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02.01 (device version)

Operating Instructions
Liquiline CM14

Four-wire transmitter with Memosens input for pH and ORP

Endress+Hauser
People for Process Automation

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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 have been observed.

1.1 Workplace safety

When working on and with the device:
- Wear the required personal protective equipment as per 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 only if it is in proper technical condition, free from errors and faults.
- The operator is responsible for the interference-free operation of the device.

Modifications to the device

Unauthorized modifications to the device are not permitted and can lead to unforeseeable dangers!
- If modifications are nevertheless required, consult with the manufacturer.

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 the repair of an electrical device.
- Use only original spare parts and accessories.

1.4 Intended use

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

- The manufacturer accepts no liability for damages resulting from incorrect use or use other than that intended. It is not permitted to convert or modify the device in any way.
- The device is designed for installation in a panel and must 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 any special announcement. Please contact your sales center for information on modifications or updates to the 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 may only be carried out by your supplier's service organization.

When returning the device for repair, enclose a note with a description of the problem and the application.

1.7 Notes on safety conventions and icons

1.7.1 Safety information

⚠ DANGER

Causes (/consequences)
Consequences of non-compliance (if applicable)
- ▶ Protective measure
- ▶ This symbol alerts you to a dangerous situation. Failure to avoid this situation will result in serious or fatal injury.

⚠ WARNING

Causes (/consequences)
Consequences of non-compliance (if applicable)
- ▶ Protective measure
- ▶ This symbol alerts you to a dangerous situation. Failure to avoid the situation can result in serious or fatal injury.

⚠ CAUTION

Causes (/consequences)
Consequences of non-compliance (if applicable)
- ▶ Protective measure
- ▶ This symbol alerts you to a dangerous situation. Failure to avoid this situation can result in moderate or minor injuries.

NOTICE

Causes (/consequences)

Consequences of non-compliance (if applicable)

- ▶ Protective measure
- ▶ This symbol alerts you to situations which may result in damage to property.

1.7.2 Document symbols

✓	Permitted Indicates procedures, processes or actions that are permitted.
✓✓	Preferred Indicates procedures, processes or actions that are preferred.
✗	Forbidden Indicates procedures, processes or actions that are forbidden.
	Additional information, tips
	Reference to documentation
	Reference to a page in this manual
	Reference to a graphic

2 Incoming acceptance and product identification

2.1 Incoming acceptance

Proceed as follows on receipt of the device:

1. Check whether the packaging is intact.
2. If damage is discovered:
   Report all damage immediately to the manufacturer.
3. Do not install damaged material, as the manufacturer cannot otherwise guarantee compliance with the safety requirements and cannot be held responsible for the consequences that may result.
4. Compare the scope of delivery to the contents of the order.
5. Remove all the packaging material used for transportation.

2.2 Product identification

The following options are available for identification of the device:

- Nameplate specifications
- Extended order code with breakdown of the device features on the delivery note

2.2.1 Nameplate

The right device?

Check the information on the nameplate of the device:
- Product name and manufacturer ID
- Order code, extended order code and serial number
- Power supply and power consumption
- Approvals
- Temperature range
- Firmware version and device revision

2.2.2 Name and address of manufacturer

Name of manufacturer:	Endress+Hauser Conducta GmbH+Co. KG
Address of manufacturer:	Dieselstraße 24, D-70839 Gerlingen

2.3 Certificates and approvals

For certificates and approvals valid for the device: see the data on the nameplate

2.3.1 Other standards and guidelines

- IEC 60529:
  Degrees of protection provided by enclosures (IP code)
- IEC 61010-1:
  Safety requirements for electrical equipment for measurement, control and laboratory use
- EN 60079-11:
  Explosive atmospheres - Part 11: Equipment protection by intrinsic safety "I" (optional)

2.4 Storage and transport

Please note the following:
The permitted storage temperature is –40 to 85 °C (–40 to 185 °F); it is possible to store the device at borderline temperatures for a limited period (48 hours maximum).

Pack the device for storage and transportation in such a way that it is reliably protected against impact and external influences. The original packaging offers the best protection.

Avoid the following environmental influences during storage and transport:
- Direct sunlight
- Vibration
- Aggressive media

3 Mounting

3.1 Installation conditions

NOTICE

Overheating due to buildup of heat in the device

▶ To avoid heat buildup, please always ensure that the device is sufficiently cooled.

Operating the display in the upper temperature limit range decreases the operating life of the display.

The transmitter is designed for use in a panel.

The orientation is determined by the readability of the display. The connections and outputs are provided on the rear. The cables are connected via coded terminals.

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

3.2 Dimensions

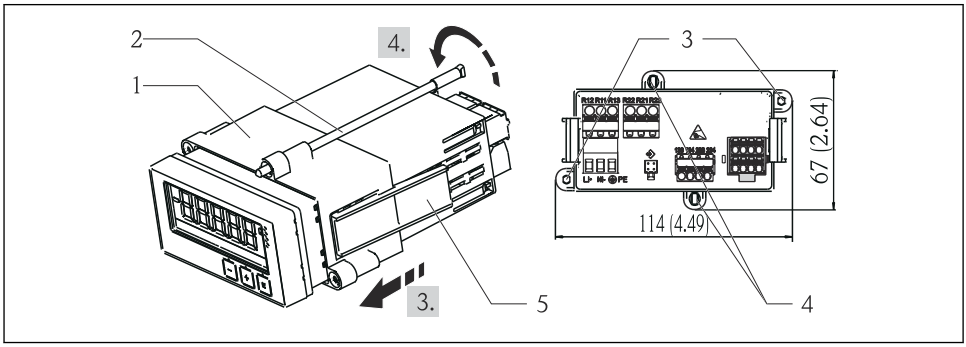
Observe the installation depth of 150 mm (5.91 ") for the device incl. terminals and fastening clips.

