

Technical Information

Liquisys M CLM223/253

Conductivity/resistivity measurement



Transmitter for conductive and inductive sensors

Application

- Ultrapure water
- Water treatment
- Ion exchanger and reverse osmosis
- Cooling water desalination
- Wastewater

Your benefits

- Field or panel-mounted housing
- Easy to use
 - Simple menu structure
 - Calibration using the CAL key
- Manual contact control and user-defined alarm configuration

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
- Plus package:
 - Configurable current output characteristic
 - Ultrapure water monitoring (USP/EP, conductive)
 - Concentration Measurement
 - Process check system (PCS): Sensor signal live check
- HART or PROFIBUS-PA/-DP
- 2nd current output: temperature, main measured value, actuating variable
- Current input for flow monitoring or for feedforward control

Function and system design

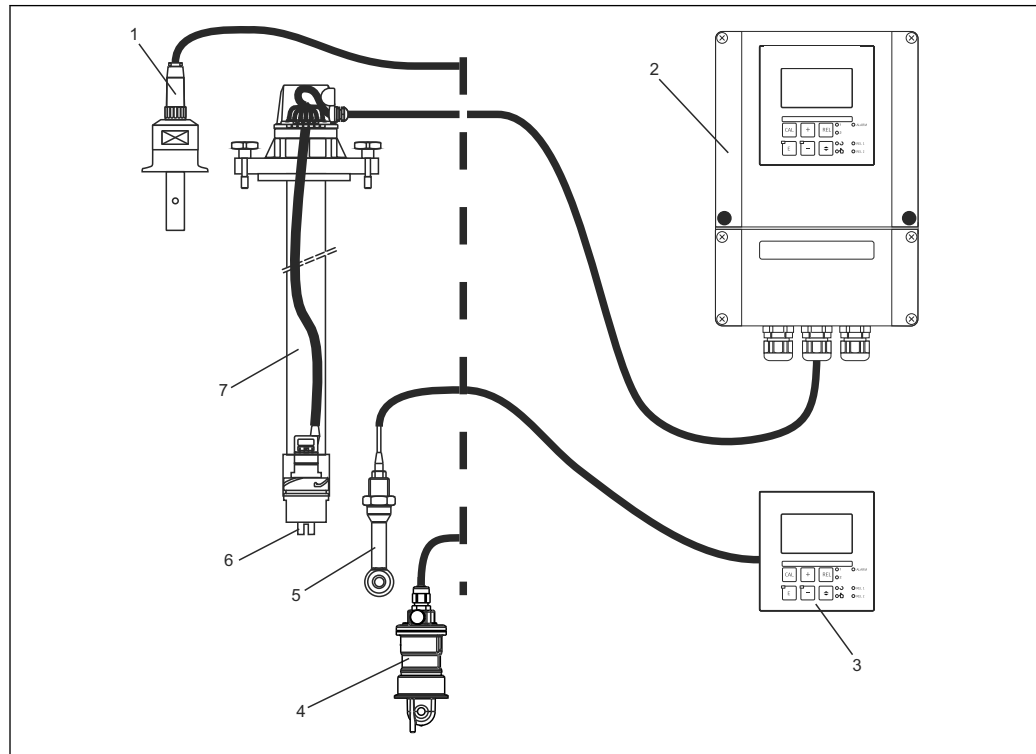
Measuring system

A complete measuring system comprises:

- Transmitter Liquisys M CLM223 or CLM253
- sensor with or without an integrated temperature sensor
- If necessary, measuring cable: CYK71 or CPK9 (conductive measurement) or CLK5 (inductive measurement)

Optionally:

- Immersion assembly, e.g. CLA111
- Extension cable, junction box VBM
- Weather protection cover CYY101 for field housing



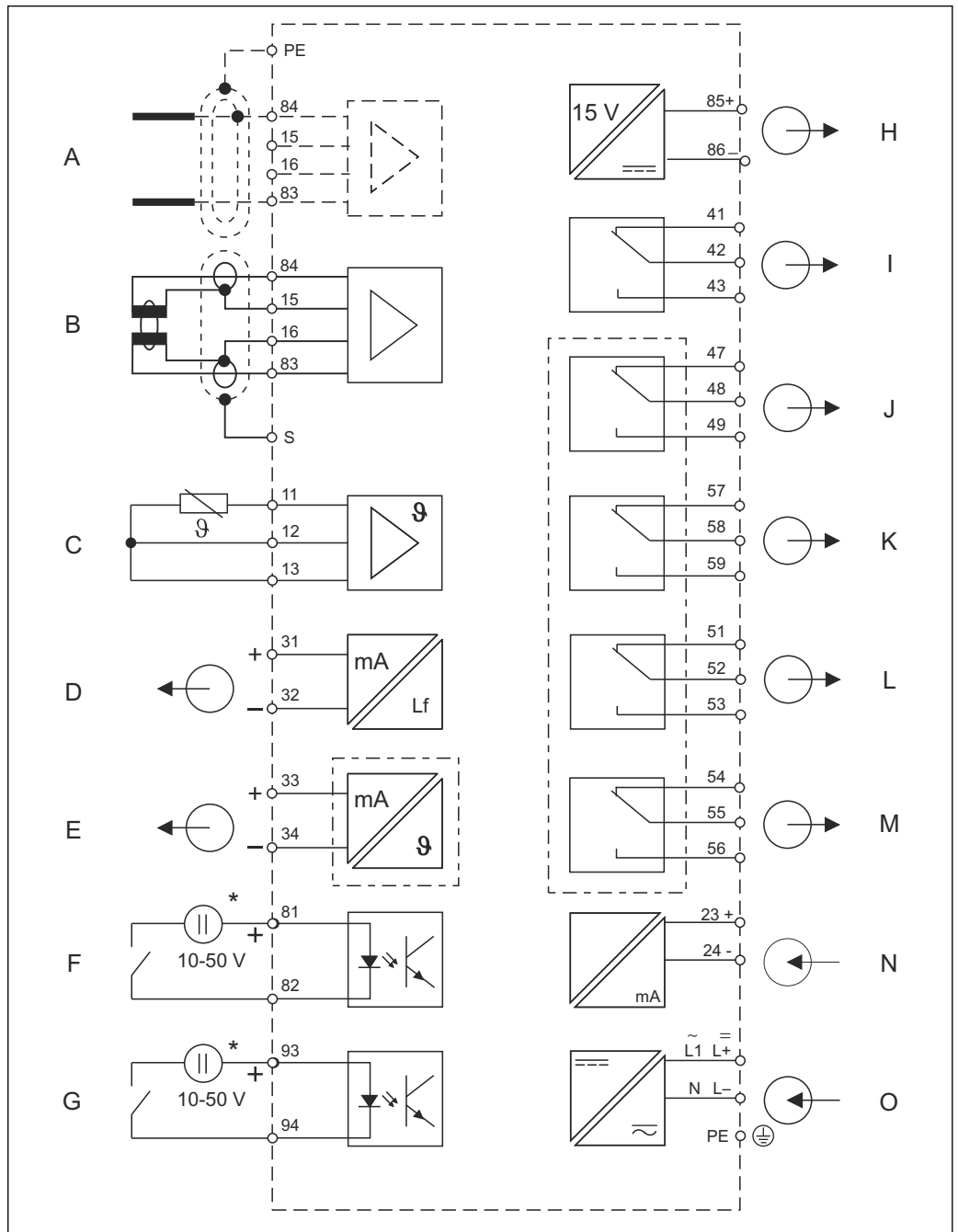
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1 Complete measuring systems

