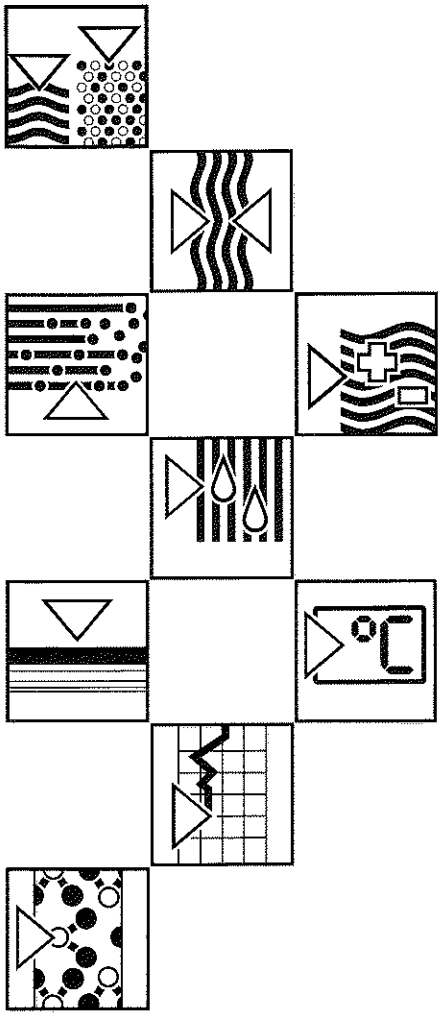
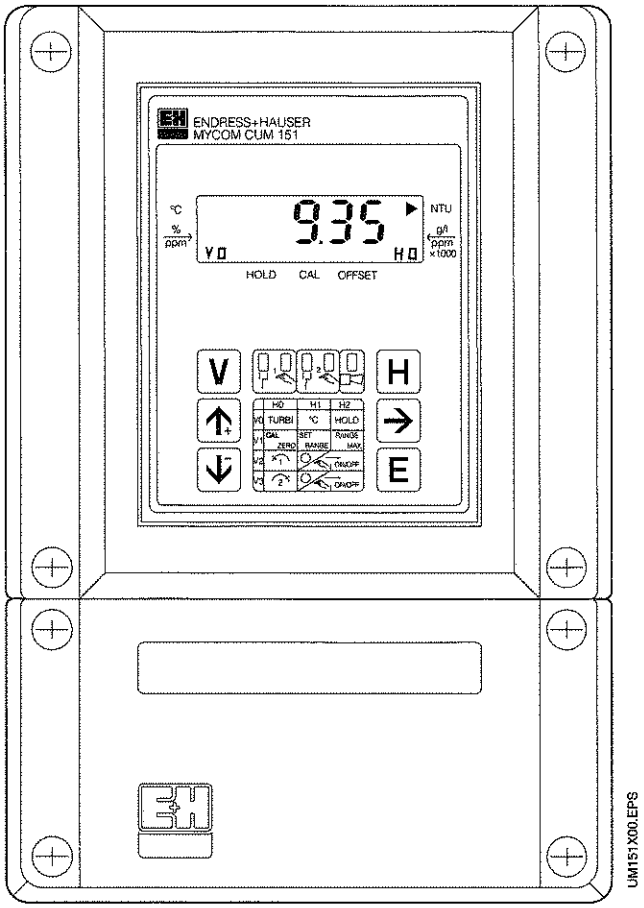
BA 107C/07/e/02.96
No. 50063020
Software version 6.0 or later

mycom
CUM 121 / 151
Turbidity and temperature transmitter

Installation and operating instructions





Quality made by
Endress+Hauser

ISO 9001

Endress+Hauser

Nothing beats know-how

Table of contents

1. General

These installation and operating instructions describe the fully equipped measuring transmitter Mycom CUM 121 / 151.

Note:

Digital interfaces require separate installation and operating instructions from the Mycom instrument family:
- Mycom serial interface BA 078C/07/e

1.1 Unpacking

- Inspect for any damaged packaging! The post office or forwarding agent must be informed of any damage. Damaged packaging material must be retained until the matter has been settled!
- Verify that the contents are undamaged! Inform the post office or forwarding agent as well as the supplier of any damage.
- Check that the delivery is complete and agrees with the shipping documents and that the unit type and version match the nameplate (see fig. 1.1).

The scope of delivery of the Mycom CUM 121 (panel-mounted unit) includes:
- 2 housing fastening elements (order no. 50047795)
- 1 submin D connector (instruments with digital interface only; order no. 50051998)
- Installation and operating instructions
- Instrument identification card(s)

The scope of delivery of the Mycom CUM 151 includes:
- 1 housing mounting kit (order no. 50061357)
- 1 measuring point marking label (order no. 50061359)
- Installation and operating instructions
- Instrument identification card(s)

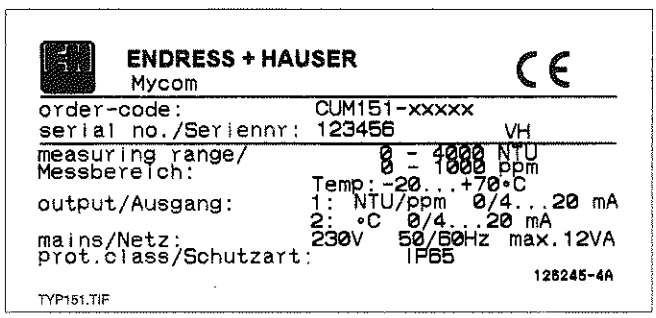
If you have any questions, consult your supplier or your competent Endress+Hauser sales center (see back page of these operating instructions for addresses).

1.2 Application

The Mycom CUM 121 and 151 are microprocessor-based measuring and control instruments used to determine turbidity in liquid media. Thanks to state-of-the art engineering, these instruments can be easily adapted to all turbidity measuring tasks.

They may be adapted to all measuring tasks under a wide range of environmental conditions.

Typical areas of application are:
- Sewage treatment plant effluent monitoring
- Water treatment
- Monitoring of public waters
- Industrial water treatment
- Sludge concentration measurement
- Drinking water monitoring



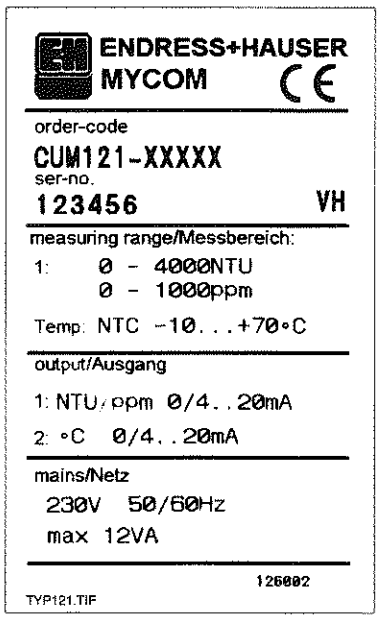


Fig. 1.1: Nameplates
left: Mycom CUM 151-I
right: Mycom CUM 121-I

1.3 Order code

Mycom CUM 121 / 151

Types
121 Housing for panel installation, 96 x 96 mm, ingress protection IP 54 (front)
151 Field housing with terminal strip and sensor receptacle, ingress protection IP 65

Measuring range
I 0 ... 4000 NTU / 0 ... 99.99 NTU / 0 ... 999.9 ppm
(scattered light turbidity measurement according to DIN / ISO) for use with CUS 1
C 0 ... 2.500 NTU / 0 ... 99.99 NTU / 0 ... 99.99 ppm
(scattered light turbidity measurement according to DIN / ISO) for use with CUS 3
R 0 ... 4000 NTU / 0 ... 99.99 g/l / 0 ... 200.0 %
(multi-channel push-pull turbidity measurement) for use with CUS 4

Versions
All versions with 2 limit contacts and alarm contact,
1 limit contact can be optionally used for cleaning control.

Power supply
0 230 V AC, 50 / 60 Hz
1 110 V AC, 50 / 60 Hz
2 200 V AC, 50 / 60 Hz
3 24 V AC, 50 / 60 Hz
4 48 V AC, 50 / 60 Hz
5 100 V AC, 50 / 60 Hz
6 127 V AC, 50 / 60 Hz
7 240 V AC, 50 / 60 Hz
8 24 V DC

Instrument outputs
0 0 / 4 ... 20 mA for turbidity
1 0 / 4 ... 20 mA for turbidity and temperature
3 0 / 4 ... 20 mA for turbidity with additional RS 232-C interface
6 0 / 4 ... 20 mA for turbidity with additional RS 485 / E+H Rackbus interface
9 Special version

CUM [ ] – [ ][ ][ ] ⇐ **complete order code**

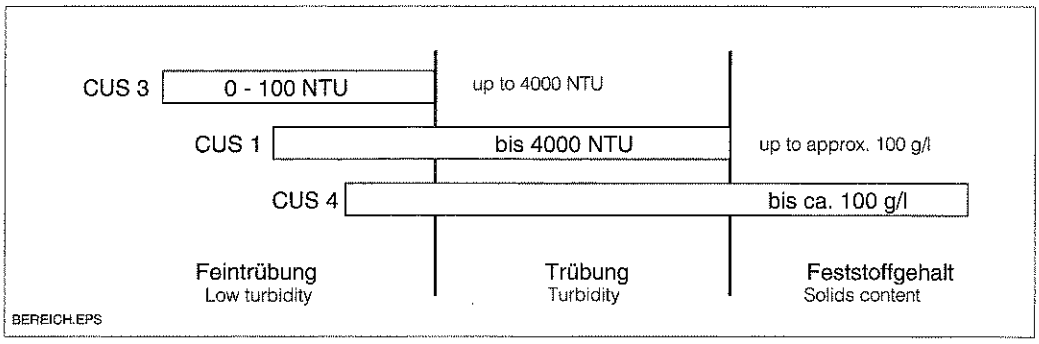


Fig. 1.2: Areas of application of turbidity sensors CUS 1, CUS 3 and CUS 4

2. Measuring system

Turbidity and solids content measurement

The measuring system consists of:

- the Mycom CUM 121 / 151 instrument
- a turbidity sensor CUS 1 / CUS 4
- an assembly holder, e.g. with an immersion tube for sensor mounting
- accessories (see chapter 10.3)