More dimensions can be found in the "Technical data" section → 🖹 32.

- 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.

3.3 Mounting procedure

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



1 Installation in a 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 casing in the panel, hold the device level and push the mounting frame (item 1), with the threaded rods screwed in, over the casing until the frame locks into position.
4. Tighten the threaded rods to fix the device in place.

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

3.4 Post-installation check

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

4 Electrical connection

4.1 Connection conditions

⚠ WARNING

Danger! Electric voltage!

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

Danger if protective ground is disconnected

► The protective ground connection must be established before all other connections.

NOTICE

Cable heat load

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

Incorrect supply voltage can damage the device or cause malfunctions

► Before commissioning the device, make sure that the supply voltage matches the specifications on the nameplate (bottom side of the housing).

Check emergency shutdown for device

► Provide suitable switch or circuit breaker in building installation. This switch must be provided close to the device (within easy reach) and marked as a circuit breaker.

Protect the device from overload

► Provide overload protection (nominal current = 10 A) for power cable.

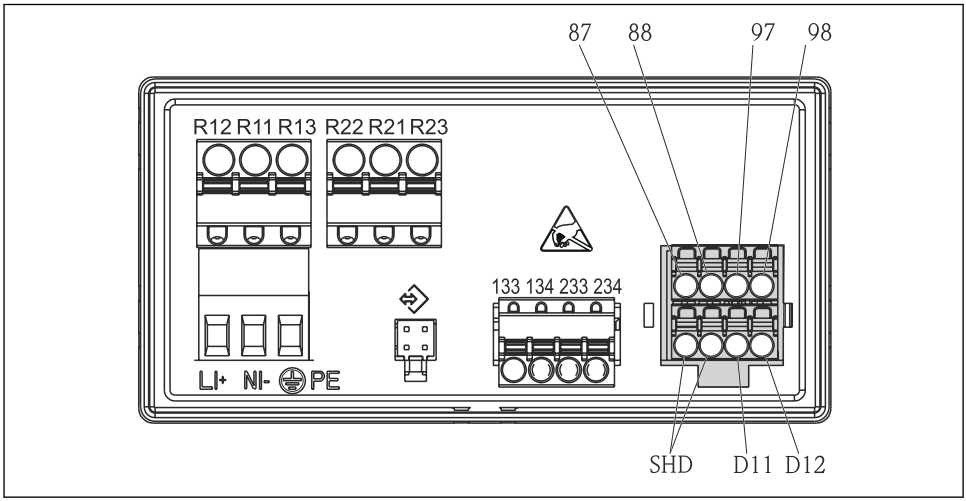
Incorrect wiring may result in the device being destroyed

► Note terminal designation on the rear of the device.

Energy-rich transients in the case of long signal lines
► Connect a suitable overvoltage protection in series upstream.

The mixed connection of safety extra-low voltage and dangerous contact voltage to the relay is permitted.

4.2 Connecting the transmitter



2 *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, -

Terminal	Description
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

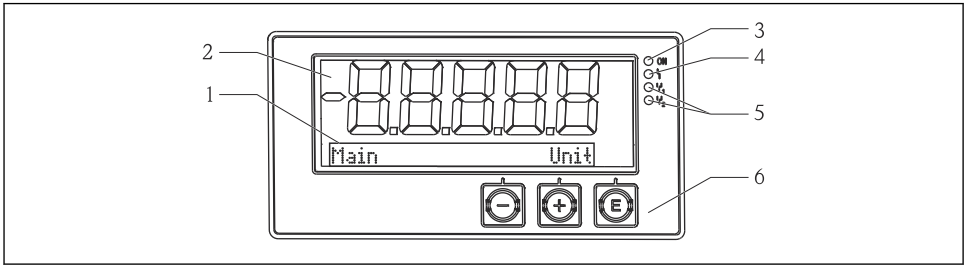
4.3 Post-connection check

Device condition and specifications	Notes
Are cables or the device 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 terminals firmly engaged in their correct slot? Is the coding on the individual terminals correct?	-
Are the mounted cables strain-relieved?	-
Are the power supply and signal cables correctly connected?	See connection diagram, → 2, 10 and on the housing.

5 Operation

The device's simple operating concept enables you to perform commissioning for many applications without the need for hardcopy operating instructions.

5.1 Display and device status indicator / LED



3 Device display

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

The device offers users a backlit LC display which is divided into two sections. The segment section displays the measured value.

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

The parameters for configuring the display are explained in detail in the "Commissioning" section.

In the event of an error, the device automatically switches between displaying the error and displaying the channel, see the "Device diagnostics" → 20 and "Troubleshooting" → 25 sections.

5.2 Local operation at the device

The device is operated using the three keys integrated in the front of the device

	▪ Open the Configuration menu ▪ Confirm an entry ▪ Select a parameter or submenu offered in the menu
	Within the Configuration menu: ▪ Gradually scroll 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 minimum and maximum values, for all the active channels.

You can always exit menu items / submenus by selecting "x Back" at the end of the menu.

Leave the setup directly without saving the changes by pressing the '-' and '+' keys simultaneously for longer (> 3 s).

5.3 Icons

5.3.1 Display symbols

⧗	Hold function → 🖹 14 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 measured value is displayed.
🔒	The device is locked / operator lock; the device setup is locked for changes to parameters; the display can be changed.

The error and the channel identifier (TAG) are specified in the dot matrix section.

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 setup
	Symbol for expert setup
	Symbol for diagnostics
✓	Accept entry. If this symbol is selected, the entry is applied at the position specified by the user, and you quit editing mode.

✗	Reject entry. If this symbol is selected, the entry is rejected and you quit editing mode. The previously set text remains.
←	Jump one position to the left. If this symbol is selected, the cursor jumps one position to the left.
⌫	Delete backwards. If this symbol is selected, the character to the left of the cursor position is deleted.
C	Delete all. if this symbol is selected, the entire entry is deleted.

