LENNTECH
WATER TREATMENT SOLUTIONS

Technical Information
Liquisys M CPM223/253

pH/ORP measurement



Transmitter for analog and digital glass and ISFET sensors

Application

- Wastewater treatment
- Neutralization
- Detoxification (electroplating)
- Water treatment

Your benefits

- Memosens technology
- Field or panel-mounted housing
- Universal application, Easy to use
- Safe to operate
  - Manual contact control and user-defined alarm configuration
  - Calibration plausibility check

The basic device can be extended with:
- 2 or 4 contacts for use as
  - Limit contacts (also for temperature)
  - P(ID) controller
  - Timer for simple rinse processes or Chemoclean
  - Current input
- Plus package:
  - Configurable current output characteristic
  - Cleaning started automatically
  - Sensor check system
  - Sensor signal live check
  - Special neutralization controller
- HART or PROFIBUS-PA/-DP
- 2nd current output for temperature, pH/ORP or actuating variable

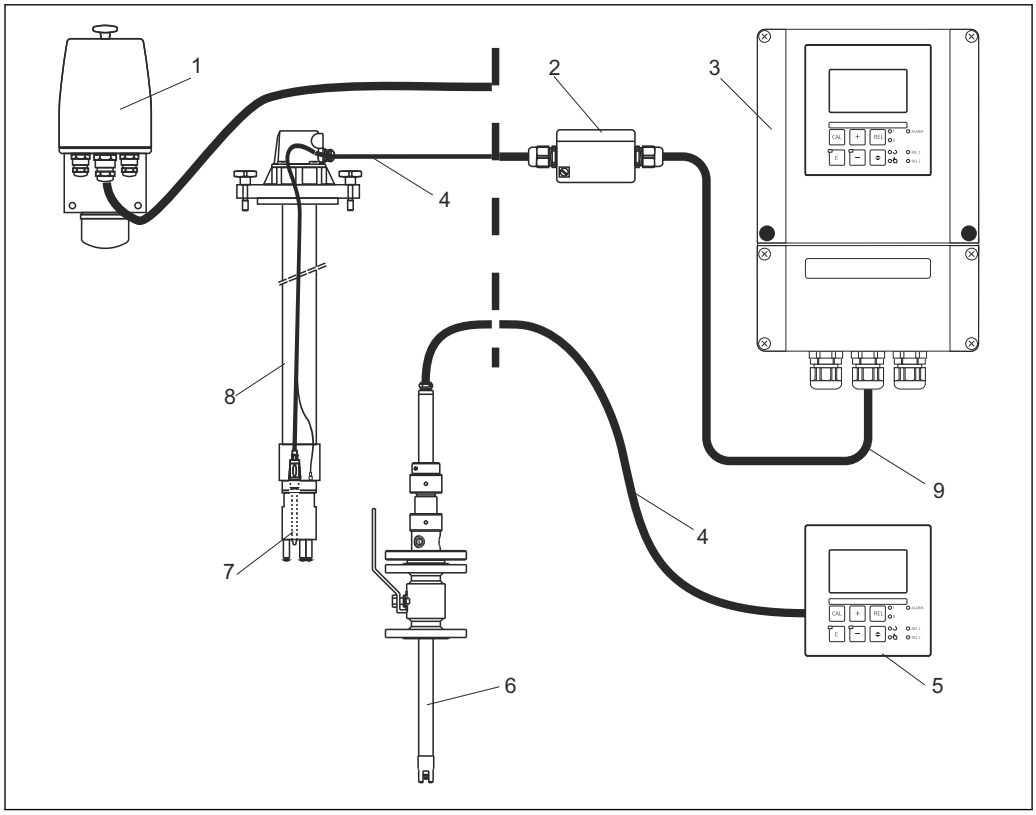
Endress+Hauser
People for Process Automation

Function and system design

Measuring system

A complete measuring system comprises:
- Transmitter Liquisys M CPM223 or CPM253
- pH or ORP sensor with or without an integrated temperature sensor
- Immersion, flow or retractable assembly
- pH measuring cable (e.g. CPK9)

Optionally:
- Extension cable, junction box VBA or VBM
- Weather protection cover CYY101 for field housing



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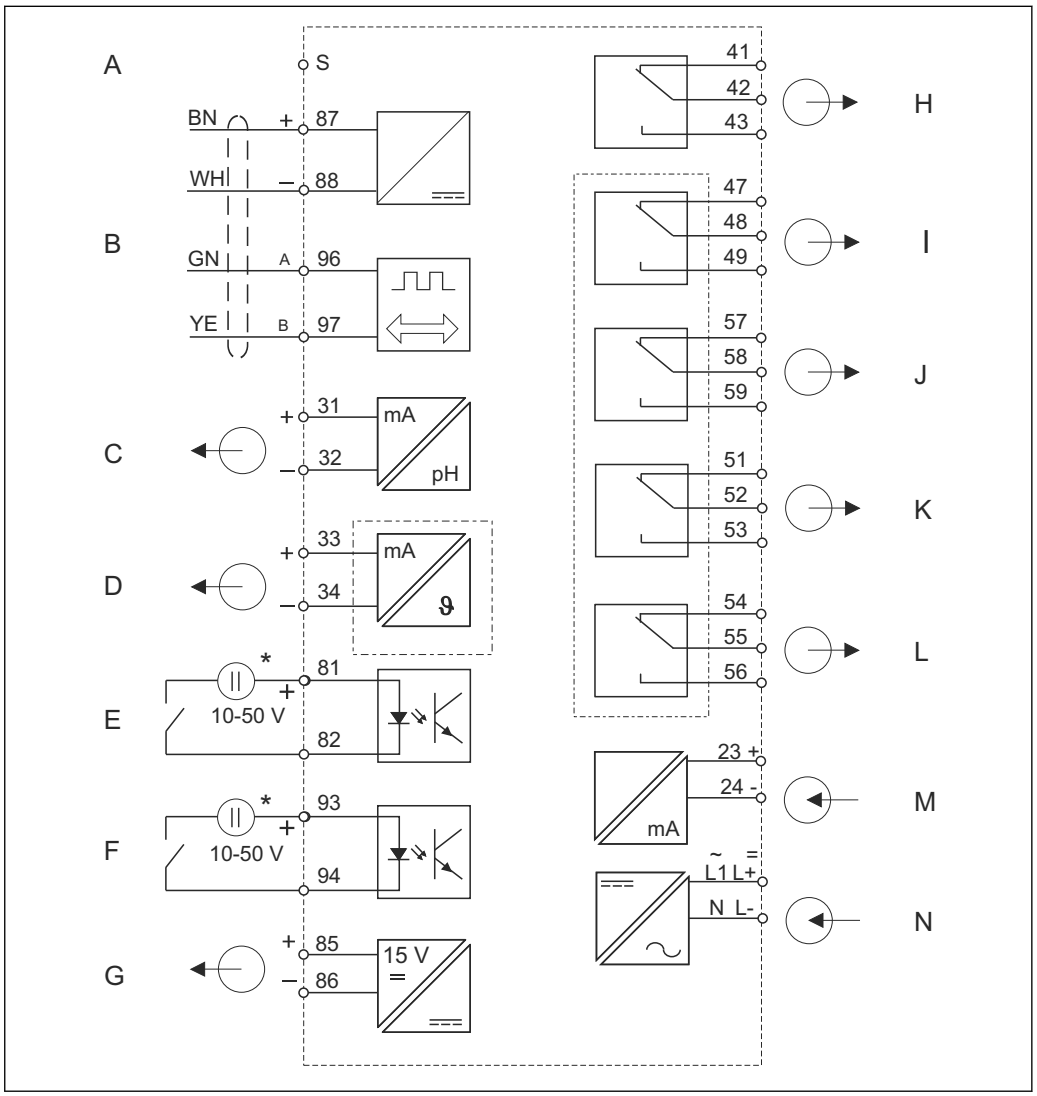
1 Complete measuring systems

