of switching cycles

> 100,000

12.4.9 Scan rate

500 ms

12.4.10 Number

1 relay (in the basic unit)
Max. number: 19 relays (depends on the number and type of extension cards)

12.5 Transmitter power supply and external power supply

- Transmitter power supply unit (MUS), terminals 81/82 or 81/83 (optional power extension cards 181/182 or 181/183):
  Max. output voltage 24 V DC ±15%
  Impedance < 345 Ω
  Max. loop current 22 mA (at U_{out} > 16 V)
- FML621 technical data:
  HART® communication is not impaired
  Number: 4 MUS in the basic device
  Max. number: 10 (depends on the number and type of extension cards)
- Additional power supply (e.g. external display), terminals 91/92:
  Supply voltage 24 V DC ±5 %
  Current max. 80 mA, short-circuit proof
  Number 1
  Source resistance < 10 Ω

12.6 Power supply

12.6.1 Supply voltage

- Low voltage power unit: 90 to 250 V AC 50/60 Hz
- Extra-low voltage power unit: 20 to 36 V DC or 20 to 28 V AC 50/60 Hz

12.6.2 Power consumption

8 to 38 VA (depending on version and wiring)

12.6.3 Connection data interface

RS232
- Connection: jack socket 3.5 mm, front
- Transmission protocol: ReadWin® 2000
- Transmission rate: max. 57,600 baud

RS485
- Connection: plug-in terminals 101/102 (in the basic unit)
- Transmission protocol: (serial: ReadWin® 2000; parallel: open standard)
- Transmission rate: max. 57,600 baud

Optional: additional RS485 interface
- Connection: plug-in terminals 103/104
- Transmission protocol and transmission rate as standard interface RS485

Optional: Ethernet interface
Ethernet interface 10/100BaseT, connector type RJ45, connection via shielded cable, issuing of IP address via Setup menu in the device. Connection by means of interface with devices in office environment.
Safety distances: office device standard IEC 60950-1 must be taken into consideration.
Connection to a PC: possible by means of a "crossover" cable.

12.7 Reference operating conditions

12.7.1 FML621 reference operating conditions

- Power supply 207 to 250 V AC ±10 %; 50 Hz ±0.5 Hz
- Warm-up period > 30 min
- Ambient temperature 25 °C ±5 °C (77 °F ±9 °F)
- Air humidity 39 % ±10 % r.h.

12.7.2 Reference operating conditions, (special calibration, Liquiphant M Density)

- Medium: water (H2O)
- Medium temperature: 0 °C to 80 °C (liquid not moved)
- Ambient temperature: 24 °C ±5 °C
- Humidity: max. 90 %
- Warm-up period: > 30 min

12.8 Performance characteristics

Note!
The accuracy described here refers to the entire density measuring line.

12.8.1 General measuring conditions for accuracy data

- Span (measuring range): 0.3 to 2.0 g/cm³
- Distance between paddle and container wall and surface of liquid: > 50 mm (see Page 13 "Mounting location")
- Temperature sensor measuring error: < 1 °C
- Maximum viscosity: 350 mPa*s (exception: maximum 50 mPa*s for FTL51C)
- Maximum flow velocity: 2 m/s
  - Laminar flow, bubble-free, see installation instructions
  - Construction-specific measures (e.g. bypass or pipe enlargement) for reduction must be put in place for higher flow velocities.
- Process temperature: 0 to +80 °C (validity of accuracy data)
- Power supply in accordance with specification FML621
- Information in accordance with DIN EN 61298-2
- Process pressure: -1 to +25 bar absolute pressure

12.8.2 Maximum measured error

- Standard calibration: ±0.02 g/cm³ (±1.2% of the span (1.7 g/cm³), under general measuring conditions)
- Special calibration: ±0.005 g/cm³ (±0.3% of the span (1.7 g/cm³), under reference operating conditions)
- Field calibration: ±0.002 g/cm³ (in operating point)

