

Special Documentation

Proline Promag 400

Custody transfer
Meter for drinking water
Modbus RS485



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1 About this document

1.1 Document function

This manual is Special Documentation that describes the use of the device in custody transfer measurement.

NOTICE

When installing:

- Follow the Operating Instructions for the device.

1.2 Using this document

1.2.1 Information on the document structure

 For more information on the arrangement of the parameters, along with a short description, according to the **Operation** menu, **Setup** menu, **Diagnostics** menu and the operating concept: see the Operating Instructions.

1.3 Symbols used

1.3.1 Symbols for certain types of information

Symbol	Meaning
	Tip Indicates additional information.
	Reference to documentation
	Reference to page
	Reference to graphic
	Notice or individual step to be observed
	Series of steps
	Result of a step

1.3.2 Symbols in graphics

Symbol	Meaning
1, 2, 3, ...	Item numbers
1 →, 2 →, 3 →, etc.	Series of steps of individual, consecutive images
	Series of steps within an image

Symbol	Meaning
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

1.4 Documentation



For an overview of the scope of the associated Technical Documentation, refer to the following:

- *Device Viewer* (www.endress.com/deviceviewer): Enter the serial number from the nameplate
- *Endress+Hauser Operations app*: Enter serial number from nameplate or scan matrix code on nameplate.

This manual is Special Documentation. It does not replace the Operating Instructions supplied with the device.

The Special Documentation is an integral part of the following Operating Instructions:

Measuring instrument	Documentation code
Promag W 400	BA01231D
Promag W 400	GP01045D



This Special Documentation is available:

In the Download Area of the Endress+Hauser Internet site: www.endress.com → Downloads

2 Basic safety instructions

2.1 Requirements for the personnel

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 starting work, read and understand the instructions in the manual and supplementary documentation as well as the certificates (depending on the application).
- ▶ Follow instructions and comply with basic conditions.

The operating personnel must fulfill the following requirements:

- ▶ Are instructed and authorized according to the requirements of the task by the facility's owner-operator.
- ▶ Follow the instructions in this manual.

3 Product description

The device consists of a transmitter and a sensor.

Two device versions are available:

- Compact version - transmitter and sensor form a mechanical unit.
- Remote version - transmitter and sensor are mounted in separate locations.

Two sensor versions are available for each transmitter.

Sensor version	Property
Standard	Continuous measuring tube
0 x DN inlet/outlet runs	Constricted measuring tube

The measuring instrument is optionally tested in accordance with OIML R 49:2013 (www.oiml.org) and has an EU type-examination certificate according to Measuring Instruments Directive 2014/32/EU (MID) for service subject to legal metrological control ("custody transfer") for cold water (Annex III).

Service is with a totalizer display subject to legal metrological control on the local display and, optionally, with a pulse output subject to legal metrological control.

Measuring instruments subject to legal metrological control totalize flow in both directions, i.e. all the outputs consider flow components in the positive (forward) and negative (reverse) flow direction.

Generally a measuring instrument subject to legal metrological control is secured against tampering by seals on the transmitter or sensor. These seals may normally only be opened by a representative of the competent authority for weights and measures services.

After putting the measuring instrument into circulation or after sealing the measuring instrument, operation via the local display is only possible to a limited extent.



Europe

Since the European Measuring Instruments Directive 2004/22/EC came into effect on November 1, 2006, and the revised 2014/32/EU version on April 20, 2016, meters with the relevant marking can be placed on the market across the borders of all EU member states that have ratified the requirements of Annex III (MI-001) of the European Measuring Instruments Directive and incorporated them into national law.

The associated Declaration of Conformity for the measuring instrument, as per the European Measuring Instruments Directive 2014/32/EC, was made in accordance with Modules B+D:

Module B: Type examination according to OIML R 49:2013. Module D: Declaration of type conformity based on quality assurance of the production process.



With the entry into force of the revised European Measuring Instruments Directive 2014/32/EU on April 20, 2016, all certificates issued under Directive 2004/22/EC will remain valid until their regular expiry date. As a result of this transitional system, various certificates and documents pertaining to the same device can make reference to different versions of the European Measuring Instruments Directive. This does not compromise the conformity of the measuring instrument in any way.



Outside Europe

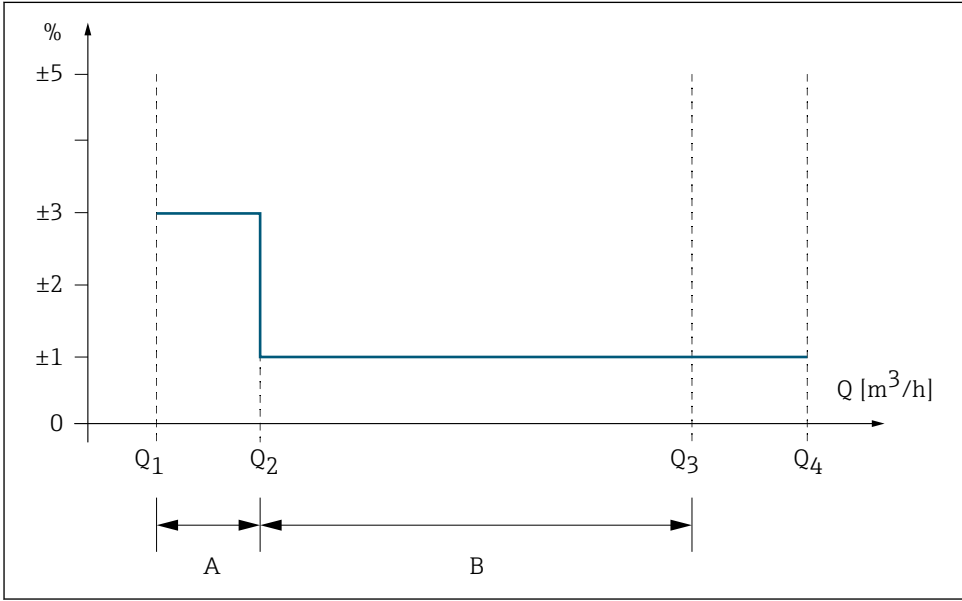
Detailed ordering information for national approvals based on OIML R 49:2013 is available from your local Endress+Hauser sales center.

4 Product identification

Measuring devices for use subject to legal metrology controls are supplied with the relevant marking.