- 1 Conductive sensor CLS15
- 2 Liquisys M CLM253
- 3 Liquisys M CLM223
- 4 Inductive sensor CLS54
- 5 Inductive sensor CLS50
- 6 Conductive sensor CLS21
- 7 Immersion assembly CLA111

Equipment architecture

Block diagram



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2 Block diagram

- | | | | |
|---|--|---|---|
| A | Sensor (conductive) | I | Alarm (current-free contact position) |
| B | Sensor (inductive) | J | Relay 1 (current-free contact position) |
| C | Temperature sensor | K | Relay 2 (current-free contact position) |
| D | Signal output 1, conductivity | L | Relay 3 (current-free contact position) |
| E | Signal output 2, user-definable variable | M | Relay 4 (current-free contact position) |
| F | Binary input 1 (hold) | N | Current input 4 to 20 mA |
| G | Binary input 2 (Chemoclean) | O | Power supply |
| H | Auxiliary voltage output | * | Auxiliary voltage, terminal 85/86 can be used |

Dependability

Reliability

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)

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.

Second current output

The second current output can be flexibly configured to output the temperature, the main measured value (conductivity, resistance, concentration) or the controller actuating variable.

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.

Integrity

Temperature compensation

The temperature compensation options are: linear, NaCl curve according to IEC 746, ultrapure water NaCl (neutral compensation) or ultrapure water HCl (acid compensation, also for ammonia).

The reference temperature is user-definable, the standard value is 25 °C (77 °F).

Polarization detection (Plus package)

Polarization effects in the boundary layer between the sensor and the medium limit the measuring range of conductive conductivity sensors.

The transmitter can detect polarization effects using a smart signal evaluation process.

Adaptive calibration for determining the installation factor (inductive sensor, Plus package)

The measured value changes if inductive sensors must be installed in narrow pipes at a short distance from the pipe wall. The built-in adaptive calibration using the installation factor allows you to compensate for this once the sensor is installed.

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.

Ultrapure water monitoring according to USP (United States Pharmacopoeia) and EP (European Pharmacopoeia) (Plus package)

Ultrapure water monitoring according to USP <645> or EP means that the uncompensated conductivity and the temperature are measured and the results are compared against a table. The transmitter (conductive with additional contacts) has the following functions:

- Monitoring of "Water for Injection" (WFI) according to USP and EP
- Monitoring of "Highly Purified Water" (HPW) according to EP
- Monitoring of "Purified Water" (PW) according to EP

The **user-configurable pre-alarm** indicates undesired operating states in good time. To comply with USP or EP requirements, it is necessary to use a sensor that measures with highest precision, e.g. CLS16.

