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Technical Information
Liquiphant FTL62 Density with Density Computer FML621

Vibronic

Density computer for liquids
Also for use in hazardous areas

Application

The density measuring line can be used in liquid media. It is used for the following purposes:
- Density measurement
- Intelligent medium detection
- Reference density calculation
- To calculate the concentration of a liquid
- To convert values to different units such as °Brix, °Baumé, °API etc.

Advantages

- Measurement used directly in tanks or pipes without the need for additional pipework
- Integration of existing temperature measurements for temperature compensation
- Additional calculations, such as the concentration of a product, can be performed in the Density Computer FML621.

Endress+Hauser
People for Process Automation

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About this document

Symbols

Safety symbols

DANGER

This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

WARNING

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in serious or fatal injury.

CAUTION

This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in minor or medium injury.

NOTICE

This symbol contains information on procedures and other facts which do not result in personal injury.

Electrical symbols

Ground connection
Grounded clamp, which is grounded via a grounding system.

Protective earth (PE)
Ground terminals, which must be grounded prior to establishing any other connections. The ground terminals are located on the inside and outside of the device.

Tool symbols

Flat-blade screwdriver

Allen key

Open-ended wrench

Symbols for certain types of information

Permitted
Procedures, processes or actions that are permitted.

Forbidden
Procedures, processes or actions that are forbidden.

Tip
Indicates additional information

Reference to documentation

Reference to another section

1., 2., 3. Series of steps

Symbols in graphics

A, B, C ... View

1, 2, 3 ... Item numbers

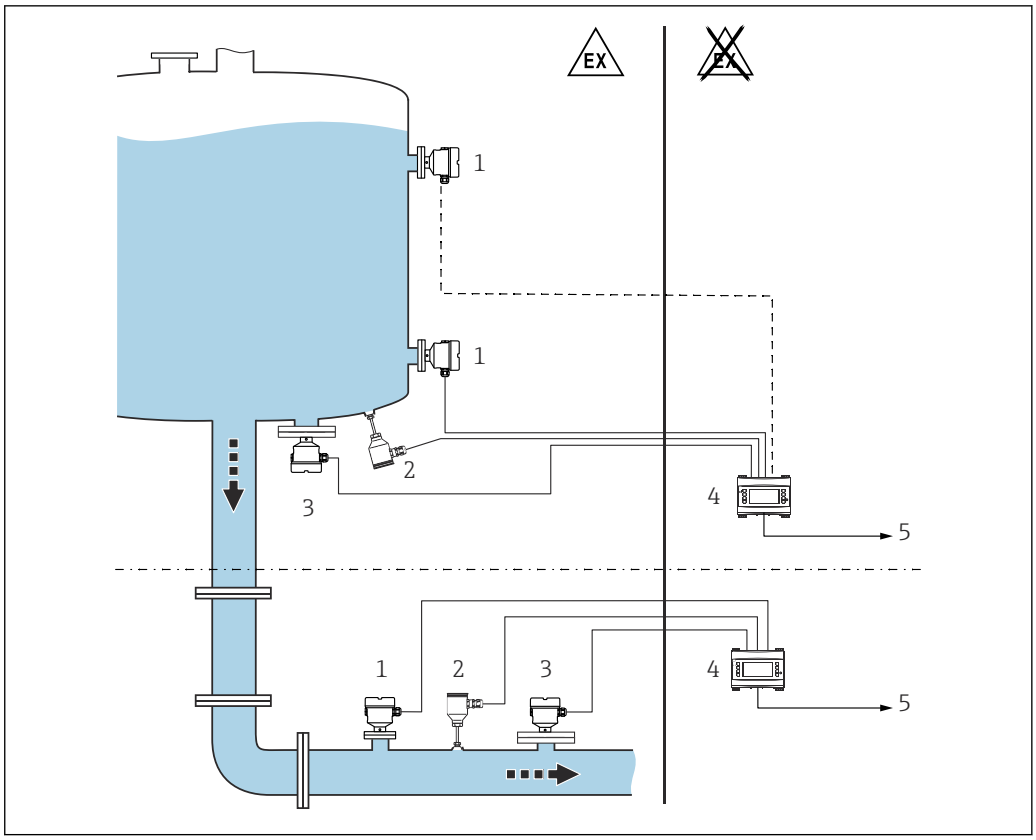
Hazardous area

Safe area (non-hazardous area)

Application

Density measurement

The Liquiphant Density measures the density of a liquid medium in pipes and tanks. The device is suitable for all Newtonian (purely viscous) fluids. In addition, the device is also suitable for use in hazardous areas.



1 *Density measurement with Density Computer FML621*

1 *Liquiphant Density → Pulse output*
2 *Temperature sensor, e.g. 4 to 20 mA output*
3 *Pressure transmitter 4 to 20 mA output required for changes in pressure >6 bar*
4 *Liquiphant Density Computer FML621 with display and operating unit*
5 *PLC*

The measurement can be affected by:
- air bubbles at the sensor
- unit not fully covered by the medium
- solid media buildup on the sensor
- high fluid velocity in pipes
- severe turbulence in the pipe due to inlet and outlet runs that are too short
- corrosion of the fork
- non-Newtonian (not purely viscous) behavior of fluids

Application examples: basic unit

1 density measuring line, pressure and temperature-compensated

- 1 Liquiphant with FEL60D
- 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

- **Product structure:** FML621-xxxAAAxxxx
- **Number of inputs:** 4x pulse input, 0 to 20 mA or 4 to 20 mA
- **Number of outputs:** 1x SPST relay, 2x 0 to 20 mA or 4 to 20 mA

2 density measuring lines, temperature-compensated

- 2 Liquiphant with FEL60D
- 2 temperature transmitters 4 to 20 mA
- 1 output: density 4 to 20 mA
- 1 output: temperature 4 to 20 mA

- **Product structure:** FML621-xxxAAAxxxx
- **Number of inputs:** 4x pulse input, 0 to 20 mA or 4 to 20 mA
- **Number of outputs:** 1x SPST relay, 2x 0 to 20 mA or 4 to 20 mA

Application examples: basic unit + 2 extension cards

3 density measuring lines, 2 x temperature-compensated, 1 x pressure- and temperature-compensated

- 3 Liquiphant with FEL60D
- 3 temperature transmitters 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

- **Product structure:** FML621-xxxBBAxxxx
- **Number of inputs:** 8 x pulse input, 0 to 20 mAor 4 to 20 mA
- **Number of outputs:** 5 x SPST relay, 6x 0 to 20 mA or 4 to 20 mA

Application examples: medium detection

Distinguish between 2 media

- **Product structure:** FML621-xxxAAAxxxx basic unit
- **Use of inputs:**
  - 1x FEL60D
  - 1x temperature 4 to 20 mA
- **Information content:**
  - 1 output: density 4 to 20 mA
  - 1 output: temperature 4 to 20 mA
  - 1 Relay

The medium detection can refer to concentrations or phase transitions

Distinguish between 3 media

- **Product structure:** FML621-xxxBAAxxxx basic unit with additional relay card
- **Use of inputs:**
  - 1x FEL60D
  - 1x temperature 4 to 20 mA
- **Information content:**
  - 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.

Applications: density

Density measurement or concentration calculation with pump protection

- **Product structure:** FML621-xxxBAAxxxx basic unit
- **Use of inputs:**
  - 1 x FEL60D
  - 1 x temperature 4 to 20 mA
- **Information content:**
  - 1 output: density 4 to 20 mA
  - 1 output: temperature 4 to 20 mA
  - 1 relay to switch off the pump

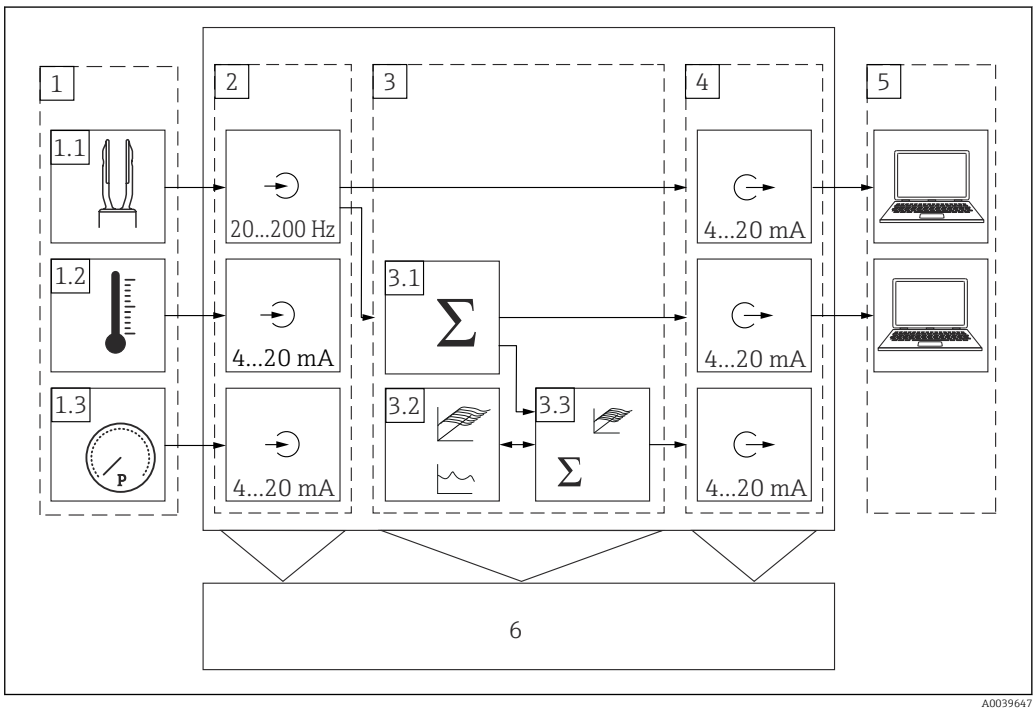
In addition to determining the density and concentration, pump protection can also be implemented by setting the appropriate switching frequency.

Function and system design

Measuring principle

A piezoelectric drive causes the tuning fork of the Liquiphant Density to vibrate at its resonance frequency. If the density of the liquid medium changes, the resonance frequency of the tuning fork also changes. The density of the medium has a direct impact on the resonance frequency of the tuning fork. As specific medium properties and mathematic relations are preprogrammed in the system, the Density Computer calculates the exact concentration of a medium.

System design



2 *Density Computer FML621, modular design diagram*

1 External sensors
1.1 Liquiphant Density
1.2 Temperature sensor
1.3 Pressure sensor
2 Input modules, Density Computer FML621
3 Computing module, Density Computer FML621
3.1 Mathematical functions, e.g. density
3.2 2D, 3D curve
3.3 Mathematical functions, e. g. concentration, 3D linearization
4 Output modules, Density Computer FML621
5 Information processing - control room
6 Additional display

Specific density applications

The software modules available calculate the density from the frequency, temperature and pressure input variables.

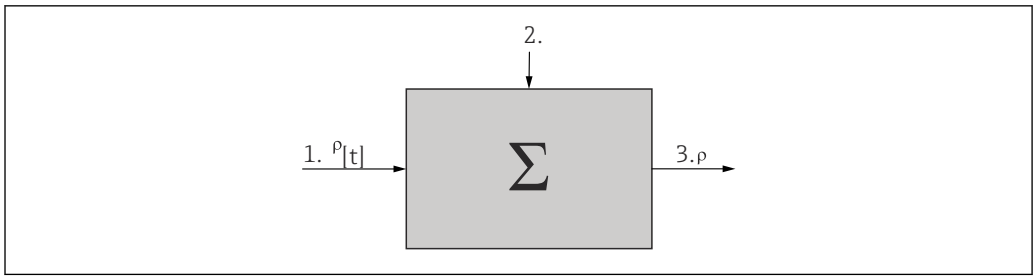
Operating principle

The vibrating frequency of the tuning fork is reduced when the tuning fork is completely covered with liquid. Using additional information, such as temperature and pressure, it is possible to calculate the corresponding density of the medium. If the value by which the density has changed is known, the concentration of the medium can be determined using a function stored in the system. This value can be determined empirically or using existing tables, for example. . The tables for converting density to concentration must be provided by the customer.

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

Reference density

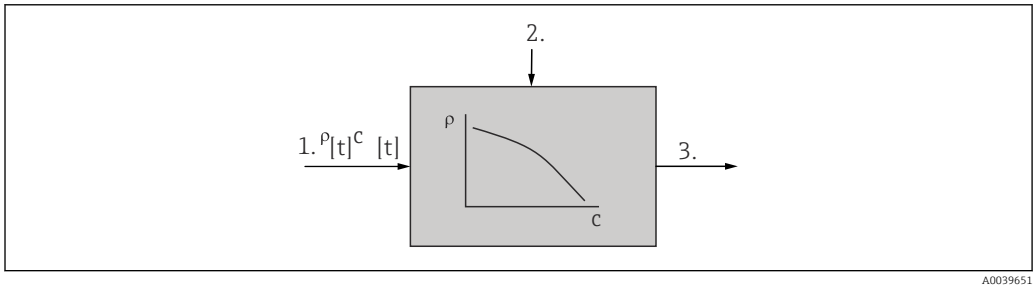
In this module, the system refers to a reference temperature, such as 15 °C (59 °F) or 20 °C (68 °F). It must be known how the density of the medium changes at different temperatures.



1 Input data: Table ρ [t]
2 Measured liquid medium: Temperature and density
3 Output: Calculated density ρ [standard]

Concentration

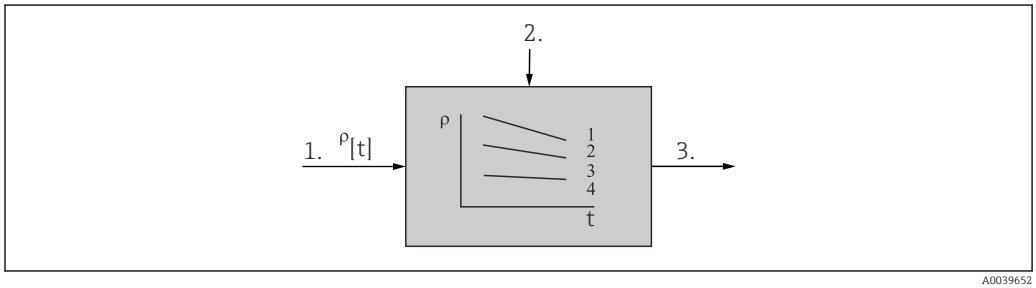
Using density and concentration curves already available or determined empirically, it is possible to determine the concentration when substances are continuously dissolved in a medium.



1 Input data: Table ρ, c [t]
2 Measured liquid medium: Temperature and density
3 Output: Calculated concentration

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. This allows the system to differentiate between two media.



1 Input data: Tables ρ [t] for two liquid media
2 Measured liquid medium: Temperature and density
3 Output: Relay output, device

Measuring system

The Density Computer FML621 supplies power directly to connected two-wire transmitters. Intrinsically safe inputs and transmitter power supply units for current cards are optionally available for applications in hazardous areas. The inputs, outputs, limit values and display as well as commissioning and maintenance of the device are performed via a dot-matrix display with eight soft keys and a backlight as well as an RS232 or RS485 interface or ReadWin® 2000 PC software. In addition, it is possible to extend the device using additional extension cards.

A change in the background color indicates alarms or limit value violations. It is possible to configure the background color.

To use the telealarm function, we recommend common industrial modems that have an RS232 interface. The measured values and events or alarms are encoded and transmitted in accordance with the serial protocol. It is possible to query the protocol type.

The number of inputs, outputs, relays and transmitter power supply units contained in the basic unit can be individually extended using a maximum of three plug-in cards.

Modularity

- Measuring density of a liquid medium
- Liquiphant with electronic insert FEL60D and Density Computer FML621
- Also for hazardous areas
- Up to 5 density measuring lines can be operated with the Density Computer FML621. All slots must be fitted with plug-in cards.

Density Computer FML621 - specification

- **Input**
  - FEL60D sensor
  - 0 to 20 mA or 4 to 20 mA analog inputs
  - 0 to 18 digital inputs
  - 4 to 10 pulse inputs
  - Temperature sensors (mA, mV, V, TC, RTD)
- **Output**
  - 2 to 8 Analog outputs 0 to 20 mA or 4 to 20 mA
  - 2 to 8 Pulse outputs - active or passive
  - 1 to 19 relays SPST, AC or DC
- **Communication**
  - Ethernet IP
  - PSTN or GSM modem
  - Serial bus RS232, RS485
  - PROFIBUS® via coupler
  - PROFINET® via coupler
  - ReadWin® 2000 PC software
- **Power supply mode**
  - 4 - 10 devices, max. current consumption 30 mA
  - 1 device, max. current consumption 80 mA
- **Internal memory**
  512 kB
- **Calculating functions**
  Pre-defined or editable

Electronic insert for density measurement

Electronic insert FEL60D

Density Computer FML621

Two-wire pulse output: Current pulses, superimposed on the power supply along the two-wire cabling

Input of Liquiphant Density

Measured variable

Density of liquids

Measuring range

Density range: 0.3 to 2 g/cm³ (18.7 to 125 lb/ft³) (0.3 to 2 SGU)

Output of Liquiphant Density

Output and input variants

2-wire density (FEL60D) for density measurement
Connection to Density Computer FML621

For detailed information, see the Technical Information.