4.1 Accuracy classes

Accuracy class 1



A0033978

 1 Flow ranges and maximum permissible errors for cold water

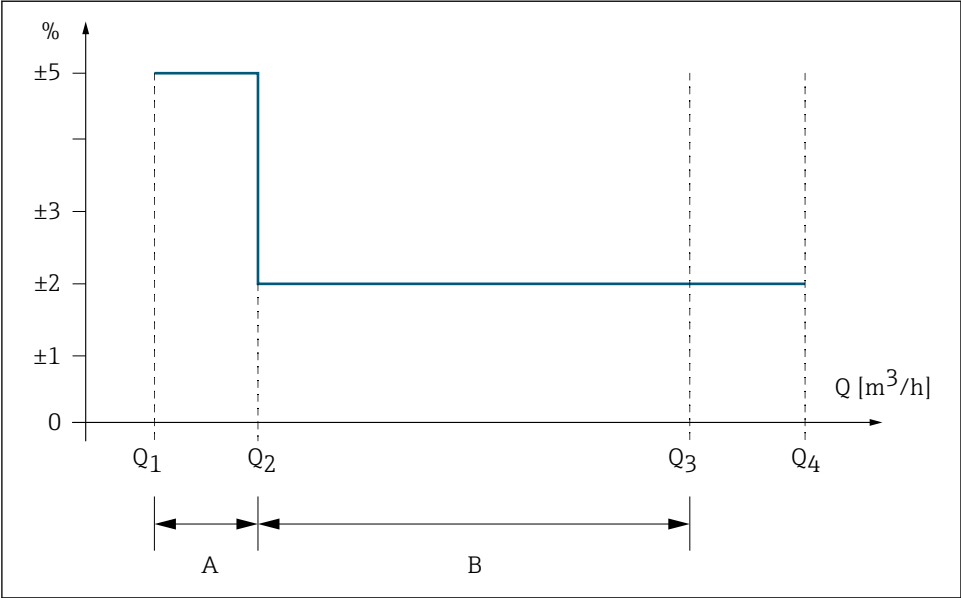
A Lower zone

Maximum permissible error: $\pm 3\%$

B Upper zone

Maximum permissible error: $\pm 1\%$

Accuracy class 2



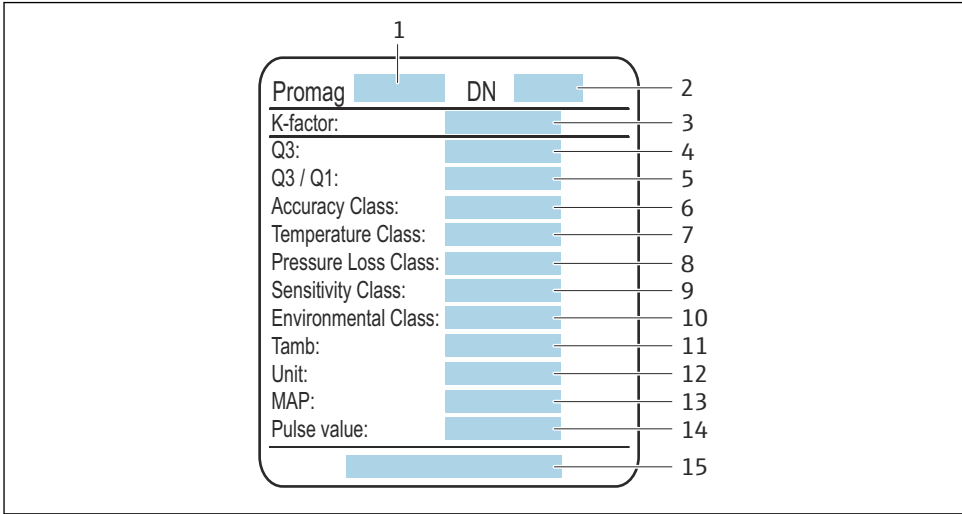
A0034622

2 Flow ranges and maximum permissible errors for cold water

- A Lower zone
Maximum permissible error: $\pm 5\%$
- B Upper zone
Maximum permissible error: $\pm 2\%$

Cold water Medium temperature range +0.1 to +50 °C (+32.2 to +122 °F)	
Minimum flowrate Q_1	The lowest flowrate at which the meter provides indications that satisfy the requirements concerning the maximum permissible errors (MPEs).
Transitional flowrate Q_2	The flowrate value occurring between the permanent flowrate Q_3 and the minimum flowrate Q_1 , at which the flowrate range is divided into two zones (the upper zone and lower zone). Each zone has a characteristic MPE.
Permanent flowrate Q_3	The highest flowrate at which the meter operates in compliance with the applicable maximum permissible error and under normal conditions of use.
Overload flowrate Q_4	The highest flowrate at which the meter operates within the limits for maximum permissible error for a short period of time without deteriorating.

4.2 Nameplate



A0052443

3 Sensor nameplate, subject to calibration obligation

- 1 Name of the sensor
- 2 Nominal diameter of the sensor
- 3 Calibration factor/zero point
- 4 Flowrate Q_3
- 5 Flowrate Q_3 / Q_1
- 6 Accuracy class
- 7 Temperature class
- 8 Pressure loss class
- 9 Sensitivity class
- 10 Environmental class
- 11 Ambient temperature
- 12 Unit
- 13 MAP
- 14 Pulse value (output option P)
- 15 Number of certificate

5 Operation and commissioning

5.1 Operating conditions for standard sensor version

The measuring instrument should be sized in such a way that, under normal operating conditions as per the specifications of OIML R 49:2013, it operates in the range from Q_1 to Q_3 .

The measuring instrument is designed for:

Accuracy class	2
Temperature class	T50
Pressure loss class	Δp 10
Environmental class	B / O / M
Electromagnetic class	E2
Mounting position	Horizontal, vertical
Inlet run from flange	5 × DN corresponds to sensitivity class U5
Outlet run from flange	2 × DN corresponds to sensitivity class D3
Flow direction	Bidirectional
Test equipment	Measurement transducer, calculator, indicating device
Test equipment	Type P



Please note the following for operation:

- Ensure an uninterrupted power supply.
- Use shielded signal cables.

5.1.1 Flow characteristic values

The following flow characteristic values correspond to the specifications of OIML R 49:2013.

DN		Q ₁	Q ₂	Q ₃	Q ₄	Q ₃ / Q ₁	Low flow cutoff with 50 % hysteresis ¹⁾
[mm]	[in]	[m ³ /h]	[m ³ /h]	[m ³ /h]	[m ³ /h]		[m ³ /h]
25	1	0.10	0.16	16.00	20.00	160	0.0160
32	1 ¼	0.16	0.25	25.00	31.25	160	0.0250
40	1 ½	0.25	0.40	40.00	50.00	160	0.0400
50	2	0.39	0.63	63.00	78.75	160	0.0630
65	2 ½	0.50	0.80	100.00	125.00	200	0.0800
80	3	0.80	1.28	160.00	200.00	200	0.128
100	4	1.25	2.00	250.00	312.50	200	0.200
125	5	1.60	2.56	400.00	500.00	250	0.256
150	6	2.52	4.03	630.00	787.50	250	0.403
200	8	4.00	6.40	1000.00	1250.00	250	0.640
250	10	6.40	10.24	1600.00	2000.00	250	1.02

DN		Q ₁	Q ₂	Q ₃	Q ₄	Q ₃ / Q ₁	Low flow cutoff with 50 % hysteresis ¹⁾
[mm]	[in]	[m ³ /h]	[m ³ /h]	[m ³ /h]	[m ³ /h]		[m ³ /h]
300	12	10.00	16.00	2 500.00	3 125.00	250	1.60
350	14	10.00	16.00	2 500.00	3 125.00	250	1.60
375	15	16.00	25.60	4 000.00	5 000.00	250	2.56
400	16	16.00	25.60	4 000.00	5 000.00	250	2.56
450	18	16.00	25.60	4 000.00	5 000.00	250	2.56
500	20	25.20	40.32	6 300.00	7 875.00	250	4.03
600	24	39.38	63.00	6 300.00	7 875.00	160	6.30
700	28	50.40	80.64	6 300.00	7 875.00	125	8.06
750	30	63.00	100.80	6 300.00	7 875.00	100	10.1
800	32	63.00	100.80	6 300.00	7 875.00	100	10.1

1) Values cannot be edited when the custody transfer mode is activated.

5.1.2 Flow characteristic values of certified pulse output

DN		Pulse value	Pulse width
[mm]	[in]	[dm ³]	[ms]
25	1	0.50	45
32	1 ¼	1.00	50
40	1 ½	1.00	35
50	2	2.50	50
65	2 ½	2.50	35
80	3	5.00	45
100	4	5.00	25
125	5	10.00	35
150	6	10.00	20
200	8	25.00	35
250	10	25.00	20
300	12	50.00	25
350	14	50.00	25
375	15	100.00	35

DN		Pulse value	Pulse width
[mm]	[in]	[dm ³]	[ms]
400	16	100.00	35
450	18	100.00	35
500	20	150.00	30
600	24	250.00	50
700	28	250.00	50
750	30	250.00	50
800	32	250.00	50



- The configuration of the certified pulse output is defined by the standard.
- The factory setting for the certified pulse output is such that the minimum measured value resolution specified in the standard is maintained for the "flow characteristic values" in the table and the pulse output does not go to overflow at Q4.
- A pulse modulation of 50/50 (high low level) is presumed.
- If the certified pulse output is configured differently, in terms of the approval this can limit the operable flow range (Q3/Q1).