Input

Measured values	Conductivity Resistivity Temperature	
Measuring ranges	Conductivity (conductive)	0 to 600 mS/cm (uncompensated)
	Conductivity (inductive)	0 to 2000 mS/cm (uncompensated)
	Resistance	0 to 200 MΩcm
	Concentration	0 to 9999 (% , ppm, mg/l, TDS)
	Temperature	-35 to +250 °C (can also be displayed in °F)
Cell constant	Configurable cell constant	k = 0.0025 to 99.99 cm ⁻¹
Measuring frequency	Conductivity, resistance (conductive)	170 Hz to 2 kHz
	Conductivity (inductive)	2 kHz
Connectable temperature sensors	Pt 100, Pt 1000, NTC 30K	
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	Conductivity	Configurable
	Resistivity	Configurable
	Concentration	Configurable
	actuating variable	Configurable
	Temperature	Configurable
Signal resolution	Max. 700 digits/mA	
Minimum spread of output signal	Conductivity	
	Measured value 0 to 1.999 $\mu\text{S/cm}$	0.2 $\mu\text{S/cm}$
	Measured value 0 to 19.99 $\mu\text{S/cm}$	2 $\mu\text{S/cm}$
	Measured value 20 to 199.9 $\mu\text{S/cm}$	20 $\mu\text{S/cm}$
	Measured value 200 to 1999 $\mu\text{S/cm}$	200 $\mu\text{S/cm}$
	Measured value 2 to 19.99 mS/cm	2 mS/cm
	Measured value 20 to 2000 mS/cm	20 mS/cm
	Resistance	
	Measured value 0 to 199.9 k Ωcm	20 k Ωcm
	Measured value 200 to 1999 k Ωcm	200 k Ωcm
	Measured value 2 to 19.99 M Ωcm	2.0 M Ωcm
	Measured value 20 to 200 M Ωcm	20 M Ωcm
	Concentration	No minimum turndown
	Temperature	15 $^{\circ}\text{C}$
Separation voltage	Max. 350 V _{RMS} / 500 V DC	
Auxiliary voltage output	Output voltage	15 V \pm 0.6 V
	Output current	Max. 10 mA
Contact outputs	Switching current with ohmic load ($\cos \varphi = 1$)	Max. 2 A
	Switching current with inductive load ($\cos \varphi = 0.4$)	Max. 2 A
	Switching voltage	Max. 250 V AC, 30 V DC
	Switching power with ohmic load ($\cos \varphi = 1$)	Max. 500 VA AC, 60 W DC
	Switching power with inductive load ($\cos \varphi = 0.4$)	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	Conductivity/resistance/concentration/ temperature/USP/EP: entire 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	0092 _h (inductive measurement), 0093 _h (conductive measurement)
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	1515 _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	1521 _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: <ul style="list-style-type: none"> ■ 100/115/230 V AC +10/-15 %, 48 to 62 Hz ■ 24 V AC/DC +20/-15 %
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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
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Mains fuse	Fine-wire fuse, semi-delay 250 V/3.15 A
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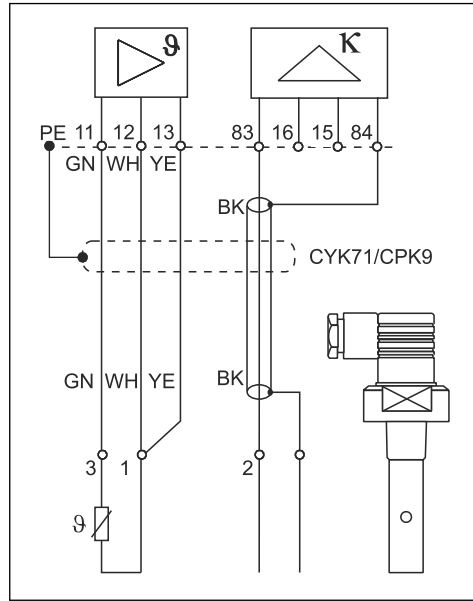
Circuit breaker	NOTICE	
	<p>The device does not have a power switch</p> <ul style="list-style-type: none"> ▶ The customer must provide a protected circuit breaker in the vicinity of the device. ▶ The circuit breaker must be a switch or power switch, and you must label it as the circuit breaker for the 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 (conductive)	Conductivity: max. 100 m (330 ft) (CYK71) Resistance: max. 15 m (49 ft) (CYK71)
	Cable length (inductive)	Max. 55 m (180 ft) (CLK5)
	CYK71 cable resistance	165 Ω/km (conductivity measurement)

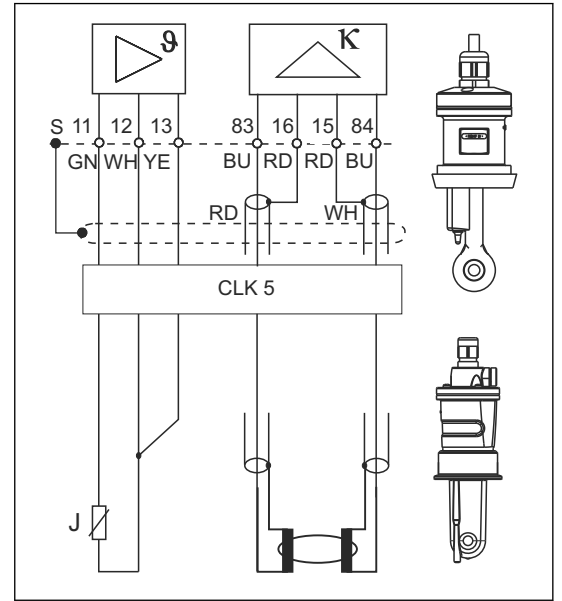
Overvoltage protection	According to EN 61000-4-5
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Sensor connection

You require shielded special measuring cables to connect conductivity sensors to the transmitter. Use a junction box and an extension cable to extend the measuring cable (see Accessories).




