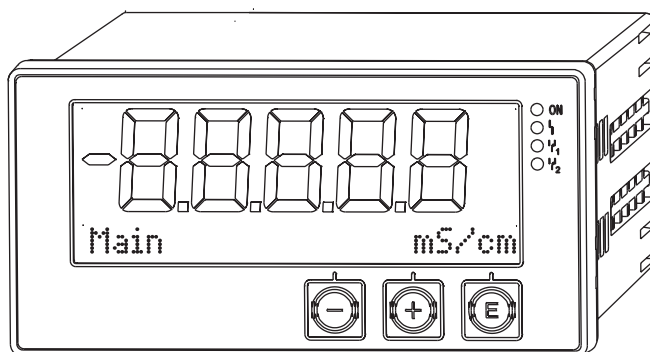


Operating Instructions

CM14

Transmitter, conductivity



Endress+Hauser 

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1 Safety instructions

Safe operation of the transmitter is only guaranteed if these Operating Instructions have been read and the safety instructions they contain have been observed.

1.1 Workplace safety

For work on and with the device:

- ▶ Wear the required personal protective equipment according to federal/national regulations.

1.2 Requirements concerning the staff

The personnel for installation, commissioning, diagnostics and maintenance must fulfill the following requirements:

- ▶ Trained, qualified specialists: must have a relevant qualification for this specific function and task
- ▶ Are authorized by the plant owner/operator
- ▶ Are familiar with federal/national regulations
- ▶ Before beginning work, the specialist staff must have read and understood the instructions in the Operating Instructions and supplementary documentation as well as in the certificates (depending on the application)
- ▶ Following instructions and basic conditions

The operating personnel must fulfill the following requirements:

- ▶ Being instructed and authorized according to the requirements of the task by the facility's owner-operator
- ▶ Following the instructions in these Operating Instructions

1.3 Operational safety

Risk of injury.

- ▶ Operate the device in proper technical condition and fail-safe condition only.
- ▶ The operator is responsible for interference-free operation of the device.

Conversions to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers.

- ▶ If, despite this, modifications are required, consult with Endress+Hauser.

Repair

To ensure continued operational safety and reliability,

- ▶ Carry out repairs on the device only if they are expressly permitted.
- ▶ Observe federal/national regulations pertaining to repair of an electrical device.
- ▶ Use original spare parts and accessories from Endress+Hauser only.

Hazardous area

To eliminate a danger for persons or for the facility when the device is used in the hazardous area (e.g. explosion protection, pressure vessel safety):

- ▶ Based on the nameplate, check whether the ordered device is permitted for the intended use in the hazardous area.

- Observe the specifications in the separate supplementary documentation that is an integral part of these Instructions.

1.4 Designated use

The transmitter evaluates measured values of an analytical sensor and shows them on its multicolored display. Using the unit's outputs and limit relays, processes can be monitored and controlled. The device is equipped with a wide range of software functions for this purpose.

- The manufacturer accepts no liability for damages resulting from incorrect use or use other than that designated. The device may not be converted or modified in any way.
- The process display unit has been designed for panel installation and may only be operated in an installed state.

1.5 Technical improvement

The manufacturer reserves the right to adapt technical details to the most up-to-date technical developments without prior notice. Contact your sales center for current information and updates to these Operating Instructions.

1.6 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.



Enclose a note describing the fault and the application when sending the unit in for repair.

1.7 Notes on safety conventions and icons

1.7.1 Warning instructions



Cause (/effects)

Where applicable, consequences of failure to comply

- Avoidance measure
- Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.



Cause (/effects)

Where applicable, consequences of failure to comply

- Avoidance measure
- Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Cause (/effects)

Where applicable, consequences of failure to comply

- ▶ Avoidance measure
- ▶ Indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury.

NOTICE

Cause (/effects)

Where applicable, consequences of failure to comply

- ▶ Avoidance measure
- ▶ This note alerts you to situations that can cause property damage.

1.7.2 Document symbols



Allowed

Indicates procedures, processes or actions that are allowed.



Preferred

Indicates procedures, processes or actions that are preferred.



Forbidden

Indicates procedures, processes or actions that are forbidden.



Additional information, tip



Reference to documentation



Reference to page of these instructions



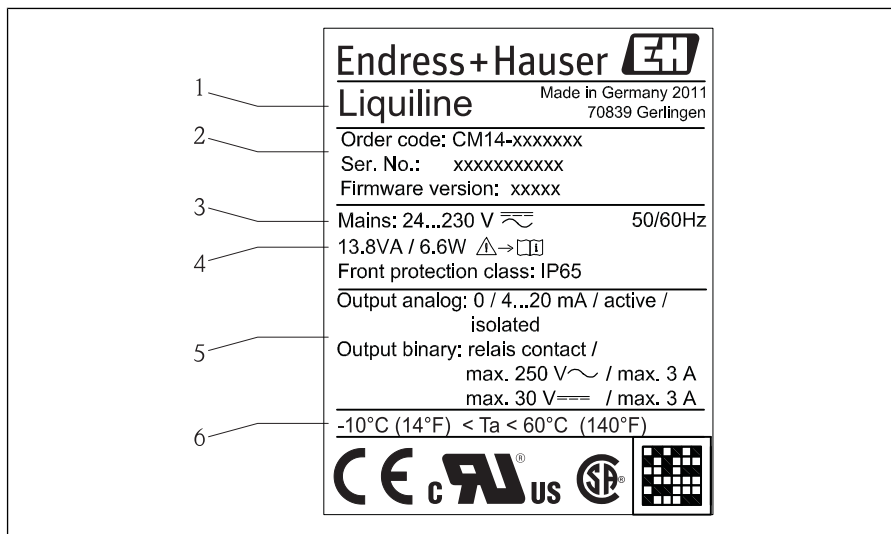
Reference to a graphic

2 Identification

2.1 Device designation

2.1.1 Nameplate

Compare the nameplate with the following illustration:



A0015221

 1 Nameplate of the transmitter (example)

- 1 Device designation
- 2 Order code, serial number and ID number of the device
- 3 Power supply
- 4 Power consumption
- 5 Output variables
- 6 Temperature range

2.2 Scope of delivery

The scope of delivery of the transmitter comprises:

- Transmitter for panel mounting
- Operating Instructions
- Fastening material

2.3 Certificates and approvals

CE mark, Declaration of Conformity

The process display unit is designed to meet state-of-the-art safety requirements, has been tested and left the factory in a condition in which it is safe to operate. The device meets the relevant standards and directives as per EN 61 010-1 "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.

For an overview of all available certificates and approvals, refer to the "Technical data" chapter.

3 Installation

3.1 Incoming acceptance, transport, storage

The permitted ambient and storage conditions must be observed. The precise specifications can be found in Section "Technical data" (→  35).

3.1.1 Incoming acceptance

On receipt of the goods, check the following points:

- Are the packaging or contents damaged?
- Is anything missing from the delivery? Compare the scope of delivery with the information you specified in the order.

3.1.2 Transportation and storage

Note the following points:

- Pack the device so that is protected against impact for storage and transportation. The original packaging provides optimum protection.
- The permitted storage temperature range is -40 to $+85$ °C (-40 to $+185$ °F); it is possible to store the device in the borderline temperature ranges for a limited period (maximum 48 hours).

3.2 Installation

NOTICE

Overheating due to heat accumulation in the device

- To avoid heat accumulation, please always make sure the device is sufficiently cooled.



If the device is operated in the upper temperature limit range, this reduces the operating life of the display.

