

# Technical Information

## Liquisys M CUM223/253

### Turbidity and suspended solids transmitter



#### Application

- Sewage treatment plants, suspended solids measurement
- Wastewater treatment
- Water treatment and drinking water monitoring
- Surface water: rivers, lakes, ocean
- Service water

#### Your benefits

- Field or panel-mounted housing
- Universal application
  - One instrument for turbidity and suspended solids
  - Units: FNU (formazine standard), ppm, g/l, % or % SS
- Simple handling
  - Logically arranged menu structure
  - Ultrasimple calibration with user samples and alarm signalling for calibration errors
- Safe operation
  - Overvoltage (lightning) protection
  - Manual contact control and user-defined alarm configuration
  - Automatic sensor self-recognition with calibration data transfer

The basic unit can be extended with:

- 2 or 4 additional contacts for use as:
  - Limit contacts (also for temperature)
  - P(ID) controller
  - Timer for simple rinse processes
  - Complete cleaning with Chemoclean
- Plus package:
  - Any current output configuration via table
  - Automatic cleaning start
  - Display in customer units (e.g. density) via table assignment
  - Live check of sensor
- HART or PROFIBUS PA / DP
- 2nd current output for temperature, main measured value or actuating variable
- Current input for flow rate monitoring with controller shut off or for feedforward control

---

## Function and system design

---

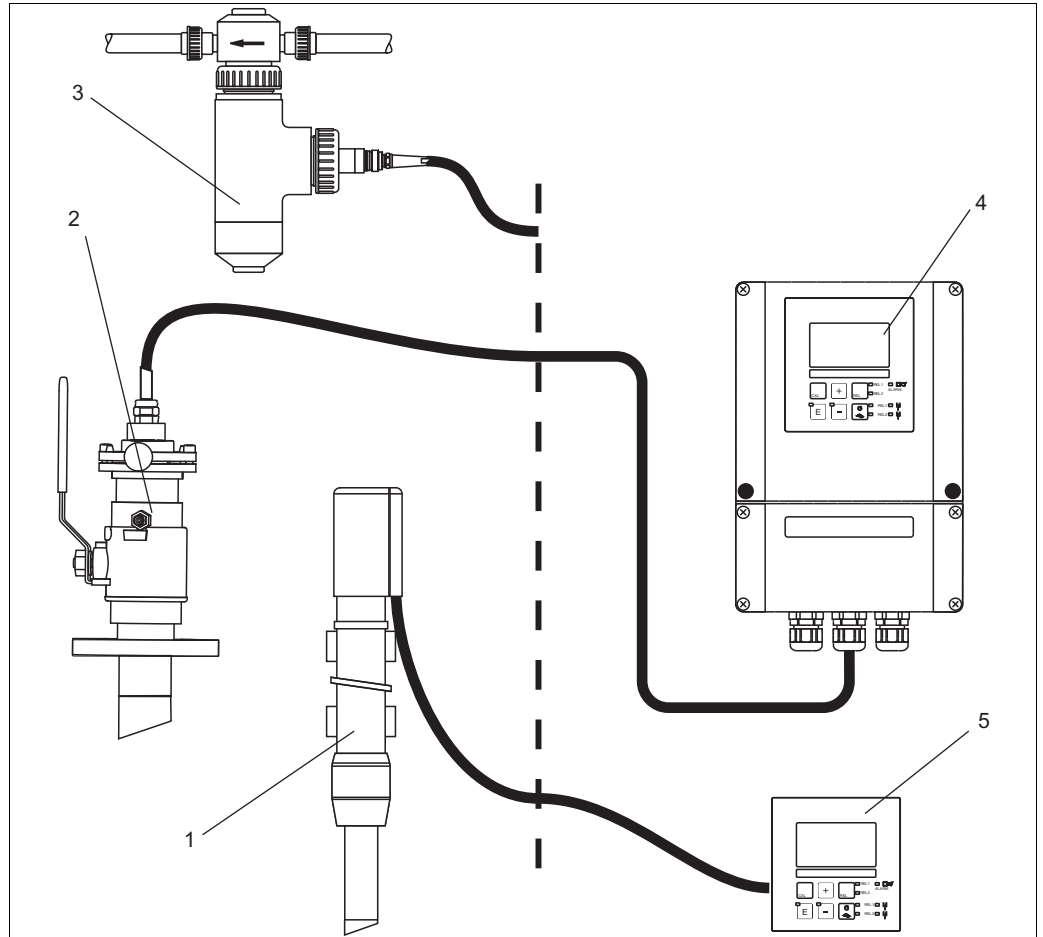
<b>Features of the basic version</b>	<p><b>Measurement of turbidity and suspended solids</b></p> <p>The sensor is selected from the menu. During measurement, the value measured can be displayed in the other measuring mode. The <b>temperature</b> is displayed at the same time if desired.</p> <p><b>Configuration</b></p> <p>Different alarms are required depending on application and operator. Therefore the transmitter permits independent <b>configuration of the alarm contact and error current</b> for each individual error. Unnecessary or undesirable alarms can be suppressed in this manner. <b>Up to four contacts Up to two contacts</b> can be used as limit contacts (also for temperature), to implement a P(ID) controller or for cleaning functions.</p> <p>Direct <b>manual operation of the contacts</b> (bypassing the menu) provides quick access to limit, control or cleaning contacts, permitting speedy correction of deviations.</p> <p>The <b>serial numbers</b> of the instrument and modules and the order code can be called up on the display.</p>
<b>Additional functions of the Plus package TS</b>	<p><b>Current output configuration</b></p> <p>In order to output wide measuring ranges while still achieving a high resolution in specific ranges, the <b>current output</b> can be configured as required via a table. This permits <b>bilinear</b> or <b>quasi-logarithmic</b> curves, etc.</p> <p><b>Process Check System (PCS)</b></p> <p>It comprises two independent safety functions:</p> <ul style="list-style-type: none"> <li>▪ Errors in applications <b>without</b> control are detected by monitoring the limit between plausible and implausible measured values, i.e. <b>the alarm threshold</b>.</li> <li>▪ Errors in applications <b>with</b> control are detected by the <b>controller monitor</b> which monitors freely adjustable, maximum permissible time intervals and reference value overshoot or undershoot.</li> </ul> <p><b>Live check</b></p> <p>The live check issues an alarm when the sensor signal does not change over a defined period of time. This may be caused by blocking, passivation, separation from the process, etc.</p>
<b>Additional functions of version TS</b>	<p><b>Display of various measurement units</b></p> <p>In addition to turbidity (FNU, NTU) and concentration (ppm / % SS), the display can also show other units (e.g. density). A table is used for conversion (calibration in %).</p>
<b>Second current output</b>	<p>The second current output can be configured for temperature, main measured value (turbidity, suspended solids) or actuating variable.</p>
<b>Current input</b>	<p>The current input of the transmitter allows two different applications: controller shut-down in case of lower flow rate violation or total failure in the main flow as well as feedforward control. Both functions are also combinable.</p>