5.2 Operating conditions for sensor version – 0 x DN inlet/outlet runs



Only applies for the order code for "Design", option C

The measuring instrument should be sized in such a way that, under normal operating conditions as per the specifications of OIML R 49:2013, it operates in the range from Q₁ to Q₃.

The measuring instrument is designed for:

Accuracy class ¹⁾	1 or 2
Temperature class	T50
Pressure loss class	Δp 40
Environmental class	B / O / M
Electromagnetic class	E2
Mounting position	Horizontal, vertical
Inlet run from flange	0 × DN corresponds to sensitivity class U0
Outlet run from flange	0 × DN corresponds to sensitivity class D0
Flow direction	Bidirectional

Test equipment	Measurement transducer, calculator, indicating device
Test equipment	Type P

- 1) Only accuracy class 2 exists as a legal basis for measuring instruments according to European approval MI-001.



Please note the following for operation:

- Ensure an uninterrupted power supply.
- Use shielded signal cables.

5.2.1 Flow characteristic values

The following flow characteristic values correspond to the specifications of OIML R 49:2013.

Accuracy class 1

DN		Q1	Q2	Q3	Q4	Q3 / Q1	Low flow cutoff with 50 % hysteresis ¹⁾
[mm]	[in]	[m³/h]	[m³/h]	[m³/h]	[m³/h]		[m³/h]
50	2	0.13	0.20	40.00	50.00	315	0.0203
65	2 ½	0.20	0.32	63.00	78.80	315	0.0320
80	3	0.32	0.51	100.00	125.00	315	0.0508
100	4	0.51	0.81	160.00	200.00	315	0.0813
125	5	0.79	1.27	250.00	312.50	315	0.127
150	6	1.27	2.03	400.00	500.00	315	0.203
200	8	2.00	3.20	630.00	787.50	315	0.320
250	10	3.17	5.08	1000.00	1250.00	315	0.508
300	12	5.08	8.13	1600.00	2000.00	315	0.813

- 1) Values cannot be edited when the custody transfer mode is activated.

Accuracy class 2

DN		Q1	Q2	Q3	Q4	Q3 / Q1	Low flow cutoff with 50 % hysteresis ¹⁾
[mm]	[in]	[m³/h]	[m³/h]	[m³/h]	[m³/h]		[m³/h]
50	2	0.06	0.10	40.00	50.00	630	0.0102
65	2 ½	0.10	0.16	63.00	78.80	630	0.0160
80	3	0.16	0.25	100.00	125.00	630	0.0254

DN		Q1	Q2	Q3	Q4	Q3 / Q1	Low flow cutoff with 50 % hysteresis ¹⁾
[mm]	[in]	[m³/h]	[m³/h]	[m³/h]	[m³/h]		[m³/h]
100	4	0.25	0.41	160.00	200.00	630	0.0406
125	5	0.40	0.63	250.00	312.50	630	0.0635
150	6	0.63	1.02	400.00	500.00	630	0.102
200	8	1.00	1.60	630.00	787.50	630	0.160
250	10	1.59	2.54	1000.00	1250.00	630	0.254
300	12	2.54	4.06	1600.00	2000.00	630	0.406

1) Values cannot be edited when the custody transfer mode is activated.

5.2.2 Flow characteristic values of certified pulse output



The pulse value is the same for both accuracy classes.

DN		Pulse value	Pulse width
[mm]	[in]	[dm³]	[ms]
50	2	0.50	15
65	2 ½	0.50	10
80	3	1.00	15
100	4	1.00	10
125	5	2.50	15
150	6	2.50	10
200	8	5.00	10
250	10	10.00	15
300	12	15.00	10



- The configuration of the certified pulse output is defined by the standard.
- The factory setting for the certified pulse output is such that the minimum measured value resolution specified in the standard is maintained for the "flow characteristic values" in the table and the pulse output does not go to overflow at Q4.
- A pulse modulation of 50/50 (high low level) is presumed.
- If the certified pulse output is configured differently, in terms of the approval this can limit the operable flow range (Q3/Q1).

5.3 As-delivered state

Europe

Measuring instruments in accordance with the type-examination certificate in accordance with the Measuring Instruments Directive 2014/32/EU, Annex III (MI-001) are supplied with the custody transfer mode enabled and thus in an electronically locked state. Changes to the measuring instrument's custody transfer-related configuration may only be made by specially qualified Endress+Hauser service technicians or by authorized representatives of the local authority responsible for weights and measures services.

Additional information for as-delivered state in Europe

Measuring instruments with the order code for "Output/input": option M and O are delivered with the **CT locking: Defined parameters** option. Measuring instruments with the order code for "Output/input": option P (certified pulse output) are delivered with the **CT locking: All parameters** option.

Custody transfer parameters	Default value
Custody transfer counter	1
Timestamp last custody transfer	Activation at the factory
Counter custody transfer changes	0

Outside Europe

Measuring instruments according to the Declaration of Conformity as per OIML R 49:2013 are supplied unlocked or with the custody transfer mode disabled. It is expected that the customer, in consultation with the competent national authority for weights and measures services, ensures that the measuring instrument is placed on the market and correctly implements the locally applicable requirements as regards the locking and sealing of the measuring instrument. The authorized representative of the national authority for weights and measures services is responsible for providing information.

Custody transfer parameters	Default value
Custody transfer counter	0
Timestamp last custody transfer	0
Counter custody transfer changes	0

5.4 Custody transfer

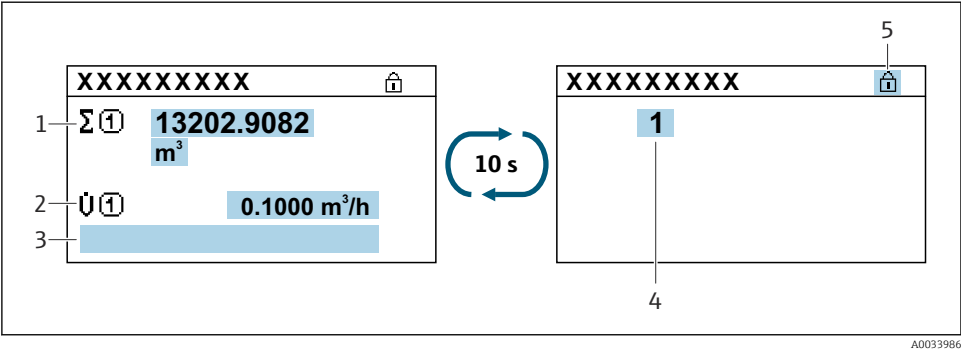
-  National rules or regulations must be observed when performing custody transfer.
-  An **authorized user login** is available: EH000 with password 177801. This **authorized user login** is the non-personalized factory login and enables the activation and deactivation of the custody transfer mode. Settings made using this login must be documented and personalized by the system operator. In addition, the responsible weights and measures services must be informed of these changes.

5.4.1 Outputs relevant for custody transfer

For the order code for "Input/output": option M and O, the local display of totalizer 1 or the Modbus protocol can be selected as the output relevant for custody transfer. For the order code "Input/output": option P, the local display, the Modbus protocol or the certified pulse output can be selected as the output relevant for custody transfer.

Local display

In Custody transfer mode, the values that are displayed on the local display are set. Any configuration settings made beforehand for the local display are overwritten. The local display shows one value in large format and two additional values. The local display alternates every ten seconds between values 1 to 3 and value 4. A padlock symbol is displayed in the top right-hand corner in the custody transfer mode.



- 1 Display for value 1
- 2 Display for value 2
- 3 Display for value 3
- 4 Display for custody transfer counter
- 5 Padlock symbol (Custody transfer active)

Value	Description
1	Totalizer with unit m³.
2	Current volume flow

Value	Description
3	User configurable.
4	Custody transfer counter.