5.4 Operating functions

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

Display	Settings for the device display: contrast, brightness, time for alternating measured values on the display
Setup	Device settings A description of the individual settings is provided in the "Commissioning" section → 🖹 14.
Calibration	Execution of the sensor calibration A description of the functions for calibration is provided in the "Calibration" section.
Diagnostics	Device information, diagnostics logbook, sensor information, simulation

5.5 Hold function

The hold function causes the current outputs and relay states to "freeze". This function can be switched on and off manually (menu **Setup** → **Manual hold**). In addition, the hold function is automatically activated during sensor calibration.

When the hold condition no longer applies, the hold function continues to be active for the configurable hold release time. The hold release time is configured in the menu **Setup** → **Extended setup** → **System** → **Hold release**.

The hold function does not affect the display of the measured value. The hold symbol is also displayed after the measured value.

6 Commissioning

6.1 Post-installation check and switching on the device

Make sure that all post-connection checks have been carried out before putting your device into operation:
- Checklist for "post-installation check", → 🖹 9.
- Checklist for "post-connection check", → 🖹 11.

After the operating voltage is applied, the green LED lights up and the display indicates the device is ready for operation.

If you are commissioning the device for the first time, program the setup as described in the following sections of the Operating Instructions.

If you are commissioning a device that is already configured or preset, the device starts measuring immediately as defined in the settings. The values of the channels currently activated are shown on the display.

Remove the protective film from the display as this would otherwise affect the readability of the display.

6.2 Display settings (Display menu)

You can access the main menu by pressing the 'E' key during operation. The Display menu appears on the display. Press the 'E' key again to open the menu. Use the "x Back" option, which can be found at the bottom of each menu/submenu, to move up one level in the menu structure.

Parameter	Possible settings	Description
Contrast	1-7 Default: **6**	Setting for the display contrast.
Brightness	1-7 Default: **6**	Setting for the brightness of the display.
Alternating time	0, 3, **5**, 10 sec	Switching time between the two measured values. 0 means that the values do not alternate on the display.

6.3 Notes on setup access protection

Access to the Setup, Diagnostics and Calibration is enabled by default (factory setting) and can be locked via the setup settings.

Proceed as follows to lock the device:

1. Press **E** to enter the configuration menu.
2. Press **+** repeatedly until **Setup** is displayed.
3. Press **E** to open the **Setup** menu.
4. Press **+** repeatedly until **Extended Setup** is displayed.
5. Press **E** to open the **Extended Setup** menu; **System** is displayed.
6. Press **E** to open the **System** menu.
7. Press **+** repeatedly until **Access code** or **Calib Code** is displayed.
8. Press **E** to open the setting for access protection.
9. Set the code: press the **+** and **-** buttons to set the desired code. The access code is a four-digit number. The corresponding position of the number is displayed in plain text. Press **E** to confirm the value entered and go to the next position.

10. Confirm the last position of the code to exit the menu. The full code is displayed. Press **+** to scroll back to the last item of the **x Back** submenu and confirm this item. By confirming the point, the value is adopted and the display returns to the **Setup** level. Again select the last parameter **x Back** to also exit this submenu and return to the measured value/channel display level.

Once access protection has been successfully activated, the lock symbol appears on the display.

To lock the calibration menu, the **Access Code** and the **Calib Code** must be activated.

This makes it possible to implement a role concept (administrator/maintenance staff) for operating the device.

Administrator role: Access to all menus (Setup, Diagnostics, Calibration) once the **Access Code** is entered.

Role of maintenance staff: Access to the Calibration menu once the **Calib Code** is entered.

If only the **Access Code** is activated, the Setup and Diagnostics menus are locked. Access to the remaining menus (including calibration) is enabled.

The **x Back** item at the end of every picklist/menu item takes the user from the submenu to the next menu level up.

If access protection is enabled, the device locks automatically after 600 seconds without operation. The display switches back to the operating display.

To enable the setup, set the setup access code in the **System** Setup to **0000** or delete the code by pressing **C**.

If you lose/misplace the code, a reset can only be performed by the Service Department.

6.4 Configuration of the device (Setup menu)

You can access the main menu by pressing the 'E' key during operation. Navigate through the available menus with the '+' and '–' keys. When the desired menu is displayed, press the 'E' key to open the menu. Use the "x Back" option, which can be found at the bottom of each menu/ submenu, to move up one level in the menu structure.

The Setup menu contains the most important settings for the operation of the device.

Parameter	Possible settings	Description
Current range	**4-20 mA** 0-20 mA	Configuration of the measuring range for the current output.
Out 1 0/4 mA	Numerical value 0.000 to 99 999 **0.0 pH**	Physical value which corresponds to the lower range limit of the analog output. When the configured value is undershot, the current output is set to the saturation current of 0/3.8 mA.

Parameter	Possible settings	Description
Out 1 20 mA	Numerical value 0.000 to 99 999 **12 pH**	Physical value which corresponds to the upper range limit of the analog output. When the configured value is exceeded, the current output is set to the saturation current of 20.5 mA.
Out 2 0/4 mA	Numerical value −50 to 250 °C **0 °C**	Temperature which corresponds to the measuring range lower limit of the temperature input. When the configured value is undershot, the current output is set to the saturation current of 0/3.8 mA.
Out 2 20 mA	Numerical value −50 to 250 °C **100 °C**	Temperature which corresponds to the measuring range upper limit of the temperature input. When the configured value is exceeded, the current output is set to the saturation current of 20.5 mA.
Damping main	0 to 60 s **0 s**	Configuration of the damping for 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 section, → 17.
Manual hold	**Off**, On	Function for freezing the current and relay outputs

6.5 Extended configuration (Extended setup menu)

You can access the main menu by pressing the 'E' key during operation. Use the '+' key 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. Use the "x Back" option, which can be found at the bottom of each menu/submenu, to move up one level in the menu structure.