**Measuring system**

A complete measuring systems comprises:

- The transmitter Liquisys M CUM223 or CUM253
- A sensor with or without an integrated temperature sensor
- An immersion, flow or retractable assembly

Options: extension cable CYK81, junction box VBM or RM



- 1 Immersion assembly CYA611
- 2 Retractable assembly CUA451
- 3 Assembly with gas bubble trap

- 4 Liquisys CUM253
- 5 Liquisys CUM223

a0003125

## Input

<b>Measured variables</b>	Turbidity, suspended solids, temperature	
<b>Measuring range</b>	CUS31:	0.000 to 9999 FNU/NTU 0.00 to 3000 ppm 0.0 to 3.0 g/l 0.0 to 200.0 %
	CUS41:	0.00 to 9999 FNU/NTU 0.00 to 9999 ppm 0.0 to 300.0 g/l 0.0 to 200.0 %
	Temperature:	-5.0 to +70.0 °C (+23 to +158 °F)
<b>Cable specification</b>	Cable length:	max. 200 m (656 ft.)
<b>Signal input</b>	Digital communication	
<b>Temperature measurement</b>	NTC 30 kΩ at 25 °C (77 °F)	
<b>Binary inputs</b>	Voltage:	10 to 50 V
	Power consumption:	max. 10 mA
<b>Current input</b>	4 to 20 mA, galvanically separated Load: 260 Ω at 20 mA (voltage drop 5.2 V)	

## Output

**Output signal** 0/4 to 20 mA, galvanically separated, active

HART	
Signal coding	Frequency Shift Keying (FSK) + 0.5 mA via current output signal
Data transfer rate	1200 Baud
Galvanic isolation	yes

PROFIBUS PA	
Signal coding	Manchester Bus Powered (MBP)
Data transfer rate	31.25 kBit/s, voltage mode
Galvanic isolation	yes (IO-Module)

PROFIBUS DP	
Signal coding	RS485
Data transfer rate	9.6 kBd, 19.2 kBd, 93.75 kBd, 187.5 kBd, 500 kBd, 1.5 MBd
Galvanic isolation	yes (IO-Module)

**Signal on alarm** 2.4 or 22 mA in case of an error

**Load** maximum 500  $\Omega$

**Transmission range** CUS31/CUS41: adjustable, min.  $\Delta$  0.1 FNU,  $\Delta$  0.1 ppm,  $\Delta$  0.1 g/l,  $\Delta$  0.1 %  
Temperature: adjustable,  $\Delta$  10 to  $\Delta$  100 % of measuring range

**Resolution** max. 700 digits/mA

**Isolation voltage** max. 350 V<sub>RMS</sub>/500 V DC

**Overvoltage protection** according to EN 61000-4-5

**Auxiliary voltage output** Output voltage: 15 V  $\pm$  0.6  
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 contactor** Pickup/dropout delay: 0 to 2000 s

---

<b>Controller</b>	Function (adjustable):	pulse length/pulse frequency controller
	Controller response:	PID
	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 for pulse length controller:	0.5 to 999.9 s
	Frequency for pulse frequency controller:	60 to 180 $\text{min}^{-1}$
	Basic load:	0 to 40% of max. set value

---

<b>Alarm</b>	Function (selectable):	Latching / momentary contact
	Alarm threshold adjustment range:	Turbidity / suspended solids / temperature: complete measuring range
	Alarm delay:	0 to 2000 s 0 to 2000 min

## Protocol specific data

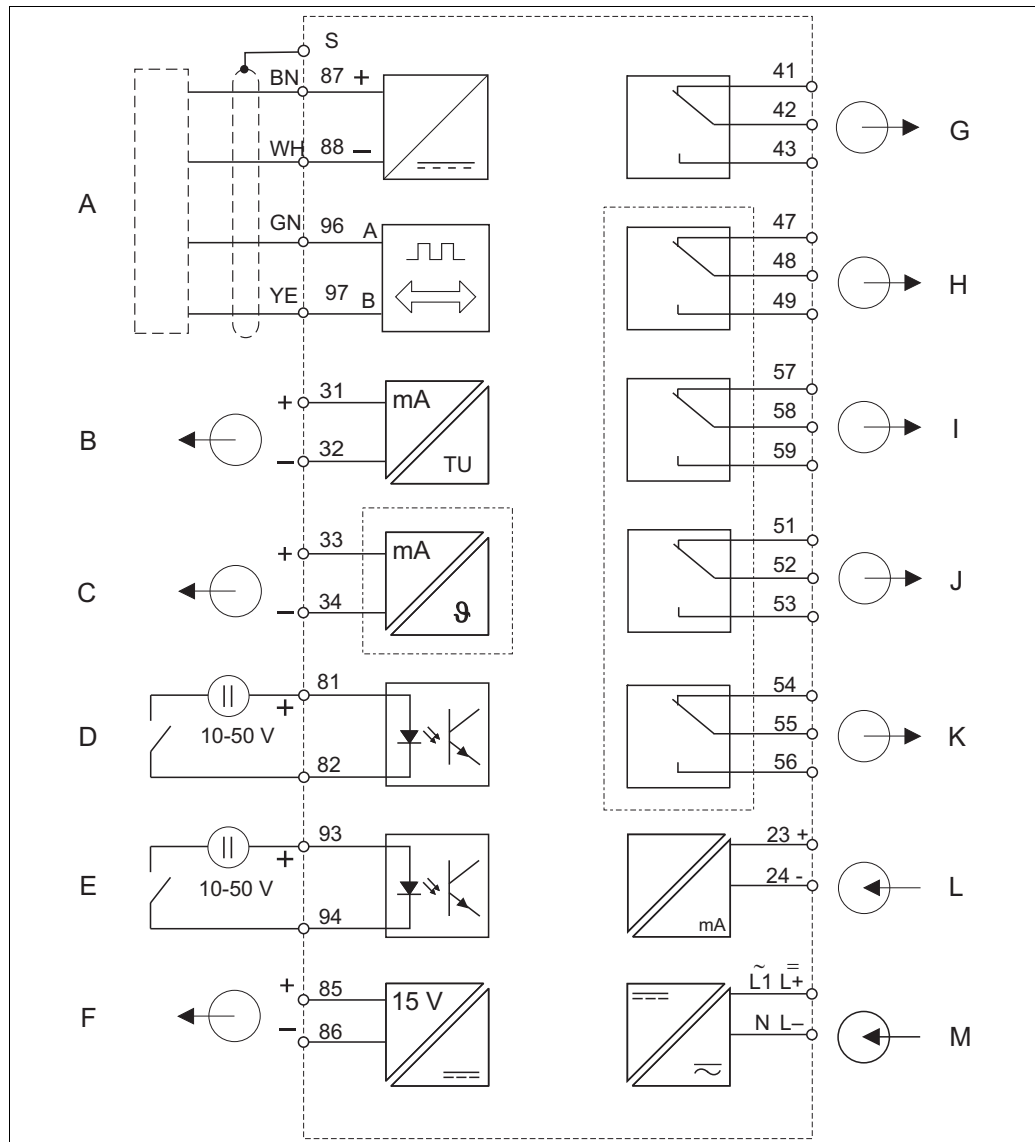
<b>HART</b>	
Manufacturer ID	11 <sub>h</sub>
Device type code	0095 <sub>h</sub>
Transmitter specific revision	0001 <sub>h</sub>
HART specification	5.0
DD files	<a href="http://www.products.endress.com/hart">www.products.endress.com/hart</a>
Load HART	250 Ω
Device variables	None (dynamic variables PV, SV, only)
Features supported	-