Certified pulse output

In the case of measuring instruments with the order code for "Input/output": option P , the PFS 1 and PFS 2 outputs can be used to display the measured values that are relevant for custody transfer on a suitable display. The PFS 1 output transmits pulses proportional to the volume, while the PFS 2 output is used to detect the flow direction.

5.4.2 Authorized user login

 To change the measuring device to the Custody transfer mode, the non-personalized, **authorized user login** (factory login) can be used. However, the use of a personalized, **authorized user login** with associated **password** is recommended. This is available only to national market surveillance and authorized persons from the relevant centers. This **authorized user login** is comparable to a personalized sealing pliers and is used to uniquely identify the person / authority who has locked or unlocked the measuring device for custody transfer measurement.

 To create an **authorized user login** with **password**, please contact your E+H sales center.

To create the **Authorized user login** parameter with **password**, the following data are required.

Required data	Example
Applicant type	▪ System operator ▪ Market surveillance ▪ Approval center ▪ Endress+Hauser employee
First name	John
Surname	Smith
Company	ABC Company
Department	ABC Department
Address	Any Street 1
Country	Anywhere
City/Town	Anytown
ZIP code	123456
Telephone	123456
E-mail address	John.Smith@sample.com

- The **Authorized user login** parameter consists of five characters comprising two letters and three digits.
- For each **Authorized user login** parameter comprising five characters, a **password** is generated.
- When changes are made, the **Authorized user login** parameter is saved in the Custody transfer logbook.

5.4.3 Parameter description for Custody transfer deactivation



An **authorized user login** is available: EH000 with password 177801. This **authorized user login** is the non-personalized factory login and enables the activation and deactivation of the custody transfer mode. Settings made using this login must be documented and personalized by the system operator. In addition, the responsible weights and measures services must be informed of these changes.

Navigation

"Setup" menu → Advanced setup → Custody transfer deactivation

► Custody transfer deactivation	
Authorized user login	→ ⓘ 20
Password	→ ⓘ 20
Login state	→ ⓘ 20
Year	→ ⓘ 20
Month	→ ⓘ 20
Day	→ ⓘ 20
AM/PM	→ ⓘ 20
Hour	→ ⓘ 20
Minute	→ ⓘ 20
Clear custody transfer logbook	→ ⓘ 20

Entry 30 of custody transfer logbook	→  20
Toggle DIP switch	→  20

Parameter overview with brief description

Parameter	Description	User entry / User interface / Selection	Factory setting
Authorized user login	Enter a specified authorized user login.	Authorized user login	EH000
Password	Enter a specified password.	0 to 999 999	177 801
Login state	Display login status.	▪ Logged in ▪ Logged out	Logged out
Year	Enter the year.	9 to 99	10
Month	Enter the month.	▪ January ▪ February ▪ March ▪ April ▪ May ▪ June ▪ July ▪ August ▪ September ▪ October ▪ November ▪ December	January
Day	Enter the day.	1 to 31 d	1 d
AM/PM	Select AM/PM.	▪ AM ▪ PM	AM
Hour	Enter the hour.	0 to 23 h	12 h
Minute	Enter the minutes.	0 to 59 min	0 min
Clear custody transfer logbook	Delete custody transfer logbook selection.	▪ Cancel ▪ Clear data	Cancel
Entry 30 of custody transfer logbook	Display the recorded logbook entries.	0...30	0
Toggle DIP switch	Display the DIP switch status.	▪ Off ▪ On	Off

5.4.4 Determining parameters locked in Custody transfer

Select the preferred write protection option for custody transfer mode.

Navigation

"Operation" menu → Custody transfer → Custody transfer locking

► Custody transfer

Custody transfer locking

→ 21

Parameter overview with brief description

Parameter	Description	Selection	Factory setting
Custody transfer locking	Select which parameters for custody transfer should be write-protected, depending on the output version.	- Defined parameters - All parameters	The factory setting depends on the order code. "Defined parameters" for order code for "Output/input": option M and O "All parameters" for order code "Output/input": option P

5.4.5 Disabling Custody transfer

A list of all the defined parameters and configurable custody transfer parameters is provided in the Annex → 34.

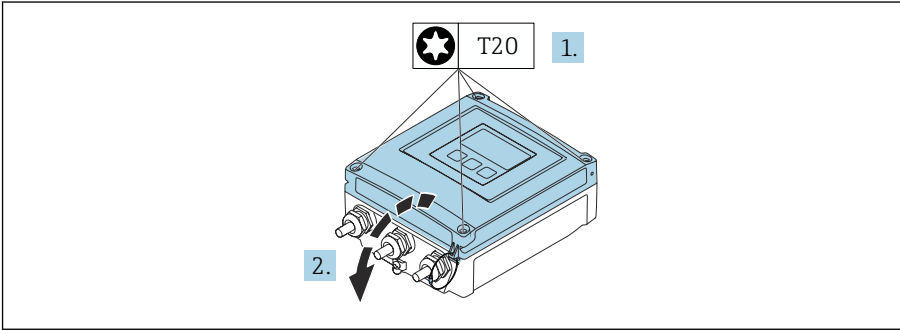
-  If the **authorized user login** and **password** are entered via the display module, perform the following steps in the order indicated. If the **authorized user login** and **password** are entered via the web server, the device must first be opened and connected to the service interface.
-  The procedure does not have a time limit.
-  The measuring device can only be unlocked with the **Authorized user login** parameter and the associated **password** and **DIP switch**. If only the **DIP switch** is set to the **OFF** position, the measuring device does not switch off the Custody transfer. A warning message is generated, which can be cleared only by resetting the **DIP switch** .
-  Use a suitable tool - preferably one with a non-metal tip - to switch the DIP switch.

Opening the measuring instrument and disabling the custody transfer mode

1. Break the optional sealing.
2. In the menu enter the **Authorized user login** parameter and the **Password** parameter→ 22.
3. Enter the time and date information.

4. Disconnect the power supply to the device.

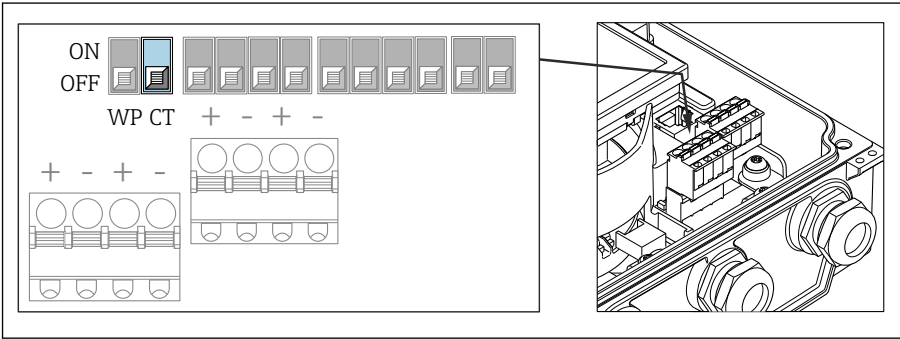
5.



A0040611

Unscrew and open the cover of the transmitter.

6.



A0048281

Set the **CT DIP switch** to the **OFF** position.

7. Reverse the procedure to close the measuring instrument.

8. Reestablish the power supply.



If the measuring instrument has been unlocked correctly with the **Authorized user login** parameter, **password** and the **CT DIP switch**, the locking symbol disappears from the display and the value of the internal Custody transfer counter increases. In addition, an entry with a Timestamp (operating hours) is generated in the logbook. An entry is also recorded in the event logbook. When the device is in an unlocked state, all parameters can be edited.

5.4.6 Parameter description for Custody transfer activation



An **authorized user login** is available: EH000 with password 177801. This **authorized user login** is the non-personalized factory login and enables the activation and deactivation of the custody transfer mode. Settings made using this login must be documented and personalized by the system operator. In addition, the responsible weights and measures services must be informed of these changes.