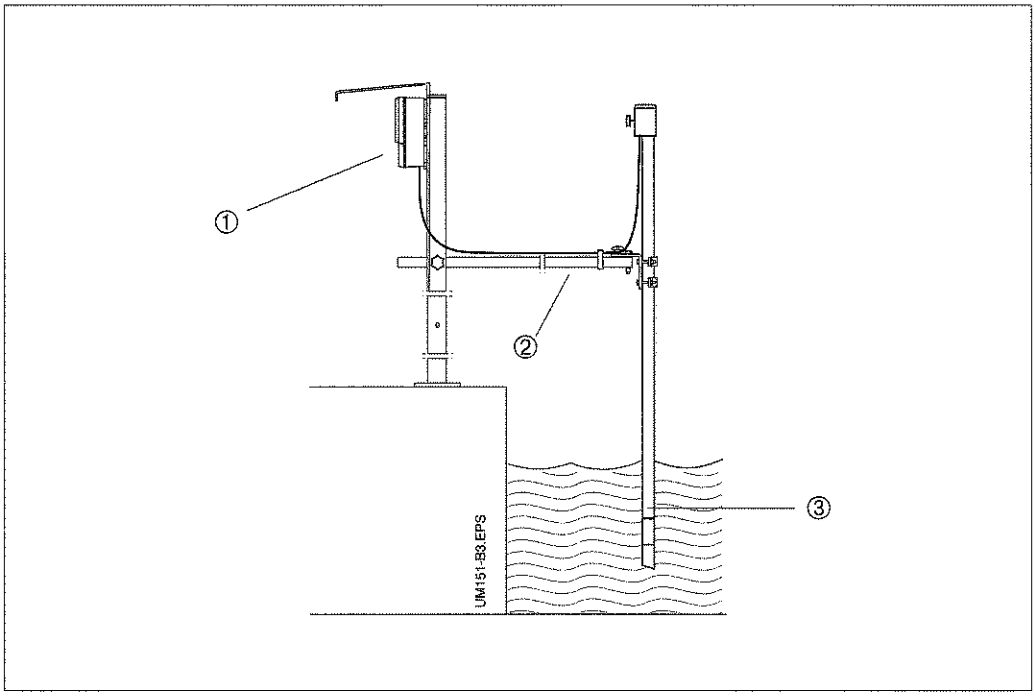


Fig. 2.1: Example of a complete measuring system:

① Mycom CUM 151 with weather protection cover
② Universal assembly holder CYH 101
③ Turbidity sensor CUS 1 (-W) or CUS 4 (-W)

Measurement in low turbidity range

The measuring system consists of:

- the Mycom CUM 121 / 151 instrument
- the turbidity sensor system CUD 3
- a wall mounting support for the turbidity sensor system CUD 3 (turbidity sensor CUS 3 with flow assembly)
- accessories (see chapter 10.3)

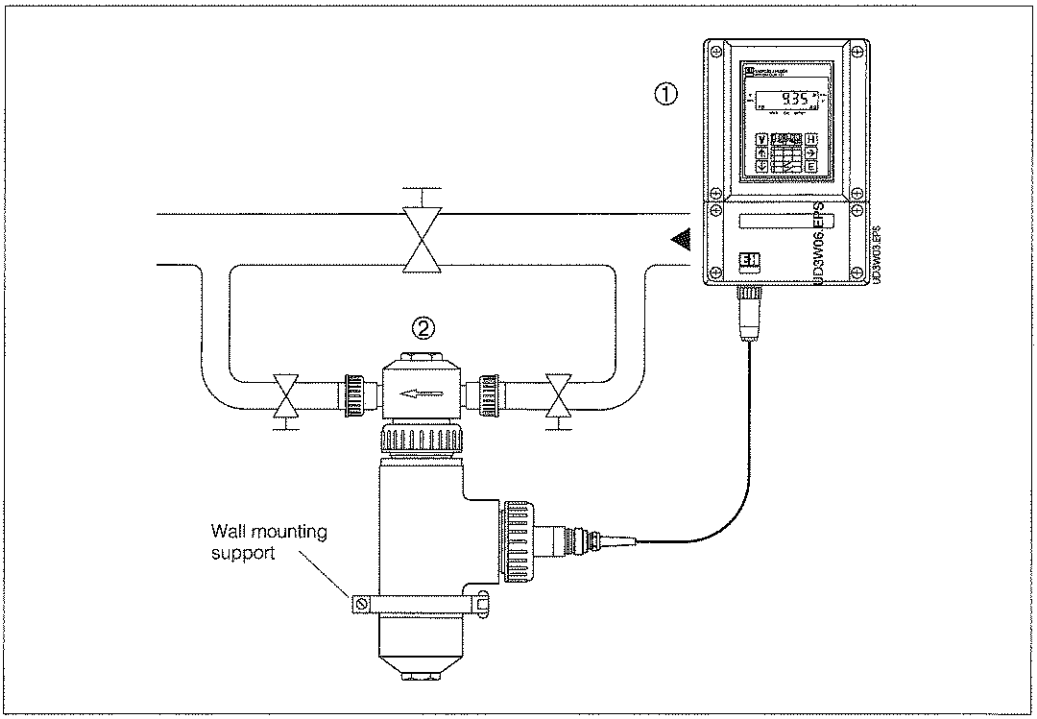


Fig. 2.2: Example of a complete measuring system:

① Mycom CUM 151
② Turbidity sensor system CUD 3

3. Installation

3.1 Dimensions

Mycom CUM 121

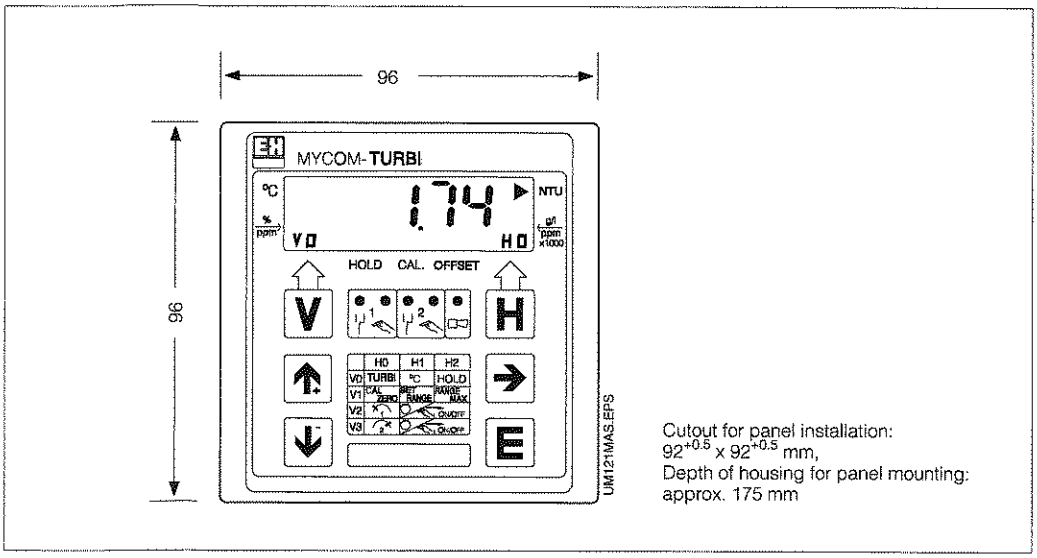


Fig. 3.1: Mycom CUM 121
Dimensions of housing for panel mounting

Mycom CUM 151

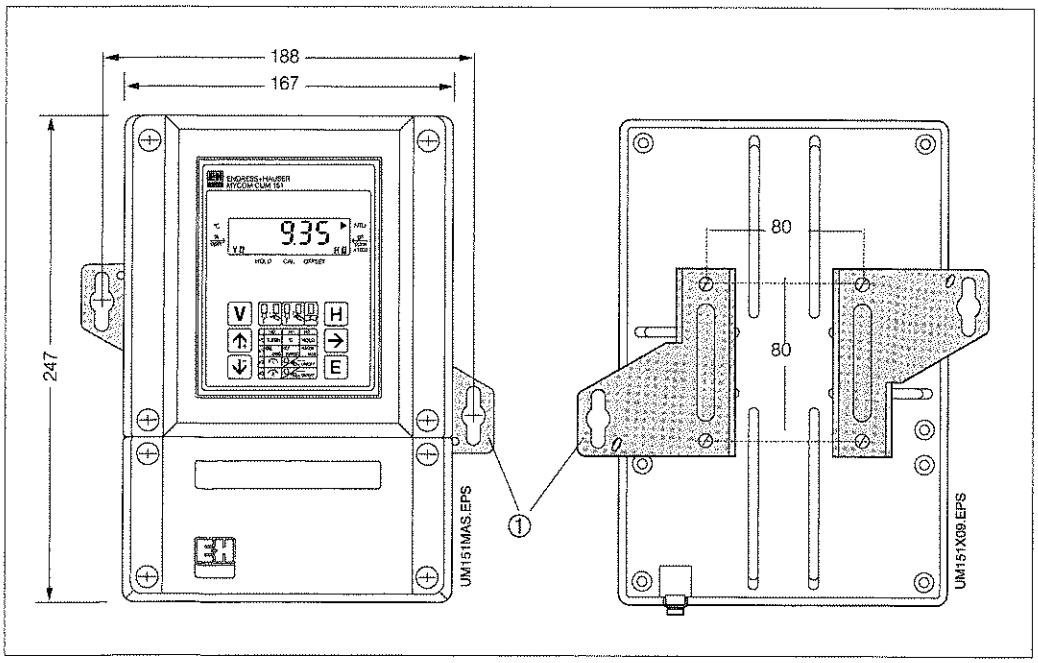


Fig. 3.2: (left) Dimensions of Mycom CUM 151

① Mounting brackets for wall installation
Screw Ø 6 mm

Fig. 3.2: (right) Rear of field housing with mounting brackets installed

Note:
Mounting brackets and screws are supplied in the housing mounting kit.

3.2 Types of mounting

3.2.1 Panel mounting of Mycom CUM 121

The instrument is mounted by means of the supplied housing mounting kit.
The required cutout for panel mounting in accordance with DIN 43 700 is $92^{+0.5}$ x $92^{+0.5}$ mm.

3.2.2 Panel mounting of Mycom CUM 151

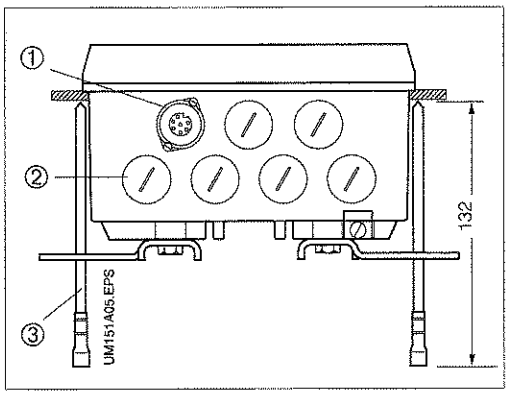


Fig. 3.3: Mycom CUM 151 Bottom of field housing with mounting dimensions and straining screws installed for panel mounting

① Receptacle for SXP connector
② Screw plugs for Pg 13.5
③ Straining screws

The instrument is mounted by means of the supplied housing mounting kit (see fig. 3.3).

The sealing of the panel cutout requires a flat packing (see chapter 10.3, Accessories).

Required cutout for panel mounting: $161^{+0.5}$ x $241^{+0.5}$ mm (W x H).