The transmitter is designed to be used in a panel.

The orientation is determined by the readability of the display. Connections and outputs are fitted on the rear of the device. The wires are connected by means of number-coded terminals.

Ambient temperature range: -10 to $+60$ °C (14 to 140 °F)

3.3 Dimensions

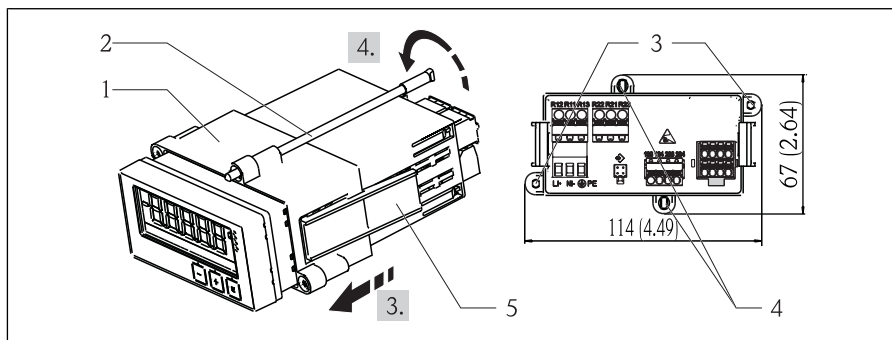
Observe the installation depth of 150 mm (5.91 ") for the device incl. terminals and fastening clips.

More dimensions can be found in Section "Technical data" (→  35).

- Panel cutout: 92 mm x 45 mm (3.62 in x 1.77 in).
- Panel thickness: max. 26 mm (1 in).
- Max. viewing angle range: 45° to the left and right from the central display axis.
- If the devices are arranged horizontally beside one another in the X-direction, or arranged vertically on top of one another in the Y-direction, the mechanical distance (specified by the housing and front section) must be observed.

3.4 Installation procedure

The required panel cutout is 92 mm x 45 mm (3.62 in x 1.77 in).



A0015216

2 Installation in the panel

1. Screw the threaded rods (item 2) into the positions provided on the mounting frame (item 1). Four opposing screw positions (item 3/4) are available for this purpose.
2. Push the device with the sealing ring through the panel cutout from the front.
3. To secure the tube in the panel, hold the device in a horizontal position and push the installation frame (item 1), with the threaded rods screwed in, over the tube until the frame locks into position.
4. Tighten the threaded rods to fasten the device in place.

To disassemble the device, the mounting frame can be unlocked at the locking elements (item 5) and then removed.

3.5 Post-installation check

- Is the sealing ring undamaged?
- Is the mounting frame securely engaged on the housing of the device?
- Are the threaded rods tightened?
- Is the device positioned in the center of the panel cutout?

4 Wiring

WARNING

Danger from electrical voltage

- The entire connection of the electrical system must take place while the device is de-energized.

Danger if protective ground is interrupted

- The protective ground connection must be established before any other connection is made.

NOTICE

Thermal load of the lines

- Use suitable lines for temperatures of 5 °C (9 °F) above ambient temperature.

Malfunction or destruction of the device due to incorrect supply voltage

- Prior to commissioning, make sure the supply voltage matches the specifications on the nameplate (bottom side of the housing).

Ensure the emergency shutoff of the device

- Provide a suitable switch or power-circuit breaker in the building installation. This switch must be provided within easy reach of the device and be labeled as a disconnecter.

Protect device from overload

- Provide a overload protection unit (rated current = 10 A) for the power supply line.

Incorrect wiring can cause destruction of the device

- Observe the terminal designation on the rear of the device.

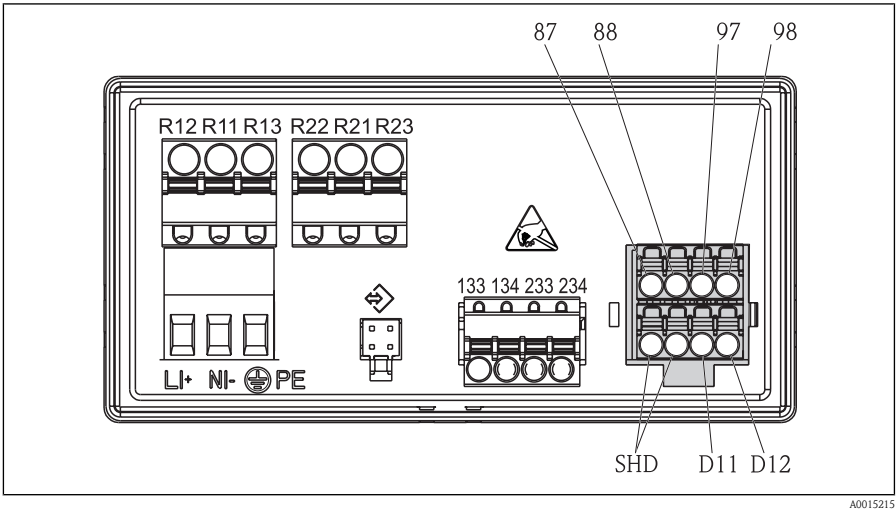
Energy-rich transients in long signal lines

- Connect suitable upstream overvoltage protection in series.



It is not permitted to connect a mixture of safety extra low voltage and voltage which poses a shock hazard to the relays.

4.1 Connecting the transmitter



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3 Connection diagram of the transmitter

Terminal	Description
87	Terminal for Memosens cable, brown, sensor power supply U+
88	Terminal for Memosens cable, white, sensor power supply U-
97	Terminal for Memosens cable, green, Com A
98	Terminal for Memosens cable, yellow, Com B
SHD	Terminal for Memosens cable, shield
D11	Terminal for alarm output, +
D12	Terminal for alarm output, -
L/+	Terminal for transmitter supply voltage
N/-	
⊕ PE	
133	Terminal for analog output 1, +
134	Terminal for analog output 1, -
233	Terminal for analog output 2, +
234	Terminal for analog output 2, -
R11, R12, R13	Terminal for relay 1
R21, R22, R23	Terminal for relay 2

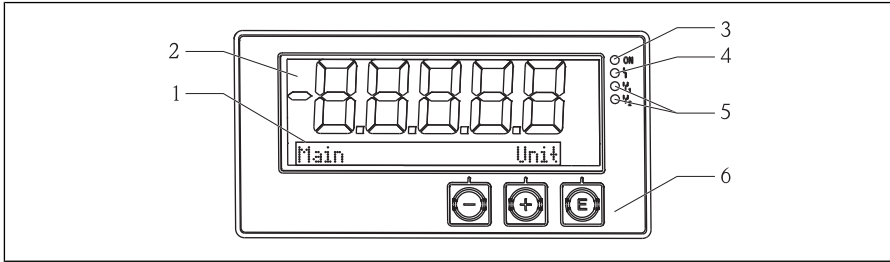
4.2 Post-connection check

Device condition and specifications	Notes
Are the device or cables damaged?	Visual inspection
Electrical connection	Notes
Does the supply voltage match the specifications on the nameplate?	24 to 230 V AC/DC (-20 % / +10 %) 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 strain-relieved?	-
Are the supply voltage and signal cables connected correctly?	See connection diagram, (→  3,  12) and on the housing.

5 Operation

The easy operating concept of the device makes it possible for users to commission the device for many applications without a printed set of Operating Instructions.