12.8.3 Non-repeatability (reproducibility)

- Standard calibration: ±0.002 g/cm³ (under general measuring conditions)
- Special calibration: ±0.0007 g/cm³ (under reference operating conditions)
- Field calibration: ±0.002 g/cm³ (in operating point)

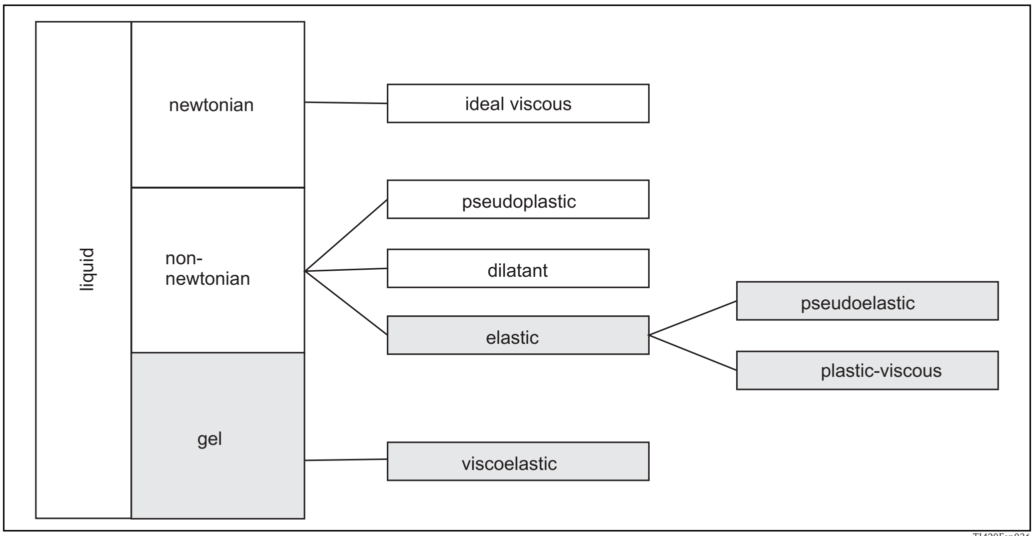
12.8.4 Factors influencing accuracy data

Note!
Cleaning of the sensor (CIP or SIP) is possible at process temperatures of up to 140°C over a long period.

- Long-term drift typ. ±0.00002 g/cm³ per day
- Temperature coefficient typ. ±0.0002 g/cm³ per 10 °C
- Fluid velocity in pipes > 2 m/s
- Buildup at the fork
- Air bubbles in the case of vacuum applications
- Incomplete coverage of the fork
- For pressure changes > 6 bar, a pressure measurement is required for compensation
- For temperatures > 1°C, a temperature measurement is required for compensation
- Mechanical stress (e.g. deformation) on the fork tines can impact accuracy and must be avoided. If a device has been subjected to mechanical stress, it must be replaced.

Cyclic field calibration can take place depending on the accuracy required.

Note!
Viscosity of liquid: All accuracy data refer to Newtonian (ideal viscous) liquids. Field calibration is recommended for elastic, pseudoelastic, plastic-viscous and viscoelastic liquids.



TI420Fen036

12.9 Installation conditions

12.9.1 FML621 installation instructions

Mounting location

In cabinet on top-hat rail IEC 60715

Orientation

No restrictions

12.9.2 Installation instructions for Liquiphant M Density

→ Chap. 3

12.10 Environment

12.10.1 Ambient temperature range

-20 to 50 °C (-4 to 122 °F)

Caution!
When using extension cards, venting with an air current of at least 0.5 m/s is necessary.