Ex connection data

See safety instructions (XA): All data relating to explosion protection are provided in separate Ex documentation and are available from the Downloads area of the Endress+Hauser website. The Ex documentation is supplied as standard with all devices approved for use in explosion hazardous areas.

Input of Density Computer FML621

Measured variable

- Voltage (analog and digital input)
- Current (analog input)
- PFM
- Pulse input

The following measured variables are implemented as an analog signal or pulse signal:
- Flow
- Level
- Pressure
- Temperature
- Density

Only Endress+Hauser flow sensors can be connected to the PFM input.

Not suitable for level and pressure measuring instruments.

Measuring range

Current input
- 0 to 20 mA or 4 to 20 mA +10 % overrange
- 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 first-order low-pass filter, adjustable filter constants 0 to 99 s
- Resolution: 13 bit

Current input (U-I-TC card with intrinsically safe inputs)
- 0 to 20 mA or 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 0.01 % / K (0.0056 % / °F)

PFM/pulse input
- Frequency range: 0.01 to 18 kHz
- Signal level - with approx. 1.3 kΩ series resistor at max. 24 V voltage level:
  - Low: 2 to 7 mA
  - High: 13 to 19 mA
- Measurement method: Period length or frequency measurement
- Accuracy: 0.01 % of reading
- Temperature drift: 0.01 % Over entire temperature range

Voltage input (digital input)
- Voltage level:
  - Low: −3 to 5 V
  - High: 12 to 30 V (as per IEC 61131-2)
- Input current typically: 3 mAwith overload and reverse polarity protection
- Sampling frequency:
  - 4x4 Hz
  - 2x 20 kHz or 2x 4 Hz

Voltage input (analog input)
- Voltage: 0 to 10 V, 0 to 5 V, ±10 V, inaccuracy ±0.1 % of measuring range, input impedance >400 kΩ
- Voltage: 0 to 100 mV, 0 to 1 V, ±1 V, ±100 mV, inaccuracy ±0.1 % of measuring range, input impedance >1 MΩ
- Temperature drift: 0.01 % / K (0.0056 % / °F)

Resistance thermometer Pt100 as per ITS 90
- Measuring range: −200 to 800 °C (−328 to 1 472 °F)
- Accuracy: 4-wire connection 0.03 % of full scale value
- Type of connection: 3-wire or 4-wire system
- Measuring current: 500 µA
- Resolution: 16 bit
- Temperature drift: 0.01 % / K (0.0056 % / °F)

Resistance thermometer Pt500 as per ITS 90
- Measuring range: −200 to 250 °C (−328 to 482 °F)
- Accuracy: 4-wire connection 0.1 % of full scale value
- Type of connection: 3-wire or 4-wire system
- Measuring current: 500 µA
- Resolution: 16 bit
- Temperature drift: 0.01 % / K (0.0056 % / °F)

Resistance thermometer Pt1000 as per ITS 90
- Measuring range: −200 to 250 °C (−328 to 482 °F)
- Accuracy: 4-wire connection 0.08 % of full scale value
- Type of connection: 3-wire or 4-wire system
- Measuring current: 500 µA
- Resolution: 16 bit
- Temperature drift: 0.01 % / K (0.0056 % / °F)

Thermocouples (TC)
- J (Fe-CuNi), IEC 584
  - Measuring range: −210 to 999.9 °C (−346 to 1 832 °F)
  - Accuracy: ± (0.15 % of measuring range +0.5 K) from −100 °C ± (0.15 % of measuring range +0.9 °F) from −148 °F
- K (NiCr-Ni), IEC 584
  - Measuring range: −200 to 1 372 °C (−328 to 2 502 °F)
  - Accuracy: ± (0.15 % of measuring range +0.5 K) from −130 °C ± (0.15 % of measuring range +0.9 °F) from −202 °F
- T (Cu-CuNi), IEC 584
  - Measuring range: −270 to 400 °C (−454 to 752 °F)
  - Accuracy: ± (0.15 % of measuring range +0.5 K) from −200 °C ± (0.15 % of measuring range +0.9 °F) from −382 °F
- N (NiCrSi-NiSi), IEC 584
  - Measuring range: −270 to 1 300 °C (−454 to 1 386 °F)
  - Accuracy: ± (0.15 % of measuring range +0.5 K) from −100 °C ± (0.15 % of measuring range +0.9 °F) from −148 °F
- B (Pt30Rh-Pt6Rh), IEC 584
  - Measuring range: 0 to 1 820 °C (32 to 3 308 °F)
  - Accuracy: ± (0.15 % of measuring range +1.5 K) from 600 °C ± (0.15 % of measuring range +2.7 °F) from 1 112 °F
- D (W3Re/W25Re), ASTME 998
  - Measuring range: 0 to 2 315 °C (32 to 4 199 °F)
  - Accuracy: ± (0.15 % of measuring range +1.5 K) from 500 °C ± (0.15 % of measuring range +2.7 °F) from 932 °F
- C (W5Re/W26Re), ASTME 998
  - Measuring range: 0 to 2 315 °C (32 to 4 199 °F)
  - Accuracy: ± (0.15 % of measuring range +1.5 K) from 500 °C ± (0.15 % of measuring range +2.7 °F) from 932 °F
- L (Fe-CuNi), DIN 43710, GOST
  - Measuring range: −200 to 900 °C (−328 to 1 652 °F)
  - Accuracy: ± (0.15 % of measuring range +0.5 K) from −100 °C ± (0.15 % of measuring range +0.9 °F) from −148 °F

- U (Cu-CuNi), DIN 43710
  - Measuring range: −200 to 600 °C (−328 to 1 112 °F)
  - Accuracy: ± (0.15 % of measuring range +0.5 K) from −100 °C
    ± (0.15 % of measuring range +0.9 °F) from −148 °F
- S (Pt10Rh-Pt), IEC 584
  - Measuring range: 0 to 1 768 °C (32 to 3 214 °F)
  - Accuracy: ± (0.15 % of measuring range +3.5 K) for 0 to 100 °C
    ± (0.15 % of measuring range +1.5 K) from 100 to 1 768 °C
    ± (0.15 % of measuring range +6.3 °F) for 0 to 212 °F
    ± (0.15 % of measuring range +2.7 °F) for 212 to 2 314 °F
- R (Pt13Rh-Pt), IEC 584
  - Measuring range: −50 to 1 768 °C (−58 to 3 214 °F)
  - Accuracy: ± (0.15 % of measuring range +3.5 K) for 0 to 100 °C
    ± (0.15 % of measuring range +1.5 K) from 100 to 1 768 °C
    ± (0.15 % of measuring range +6.3 °F) for 0 to 212 °F
    ± (0.15 % of measuring range +2.7 °F) for 212 to 2 314 °F

Galvanic isolation

The inputs between the individual extension cards and the basic unit are galvanically isolated (→ 🖹 12).

With digital inputs, all terminal blocks are galvanically isolated from one another.

Output of Density Computer FML621

Output signal

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

Galvanic isolation

- The signal inputs and outputs are galvanically isolated from the supply voltage.
  Testing voltage: 2.3 kV
- All signal inputs and outputs are galvanically isolated from one another.
  Testing voltage: 500 V

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.

Current output, pulse output

Current output
- 0 to 20 mA or 4 to 20 mA +10 % overrange, reversible
- Max. loop current: 22 mA- short-circuit current
- Max. load: 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 value in accordance NAMUR NE 43 - adjustable

Pulse output
- Basic unit:
  - Frequency range: up to 12.5 kHz
  - Voltage level: 0 to 1 V low, 12 to 28 V high
  - Min. load: 1 kΩ
  - Pulse width: 0.04 to 1 000 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 1 000 ms

Number of outputs
- 2x 0 to 20 mA or 4 to 20 mA / pulse - in basic unit
- Ethernet option: No current output present in the basic unit
- Max. number:
  - 8x 0 to 20 mA or 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 existing multifunctional inputs and results of mathematic calculations can be freely assigned to the outputs.

Switch output

Function
Limit relay switches in the operating modes: Minimum or maximum safety, gradient, alarm, frequency or pulse, device error.

Switching behavior
Binary, switches when the limit value is reached - potential-free NO contact.

Switching capacity
Max. 250 V_{AC} 3 A / 30 V_{DC} 3 A

Do not combine line voltage and protective extra low voltage for extension card relays.

Switching frequency
Maximum 5 Hz

Threshold
User-programmable

Hysteresis
0 to 99 %

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

Number of switching cycles
> 100,000

Scan rate
500 ms

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

Transmitter power supply and external power supply

Transmitter power supply, 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: 3 MUS in the basic unit
- Max. number: 10 - depends on the number and type of extension cards

Additional power supply terminals 91/92, e.g. external display:
- Supply voltage: 24 V_{DC}±5 %
- Max. current: 80 mA, short-circuit proof
- Number: 1
- Source resistance: <10 Ω

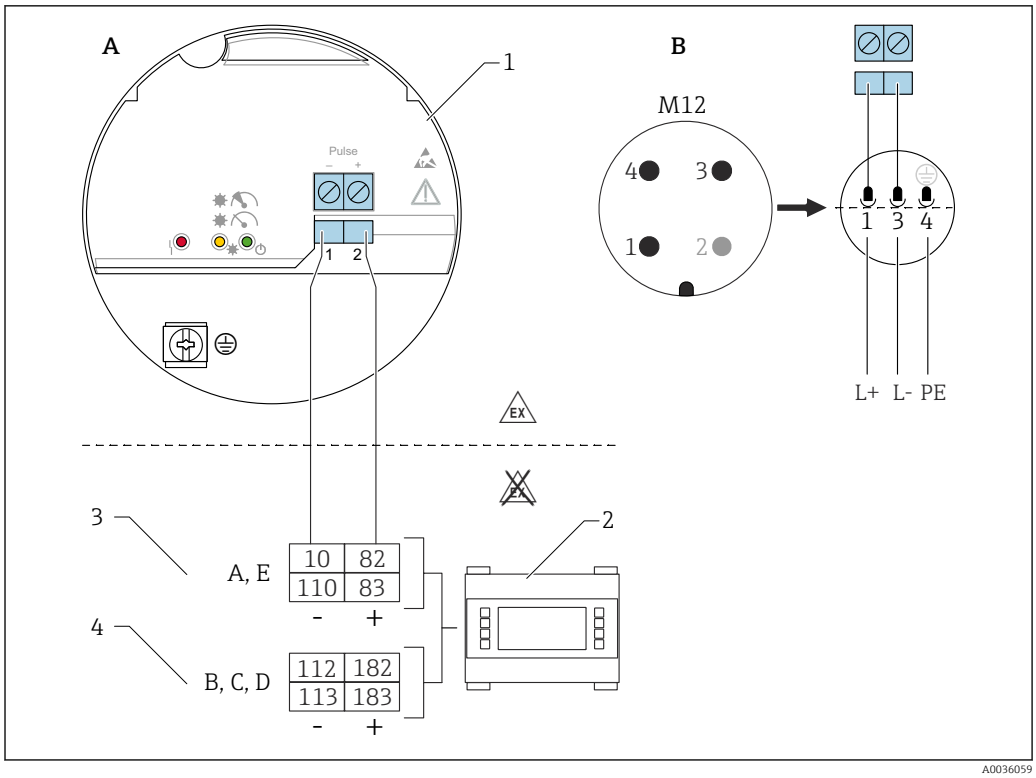
Power supply of Liquiphant Density

NOTICE

Operation with other switching units is not permitted.
Destruction of electronic components.
- ▶ Do not install the FEL60D electronic insert in devices that were originally used as point level switches.

Terminal assignment

The output signal of the density sensor is based on pulse technology. With the aid of this signal, the fork frequency is constantly forwarded to the Density Computer FML621.



3 *Connection diagram: electronic insert FEL60D connection to Density Computer FML621*

A Connection wiring with terminals
B Connection wiring with M12 plug in housing as per EN61131-2 standard
1 Electronic insert FEL60D
2 Density Computer FML621
3 Slots A, E with extension cards (already installed in the basic unit)
4 Slots B, C, D with extension cards (optional)

Supply voltage	U = 24 V_{DC} ±15 %, only suitable for connecting to the Density Computer FML621 The device must be powered by a voltage supply categorized as "CLASS 2" or "SELV".
Power consumption	P < 160 mW
Current consumption	I < 10 mA
Overvoltage protection	Overvoltage category I
Pulse signal in case of alarm	Output signal in case of power failure and damaged sensor: 0 Hz.

Adjustment

There are 3 different types of adjustment:

- Standard adjustment (order configuration):
  Two fork parameters are determined at the factory to describe the sensor characteristics and are provided in the calibration report with the product. These parameters must be transmitted to the Density Computer FML621.
- Special adjustment (select in the Product Configurator):
  Three fork parameters are determined at the factory to describe the sensor characteristics and are provided in the calibration report with the product. These parameters must be transmitted to the Density Computer FML621.
  This type of adjustment achieves an even higher level of accuracy.
- Field adjustment:
  With a field adjustment, the density determined by the user is transmitted to the FML621.

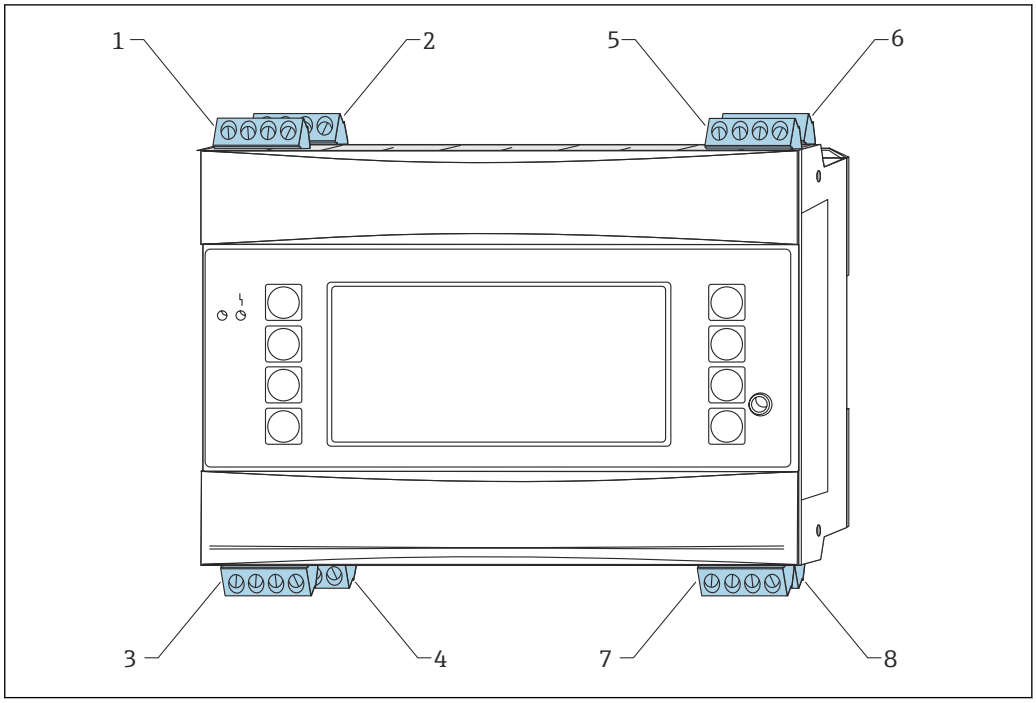
All the necessary parameters of the Liquiphant Density are documented in the **adjustment report** and in the **sensor pass**.

The documents are included in the scope of delivery.

Further information and the documentation currently available can be found on the Endress+Hauser website: www.endress.com → Downloads.