5.1 Display and device status indicator/LED



A0015891

4 Display of the device

- 1 Dot-matrix section
- 2 7-segment section
- 3 LED status indicator power supply connected
- 4 LED status indicator alarm function
- 5 LED status indicator limit function relay 1/2
- 6 Operating keys

The device provides a backlit LC display which is split into two sections. The segment section shows the measured value.

In the dot matrix section, additional channel information, such as the TAG, unit or bar graph, is shown in display mode. Operating text in English is displayed here during operation.

The parameters for configuring the display are explained in detail in Section 6.4.

In the event of an error, the device switches automatically between displaying the error and displaying the channel, see Section 6.5.3 and Section 9 'Troubleshooting'.

5.2 Local operation at the device

The device is operated by means of the three keys integrated in the front part of the device



A0010420



A0010421

- Open the configuration menu
- Confirm an entry
- Select a parameter or submenu offered in the menu



A0010422

- Within the configuration menu:
- Scroll step-by-step through the parameters/menu items/characters offered
 - Change the value of the selected parameter (increase or decrease)

Outside the configuration menu:
Display enabled and calculated channels, as well as min. and max. values for all the active channels.

You can always exit items/submenus at the end of the menu by selecting "x Back".
Leave the setup directly without saving the changes by pressing the '–' and '+' keys simultaneously for over 3 s seconds.

5.3 Icons

5.3.1 Display icons

	Hold function ((→ 16)) active.
Max	Maximum value/value of the maximum indicator of the channel displayed.
Min	Minimum value/value of the minimum indicator of the channel displayed.
-----	Error, under/over range. No display of the measured value.

In the dot matrix section, the error and the channel name (TAG) are specified.

5.3.2 Icons in the editing mode

The following characters can be used to enter user-defined text:
'0-9', 'a-z', 'A-Z', '+', '-', '*', '/', '\', '%', '°', '2', '3', 'm', ':', ';', '<', '>', '!', '?', '_', '#', '\$', '"', '[,]', '(', ')', '~'

For numerical entries, the numbers '0-9' and the decimal point are available.

Furthermore, the following icons are used in the editing mode:

	Symbol for the setup
	Symbol for the Expert setup
	Symbol for diagnostics

✓	Accept entry. If this icon is selected, the information entered is accepted at the position and the user exits the editing mode.
✗	Reject entry. If this icon is selected, the information entered is rejected and the user exits the editing mode. The text configured beforehand remains unchanged.
←	Move one position to the left. If this icon is selected, the cursor moves one position to the left.
⬅	Delete back. If this icon is selected, the character to the left of the cursor is deleted.
Ⓢ	Delete all. If this icon is selected, all the information entered is deleted.

5.4 Operating functions

The operating functions of the transmitter are organized into the following menus:

Display	Adjusting the device display: contrast, brightness, switching time for displaying the measured values
Setup	Device settings For descriptions of the individual settings, refer to the chapter on Commissioning, (→ 17).
Calibration	Carrying out the sensor calibration For descriptions of the calibration functions, refer to the chapter on Calibration, (→ 26).
Diagnostics	Device information, diagnostic logbook, sensor information, simulation

5.5 Hold function

The effect of the Hold function is to "freeze" the current outputs and relay states. It can be switched on or off manually (menu **Setup → Manual hold**). Furthermore, the Hold function is automatically activated during sensor calibration.

The Hold function remains active after discontinuation of the hold condition for an adjustable Hold-release time. The Hold-release time can be set under **Setup → Extended setup → System → Hold release**.

The measured value display is not affected by the Hold function. The Hold symbol is displayed behind the measured value.

6 Commissioning

6.1 Installation check and switching on the device

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

- "Installation check" checklist, (→  10).
- "Post-connection check" checklist, (→  13).

Once the operating voltage is applied, the green LED lights up and the display indicates that the device is operational.

When you commission the device for the first time, you program the setup in accordance with the descriptions provided in these Operating Instructions in the following sections.

When commissioning a device already configured or preset, measuring is immediately started as per the settings. The values of the channels currently activated appear on the display.



Remove the protective foil from the display as this restricts display legibility otherwise.

6.2 Display settings (Display menu)

Press the 'E' button during operation to call up the main menu. The Display menu appears in the display. Pressing the 'E' key again opens the menu. Select the "x Back" option at the end of each menu/submenu to navigate one level higher in the menu structure.

Parameter	Configuration options	Description
Contrast	1-7 Default: 5	Configures the display contrast.
Brightness	1-7 Default: 5	Configures the display brightness.
Display scrolling	0, 3, 5 , 10 sec	Switching time between the two measured values. 0 means no switching.

6.3 Configuration of the device (Setup menu)

Press the 'E' button during operation to call up the main menu. Use the '+' and '-' buttons to navigate through the available menus. When the desired menu is displayed, press the 'E' key to open the menu. Select the "x Back" option at the end of each menu/submenu to navigate one level higher in the menu structure.

The Setup menu includes the most important settings for the function of the device.

Parameter	Configuration options	Description
Tag	Free text Max. 16 characters	Enter the device designation (tag).
Current range	4-20 mA 0-20 mA	Configure the measuring range for the current output.

Parameter	Configuration options	Description
Out main 0/4 mA	Numerical value 0.000 to 99 999 0.1 mS/cm	Physical value corresponding to the lower range limit of the analog output. When the value set is undershot, the current output is set to the saturation current 0/3.8 mA.
Out main 20 mA	Numerical value 0.000 to 99 999 200 mS/cm	Physical value corresponding to the upper range limit of the analog output. When the value set is exceeded, the current output is set to the saturation current 20.5 mA.
Out temp 0/4 mA	Numerical value -50 to 250 °C -5 °C	Temperature corresponding to the measuring range lower limit of the temperature input. When the value set is undershot, the current output is set to the saturation current 0/3.8 mA.
Out temp 20 mA	Numerical value -50 to 250 °C 100 °C	Temperature corresponding to the measuring range upper limit of the temperature input. When the value set is exceeded, the current output is set to the saturation current 20.5 mA.
Damping main value	0 to 60 s 0 s	Configure the damping for the low-pass filtering of the input signals.
Extended setup		Advanced settings for the device, such as the relay, limit values etc. The functions are described in the following chapter, (→ 18).
Manual hold	Off , On	Function for "freezing" the current and relay outputs.

6.4 Extended configuration (Extended setup menu)

Press the 'E' button during operation to call up the main menu. Press the '+' button during operation to navigate to the Setup menu. Press the 'E' key to open the menu. Navigate to the Extended Setup menu and open the menu by pressing the 'E' key. Select the "x Back" option at the end of each menu/submenu to navigate one level higher in the menu structure.

Parameter	Configuration options	Description
System		General settings
Tag	Free text Max. 16 characters	Enter the device designation (tag).
Temp. Unit	°C °F	Configures the temperature unit.
Hold release	0 to 600 s 0 s	Configures the time by which a device hold is extended after the hold condition is discontinued.