Navigation

"Setup" menu → Advanced setup → Custody transfer activation

► Custody transfer activation		
Authorized user login	→	 24
Password	→	 24
Login state	→	 24
Display test	→	 24
Year	→	 24
Month	→	 24
Day	→	 24
AM/PM	→	 24
Hour	→	 24
Minute	→	 24
Clear custody transfer logbook	→	 24
Entry 30 of custody transfer logbook	→	 24
Checksum	→	 24
Toggle DIP switch	→	 24

Parameter overview with brief description

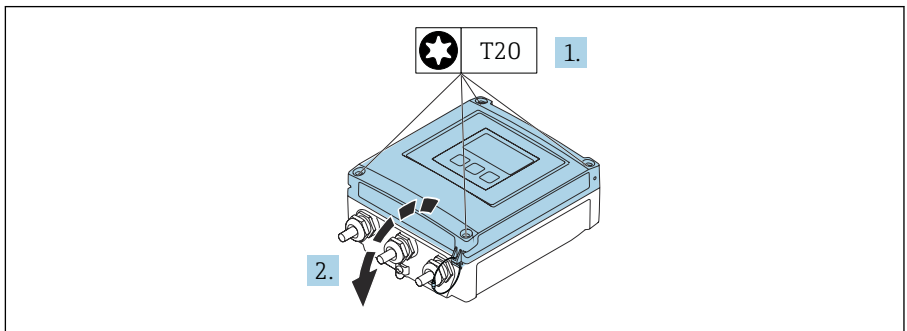
Parameter	Description	User entry / User interface / Selection	Factory setting
Authorized user login	Enter a specified authorized user login.	Authorized user login	EH000
Password	Enter a specified password.	0 to 999 999	177 801
Login state	Display login status.	■ Logged in ■ Logged out	Logged out
Display test	Start or cancel display test.	■ Cancel ■ Start	Cancel
Year	Enter the year.	9 to 99	10
Month	Enter the month.	■ January ■ February ■ March ■ April ■ May ■ June ■ July ■ August ■ September ■ October ■ November ■ December	January
Day	Enter the day.	1 to 31 d	1 d
AM/PM	Select AM/PM.	■ AM ■ PM	AM
Hour	Enter the hour.	0 to 23 h	12 h
Minute	Enter the minutes.	0 to 59 min	0 min
Clear custody transfer logbook	Delete custody transfer logbook selection.	■ Cancel ■ Clear data	Cancel
Entry 30 of custody transfer logbook	Display the recorded logbook entries.	0...30	0
Checksum	Shows the firmware's checksum.	Positive integer	–
Toggle DIP switch	Display the DIP switch status.	■ Off ■ On	Off

5.4.7 Setting up Custody transfer mode

- i** If the **authorized user login** and **password** are entered via the display module, perform the following steps in the order indicated. If the **authorized user login** and **password** are entered via the web server, the device must first be opened and connected to the service interface.
- i** The procedure does not have a time limit.
- i** The measuring device can only be locked with the **Authorized user login** parameter and the associated password and **CT DIP switch**. If only the **CT DIP switch** is set to the **ON** position, the measuring device does not switch to the custody transfer mode. A warning message is generated, which can be cleared only by resetting the **CT DIP switch**.
- i** Defined parameters and custody transfer parameters cannot be edited in the locked state. A list of all the non-editable parameters is provided in Section 6 → 34.
- i** Before you enable the custody transfer mode, choose whether **All parameters** or **Defined parameters** should be locked. → 34
- i** Use a suitable tool - preferably one with a non-metal tip - to switch the DIP switch.

Opening the measuring instrument and setting up the custody transfer mode

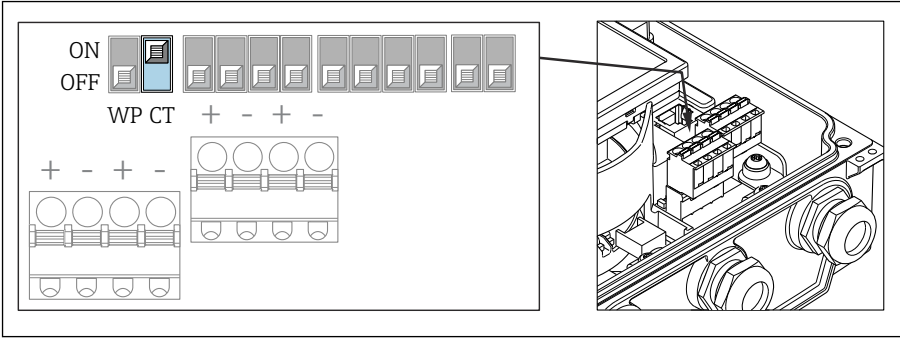
1. Select the parameters to be locked with the **Custody transfer locking** parameter → 26.
2. In the menu enter the **Authorized user login** parameter and the **Password** parameter → 22.
3. Enter the time and date information.
4. As an option, the custody transfer logbook can be cleared.
5. Disconnect the power supply to the device.
- 6.



A0040611

Unscrew and open the cover of the transmitter.

7.



A0048554

Set the **CT DIP switch** to the **ON** position.

8. Follow the reverse sequence to close the measuring instrument, and seal if desired.
9. Reestablish the power supply.
10. A padlock symbol (🔒) appears in the header of the display.



If the measuring instrument has been locked correctly with the **Authorized user login** parameter, **Password** parameter and the **CT DIP switch**, the locking symbol appears on the display and the value of the internal Custody transfer counter increases. In addition, an entry with a Timestamp (operating hours) is generated in the Custody transfer logbook. An entry is also recorded in the event logbook.

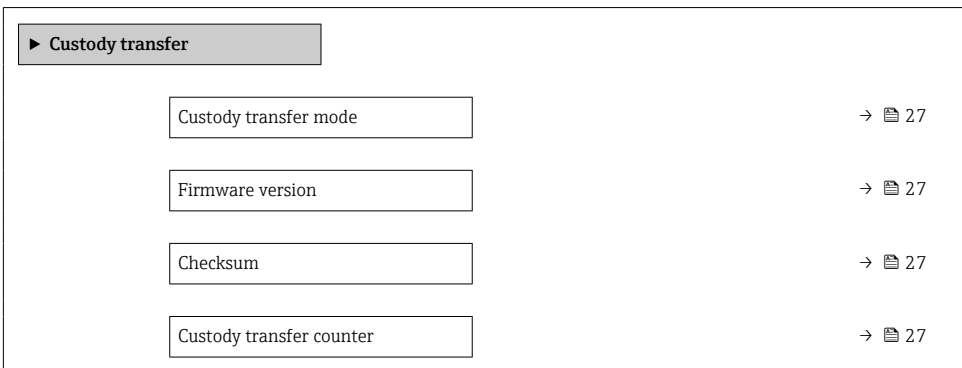
5.5 Reading parameters relevant for custody transfer



In custody transfer mode, the following parameters can be viewed via the display or the service interface (web server). These can also be read via MODBUS RS485 Register.

Navigation

"Operation" menu → Custody transfer



Custody transfer locking	→  27
Timestamp last custody transfer	→  27
Display test	→  27

Parameter overview with brief description

Parameter	Description	User interface / Selection	Factory setting
Custody transfer mode	Shows if the device is in custody transfer mode.	■ Off ■ On	Off
Firmware version	Shows the device firmware version installed.	Character string in the format xx.yy.zz	–
Checksum	Shows the firmware's checksum.	Positive integer	–
Custody transfer counter	Indicates how often custody transfer mode has been enabled so far.	0 to 65 535	–
Custody transfer locking	Select which parameters for custody transfer should be write-protected, depending on the output version.	■ Defined parameters ■ All parameters	The factory setting depends on the order code. ■ "Defined parameters" for order code for "Output/input": option M and O ■ "All parameters" for order code "Output/input": option P
Timestamp last custody transfer	Indicates the time when the custody transfer mode was last enabled.	Days (d), hours (h), minutes (m) and seconds (s)	–
Display test	Start or cancel display test.	■ Cancel ■ Start	Cancel

5.5.1 Display test

The character test string is used to test the display. When the test string is selected, the display test sequence starts and the test string is displayed with an inverted background. Once the text display is confirmed, the test string is displayed again with a non-inverted background and the display test is finished.