1 Flow assembly CPA250
2 Junction box VBA
3 Liquisys M CPM253
4 Measuring cable e.g. CPK9
5 Liquisys M CPM223
6 Retractable assembly Cleanfit W CPA450
7 Electrode, e.g. Orbisint CPS11
8 Immersion assembly CPA111
9 Extension cable

Equipment architecture

Block diagram

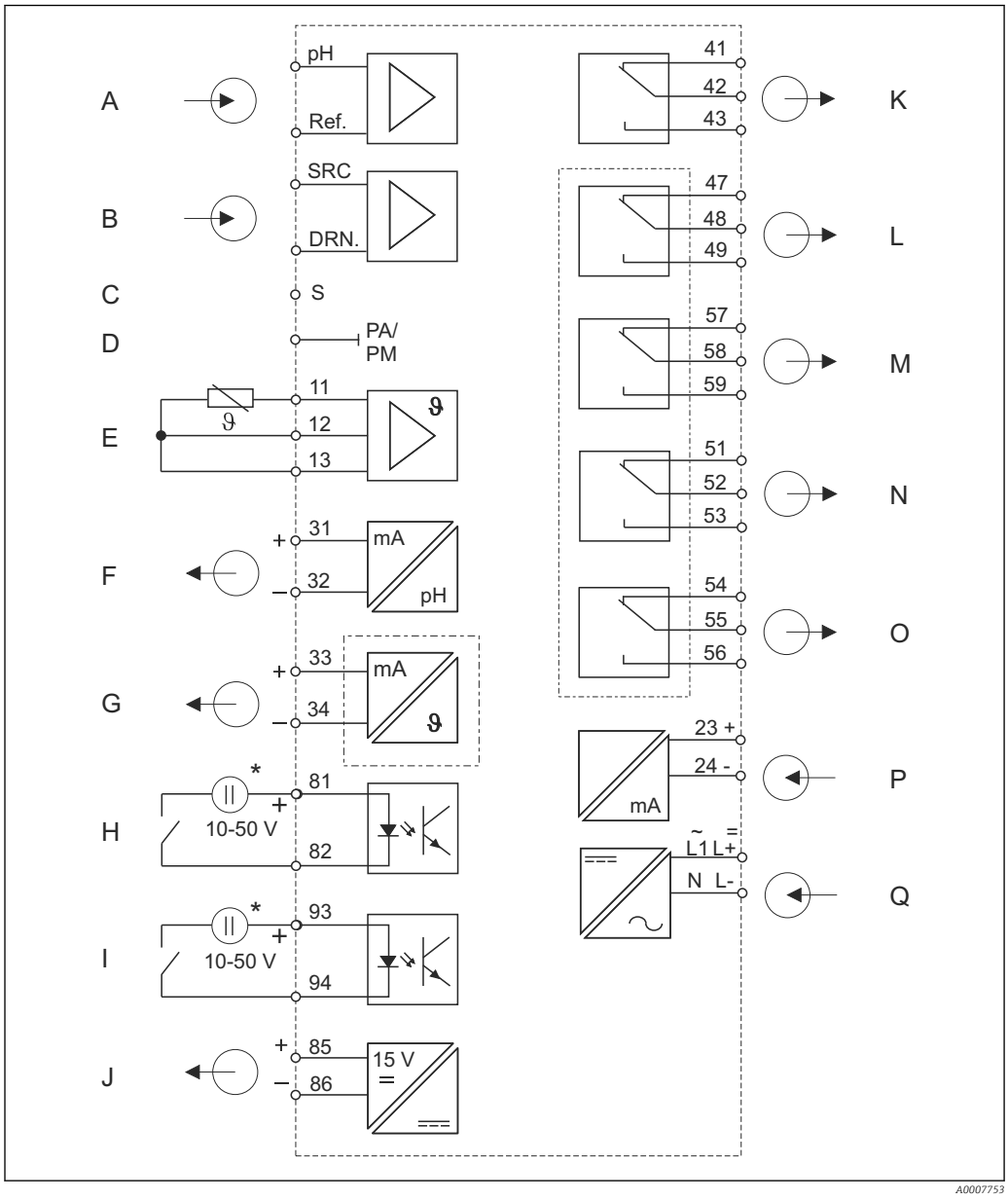
With Memosens sensors



2 *Block circuit diagram with Memosens sensors*

A	*Shielding*
B	*Sensor*
C	*Signal output 1 pH/ORP*
D	*Signal output 2 temperature, pH/ORP or controller*
E	*Binary input 1 (hold)*
F	*Binary input 2 (Chemoclean)*
G	*Auxiliary voltage output*
*	*Auxiliary voltage, terminal 85/86 can be used*
H	*Alarm (current-free contact position)*
I	*Relay 1 (current-free contact position)*
J	*Relay 2 (current-free contact position)*
K	*Relay 3 (current-free contact position)*
L	*Relay 4 (current-free contact position)*
M	*Current input 4 to 20 mA*
N	*Power supply*

With analog sensors



3 *Block circuit diagram with analog sensors*

A	*Standard sensor*
B	*ISFET sensor*
C	*Outer shield connection with glass electrodes*
D	*Potential equalization*
E	*Temperature sensor*
F	*Signal output 1 pH/ORP*
G	*Signal output 2 temperature, pH/ORP or controller*
H	*Binary input 1 (hold)*
I	*Binary input 2 (Chemoclean)*
J	*Auxiliary voltage output*
K	*Alarm (current-free contact position)*
L	*Relay 1 (current-free contact position)*
M	*Relay 2 (current-free contact position)*
N	*Relay 3 (current-free contact position)*
O	*Relay 4 (current-free contact position)*
P	*Current input 4 to 20 mA*
Q	*Power supply*
*	*Auxiliary voltage, terminal 85/86 can be used*

Dependability

Reliability

Sensor check system (SCS (Plus package))

The Sensor Check System (SCS) monitors the high impedance of the pH glass. An alarm is issued if a minimum impedance value is undershot or a maximum impedance is exceeded.
- Glass breakage is the main reason for a drop in high impedance values
- The reasons for increasing impedance values include:
  - Dry sensor
  - Worn pH glass membrane

Sensor live check (process check system, PCS (Plus package))

The process check system (PCS) checks the measuring signal for stagnation. An alarm is triggered if the measuring signal does not change over a specific period (several measured values).

The main causes of stagnating measured values are:
- Contaminated sensor, or sensor outside of medium
- Sensor defective
- Process error (e.g. through control system)

Plausibility check

pH electrodes are usually always calibrated with the same pH values. The transmitter therefore provides the setting for the last calibration as a default value when the next calibration is performed. If the buffer solutions are swapped by mistake during the calibration (e.g. pH 4 buffer first, then pH 7 buffer instead of pH 7 buffer first, then pH 4 buffer), the plausibility check ensures that the calibration is accepted nevertheless.

Current output configuration (Plus package)

In order to display wide measuring ranges while still achieving a high resolution in specific ranges, the current output can be configured as required via a table. This permits **bilinear** and **quasi-logarithmic** curves etc.

Current input

The transmitter current input permits two different applications:
- Flow monitoring with controller switch-off if flow falls below lower flow level in the main flow
- Feedforward control to the controller

The two functions can also be combined.

Neutralization controller (Plus package)

The neutralization of solutions requires a special control response which cannot be provided satisfactorily with a simple P(ID) response. The transmitter provides the control response of a special neutralization controller combined with two P(ID) controllers.

Safety

Process safety

Different alarms are required depending on the application and operator. The transmitter therefore permits the independent configuration of the fault-signaling contact and the error current for every individual error. Unnecessary or undesired alarms can be suppressed in this way. Up to four contacts can be used as limit contacts (also for temperature), as a P(ID) controller and for cleaning functions. The direct manual operation of the contacts (bypassing the menu) enables quick access to limit value, control or cleaning contacts. Any deviations can be quickly corrected in this way.