3.2.3 Wall mounting of Mycom CUM 151

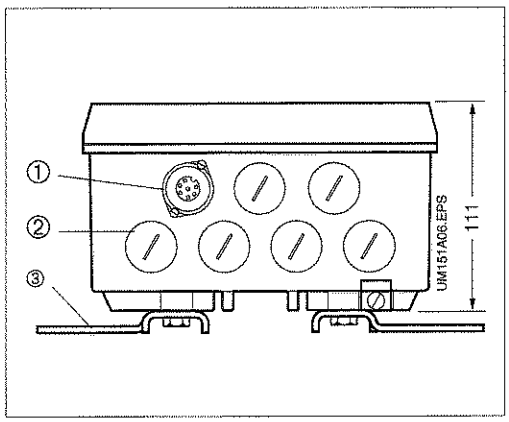


Fig. 3.4: Mycom CUM 151 Bottom of field housing with brackets installed for wall mounting

① Receptacle for SXP connector
② Screw plugs for Pg 13.5
③ Mounting brackets

Install mounting brackets on rear of instrument according to fig. 3.4.

For housing and mounting dimensions of the field housing see figures 3.2 and 3.4.

3.2.4 Post mounting of CUM 151

The field housing Mycom CUM 151 can be mounted on vertical or horizontal tubing with a max. pipe diameter of 70 mm by means of the supplied housing mounting kit.

The parts of the housing mounting kit are to be installed on the rear of the unit in accordance with figures 3.5 und 3.6.

See chapter 10.3 for further accessories for Mycom CUM 151.

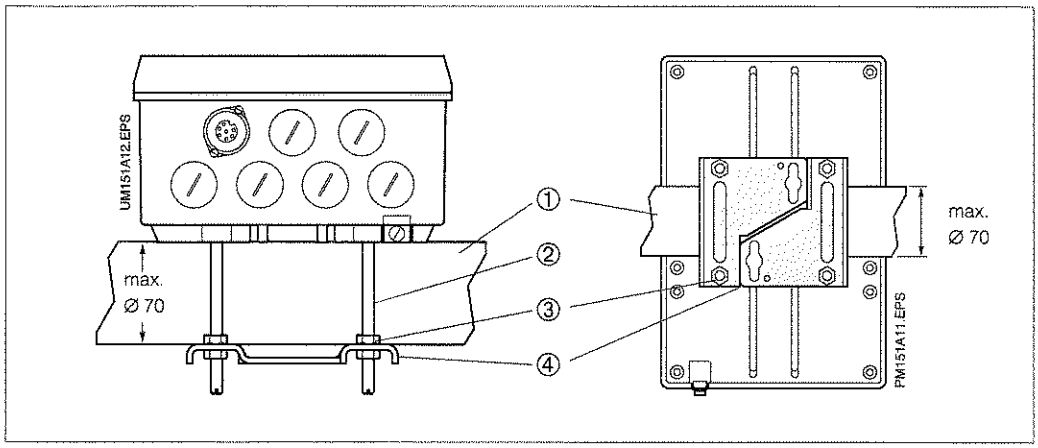


Fig. 3.5: Installation of field housing on horizontal tubing

left: bottom view
right: rear view

① Horizontal tubing
② Threaded rods M6 x 92
③ Mounting nut M6
④ Mounting plate

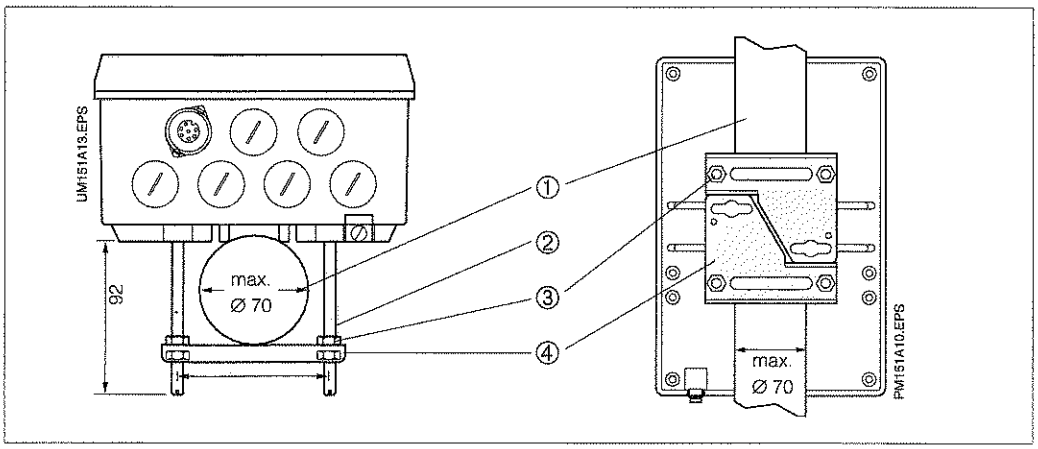


Fig. 3.6: Installation of field housing on vertical tubing

left: bottom view
right: rear view

① Vertical tubing
② Threaded rods M6 x 92
③ Mounting nut M6
④ Mounting plate

3.3 Accessories for installation

3.3.1 Weather protection cover CYY 101

Weather protection cover CYY 101 is required for outdoor installation of Mycom CUM 151.

- In conjunction with CYH 101:
  - Install weather protection cover
  - Install instrument
- Round post or wall mounting:
  - install on upright post or
  - round post or
  - wall.

Refer to figures 3.7 and 3.9 for the mounting holes to be drilled.

The weather protection cover CYY 101 can be installed directly on the upright post of assembly holder CYH 101 by means of 2 screws (M8), see fig. 3.7, mounting position ①.

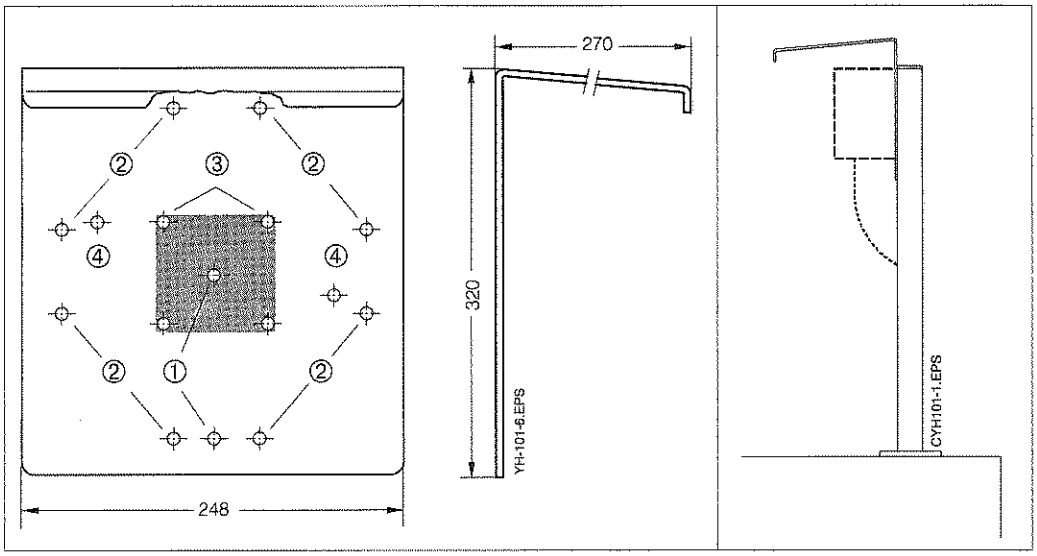


Fig. 3.7: (left) Weather protection cover CYY 101 with dimensions and mounting positions for

① installation on upright post with 2 M8 screws
② installation on vertical or horizontal pipe with 2 round post mounts
③ installation on instrument
④ wall installation with Mycom CUM 151 instrument installed

Fig. 3.8 (right) Weather protection cover CYY 101 with Mycom CUM 151 mounted on upright post

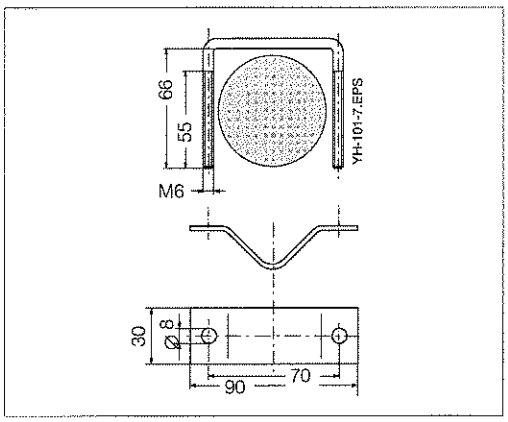


Fig. 3.9: Post mounting kit for weather protection cover CYY 101 when not mounted on assembly holder CYH 101

Installation on vertical or horizontal tubing and upright posts (max. diameter 70 mm) requires an additional round post mounting kit (see chapter 10.3).

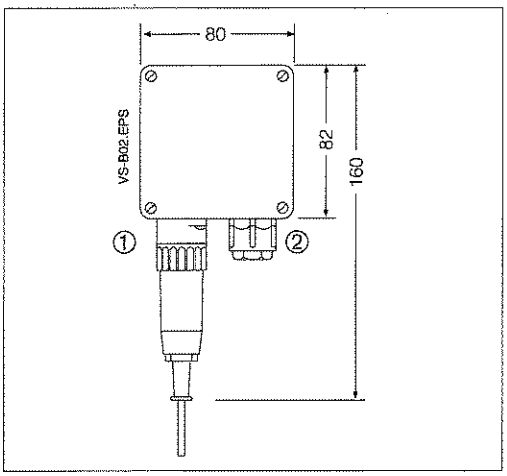


Fig. 3.10: Junction box VS for extension of connecting cable between turbidity sensor CUS 1 / CUS 4 and Mycom CUM 121 / 151

① SXP connector
② Pg 13.5 cable gland

3.3.2 Junction box VS

The junction box is required to extend the connecting cable between the sensor and CUM 121 / 151 transmitter to a maximum length of 50 m or to connect a sensor with an SXP connector to the CUM 121 transmitter. Junction box VS is equipped with a 7-pin receptacle to connect the sensor. The measuring cable is connected to the instrument via the terminal strip built into the instrument.

The ingress protection of junction box VS is IP 65.

4. Electrical connection

4.1 Connection principles

Cautions:

- The instrument must be grounded before start-up!
- If faults cannot be remedied, the instrument must be removed from service and secured to prevent accidental start-up.
- Repair work must be carried out directly by the manufacturer or by the Endress+Hauser Service organization.
- Keep the screen ground line as short as possible. Do not solder an extension onto the screen! This also applies to the connection of junction box VS (see chapter 3.3.2).
- Ground the upright post when installing the field housing (CUM 151) to increase immunity to interference. Running the cable in the post will improve interference suppression.

Warnings:

- The notes and warnings in these operating instructions must be strictly adhered to! Maintenance work may only be carried out by qualified personnel if the instrument remains energized.
- This instrument has been tested for electromagnetic compatibility with industrial areas according to EN 500081-2, 03.94 and prEN 50082-2, 11.94. This is only valid, however, for a properly grounded instrument with a screened measured value output line.