Parameter		Possible settings	Description
System			General settings
	Device tag	User-defined text Max. 16 characters	Use this function to enter the device tag.
	Temp. unit	**°C** °F	Configuration of the temperature unit
	Hold release	0 to 600 s **0 s**	Sets the time by which a device hold is extended after the hold condition is discontinued.
	Alarm delay	0 to 600 s **0 s**	Delay time for outputting an alarm. This suppresses alarm conditions that are present for a period that is shorter than the alarm delay time.

Parameter			Possible settings	Description
	Access code		0000...9999 Default: **0000**	User code to protect the device configuration. **Additional information:** 0000 = user code protection is disabled
	Calib Code		0000...9999 Default: **0000**	User code to protect the calibration function. **Additional information:** 0000 = user code protection is disabled
Input				Input settings
	Main value		**pH** mV	Unit of the physical value.
	Format		None (pH only) **One** Two	Number of places after decimal point for the display.
	Damping main		0 to 60 s **0 s**	Configuration of the damping for low-pass filtering of the input signals.
	Temp. comp.		Off **Automatic** Manual	Configuration of the temperature compensation. Only visible for **Main value** = **pH**
	Temp. offset		Numerical value: −50 to 250 °C **0 °C**	Configuration of a temperature offset. Only visible for **Main value** = **mV**
	Ref. temp.		Numerical value: −5.0 to 100 °C **25 °C**	Configuration of the reference temperature. Only visible for **Main value** = **pH** and **Temp. comp.** = **Manual**.
	Calib. settings			Settings for calibration
		Buffer 1	2.00 pH 4.00 pH **7.00 pH** 9.00 pH 9.18 pH 10.00 pH 12.00 pH	pH value of buffer solution 1. Only visible for **Main value** = **pH**
		Buffer 2	2.00 pH **4.00 pH** 7.00 pH 9.00 pH 9.18 pH 10.00 pH 12.00 pH	pH value of buffer solution 2. Only visible for **Main value** = **pH**
		Buffer mV	Numerical value **100 mV**	mV value for buffer solution. Only visible for **Main value** = **mV**
	Stability crit.			
		Delta mV	1 to 10 mV **1 mV**	
		Duration	10 to 60 s **20 s**	

Parameter			Possible settings	Description
	Process check			Checks the process settings
		Function	On, **Off**	Switch on the process check.
		Inactive time	1 to 240 min **60 min**	Duration of the process check
Analog outputs				Settings for analog outputs
	Current range		**4-20 mA** 0-20 mA	Current range for analog output
	Out 1 0/4 mA		Numerical value 0.000 - 99999 **0.0 pH**	Physical value which corresponds to the lower range limit of the analog output.
	Out 1 20 mA		Numerical value 0.000 - 99999 **12 pH**	Physical value which corresponds to the upper range limit of the analog output.
	Out 2 0/4 mA		Numerical value −50 to 250 °C **0 °C**	Temperature which corresponds to the measuring range lower limit of the temperature input.
	Out 2 20 mA		Numerical value −50 to 250 °C **100 °C**	Temperature which corresponds to the measuring range upper limit of the temperature input.
	Damping main value		0 to 60 s **0 s**	Configuration of the damping for low-pass filtering of the input signals.
Relay 1/2				Settings for the relay outputs.
	Function		**Off**, Min limit, Max limit, In band, Out band, Error	Configuration of the relay function. If Function = **Error**, no additional settings are possible.
	Assignment		**Main**, Temp	Assignment of the relay to the main input or temperature input
	Set point		Numerical value **0.0**	Setting for the limit value.
	Set point 2		Numerical value **0.0**	Only for the **In band** or **Out band** function.
	Hyst.		Numerical value **0.0**	Configuration of the hysteresis.
	Delay time		0 to 60 s **0 s**	Configuration of the delay time until the relay switches.
Factory default				Resets the device settings to the factory default settings.
	Please confirm		**no**, yes	Confirm the reset.

6.5.1 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 limit value is entered as a numerical value including the decimal position. The mode of operation of the relays as normally open or normally closed is determined by the wiring of the changeover contact (→ 34). Limit values are always assigned to a relay. Each relay can be assigned to a channel or a calculated value. In the "Error" mode, the relay functions as an alarm relay and switches each time a fault or alarm occurs.

The following settings can be made for each of the 2 limit values: assignment, limit, hysteresis, switching behavior, delay and failure mode.

6.6 Device diagnostics (Diagnostics menu)

You can access the main menu by pressing the 'E' key during operation. Navigate through the available menus with the '+' and '–' keys. When the desired menu is displayed, press the 'E' key to open the menu. Use the "x Back" option, which can be found at the bottom of each menu/ submenu, to move up one level in the menu structure.

Parameter		Possible settings	Description
Current diag.		Read only.	Displays the current diagnostic message
Last diag.		Read only.	Displays the last diagnostic message
Diagnost logbook		Read only	Displays the last diagnostic messages
Device info		Read only.	Displays the device information
	Device tag	Read only.	Displays the device tag
	Device name	Read only.	Displays 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.	Displays the firmware version
	ENP version	Read only.	Displays the version of the electronic nameplate
	Module ID	Read only.	Displays the module ID
	Manufact. ID	Read only.	Displays the manufacturer ID
	Manufact. name	Read only.	Displays the manufacturer name

7 Calibration and adjustment

7.1 Definitions

7.1.1 Calibration (as per DIN 1319):

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.

7.1.2 Adjustment

An adjustment corrects the value displayed by a measuring device, in other words the measured/displayed value (the actual value) is corrected so that the reading agrees with the correct, set value.

The value determined during calibration is used to calculate the correct measured value and saved in the sensor.