12.10.2 Storage temperature

-30 to 70 °C (-22 to 158 °F)

12.10.3 Climate class

As per IEC 60 654-1 Class B2 / EN 1434 Class 'C' (no condensation permitted)

12.10.4 Electr. safety

As per IEC 61010-1: environment < 2000 m (6560 ft) height above sea level

12.10.5 Degree of protection

- Basic unit: IP 20
- Remote operating and display unit: Front IP 65

12.10.6 Electromagnetic compatibility

Interference emission

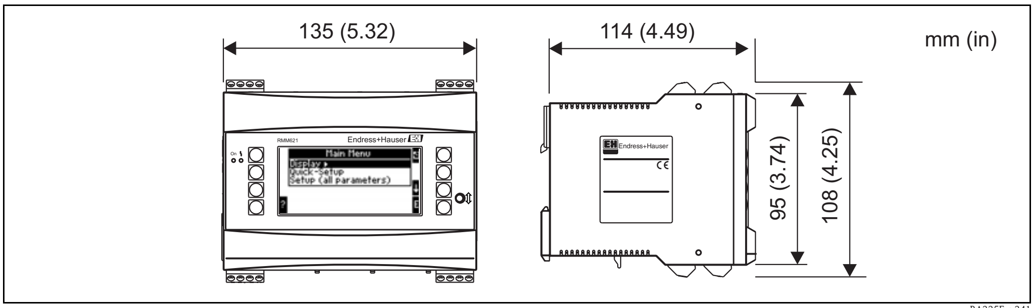
IEC 61326 Class A

Interference immunity

- Power failure: 20 ms, no influence
- Starting current limitation: $I_{max}/I_n \leq 50\%$ (T50% ≤ 50 ms)
- Electromagnetic fields: 10 V/m as per IEC 61000-4-3
- Conducted HF: 0.15 to 80 MHz, 10 V as per IEC 61000-4-3
- Electrostatic discharge: 6 kV contact, indirect as per IEC 61000-4-2
  - Burst (power supply): 2 kV as per IEC 61000-4-4
  - Burst (signal): 1 kV/2 kV as per IEC 61000-4-4
  - Surge (power supply AC): 1 kV/2 kV as per IEC 61000-4-5
  - Surge (power supply DC): 1 kV/2 kV as per IEC 61000-4-5
  - Surge (signal): 500 V/1 kV as per IEC 61000-4-5

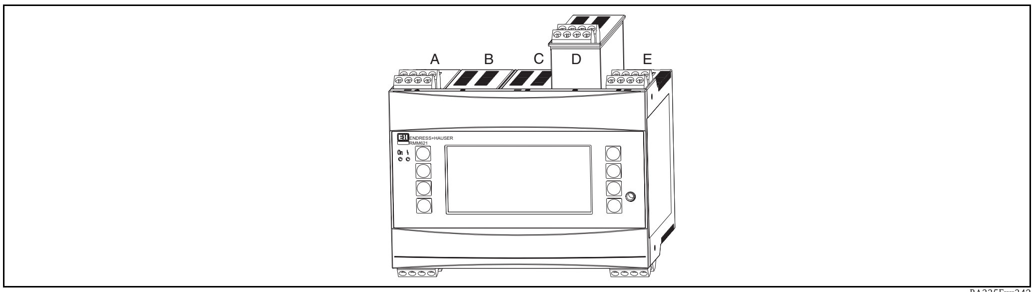
12.11 Mechanical construction

12.11.1 Design, dimensions



BA335Fen341

Fig. 69: Housing for top-hat rail as per IEC 60715



BA335Fxx342

Fig. 70: Device with extension cards (available optionally or as accessory)
– Slots A and E are integral components of the basic device
– Slots B, C and D can be expanded with extension cards

12.11.2 Weight

- Basic device: 500 g (17.6 oz) (in maximum configuration with extension cards)
- Remote operating unit: 300 g (10.6 oz)