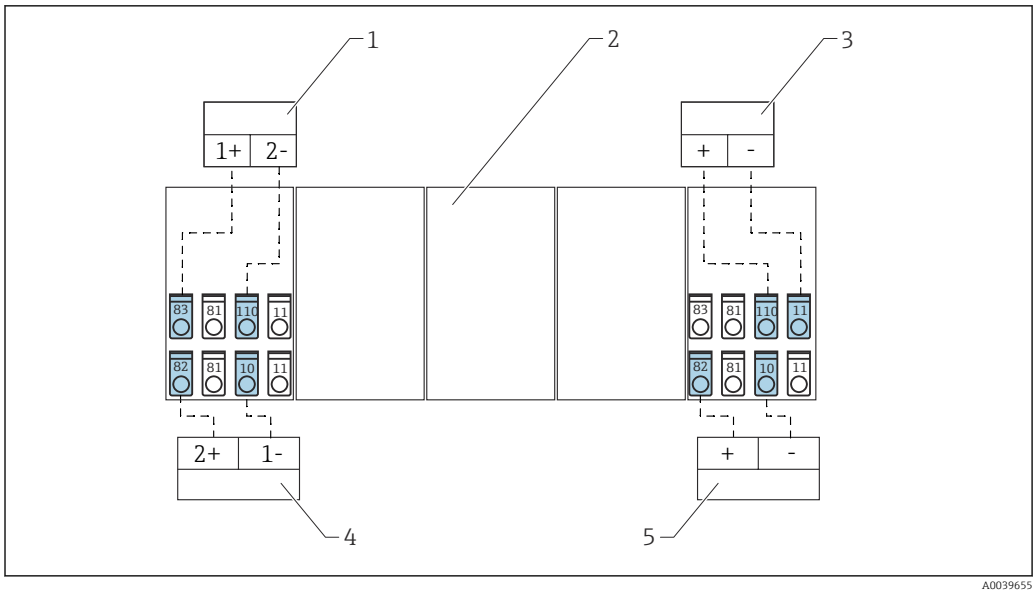
Power supply of Density Computer FML621

Terminal assignment of density computer



4 *Slot coding of basic unit*

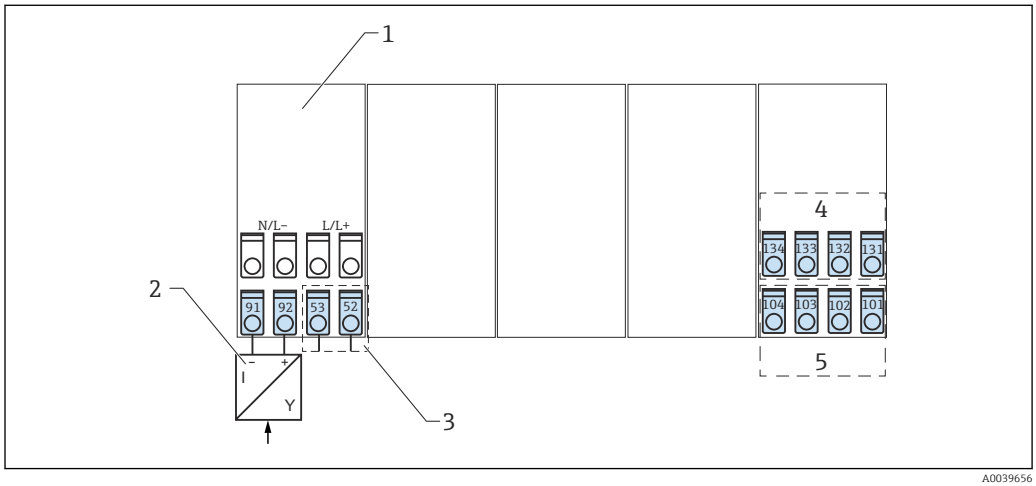
1 *Slot A I - input*
2 *Slot A II - input*
3 *Slot A III - output*
4 *Slot A IV - output*
5 *Slot E I - input*
6 *Slot E II - input*
7 *Slot E III - output*
8 *Slot E IV - output*



5 *Overview of connections - inputs*

1 *Passive sensor, e.g. pressure measurement*
2 *Slot for additional extension cards*
3 *Active sensor*
4 *Passive sensor, e.g. pressure measurement*
5 *Passive sensor, e.g. passive temperature transmitter*

Active sensor: The passing on of temperature information from a PLC is an example of why an active sensor may be connected.



6 *Overview of connections - outputs*

1 *Extension card*
2 *Power supply for sensors*
3 *Relay contact*
4 *Pulse and current outputs - active*
5 *Bus interfaces*

With the Ethernet option, the current output or pulse output is not available at slot **E**.

Slot A I
Input: current or PFM or pulse input 1
- Terminal 10: (+) 0 to 20 mA or 4 to 20 mA, PFM, pulse input 1
- Terminal 11: ground for 0 to 20 mA or 4 to 20 mA, PFM, pulse input
- Terminal 81: ground, sensor power supply 1
- Terminal 82: 24 V sensor power supply 1

Slot A II
Input: current or PFM or pulse input 2
- Terminal 110: (+) 0 to 20 mA or 4 to 20 mA, PFM, pulse input 2
- Terminal 11: ground for 0 to 20 mA or 4 to 20 mA, PFM, pulse input
- Terminal 81: ground, sensor power supply 2
- Terminal 83: 24 V sensor power supply 2

Slot A III
Output: relay or additional sensor power supply
- Terminal 52: common relay (COM)
- Terminal 53: NO contact relay (NO)
- Terminal 91: ground, sensor power supply
- Terminal 93: +24 V sensor power supply

Slot A IV
Output: power supply
- Terminal L/L+: **L** for AC, **L+** for DC
- Terminal N/L-: **N** for AC, **L-** for DC

Slot E I
Input: current or PFM or pulse input 1
- Terminal 10: (+)0 to 20 mA or 4 to 20 mA, PFM, pulse input 3
- Terminal 11: ground for 0 to 20 mA or 4 to 20 mA, PFM, pulse input
- Terminal 81: ground, sensor power supply 3
- Terminal 82: 24 V sensor power supply 3

Slot E II
Input: current or PFM or pulse input 2
- Terminal 110: (+) 0 to 20 mA or 4 to 20 mA, PFM, pulse input 4
- Terminal 11: ground for 0 to 20 mA or 4 to 20 mA, PFM, pulse input
- Terminal 81: ground, sensor power supply 4
- Terminal 83: 24 V sensor power supply 4

Slot E III
Output: RS485
- Terminal 101: (-) RxTx 1
- Terminal 102: (+) RxTx 1

Slot E III
Output: RS485 (optional)
- Terminal 103: (-) RxTx 2
- Terminal 104: (+) RxTx 2

Slot E IV
Output: current/pulse output 1
- Terminal 131: (-) 0/4 to 20 mA/pulse output 1
- Terminal 132: (+) 0/4 to 20 mA/pulse output 1

Slot E IV
Ethernet, if the Ethernet option has been ordered.
Output: current/pulse output 2
- Terminal 133: (-) 0/4 to 20 mA/pulse output 2
- Terminal 134: (+) 0/4 to 20 mA/pulse output 2

The inputs in the same slot are not galvanically isolated. There is a separation voltage of 500 V between the inputs and outputs in various slots. Terminals with identical second digits are bridged internally, for example terminals 11 and 81.

Supply voltage
- Low voltage power supply unit: 90 to 230 V_{AC} 50 to 60 Hz
- Extra-low voltage power supply unit: 20 to 36 V_{DC} or 20 to 28 V_{AC} 50 to 60 Hz

Power consumption
8 to 38 VA - depending on version and wiring.

Power supply connection
NOTICE
Destruction of electronic components.
- ▶ Check whether the supply voltage matches the voltage indicated on the nameplate of the device.

DANGER

Impermissible supply voltage

There is a high risk of physical injury and damage to the electronic components.

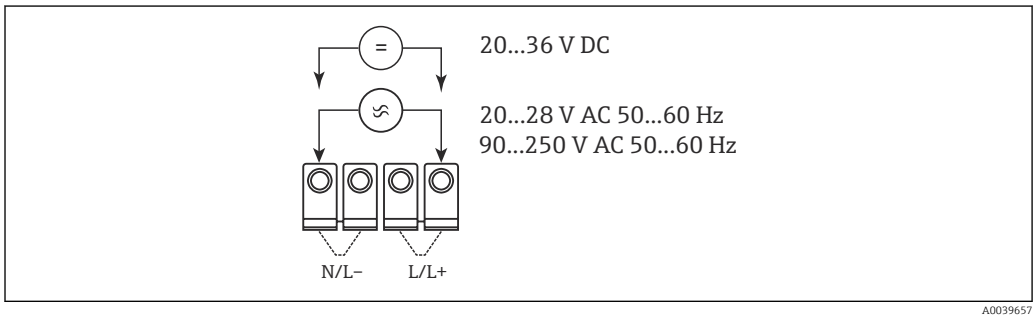
- ▶ For the device version with a supply voltage of 90 to 250 V, a switch must be installed in an easily accessible location. This switch is identified as a barrier in the power circuit of the device.

NOTICE

The power circuit of the device is not adequately protected.

Destruction of electronic components.

- ▶ Protect the power circuit with a 10-A fuse if the device is supplied with 90 to 250 V.



7 *Power supply connection*

Interface connection data

RS232

The RS232 interface is connected via an interface cable and a jack plug socket on the front of the housing.

- Connection: jack socket 3.5 mm (0.14 in), front
- Transmission protocol: ReadWin® 2000
- Transmission rate: max. 57 600 baud

RS485

- Connection: plug-in terminals 101 and 102
- Transmission protocol:
  - Serial: ReadWin® 2000
  - Parallel: open standard
- Transmission rate: max. 57 600 baud

PROFIBUS®, PROFINET®

- Optional connection of the Density Computer FML621 to PROFIBUS® or PROFINET® via the serial RS485 interface with the external HMS AnyBus protocol converter module for PROFIBUS® or PROFINET®
- Suitable protocol converter available as an accessory

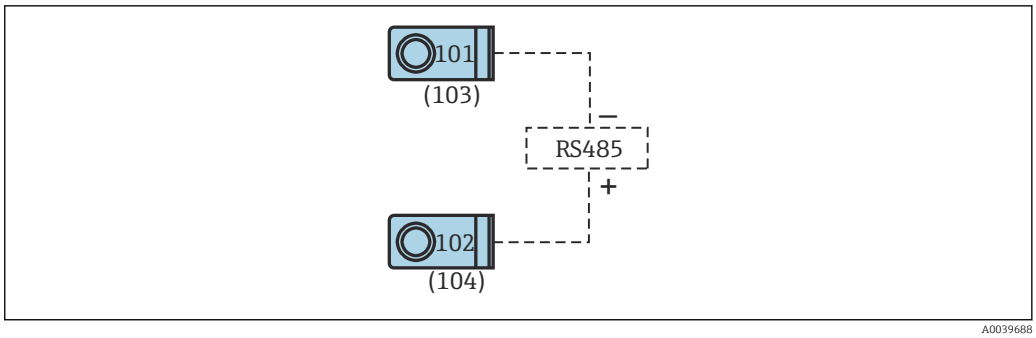
Optional: additional RS485 interface

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

Optional: Ethernet interface

- Ethernet interface: 10/100 BaseT
- Connection type: RJ45
- Connection via shielded cable
- IP address output via Setup menu in device

- Connection to devices via an interface is only possible in office environments
- Safety distances: office device standard IEC 60950-1 must be taken into consideration
- Connection to a PC is possible via a "crossover" cable

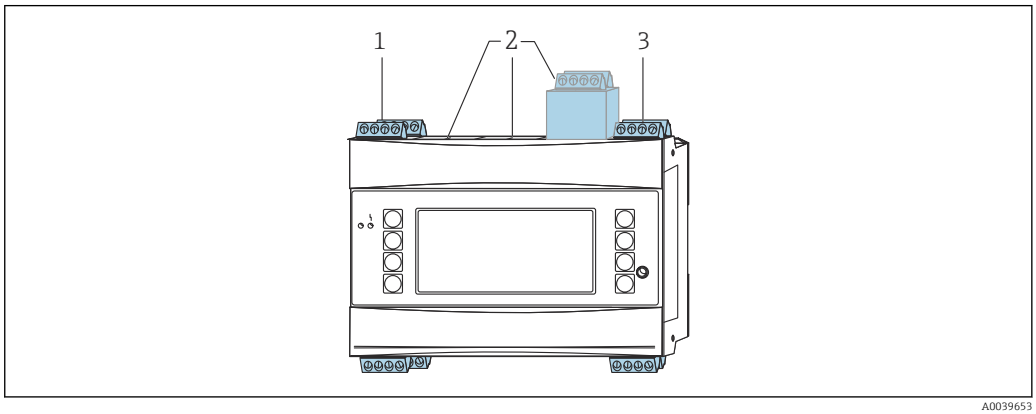


8 *Interface connection*

Slots, extension cards

WARNING

The device is connected to the mains and is live.
Possibility of physical injury and destruction of electronic components.
- ▶ Ensure the device is in a de-energized state.
- ▶ Do not install or wire the device when it is connected to the mains voltage.



9 *Slots and extension cards in the density computer*

1 Slot A, extension card already installed
2 Slots B, C, D can be extended with extension cards
3 Slot E, extension card already installed

The extension cards installed in slots A and E are an integral part of the basic unit.

Slots B, C and D can be expanded with additional extension cards.

Slots - specification
- Slot A:
  - Input: 2x density sensors, 0 to 20 mA or 4 to 20 mA
  - Output: 2x 0 to 20 mA or 4 to 20 mA
- Slots B, C, D:
  - Input: max. 10 analog inputs or 18 digital inputs
  - Output: max. 8 analog outputs or 6 digital outputs or 19 SPST relays
- Slot E:
  - Input: 2x density sensors 0 to 20 mA or 4 to 20 mA
  - Output: SPST relay

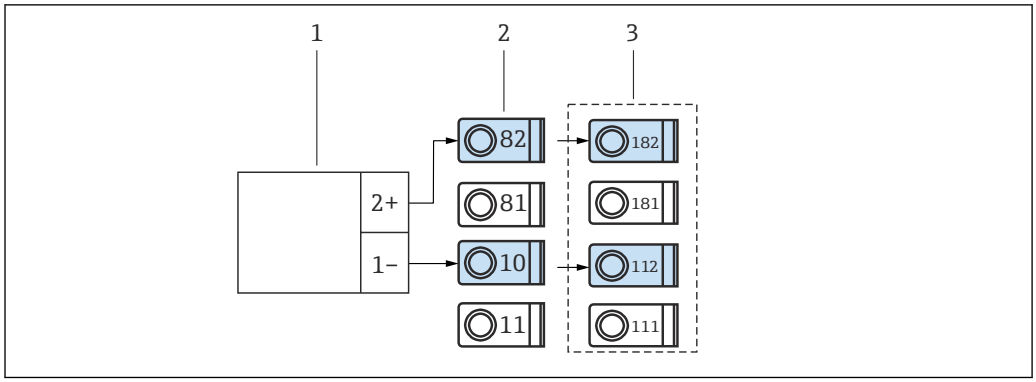
Endress+Hauser-specific devices

In the basic version of the Density Computer FML621, slots A and E are already fitted with extension cards.

Slots B, C and D can be expanded with additional extension cards.

The maximum cable length is 1 000 m (3 280.8 ft). The cable must be shielded to comply with EMC requirements. The maximum permitted power supply per core is 25 Ω.

Density sensor with a pulse output

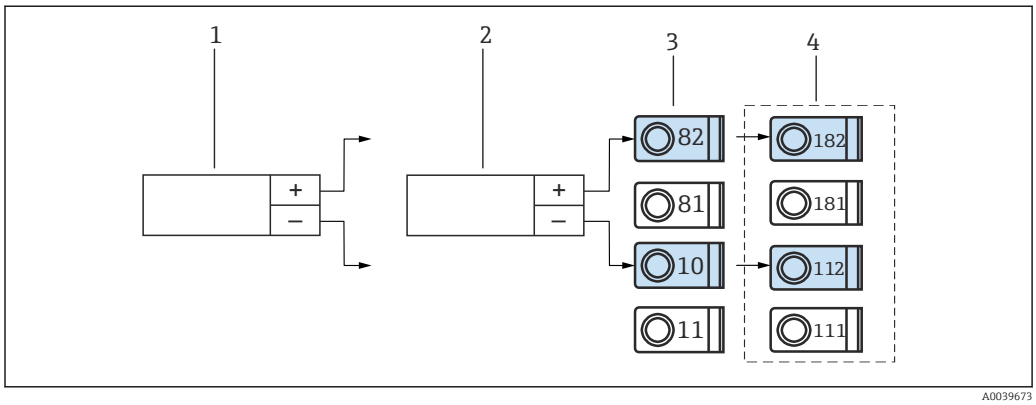


10 *Connecting the density sensor with pulse output*

1 *Density sensor*
2 *Slot A I*
3 *Additional slot B I*

Temperature sensor via temperature head transmitter

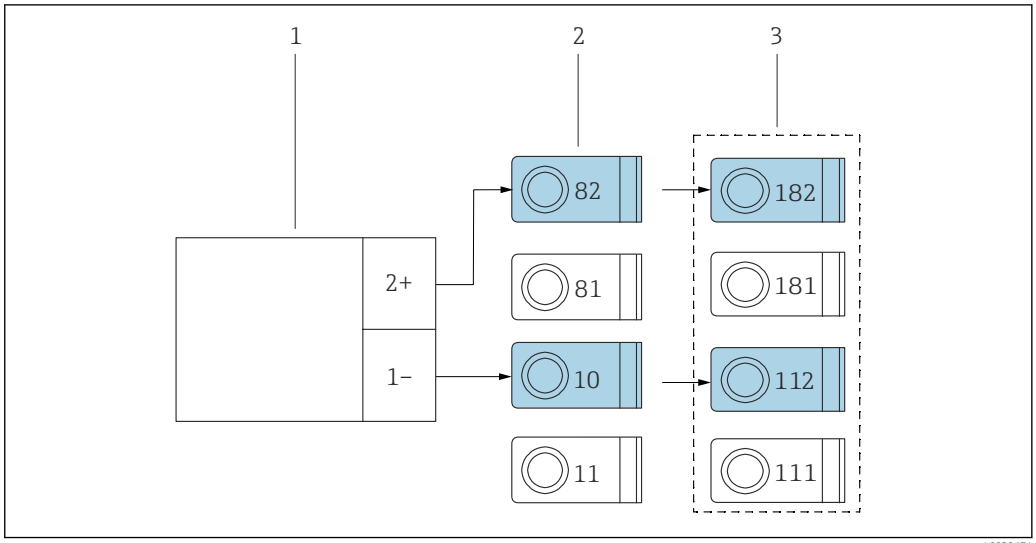
Connection of PT100, PT500 and PT1000 sensors is possible only via an optional extension card (in slot B, C, or D).