Parameter		Configuration options	Description
	Alarm delay	0 to 600 s 0 s	Delay time for output of an alarm. Alarm conditions which are present for a shorter time than the Alarm-delay time are thus suppressed.
Input			Settings of the device
	Operating mode	conductivity resistivity TDS	Configures the operating mode.
	Cell constant	Read only (present only if a sensor is connected)	Displays the cell constant of the connected sensor (see sensor certificate).
	Install factor	0.1 to 5.0 1.0	Installation factor for inductive sensors to correct the conductivity measurement. Configured by input. For additional information about the installation factor, refer to (→  21).
	Unit	auto , µS/cm, mS/cm	Unit of the physical value. "auto" toggles automatically between µS/cm and mS/cm.
	Format	none , one, two	Configure the number of decimal places for the display.
	Damping main value	0 to 60 s 0 s	Configure the damping for the low-pass filtering of the input signals.
	Temp. comp.	off, Linear , UPW HCl, UPW NaCl, NaCl (IEC 746-3), Water ISO 7888	Configures the temperature compensation. Various methods are available for compensating for the dependence on temperature. This depends on the processes in which the measurement is used. For additional information about temperature compensation, refer to (→  22).
	T. comp. cal.	off , Linear	Configure the temperature compensation for cell constant calibration.
	Alpha coeff.	1.0 to 20.0 %/K 2.1 %/K	Coefficient for linear temperature compensation.
	Ref. temp.	25 °C	Reference temperature for calculating the linear temperature-compensated conductivity. For more information on alpha coefficients and the alpha reference temperature, refer to the Temperature compensation section, (→  22).
	Process check		Check the process settings.
	Function	On, Off	Switch on the process check.
	Inactive time	1 to 240 min 60 min	Duration of the process check.

Parameter		Configuration options	Description
	Band width	1 to 20 % 1 %	Bandwidth for the process check.
Analog outputs			Settings for analog outputs.
	Current range	4-20 mA 0-20 mA	Current span for analog output.
	Out main 0/4 mA	Numerical value 0.000 - 99999 0.1 mS/cm	Physical value corresponding to the range lower limit of the analog output.
	Out main 20 mA	Numerical value 0.000 - 99999 200 mS/cm	Physical value corresponding to the upper range limit of the analog output.
	Out temp 0/4 mA	Numerical value -273 to 1 272 K -5 °C	Temperature corresponding to the measuring range lower limit of the temperature input.
	Out temp 20 mA	Numerical value -273 to 1 272 K 100 °C	Temperature corresponding to the measuring range upper limit of the temperature input.
	Damping main value	0 to 60 s 0 s	Configure the damping for the low-pass filtering of the input signals.
Relay 1/2			Settings for the relay outputs. For additional information about configuration of the relays, refer to (→ 23).
	Function	Off , USP alarm, EP alarm, USP pre-alarm, EP pre-alarm, Min limit, Max limit, In band, Out band, Error	Configure the function of the relay.
	Assignment	Main , Temp	Assign the relay to the main or temperature input.
	Set point	Numerical value 0.0	Cannot be configured for function Error (error message relay).
	Set point 2	Numerical value 0.0	Only for function In band or Out band .
	Hyst.	Numerical value 0.0	Configures the hysteresis. Not for function Error .
	Delay time	0 to 60 s 0 s	Configure the delay until the relay switches. Not for function Error .
Factory default			Reset the device settings to the factory settings.
	Please confirm	no , yes	Confirm reset.

6.4.1 Configuration of the relays

The device has two relays with limit values that are either switched off or can be allocated to the input signal. The operating mode of the relays as normally open or normally closed is determined by the wiring of the changeover contact ((→ 37)). The limit value is entered as a numerical value including the position of the decimal point. Limit values are always assigned

to a relay. Each relay can be assigned a channel or calculated value. In "Error" mode, the relay acts as an alarm relay and switches for each error or alarm.

The following settings can be made for each of the two limit values: assignment, limit, hysteresis, switching behavior, delay and fault mode.

6.4.2 Installation factor (inductive sensors only)

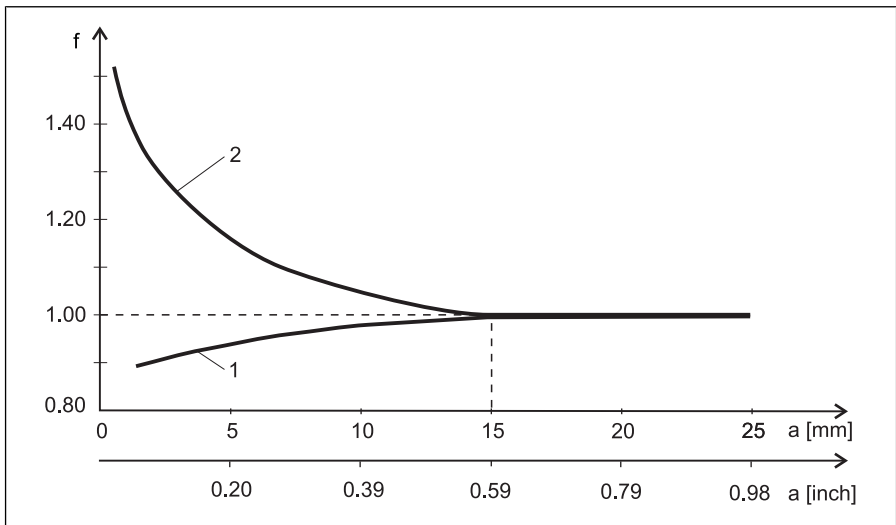
In tight installation situations, the conductivity measurement in the liquid is affected by the wall. This effect is compensated for by the installation factor. The transmitter corrects the cell constant by multiplying it by the installation factor.

The size of the installation factor depends on the diameter and conductivity of the pipe neck as well as the wall distance of the sensor.

If the wall distance is sufficient ($a > 15 \text{ mm}$ (0.59 in), DN 80 or higher) the installation factor f does not have to be taken into account ($f = 1.00$).

For small wall distances, the installation factor becomes greater for electrically insulating pipes ($f > 1$) and less in the case of electrically conductive pipes ($f < 1$).

It can be measured using the calibration solutions or determined approximately from the following diagram.



A0005441

5 Dependence of the installation factor (f) on the wall distance (a)

- 1 Electrically conductive pipe wall
- 2 Electrically insulating pipe wall

6.4.3 Temperature compensation

The conductivity of a fluid is highly temperature-dependent, as the movement of the ions and the number of dissociated molecules is temperature-dependent. To compare measured values, they have to be converted to a defined temperature. The reference temperature is 25 °C (77 °F).

When specifying the conductivity, it is always necessary to specify the temperature. $\kappa(T_0)$ is the conductivity measured in 25 °C (77 °F) or converted to 25 °C (77 °F).

The temperature coefficient α represents the percentage change of conductivity per degree change in temperature. The conductivity κ at the process temperature is calculated as follows:

$$\kappa(T) = \kappa(T_0) (1 + \alpha(T - T_0))$$

$\kappa(T)$ conductivity at the process temperature T

$\kappa(T_0)$... conductivity at reference temperature T_0

The temperature coefficient depends both on the chemical composition of the solution and the temperature and is between 1 % and 5 % per °C. The electrical conductivity of most dilute saline solutions and natural water changes in an approximately linear manner.