12.11.3 Material

Housing: polycarbonate plastic, UL 94V0

12.11.4 Terminals

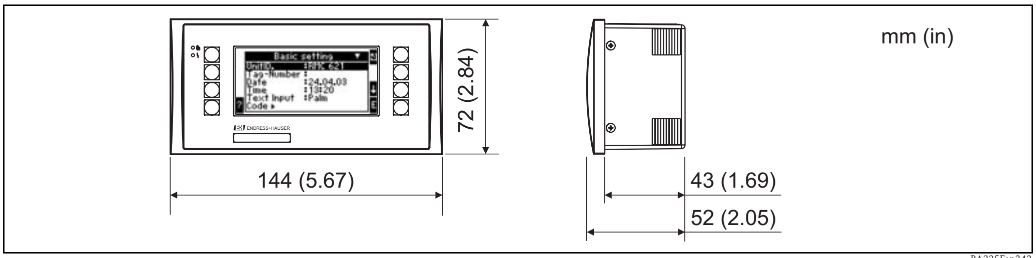
Pluggable screw terminals (power supply terminal coded); clamping area 1.5 mm^2 (16 AWG) solid, 1.0 mm^2 (18 AWG) flexible with ferrules (applies to all connections).

12.12 Display and operating elements

Note!
- An operating and display unit is absolutely essential for field calibration.
- An operating and display unit can also be used for commissioning density computer FML621. If necessary, the operating and display unit can also be used for a number of devices.

12.12.1 Display elements

- Display (optional):
  160 x 80 DOT-Matrix LCD with blue background lighting, color change to red in event of error (configurable)
- LED status display:
  Operation: 1 x green (2 mm (0.08"))
  Fault message: 1 x red (2 mm (0.08"))
- Operating and display unit (optional or as accessory):
  An operating and display unit can be additionally connected to the device in the panel mounting housing (dimensions WxHxD = 144 x 72 x 43 mm (5.67" x 2.83" x 1.69")). The connection to the integrated RS484 interface is made using the connecting cable (l = 3 m (9.8 ft)), which is included in the accessories kit. Parallel operation of the operating and display unit with a device-internal display in the FML621 is possible.



BA335Fen343

Fig. 71: Operating and display unit for panel mounting (available optionally or as accessory)

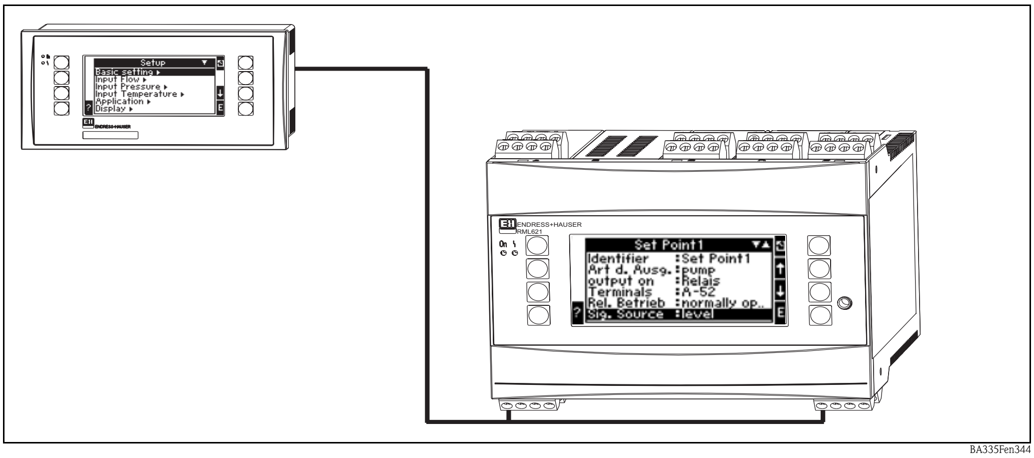


Fig. 72: Operating and display unit in panel mounting housing

12.12.2 Operating elements

Eight front-panel soft keys interact with the display (key functions are shown on the display).

12.12.3 Remote operation

RS232 interface (jack socket on front panel 3.5 mm (0.14 in)): configuration via PC with ReadWin® 2000 PC operating software.
RS485 interface

12.12.4 Real time clock

- Deviation: 30 min per year
- Power reserve: 14 days

12.13 Certificates and approvals

12.13.1 CE mark

The measuring system meets the legal requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

12.13.2 Ex approval

Information about currently available Ex versions (ATEX, FM, CSA, etc.) can be supplied by your E+H Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.