<b>PROFIBUS PA</b>	
Manufacturer ID	11 <sub>h</sub>
Ident number	1517 <sub>h</sub>
Device revision	11 <sub>h</sub>
Profile version	2.0
GSD files	<a href="http://www.products.endress.com/profibus">www.products.endress.com/profibus</a>
GSD file version	
Output values	Main value, temperature value
Input values	Display value of PLC
Features supported	Device locking: The device can be locked by hardware or software.

<b>PROFIBUS DP</b>	
Manufacturer ID	11 <sub>h</sub>
Ident number	151F <sub>h</sub>
Profile version	2.0
GSD files	<a href="http://www.products.endress.com/profibus">www.products.endress.com/profibus</a>
GSD file version	
Output values	Main value, temperature value
Input values	Display value of PLC
Features supported	Device locking: The device can be locked by hardware or software.

## Power supply

### Electrical connection



a00091226

#### Electrical connection of the transmitter

A	Sensor	H	Relay 1 (current-free contact position)
B	Signal output 1 turbidity/solids content	I	Relay 2 (current-free contact position)
C	Signal output 2 temperature	J	Relay 3 (current-free contact position)
D	Binary input 1 (Hold)	K	Relay 4 (current-free contact position)
E	Binary input 2 (Chemoclean)	L	Current input 4 to 20 mA
F	Aux. voltage output	M	Power supply
G	Alarm (current-free contact position)		



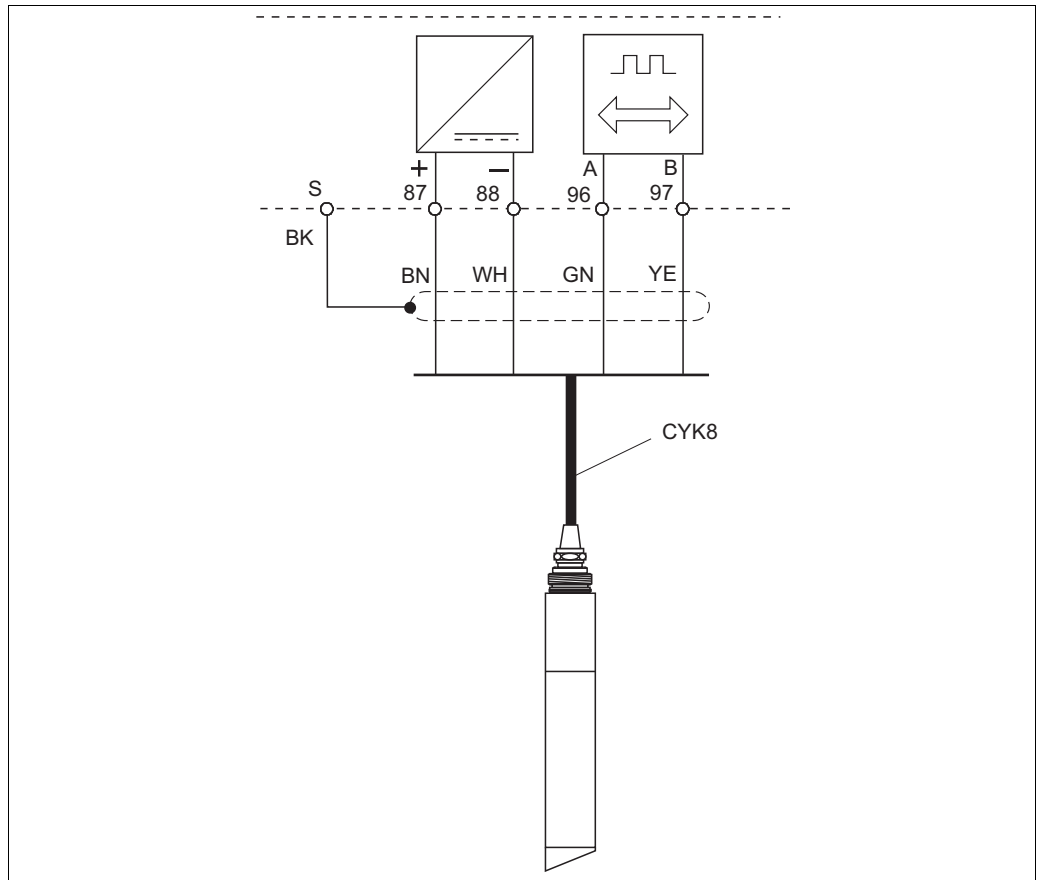
The device is approved for protection class II and is generally operated without a protective ground connection.

The circuits "C" and "F" are not galvanically isolated from each other.