Notes:

- This instrument has been built and tested in accordance with EN 61010-1, and left the manufacturer's works in perfect condition.
- Any faults in the instrument may be remedied with the aid of the error list in chapter 8.4 without requiring intervention in the instrument itself.

  Interventions in or changes to the instrument are impermissible and will void the warranty.
- After installing and connecting the instrument and sensors, the entire measuring system must be checked for proper function.

4.2 Manufacturer's certificate

This is to certify that the measuring instruments of the

Mycom family

have been radio interferencesuppressed in accordance with the regulations as decreed in BMPT bulletin 243 / 1991 with supplement 46 / 1992, EN 55011:91 = DIN VDE 0875, part 11, 07.92 and EN 500811.

The German Federal Office for Telecommunication Approvals was advised that these units have been brought into circulation and was granted the right to inspect the series for conformance with the regulations.

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4.3 Connection of CUM 121 / 151

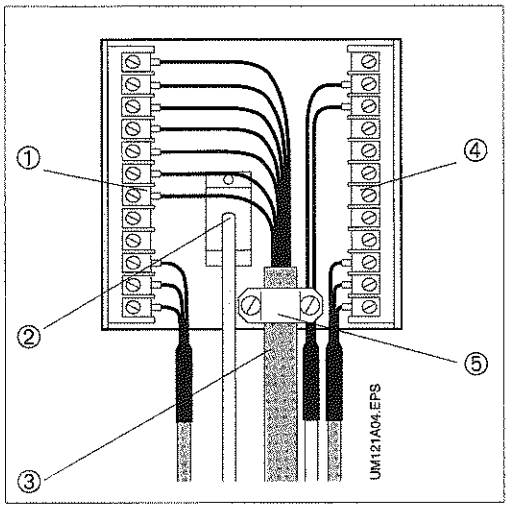


Fig. 4.1: Mycom CUM 121
Rear of instrument with connections

① Terminal strip for transmitter and signal lines
② Terminal for output 2 or submin D connector (digital interface only)
③ Sensor line (measuring cable OMK)
④ Terminal strip for power supply and switching contacts
⑤ Strain relief clamp and additional screen connection for outer measuring cable screen

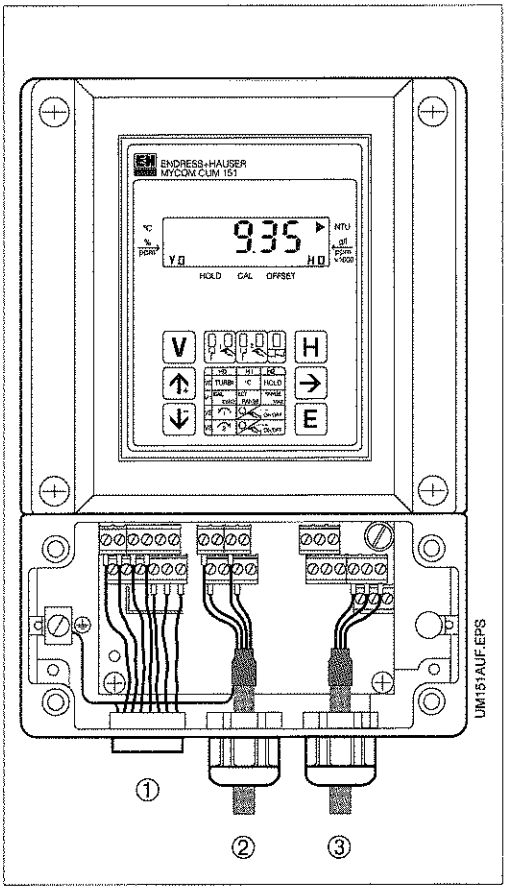


Fig. 4.2: Mycom CUM 151 with instrument connections in separate terminal connection compartment

① Sensor connection
② Measured value output or interface
③ Power supply

The electrical connections (sensor and signal lines, mains connection and switching contacts) to the unit are established as follows:

- **Mycom CUM 121**
  Via the removable terminal strips on the rear of the unit (fig 4.1).

  – Use junction box or remove plug from sensor cable.
  – Connection diagrams (see figs. 6.1, 6.3, 6.5, 6.7, 6.9, 6.11)

- **Mycom CUM 151**
  Via the separate terminal connection compartment (fig. 4.2).

  – Replace the screw plugs underneath the unit with the corresponding number of Pg cable glands.
  – Introduce the connecting cables through the Pg cable glands (see fig. 4.2).
  – Connect the unit according to the connection diagram (see figs. 6.2, 6.3, 6.6, 6.7, 6.10, 6.11).
  Signal cables must be spatially separated from mains and power cables!
  – Tighten the cable glands.
  – Install the cover on the separate terminal connection compartment and tighten the cover screws.

  – Insert the SXP connector on the turbidity sensor connecting cable in the receptacle underneath the instrument.

Terminals	
Cross section:	4.0 mm²
Optionally connectable:	1 wire with 2.5 mm² 1 wire with 4.0 mm² 2 litz wires 1.5 mm² each and end sleeves 1 litz wire with 2.5 mm² and end sleeve
Terminal designations:	acc. to DIN 45140

Note:

Refer to the following chapters for the turbidity sensor connection diagrams:

- Chapter 6.1
  Turbidity sensors CUS 1, CUS 1-W
- Chapter 6.2
  Turbidity sensor system CUD 3, CUD 3-W
- Chapter 6.3
  Turbidity sensors CUS 4, CUS 4-W

4.4 Start-up

Power-up

- Make sure the mains ratings match the ratings on the nameplate (see fig. 1.1) before power-up.
- After power-up, all LCD segments of the display light up briefly (for approx. 2 seconds), and all LEDs turn red.
  Then the unit starts measuring. The operating and start-up levels are locked.

Power failure

- In the event of a power failure with a maximum duration of 20 ms, measuring operation continues.
- If there is a power failure with a duration of more than 20 ms, measuring operation is interrupted, but the values entered for the parameters are retained.
- When the operating voltage returns, the unit resumes measuring operation as described under "Power-up" above.

Note:

Refer to the following chapters for the individual steps required for start-up with the various turbidity sensors:

- Chapter 6.1.3
  Steps for start-up with CUS 1
- Chapter 6.2.3
  Steps for start-up with CUD 3
- Chapter 6.3.3
  Steps for start-up with CUS 4
- Chapter 7
  Limit contacter adjustment
- Chapter 7.2
  Alarm contact adjustment

5. Operation

5.1 General notes on operation

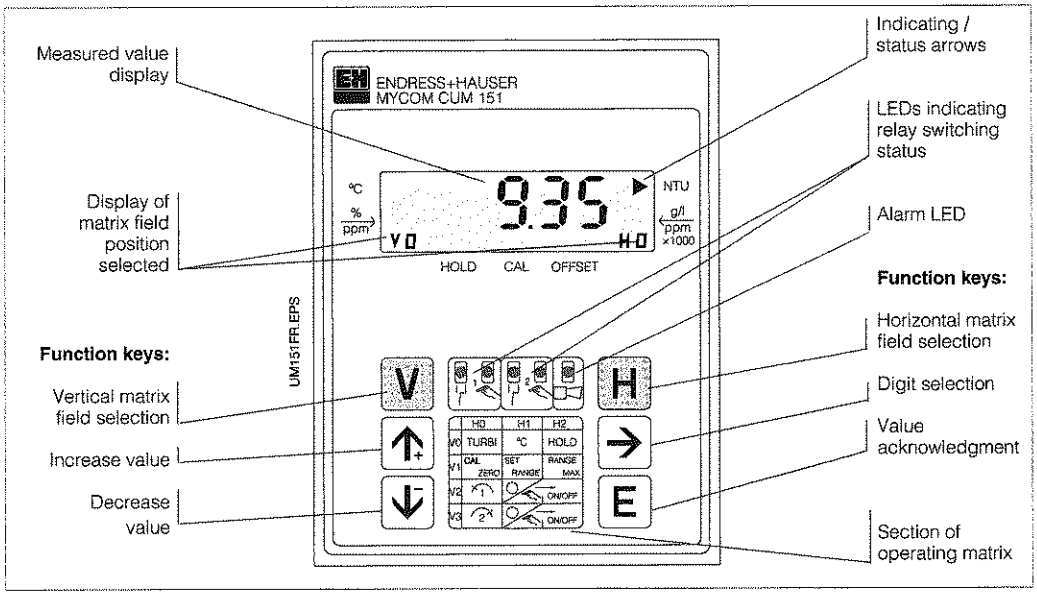


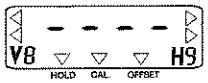
Fig. 5.1: Mycom CUM 151 Front view of instrument with display and operating elements

The operation of the unit is matrix-oriented, i.e. each instrument function is allocated to one position in the 10 x 10 field matrix (fields V0 / H0 to V9 / H9).

The individual operating functions are selected via the V (vertical) and H (horizontal) keys. These keys cycle through the matrix fields, including those which have not been assigned a function.
The functions of the matrix fields are grouped into 3 levels, depending on their purpose:

- Level 0: **Indication**
  (turbidity value, temperature, lock and unlock)
  Access code: **none**
- Level 1: **Operation**
  (calibration, hold, limit value setting, manual/auto switching, alarm, cleaning function)
  Access code: **1111**
- Level 2: **Start-up**
  (current output assignment, filter, limit value configuration / alarm, interface and current simumulation)
  Access code: **2222**

Without previous code entry, the content of each matrix field can only be displayed.
All matrix fields for which the corresponding function has not been activated display:



Access to levels 1 and 2 is secured by means of an access code.
If level 2 is unlocked, all functions of level 1 can be accessed, too.

Keys for value entry and function selection:

Value adjustment

Selection of digit. Cycles from 1st to 2nd, 2nd to 3rd digit, etc.

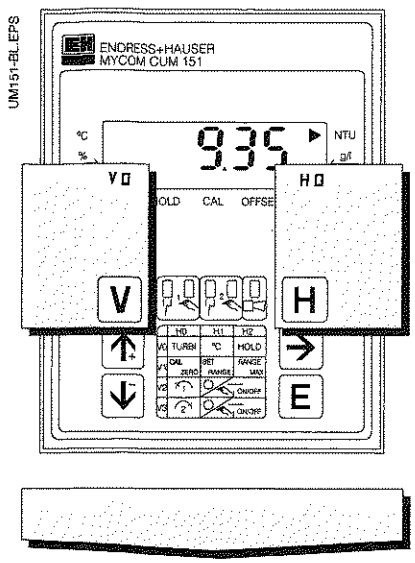
Accept value
Verification: a value has been accepted when it is displayed continuously.