11 *Connecting the temperature sensor via the temperature head transmitter*

1 *Temperature transmitter 1*
2 *Temperature transmitter 2*
3 *Slot A I*
4 *Slot B I (optional extension card)*

Pressure sensor with passive current output

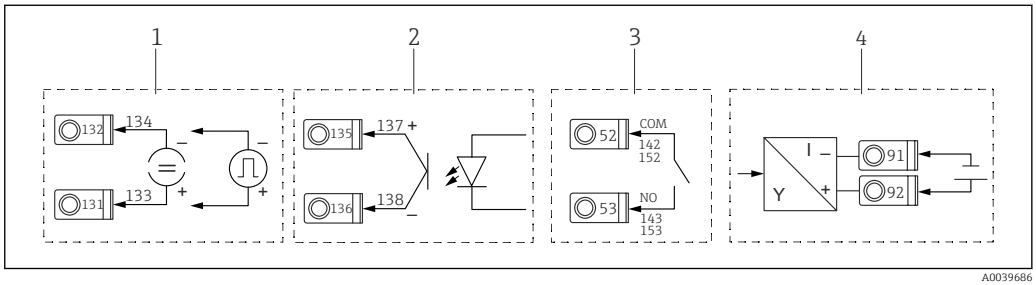


12 *Connecting the pressure sensor with passive current output*

1 *Pressure transmitter*
2 *Slot A I*
3 *Slot B I (optional extension card)*

Connection of outputs

The device has two galvanically isolated outputs or an Ethernet connection, which can be configured as an analog output or active pulse output. In addition, an output for connecting a relay and the option of transmitter power supply are available for each device. The number of outputs increases with the number of additionally installed extension cards (→ 22).



13 *Connection of outputs*

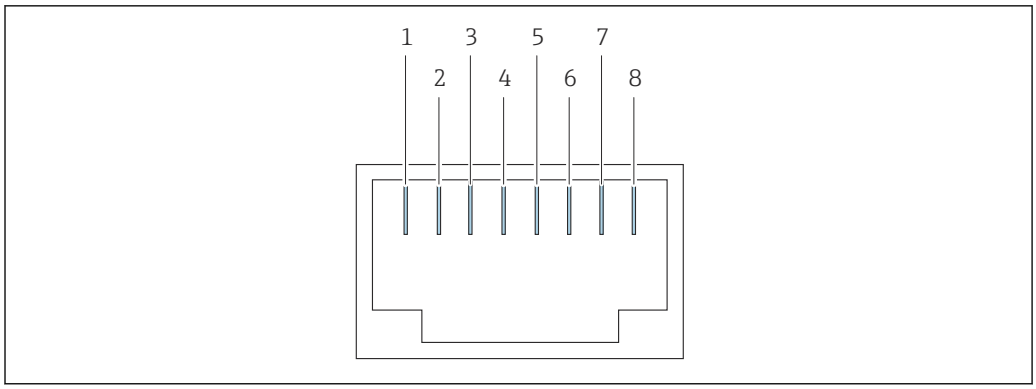
1 *Active pulse and current outputs*
2 *Passive pulse output with open collector*
3 *Relay output (NO), e. g. slot A III*
4 *Transmitter power supply (MUS) output*

Ethernet option

Ethernet connection

An IEEE 802.3-compatible connection on a shielded RJ45 connector on the underside of the device is available as a network connection. This can be used to connect the device to devices in the network environment with a hub or switch. For safety distances, the office equipment standard EN 60950 must be taken into account. The arrangement corresponds to a standard MDI interface (AT&T258), which means that a shielded 1:1 cable with a maximum length of 100 m (328 ft) can be used. 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 are supported.

If the Density Computer FML621 has an Ethernet interface, no analog outputs are available on the basic unit beyond slot E!



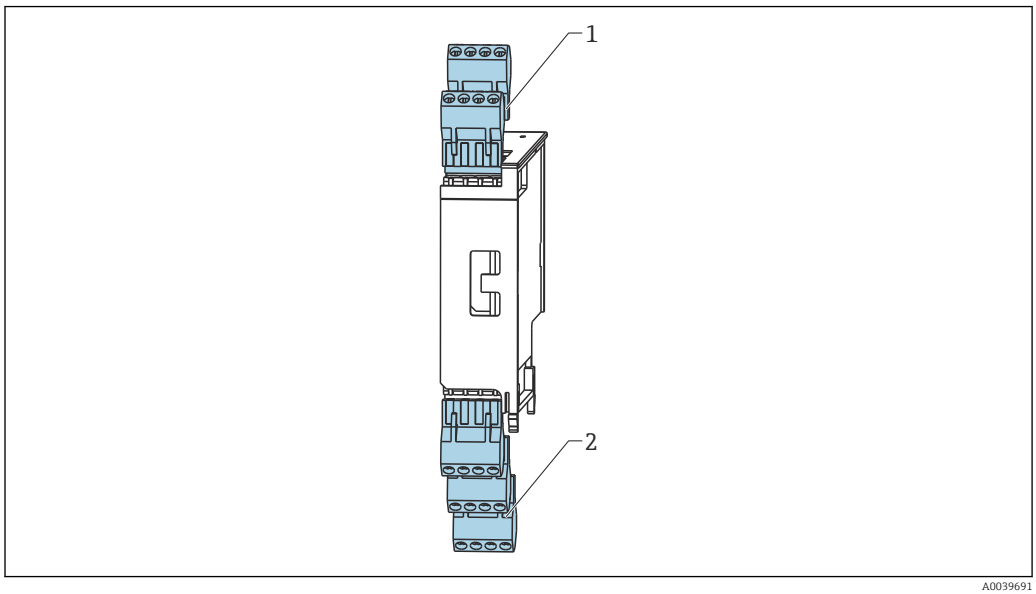
14 *RJ45 socket*

1 *Tx+*
2 *Tx-*
3 *Rx+*
4 *Not connected*
5 *Not connected*
6 *Rx-*
7 *Not connected*
8 *Not connected*

LED indicators

Two LEDs below the plug-in connector indicate the status of the Ethernet interface:
- Yellow LED - connection signal
  LED is lit when the device is connected to a network.
- Green LED - Tx/Rx
  - LED flashes when the device is sending or receiving data.
  - LED is continuously lit when the device is not sending or receiving data.

Extension cards (optional)



15 *Extension card with terminals (slots B, C and D)*

1 *Input: slots I, II*
2 *Output: slots III, IV, V*

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

Slots B I, C I, D I
Input: current or PFM or pulse input 1
- Terminal 182: 24 V sensor power supply 1
- Terminal 112: (+) 0 to 20 mA or 4 to 20 mA, PFM, pulse input 1
- Terminal 111: ground for 0 to 20 mA or 4 to 20 mA, PFM, pulse input
- Terminal 181: sensor power supply ground 1

Slots B II, C II, D II
Input: current or PFM or pulse input 2
- Terminal 183: 24 V sensor power supply 2
- Terminal 181: sensor power supply ground 2
- Terminal 113: (+) 0 to 20 mA or 4 to 20 mA, PFM, pulse input 2
- Terminal 111: ground for 0 to 20 mA or 4 to 20 mA, PFM, pulse input

Slots B III, C III, D III
- Output: relay 1
  - Terminal 142: common relay (COM)
  - Terminal 143: NO contact relay (NO)
- Output: relay 2
  - Terminal 152: common relay (COM)
  - Terminal 153: NO contact relay (NO)

Slots B IV, C IV, D IV
Output: Current or pulse output - active
- Terminal 131: + 0 to 20 mA or 4 to 20 mA pulse output 1
- Terminal 132: - 0 to 20 mA or 4 to 20 mA pulse output 1
- Terminal 133: + 0 to 20 mA or 4 to 20 mA pulse output 2
- Terminal 134: - 0 to 20 mA or 4 to 20 mA pulse output 2

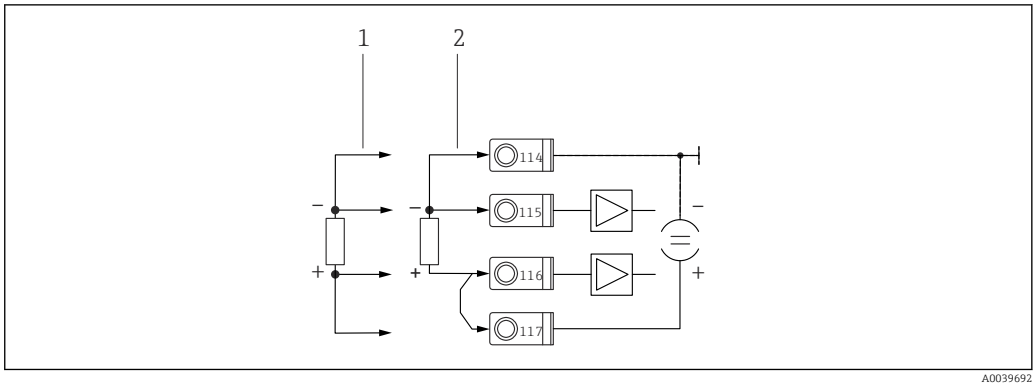
Slots B V, C V, D V
Output: Current or pulse output - passive
- Terminal 135: + pulse output 3 - open collector
- Terminal 136: - pulse output 3
- Terminal 137: + pulse output 4 - open collector
- Terminal 138: - pulse output 4

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

Temperature sensors

Connection for Pt100, Pt500 and Pt1000.

Terminals 116 and 117 must be bridged when connecting 3-wire sensors.



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16 Connecting the temperature sensor, optional temperature extension card e.g. in slot B (Slot B I)

1 4-wire input
2 3-wire input

Slots B I, C I, D I
Input: RTD input 1
- Terminal 117: + RTD power supply 1
- Terminal 116: + RTD sensor 1
- Terminal 115: - RTD sensor 1
- Terminal 114: - RTD power supply 1

Slots B II, C II, D II
Input: RTD input 2
- Terminal 121: + RTD power supply 1
- Terminal 120: + RTD sensor 1
- Terminal 119: - RTD sensor 1
- Terminal 118: - RTD power supply 1

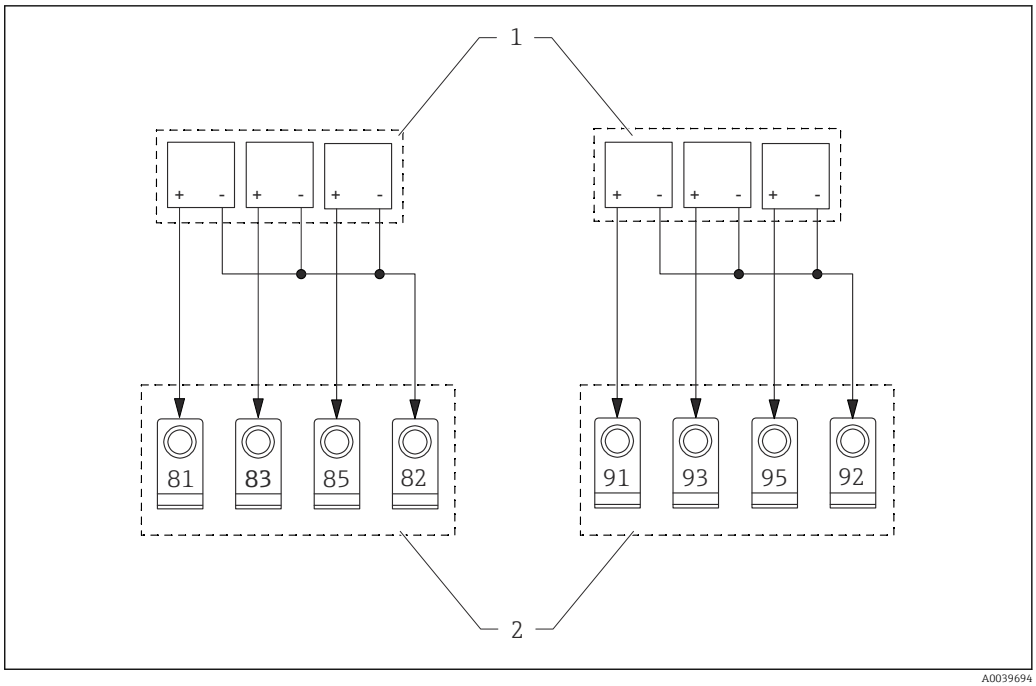
Slots B III, C III, D III
- Output: relay 1
  - Terminal 142: common relay 1 (COM)
  - Terminal 143: NO contact relay 1 (NO)
- Output: relay 2
  - Terminal 152: common relay 2 (COM)
  - Terminal 153: NO contact relay 21 (NO)

Slots B IV, C IV, D IV
- Output: current or pulse output 1 - active
  - Terminal 131: + 0 to 20 mA or 4 to 20 mA
  - Terminal 132: - 0 to 20 mA or 4 to 20 mA
- Output: current or pulse output 2 - active
  - Terminal 133: + 0 to 20 mA or 4 to 20 mA
  - Terminal 134: - 0 to 20 mA or 4 to 20 mA

Slots B V, C V, D V
- Output: passive pulse output
  - Terminal 135: + pulse output 3 - open collector
  - Terminal 136: - pulse output 3
- Output: passive pulse output
  - Terminal 137: + pulse output 4 - open collector
  - Terminal 138: - pulse output 4

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

The digital card has six intrinsically safe inputs. Terminals E1 and E4 can be defined as pulse inputs.



17 *Connecting the digital card*

1 Digital input device
2 Terminal

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 identical second digits are bridged internally.

Slots B I, C I, D I
Digital inputs E1 to 3
- Terminal 81: E1 20 kHz or 4 Hz as pulse input
- Terminal 83: E2 4 Hz
- Terminal 85: E3 4 Hz
- Terminal 82: signal ground E1 to 3

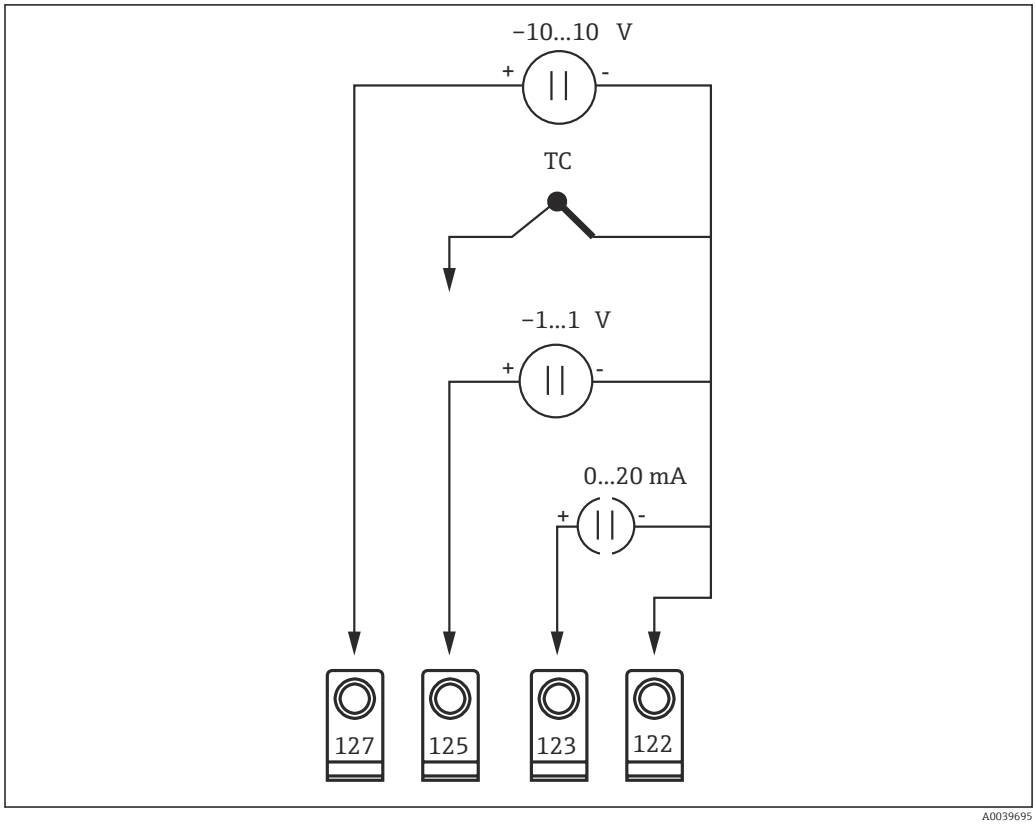
Slots B II, C II, D II
Digital inputs E4 to 6
- Terminal 91: E4 20 kHz or 4 Hz as pulse input
- Terminal 93: E5 4 Hz
- Terminal 95: E6 4 Hz
- Terminal 92: signal ground E4 to 6

Slots B III, C III, D III
- Output: relay 1
  - Terminal 142: common relay 1 (COM)
  - Terminal 143: NO contact relay 1 (NO)
- Output: relay 2
  - Terminal 152: common relay 2 (COM)
  - Terminal 153: NO contact relay 2 (NO)

Slots B IV, C IV, D IV
- Output: relay 3
  - Terminal 145: common relay 3 (COM)
  - Terminal 146: NO contact relay 3 (NO)
- Output: relay 4
  - Terminal 155: common relay 4 (COM)
  - Terminal 156: NO contact relay 4 (NO)

Slots B V, C V, D V
- Output: relay 5
  - Terminal 242: common relay 5 (COM)
  - Terminal 243: NO contact relay 5 (NO)
- Output: relay 6
  - Terminal 252: common relay 6 (COM)
  - Terminal 253: NO contact relay 6 (NO)

Terminal assignment of extension card "U-I-TC card" with intrinsically safe inputs



18 *U-I-TC card*

The card supports two input channels.