**Sensor cable**

The sensors are delivered with measuring cables. Use a junction box and an extension cable to extend the measuring cable (see "Accessories")



Connection of the turbidity sensors CUS31 and CUS41

a0003129

**Supply voltage**

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

**Fieldbus connection**

HART	
Supply voltage	n/a, active current outputs
Integrated reverse voltage protection	n/a, active current outputs

PROFIBUS PA	
Supply voltage	9 V to 32 V, max. 35 V
Polarity sensitive	no
FISCO/FNICO compliant acc. to IEC 60079-27	no

PROFIBUS DP	
Supply voltage	9 V to 32 V, max. 35 V
Polarity sensitive	n/a
FISCO/FNICO compliant acc. to IEC 60079-27	no

<b>Power consumption</b>	max. 7.5 VA
<b>Mains protection</b>	Fine-wire fuse, medium-slow blow 250 V/3.15 A

**Circuit breaker****NOTICE****The device does not have a power switch**

- ▶ You must provide a protected circuit breaker in the vicinity of the device.
- ▶ This must be a switch or a power-circuit breaker 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.

## Performance characteristics

<b>Measured value resolution</b>	CUS31:	0.001 FNU/NTU, 0.01 ppm, 0.01 g/l, 0.01 %
	CUS41:	0.01 FNU/NTU, 0.01 ppm, 0.01 g/l, 0.01 %
	Temperature:	0.1 °C

<b>Maximum measured error<sup>1)</sup></b>	Display	
	CUS31/CUS41:	± 2 % of measured value (min. 0.02 FNU)
	Temperature:	max. 1.0 % of measuring range
	Signal output	
CUS31/CUS41:	1 % of current output range (min. 0.02 FNU)	
Temperature:	max. 1.25 % of current output range	

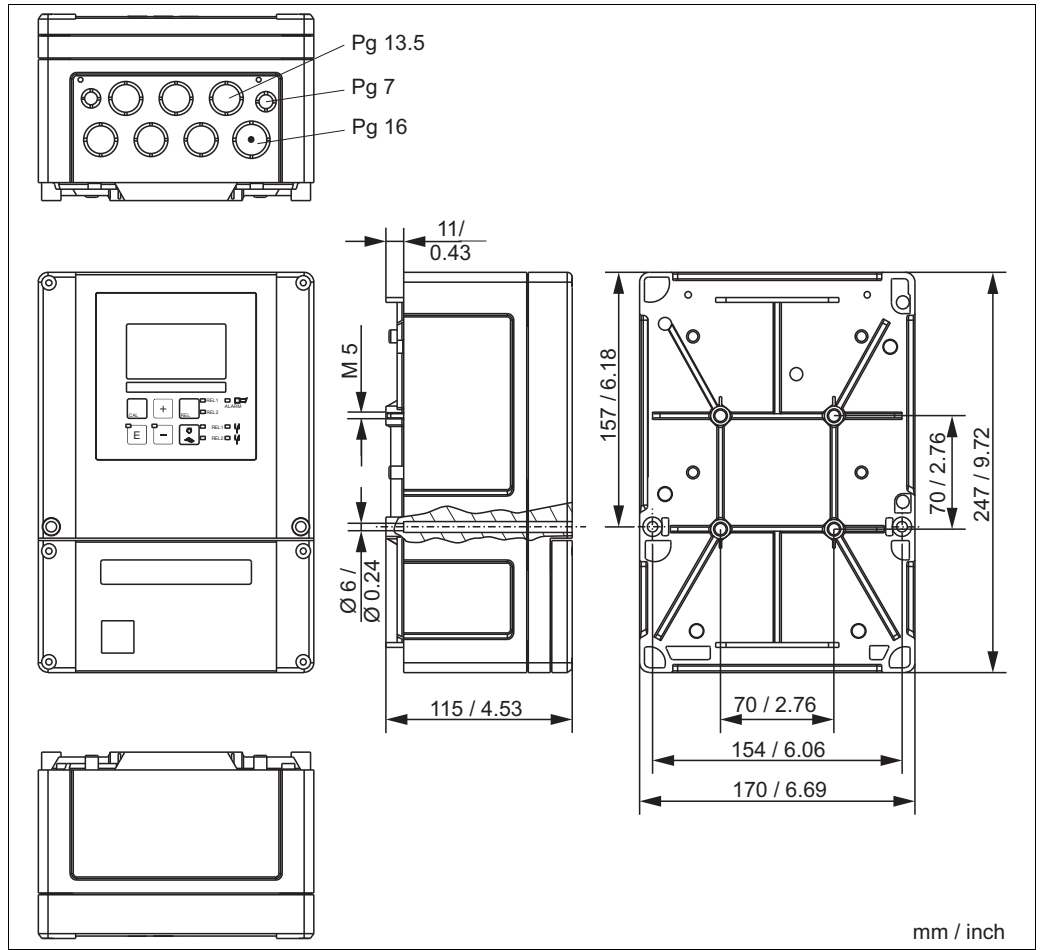
<b>Repeatability<sup>2)</sup></b>	± 1 % of measured value (min. 0.01 FNU)
-----------------------------------	---