5.6 Custody transfer logbook

The Custody transfer logbook can be viewed on the display, via FieldCare or via the web server.

- The last entry is displayed first.
- A maximum of 30 entries can be saved in the Custody transfer logbook. If this value is exceeded, no further entries can be saved and a warning message will appear.
- If parameters relating to Custody transfer mode are changed while custody transfer mode is disabled, this is recorded in the Custody transfer logbook. In addition, an exact description of the changed parameter is saved in the event logbook.

Navigation

"Diagnostics" menu → Custody transfer logbook

► Custody transfer logbook		
Logbook entry		→  28
Entry 30 of custody transfer logbook		→  28
Event number		→  28
Event logbook		→  29
Timestamp		→  29
Authorized user login		→  29
Totalizer value		→  29
Totalizer overflow		→  29
Date/time		→  29

Parameter overview with brief description

Parameter	Description	User entry / User interface	Factory setting
Logbook entry	Select a logbook entry.	1 to 30	1
Entry 30 of custody transfer logbook	Display the recorded logbook entries.	0...30	0
Event number	Display the event number.	Positive integer	1

Parameter	Description	User entry / User interface	Factory setting
Event logbook	Display the event.	–	0
Timestamp	Display the timestamp.	Date of timestamp.	0
Authorized user login	Display the specified authorized user login.	Authorized user login	EH000
Totalizer value	Display the totalizer value.	Signed floating-point number	0
Totalizer overflow	Display the totalizer overflow.	Signed floating-point number	0
Date/time	Display the date/time.	Date/time	0

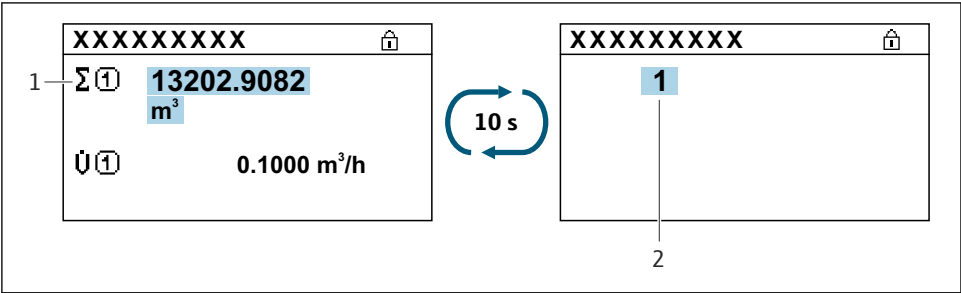
5.6.1 Clearing the Custody transfer logbook

The Custody transfer logbook can be cleared only if you have previously logged in using an **Authorized user login** parameter and **password**.

- 1. In the **Custody transfer activation** wizard, log in with an **Authorized user login** parameter and **password**.
- 2. The **Clear custody transfer logbook** parameter is available in the **Custody transfer activation** wizard.
 - If the Custody transfer logbook is cleared, this is stored as the first new entry in the custody transfer logbook.

5.7 Procedure for market surveillance

The recommended procedure for market surveillance is the comparison between the status of the custody transfer counter shown under display value 4 on the display and the last documented status of the custody transfer counter. The display alternates every ten seconds between the custody transfer counter status and the totalizer.



- 1 Display for totalizer
- 2 Custody transfer counter status indicator

A0024892

If the custody transfer counter status on the display and the last documented custody transfer counter status are identical, the device has not been tampered with.

However, if the two custody transfer counter statuses are not identical, the following procedure is recommended:

Retrieve the following parameters in the Custody transfer logbook:

1. **Authorized user login** parameter: Check the last authorized user login where a change was made to parameters relevant for custody transfer.
2. **Event logbook** parameter: Verify changes.
3. **Totalizer value** parameter: Check the value of the totalizer at the time of the change.
4. **Timestamp** parameter: Check the operating time at which the change was made.
5. In the Event logbook, search for the entry with the applicable Timestamp in the Event logbook and verify which changes were carried out.

This enables market surveillance to check what exact time custody transfer mode was disabled and whether a custody transfer parameter was changed.

5.8 Repeated calibration due to legal metrology controls

The system operator is obliged to perform a recalibration in accordance with the relevant applicable national regulations.

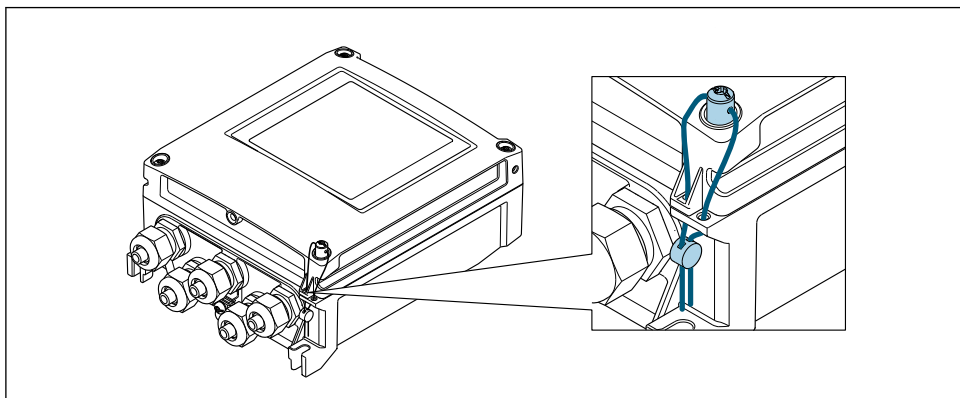
5.9 Sealing



It is possible to seal the measuring device.. The seal can be applied using a sealing screw and the relevant holder on the housing. The system operator or the competent calibration authority is responsible for applying the seal.

5.9.1 Sealing the transmitter

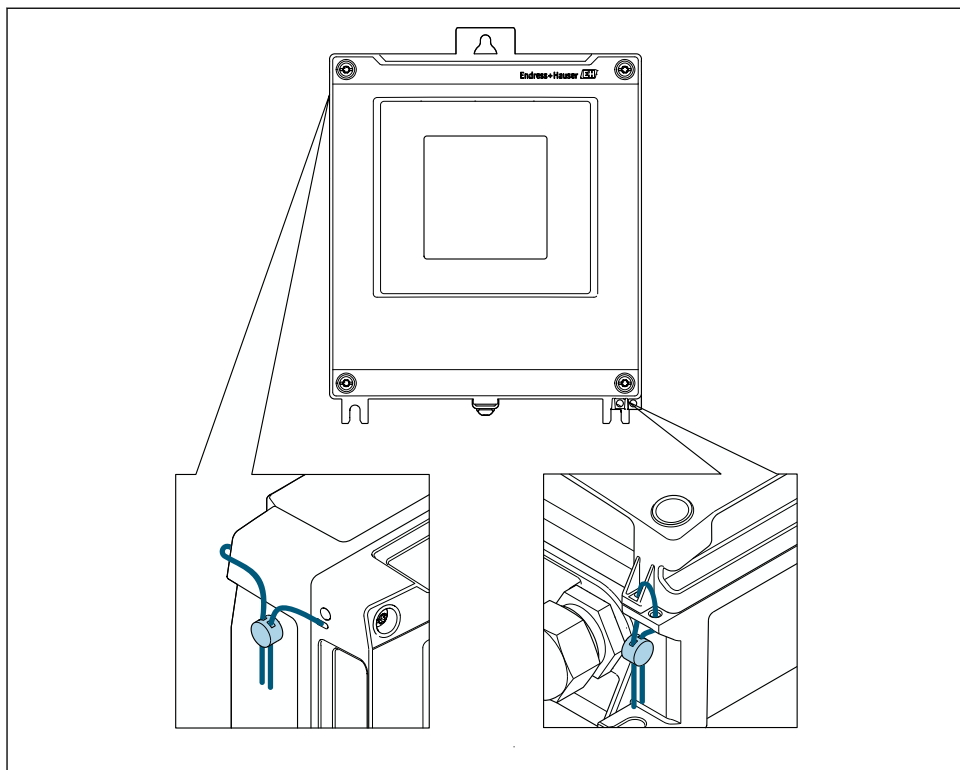
Aluminum transmitter



A0025237

1. Pull the wire through the bore in the housing and through the screw head. In doing so, ensure that the wire is taut and there is no leeway for the screw to loosen.
2. Seal the wire ends.