7.2 pH sensors

The pH value is calculated using the Nernst equation

pH = -lg(aH+), aH+ ... activity of the hydrogen ions

Ui ... raw measured value in mV

U0 ... zero point (=voltage at pH 7)

R ... relative gas constant (8.3143 J/molK)

T ... temperature [K]

F ... Faraday constant (26.803 Ah)

The slope of the Nernst equation (−2.303 RT/F) is known as the **Nernst factor** and is −59.16 mV/pH at 25 °C (77 °F).

The smaller the slope, the less sensitive the measurement, and the accuracy deteriorates particularly in the low measuring range.

The calibration provides important information on the condition of your sensor and the quality of the pH measurement.

The service life of a pH glass electrode is limited. One of the reasons for this is the deterioration and aging of the pH-sensitive membrane glass. This aging causes the gel-like layer to change and become thicker over time.

Symptoms of aging include:
- Higher membrane resistance
- Slow response
- Decrease in the slope

To ensure a high level of accuracy, it is important to readjust the pH sensors at set intervals.

The calibration interval depends heavily on the area of application of the sensor, as well as the required level of accuracy and reproducibility. The calibration interval can vary between weekly and once every few months.

Two-point calibration is the preferred method for pH sensors, particularly in the following applications:
- Municipal and industrial wastewater
- Natural waters and drinking water
- Boiler feedwater and condensates
- Beverages

Calibrating with buffers with pH 7.0 and 4.0 is recommended for most applications.

You use calibration buffers to perform two-point calibration. The quality buffers supplied by Endress+Hauser are certified and measured in an accredited laboratory. The accreditation (DAR registration number "DKD-K-52701") confirms that the actual values and the maximum deviations are correct and traceable.

To calibrate the sensor, remove it from the medium and calibrate it in the laboratory. Since Memosens sensors save the data, you can always work with "precalibrated" sensors and do not have to stop monitoring the process to perform a calibration.

Calibration of a pH glass electrode:

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.
   ↳ Display reads "pH glass".
4. Press "E" to open the menu.
   ↳ Display reads "pH (act)".
5. Press "+".
   ↳ Display reads "Insert sensor".
6. Remove the glass electrode from buffer 1, rinse with distilled water, dry and immerse in buffer 2.
7. Press "+".
8. Display reads "wait for stable value", when the value is stable, the display changes.
   ↳ Display for buffer 2 value, "pH Buffer 2".
9. Press "+".
   ↳ Display reads "Save Calib. Data?"
10. Press "+".
    ↳ Display reads "Calib. successful".
11. Press "+".

Return to measuring operation

The calibration is not completed successfully or is canceled and is not valid.
Possible reasons:
- The sensor is old or contaminated. As a result, the permitted limit values for the slope and/or zero point are exceeded.
  - Clean the sensor
  - Regenerate or replace the sensor
- The measured value or temperature is not stable. As a result, the stability criterion is not met.
  - Keep the temperature constant during calibration.
  - Replace the buffer.
  - The sensor is old or contaminated. Clean or regenerate.

To calibrate the sensor, you can also remove it from the medium and calibrate it in the laboratory. Since Memosens sensors save the data, you can always work with "precalibrated" sensors and do not have to stop monitoring the process to perform a calibration.

7.3 ORP sensors

7.3.1 Single-point calibration

The buffers contain ORP pairs with a high exchange current density. Such buffers have the advantage of higher accuracy levels, better reproducibility and faster measurement response times.

Temperature compensation does not take place when measuring the ORP since the thermal behavior of the medium is not known. The temperature is indicated with the measurement result, however.

With this type of calibration, you work with calibration buffers, e.g. ORP buffers from Endress +Hauser.

Calibration of an ORP sensor

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.
   ↳ Display reads "mV (act)".
4. Remove the ORP electrode from the measurement medium, flush with distilled water, dry it and immerse it in the ORP buffer.
5. Press "+".
   ↳ Display reads "Insert sensor in med.".
6. Press "+".
   ↳ Display reads "wait for stable value".
7. The current status of the ORP buffer appears on the display.
8. Press "+".
   ↳ Display reads "Save Calib. Data?"

9. Press "E" and select "yes" to confirm.
10. Remove the sensor from the measurement medium, flush with distilled water, dry it and place it back into the measurement medium.

To calibrate the ORP sensors, you can also remove them from the medium and calibrate them in the laboratory.

Since Memosens sensors save the data, you can always work with "precalibrated" sensors and do not have to stop monitoring the process for extended periods to perform a calibration.

7.4 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
pH glass			Calibrate the pH measurement.
	Calib. start	Read only	
	pH act.	Read only	Displays the current pH value
	pH Buffer 1	Numerical value pH	Displays the buffer value measured
	pH Buffer 2	Numerical value pH	Displays the buffer value measured
	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?

8 Maintenance

No special maintenance work is required for the device.

8.1 Cleaning

A clean, dry cloth can be used to clean the device.

9 Accessories

9.1 Sensors

Glass electrodes for pH measurement

Orbisint CPS11D
- pH electrode for process engineering, with dirt-repellent PTFE junction
- Memosens technology
- Order as per product structure, see Technical Information (TI00028C/07/en)

Orbipore CPS91D
- pH sensor with Memosens technology
- Open aperture junction for media with high dirt load
- Order depending on version, see Technical Information (TI00375C/07/en)

Orbipac CPF81D
- pH compact sensor for installation or immersion operation in industrial water and wastewater
- Order as per product structure, see Technical Information (TI00191C/07/EN)

ORP sensors

Orbisint CPS12D
- ORP sensor with Memosens technology
- Dirt-repellent PTFE junction
- Order depending on version, see Technical Information (TI00367C/07/en)

Orbipore CPS92D
- ORP sensor with Memosens technology
- Open aperture junction for media with high dirt load
- Order depending on version, see Technical Information (TI00435C/07/en)

Orbipac CPF82D
- ORP compact sensor for installation or immersion operation in industrial water and wastewater
- Order as per product structure, see Technical Information (TI00191C/07/EN)

10 Diagnostics and troubleshooting

To help you troubleshoot, the following section is designed to provide an overview of possible causes of errors and initial remedial measures.