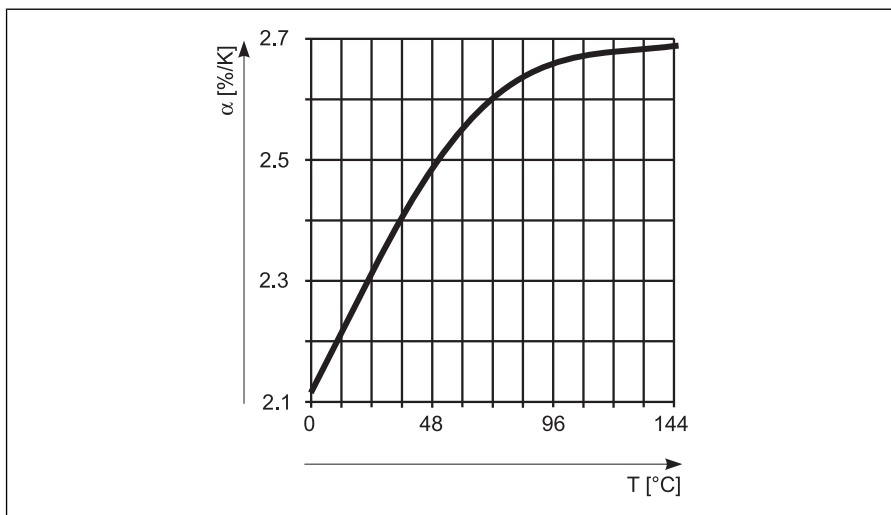
Typical values for the temperature coefficient Alpha:

Natural water	Approx. 2 %/K
Salts (e.g. NaCl)	Approx. 2.1 %/K
Alkalis (e.g. NaOH)	Approx. 1.9 %/K
Acids (e.g. HNO ₃)	Approx. 1.3 %/K

NaCl compensation

The NaCl compensation is activated using the setting **Extended setup → Input → Temp. comp. = NaCl (IEC 746-3)**.

In the NaCl compensation to (IEC 60746), a fixed nonlinear curve is stored that defines the relationship between the temperature coefficient and temperature. This curve is valid for low concentrations up to approx. 5 % NaCl.



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Compensation for natural water

The compensation for natural water is activated using the setting **Extended setup → Input → Temp. comp. = Water ISO 7888**.

For temperature compensation in natural water, a nonlinear function to ISO 7888 is stored.

Ultrapure water compensation (for conductive sensors)

The compensation for ultrapure water is activated using the setting **Extended setup → Input → Temp. comp. = UPW HCl** or **UPW NaCl**.

Algorithms are stored for pure and ultrapure water that take into account the self-dissociation of the water and its high level of temperature-dependence. They are used up to conductivity levels of approx. 100 µS/cm.

- UPW NaCl: optimized for pH-neutral impurities.
- UPW HCl: optimized for measuring acid conductivity downstream of a cation exchanger. Also suitable for ammonia (NH₃) and caustic soda (NaOH).

6.4.4 Configuration of the relays

The device has two relays with limit values that are either switched off or can be allocated to the input signal. The limit value is entered as a numerical value including the position of the decimal point. Limit values are always assigned to a relay. Each relay can be assigned a channel or calculated value. In "Error" mode, the relay acts as an alarm relay and switches for each error or alarm.

The following settings can be made for each of the two limit values: assignment, operating mode, limit, hysteresis, switching behavior, delay and fault mode.

Limit values for pharmaceutical waters as per United States Pharmacopeia (USP) and European Pharmacopoeia (EP) (only for conductive sensors)

For conductive sensors, the transmitter has functions for monitoring "Water for Injection" (WFI), "Highly Purified Water" (HPW) and "Purified Water" (PW) according to the United States Pharmacopeia (USP) Part 645 and European Pharmacopoeia (EP) standards.

USP function: For "Water for Injection" (WFI) according to USP and EP and for "Highly Purified Water" (HPW) according to EP, the temperature-dependent limit values from the following table apply. The table is stored in the transmitter.

Temperature [°C]	Conductivity [µS/cm]	Temperature [°C]	Conductivity [µS/cm]
0	0.6	55	2.1
5	0.8	60	2.2
10	0.9	65	2.4
15	1.0	70	2.7
20	1.1	75	2.7
25	1.3	80	2.7
30	1.4	85	2.7
35	1.5	90	2.7
40	1.7	95	2.9
45	1.8	100	3.1
50	1.9		

The measurement is carried out in the following steps:

- The transmitter measures the uncompensated conductivity and the water temperature.
- The transmitter rounds the temperature down to the next 5 °C step and compares the measured conductivity with the associated value in the table.
- If the measured value is greater than the table value, an alarm is triggered (E151).

EP-PW function: The following table lists the temperature-dependent limit values for "Purified Water" (PW) according to EP; it is also stored in the transmitter.

Temperature [°C]	Conductivity [µS/cm]	Temperature [°C]	Conductivity [µS/cm]
0	2.4	60	8.1
10	3.6	70	9.1
20	4.3	75	9.7
25	5.1	80	9.7
30	5.4	90	9.7
40	6.5	100	10.2
50	7.1		

The measurement is carried out in the following steps:

- The transmitter measures the uncompensated conductivity and the water temperature.
- If the temperature is between two table entries, the limit value for conductivity is determined by interpolation from the two neighboring points.
- If the measured value is greater than the limit value, an alarm is triggered.

Pre-alarm

In addition, a USP pre-alarm is available that is activated at an adjustable switch-on point of 80 % of the USP/EP limit value. Thus the user has a timely signal indicating the need to regenerate his or her system.

6.5 Device diagnostics (Diagnostics menu)

Press the 'E' button during operation to call up the main menu. Use the '+'- and '-' buttons to navigate through the available menus. When the desired menu is displayed, press the 'E' key to open the menu. Select the "x Back" option at the end of each menu/submenu to navigate one level higher in the menu structure.

Parameter		Configuration options	Description
Current diag.		Read only	Display the current diagnostic message
Last diag.		Read only	Display the last diagnostic message
Diagnost logbook		Read only	Display the last diagnostic messages
Device info		Read only	Display device information
	Device tag	Read only	View the device designation
	Device name	Read only	Display the device name
	Serial number	Read only	Displays the serial number of the device
	Order ident	Read only	Displays the order code of the device
	FW revision	Read only	Display the firmware version
	ENP version	Read only	Display the version of the electronic type plate
	Module ID	Read only	Display the module ID
	Manufact. ID	Read only	Display the manufacturer's ID
	Manufact. name	Read only	Display the manufacturer name

7 Calibration (Calibration menu)

7.1 General

Determining the relationship between the measured or expected value of the output variable and the corresponding true or correct value of the measured variable (input variable) for a measuring device under specified conditions.

During calibration, there is no intervention that changes the measuring instrument.

7.2 Device functions for calibration

Press the 'E' button during operation to call up the main menu. Use the '+' and '-' buttons to navigate through the available menus. When the desired menu is displayed, press the 'E' key to open the menu. Select the "x Back" option at the end of each menu/submenu to navigate one level higher in the menu structure.

Parameter		Configuration options	Description
Conductivity			Calibrate the conductivity measurement.
	C calib. start	Read only	
	k	Read only	Current cell constant
	C cal.	Numerical value 0 mS/cm	
	k	Read only	Newly calculated cell constant
	Save calib data?	Yes , No	Save or discard calibration data?
Temperature			Calibrate the temperature measurement.
	T cal. start	Read only	
	T cal.	Numerical value	
	Save calib data?	Yes , No	Save or discard calibration data?

7.2.1 Calibrate cell constant

A conductivity measurement system is always calibrated such that the exact cell constant is determined/verified using suitable calibration solutions. This method is described, for example, in the EN 7888 and ASTM D 1125 standards, each of which details the manufacture of a few calibration solutions. Another option is to obtain international calibration standards from government metrology authorities. This is particularly important in the pharmaceutical industry, where traceability of the calibration to internationally recognized standards is mandatory. To calibrate its test equipment, Endress+Hauser uses the SRM (Special Reference Material) of the US government agency NIST (National Institute of Standards and Technology).

Calibrating the cell constant

In the cell constant calibration, always use a defined conductivity reference solution with raw conductance values that are specified at the various temperatures. The correct calibration always takes place without temperature compensation.

Setting: In the menus, navigate to **Extended Setup → Input → T.comp.cal**: Select "off".