1) acc. to IEC 746-1, for nominal operating conditions

2) acc. to IEC 746-1, for nominal operating conditions

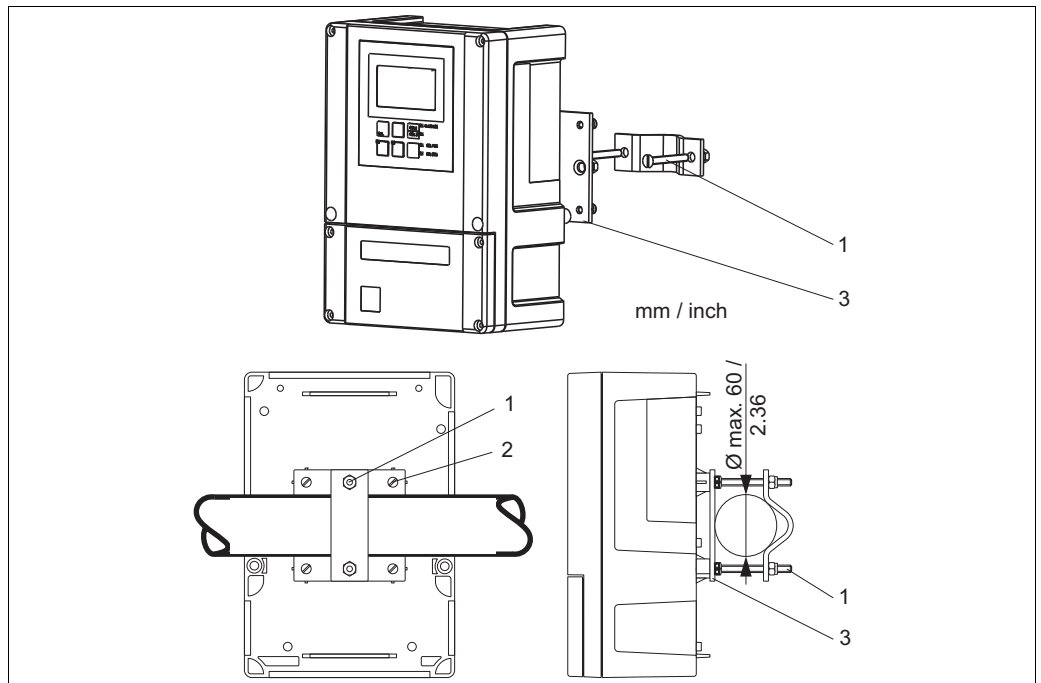
# Installation

## Installation instructions



a0005733

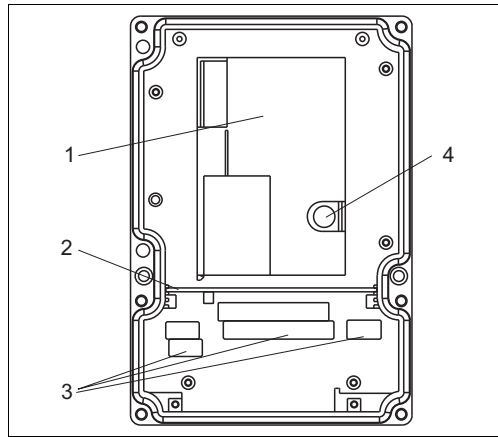
## Field instrument



a0005737

## Mounting on pipes

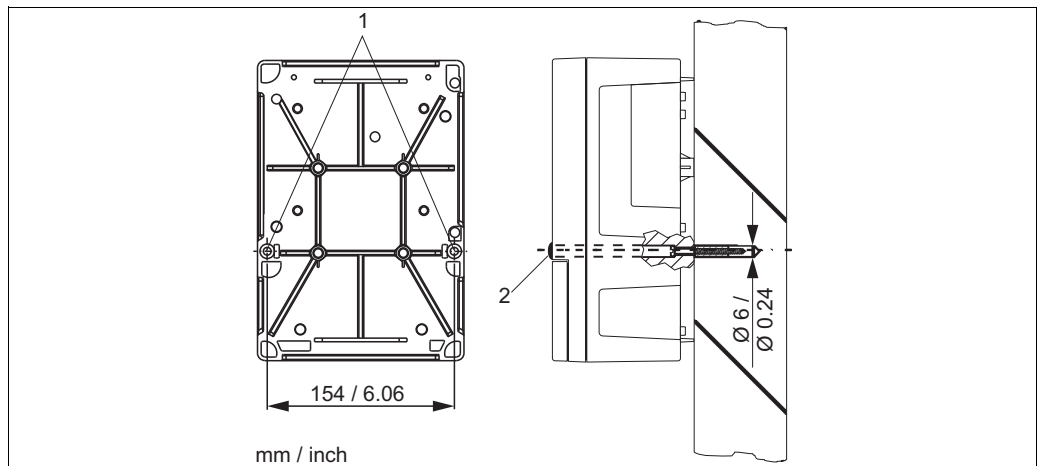
1 - 3 Mounting screws and mounting plate