Polycarbonate transmitter

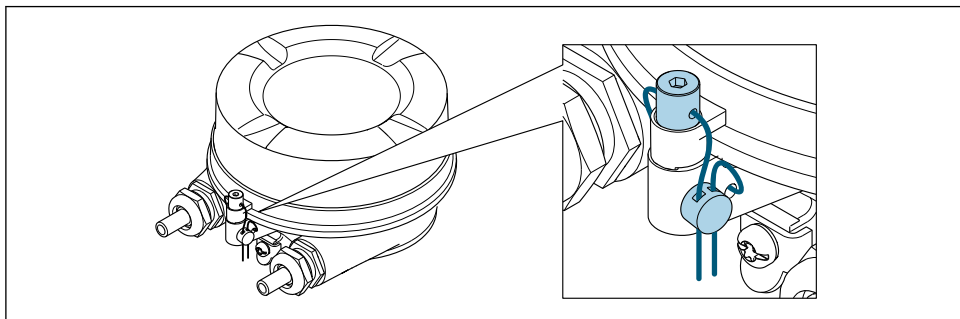


A0041369

1. Remove the display guard before sealing.
2. Pull the wire through the holes in the housing.
3. Seal the wire ends.
4. Fit the display guard back on after sealing.

5.9.2 Sealing the connection housing

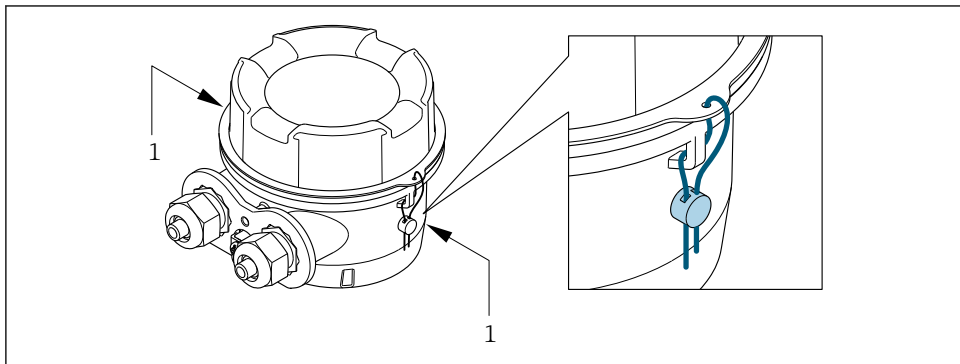
Connection housing remote version



A0025239

1. Pull the wire through the bore in the housing and through the screw head. In doing so, ensure that the wire is taut and there is no leeway for the screw to loosen.
2. Seal the wire ends.

Connection housing remote version, IP68



A0025238

1. Feed the wire through the bore hole in the cover and connection housing. In doing so, ensure that the wire is taut.
2. Seal the wire ends.

6 List of the parameters that can be configured in custody transfer mode

Parameters that are relevant for custody transfer must be write-protected in the custody transfer mode. Three options are available for this purpose:

Write protection	Description
Hardware write protection	Sets every parameter to write-protected.
CT locking: All parameters	Factory setting for devices with the order code for "Output/input": option P "Modbus RS485, 4-20mA", certified pulse output, pulse/freq., switch output.
CT locking: Defined parameters	Factory setting for devices with the order code for "Output/input": option M "Modbus RS485" and option O "Modbus RS485, 4-20mA, 2x pulse/freq./switch output".

6.1 Configurable parameters

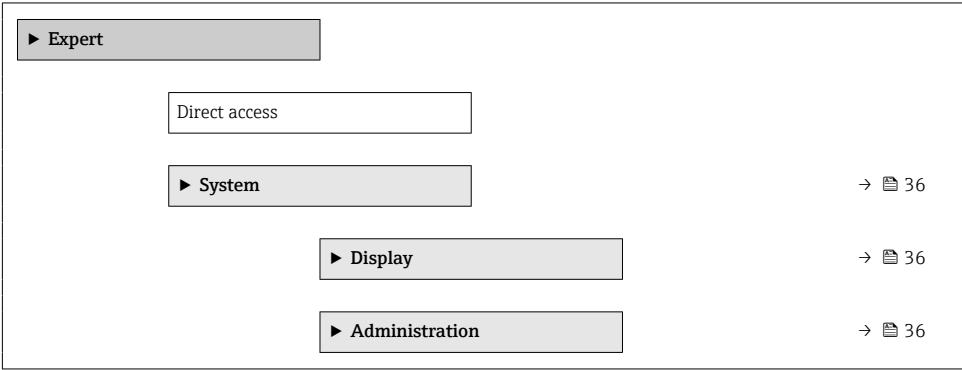
Description

- The parameters that are not marked can be edited in **CT locking: All parameters** and **Defined parameters**.
- The parameters that are marked  can also be edited in **CT locking: Defined parameters**.
- Generally speaking, all the parameters that are not listed cannot be edited in the custody transfer mode.

 A description of the device parameters is provided in the associated Technical Documentation →  5

Navigation

"Expert" menu



▶ Sensor	→ 37
▶ System units	→ 37
▶ Process parameters	→ 38
▶ External compensation	→ 38
▶ Calibration	→ 39
▶ Output	→ 39
▶ Current output 1	→ 39
▶ Pulse/frequency/switch output 1 to n	→ 40
▶ Communication	→ 41
▶ Modbus configuration	→ 41
▶ Modbus data map	→ 42
▶ Web server	→ 42
▶ WLAN settings	→ 43
▶ Diagnostics	→ 44
▶ Event logbook	→ 44
▶ Data logging	→ 44
▶ Heartbeat Technology	→ 45
▶ Simulation	→ 46

6.1.1 "System" submenu

"Display" submenu

Navigation

"Expert" menu → System → Display

► Display

Display language

Value 3 display

0% bargraph value 3

100% bargraph value 3

Decimal places 3

Header

Header text

Separator

Contrast display

Backlight

"Administration" submenu

Navigation

"Expert" menu → System → Administration

► Administration

► Define access code

Define access code

Confirm access code

▶ Reset access code

Reset access code

6.1.2 "Sensor" submenu

"System units" submenu

Navigation

"Expert" menu → Sensor → System units

▶ System units

Conductivity unit

Temperature unit

Mass flow unit

Mass unit

Density unit

Corrected volume flow unit

Corrected volume unit

Date/time format

"Process parameters" submenu

Navigation

"Expert" menu → Sensor → Process parameters

► Process parameters

Conductivity measurement

Conductivity damping

Conductivity temperature coefficient

Temperature damping

Reference density

► Build-up index

Build-up index

Build-up index damping

"External compensation" submenu

Navigation

"Expert" menu → Sensor → External compensation

► External compensation

Density source

Fixed density

Temperature source

Reference temperature

"Calibration" submenu

Navigation

"Expert" menu → Sensor → Calibration

► Calibration

Conductivity calibration factor

6.1.3 "Output" submenu

"Current output 1" submenu

Navigation

"Expert" menu → Output → Current output 1

► Current output 1

Process variable current output

Current range output

Fixed current

Lower range value output

Upper range value output

Measuring mode current output

Damping current output

Failure behavior current output

Failure current

"Pulse/frequency/switch output 1 to n" submenu

Navigation

"Expert" menu → Output → Pulse/frequency/switch output 1 to n

► Pulse/frequency/switch output 1 to n

Operating mode

Assign pulse output 1 to n

Pulse scaling

Pulse width

Measuring mode

Failure mode

Assign frequency output

Minimum frequency value

Maximum frequency value

Measuring value at minimum frequency

Measuring value at maximum frequency

Measuring mode

Damping output 1 to n

Failure mode

Failure frequency

Switch output function	
Assign diagnostic behavior	
Assign limit	
Switch-on value	
Switch-off value	
Assign flow direction check	
Assign status	
Switch-on delay	
Switch-off delay	
Failure mode	
Invert output signal	