Input

Measured values

pH value
ORP
Temperature

Measuring ranges

pH	0 to 14
ORP	−1500 to +1500 mV / 0 to 100 %
Temperature	
Pt 100	-50 to +150 °C (-60 to +300 °F)
Pt 1000 (CPM2x3-IS)	-50 to +150 °C (-60 to +300 °F)
NTC 30K (CPM2x3-IS)	-20 to +100 °C (0 to +212 °F)

Input impedance

> 10^{12} Ω (under rated operating conditions) for standard sensors

Binary inputs

Voltage	10 to 50 V
Current consumption	Max. 10 mA

Current input

4 to 20 mA, galvanically isolated

Load: 260 Ω for 20 mA (voltage drop 5.2 V)

Output

Output signal

0/4 to 20 mA, galvanically isolated, active

HART	
Signal encoding	Frequency Shift Keying (FSK) + 0.5 mA via current output signal
Data transmission rate	1200 baud
Galvanic isolation	Yes

PROFIBUS PA	
Signal encoding	Manchester Bus Powered (MBP)
Data transmission rate	31.25 kBit/s, voltage mode
Galvanic isolation	Yes (IO modules)

PROFIBUS DP	
Signal encoding	RS485
Data transmission rate	9.6 kBd, 19.2 kBd, 93.75 kBd, 187.5 kBd, 500 kBd, 1.5 MBd
Galvanic isolation	Yes (IO modules)

Signal on alarm

2.4 or 22 mA in the event of an error

Load

Max. 500 Ω

Transmission range	pH	Configurable, min. Δ 1 pH
	ORP	
	Absolute	Configurable, min. Δ 50 mV
	Relative	Fixed, 0 to 100 %
	Temperature	Configurable, Δ 10 to Δ 100 % of end of measuring range
Signal resolution	Max. 700 digits/mA	
Minimum spread of output signal	10 % of the measuring range span	
Separation voltage	Max. 350 V_{RMS} / 500 V DC	
Auxiliary voltage output	Output voltage	15 V ± 0.6 V
	Output current	Max. 10 mA
Contact outputs	Switching current with ohmic load (cos φ = 1)	Max. 2 A
	Switching current with inductive load (cos φ = 0.4)	Max. 2 A
	Switching voltage	Max. 250 V AC, 30 V DC
	Switching power with ohmic load (cos φ = 1)	Max. 500 VA AC, 60 W DC
	Switching power with inductive load (cos φ = 0.4)	Max. 500 VA AC, 60 W DC
Limit contactors	Pickup/dropout delay	0 to 2000 s
Controller	Function (configurable)	Pulse length/pulse frequency controller, continuous controller
	Controller behavior	P, PI, PD, PID, basic load dosing
	Control gain K_p	0.01 to 20.00
	Integral action time T_n	0.0 to 999.9 min
	Derivative action time T_v	0.0 to 999.9 min
	Period length for pulse length controller	0.5 to 999.9 s
	Frequency for pulse frequency controller	60 to 180 min^{-1}
	Basic load	0 to 40 % of max. actuating variable
Alarm	Function (switchable)	Latching/momentary contact
	Alarm threshold adjustment range	pH/temperature: entire measuring range
	Alarm delay	0 to 2000 s
	Monitoring time for lower limit violation	0 to 2000 min
	Monitoring time for upper limit violation	0 to 2000 min

Protocol-specific data

HART	
Manufacturer ID	11_h
Device type	0091_h
Transmitter-specific revision	0001_h
HART version	5.0
Device description files (DD)	www.endress.com/hart
HART load (communication resistor)	250 Ω
Device variables	None (only dynamic variables PV and SV)
Supported features	-

PROFIBUS PA	
Manufacturer ID	11_h
Device type	1516_h
Device revision	0001_h
Profile version	2.0
GSD files	www.endress.com/profibus
GSD version	
Output values	Primary value, temperature
Input variables	PCS display value
Supported features	Device lock: The device can be locked using the hardware or software.

PROFIBUS DP	
Manufacturer ID	11_h
Device type	1520_h
Profile version	2.0
GSD files	www.endress.com/profibus
GSD version	
Output values	Primary value, temperature
Input variables	PCS display value
Supported features	Device lock: The device can be locked using the hardware or software.

Power supply

Supply voltage

Depending on order version:
- 100/115/230 V AC +10/-15 %, 48 to 62 Hz
- 24 V AC/DC +20/-15 %

Power supply via fieldbus

HART	
Supply voltage	Not applicable, active current outputs
Reverse polarity protection	Not applicable, active current outputs

PROFIBUS PA	
Supply voltage	9 V to 32 V, max. 35 V
Sensitivity to reverse polarity	No
FISCO/FNICO compliant according to IEC 60079-27	No

PROFIBUS DP	
Supply voltage	9 V to 32 V, max. 35 V
Sensitivity to reverse polarity	Not applicable
FISCO/FNICO compliant according to IEC 60079-27	No

Power consumption

Max. 7.5 VA

Mains fuse

Fine-wire fuse, semi-delay 250 V/3.15 A

Circuit breaker

NOTICE

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 you must label it as the circuit breaker for the device.
- At the supply point, the power supply for the 24 V versions must be isolated from dangerous live cables by double or reinforced insulation.

Cable specification

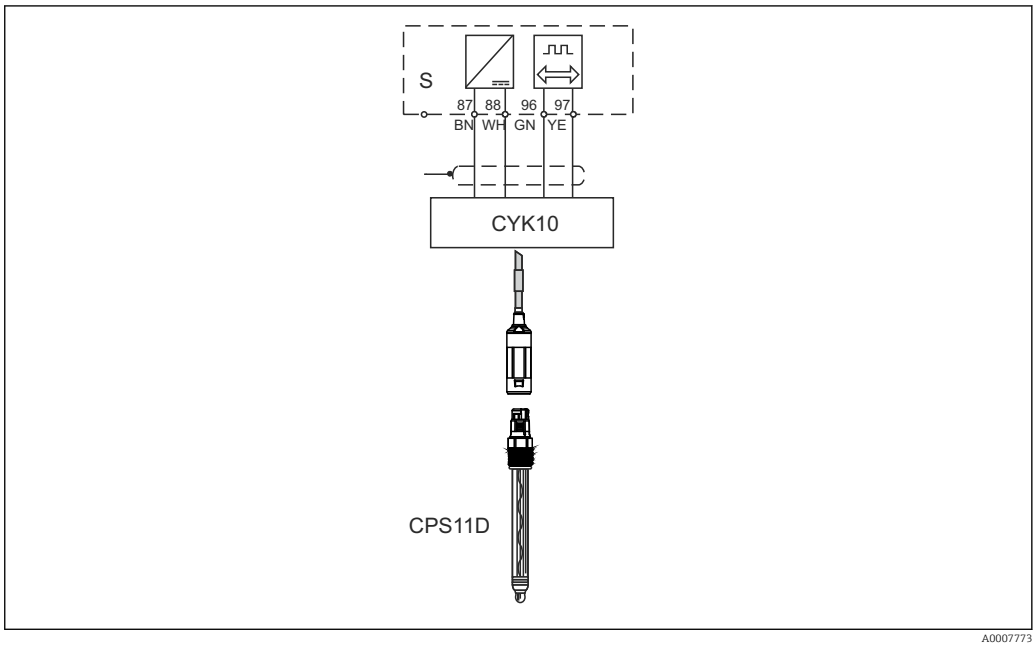
Cable length Memosens	Max. 100 m (330 ft)
Cable length analog sensors	Max. 50 m (160 ft)