Channel 1 is supported by terminals 122, 123, 125 and 127.

Channel 2 is supported by terminals 222, 223, 225 and 227.

Slots B I, C I, D I
U-I-TC Input 1
- Terminal 127: −10 to +10 V input
- Terminal 125: −1 to +1 input, thermocouple
- Terminal 123: 0 to 20 mA input
- Terminal 122: input, signal ground

Slots B II, C II, D II
U-I-TC Input 2
- Terminal 227: −10 to +10 V input
- Terminal 225: −1 to +1 input, thermocouple
- Terminal 223: 0 to 20 mA input
- Terminal 222: input, signal ground

Slots B III, C III, D III
- Output: relay 1
  - Terminal 142: common relay 1 (COM)
  - Terminal 143: NO contact relay 1 (NO)
- Output: relay 2
  - Terminal 152: common relay 2 (COM)
  - Terminal 153: NO contact relay 2 (NO)

Slots B IV, C IV, D IV
- Output: current or pulse output 1 - active
  - Terminal 131: + 0 to 20 mA or 4 to 20 mA or pulse output 1
  - Terminal 132: - 0 to 20 mA or 4 to 20 mA pulse output 1
- Output: current or pulse output 2 - active
  - Terminal 133: + 0 to 20 mA or 4 to 20 mA or pulse output 2
  - Terminal 134: - 0 to 20 mA or 4 to 20 mA or pulse output 2

Slots B V, C V, D V
- Output: passive pulse output
  - Terminal 135: + pulse output 3 - open collector
  - Terminal 136: - pulse output 3
- Output: passive pulse output
  - Terminal 137: + pulse output 4 - open collector
  - Terminal 138: - pulse output 4

Connecting the remote display and operating unit

Description of functions

The remote display is an innovative addition to the powerful FML621 DIN 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 a DIN rail device both with and without an integrated display or operating unit. A 4-pin cable is supplied to connect the remote display with the basic unit. Other components are not necessary.

Please note the following:
- The remote display must be connected in order to use all of the functions of the operating unit
- Operating the unit solely with ReadWin® 2000 is not permitted
- Only ever connect one display or operating unit to the Density Computer FML621 (DIN rail device)

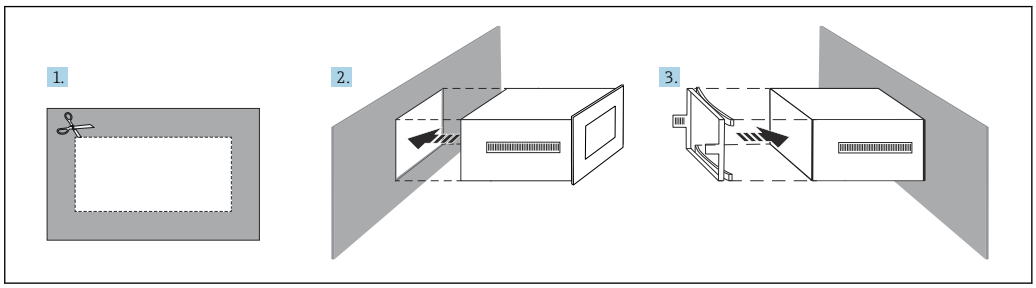
Installing the remote display or operating unit

The mounting location of the display unit must be free from vibrations.

The permitted ambient temperature during operation is –20 to +60 °C (–4 to +140 °F).

The device must be protected against high temperatures or heat.

Installing the display unit

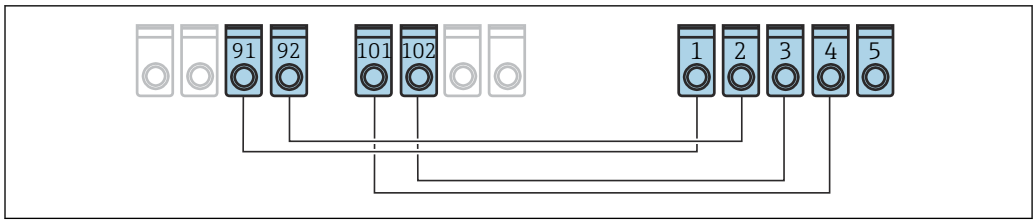


19 *Installing the display unit*

1. Cut out a mounting opening with the following dimensions: 138 mm (5.43 in) x 68 mm (2.68 in), installation depth43 mm (1.69 in).
2. Push the device, along with the sealing ring, through the cutout from the front.
3. Slide the securing frame over the rear of the housing and press it against the cabinet until the retaining clips click into place.
   ↳ The display unit is now installed.

Wiring

The remote display and operating unit is connected directly to the basic unit using the enclosed cable.



20 Wire connections between remote display unit and basic unit.

1 Terminal GDN - remote display unit
2 Terminal 24 V_{DC} - remote display unit
3 Terminal + Rx Tx - remote display unit
4 Terminal - Rx Tx - remote display unit
5 Terminal PE - remote display unit
91 Terminal GND - slot A III - basic unit
92 Terminal 24 V_{DC} - slot A III - basic unit
101 Terminal - Rx Tx - slot E III - basic unit
102 Terminal + Rx Tx - slot E III - basic unit

Performance characteristics

Reference conditions

Normal operating conditions for special calibration and Liquiphant Density

- Medium: water H_2O
- Medium temperature: 0 to +80 °C (+32 to +176 °F), motionless fluid
- Ambient temperature: 24 °C (75 °F) ±5 °C (±9 °F)
- Moisture: max. 90 %
- Warm-up time: >30 min

Reference operating conditions of Density Computer FML621

- Power supply: 207 to 250 V_{AC} ±10 %, 50 Hz, ±0.5 Hz
- Warm-up time: >30 min
- Ambient temperature: +25 °C (+77 °F), ±5 °C (±9 °F)
- Humidity: 39 % ±10 % rF.

Measurement accuracy

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

General measuring conditions for accuracy data

- Measuring range: 0.3 to 2 g/cm³ (0.3 to 2 SGU)
- Observe the distance between the tuning fork and the surface of the medium (> 50 mm (1.97 in))
  see the "Orientation" section
- Measured error, temperature sensor: < 1 K
- Maximum viscosity: 50 mPa·s (0.5 P)
- Maximum flow velocity: 2 m/s (6.56 ft/s)
  - Laminar flow rate, bubble-free
  - For higher flow velocities, structural measures such as a bypass or an increase in pipe diameter must be taken to reduce the flow.
- Process temperature: 0 to +80 °C (+32 to +176 °F) - validity of accuracy data
- Power supply as per FML621 specification
- Data as per DIN EN 61298-2
- Process pressure: −1 to +25 bar (−14.5 to +362.5 psi)

Measured error

1 g/cm³ (62.4 lb/ft³) = 1 SGU (Specific Gravity Unit)
- Standard adjustment: ±0.02 g/cm³ (±1.2 lb/ft³) (±1.2 % of the span 1.7 g/cm³ (106.1 lb/ft³), under general measuring conditions)
- Special adjustment: ±0.005 g/cm³ (±0.3 lb/ft³) (±0.3 % of span 1.7 g/cm³ (106.1 lb/ft³), under normal operating conditions)
- Field adjustment: ±0.002 g/cm³ (±0.1 lb/ft³), at operating point

Non-repeatability - reproducibility

1 g/cm³ (62.4 lb/ft³) = 1 SGU (Specific Gravity Unit)
- Standard adjustment: ±0.002 g/cm³ (±0.1 lb/ft³) (under general measuring conditions)
- Special adjustment: ±0.0007 g/cm³ (±0.04 lb/ft³) (under normal operating conditions)
- Field adjustment: ±0.002 g/cm³ (±0.1 lb/ft³), at operating point

Factors influencing accuracy data

- Clean the sensor (CIP/SIP) if process temperatures of up to 140 °C (284 °F) persist over a long period
- All information relating to accuracy when determining the viscosity of liquids is based on Newtonian fluids
- A density measurement can be performed in the following liquids: gels, viscoelastic gels, non-Newtonian elastic fluids, pseudoelastic and plastic-viscous fluids.

- Long-term drift typically: ±0.00002 g/cm³ (±0.0012 lb/ft³) per day
- Temperature coefficient typically: ±0.0002 g/cm³ (±0.002 lb/ft³) per 10 K
- Flow velocity in pipes: > 2 m/s (6.56 ft/s)
- Buildup on fork
- Air bubbles in the case of vacuum applications or improper installation
- Incomplete coverage of the fork
- In the event of changes in pressure >6 bar (87 psi), a pressure measurement is necessary for compensation
- In the event of changes in temperature >1 K, a temperature measurement is necessary for compensation
- Mechanical stress, such as deformation of the tuning fork, can impair accuracy and must be avoided
- Devices exposed to mechanical stress must be replaced

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

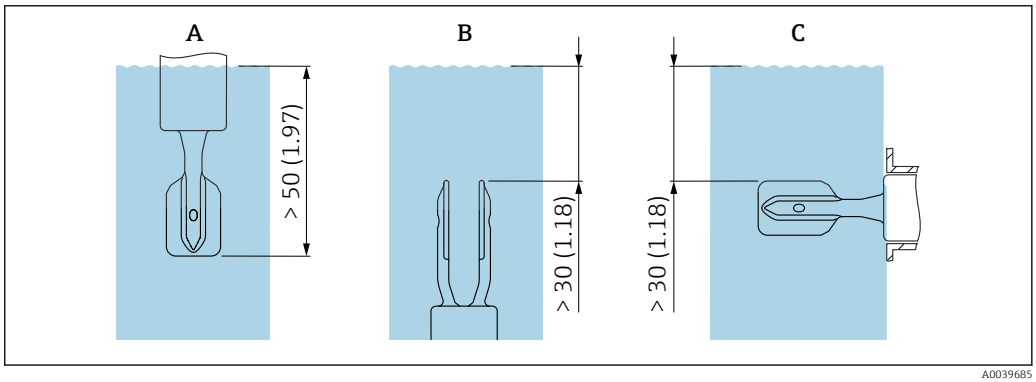
Mounting

Installation instructions for Liquiphant Density

The following information is supplemented by additional documentation for the Liquiphant (Endress+Hauser website www.endress.com → Downloads)

Orientation

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



21 Unit mm (in)

A Installation from above
B Installation from below
C Installation from the side

- Avoid air bubbles in pipe or nozzle
- Ensure suitable ventilation

Input of correction factor "r"

The measurement result is affected if the distance between the tuning fork and the wall of the tank or pipe is very short:
- The medium has to flow around the tuning fork.
- The tuning fork of Liquiphant requires space to vibrate.

The measured error can be compensated for by entering a correction factor "r".

Pipe nominal diameters with internal measurements <44 mm (1.73 in) are not permitted!

For detailed information, please refer to the relevant Operating Instructions.

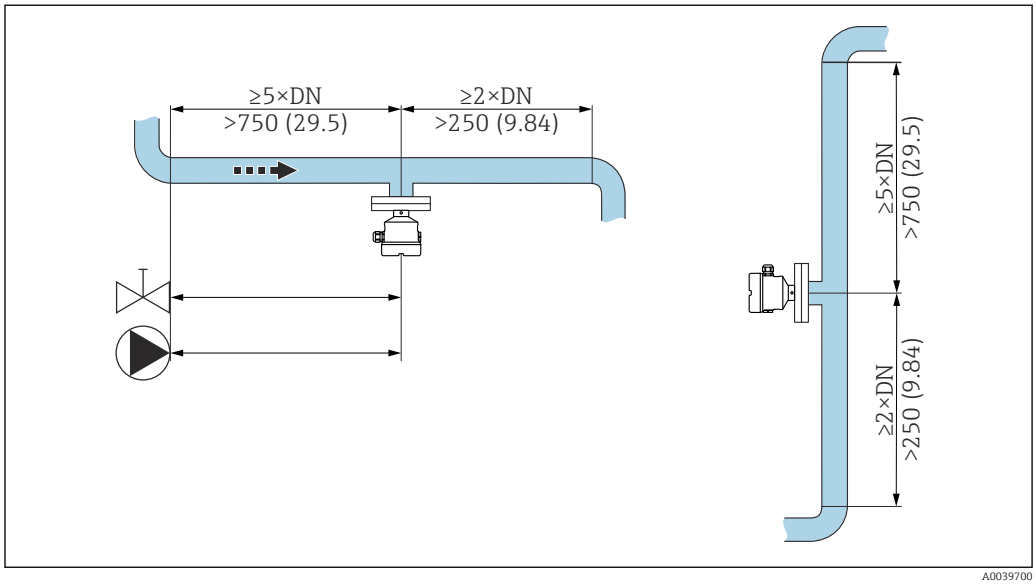
Inlet and outlet runs

Inlet run

If possible, install the sensor as far upstream as possible, e.g. valves, T-pieces, elbows, flange elbows, etc.

To comply with the accuracy specification, the inlet run must meet the following requirements:

Inlet run: ≥ 5x DN (nominal diameter) - min. 750 mm (29.5 in)



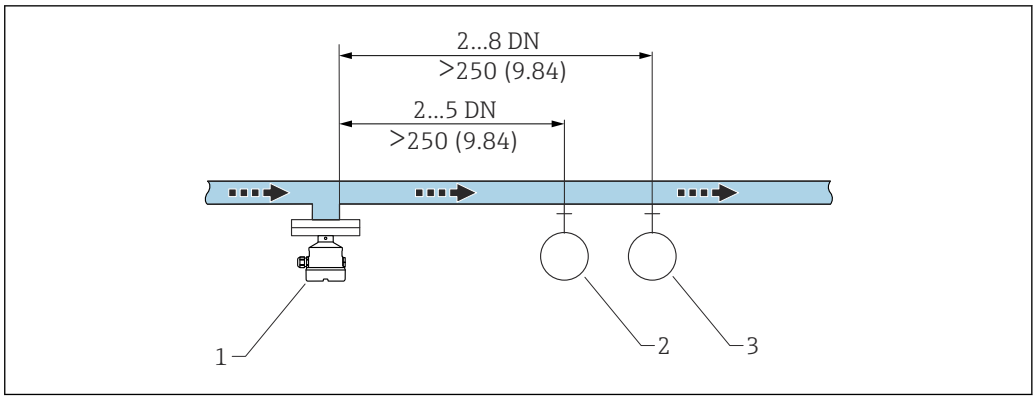
22 Installing the inlet run. Unit of measurement mm (in)

Outlet run

To comply with the accuracy specification, the outlet run must meet the following requirements:

Outlet run: ≥ 2x DN (nominal diameter) - min. 250 mm (9.84 in)

The pressure and temperature sensor must be installed on the outlet side of the flow direction after the Liquiphant density sensor. When installing pressure and temperature measuring points downstream of the device, make sure the distance between the measuring point and the measuring device is sufficient.



23 *Installing the outlet run. Unit of measurement mm (in)*

1 *Liquiphant density sensor*
2 *Pressure measuring point*
3 *Temperature measuring point*

Installing the device in piping

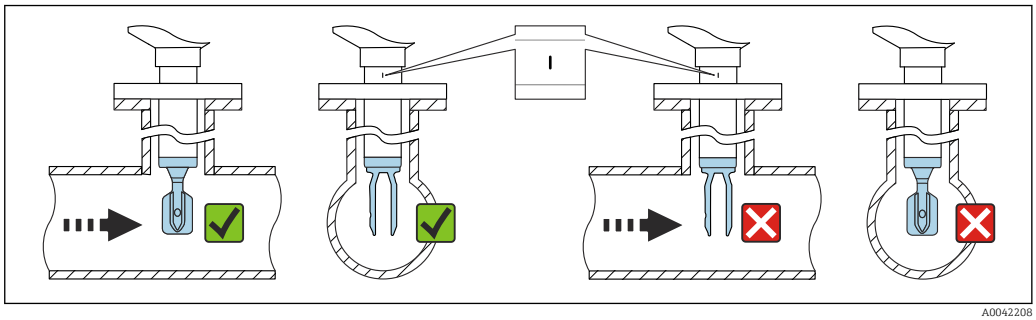
NOTICE

Incorrect alignment of the tuning fork

Vortices and eddies can falsify the measuring result.