3 Connection of conductive sensors



4 Connection of inductive sensors

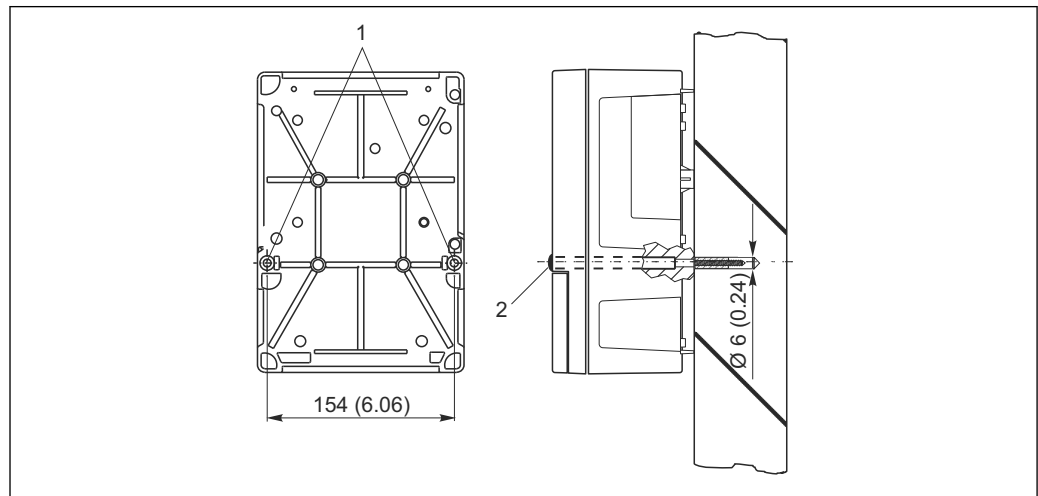
Performance characteristics

Reference operating conditions	Reference temperature:	25 °C (77 °F)
Measured value resolution	Conductivity	Depends on measured value; 0.001 µS/cm up to a measured value of 1.999 µS/cm and $k \leq 0.5 \text{ cm}^{-1}$
	Temperature	0.1 °C
Maximum measured error	Display	
	Conductivity	Max. 0.5 % of measured value ± 4 digits
	Resistance	Max. 0.5 % of measured value ± 4 digits
	Temperature	Max. 1.0 % of measuring range
	Signal output	
	Conductivity	Max. 0.75 % of current output range
	Resistance	Max. 0.75 % of current output 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 measured value ± 2 digits	
Temperature compensation	Range	-35 to +250 °C (-30 to 480 °F)
	Types of compensation	Uncompensated, linear, NaCl, table Conductive only: ultrapure water NaCl, ultrapure water HCl
Offset	Temperature	±5 °C for adjusting the temperature display

Installation

Installation instructions

Field device wall mounting

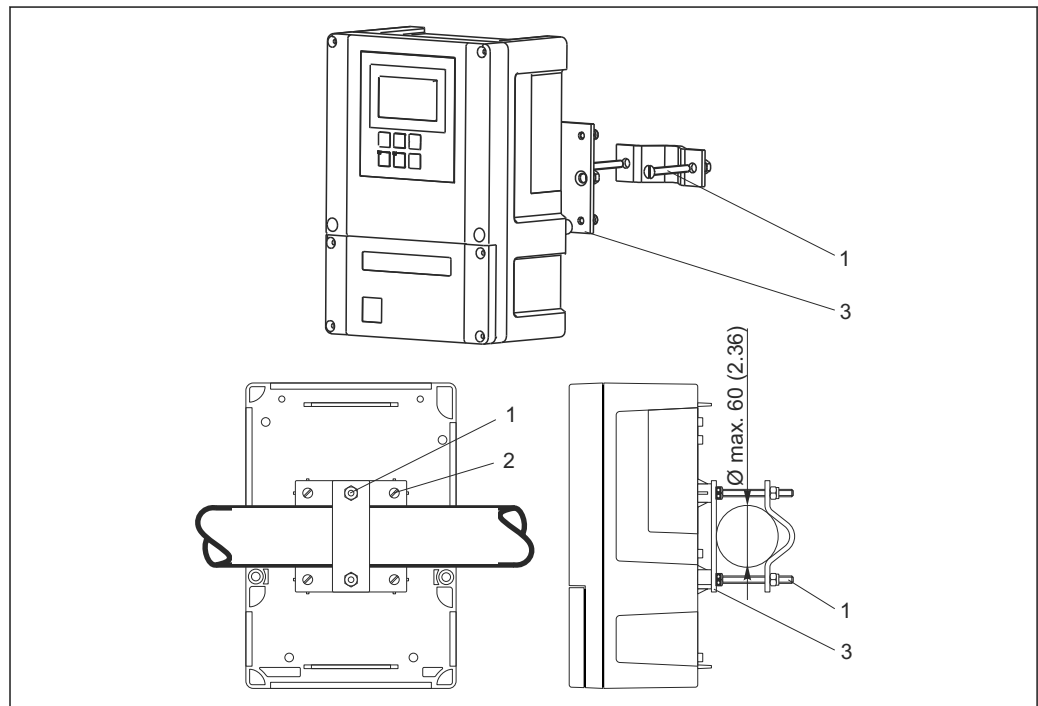


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5 Field device wall mounting