10.1 Troubleshooting instructions

⚠ WARNING

Danger! Electric voltage!

► Do not operate the device in an open condition for error diagnosis!

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

10.2 Diagnostic messages

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

The diagnostic code consists of the error category as per Namur NE 107 and the message number.

Error category (letter in front of the message number)
- F = Failure, a malfunction has been detected.
  The measured value of the affected channel is no longer reliable. The cause of the malfunction is to be found in the measuring point. Any control system connected should be set to manual mode.
- M = Maintenance required, action should be taken as soon as possible.
  The device still measures correctly. Immediate measures are not necessary. However, proper maintenance efforts would prevent a possible malfunction in the future.
- C = Function check, queue (no error).
  Maintenance work is being performed on the device. Wait until the work has been completed.
- S = Out of specification, the measuring point is being operated outside its specifications.
  Operation is still possible. However, you run the risk of increased wear, shorter operating life or lower measurement accuracy. The cause of the problem is to be found outside the measuring point.

Examples of how messages are displayed:

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 the transmitter data ▪ Replace sensor
F12	Writing data	Not possible to write the sensor data. Remedy: ▪ Repeat writing the sensor data ▪ Replace sensor
F13	Sensor type	Incorrect sensor type. Remedy: Change to a sensor of the type that is configured.
F61	Sensor elec.	Sensor electronics defective. Remedy: ▪ Replace sensor ▪ Contact the Service Department
F62	Sens. Connect	Sensor connection. Remedy: ▪ Replace sensor ▪ Contact the Service Department
F100	Sensor comm.	Sensor not communicating. Possible reasons: ▪ No sensor connection ▪ Incorrect sensor connection ▪ Short-circuit in sensor cable ▪ Short-circuit in adjacent channel ▪ Sensor firmware update interrupted incorrectly Remedy: ▪ Check sensor cable connection ▪ Check sensor cable for short-circuit ▪ Change sensor ▪ Restart the firmware update ▪ Contact the Service Department

Diagnostic code	Message text	Description
F118	Glass crack	Sensor glass breakage alarm. Impedance of glass membrane too low. Remedy: ▪ Check glass electrode for breaks and hair-line cracks ▪ Check medium temperature ▪ Check the electrode plug-in head for moisture and dry if necessary ▪ Replace sensor
F120	Sensor ref.	Sensor reference alarm. Impedance of reference too low. Remedy: ▪ Check glass electrode for breaks and hair-line cracks ▪ Check medium temperature ▪ Check the electrode plug-in head for moisture and dry if necessary ▪ Replace sensor
F124	Sensor glass	Sensor glass limit value exceeded, alarm. Impedance of glass membrane too high. Remedy: ▪ Check pH sensor, replace if necessary ▪ Check glass limit value, correct if necessary ▪ Replace sensor
F142	Sensor signal	Sensor check. No conductivity displayed. Possible reasons: ▪ Sensor in air ▪ Sensor defective Remedy: ▪ Check sensor installation ▪ Replace sensor
F143	Self-test	Sensor self-test error. Remedy: ▪ Replace sensor ▪ Contact the Service Department
F845	Device id	Incorrect hardware configuration
F846	Param error	Incorrect parameter checksum Possible cause: Firmware update Remedy: Reset parameter to factory defaults
F847	Couldn't save param	The parameters could not be saved
F848	Calib AO1	Incorrect calibration values for analog output 1

Diagnostic code	Message text	Description
F849	Calib AO2	Incorrect calibration values for analog output 2
F904	Process check	Process check system alarm. Measuring signal has not changed for a long time. Possible reasons ▪ Contaminated sensor, or sensor in air ▪ No flow to sensor ▪ Sensor defective ▪ Software error Remedy: ▪ Check electrode system ▪ Check sensor ▪ Restart the software

Diagnostic code	Message text	Description
C107	Calib. active	Sensor calibration is active. Remedy: Wait for calibration to be finished
C154	No calib. data	Sensor data. No calibration data available, factory settings are used. Remedy: ▪ Check the calibration information of the sensor ▪ Calibrating the cell constant
C850	Simu AO1	Simulation of analog output 1 is active
C851	Simu AO2	Simulation of analog output 2 is active
C853	Download act.	Parameter transmission is active

Diagnostic code	Message text	Description
S844	Process value	Measured value outside the specified range. Measured value outside the specified range Possible reasons: ▪ Sensor in air ▪ Air pockets in the assembly ▪ Incorrect flow to sensor ▪ Sensor defective Remedy: ▪ Increase process value ▪ Check electrode system ▪ Change sensor type
S910	Limit switch	Limit switch activated

Diagnostic code	Message text	Description
M126	Sensor check	Check the sensor. Poor condition of electrode. Possible reasons: ▪ Glass membrane blocked or dry ▪ Diaphragm blocked Remedy: ▪ Clean sensor, regenerate ▪ Replace sensor
M500	Not stable	Sensor calibration aborted. Main measured value fluctuating. Possible reasons: ▪ Sensor aging ▪ Sensor periodically dry ▪ Buffer value not constant Remedy: ▪ Check sensor, replace if necessary ▪ Check buffer

10.3 Firmware history

Revision history

The firmware version (FW) on the nameplate and in the Operating Instructions indicates the device release: XX.YY.ZZ (example 01.02.01).