► Align the tuning fork in the flow direction for internal fixtures in pipes or tanks with an agitator.

- The flow velocity of the medium must not exceed 2 m/s (6.56 ft/s) during operation
- Flow velocity > 2 m/s: Separate the tuning fork from the direct flow of media by using structural features such as a bypass or pipe expansion to reduce the flow velocity to max. 2 m/s (6.56 ft/s)
- The flow will not be significantly impeded if the tuning fork is correctly aligned and the marking is pointing in the direction of flow.
- A marking on the process connection indicates the position of the tuning fork.
  Threaded connection = dot on the hexagon head; flange = two lines on the flange.
  The marking is visible when installed.

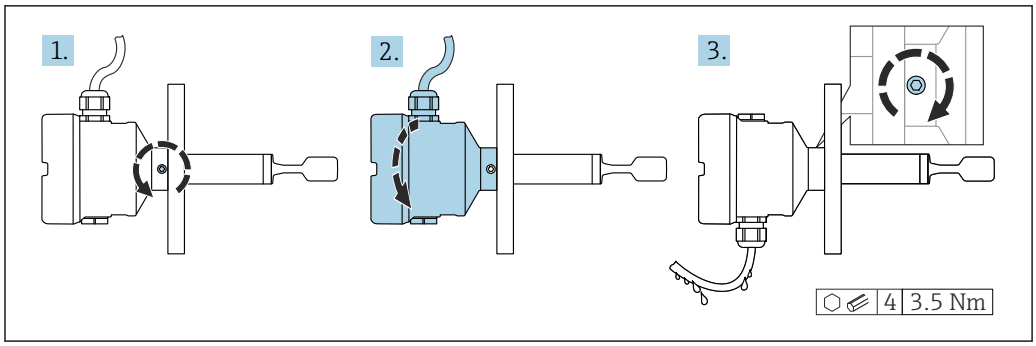


24 *Installation in pipes (take fork position and marking into consideration)*

Aligning the cable entry

Housings with locking screw:
- The housing can be turned and the cable aligned by turning the locking screw.
- The locking screw is not tightened when the device is delivered.

Housing with locking screw: The housing can be turned and the cable aligned by turning the locking screw.



25 *Housing with external locking screw and drip loop*

Density Computer FML621

Mounting location

Mount the device in a cabinet on a DIN rail as per IEC 60715.

Orientation

No restrictions.

Environment

Liquiphant Density

Ambient temperature range

−40 to 70 °C (−40 to 158 °F)

The minimum permitted ambient temperature of the plastic housing is limited to −20 °C (−4 °F); 'indoor use' applies for North America.

Outdoor operation in strong sunlight:
- Mount the device in a shaded location
- Avoid direct sunlight, particularly in warmer climatic regions
- Use a weather protection cover, can be ordered as an accessory

Further information on using the device in hazardous areas (ATEX) and on documentation that is currently available can be found on the Endress+Hauser website: www.endress.com → Downloads.

Storage temperature

−40 to +80 °C (−40 to +176 °F)

Operating altitude

As per IEC 61010-1 Ed.3:
- Up to 2 000 m (6 600 ft) above sea level
- Can be extended to 3 000 m (9 800 ft) above sea level if overvoltage protection is used

Climate class

As per IEC 60068-2-38 test Z/AD

Degree of protection

Testing according to IEC 60529 and NEMA 250

IP68 test condition: 1.83 m H_2O for 24 h

Housing

See cable entries

Cable entries

- M20 threaded joint, plastic, IP66/68 NEMA Type 4X/6P
- M20 threaded joint, nickel-plated brass, IP66/68 NEMA Type 4X/6P
- M20 threaded joint, 316L, IP66/68 NEMA Type 4X/6P
- M20 thread, IP66/68 NEMA Type 4X/6P
- G ½ thread, NPT ½, NPT ¾ IP66/68 NEMA Type 4X/6P

Degree of protection for M12 plug

- When housing is closed and connecting cable is plugged in: IP66/67 NEMA Type 4X
- When housing is open or connecting cable is not plugged in: IP20, NEMA Type 1

NOTICE

M12 plug: Loss of IP protection class due to incorrect installation!

- ▶ The degree of protection only applies if the connecting cable used is plugged in and screwed tight.
- ▶ The degree of protection only applies if the connecting cable used is specified according to IP67 NEMA Type 4X.

If the "M12 plug" option is selected as the electrical connection, **IP66/67 NEMA Type 4X** applies for all housing types.

Pollution degree

Pollution degree 2

Density Computer FML621

Ambient temperature range

⚠ CAUTION

Extension cards generate additional heat.
Destruction of electronic components.

- ▶ Install additional ventilation with a minimum air current of 0.5 m/s (1.64 ft/s).

Temperature range: –20 to 50 °C (–4 to 122 °F).

Storage temperature

–30 to 70 °C (–22 to 158 °F)

Climate class

As per IEC 60654-1 Class B2/EN 1434 Class "C" - no condensation permitted.

Electrical safety

As per IEC 61010-1: operating environment at altitudes of < 2 000 m (6 560 ft) above sea level.

Degree of protection

- Basic unit: IP20
- Remote operating and display unit: front IP65

Electromagnetic compatibility

Interference emission
IEC 61326 Class A

Interference immunity

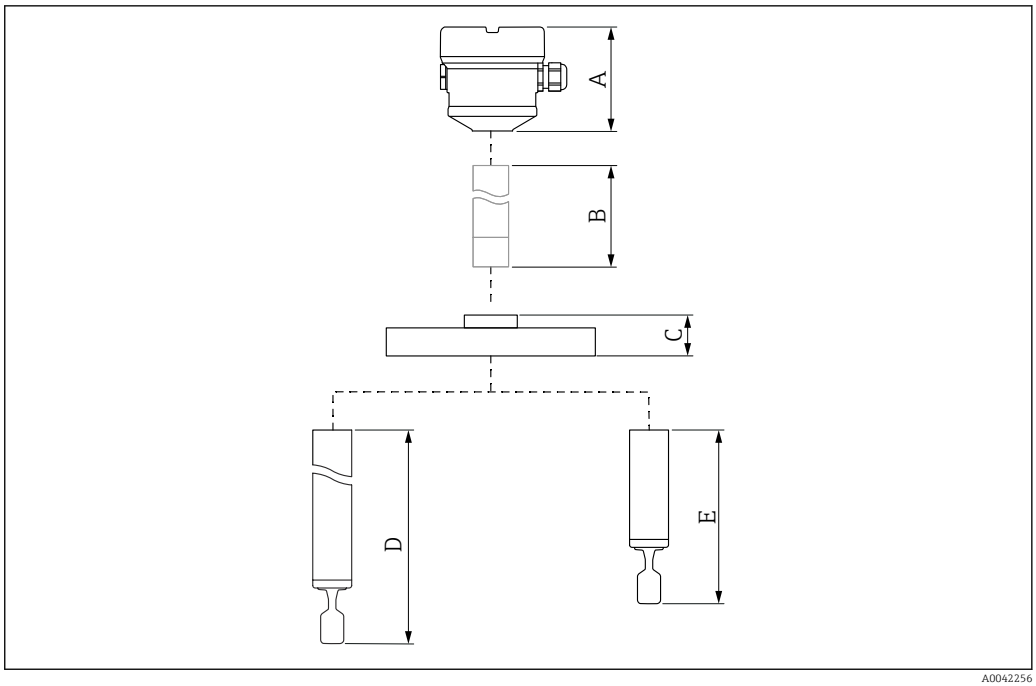
- Power failure: 20 ms, no effect
- Starting current limitation: I_{max}/I_n <50 % (T 50 % ≤ 50 ms)
- Electromagnetic fields: 10 V/m (3.048 V/ft) as per IEC 61000-4-3
- Conducted HF: 0.15 to 80 Hz, 10 V as per IEC 61000-4-3
- Electrostatic discharge: 6 kV contact, indirect as per IEC 61000-4-2
  - Burst pulses - power supply: 2 kV as per IEC 61000-4-4
  - Burst pulses - signal: 1 kV/2 kV as per IEC 61000-4-4
  - Voltage peak - AC power supply: 1 kV/2 kV as per IEC 61000-4-5
  - Voltage peak - DC power supply: 1 kV/2 kV as per IEC 61000-4-5
  - Voltage peak - signal: 0.5 kV/1 kV as per IEC 61000-4-5

Liquiphant Density process

Process temperature range	0 to 80 °C (32 to 176 °F)
Thermal shock	≤ 120 K/s
Process pressure range	−1 to +25 bar (−14.5 to +362.5 psi) **⚠ WARNING** **The maximum pressure for the device depends on the lowest-rated element, with regard to pressure, of the selected component. This means that it is necessary to pay attention to the process connection as well as the sensor.** ▶ Pressure specifications, Technical Information, "Mechanical construction" section. ▶ Only operate the device within the specified limits! ▶ The Pressure Equipment Directive (2014/68/EU) uses the abbreviation "PS". The abbreviation "PS" corresponds to the MWP (maximum working pressure) of the device.
Pressure tightness	Up to vacuum
Solids contents	Ø ≤ 5 mm (0.2 in)

Mechanical construction of Liquiphant Density

Design, dimensions	**Device height** The device height consists of the following components: ▪ Housing including cover ▪ Temperature spacer and/or pressure-tight feedthrough (second line of defense), optional ▪ Pipe extension or short pipe version, optional ▪ Process connection The individual heights of the components can be found in the following sections: ▪ Determine the height of the device and add the individual heights ▪ Take the installation clearance into consideration (space that is needed to install the device)



A0042256

26 *Components to determine the device height*

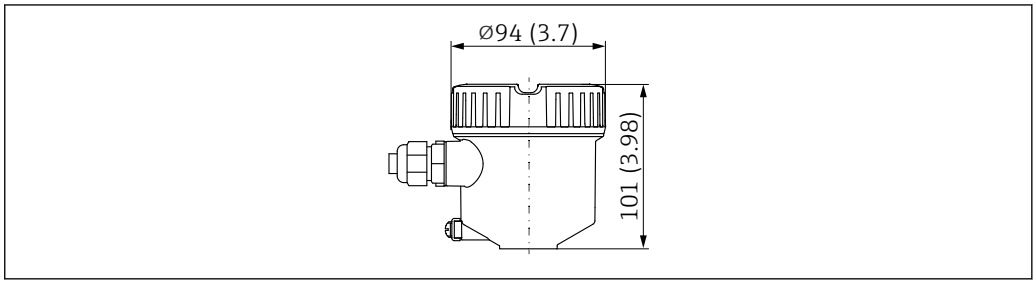
A Housing including cover
B Temperature spacer, pressure-tight feedthrough (optional), details in the Product Configurator
C Process connection
D Probe design: pipe extension with tuning fork
E Probe design: short pipe version with tuning fork

Dimensions

Housing and cover

All housings can be aligned. The housing alignment can be fixed on housings with a locking screw.

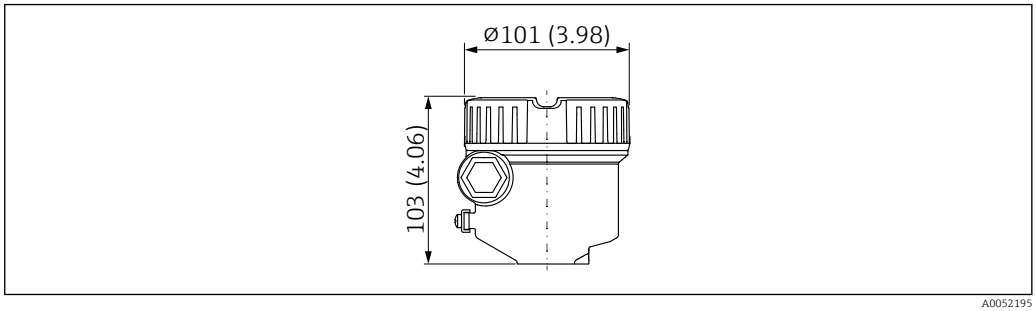
Single compartment housing, plastic



A0051909

27 *Dimensions of single compartment housing, plastic; cover without sight glass. Unit of measurement mm (in)*

Single compartment housing, aluminium, coated



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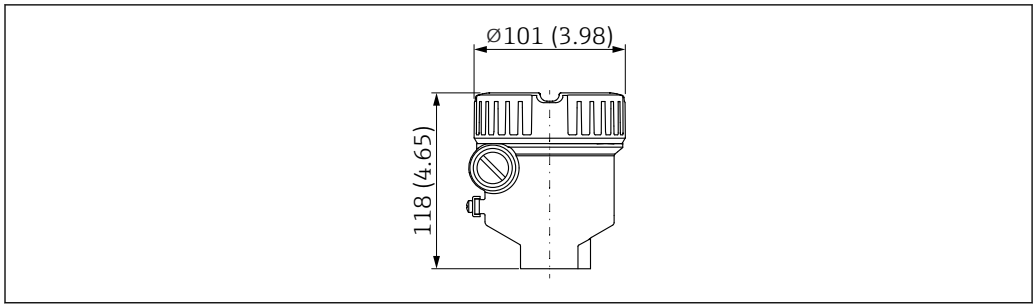
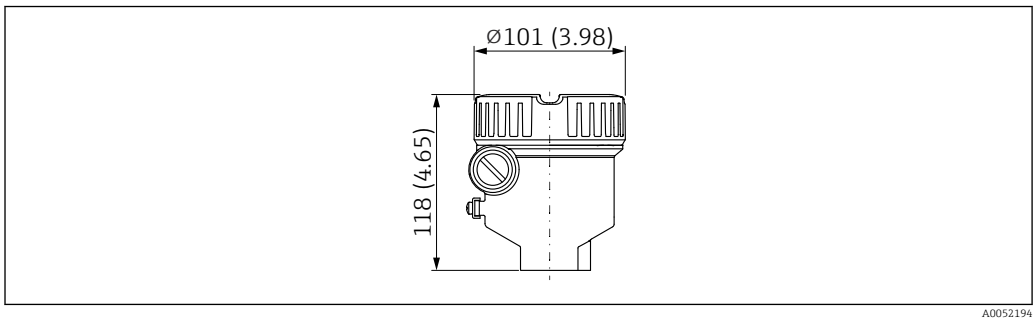
28 *Dimensions of single compartment housing, aluminium; cover without sight glass. Unit of measurement mm (in)*

Single compartment housing, aluminum, coated (Ex d/XP, dust ignition-proof)



29 Dimensions of single compartment housing, aluminum, coated; suitable for Ex d/XP, dust ignition-proof; cover without sight glass. Unit of measurement mm (in)

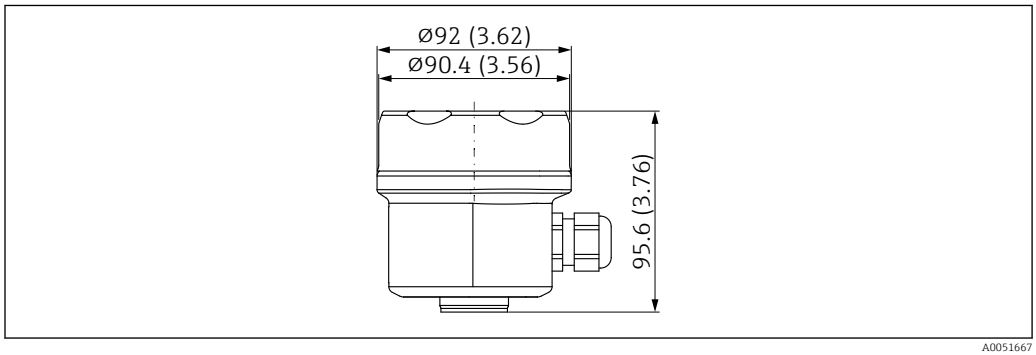
Single compartment housing, 316L



30 Dimensions of single compartment housing, 316L; with Ex d/XP also, dust ignition-proof; cover without sight glass. Unit of measurement mm (in)

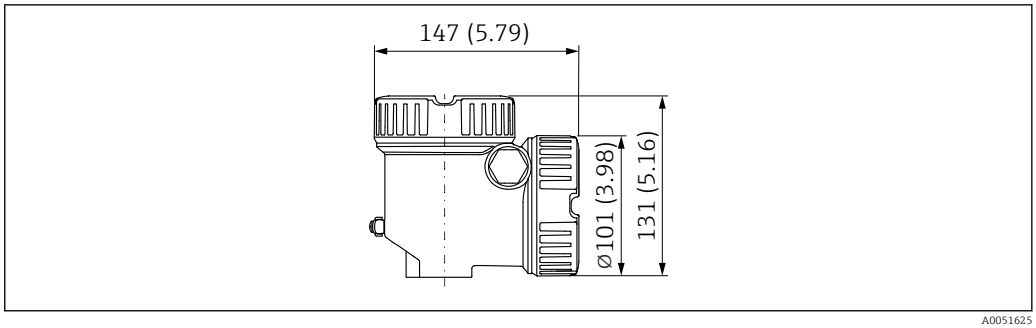
Single compartment housing, 316L, hygienic

The housing with ground terminal and cover with cover lock are required for use in hazardous areas with a certain type of protection.