This switches off the temperature compensation for the calibration.

The new cell constant is calculated from the new conductivity reference solution.

The method for cell constant calibration is the same for conductive and inductive conductivity. Only the conductivity reference or standard solutions that are adapted to the measuring ranges may be used.

For the conductive sensors (CLS15D, CLS16D and CLS21D), standard solution CLY11-A 74.02 $\mu\text{S}/\text{cm}$, CLY11-B 149.75 $\mu\text{S}/\text{cm}$.

For the inductive sensor (CLS50D), standard solution CLY11-C 1.40 mS/cm , CLY11-D 12.65 mS/cm .

1. Press "E" to call up the main menu.
2. Press the "+" button to navigate to the "Calibration" menu.
3. Press "E" to open the menu.
4. Press "E" to open the "Cell const." submenu.
 - ✓ The current cell constant is displayed.
5. Remove the sensor from the measurement medium, flush with distilled water and dry.
6. Press "+" to enter the conductivity reference solution "cond. Ref."
 - ✓ Entering the value of the conductivity reference solution at the current temperature
7. Press "+".
 - ✓ "Insert sensor in med." is displayed.
8. Insert the sensor into the conductivity reference solution.
9. Press "+".
 - ✓ "wait for stable value" is displayed.
Display reads "wait for stable value", when the value is stable, the display switches to "New cell constant".
10. Press "+".
 - ✓ "Save Calib. Data" is displayed.
Press E and apply calibration data using "Yes".

8 Maintenance

No special maintenance work is required on the device.

9 Accessories

9.1 Sensors

Conductivity sensors, conductive

Condumax W CLS15D

- For measurement in pure and ultrapure water and in Ex applications
- Ordering according to product structure, see Technical Information TI109C/07/en

Condumax H CLS16D

- Hygienic sensor for measurement in pure and ultrapure water and in Ex applications
- With EHEDG and 3A certificates
- Ordering according to product structure, see Technical Information TI227C/07/en

Condumax W CLS21D

- Two-electrode sensor in fixed cable and plug-in head version
- Ordering according to product structure, see Technical Information TI085C/07/en

Conductivity sensors, inductive

Indumax CLS50D

- High-stability inductive conductivity sensor for standard, Ex and high-temperature applications
- Memosens technology
- Order as per product structure, see Technical Information TI182C/07/en

10 Troubleshooting

The following section provides you with an overview of possible causes of errors to provide you with an initial troubleshooting aid.

10.1 Troubleshooting instructions

WARNING

Danger from electrical voltage

- Do not operate the device for troubleshooting purposes while it is open!

Display	Cause	Remedy
No measured value display	No power supply connected	Check the power supply of the device.
	Power supply applied, device defective	The device must be replaced.
Diagnostic message is displayed	For the list of diagnostic messages, refer to the following section.	

10.2 Diagnostic messages

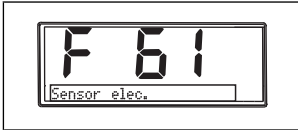
The diagnostic message consists of a diagnostic code and a message text.

The diagnostic code consists of an error category according to Namur NE 107 and a message number.

Error category (character front of message number)

- F = Failure, a malfunction has been detected.
The measured value of the respective channel is no longer reliable. The cause can be found at the measuring point. If a control system is connected, you should switch to manual operation.
- M = Maintenance required, action has to be taken as soon as possible.
Functionality of the measurement is fulfilled. No immediate measure needs to be taken. However, maintenance prevents possible future malfunction.
- C = Function check, wait loop (no error).
Maintenance is performed on the device. Wait for completion of the process.
- S = Out of specification, the measurement point is operated out of specification.
Measurement is still possible. However, operation takes place with risk of higher wear, shortened lifespan or lower measurement accuracy. The cause can be found at the measurement point.

Examples:



A0015896

F 61
sensor elec.



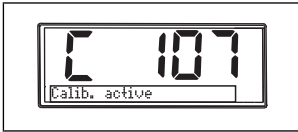
A0015897

M 915
USP warning



A0015898

S 844
Process value



A0015899

C 107
Calib. active

Diagnostic code	Message text	Description
F5	Sensor data	Sensor data invalid. Remedy: ■ Update date of the transmitter ■ Replace sensor
F12	Writing data	The sensor data could not be written. Remedy: ■ Repeat writing of the sensor data ■ Replace sensor
F13	Sensor type	Incorrect sensor type. Remedy: Switch to a sensor of the configured type.
F61	Sensor elec.	Sensor electronics defective. Remedy: ■ Replace sensor ■ Contact service
F62	Sens. Connect	Sensor connection. Remedy: ■ Replace sensor ■ Contact service

Diagnostic code	Message text	Description
F100	Sensor comm.	No sensor communication. Possible reasons: ■ No sensor connection ■ Faulty sensor connection ■ Short-circuit in the sensor cable ■ Short-circuit in the neighboring channel ■ Sensor firmware update canceled with an error Remedy: ■ Check sensor cable connection ■ Check sensor cable for short-circuit ■ Replace sensor ■ Restart firmware update ■ Contact service
F130	Sensor supply	Sensor check. Poor energy supply to sensor. Remedy: ■ Check cable connections ■ Replace sensor
F142	Sensor signal	Sensor check. No conductivity display. Possible reasons: ■ Sensor in air ■ Sensor defective Remedy: ■ Check sensor installation ■ Replace sensor
F143	Self test	Sensor self-test error. Remedy: ■ Replace sensor ■ Contact service
F152	No airset	Sensor data. No calibration data present Remedy: Carry out airset calibration
F523	Cell const.	Sensor calibration warning. Invalid cell constant, max. range reached. Remedy: ■ Recalibrate ■ Enter cell constant according to factory specifications ■ Replace sensor
F524	Cell const.	Sensor calibration alarm. Min. possible cell constant undershot. Remedy: ■ Recalibrate ■ Enter cell constant according to factory specifications

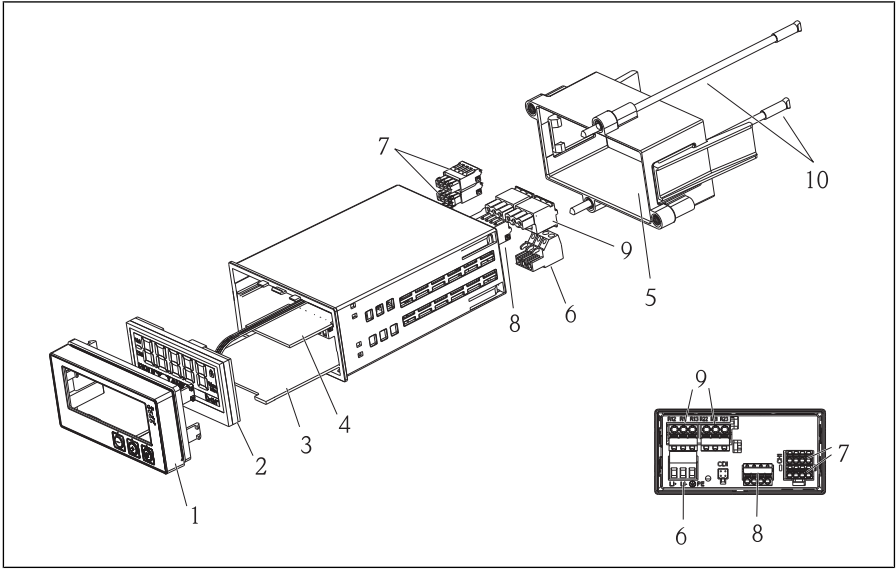
Diagnostic code	Message text	Description
F845	Device id	Faulty hardware configuration
F846	Param error	Faulty parameter checksum Possible cause: Firmware update Remedy: Reset parameters to factory defaults
F847	Couldn't save param	Parameters could not be saved
F848	Calib AO1	Faulty calibration values for analog output 1
F849	Calib AO2	Faulty calibration values for analog output 2
F904	Process check	Process check system alarm. No change in measurement signal for a long time. Possible reasons ■ Sensor dirty or in air ■ No sensor inflow ■ Sensor defective ■ Software error Remedy: ■ Check measuring chain ■ Inspect sensor ■ Carry out software restart