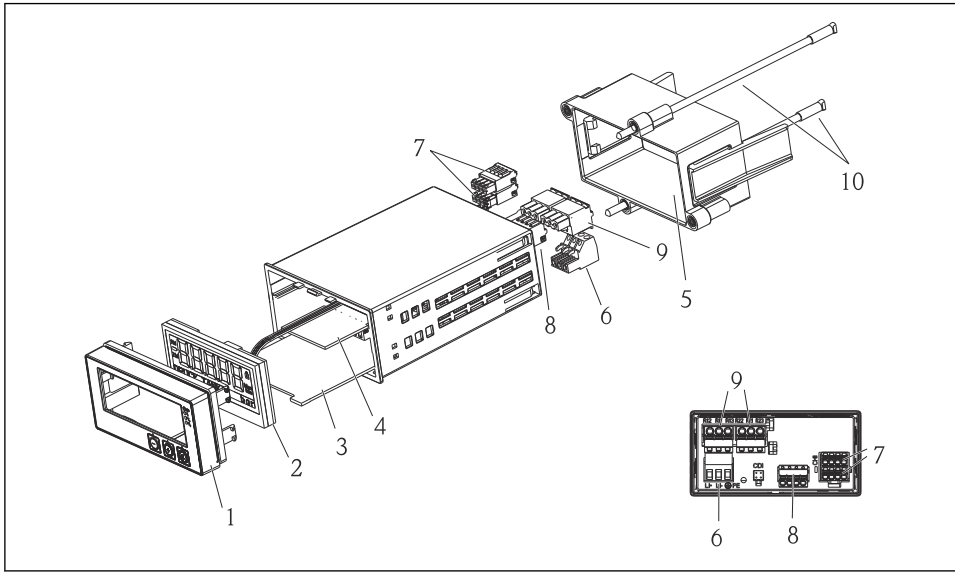
XX Change to main version. No longer compatible. The device and Operating Instructions change.

YY Change to functions and operation. Compatible. The Operating Instructions change.

ZZ Fixes and internal changes. No changes to the Operating Instructions.

Date	Firmware version	Changes	Documentation
09/2011	01.01.zz	Original firmware	BA01032C/09/en/01.11
06/2014	02.00zz	Limit values for sensors changed	BA01032C/09/en/02.14
11/2019	02.01.zz	Password protection for users amended	BA01032C/09/en/03.19
09/2022	02.01.zz	No changes to functions and operation; bug fixes	BA01032C/09/en/04.22

10.4 Spare parts



4 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 pH, ORP (glass)	XPM0004-CM
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

10.5 Return

The device must be packed in protective packaging if it is being returned for repair, for example. The original packaging offers the best protection. Repairs may only be carried out by your supplier's service organization.

When returning the device for repair, please enclose a note with a description of the error and the application.

10.6 Disposal

The device contains electronic components and must therefore be disposed of as electronic waste. Please pay particular attention to the local regulations governing waste disposal in 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)

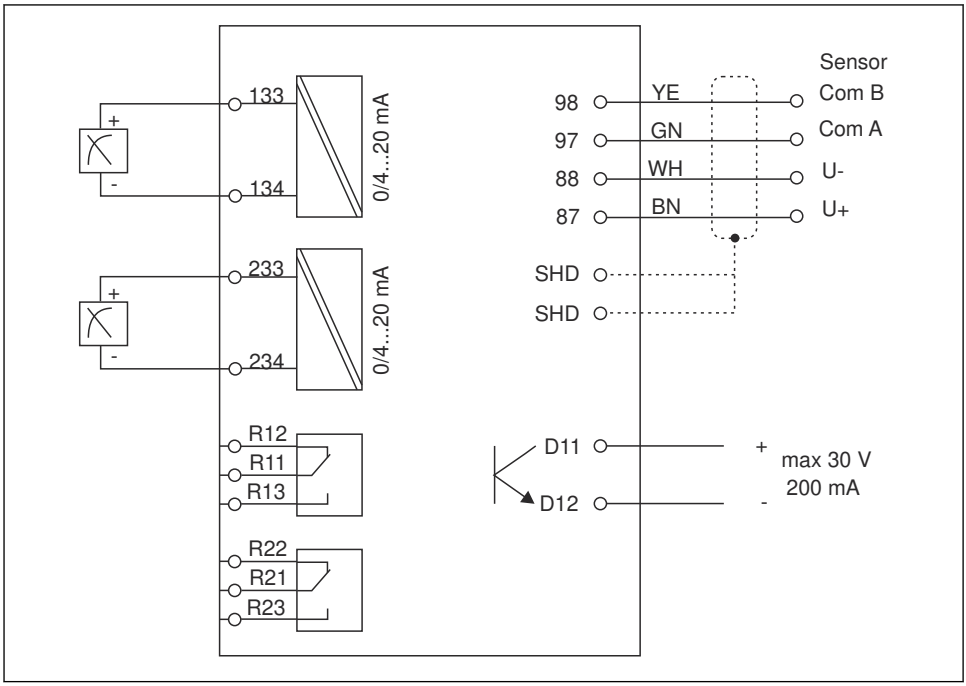
11.4.3 Cable specification

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 unit 24 to 230 V AC/DC (-20 % / +10 %) 50/60Hz

The device does not have a power switch
- The customer must provide a protected circuit breaker in the vicinity of the device.
- The circuit breaker must be a switch or power switch, and must be labeled as the circuit breaker 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 Mounting conditions

11.7.1 Installation instructions

Mounting location

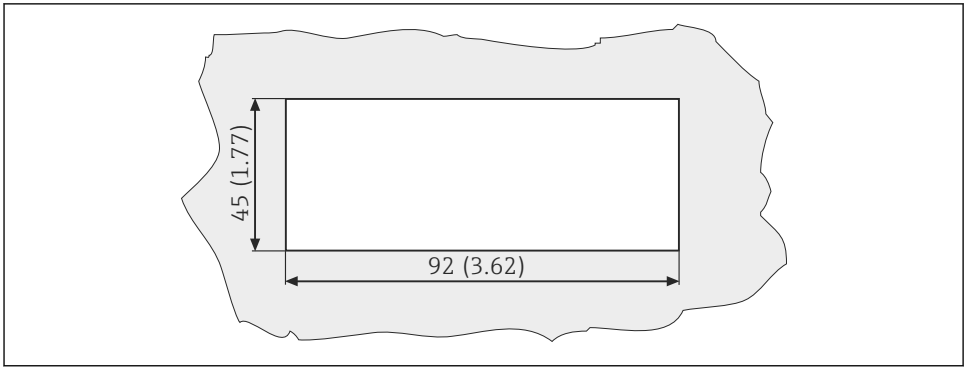
Panel, cutout 92 x 45 mm (3.62 x 1.77 in)

Max. panel thickness 26 mm (1 in)

Installation position

The orientation is determined by the legibility of the display.