Overvoltage protection

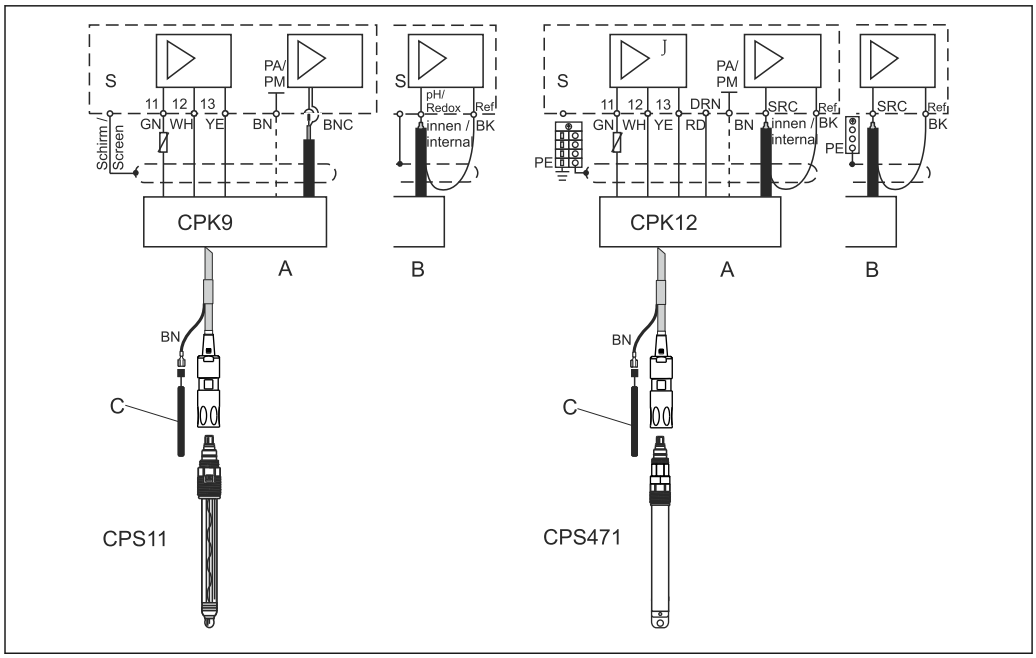
According to EN 61000-4-5

Sensor connection

The pH and ORP sensors are connected via multi-core, pre-terminated, shielded special cables. Use a junction box and an extension cable to extend the measuring cable. Cable termination instructions are provided with the measuring cables.



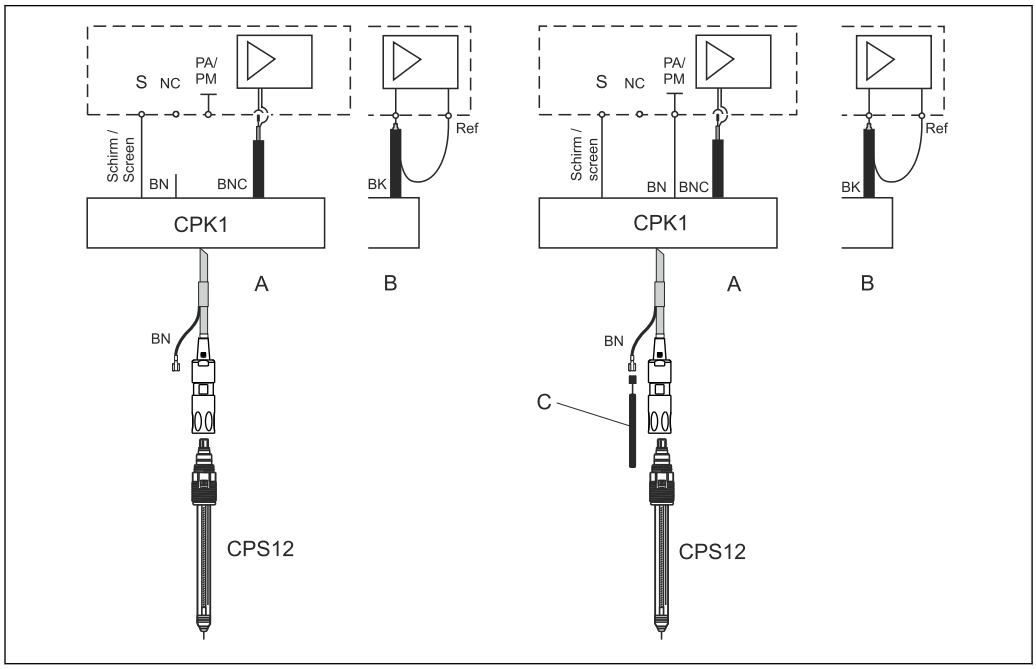
4 *Connecting the digital sensor CPS11D with CYK10*



A0024643

5 Connecting the glass electrode CPS11 with CPK9 (left) and ISFET sensor CPS471 with CPK12 (right)

A Panel-mounted device
B Field device
C Potential matching PM for symmetrical connection



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6 Asymmetrical (without PML) and symmetrical (with PML) connection of ORP electrodes

A Panel-mounted device
B Field device
C Potential matching PM for symmetrical connection

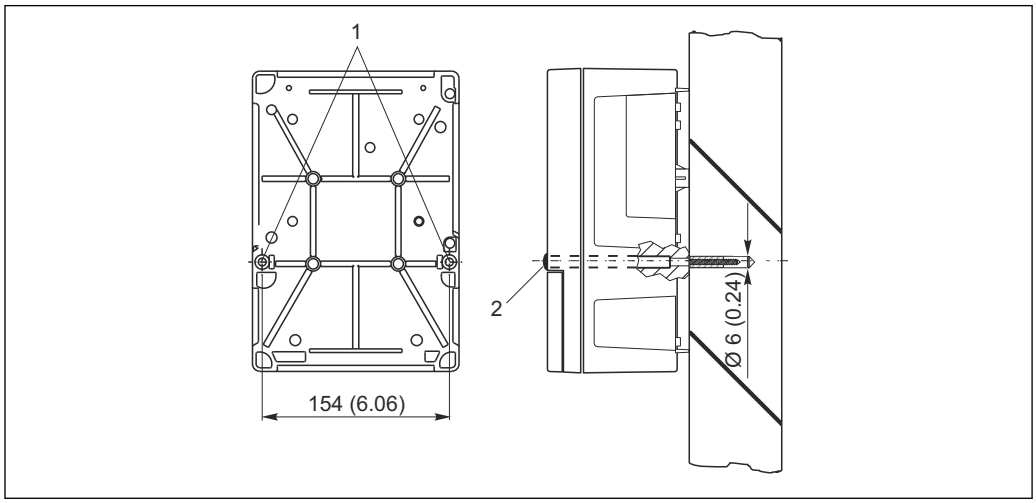
Performance characteristics

Reference operating conditions	Reference temperature:	25 °C (77 °F)
Measured value resolution	pH value	0.01 pH
	ORP	1 mV/0.1 %
	Temperature	0.1 °C
Maximum measured error	Display	
	pH	Max. 0.5 % of measuring range
	ORP	Max. 0.5 % of measuring range
	Temperature	Max. 1.0 % of measuring range
	Signal output	
	pH	Max. 0.75 % of measuring range
	ORP	Max. 0.75 % of measuring range
	Temperature	Max. 1.25 % of measuring range
	Measured errors in accordance with DIN IEC 746 Part 1, at rated operating conditions	
Repeatability	Max. 0.2 % of measuring range	
Zero point shift	Glass electrode	pH 5.0 to 9.0 (nominal pH 7.00)
	Antimony electrode	pH -1.0 to 3.0 (nominal pH 1.00)
	ISFET sensor	-500 to +500 mV
Slope adjustment	Glass electrode	38.00 to 65.00 mV/pH (nominal 59.16 mV/ pH)
	Antimony electrode	25.00 to 65.00 mV/pH (nominal 59.16 mV/ pH)
	ISFET sensor	38.00 to 65.00 mV/pH (nominal 59.16 mV/ pH)
Offset	pH	±2 pH units
	ORP	±120 mV/±50 %
	Temperature	±5 °C for adjusting the temperature display