- 1 Fixing bore holes
- 2 Plastic caps

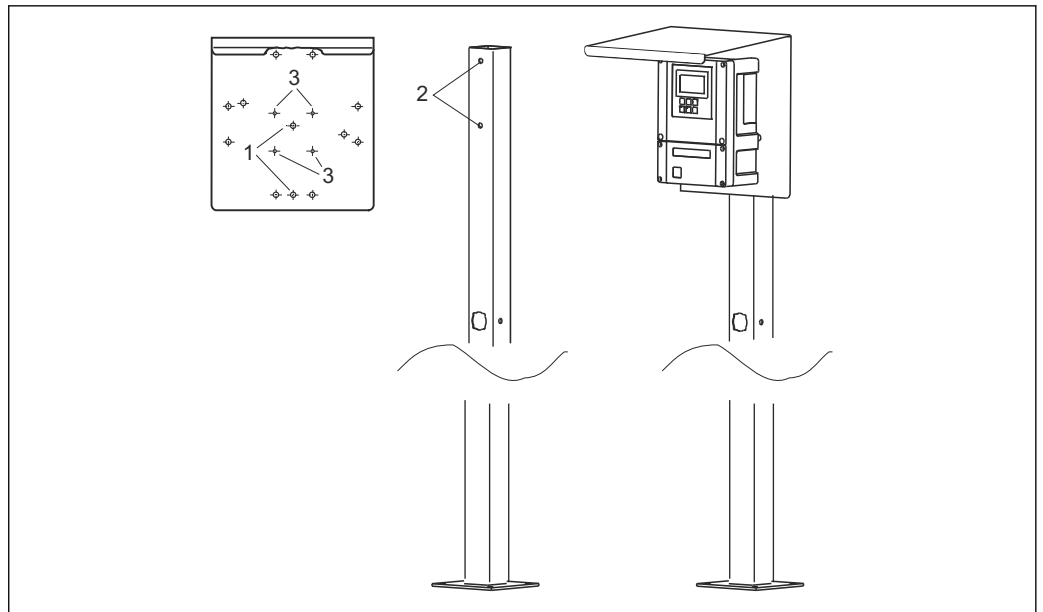
Field device post mounting



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6 Field device on horizontal or vertical pipes

- 1 Securing screws
- 2 Fixing screws
- 3 Securing plate

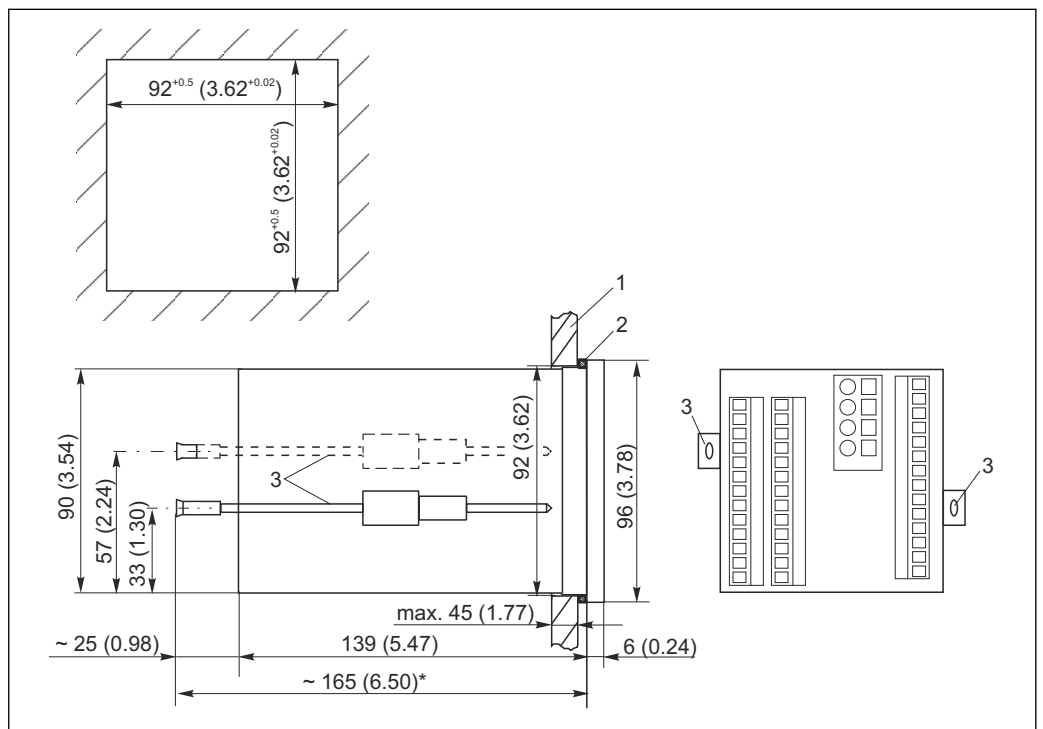


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7 Field device with universal post and weather protection cover

- 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



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8 Dimensions in mm (inch)

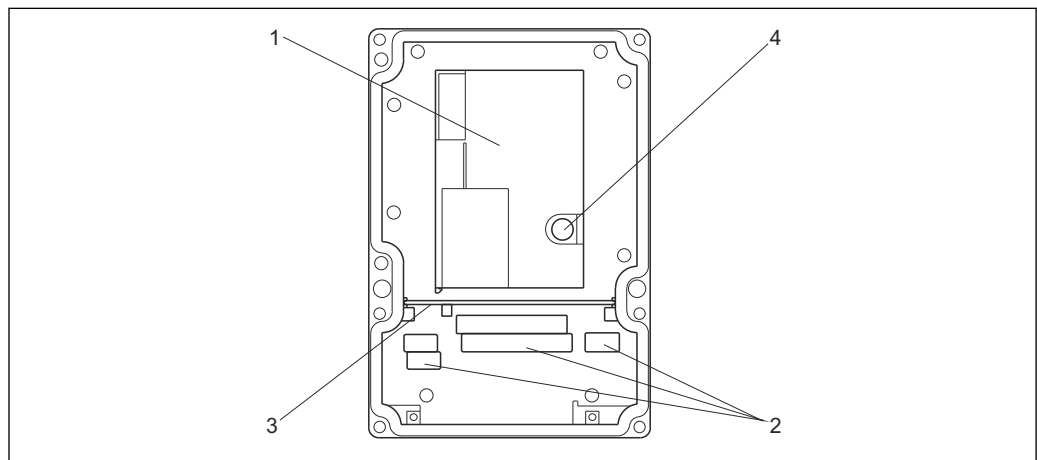
- 1 Mounting plate
- 2 Seal
- 3 Tensioning screws
- * Necessary installation depth

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 Panel-mounted device	IP 65 / integrity according to NEMA 4X 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