Max. viewing angle range of +/- 45° from the central display axis in every direction.



5 Panel cutout, dimensions in mm (in)

11.8 Environment

11.8.1 Ambient temperature

−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 altitude

< 2 000 m (6 561 ft) above MSL

11.8.4 Electromagnetic compatibility

Interference emission and interference immunity as per EN 61326-1: class A for industry

11.8.5 Degree of protection

Front

Front IP65 / NEMA 4X

Casing

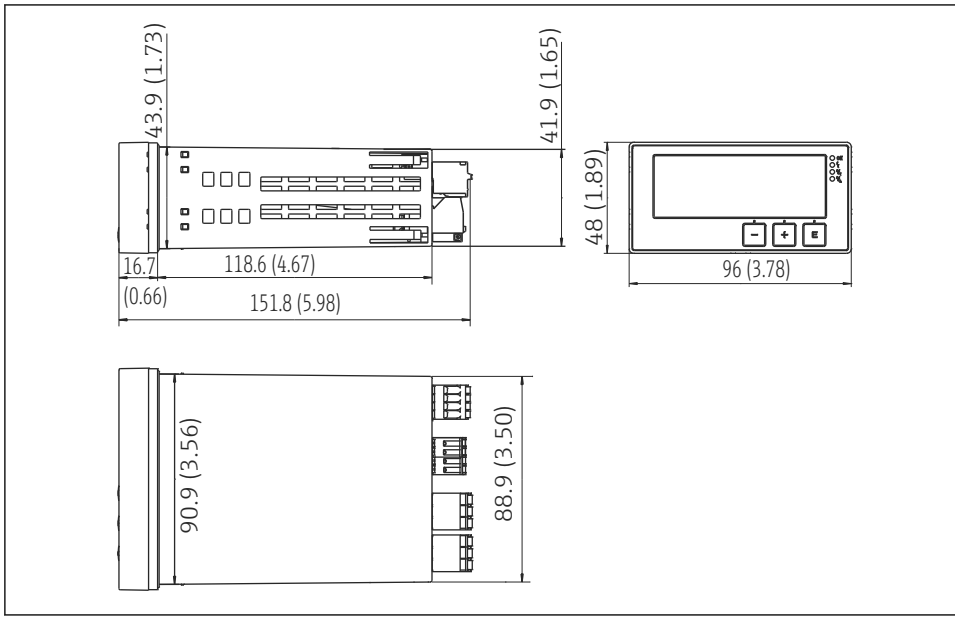
IP20 shock protection

11.8.6 Relative humidity

5 to 85 %, non-condensing

11.9 Mechanical construction

11.9.1 Dimensions



6 Dimensions of the transmitter in mm (in)

11.9.2 Weight

0.3 kg (0.66 lbs)

11.9.3 Materials

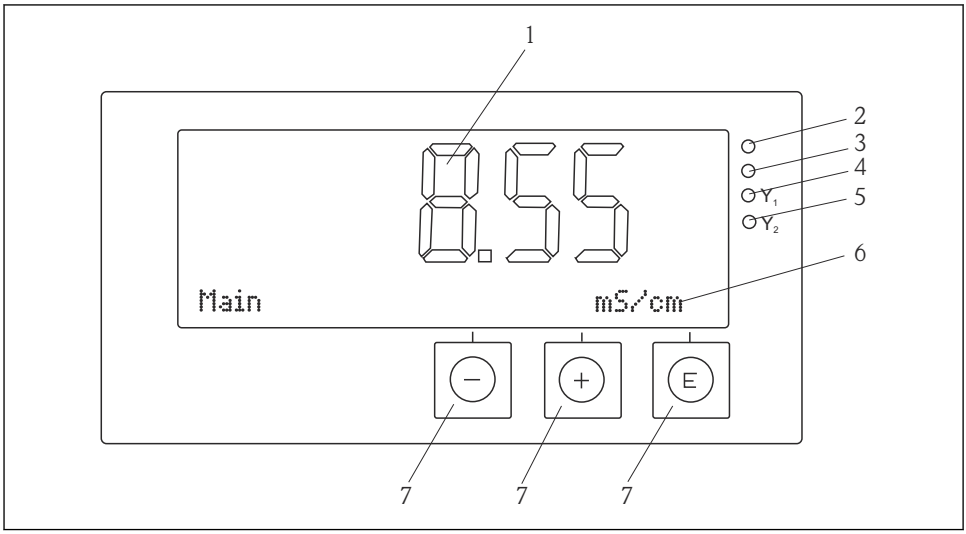
Housing, casing:	Polycarbonate
Front foil:	Polyester, UV-resistant

11.9.4 Terminals

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

11.10 Display and operating elements

11.10.1 Operating elements



7 Display and operating elements

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

11.11 Certificates and approvals

11.11.1 CE mark

Declaration of Conformity

The product meets the requirements of the harmonized European standards.

As such, it complies with the legal specifications of the EC directives.

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

Other standards and guidelines

- IEC 60529:
  Degrees of protection provided by enclosures (IP code)
- IEC 61010-1:
  Safety requirements for electrical equipment for measurement, control and laboratory use

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