Installation

Installation instructions

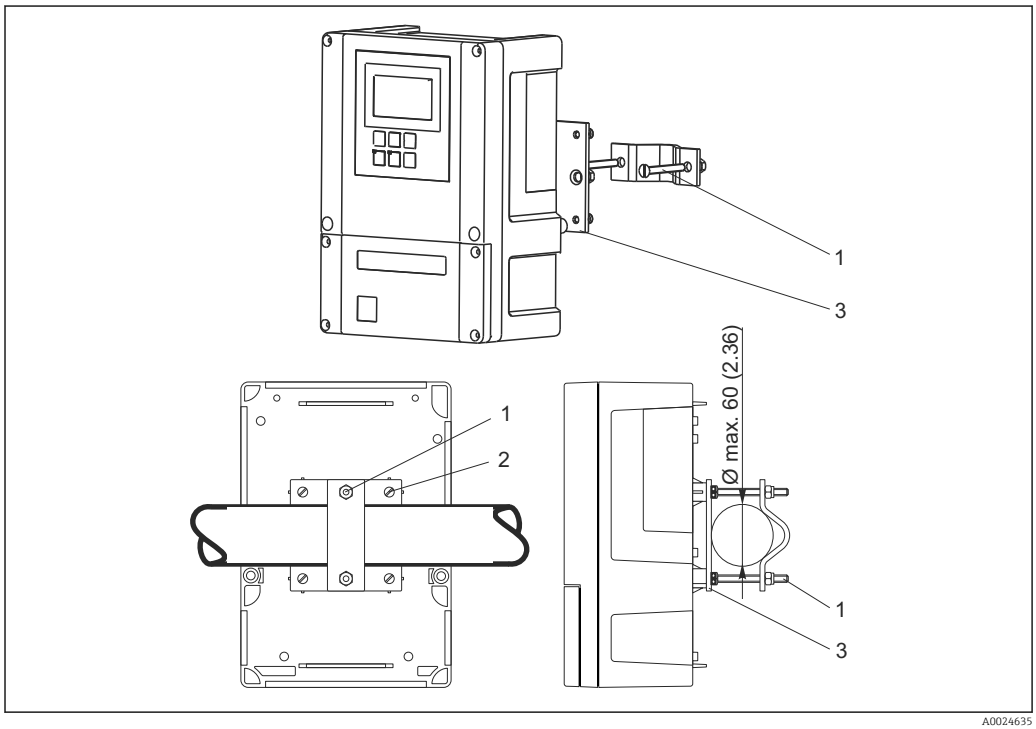
Field device wall mounting



7 *Field device wall mounting*

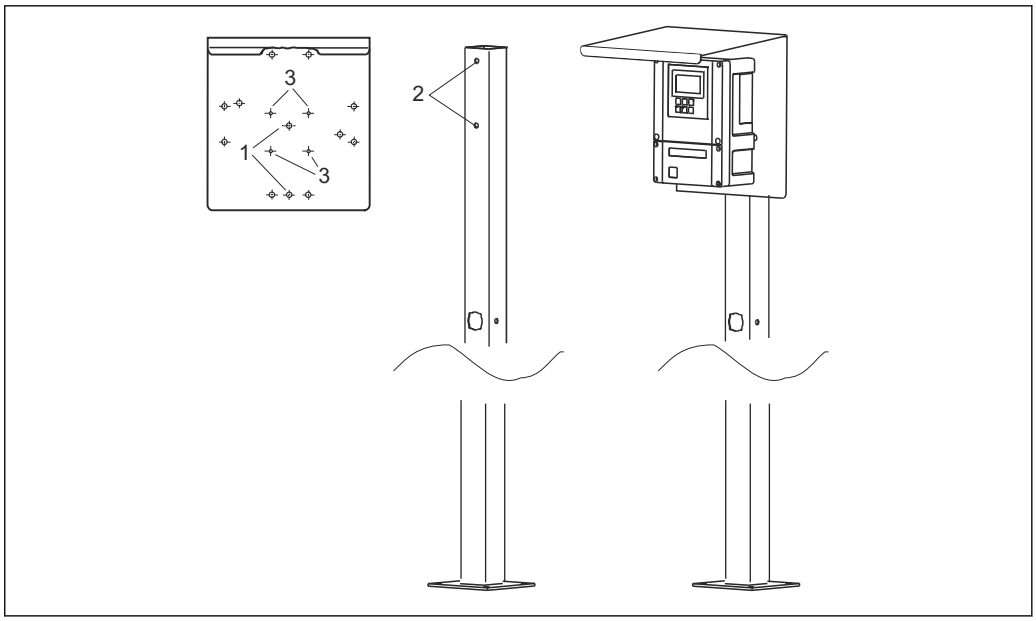
1 Fixing bore holes
2 Plastic caps

Field device post mounting



8 *Field device on horizontal or vertical pipes*

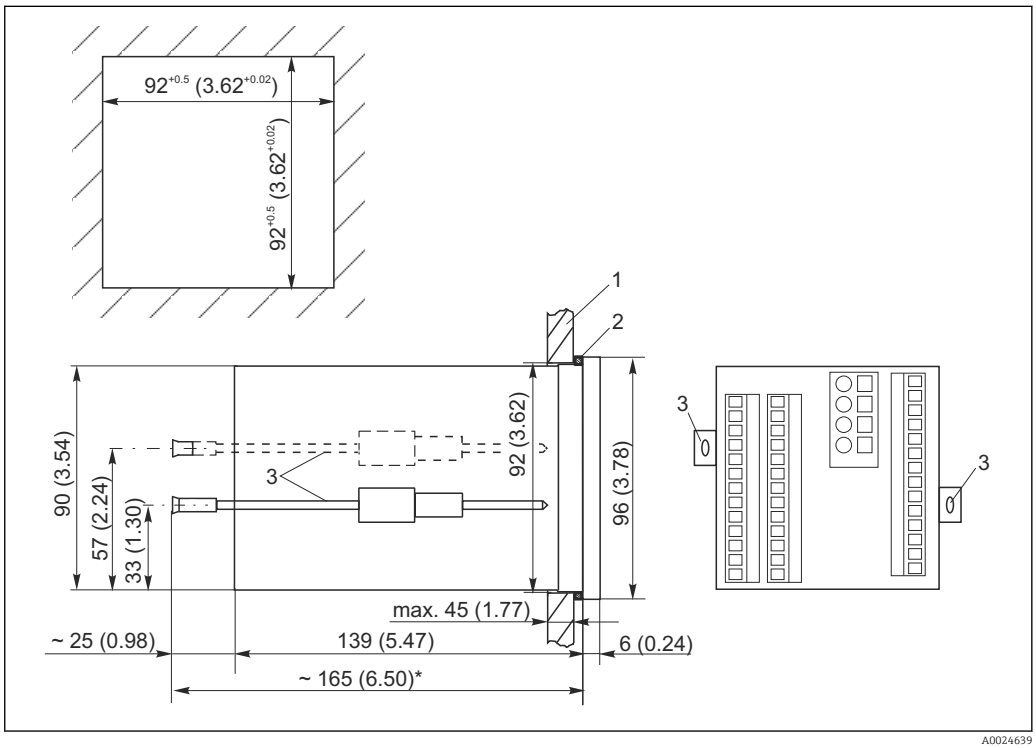
1 Securing screws
2 Fixing screws
3 Securing plate



9 *Field device with universal post and weather protection cover*

1 Bore holes in the weather protection cover to secure to the upright post
2 Bore holes in the upright post to secure the weather protection cover
3 Bore holes in the weather protection cover to secure the field device