Diagnostic code	Message text	Description
C107	Calib. active	Sensor calibration is active. Remedy: Wait for calibration
C154	No calib. data	Sensor data. No calibration data present, factory settings will be used. Remedy: ■ Check calibration information of the sensor ■ Calibrate cell constant
C850	Simu AO1	Simulation of analog output 1 is active
C851	Simu AO2	Simulation of analog output 2 is active
C852	Simu DO	Simulation of status output is active
C853	Download act.	Parameter transmission is active

Diagnostic code	Message text	Description
S844	Process value	Measured value outside the specified range. Possible reasons: ■ Sensor in air ■ Air cushion in the assembly ■ Incorrect sensor inflow ■ Sensor defective Remedy: ■ Increase process value ■ Check measuring chain ■ Change sensor type
S910	Limit switch	Limit switch energized

Diagnostic code	Message text	Description
M500	Not stable	Sensor calibration canceled. Main measured value unsteady. Possible reasons: ■ Sensor overaged ■ Sensor temporarily dry ■ Buffer value not constant Remedy: ■ Check sensor, replace if required ■ Check buffer
M526	Cell const.	Sensor calibration warning. Invalid cell constant, max. range reached. Remedy: ■ Recalibrate ■ Enter cell constant according to factory specifications ■ Replace sensor
M528	Cell const.	Sensor calibration warning. Min. possible cell constant undershot. Remedy: ■ Recalibrate ■ Enter cell constant according to factory specifications
M914	USP alarm	USP alarm. Conductivity limit value for USP exceeded. Remedy: Check process
M915	USP warning	USP warning. Conductivity limit value for USP undershot. Remedy: Check process

10.3 Spare parts



A0015745

6 Spare parts of the device

Item no.	Description	Order no.
1	Housing front + foil, incl. keyboard CM14, without display	XPM0004-DA
2	CPU/Display board CM14 conductivity conductive CPU/Display board CM14 conductivity inductive	XPM0004-CK XPM0004-CL
3	Mainboard 24-230VDC/AC, CM14	XPM0004-NA
4	Relay board + 2 limit relays	RIA45X-RA
5	Fixing frame for housing W07	71069917
6	Terminal, 3-pole (power supply)	50078843
7	Pluggable terminal, 4-pole (Memosens input)	71037350
8	Pluggable terminal, 4-pole (current output)	71075062
9	Pluggable terminal, 3-pole (relay terminal)	71037408
10	Threaded bar for tube fixing clip 105mm	71081257

10.4 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.



Please enclose a note describing the fault and the application when sending the unit in for repair.

10.5 Disposal

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

11 Technical data

11.1 Input

11.1.1 Measured variables

—> Documentation of the connected sensor

11.1.2 Measuring ranges

—> Documentation of the connected sensor

11.1.3 Input types

Digital sensor inputs, Memosens and Memosens protocol

11.1.4 Cable specification

Cable type

Memosens data cable or fixed sensor cable, each with cable end sleeves

Cable length

Max. 100 m (330 ft)

11.2 Output

11.2.1 Output signal

2 x 0/4 to 20 mA active, potentially isolated from the sensor circuits and from each other

11.2.2 Load

Max. 500 Ω

11.2.3 Linearization/transmission behavior

Linear

11.2.4 Alarm output

The alarm output is designed as an "open collector." In normal operation the alarm output is closed. In the event of a fault (F-fault, device without current) the "open collector" opens.

Current max. 200 mA

Voltage max. 30 V DC

11.3 Current outputs, active

11.3.1 Span

0 to 23 mA

11.3.2 Signal characterization

Linear

11.3.3 Electrical specification

Output voltage

Max. 24 V

11.3.4 Cable specification

Cable type

Recommendation: shielded line

Cross-section

Max. 1.5 mm² (16 AWG)

11.4 Relay outputs

11.4.1 Relay types

2 changeover contacts

11.4.2 Relay switching capacity

Max. 3 A24 V DC

Max. 3 A253 V AC

Min. 100 mW (5 V / 10 mA)

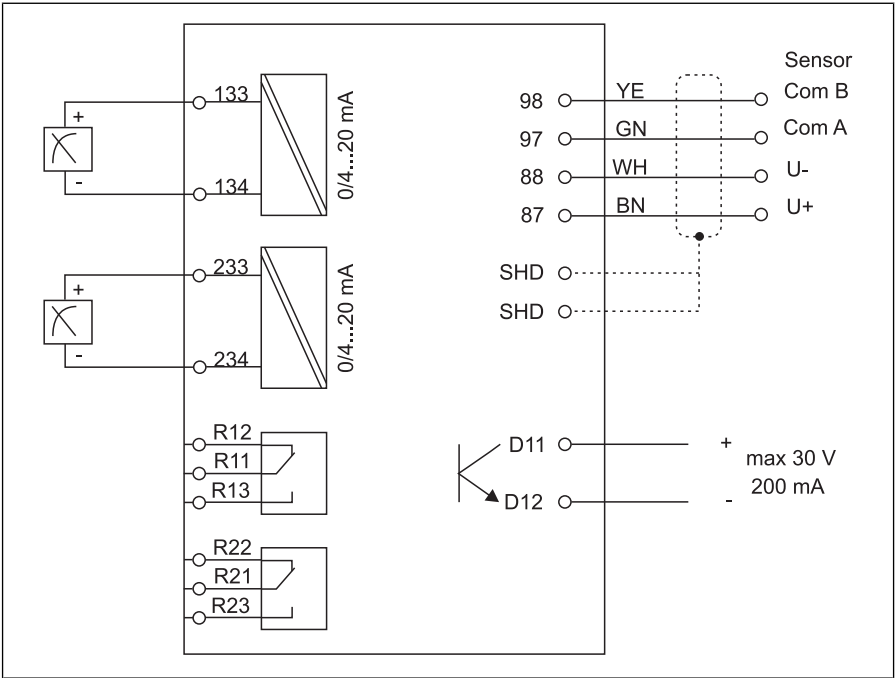
11.4.3 Cable specification

Cross-section

Max. 2.5 mm² (14 AWG)

11.5 Wiring

11.5.1 Electrical connection



A0015303

Connection	Description
87	Terminal for Memosens cable, brown, sensor power supply U+
88	Terminal for Memosens cable, white, sensor power supply U-
97	Terminal for Memosens cable, green, Com A
98	Terminal for Memosens cable, yellow, Com B
SHD	Terminal for Memosens cable, shield
D11	Terminal for alarm output, +
D12	Terminal for alarm output, -
L/+	Terminal for transmitter supply voltage
N/-	
⊕PE	
133	Terminal for analog output 1, +

Connection	Description
134	Terminal for analog output 1, -
233	Terminal for analog output 2, +
234	Terminal for analog output 2, -
R11, R12, R13	Terminal for relay 1
R21, R22, R23	Terminal for relay 2

11.5.2 Supply voltage

Wide-range power supply 24 to 230 V AC/DC (-20 % / +10 %) 50/60Hz



The device does not have a power switch

- The customer has to provide a protected circuit breaker close to the device.
- The disconnecter must be a switch or power-circuit breaker and must be identified as a disconnecter for the device.