6.1.4 "Communication" submenu

"Modbus configuration" submenu

Navigation

"Expert" menu → Communication → Modbus configuration

► Modbus configuration
Bus address
Baudrate
Data transfer mode

Parity
Byte order
Telegram delay
Failure mode
Fieldbus writing access

"Modbus data map" submenu

Navigation

"Expert" menu → Communication → Modbus data map

► Modbus data map
Scan list register 0 to 15

"Web server" submenu

Navigation

"Expert" menu → Communication → Web server

► Web server
Web server language
DHCP client
IP address
Subnet mask
Default gateway

Web server functionality

Login page

"WLAN settings" wizard

Navigation

"Expert" menu → Communication → WLAN settings

► WLAN settings

WLAN

WLAN mode

SSID name

Network security

User name

WLAN password

WLAN IP address

WLAN subnet mask

WLAN passphrase

Assign SSID name

SSID name

2.4 GHz WLAN channel

Select antenna

WLAN IP address

6.1.5 "Diagnostics" submenu

"Event logbook" submenu

Navigation

"Expert" menu → Diagnostics → Event logbook

► Event logbook

Filter options

"Data logging" submenu

Navigation

"Expert" menu → Diagnostics → Data logging

► Data logging

Assign channel 1

Assign channel 2

Assign channel 3

Assign channel 4

Logging interval

Clear logging data

Data logging

Logging delay

Data logging control

"Heartbeat Technology" submenu

Navigation

"Expert" menu → Diagnostics → Heartbeat Technology

▶ Heartbeat Technology

▶ Heartbeat base settings

Plant operator

Location

Partially filled pipe

▶ Performing verification

Year

Month

Day

Hour

AM/PM

Minute

External device information

Measured values

"Simulation" submenu

Navigation

"Expert" menu → Diagnostics → Simulation

► Simulation

Current output 1 simulation

Current output value

Frequency output 1 to n simulation

Frequency output 1 to n value

Pulse output simulation 1 to n

Pulse value 1 to n

Switch output simulation 1 to n

Switch state 1 to n

6.2 Deviating parameter configuration

 The configuration of the following parameters deviates from the factory settings and corresponds to the specifications of OIML R 49:2013.

Parameter	Factory setting	Parameter configuration for custody transfer
Volume flow unit	Depends on country and nominal diameter	m ³ /h
Filter options	Adaptive	Binomial
On value low flow cutoff	Depends on country and nominal diameter	See the "Operation and commissioning" section →  10
Empty pipe detection	Off	On
Format display	1 value, max. size	1 value, large + 2 values ¹⁾
Value 1 display	Volume flow	Totalizer 1 ¹⁾
Decimal places 1	x.xx	Depends on the nominal diameter ¹⁾

Parameter	Factory setting	Parameter configuration for custody transfer
Value 2 display	None	Volume flow ¹⁾
Value 4 display	None	Custody transfer counter ¹⁾
Display interval	5 s	10 s ¹⁾
Totalizer 1 to n (Unit totalizer 1 to n)	Depends on country and nominal diameter	m ³
Totalizer 2 (Operation mode)	Net flow total	Forward flow total
Totalizer 3 (Operation mode)	Net flow total	Reverse flow total
PFS output 1 1(Assign pulse 1) ²⁾	Off	Volume flow
PFS output 1 (Pulse scaling) ²⁾	Depends on country and nominal diameter	See the "Operation and commissioning" section →  10
PFS output 1 (Pulse width) ²⁾	100	See the "Operation and commissioning" section →  10
PFS output 1 (Measuring mode) ²⁾	Forward flow	Forward/reverse flow
PFS output 2 (Operating mode) ²⁾	Pulse	Switch
PFS output 2 (Switch output function) ²⁾	Off	Flow direction check

- 1) These parameters are set automatically when the custody transfer mode is activated and reset when custody transfer mode is deactivated.
- 2) Only available for the order code for "Output;input", option P.

7 Modbus RS485 Register information

7.1 Notes

7.1.1 Structure of the register information

The individual parts of a parameter description are described in the following section:

Navigation: navigation path to the parameter					
Parameter	Register	Data type	Access type	User interface/ Selection/ User entry	→ 
Name of parameter	Indicated in decimal numerical format	▪ Float length = 4 byte ▪ Integer length = 2 byte ▪ String length, depending on parameter	Possible type of access to parameter: ▪ Read access via function codes 03, 04 or 23 ▪ Write access via function codes 06, 16 or 23	Options List of the individual options for the parameter ▪ Option 1 ▪ Option 2 ▪ Option 3 ⁽⁺⁾  ⁽⁺⁾ = Factory setting depends on country, order options or device settings User entry Specific value or input range for the parameter	Page number information and cross-reference to the standard parameter description

NOTICE

If non-volatile device parameters are modified via the MODBUS RS485 function codes 06, 16 or 23, the change is saved in the EEPROM of the measuring device.

The number of writes to the EEPROM is technically restricted to a maximum of 1 million.

- Make sure to comply with this limit since, if it is exceeded, data loss and measuring device failure will result.
- Avoid constantly writing non-volatile device parameters via the MODBUS RS485.

7.1.2 Address model

The Modbus RS485 register addresses of the measuring device are implemented in accordance with the "Modbus Applications Protocol Specification V1.1".

In addition, systems are used that work with the register address model "Modicon Modbus Protocol Reference Guide (PI-MBUS-300 Rev. J)".

Depending on the function code used, a number is added at the start of the register address with this specification:

- "3" → "Read" access
- "4" → "Write" access

Function code	Access type	Register in accordance with "Modbus Applications Protocol Specification"	Register in accordance with "Modicon Modbus Protocol Reference Guide"
03 04 23	Read	XXXX Example: mass flow = 2007	3XXXX Example: mass flow = 32007
06 16 23	Write	XXXX Example: reset totalizer = 6401	4XXXX Example: reset totalizer = 46401

7.2 Overview of the operating menu

The following table provides an overview of the menu structure of the operating menu and its parameters. The page reference indicates where the associated description of the submenu or parameter can be found.

Navigation

"Operation" menu → Custody transfer

► Custody transfer		
Custody transfer mode	→	📄 50
Firmware version	→	📄 50
Checksum	→	📄 50
Custody transfer counter	→	📄 50
Custody transfer locking	→	📄 50
Timestamp last custody transfer	→	📄 50
Display test	→	📄 50

7.3 Register information

Navigation: Custody transfer					
Parameter	Register	Data type	Access	Selection / User entry / User interface	→ 
Custody transfer mode	3094	Integer	Read	0 = Off 1 = On	27
Firmware version	7277 to 7280	String	Read	Character string in the format xx.yy.zz	27
Checksum	6117	Integer	Read	Positive integer	24
Custody transfer counter	2849	Integer	Read	0 to 65 535	27
Custody transfer locking	5926	Integer	Read / Write	0 = All parameters 1 = Defined parameters	21
Timestamp last custody transfer	4482 to 4488	String	Read	Days (d), hours (h), minutes (m) and seconds (s)	27
Display test	28731	Integer	Read / Write	0 = Cancel 1 = Start	24



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www.addresses.endress.com