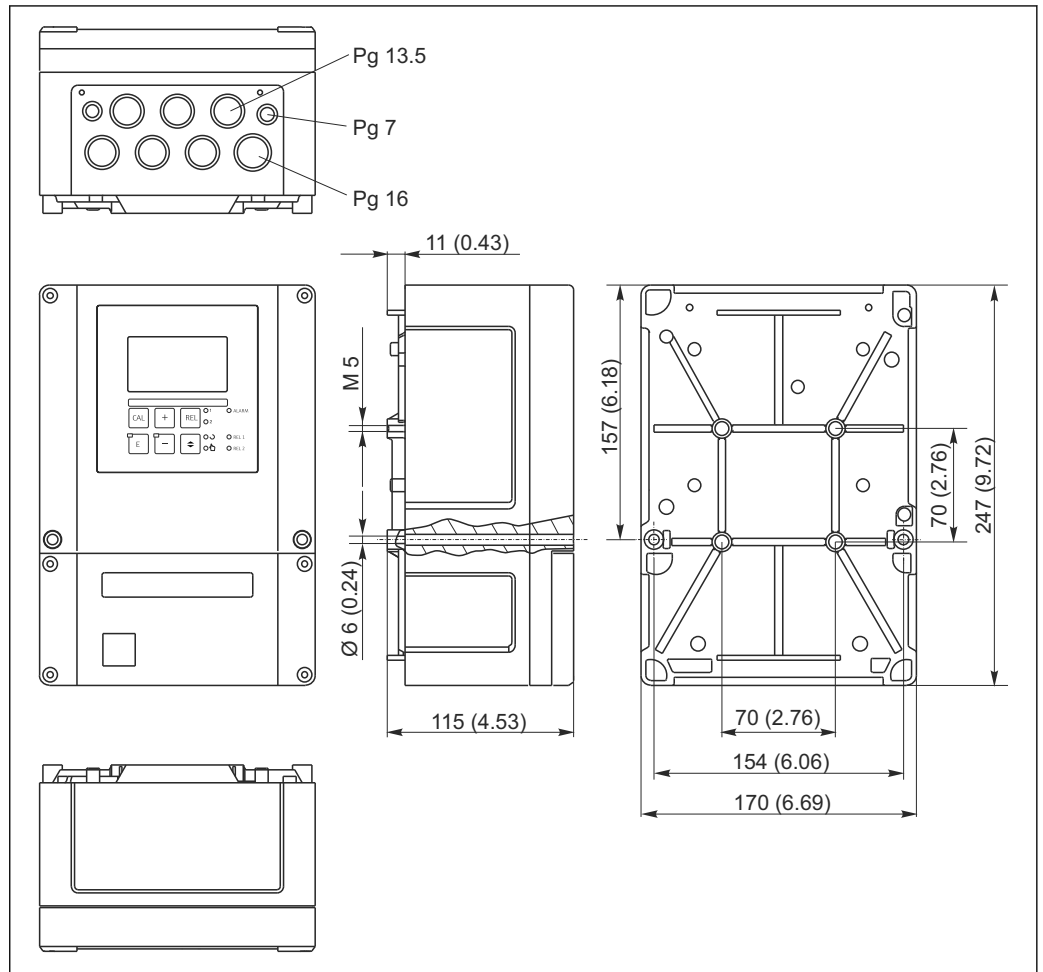


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9 View into the field device housing

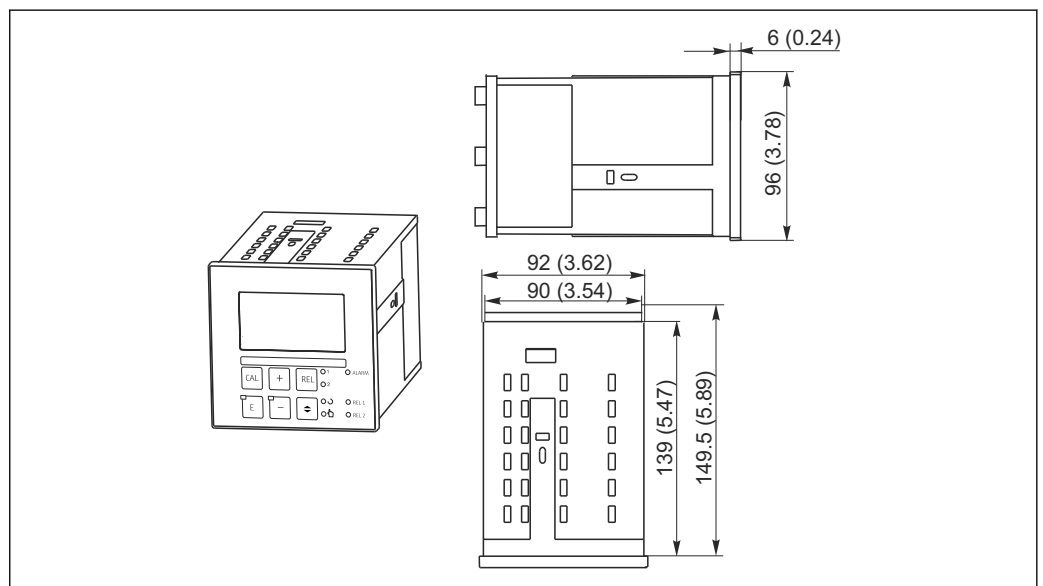
- 1 Removable electronics box
- 2 Terminals
- 3 Partition plate
- 4 Fuse

Dimensions



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10 Field device: dimensions in mm (inch)



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

Weight

Panel-mounted device

Max. 0.7 kg (1.54 lbs.)