12.13.3 Other standards and guidelines

- IEC 60529:
  Degrees of protection through housing (IP code)
- IEC 61010:
  Protection measures for electrical equipment for measurement, control, regulation and laboratory procedures
- EN 61326 (IEC 1326):
  Electromagnetic compatibility (EMC requirements)
- NAMUR NE 21, NE 43
  Association for Standards for Control and Regulation in the Chemical Industry

12.14 Documentation

✎ Note!
This supplementary documentation can be found on our product pages on www.endress.com

12.14.1 Brochures

Innovation brochure on Liquiphant M Density
IN017F/00

Density Measurement for Quality Monitoring and Process Control
CP024F/00

The Liquiphant Family
CP003F/00

12.14.2 Technical Information

Liquiphant M Density Computer FML621
TI420F/00

Liquiphant M FTL50, FTL51 (for standard and hygiene applications)
TI328F/00

Liquiphant M FTL51C (with highly corrosion-resistant coating)
TI347F/00

12.14.3 Operating Instructions

Density Computer FML621
BA335F/00

Liquiphant M Density FTL50, FTL51 with FEL50D
KA284F/00

Liquiphant M Density FTL50(H), FTL51(H) with FEL50D
KA285F/00

Liquiphant M Density FTL51C with FEL50D
KA286F/00

12.14.4 Certificates

FM
ZD041F/00

CSA
ZD042F/00/en

12.14.5 Safety instructions (ATEX)

Density Computer FML621
CE Ex II (1) GD, (EEx ia) IIC
(PTB 04 ATEX 2019)
XA038R/09/a3

Liquiphant M FTL50(H), FTL51(H), FTL51C, FTL70, FTL71
CE Ex II 1/2 G, EEx d IIC/B
(KEMA 99 ATEX 1157)
XA031F/00/a3

Liquiphant M FTL50(H), FTL51(H), FTL51C, FTL70, FTL71

CE ⟨Ex⟩ II 1/2 G, EEx ia/ib IIC/B
(KEMA 99 ATEX 0523)
XA063F/00/a3

Liquiphant M FTL50(H), FTL51(H), FTL51C
CE ⟨Ex⟩ II 1 G, EEx ia IIC/B
(KEMA 99 ATEX 5172 X)
XA064F/00/a3

Liquiphant M FTL50(H), FTL51(H), FTL51C, FTL70, FTL71
CE ⟨Ex⟩ II 1/2 G, EEx de IIC/B
(KEMA 00 ATEX 2035)
XA108F/00/a3

Liquiphant M FTL51C
CE ⟨Ex⟩ II 1/2 G, EEx ia/ib IIC
(KEMA 00 ATEX 1071 X)
XA113F/00/a3

Liquiphant M FTL51C
CE ⟨Ex⟩ II 1/2 G, EEx d IIC
(KEMA 00 ATEX 2093 X)
XA114F/00/a3

Liquiphant M FTL51C
CE ⟨Ex⟩ II 1/2 G, EEx de IIC
(KEMA 00 ATEX 2092 X)
XA115F/00/a3

Liquiphant M FTL50(H), FTL51(H), FTL51C, FTL70, FTL71
CE ⟨Ex⟩ II 3 G, EEx nA/nC II
(EG 01 007-a)
XA182F/00/a3

13 Appendix

13.1 List of abbreviations

Abbreviation	Meaning
… temp.	…temperature
betw. calls	between calls
Ch. Speed	Change speed
Circuit br. det.	Circuit break detection
curr.	current
Disp.+Ackn.	Display and acknowledge
Event mess.	Event message
Gen.	General
High stat.	High status
horz.	horizontal
Int. evaluation	Intermediate evaluation
Low stat.	Low status
No.	Number
Pnts	Points
Prog.	Program
Res. value	Reset value
Resp.	Response
Time del.	Time delay
Unit adr.	Unit address
Unit ID	Device designation
vert.	vertical

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