Panel mounting



10 *Dimensions in mm (inch)*

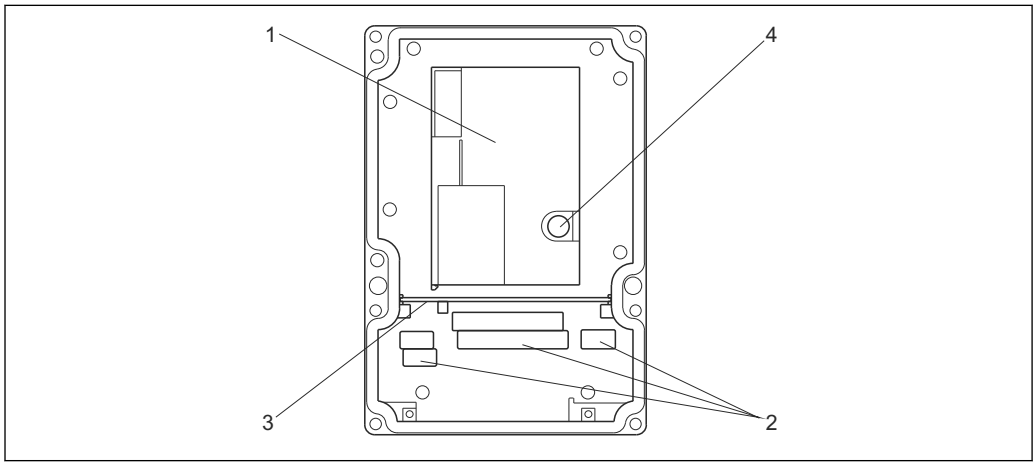
1 Mounting plate
2 Seal
3 Tensioning screws
* *Necessary installation depth*

Environment

Ambient temperature range	-10 to +55 °C (+10 to +130 °F)	
Storage temperature	–25 to +65 °C (-10 to +150 °F)	
Electromagnetic compatibility	Interference emission and interference immunity as per EN 61326-1:2006, EN 61326-2-3:2006	
Degree of protection	Field device	IP 65 / integrity according to NEMA 4X
	Panel-mounted device	IP 54 (front), IP 30 (housing)
Electrical safety	As per EN/IEC 61010-1:2010, overvoltage category II for installations up to 2000 m (6500 ft) above MSL	
CSA	Device versions with CSA General Purpose approval are certified for indoor use.	
Relative humidity	10 to 95%, not condensing	
Degree of contamination	The product is suitable for pollution degree 2.	

Mechanical construction

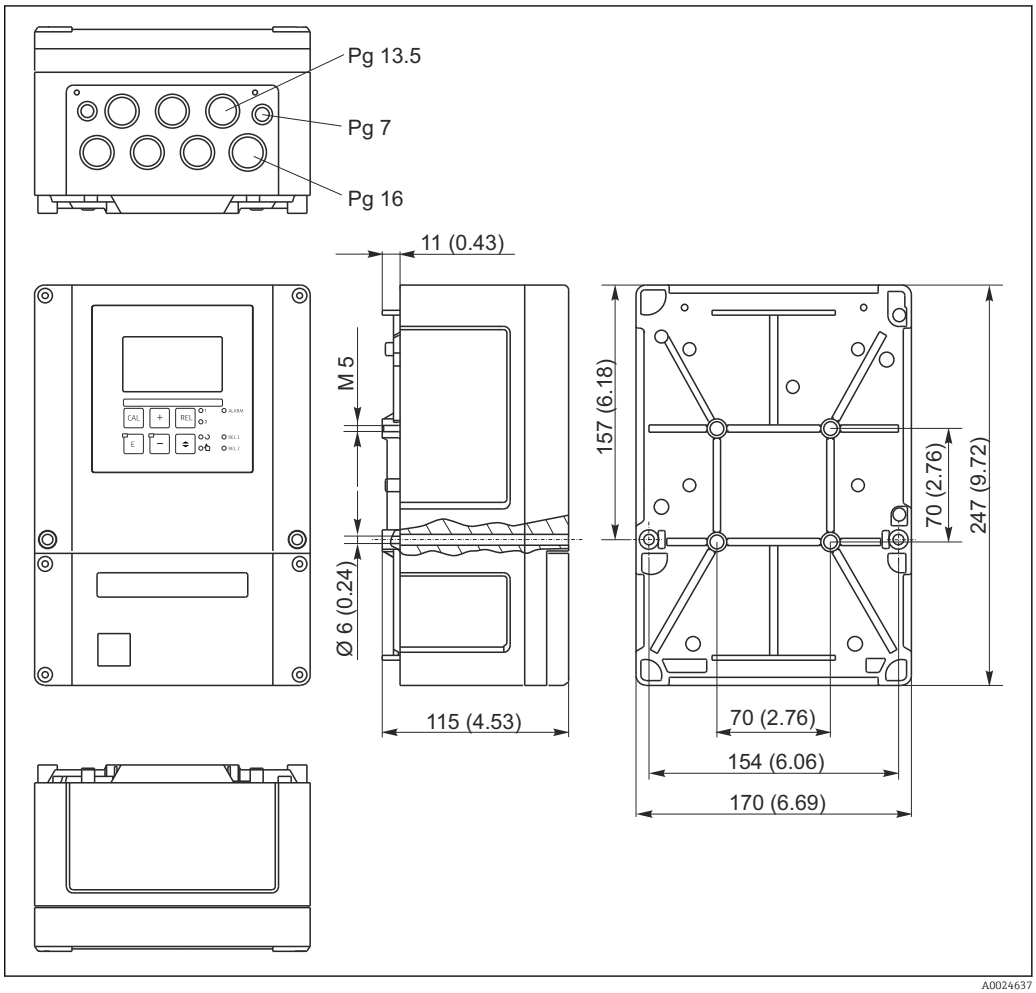
Design



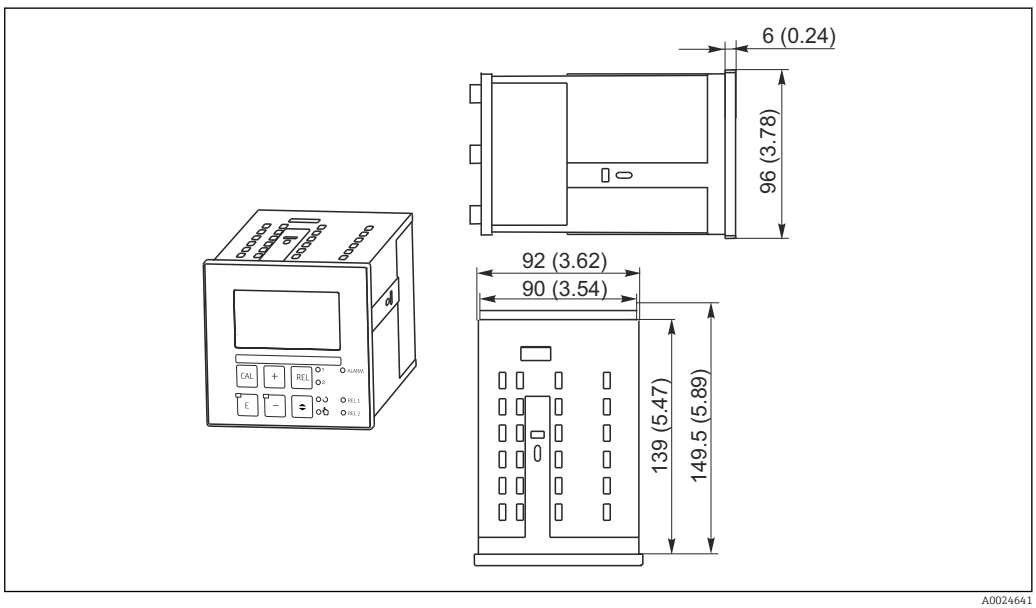
11 View into the field device housing

1 Removable electronics box
2 Terminals
3 Partition plate
4 Fuse

Dimensions



12 Field device: dimensions in mm (inch)



13 Panel-mounted device: dimensions in mm (inch)

Weight	Panel-mounted device	Max. 0.7 kg (1.54 lbs.)
	Field device	Max. 2.3 kg (5.07 lbs.)