- 1 Removable electronics box
- 2 Partition plate
- 3 Terminal blocks
- 4 Fuse

a0005734

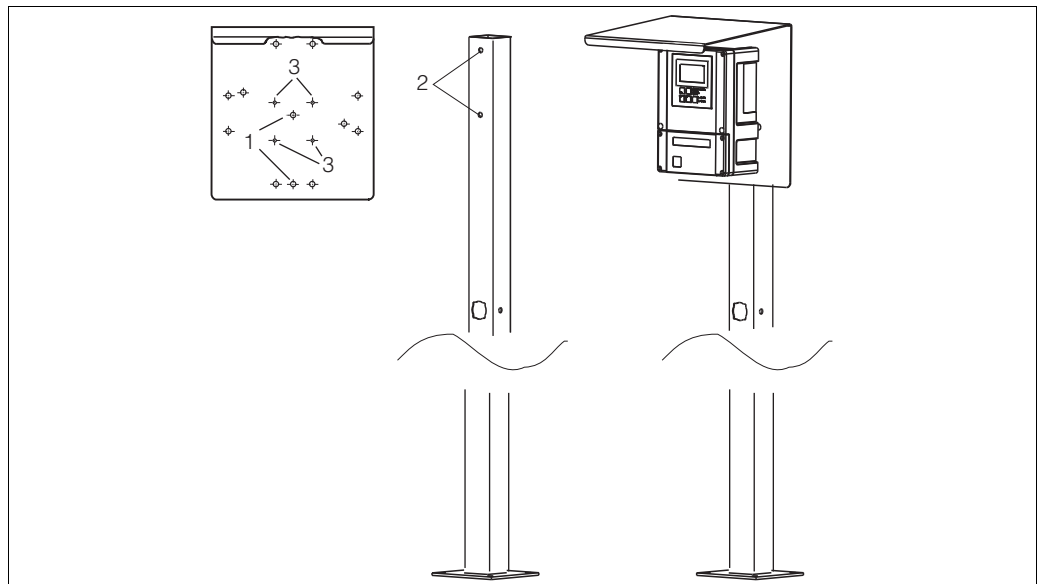
View into the field instrument



a0005736

Wall mounting of the field instrument

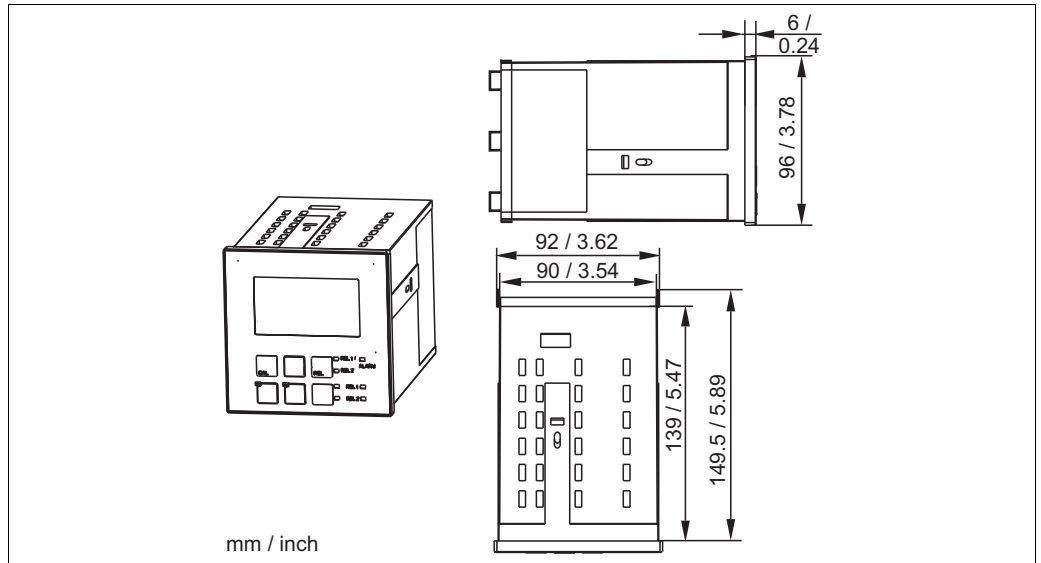
- 1 Mounting holes
- 2 Protecting cap



a0005738

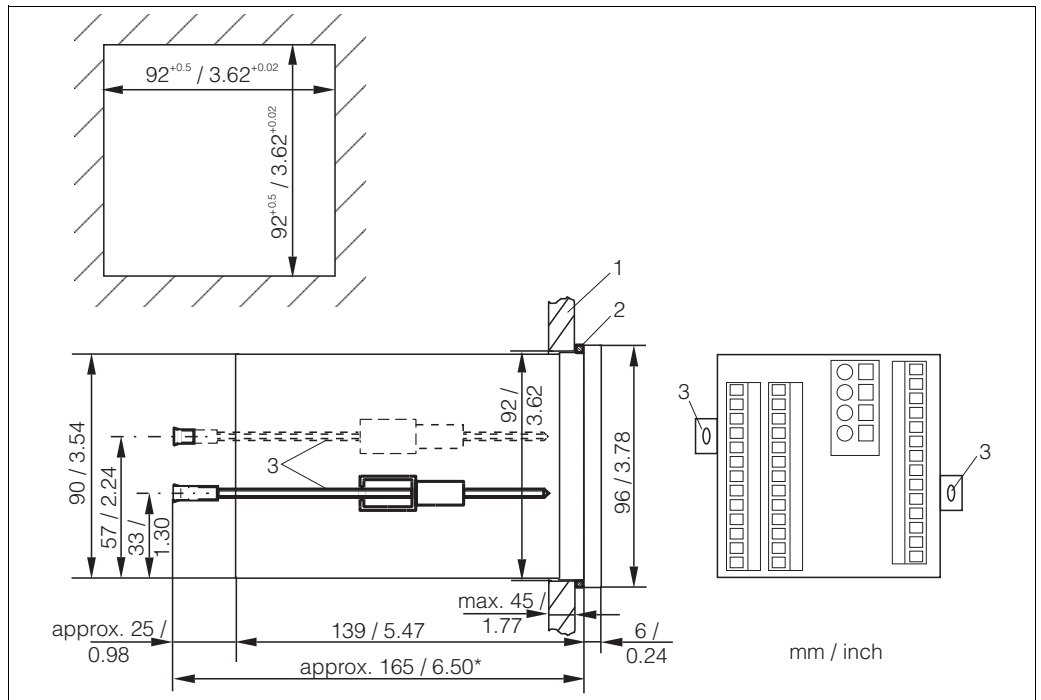
Mounting of the field instrument with mounting post and weather protection cover

- 1 - 3 Mounting holes



a0005735

Dimensions panel-mounted instrument



a0005739

Installation of the panel-mounted instrument

- 1 Wall of control cabinet
- 2 Gasket
- 3 Tensioning screws
- \* Required installation depth

## Environment

<b>Ambient temperature</b>	-10 to +55 °C (+14 to +131 °F)	
<b>Storage temperature</b>	-25 to +65 °C (-13 to +149 °F)	
<b>Electromagnetic compatibility</b>	Interference emission and interference immunity as per EN 61326-1:2006, EN 61326-2-3:2006	
<b>Ingress protection</b>	Panel mounted instrument: Field instrument:	IP 54 (front), IP 30 (housing) IP 65 / tightness acc. to NEMA 4X
<b>Electrical safety</b>	according EN/IEC 61010-1:2001, Installation Category II, for use up to 2000 m above sea level	
<b>CSA</b>	Apparatus with CSA General Purpose Approval are certified for indoor use.	
<b>Relative humidity</b>	10 to 95%, non-condensing	
<b>Pollution degree</b>	The product is suitable for pollution degree 2.	

## Mechanical construction

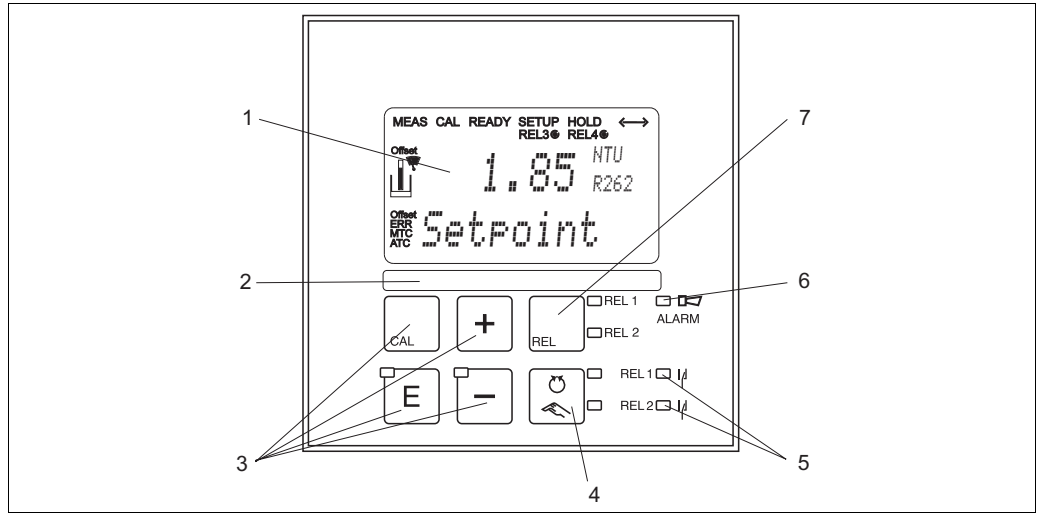
<b>Dimensions</b>	Panel-mounted instrument: Field instrument:	96 x 96 x 145 mm (3.78 x 3.78 x 5.71 inches) Installation depth: approx. 165 mm (6.50") 247 x 170 x 115 mm (9.72 x 6.69 x 4.53 inches)
<b>Weight</b>	Panel-mounted instrument: Field instrument:	max. 0.7 kg (1.5 lb) max. 2.3 kg (5.1 lb)
<b>Material</b>	Housing of panel-mounted instrument: Field housing: Front membrane:	Polycarbonate ABS PC Fr Polyester, UV-resistant
<b>Terminals</b>	Cross section	max. 2.5 mm <sup>2</sup> (14 AWG)

## Operability

### Operating concept

All instrument control functions are arranged in a logical menu structure. Following access code entry, the individual parameters can be easily selected and modified as needed.