31 Dimensions of single compartment housing, 316L, hygienic; cover without sight glass. Unit of measurement mm (in)

Dual compartment housing, L-shaped, aluminum, coated



32 *Dimensions of dual compartment housing, L-shaped, aluminum, coated; also with Ex d/XP, dust ignition-proof; cover without sight glass. Unit of measurement mm (in)*

Ground terminal

- Ground terminal inside the housing, max. conductor cross-section 2.5 mm² (14 AWG)
- Ground terminal outside on the housing, max. conductor cross-section 4 mm² (12 AWG)

Cable glands

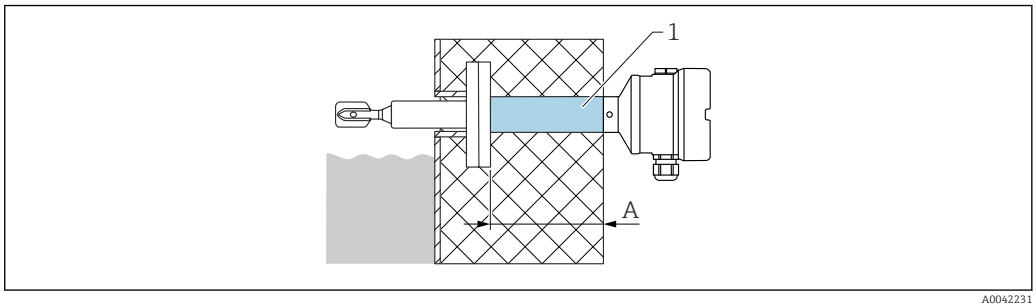
Cable diameter:
- Plastic: Ø5 to 10 mm (0.2 to 0.38 in)
- Nickel-plated brass: Ø7 to 10.5 mm (0.28 to 0.41 in)
- Stainless steel: Ø7 to 12 mm (0.28 to 0.47 in)

The scope of delivery comprises:
- 1 cable gland installed
- 1 cable gland sealed with dummy plug

Exceptions: with Ex d/XP, only threaded entries are permitted.

Temperature spacer, pressure-tight feedthrough (optional)

Provides sealed insulation for the vessel and a normal ambient temperature for the housing.



1 Temperature spacer and/or pressure-tight feedthrough with maximum insulation length
A 140 mm (5.51 in)

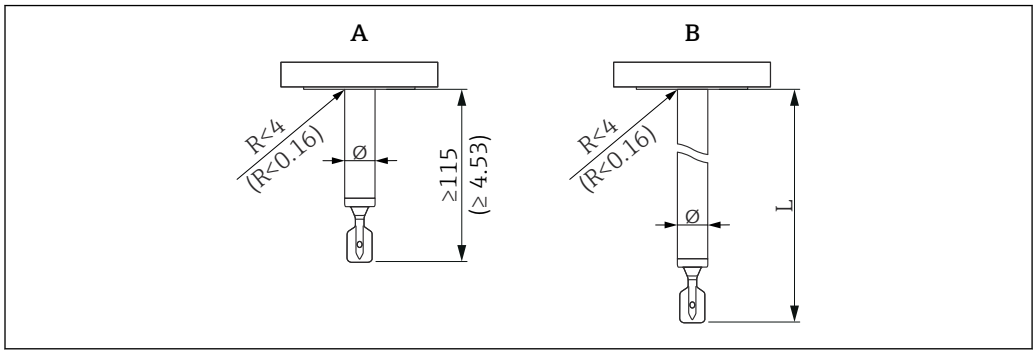
Product Configurator, feature "Sensor design":
- Temperature spacer
- Pressure-tight feedthrough (second line of defense)
  If the sensor is damaged, this protects the housing from vessel pressures up to 100 bar (1 450 psi).

The "Pressure-tight feedthrough" version can only be selected in conjunction with the "Temperature spacer" option.

Probe design

Short pipe
Fixed length (A)
- Base material: 316L
- Sensor length: approx. 115 mm (4.53 in)
- Flanges according to DIN/EN, ASME, JIS from DN 40 / 1½"
  For DN25/ASME flanges, the radius (R) ≤ 4 mm (0.16 in) applies

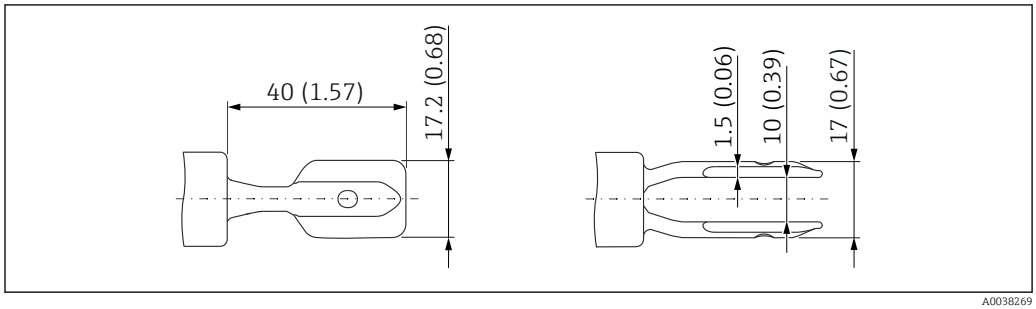
Pipe extension
Variable length L (B)
- Base material: 316L
- Sensor length depends on enamel coating: 148 to 1200 mm (5.83 to 47.2 in)
- Sensor length depends on plastic coating: 148 to 3000 mm (5.83 to 118 in)
- Length tolerances L: < 1 m (3.3 ft) = −5 mm (−0.2 in), 1 to 3 m (3.3 to 9.8 ft) = (−10 mm (−0.39 in)



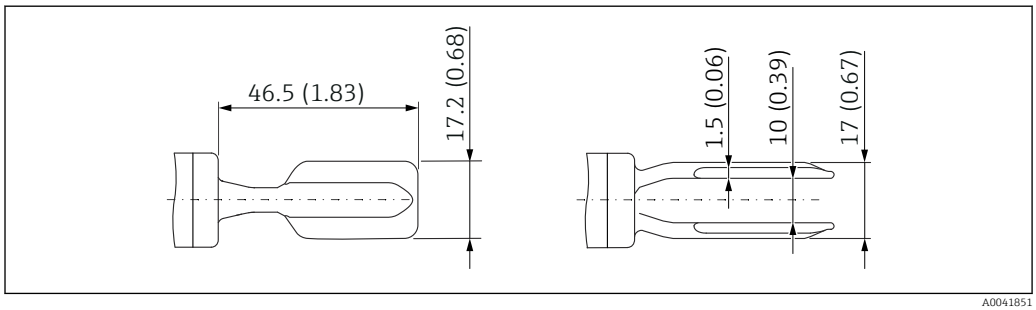
33 *Probe design: short pipe, pipe extension. Unit of measurement mm (in)*

A Short pipe: fixed length
B Pipe extension: variable length L
Ø Maximum diameter: depends on coating material
R Radius: take into consideration for counterflange

Tuning fork



34 *Tuning fork with plastic coating (ECTFE, PFA). Unit of measurement mm (in)*



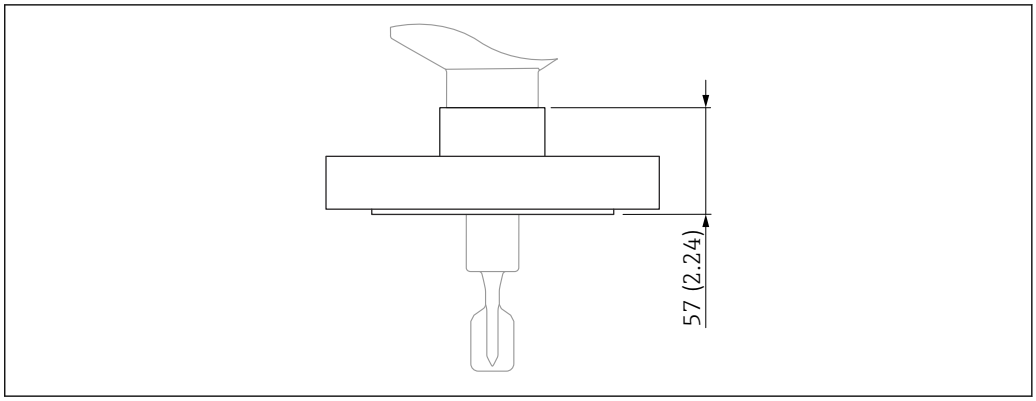
35 *Tuning fork with enamel coating. Unit of measurement mm (in)*

Process connections

Process connection, sealing surface

- Flange ASME B16.5, RF (Raised Face)
- Flange EN1092-1, Form A
- Flange EN1092-1, Form B1
- Flange JIS B2220, RF (Raised Face)

Height of process connection



36 *Process connection with flange (maximum specification of height) . Unit of measurement mm (in)*

ASME B16.5 flanges, RF

Pressure rating	Type	Material	Weight
Cl.150	NPS 1"	316/316L	1.0 kg (2.21 lb)
Cl.150	NPS 1-½"	316/316L	1.5 kg (3.31 lb)
Cl.150	NPS 2"	316/316L	2.4 kg (5.29 lb)
Cl.150	NPS 2"	Enamel 1.0487	2.4 kg (5.29 lb)
Cl.150	NPS 3"	316/316L	4.9 kg (10.8 lb)
Cl.150	NPS 4"	316/316L	7 kg (15.44 lb)
Cl.300	NPS 2"	316/316L	3.2 kg (7.06 lb)
Cl.300	NPS 2"	Enamel 1.0487	3.2 kg (7.06 lb)

EN flanges EN 1092-1, A

Pressure rating	Type	Material	Weight
PN6	DN50	316L (1.4404)	1.6 kg (3.53 lb)
PN10/16	DN100	316L (1.4404)	5.6 kg (12.35 lb)
PN25/40	DN25	316L (1.4404)	1.3 kg (2.87 lb)
PN25/40	DN32	316L (1.4404)	2.0 kg (4.41 lb)
PN25/40	DN40	316L (1.4404)	2.4 kg (5.29 lb)
PN25/40	DN50	316L (1.4404)	3.2 kg (7.06 lb)
PN25/40	DN80	316L (1.4404)	5.9 kg (13.01 lb)

EN flanges EN 1092-1, B1

Pressure rating	Type	Material	Weight
PN25/40	DN50	Enamel 1.0487	3.2 kg (7.06 lb)
PN25/40	DN80	Enamel 1.0487	5.9 kg (13.01 lb)

JIS flanges B2220 (RF)

Pressure rating	Type	Material	Weight
10K	10K 50A	316L (1.4404)	1.7 kg (3.75 lb)

Coating material and layer thickness

The maximum diameter Ø depends on the coating material.

ECTFE
- Lower limit: 0.5 mm (0.02 in)
- Upper limit: 1.6 mm (0.06 in)
- Maximum diameter: Ø 24.6 mm (0.97 in)

PFA (Edlon™), PFA (RubyRed®), PFA (conductive)
- Lower limit: 0.45 mm (0.02 in)
- Upper limit: 1.6 mm (0.06 in)
- Maximum diameter: Ø 24.6 mm (0.97 in)

PFA (Edlon™): FDA-compliant material in accordance with 21 CFR Part 177.1550/2600

Enamel
- Lower limit: 0.4 mm (0.02 in)
- Upper limit: 0.8 mm (0.03 in)
- Maximum diameter: Ø 23 mm (0.91 in)

Properties and benefits of coatings

ECTFE (ethylene chlorotrifluoroethylene)
- Thermoplastic fluoropolymer coating
- Also known as HALAR®
- Very good chemical and corrosion resistance
- High abrasion performance
- Good non-stick properties
- Ideal for use in the chemicals industry

PFA (perfluoroalkoxy)
- Properties similar to PTFE (polytetrafluoroethylene) and FEP (perfluoroethylenepropylene)
- Also known as Teflon®-PFA
- Very good chemical and corrosion resistance
- High abrasion performance
- Good non-stick and sliding properties
- High temperature stability
- Ideal for use in the chemical and pharmaceutical industry
- Available as PFA (Edlon™), PFA (Ruby Red®) or also as PFA (conductive), specially developed for use in explosive atmospheres

PFA (Edlon™): FDA-compliant material in accordance with 21 CFR Part 177.1550/2600

Enamel
- Glass-like material
- Very good chemical and corrosion resistance
- Acid-resistant
- High temperature stability
- Dirt-repellent
- Low resistance to impact

Use of the selected coating material influences the approved IIB/IIC gas groups. Pay attention to the information in the safety documentation (XA).

Weight

Basic weight: 0.65 kg (1.43 lb)
The basic weight comprises:
- Probe design: short pipe version
- Electronic insert
- Housing: single compartment, plastic with cover

Differences in weight are caused by the housing and cover selected.

Housing
- Single compartment, aluminum, coated: 0.8 kg (1.76 lb)
- Single compartment; 316L: 2.1 kg (4.63 lb)
- Single compartment; 316L, hygienic: 0.45 kg (0.99 lb)
- Dual compartment, L-shaped; aluminum, coated: 1.22 kg (2.69 lb)

Temperature spacer
0.6 kg (1.32 lb)

Pressure-tight feedthrough
0.7 kg (1.54 lb)

Pipe extension
- 1000 mm: 0.9 kg (1.98 lb)
- 50 in: 1.15 kg (2.54 lb)

Process connection

See "Process connections" section

Protective cover, plastic
0.2 kg (0.44 lb)

Protective cover, 316L
0.93 kg (2.05 lb)

Materials

No coating: temperature spacer, pressure-tight feedthrough

Materials in contact with process

Pipe extension

- With plastic coating: carrier material: 316L (1.4435 or 1.4404)
- With enamel coating: carrier material: Alloy C4

Tuning fork

- With plastic coating: carrier material: 316L (1.4435 or 1.4404)
- With enamel coating: carrier material: Alloy C4

Flanges

- With ECTFE, PFA (Edlon™) [1], PFA (RubyRed), PFA (conductive): carrier material: 316L (1.4404)
- With enamel coating: carrier material: A516 Gr.60 (1.0487), (ASTMA 529)
- Additional flanges:
  - According to EN/DIN 1092-1 from DN 25
  - According to ASME B16.5 from 1"
  - According to JIS B 2220 (RF) from 10K50

Materials not in contact with process

Plastic housing

- Housing: PBT/PC
- Dummy cover: PBT/PC
- Cover seal: EPDM
- Potential equalization: 316L
- Seal under potential equalization: EPDM
- Plug: PBT-GF30-FR
- M20 cable gland: PA
- Seal on plug and cable gland: EPDM
- Threaded adapter as replacement for cable glands: PA66-GF30
- Adapter for NPT ¾: plastic
- Nameplate: plastic foil
- TAG plate: plastic foil, metal or provided by customer

Aluminum housing, coated

- Housing: aluminum EN AC 43400
- Dummy cover: aluminum EN AC 43400
- Cover seal materials: HNBR
- Cover seal materials: FVMQ
- Plug: aluminum
  Plastic (PBT-GF30-FR) in Ex-free, Ex i or IS combination with cable gland, plastic, M20 thread or G ½ thread

1) FDA-compliant material in accordance with 21 CFR Part 177.1550/2600

- Nameplate: plastic foil
- TAG plate: plastic foil, stainless steel or provided by the customer
- M20 cable glands: select material (stainless steel, nickel-plated brass, polyamide)

Stainless steel housing, 316L

- Housing: stainless steel AISI 316L (1.4409)
- Cover: stainless steel AISI 316L (1.4409)
- Cover seal materials: FVMQ
- Cover seal materials: HNBR
- Plug: stainless steel
- Nameplate: stainless steel housing labeled directly
- TAG plate: plastic foil, stainless steel or provided by the customer
- M20 cable glands: select material (stainless steel, nickel-plated brass, polyamide)