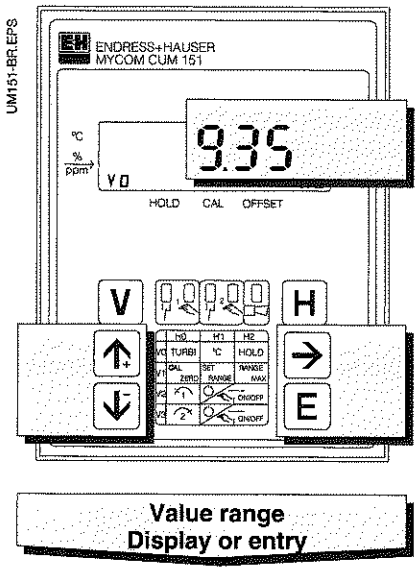
Recall

Note:

After each interruption in operation the instrument automatically returns to the indication mode (matrix field V0 / H0).

5.2 Matrix user interface





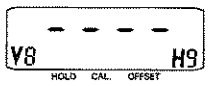
V key:
Selection of row
Matrix fields V0 to V9

Every press of the V key increases the V (row) display by one.

H key:
Selection of column
Matrix fields H0 to H9

Every press of the H key increases the H (column) display by one.

Display for locked matrix fields:



Display for changeable matrix fields:
Digit which can be edited flashes.

Value entry and function selection by key actuation:

Increase value

Decrease value

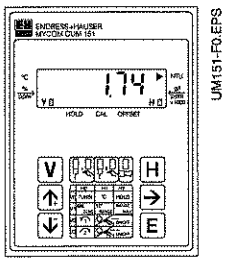
- Selection of digit. Cycles from 1st to 2nd to 3rd digit, etc.
- Start editing
- Recall after E

Acknowledge value

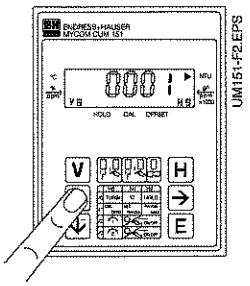
5.2.1 Unlocking the levels

- Press the E key (Enter) in matrix field V0 / H0 (indication of measuring value) to jump directly to matrix field V8 / H9.
- Code is shown in matrix field V8 / H9.
- Unlock level 1 **Operation** by entering **Code 1111** or
- unlock level 2 **Start-up** by entering **Code 2222**.
- Acknowledge with the E key.
- Jump back to matrix field V0 / H0 (measured value display) by pressing the V and H keys simultaneously.

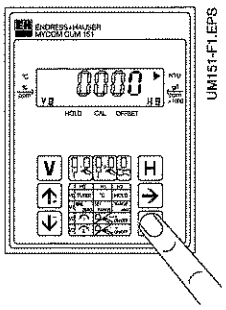
Example for unlocking level 1 (operation)



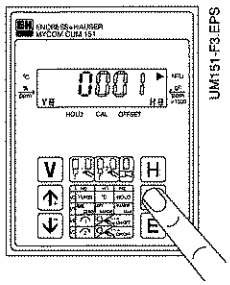
Initial state:
Instrument is in measuring mode.
Displayed matrix field position: V0 / H0



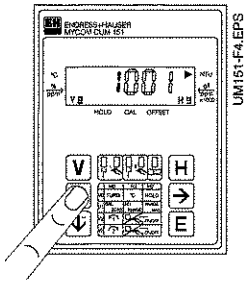
Step 2:
Set value 1 by pressing the " ↑+" or "↓–" key.



Step 1:
Press the "E" key.
Matrix field V8 / H9 "Unlock / Lock" is selected.
Digit 4 of display flashes.

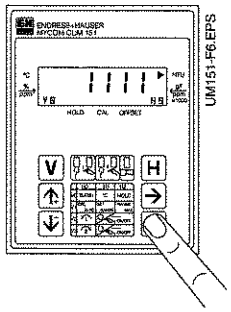


Step 3:
Press the "→ " key to go to digit 1.
Digit 1 flashes.

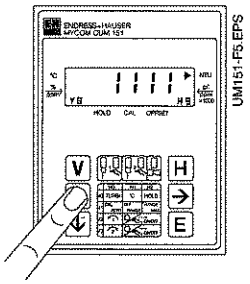


Step 4:
Set value 1 by pressing the "↑ +" or "↓–" key.

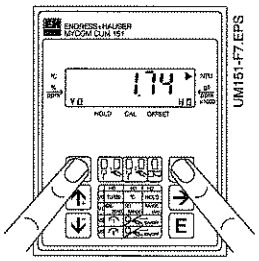
Steps 5 and 6:
Same as steps 3 and 4.
Press the "→ " key to go to digit 2 and set value 1.



Step 9:
Press the "E" key.
The unlocking code **1111** for the operating level is set.
All matrix fields of the operating level are now unlocked, i.e. changes and inputs by the user are possible.



Steps 7 and 8: Same as steps 3 and 4.
Press the "→ " key to go to digit 3 and set value 1.
Now value **1111** should be displayed.
If not, steps 2 to 8 can be repeated.



Step 10:
Press the V and H keys simultaneously.
The instrument is now in measuring mode.
Displayed matrix field postion is V0 / H0.

Unlocking level 2 (start up)

Proceed as described in steps 1 to 10, but enter code number **2222**.

Locking levels 1 and 2

Proceed as described in steps 1 to 10 but enter or edit to any number **except** 1111 or 2222.

Notes:

1. At initial startup or after power failure locking value 0000 is displayed.
2. Direct selection of any matrix field with the "E" key is only possible for field V8 / H9.
   All other matrix fields are selected by pressing the "V" and "H" keys separately.
3. The **return** to matrix field **V0 / H0** by pressing the " V " and " H " keys simultaneously is possible from every matrix field position.

6. Operation with sensors

6.1 Turbidity sensor CUS 1

The sensor CUS 1 is suitable for continuous turbidity and solids content measurement in liquid media (refer to CUS 1 operating instructions for technical data).

6.1.1 Matrix for operation with CUS 1

(See chapter 6.4 for description of operating functions.)

V \ H	0	1	2	3
Basic functions I **0**	Measurement 0 to 99.99/4000 NTU 0 to 999.9 ppm	Temperature display – 10 to +70 °C	HOLD ON / OFF 0 = OFF 1 = ON	Toggle 0 to 20 mA / 4 to 20 mA 0 = 0 to 20 mA 1 = 4 to 20 mA
Basic functions II **1**	Zero point calibration (CAL ZERO) 0 = offset value entry 1 = auto. rel. offset	Selection of measuring range (SET RANGE) 0 = 0 to 99.99 NTU 1 = 0 to 4000 NTU 2 = 0 to 999.9 ppm	Display of range (RANGE MAX) 99.99 (NTU) 4000 (NTU) 999.9 (ppm)	Entry of calibration value 1 40 (2 to 100) NTU 4.0 (1.0 to 10.0 ppm)
Limit value 1 **2**	Limit value entry 0: 0.00 to 99.99 NTU 1: 0 to 4000 NTU 2: 0 to 999.9 ppm	Toggle Manual / Auto 0 = Manual 1 = Auto	Manual OFF / ON Measured value	Pickup delay 0 to 6000 s
Limit value 2 **3**	Limit value entry 0: 0.00 to 99.99 NTU 1: 0 to 4000 NTU 2: 0 to 999.9 ppm	Toggle Manual / Auto 0 = Manual 1 = Auto	Manual OFF / ON Measued value	Pickup delay 0 to 6000 s
Sensor cleaning **4**	Cleaning function 0: cleaning off 1: contact cleaning 2: wiper cleaning	Type of cleaning 0: Manual 1: Automatic	Manual cleaning Key ↓ = OFF Key ↑ = cleaning	Cleaning period (Auto) 3 to 600 s
Alarm **7**	Alarm treshold 0: 0.00 to 50.00 NTU 1: 0 to 2000 NTU 2: 0 to 500.0 ppm	Alarm delay 0 to 6000 s	Toggle steady / fleeting contact 0 = steady contact 1 = fleeting contact	Alarm assignment 0: both limit contacts 1: limit contact 1 only 2: limit contact 2 only
Configuration **8**	Parity 0 = none 1 = odd 2 = even	Baud rate selection 0 = 4800 Bd 1 = 9600 Bd 2 = 19200 Bd		Sensor variant selection 1 = CUS 1 3 = CUS 3
Service and simulation **9**	Diagnostic code E— to E145	Number of auto resets 0 to 255	Display instrument configuration 0000 to 9999	Software version 0.00 to 99.99

Level 0 | **1111** Level 1 | **2222** Level 2

4	5	6	7	8	9
Rate of mA / s	Turbidity at 0 / 4 mA	Turbidity at 20 mA	Temperature at 0 / 4 mA	Temperature at 20 mA	Measured value filter
0.1 to 20.0 mA / s	0: 0 to 80 NTU 1: 0 to 3200 NTU 2: 0 to 800.0 ppm	0: 1 to 99.99 NTU 1: 40 to 4000 NTU 2: 10 to 999.9 ppm	- 10 to + 50 °C	10 ° to 70.0 °C	Time constant 0 to 120 S
Calibration with value 1	Entry of cal. value 2	Calibration with value 2	Entry of cal. value 3	Calibration with value 3	Type of calibration
100 % (10 to 500 %)	800 (110 to 1000 NTU) 100 (11,0 to 100,0 ppm)	100 % (10 to 500 %)	2400 (1100 to 4000 NTU) 240 (110.0 to 999.9 ppm)	100 % (10 to 500 %)	0: Editing function 1: wet calibration
Dropout delay	Toggle MIN / MAX	Toggle normally closed / normally open contact	Hysteresis		
0 to 6000 s	0 = MIN 1 = MAX	0 = normally closed contact 1 = normally open contact	0: 0.00 to 99.99 NTU 1: 0 to 4000 NTU 2: 0 to 999.9 ppm		
Dropout delay	Toggle MIN / MAX	Toggle normally closed / normally open contact	Hysteresis		
0 to 6000 s	0 = MIN 1 = MAX	0 = normally closed contact 1 = normally open contact	0: 0.00 to 99.99 NTU 1: 0 to 4000 NTU 2: 0 to 999.9 ppm		
Pause period (Auto)	Wiper propulsion	Display delay after cleaning			
1 to 1440 min	50 to 250 time units	0 to 300 s			
					Auto hold during calibration and wiper cleaning
					0: without 1: with
					Unlock / lock
					0000 to 9999
Unit addresses	Instrument defaults	Sensor defaults		Simulation ON / OFF	Output current simulation
Rackbus: 0 to 63 RS 232 / 485: 1 to 32				0 = simulation OFF 1 = simulation ON	0.00 to 20.00 mA