Field device

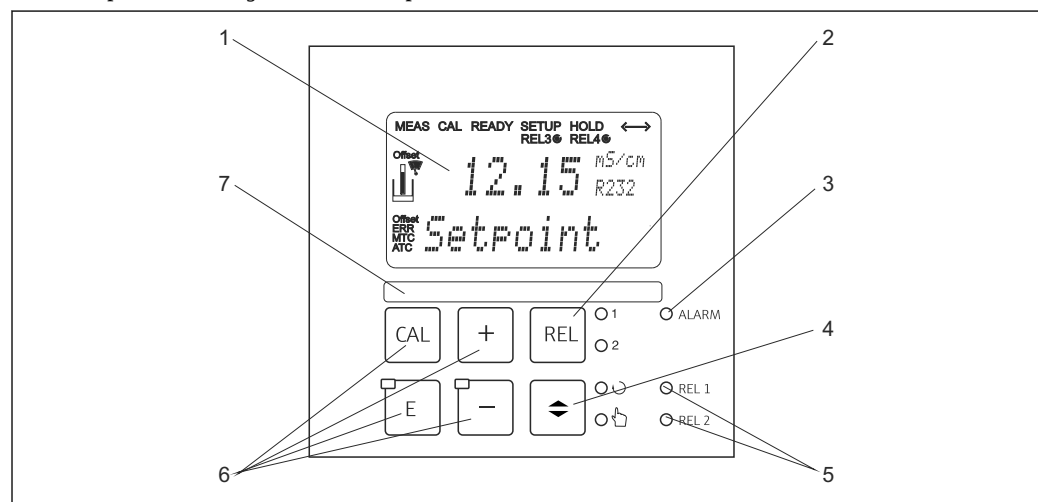
Max. 2.3 kg (5.07 lbs.)

Materials	Panel-mounted device housing	Polycarbonate
	Field housing	ABS PC FR
	Front membrane	Polyester, UV-resistant
Terminals	Cable cross-section	Max. 2.5 mm ² (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.



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12 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:

- CLM253-**2/3/7***
- CLM223-**2/3/7***

Ordering information

Product page

www.endress.com/clm223

www.endress.com/clm253

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 CLM253
- 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 CLM223
- 1 set of plug-in screw terminals
- 2 tensioning screws
- 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

Sensors with conductive measurement of conductivity

Condumax CLS12

- Conductive conductivity sensor
- For pure water, Ex and high-temperature applications
- Product Configurator on the product page: www.endress.com/CLS12



Technical Information TI00082C

Condumax CLS13

- Conductive conductivity sensor
- For pure water, Ex and high-temperature applications
- Product Configurator on the product page: www.endress.com/CLS13



Technical Information TI00083C

Condumax CLS15

- Conductive conductivity sensor
- For pure water applications, ultrapure water applications and Ex applications
- Product Configurator on the product page: www.endress.com/CLS15



Technical Information TI00109C

Condumax CLS16

- Hygienic, conductive conductivity sensor
- For pure water applications, ultrapure water applications and Ex applications
- With EHEDG and 3A approval
- Product Configurator on the product page: www.endress.com/CLS16



Technical Information TI00227C

Condumax CLS19

- Cost-effective, conductive conductivity sensor
- For applications with pure and ultrapure water
- Product Configurator on the product page: www.endress.com/CLS19



Technical Information TI00110C

Condumax CLS21

- Two-electrode sensor in plug-in head and fixed cable version
- Product Configurator on the product page: www.endress.com/CLS21



Technical Information TI00085C

Sensors with inductive measurement of conductivity

Indumax CLS50

- High-durability inductive conductivity sensor
- For standard, hazardous and high-temperature applications
- Product Configurator on the product page: www.endress.com/CLS50



Technical Information TI182C

Indumax CLS52

- Inductive conductivity sensor
- Short response times for the food industry
- Product Configurator on the product page: www.endress.com/CLS52



Technical Information TI00167C

Indumax CLS54

- Inductive conductivity sensor
- For standard and hazardous area applications, available with hygienic design for food, beverages, pharmaceuticals and biotechnology
- Product Configurator on the product page: www.endress.com/CLS54

 Technical Information TI00400C

Connection accessories

Measuring cable CYK71

- Unterminated cable for connecting analog sensors and for extending sensor cables
- Sold by the meter, order numbers:
 - Non-Ex version, black: 50085333
 - Ex-version, blue: 50085673

Measuring cable CLK6

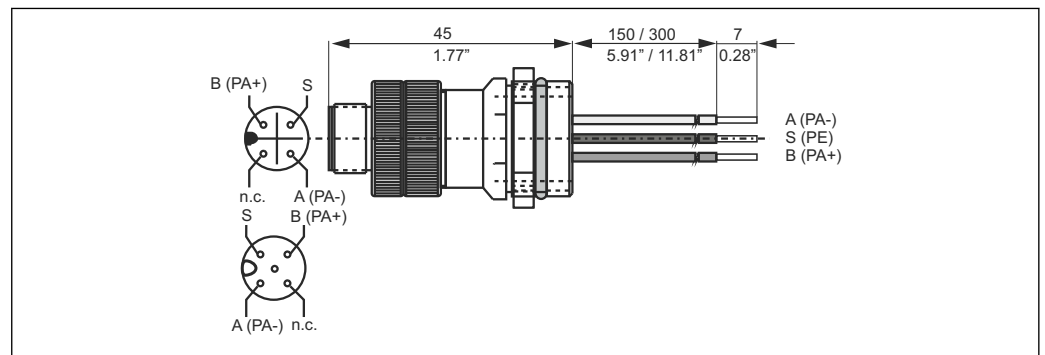
- Extension cable for inductive conductivity sensors, for extension via VBM junction box
- Sold by the meter, order number: 71183688