Stainless steel housing, 316L hygienic

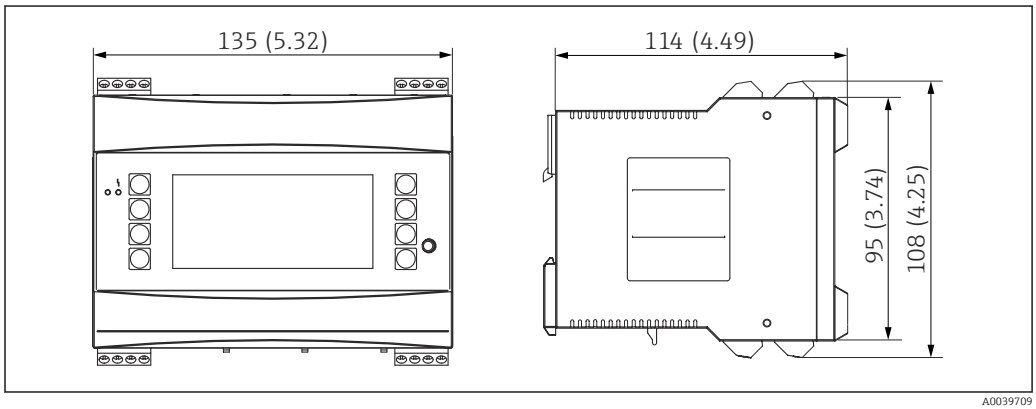
- Housing: stainless steel AISI 316L (1.4404)
- Cover: stainless steel AISI 316L (1.4404)
- Cover seal materials: EPDM
- Cover seal materials: HNBR
- Nameplate: stainless steel housing labeled directly
- TAG plate: plastic foil, stainless steel or provided by the customer
- M20 cable glands: select material (stainless steel, nickel-plated brass, polyamide)

Mechanical construction of Density Computer FML621

Terminal

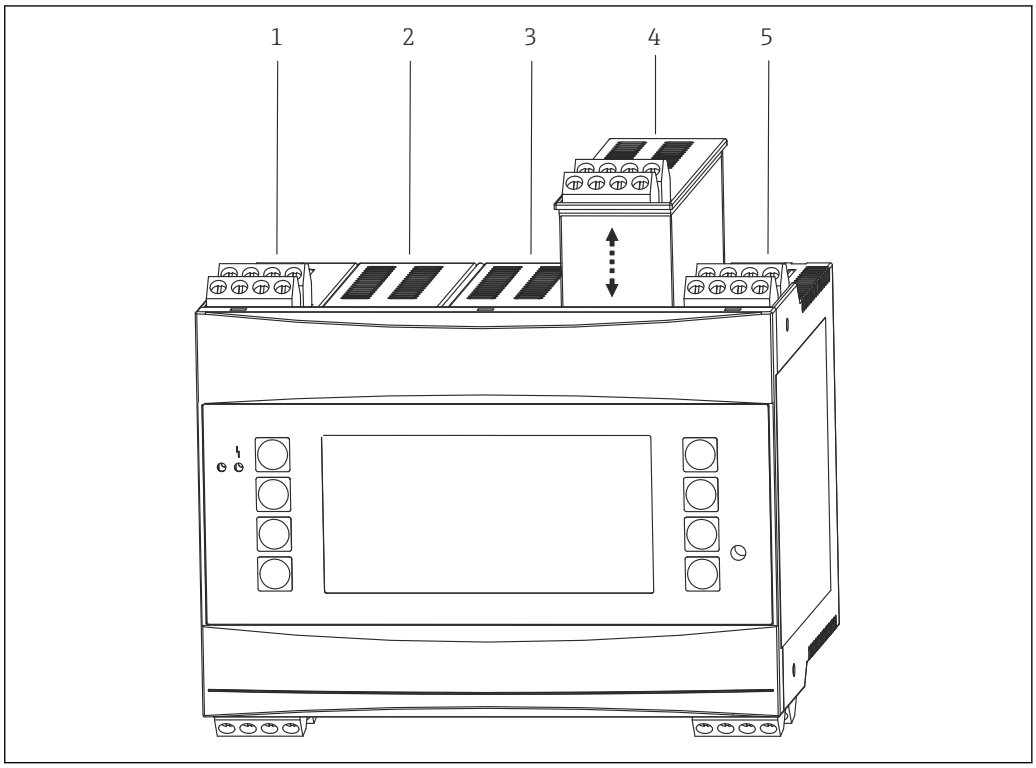
Pluggable screw terminals - power supply terminal is coded. The terminal range - 1.5 mm^2 (16 AWG) solid, 1 mm^2 (18 AWG) flexible with ferrules - applies to all connections.

Dimensions



37 Housing for DIN rail as per IEC 60715. Unit of measurement mm (in)

Slots with extension cards



38 *Device with additional extension cards*

1 *Slot A, extension card (already included in the basic unit)*
2 *Slot B, extension card (optional or available as an accessory)*
3 *Slot C, extension card (optional or available as an accessory)*
4 *Slot D, extension card (optional or available as an accessory)*
5 *Slot E, extension card (already included in the basic unit)*

Weight

Basic unit:
500 g (17.6 oz) Weight with all additional extension cards.

Remote operating unit:
300 g (10.6 oz).

Materials

Housing:
Polycarbonate plastic, UL 94V0

User interface of Density Computer FML621

- An operating and display unit can also be used for commissioning the Density Computer FML621
- The operating and display unit can also be used for multiple devices
- An operating and display unit is absolutely essential for field adjustment

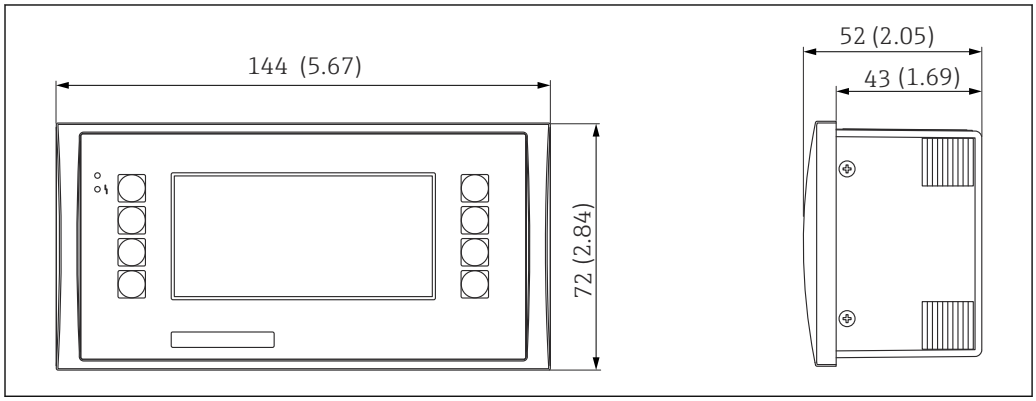
Display elements

Display
160x80 dot-matrix LCD with blue background lighting. In the event of an error, the color of the background lighting changes to red. It is possible to configure the background color.

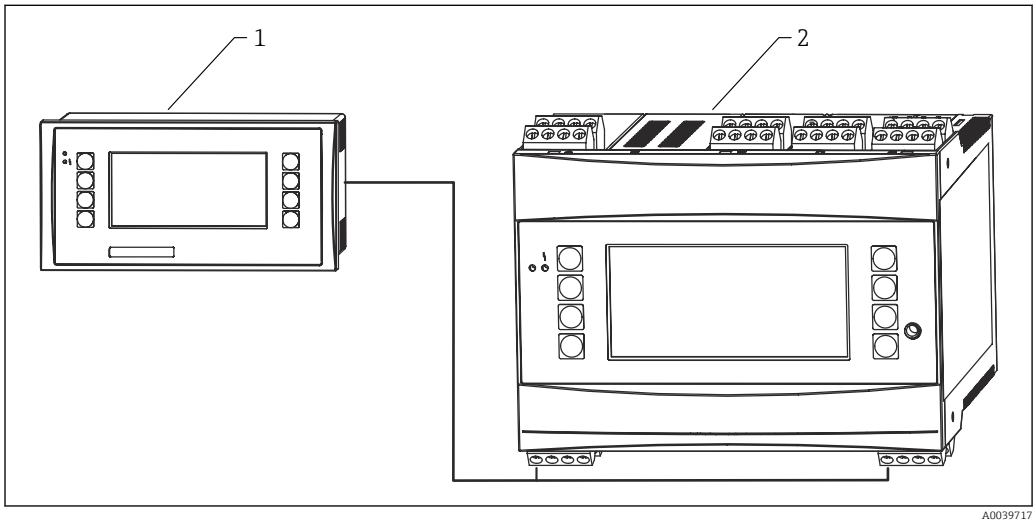
LED status indicator
- Operation: 1 x green 2 mm (0.08 in)
- Fault message: 1 x red 2 mm (0.08 in)

Operating and display unit - optional or as an accessory

- In addition, a display and operating unit with the following dimensions can be connected to the device in the panel-mounted housing:
  - W: 144 mm (5.67 in)
  - H: 72 mm (2.83 in)
  - D: 43 mm (1.69 in)
- Connection to the integrated RS484 interface is performed using the connection cable (length = 3 m (9.84 ft)), which is included in the accessory kit
- It is possible to operate the operating and display unit in parallel with a device-internal display in the FML621



39 Operating and display unit for panel mounting. Unit of measurement mm (in)



40 Operating and display unit in panel-mounted housing

1 Operating and display unit
2 Basic unit

Operating elements

Eight soft keys at the front are used to interact with the display. The functions of the keys are shown on the display.

Remote operation

- RS232 interface via mini jack plug socket3.5 mm (0.14 in), configuration using a PC and ReadWin® 2000 PC software
- RS485 interface

Real-time clock

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

Certificates and approvals

CE mark

The measuring system meets the legal requirements of the applicable EU Directives. These are listed in the corresponding EU Declaration of Conformity along with the standards applied.

Endress+Hauser confirms that the device has been successfully tested by applying the CE mark.

Ex approval

For available Ex approvals, see Product Configurator.

All explosion protection data are listed in a separate document, which is available on request.

Other standards and guidelines

IEC 60529
Degrees of protection provided by enclosures (IP code)

IEC 61010
Safety requirements for electrical equipment for measurement, control and laboratory use

EN 61326 series
EMC product family standard for electrical equipment for measurement, control and laboratory use

NAMUR
User association of automation technology in process industries

Ordering information

Detailed ordering information is available from your nearest sales organization www.addresses.endress.com or in the Product Configurator at www.endress.com:

1. Select the product using the filters and search field.
2. Open the product page.
3. Select **Configuration**.

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

TAG

Measuring point (TAG)

The device can be ordered with a tag name.

Location of tag name
Select in the additional specification:
- Stainless steel tag plate
- Paper adhesive label
- Tag provided by the customer
- RFID tag
- RFID tag + stainless steel tag plate
- RFID tag + paper adhesive label
- RFID tag + tag provided by the customer
- IEC 61406 stainless steel tag
- IEC 61406 stainless steel tag + NFC tag
- IEC 61406 stainless steel tag, stainless steel tag
- IEC 61406 stainless steel tag + NFC, stainless steel tag
- IEC 61406 stainless steel tag, plate supplied
- IEC 61406 stainless steel tag + NFC, plate supplied

Definition of tag name
Specify in the additional specification:
3 lines of maximum 18 characters each
The specified tag name appears on the selected plate and/or on the RFID tag.

Test reports, declarations and inspection certificates

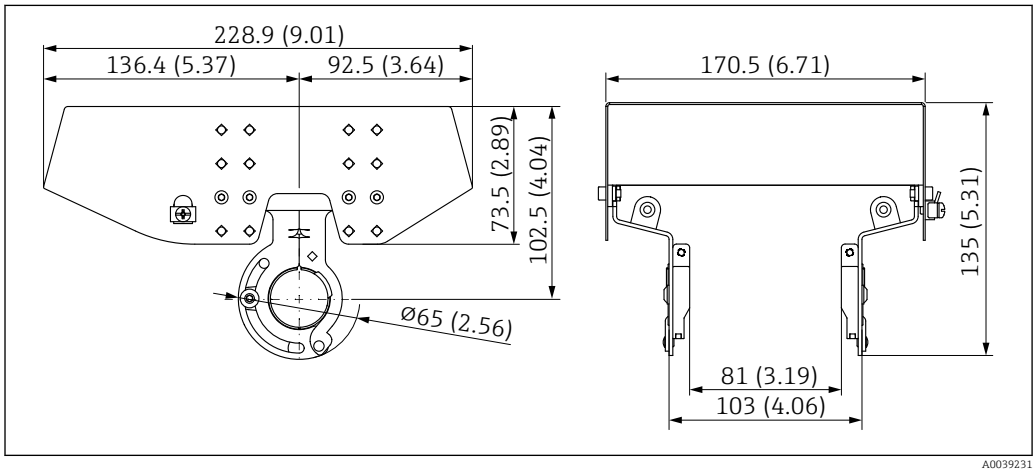
All test reports, declarations and inspection certificates are provided electronically in the *Device Viewer*:
Enter the serial number from the nameplate (www.endress.com/deviceviewer)

Product documentation on paper
Test reports, declarations and inspection certificates in hard copy can optionally be ordered with feature 570 "Service", Version I7 "Product documentation on paper". The documents are then provided with the device upon delivery.

Accessories for Liquiphant Density

Protective cover for aluminum dual compartment housing

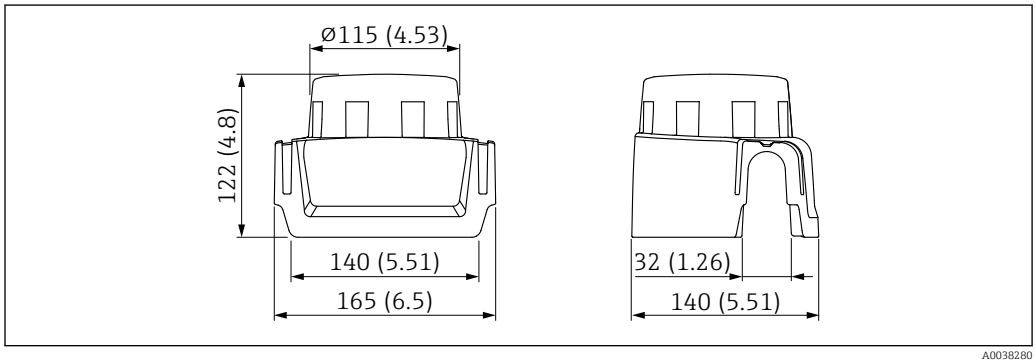
- Material: stainless steel 316L
- Order number: 71438303



41 *Protective cover for aluminum dual compartment housing. Unit of measurement mm (in)*

Protective cover for single compartment housing, aluminum or 316L

- Material: plastic
- Order number: 71438291



42 *Protective cover for single compartment housing, aluminum or 316L. Unit of measurement mm (in)*

M12 socket

The M12 sockets listed are suitable for use in the temperature range −25 to +70 °C (−13 to +158 °F).

M12 socket IP69
- Terminated at one end
- Angled
- 5 m (16 ft) PVC cable (orange)
- Slotted nut 316L (1.4435)
- Body: PVC
- Order number: 52024216

M12 socket IP67
- Angled
- 5 m (16 ft) PVC cable (gray)
- Slotted nut Cu Sn/Ni
- Body: PUR
- Order number: 52010285

Additional accessories

Documentation currently available can be found on the Endress+Hauser website: www.endress.com → Downloads.

Accessories for Density Computer FML621

General

RXU10-A1
Cable set for Density Computer FML621 for connecting to a PC or modem

FML621A-AA
Remote display for panel mounting:
- B: 144 mm (5.67 in)
- H: 72 mm (2.83 in)
- T: 43 mm (1.69 in)

RMS621A-P1
PROFIBUS interface

51004148
Adhesive label, printed, max. 2 x 16 characters

51002393
Metal sign for TAG number

51010487
Sign, paper, TAG 3 x 16 characters

Extension cards

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

FML621A-DA
Digital
- 6 x digital input
- 6 x relay output
- Kit with terminals and fixing frame

FML621A-DB
Digital, ATEX-approved
- 6 x digital input
- 6 x relay output
- Kit with terminals

FML621A-CA
2x U, I, TC
- 2x 0 to 20 mA or 4 to 20 mA per pulse
- 2x digital
- 2x SPST relay

FML621A-CB
Multifunction, 2x U, I, TC ATEX
- 2x 0 to 20 mA or 4 to 20 mA per pulse
- 2x digital
- 2x SPST relay

FML621A-TA
Temperature (Pt100/Pt500/Pt1000)
Complete, including terminals and securing frame

FML621A-TB
Temperature, ATEX-approved (Pt100/PT500/PT1000)
Complete, including terminals

FML621A-UA
Universal - PFM or pulse or analog or transmitter power supply
Complete, including terminals and securing frame

FML621A-UB
Universal ATEX-approved - PFM or pulse or analog or transmitter power supply
Complete, including terminals

PROFINET® Interface

Order code RMS621A-P2

Supplementary documentation

The certificates, approvals and other documentation currently available can be accessed as follows:
Endress+Hauser website: www.endress.com → Downloads.

Standard documentation

Document type: Operating Instructions (BA)
Installation and initial commissioning – contains all the functions in the operating menu that are needed for a normal measuring task. Functions beyond this scope are not included.

Document type: Brief Operating Instructions (KA)
Quick guide to the first measured value – includes all essential information from incoming acceptance to electrical connection.

Document type: Safety Instructions, certificates
Depending on the approval, Safety Instructions are also supplied with the device, e.g. XA. This documentation is an integral part of the Operating Instructions.
The nameplate indicates the Safety Instructions (XA) that are relevant to the device.

Supplementary device-dependent documentation

Special Documentation

TI00426F: Adapter and flanges (overview)

71624368

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