6.1.2 Connection diagrams for CUS 1, CUS 1-W

Connection of turbidity sensor CUS 1 to Mycom CUM 121-I

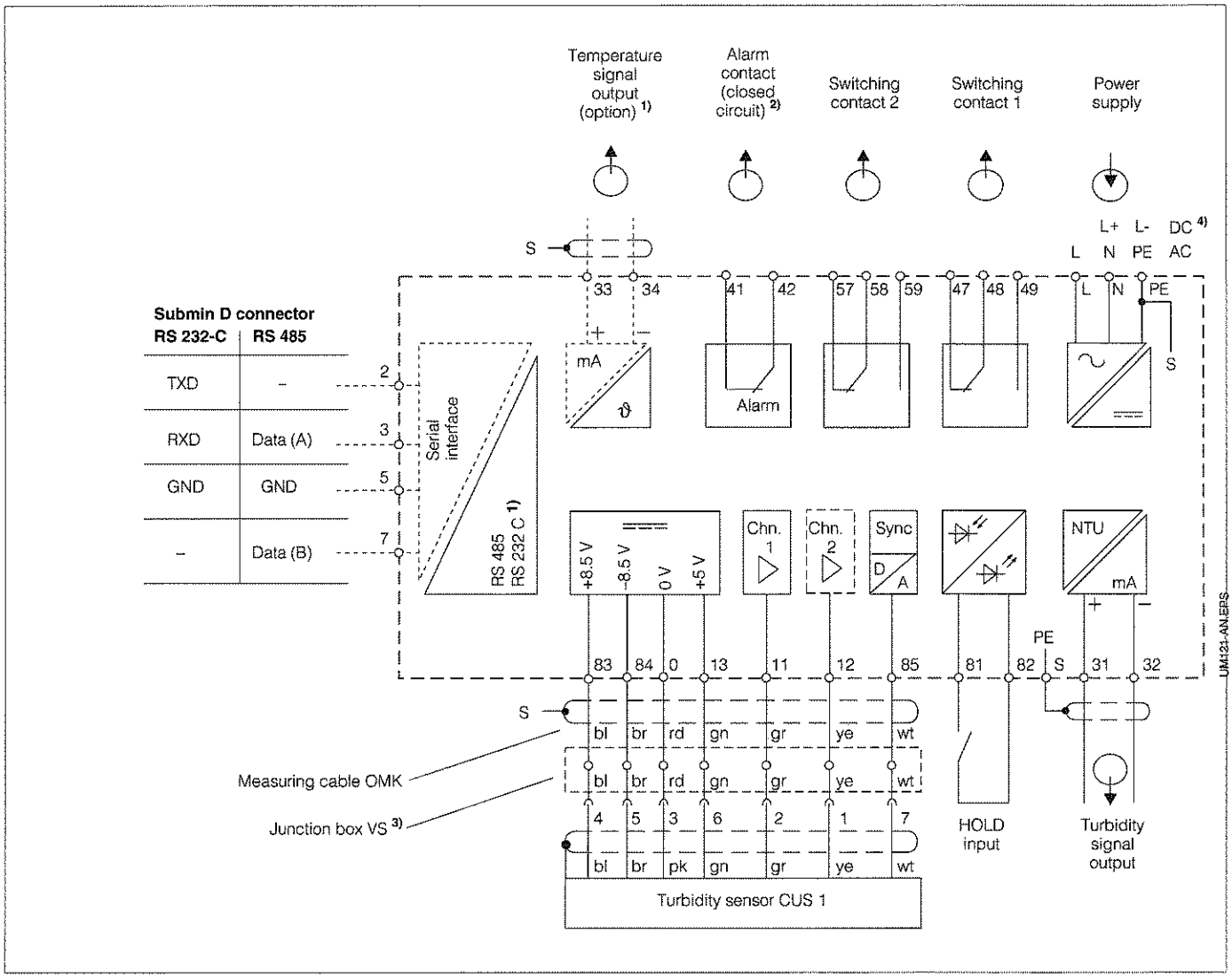


Fig. 6.1: Electrical connection Mycom CUM 121 with junction box and sensor CUS 1

Note:

Connection diagrams 6.1 und 6.2 show the fully equipped instrument!

1) Instrument version optionally with temperature signal output or serial digital interface according to order code (see chapter 1.3).

Connection of turbidity sensor CUS 1 to Mycom CUM 151-I

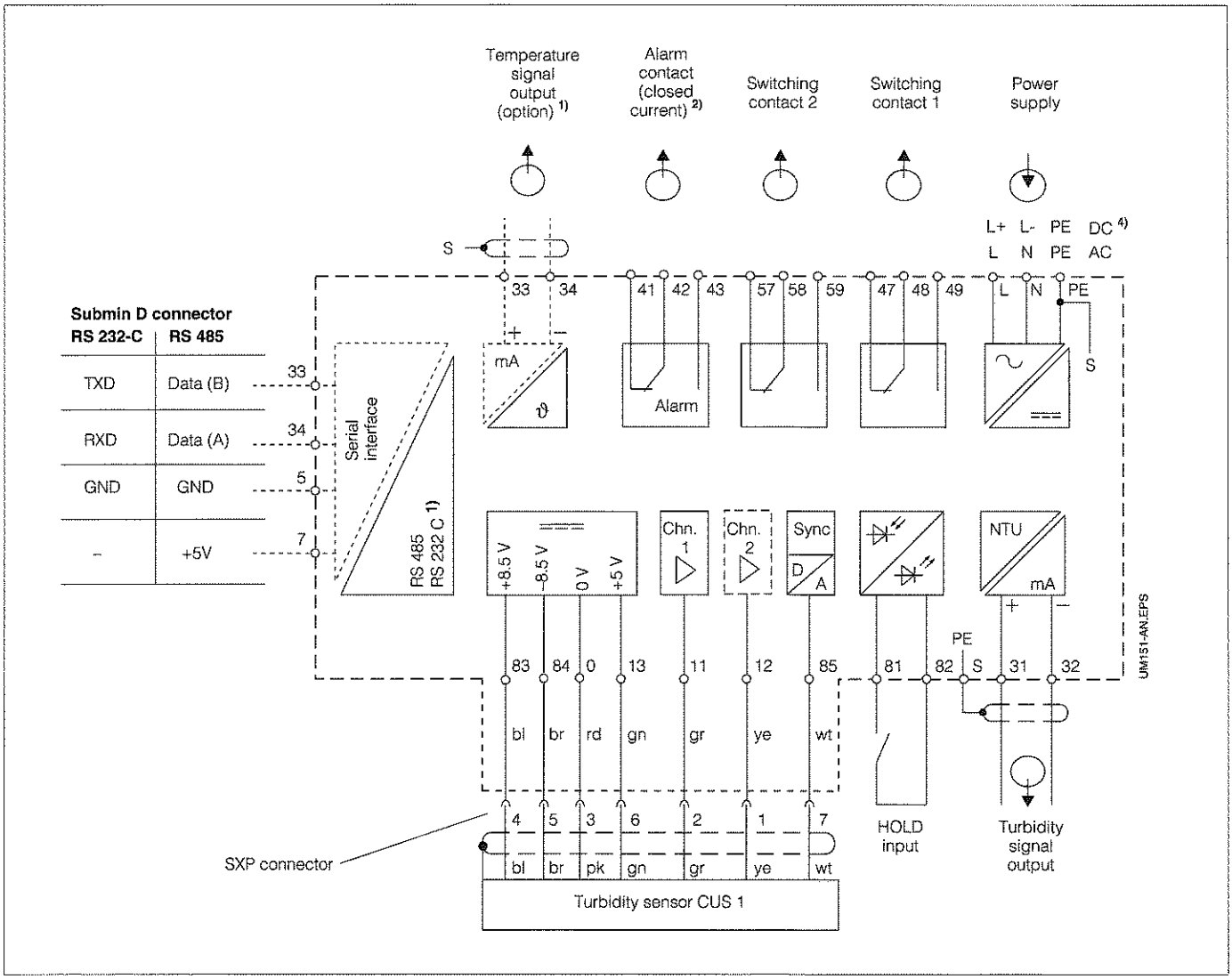


Fig. 6.2: Electrical connection Mycom CUM 151 and sensor CUS 1

2) Contact status shown:
no current or fault present

All switching contacts are interference-suppressed by varistors. External loads connected may have to be additionally interference-suppressed.

3) Use junction box VS with the matching plug-in connector for turbidity sensors or remove connector on sensor cable.

4) 24 V DC floating or minus pole grounded.

Caution:

The DC power supply connection is different for the CUM 121 and CUM 151. Pay attention to the connection diagrams!

Connection of turbidity sensor CUS 1-W

When connecting the CUS 1-W sensor (with the wiper) to the Mycom CUM 121 / 151, two jumpers must be connected in addition to the status shown on the basic wiring diagram, and the yellow wire must be connected to terminal 58. The jumpers required are supplied with the sensor.

Caution:

Exchanging the jumpers causes instrument malfunction!

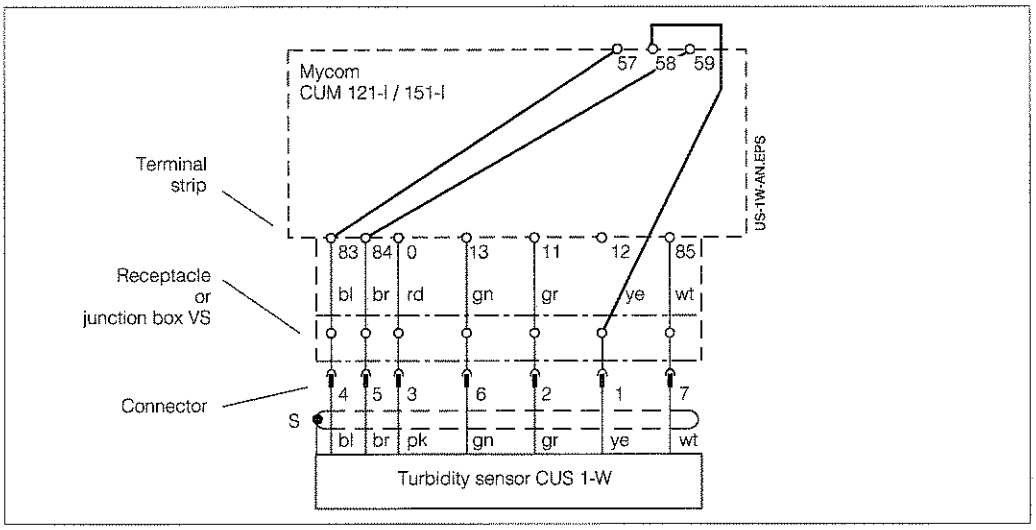


Fig. 6.3: Connection of turbidty sensor CUS 1-W to Mycom CUM 121-I / 151-I

6.1.3 Start-up with CUS 1

Operating steps for start-up with CUS 1

	Sensor type: CUS 1 and CUS 1-W	
		Only for CUS 1-W
1	**Sensor preparation** Connect the sensor but do not place it in the assembly yet. Remove the cap from the sensor and align the sensor in air at a min. distance of 1 m from all surrounding objects. Avoid direct exposure to light. Measured values below 5 NTU or smaller wall clearance at place of installation: Install sensor and maintain clear water flow.	
2		Position the sensor such that the wiper can operate without being obstructed.
3	**Power-up** (see chapter 4.4)	
4	**CODE entry** to unlock level 2 (see chapter 5.2)	
5	**Sensor variant check and change** Matrix postion V8 / H3, see chapter 6.4. **Only if sensor variant is changed:** Select sensor variant in matrix position V8 / H3 (see chapter 6.4), and confirm with [E] (make sure sensor is wired correctly!). When instrument displays "END" press [V] and [H] keys simultaneously. The instrument is restarted. The default settings are retrieved. Repeat code entry to access level 2.	
6	**Retrieve sensor defaults** Press the [E] key in matrix position V9 / H6.	
7		After „END" - in matrix position V4 / H0 = 2: select wiper cleaning, confirm with [E] key.
8		Wait approx. 1 minute while the wiper operates and finally stops. If the wiper does not reach the rest postion, select matrix position V4 / H5 and choose a shorter wiper propulsion time setting.
9	**Measuring range (MR) selection** Select the desired measuring range in matrix position V1 / H1 (see chapter 6.4).	
10	**Sensor calibration** (see chapter 6.1.4) - with factory calibration data (see chapter 6.1.4.1) or - with formazine solution (see chapter 6.1.4.2) or - with user-specific samples (see chapter 6.1.4.2)	
11	**Install the sensor** in the assembly.	
12	**Enter the limit function and alarm values** (see chapter 6.1.1)	