### Display elements



#### Operating elements

- 1 LC display for displaying the measured values and configuration data
- 2 Field for user labelling
- 3 4 main operating keys for calibration and device configuration
- 4 Changeover switch for automatic/manual mode of the relays
- 5 LEDs for limit contactor relay (switch status)
- 6 LED for alarm function
- 7 Display of the active contact and key for relay changeover in manual mode

## Certificates and approvals

### CE symbol

#### Declaration of conformity

The product meets the requirements of the harmonized European standards. It thus complies with the legal requirements of the EC directives.

The manufacturer confirms successful testing of the product by affixing the CE symbol.

### CSA General Purpose

#### CSA General Purpose

The products listed below are eligible to bear the CSA Mark shown with adjacent indicators "C" and "US":

Version	Approval
CUM253-..2... CUM253-..3... CUM253-..7...	CSA Mark for Canada and USA
CUM223-..2... CUM223-..3... CUM223-..7...	CSA Mark for Canada and USA

## Ordering information

### Order code

Enter the following address into your browser to access the relevant product page:  
[www.products.endress.com/cum223](http://www.products.endress.com/cum223) or  
[www.products.endress.com/cum253](http://www.products.endress.com/cum253)

1. You can choose from the following options on the product page located on the right:

Product page function
:: Add to product list
:: Price & order information
:: Compare this product
:: Configure this product

2. Click "Configure this product".
3. The configurator opens in a separate window. You can now configure your device and receive the complete order code that applies for the device.
4. Afterwards, export the order code as a PDF or Excel file. To do so, click the appropriate button at the top of the page.

### Product structure

Input, software version	
TB	Suspended solids with factory setup > residual concrete water
TU	Turbidity and suspended solids measurement
TS	Turbidity and suspended solids measurement, with additional functions (Plus package)
Power supply; approval	
0	230 V AC
1	115 V AC
2	230 V AC; CSA Gen. Purp.
3	115 V AC; CSA Gen. Purp.
5	100 V AC
7	24 V AC/DC; CSA Gen. Purp.
8	24 V AC/DC
Output	
0	1 x 20 mA, primary value
1	2 x 20 mA, primary value + secondary value
3	PROFIBUS PA
4	PROFIBUS DP
5	1 x 20 mA, primary value, HART
6	2 x 20 mA, primary value, HART + secondary value
Additional contacts	
05	not selected
10	2 relays (limit/P(ID)/timer)
15	4 relays (limit/P(ID)/Chemoclean) <b>(not with PROFIBUS DP)</b>
16	4 relays (limit/P(ID)/timer) <b>(not with PROFIBUS DP)</b>
20	1 x 4 to 20 mA input + 2 relays (limit/P(ID)/timer)
25	1 x 4 to 20 mA input + 4 relays (limit/P(ID)/Chemoclean) <b>(not with PROFIBUS DP)</b>
26	1 x 4 to 20 mA input + 4 relays (limit/P(ID)/timer) <b>(not with PROFIBUS DP)</b>
Marking	
1	Tagging (Tag), see additional spec.
CUM253-	
CUM223-	
complete order code	

### Additional functions of the Plus package

- Current output table to cover wide ranges with varying resolution, fields O33x
- Process Check System (PCS): live check of the sensor, function group P
- Concentration measurement, function group K
- Automatic cleaning function start, field F8



**Scope of delivery**

The delivery of the field instrument includes:

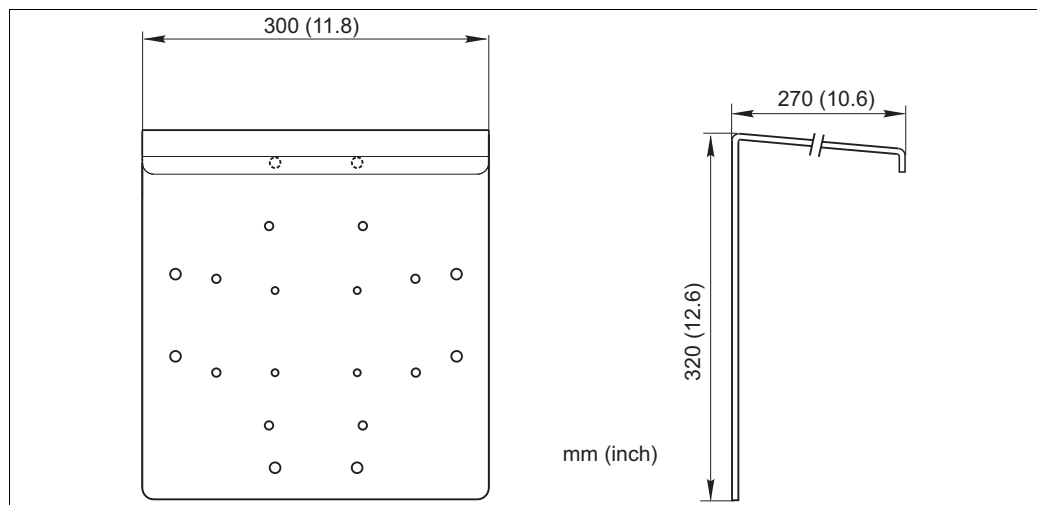
- 1 transmitter CUM253
- 1 plug-in screw terminal
- 1 cable gland Pg 7
- 1 cable gland Pg 16 reduced
- 2 cable glands Pg 13.5
- 1 Operating Instructions
- 1 Operating Instructions BA00200C/07/EN
- versions with HART communication:
  - 1 Operating Instructions Field Communication with HART, BA00208C/07/EN
- versions with PROFIBUS communication:
  - 1 Operating Instructions Field Communication with PROFIBUS PA/DP, BA00209C/07/EN

The delivery of the panel-mounted instrument includes:

- 1 transmitter CUM223
- 1 set of plug-in screw terminals
- 2 tensioning screws
- 1 Operating Instructions
- 1 Operating Instructions BA00200C/07/EN
- versions with HART communication:
  - 1 Operating Instructions Field Communication with HART, BA00208C/07/EN
- versions with PROFIBUS communication:
  - 1 Operating Instructions Field Communication with PROFIBUS PA/DP, BA00209C/07/EN

## Accessories

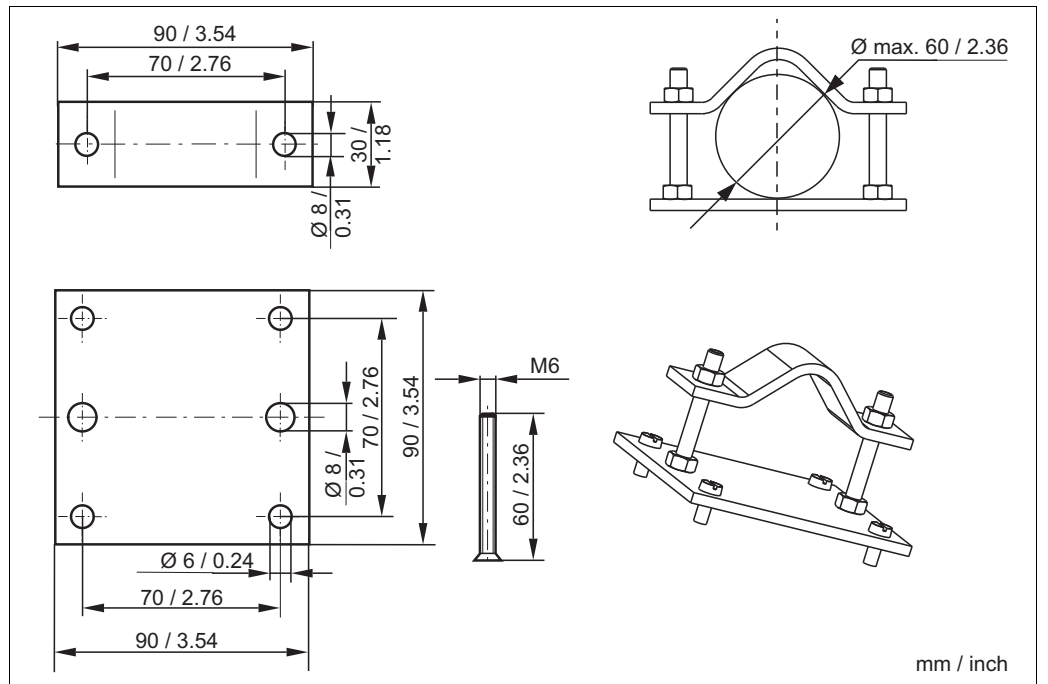
<b>Sensors</b>	<p>Turbimax W CUS31</p> <ul style="list-style-type: none"> <li>■ Turbidity sensor for drinking water and wastewater applications, 90 ° scattered light method</li> <li>■ Ordering acc. to product structure, see Technical Information (TI176C/07/en)</li> </ul> <p>Turbimax W CUS41</p> <ul style="list-style-type: none"> <li>■ Turbidity sensor for wastewater and solid content measurements, 90 ° scattered light method</li> <li>■ Ordering acc. to product structure, see Technical Information (TI177C/07/en)</li> </ul>
<b>Connection accessories</b>	<p>CYK81 measuring cable</p> <ul style="list-style-type: none"> <li>■ Non-terminated cable for extending the sensor cables (e.g. Memosens)</li> <li>■ 2x2 wires, twisted with shield and PVC sheath (2 x 2 x 0.5 mm<sup>2</sup> + shield)</li> <li>■ Goods sold by meter, order no.: 51502543</li> </ul> <p>Junction box RM</p> <ul style="list-style-type: none"> <li>■ For cable extension (e.g. for Memosens sensors)</li> <li>■ 5 terminals</li> <li>■ Cable entries: 2 x Pg 13.5</li> <li>■ Material: PC</li> <li>■ Ingress protection: IP 65</li> <li>■ Order no.: 51500832</li> </ul>
<b>Mounting accessories</b>	<p>CYY101 weather protection cover for field devices, absolutely essential if operating the unit outdoors</p> <ul style="list-style-type: none"> <li>■ Material: stainless steel 1.4031 (AISI 304)</li> <li>■ Order No. CYY101-A</li> </ul>



Weather protection cover for field devices

Post mounting kit

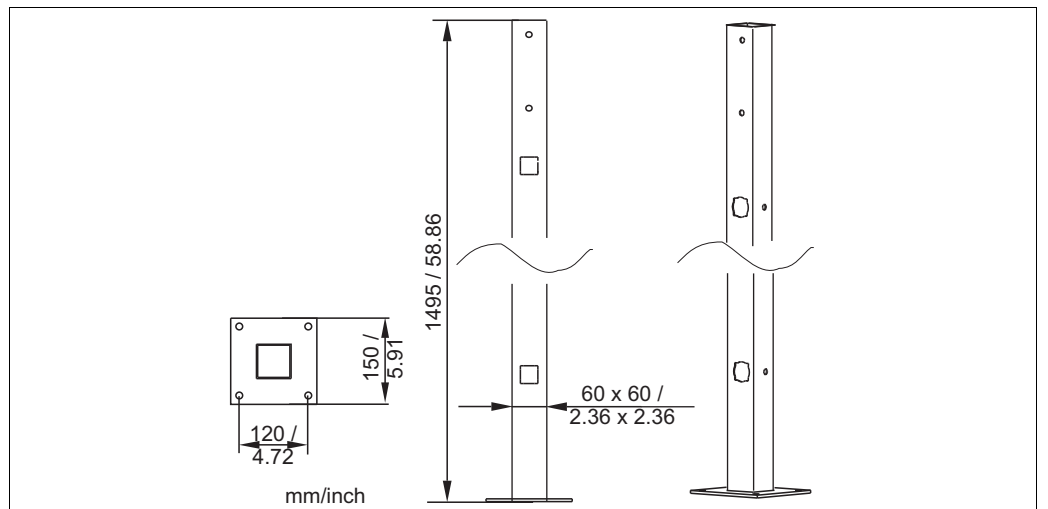
- For mounting of field housing on horizontal or vertical pipes ( $\varnothing$  max. 60 mm (2.36"))
- Material: stainless steel 1.4301
- order no. 50086842



Post mounting kit

CYY102 universal post

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



Universal post

[www.addresses.endress.com](http://www.addresses.endress.com)

---