Materials	Panel-mounted device housing	Polycarbonate
	Field housing	ABS PC FR
	Front membrane	Polyester, UV-resistant
Terminals	Cable cross-section	Max. 2.5 mm² (14 AWG)

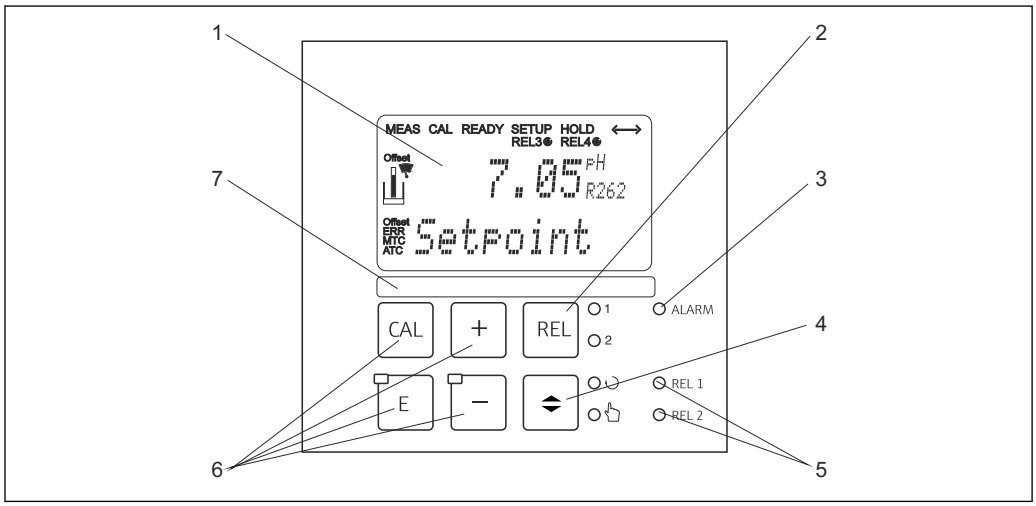
Operability

Operating concept

All the device's operating functions are arranged in a clear menu structure. The individual parameters can be selected and modified once the access code has been entered.

Display and operating elements

The display shows the current measured value and the temperature simultaneously, which means you have an overview of the most important process data at once. Help text in the configuration menu helps users configure the device parameters.



14 Operating elements

1 *LC display for displaying the measured values and configuration data*
2 *Key to switch relays in manual mode and to display the active contact*
3 *LED for alarm function*
4 *Changeover switch for automatic/manual mode*
5 *LEDs for limit contactor relay (switch status)*
6 *Main operating keys for calibration and device configuration*
7 *Field for user-defined information*

Certificates and approvals

CE mark

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.

CSA General Purpose

The following device versions meet the requirements of CSA and ANSI/UL for Canada and the US:
- CPM253-**2/3/7***
- CPM223-**2/3/7***

Ordering information

Product page

www.endress.com/cpm223

www.endress.com/cpm253

Product Configurator

The navigation area is located on the right of the product page.

2. Under "Device support" click "Configure your selected product".
   ↳ The Configurator opens in a separate window.
3. Select all the options to configure the device in line with your requirements.
   ↳ In this way, you receive a valid and complete order code for the device.
4. Export the order code as a PDF or Excel file. To do so, click the appropriate button at the top of the screen.

Scope of delivery

The delivery of the field device comprises:
- 1 transmitter CPM253
- 1 plug-in screw terminal, 3-pin
- 1 cable gland Pg 7
- 1 cable gland Pg 16 reduced
- 2 cable glands Pg 13.5
- 1 set of Operating Instructions
- For versions with HART communication:
  1 set of Operating Instructions: Field communication with HART
- For versions with PROFIBUS interface:
  1 set of Operating Instructions: Field communication with PROFIBUS PA/DP

The delivery of the panel-mounted device comprises:
- 1 transmitter CPM223
- 1 set of plug-in screw terminals
- 2 tensioning screws
- 1 BNC connector (solder-free measuring cable connection)
- 1 set of Operating Instructions
- For versions with HART communication:
  1 set of Operating Instructions: Field communication with HART
- For versions with PROFIBUS interface:
  1 set of Operating Instructions: Field communication with PROFIBUS PA/DP

Accessories

The following are the most important accessories available at the time this documentation was issued. For accessories not listed here, please contact your service or sales office.

Sensors

pH glass electrodes

Orbisint CPS11D/ CPS11
- pH electrode for process technology
- Optional SIL version for connecting to SIL transmitter
- With dirt-repellent PTFE diaphragm
- Product Configurator on the product page: www.endress.com/cps11d or www.endress.com/cps11

Technical Information TI00028C

Ceraliquid CPS41D/ CPS41
- pH electrode with ceramic junction and KCl liquid electrolyte
- Product Configurator on the product page: www.endress.com/cps41d or www.endress.com/cps41

Technical Information TI00079C

Ceragel CPS71D/ CPS71
- pH electrode with double-chamber reference system and integrated bridge electrolyte
- Product Configurator on the product page: www.endress.com/cps71d or www.endress.com/cps71

Technical Information TI00245C

Orbipore CPS91D/ CPS91
- pH electrode with open aperture diaphragm for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps91d or www.endress.com/cps91

Technical Information TI00375C

pH ISFET sensors

Tophit CPS441D/ CPS441
- Sterilizable ISFET sensor for low-conductivity media
- Liquid KCl electrolyte
- Product Configurator on the product page: www.endress.com/cps441d or www.endress.com/cps441

Technical Information TI00352C

Tophit CPS471D/ CPS471
- Sterilizable and autoclavable ISFET sensor for food and pharmaceutics, process engineering
- Water treatment and biotechnology
- Product Configurator on the product page: www.endress.com/cps471d or www.endress.com/cps471

Technical Information TI00283C

Tophit CPS491D/ CPS491
- ISFET sensor with open aperture diaphragm for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps491d or www.endress.com/cps491

Technical Information TI00377C

ORP sensors

Orbisint CPS12D/ CPS12
- ORP sensor for process technology
- Product Configurator on the product page: www.endress.com/cps12d or www.endress.com/cps12

Technical Information TI00367C

Ceraliquid CPS42D/ CPS42
- ORP electrode with ceramic junction and KCl liquid electrolyte
- Product Configurator on the product page: www.endress.com/cps42d or www.endress.com/cps42

Technical Information TI00373C

Ceragel CPS72D/ CPS72
- ORP electrode with double-chamber reference system and integrated bridge electrolyte
- Product Configurator on the product page: www.endress.com/cps72d or www.endress.com/cps72

Technical Information TI00374C

Orbipore CPS92D/ CPS92
- ORP electrode with open aperture diaphragm for media with high dirt load
- Product Configurator on the product page: www.endress.com/cps92d or www.endress.com/cps92

Technical Information TI00435C

Sensor simulators

Memocheck Plus CYP01D / Memocheck CYP02D / Memocheck Sim CYP03D
- Testing tools for analysis measuring points
- Simple, fast and reliable sensor simulation
- Product Configurator on the product page:
  - www.endress.com/cyp01d
  - www.endress.com/cyp02d
  - www.endress.com/cyp03d

Technical Information TI00481C

Connection accessories

CYK10 Memosens data cable
- For digital sensors with Memosens technology
- Product Configurator on the product page: www.endress.com/cyk10

Technical Information TI00118C

Memosens data cable CYK11
- Extension cable for digital sensors with Memosens protocol
- Product Configurator on the product page: www.endress.com/cyk11

Technical Information TI00118C

CPK9
For pH/ORP electrodes with TOP68 plug-in head

CPK1
For pH/ORP electrodes with GSA plug-in head

CPK2
For pH/ORP electrodes with GSA plug-in head, with three electrode connectors