6.1.4 Calibration of sensor CUS 1

This chapter describes the following calibration procedures:

- **Measurement in NTU units**
  Measuring ranges 0 and 1
  Initial installation with factory calibration data (referred to formazine),
  chapter 6.1.4.1
- **Measurement in NTU units**
  Measuring ranges 0 and 1
  Recalibration with formazine solution,
  chapter 6.1.4.2
- **Concentration measurement in ppm**
  Measuring range 2
  Calibration to user-specific sample,
  chapter 6.1.4.2

When to calibrate and fequency of calibration:

- **Mandatory:**
  The turbidity measuring system must be calibrated
  – before first-time operation
  – following replacement of sensor
- **Other times:**
  – periodically at intervals of approx. 1 year or depending on experience and
  – environmental conditions.

Sensor zero point calibration

- **Zero point calibration in air:**
  When measuring in the range above 5 NTU, the zero calibration can be performed in an empty corner of the room (distance 1 m from surrounding objects), avoiding direct exposure to light (sun or bright fluorescent lamp).
  Make sure there is no wall reflection, etc., that might increase the values measured.

Note:

The zero calibration is performed automatically when the sensor defaults are retrieved in matrix position V9 / H6.
An additional zero calibration via matrix field V1 / H0 is therefore only necessary due to special environmental conditions (e.g., wall reflection affecting sensor).

- **Zero calibration in zero solution:**
  When measuring in the range below 5 NTU, the zero calibration should be perfromed with zero solution under installation conditions (e.g., sensor in flow assembly).
  Demineralized or distilled water additionally filtered through a microfilter is suitable for the zero solution.
  Bubble-free handling of zero or standard solutions is essential.

Calibration of sensor characteristic

Select the calibration type and measuring range according to the measuring task at hand.

Note:

The calibration is valid for the selected measuring range only.

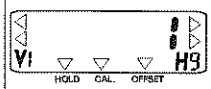
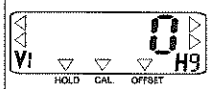
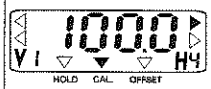
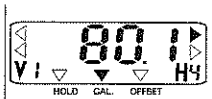
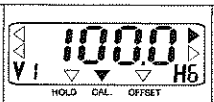
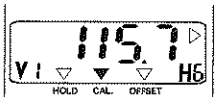
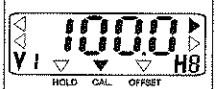
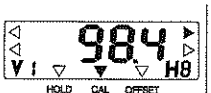
- **Calibration with factory calibration data:**
  (wet calibration values determined at the factory with the aid of fromazine are entered)
  – for example, for turbidity measurement in sewage treatment plant effluent, in raw water or service water.
  – If the results of the measurement are to be reproducible and comparable,, and the factory calibration points 40 / 800 / 2400 NTU have been assigned to the application range (e.g., process water measurement, backwater measurement, rinse water measurement). See chapter 6.1.4.1 for calibration procedure.
- **Calibration with standard formazine solution or user-specific samples:**
  – The undissolved constituents of water are to be measured, rendering absolute values referred to the selected calibration standard.

Note:

We recommend using our calibration vessel (order no. 50057944) for wet calibration.

6.1.4.1 Calibration of CUS 1 with factory calibration data

This procedure is applicable to measuring ranges 0 and 1

Operating step	Procedure	Matrix field	Instrument display	Notes
Select calibration type	Select matrix field	V1 / H9		1 = factory settings
	Press ↓ key Confirm with E key			Select calibration type 0 = editing function for value entry.
Enter Calibration value 1	Select matrix field	V1 / H4		Factory setting 100.0 (only appears during first start-up)
	Factory calibration value 1 Read from „Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → keys Confirm with E key			Calibration value 1 is stored.
Calibration with factory calibration data is complete for measuring range 0.				
Enter calibration value 2	Select matrix field	V1 / H6		Factory setting 100.0 (only appears during first start-up)
	Factory calibration value 2 Read from „Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → keys. Confirm with E key.			Calibration value 2 is stored.
Enter calibration value 3	Select matrix field	V1 / H8		Factory setting 100.0 (only appears during first start-up)
	Factory calibration value 3 Read from „Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → keys. Confirm with E key.			Calibration value 3 is stored.
Calibration with factory calibration data is complete for measuring range 1.				

Note:

▽ Status / indication arrow invisible

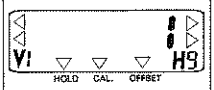
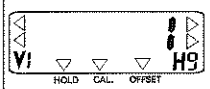
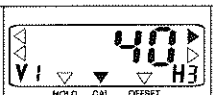
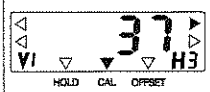
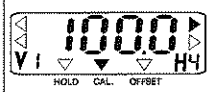
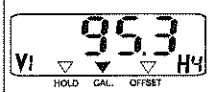
▼ Status / indication arrow visible

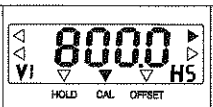
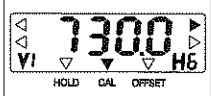
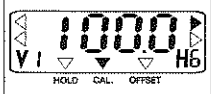
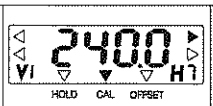
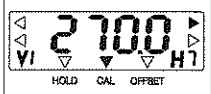
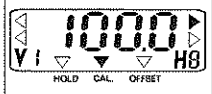
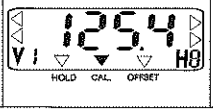
6.1.4.2 Calibration of CUS 1 with standard solutions or user-specific samples

Wet calibration

Note:

- The sensor optics must be clean.
- Do not fill the calibration vessel more than 1 cm above the internal support mandrel. Insert the sensor in the calibration vessel such that the sensor rests on the internal support mandrel.
- Turn the sensor to obtain maximum immersion.
- Make sure the sensor is properly seated on the support mandrel and does not rest on the bottom of the calibration vessel. A dark container blackened or mat on the inside and sufficiently large to leave a distance of at least 15 cm between the walls and the sensor is also suitable for calibration.
- See the description in chapter 6.4.3 for the calibration value range limits.

Operating step	Procedure	Matrix field	Instrument display	Notes
Select calibration type	Select matrix field	V1 / H9		1 = factory settings
	Press ↓ key Confirm with E key			Select calibration type 1 = wet calibration for calibration.
Immerse sensor in standard solution 1 or user-specific sample 1 (lowest concentration)				
Edit calibration value 1 (Enter solution or sample values manually) (Lab value)	Select matrix field	V1 / H3		Factory setting (see chapter 6.4)
	Value entry with ↑ ↓ → keys Confirm with E key			Changed calibration value 1
Calibration with value 1	Select matrix field	V1 / H4		Factory setting 100.0 (only appears during first start-up)
	Press → key Confirm with E key			Relative slope value. For error messages see chapter 6.4 and 8.

Operating steps	Procedure	Matrix field	Instrument display	Notes
Immerse sensor in standard solution 2 or user-specific sample 2 (medium concentration)				
Edit calibration value 2 (Enter solution or sample values manually)	Select matrix field	V1 / H5		See chapter 6.4 for default values.
	Value entry with ↑ ↓ → keys. Confirm with E key			Changed calibration value 2
Calibration with value 2	Select matrix field	V1 / H6		Calibration value 2
	Press → key Confirm with E key			Relative slope value. For error messages see chapters 6.4 and 8
Immerse sensor in standard solution 3 or user-specific sample 3 (highest concentration)				
Edit calibration value 3 (Enter solution or sample values manually)	Select matrix field	V1 / H7		See chapter 6.4 for default values
	Value entry with ↑ ↓ → keys Confirm with E key			Changed Calibration value 3
Calibration with value 3	Select matrix field	V1 / H8		Calibration value 3
	Press → key Confirm with E key			Relative slope value. For error messages see chapters 6.4 and 8.
Calibration is complete.				

Note:

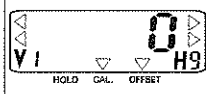
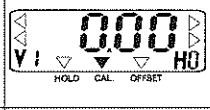
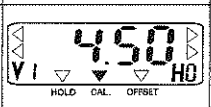
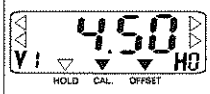
▽ Status / indication arrow invisible

▼ Status / indication arrow visible

6.1.4.3 Offset entry for special cases

When measuring in pipes, cross reflections may occur in rare cases. These may result in inaccurate zero display.

If an automatic zero calibration for wet calibration (see V1 / H0, chapter 6.1.4) cannot be performed, a zero correction may be performed using the following procedure:

Operating step	Procedure	Matrix field	Display value	Instruement display	Notes
Select calibration type 0	Select 0 with ↑ 0 key Confirm with E key	V1 / H9	Value selected		Calibration type 0 = editing function
Zero calibration offset entry	Select matrix field	V1 / H0			
	Value entry with ↑ ↓ → keys. Confirm with E key		Correction value in selected unit (NTU / ppm)		Enter offset value. Error message: see chapters 6.4 and 8
					

Note:

The display format for numbers depends on the measuring range selected (number of decimal places).