11.5.3 Power consumption

Max. 13.8 VA / 6.6 W

11.6 Performance characteristics

11.6.1 Response time

Current outputs

t_{90} = max. 500 ms for a jump from 0 to 20 mA

11.6.2 Reference temperature

25 °C (77 °F)

11.6.3 Maximum measured error of inputs

—> Documentation of the connected sensor

11.6.4 Resolution of current output

> 13 bit

11.6.5 Repeatability

—> Documentation of the connected sensor

11.7 Installation

11.7.1 Installation instructions

Mounting location

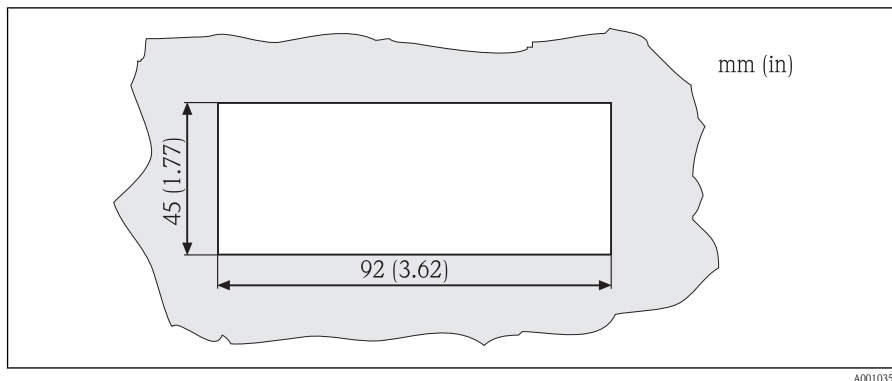
Panel, cutout 92 x 45 mm (3.62 x 1.77 in)

Max. panel thickness 26 mm (1 in)

Orientation

The orientation is determined by the readability of the display.

Max. viewing angle range $\pm 45^\circ$ from the central display axis in every direction.



A0010351

 7 Panel cutout

11.8 Environment

11.8.1 Ambient temperature range

-10 to +60 °C (14 to 140 °F)

11.8.2 Storage temperature

-40 to +85 °C (-40 to +185 °F)

11.8.3 Operating height

< 2000 m (6561 ft) above MSL

11.8.4 Electromagnetic compatibility

Emitted interference and interference immunity to EN 61326-1:2006, Class A for industrial areas

11.8.5 Degree of protection

Front

Front IP65 / NEMA 4X

Tube

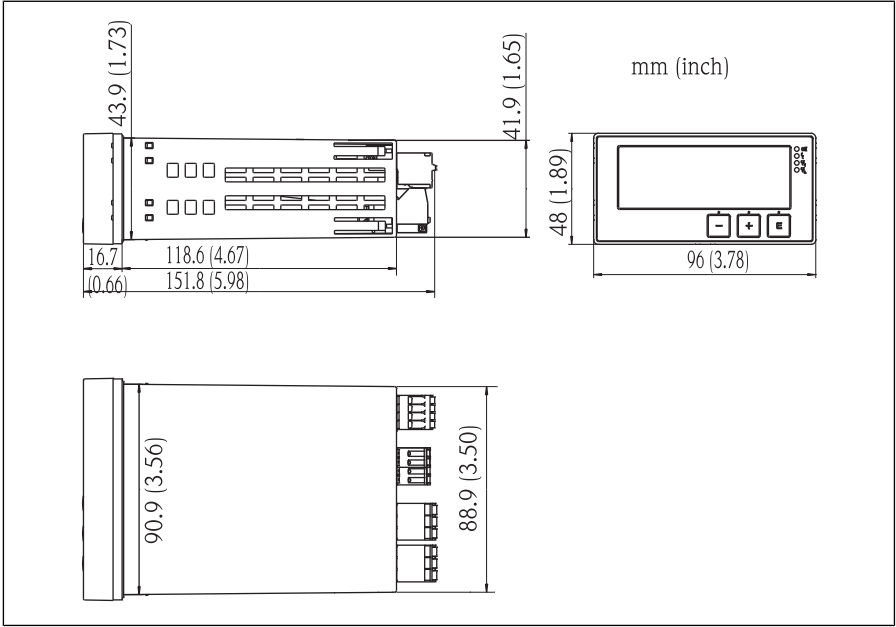
Shock protection IP20

11.8.6 Relative humidity

5 to 85 %, non-condensing

11.9 Mechanical construction

11.9.1 Dimensions



8 Dimensions of the transmitter

11.9.2 Weight

0.3 kg (0.66 lbs)

11.9.3 Material

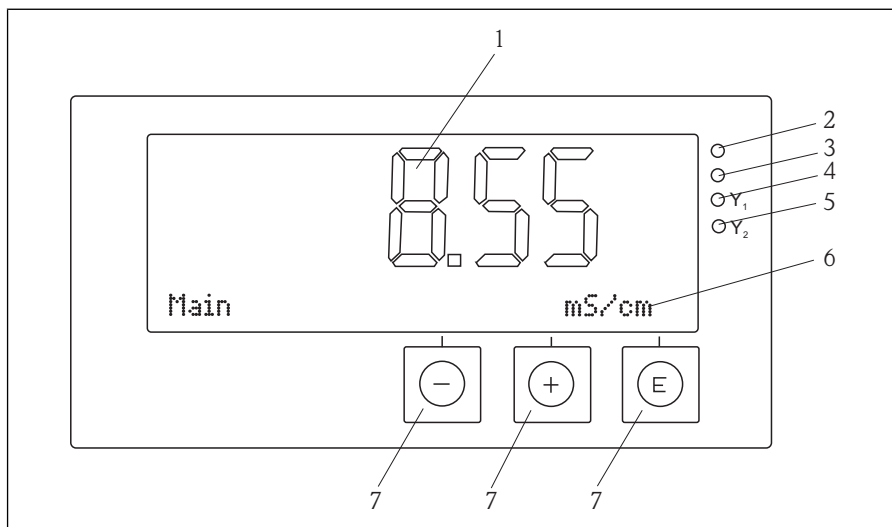
Housing, tube:	Polycarbonate
Front foil:	Polyester, UV-resistant

11.9.4 Terminals

Max. 2.5 mm² (22-14 AWG; torque 0.4 Nm (3.5 lb in)) line, relay

11.10 Display and operating elements

11.10.1 Operating elements



A0018699

9 Display and operating elements

- 1 LC display for measured values and configuration data
- 2 Status LED power supply connected
- 3 Status LED alarm function
- 4 Status LED limit function relay 1
- 5 Status LED limit function relay 2
- 6 Dot matrix display for dimensions and menu items
- 7 Operating keys

11.11 Certificates and approvals

11.11.1 mark

Declaration of Conformity

The product fulfills the requirements of harmonized European standards.

Thus it fulfills the legal requirements of the EC Directives.

The manufacturer confirms successful testing of the device by affixing to it the  mark.

Other standards and guidelines

- IEC 60529:
Degree of protection by housing (IP code)
- IEC 61010-1: 2001 Cor 2003
Safety requirements for electrical equipment for measurement, control and laboratory use

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