CPK12
For pH glass electrodes and ISFET sensors with TOP68 plug-in head

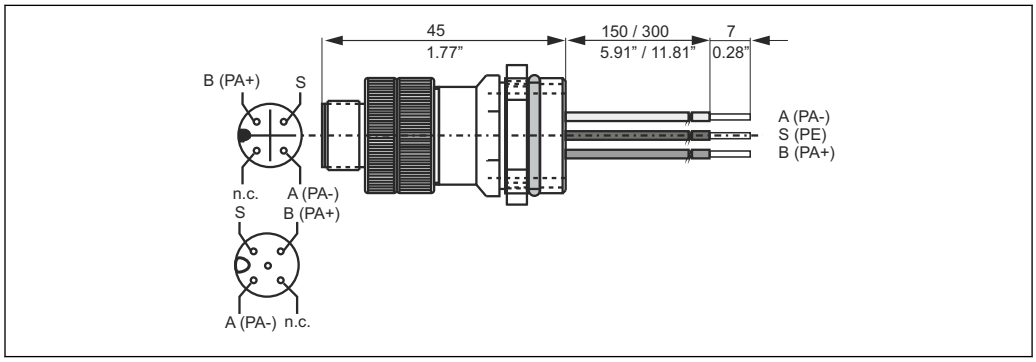
Ordering information is available from your sales office or at www.endress.com.

VBM
- Junction box for cable extension
- 10 terminal strips
- Cable entries: 2 x Pg 13.5 or 2 x NPT ½"
- Material: aluminum
- Degree of protection: IP 65
- Order numbers
  - Cable entries Pg 13.5 : 50003987
  - Cable entries NPT ½": 51500177

VBA
- Junction box for cable extension
- 10 terminal strips
- Cable entries: 2 x Pg 13.5, 2 x Pg 16

- Material: polycarbonate
- Degree of protection: IP 65
- Order number: 50005276

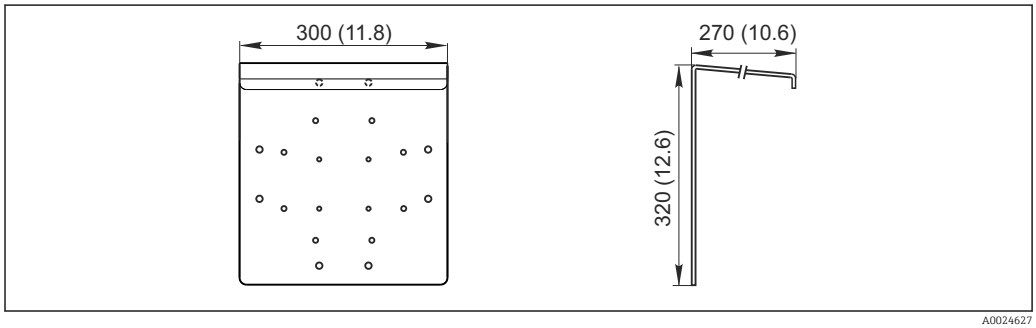
M12 socket
- Four-pin metal socket for mounting on transmitter
- For connecting sensor cables with an M12 connector
- Length of connecting cable for wiring in transmitter: 150 mm (5.9 inch).
- Order number: 51502184



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Installation accessories

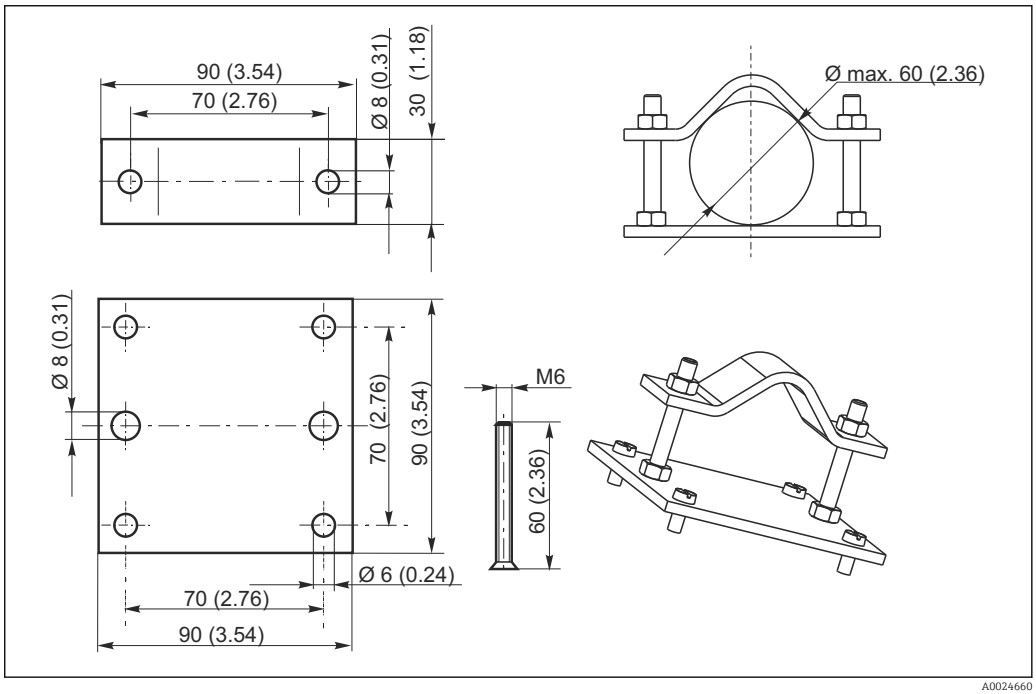
CYY101
- Weather protection cover for field devices
- Absolutely essential for field installation
- Material: stainless steel 1.4301 (AISI 304)
- Order No. CYY101-A



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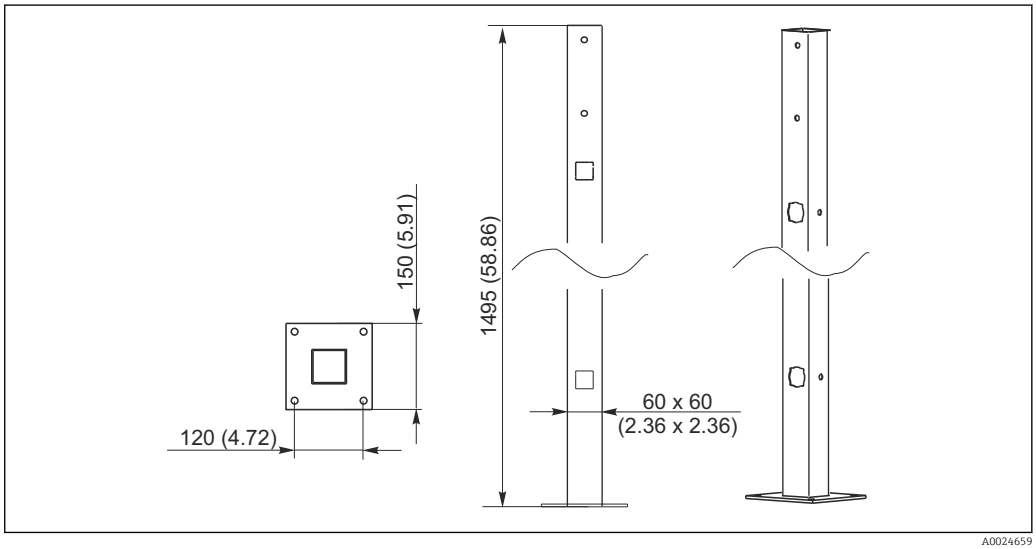
15 Dimensions in mm (inch)

Post mounting kit
- For securing the field housing to horizontal and vertical posts and pipes
- Material: stainless steel 1.4301 (AISI 304)
- Order No. 50086842



16 *Dimensions in mm (inch)*

Universal post CYY102
- Square pipe for mounting transmitters
- Material: stainless steel 1.4301 (AISI 304)
- Order No. CYY102-A



17 *Dimensions in mm (inch)*

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