VBM

- Junction box for cable extension
- 10 terminal strips
- Cable entries: 2 x Pg 13.5 or 2 x NPT 1/2"
- Material: aluminum
- Degree of protection: IP 65
- Order numbers
 - Cable entries Pg 13.5 : 50003987
 - Cable entries NPT 1/2": 51500177

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

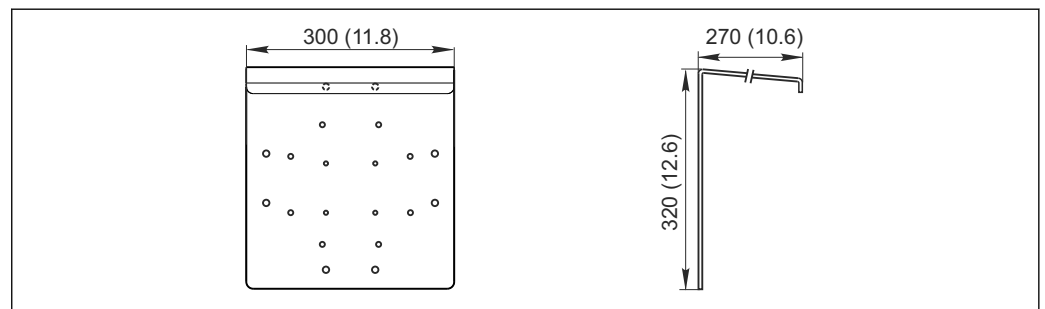


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Installation accessories

CYY101

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

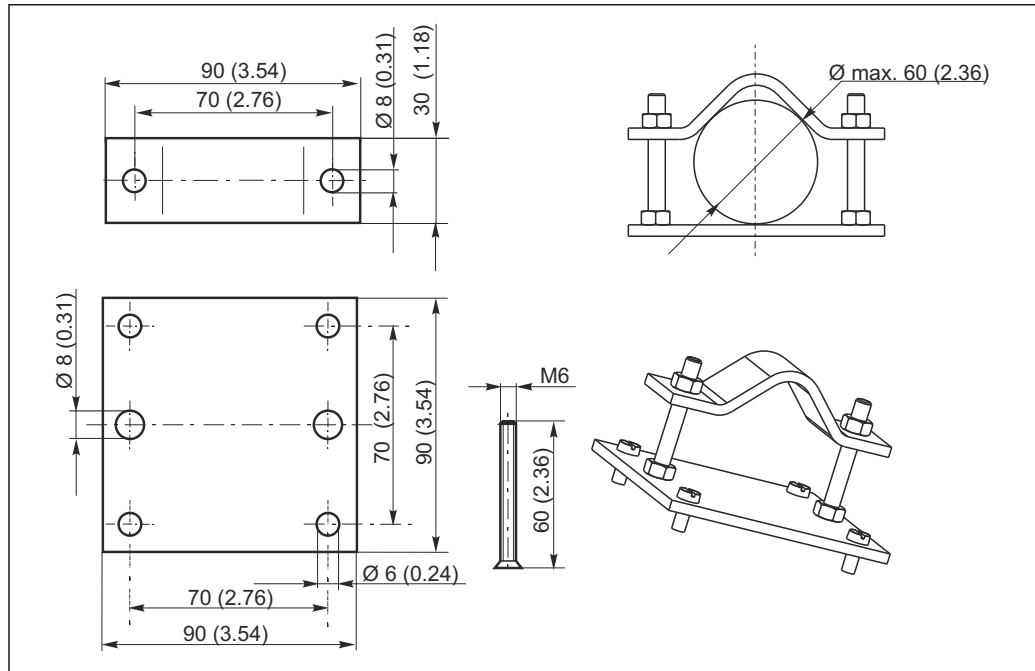


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 13 Dimensions in mm (inch)

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

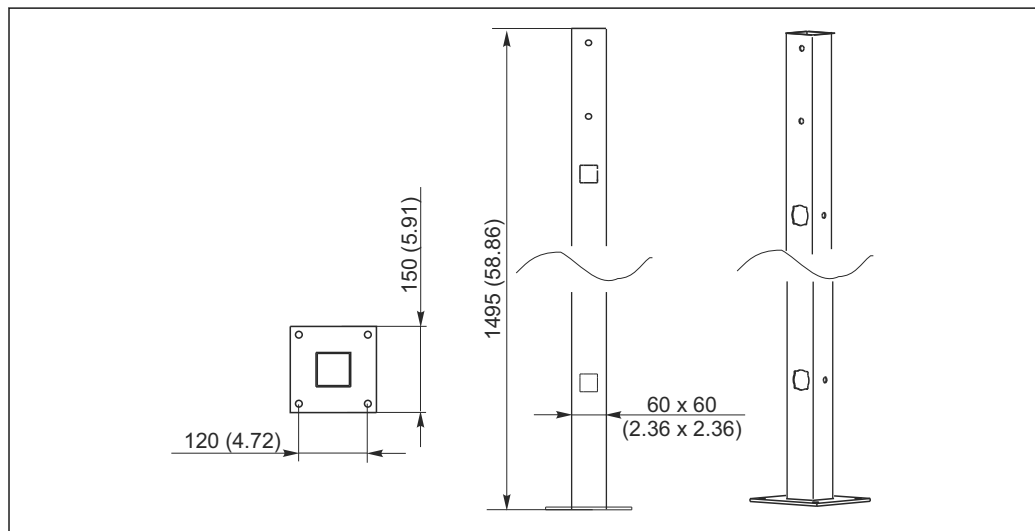


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14 Dimensions in mm (inch)

Universal post CY102

- Square pipe for mounting transmitters
- Material: stainless steel 1.4301 (AISI 304)
- Order No. CY102-A



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15 Dimensions in mm (inch)

www.addresses.endress.com