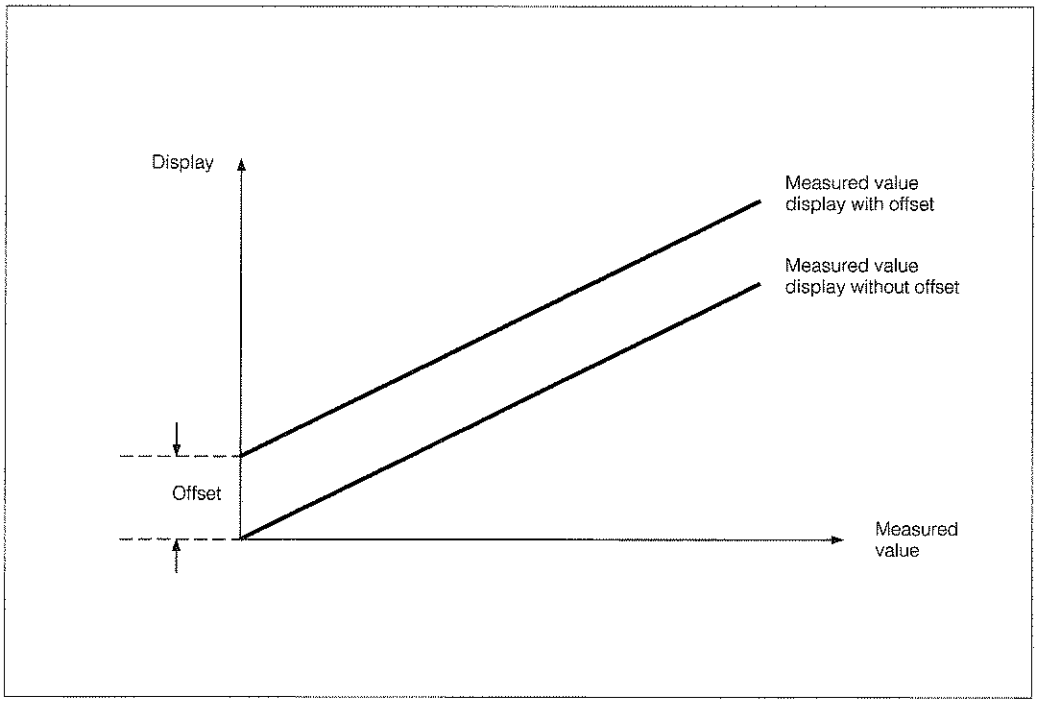


Fig. 6.4: Offset value entry: All display values are shifted by the offset value. The offset value may be positive or negative.

6.2 Turbidity sensor system CUD 3

The sensor system CUD 3 is suitable for continuous low turbidity measurement in liquid media (refer to CUD 3 operating instructions for technical data).

6.2.1 Matrix for operation with CUD 3

(See chapter 6.4 for description of operating functions.))

	V \ H	0	1	2	3
Basic functions I	0	Measurement	Temperature display	HOLD ON / OFF	Toggle 0 to 20 mA / 4 to 20 mA
		0: 0.000 to 2.500 NTU 1: 0.00 to 99.99 NTU 2: 0.00 to 99.99 ppm	– 10 to +70 °C	0 = OFF 1 = ON	0 = 0 to 20 mA 1 = 4 to 20 mA
Basic functions II	1	Zero point calibration (CAL ZERO)	Selection of measuring range (SET RANGE)	Display of range (RANGE MAX)	Entry calibration value 1
		0 = offset value entry 1 = auto. rel. offset 2 = zero value entry	0: 0.000 to 2.500 NTU 1: 0.00 to 99.99 NTU 2: 0.00 to 99.99 ppm	2.500 (NTU) 99.99 (NTU) 99.9 (ppm)	2.00 (0.10 to 2.50) NTU 5.0 (0.20 to 6.50) ppm)
Limit value 1	2	Limit value entry	Togle Manual / Auto	Manual OFF / ON	Pickup delay
		0: 0.000 to 2.500 NTU 1: 0.00 to 99.99 NTU 2: 0.00 to 99.99 ppm	0 = Manual 1 = Auto	Measued value	0 to 6000 s
Limit value 2	3	Limit value entry	Toggle Manual / Auto	Manual OFF / ON	Pickup delay
		0: 0.000 to 2.500 NTU 1: 0.00 to 99.99 NTU 2: 0.00 to 99.99 ppm	0 = Manual 1 = Auto	Measued value	0 to 6000 s
Sensor cleaning	4	Cleaning function	Type of cleaning	Manual cleaning	Cleaning period (Auto)
		0: cleaning off 1: contact cleaning 2: wiper cleaning	0: Manual 1: Automatic	Key ↓ = IFF Key ↑ = Cleaning	3 to 600 s
Alarm	7	Alarm threshold	Alarm delay	Toggle steady / fleeting contact	Alarm assignment
		0: 0.000 to 2.500 NTU 1: 0.00 to 99.99 NTU 2: 0.00 to 99.99 ppm	0 to 6000 s	0 = steady contact 1 = fleeting contact	0: both limit contacts 1: limit contact 1 only 2: limit contact 2 only
Configuration	8	Parity	Toggle baud rate		Toggle sensor variant
		0 = none 1 = odd 2 = even	0 = 4800 Bd 1 = 9600 Bd 2 = 19200 Bd		1 = CUS 1 3 = CUS 3
Service and simulation	9	Diagnostic code	Number of auto resets	Display instrument configuration	Software version
		E--- to E145	0 to 255	0000 to 9999	0.00 to 99.99

Level 0 | 1111 Level 1 | 2222 Level 2

4	5	6	7	8	9
Rate of rise mA / s	Turbidity at 0 / 4 mA	Turbidity at 20 mA	Temperature at 0 / 4 mA	Temperature at 20 mA	Measured value filter
0.1 to 20.0 mA / s	0: 0 to 2.0 NTU 1: 0 to 80 NTU 2: 0 to 80 ppm	0: 0.025 to 2.5 NTU 1: 1 to 99.99 NTU 2: 1 to 99.99 ppm	- 10 to + 50 °C	10 ° to 70.0 °C	Time constant 0 to 120 S
Calibration with value 1	Entry cal. value 2	Calibration with value 2	Entry cal. value 3	Calibration with value 3	Type of calibration
100 % (10 to 500 %)	8 (3.00 to 10.00 NTU) 20 (7.00 to 25.00 ppm)	100 % (10 to 500 %)	40 (11.00 ... 99.99 NTU) 99.99 (26.00 ... 99.9 ppm)	100 % (10 to 500 %)	0: editing function 1: wet calibration 2: edit factory values
Dropout delay	Toggle MIN / MAX	Toggle normally closed / normally open contact	Hysteresis		
0 to 6000 s	0 = MIN 1 = MAX	0 = normally closed contact 1 = nromally open contact	0: 0.000 to 2.500 NTU 1: 0.00 to 99.99 NTU 2: 0.00 to 99.99 ppm		
Dropout delay	Toggle MIN / MAX	Toggle normally closed / normally open contact	Hysteresis		
0 to 6000 s	0 = MIN 1 = MAX	0 = normally closed contact 1 = normally open contact	0: 0.000 to 2.500 NTU 1: 0.00 to 99.99 NTU 2: 0.00 to 99.99 ppm		
Pause period (Auto)	Wiper propulsion	Display delay after cleaning			Soiling detection
1 to 1440 min	230 to 320 time units	0 to 300 s			0 = off 1 = fine 2 = medium 3 = coarse
					Auto hold during calibration and wiper cleaning
					0: without 1: with
					Unlock / lock
					0000 to 9999
Unit addresses	Instrument defaults	Sensor defaults		Simulation ON / OFF	Output current simulation
Rackbus: 0 to 63 RS 232 / 485: 1 to 32				0 = simulation OFF 1 = simulation ON	0.00 to 20.00 mA

6.2.2 Connection diagrams for CUD 3, CUD 3-W

Connection of turbidity sensor CUS 3 to Mycom CUM 121

(use junction box VS for connection only, not for extension) (max. 1m)

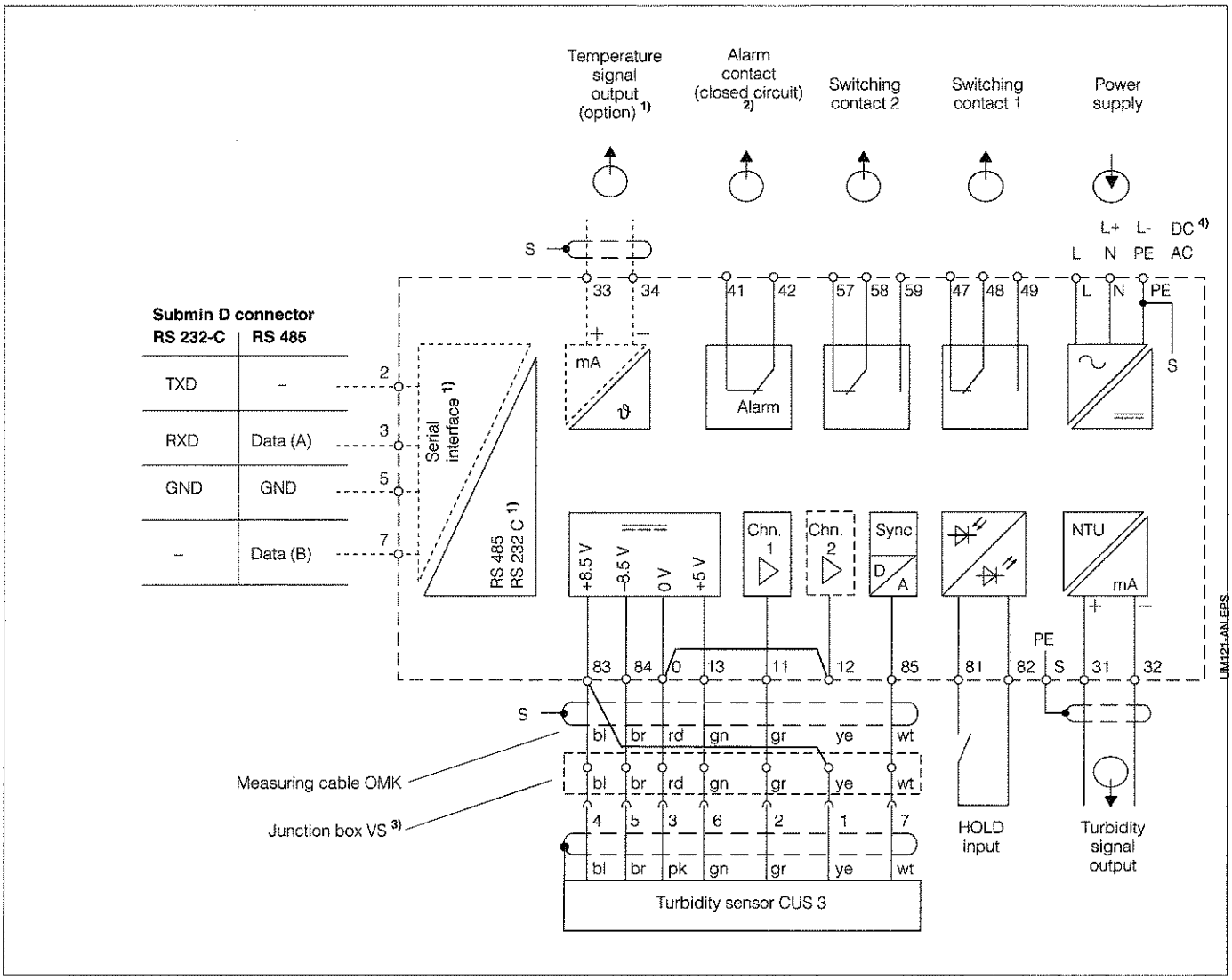


Fig. 6.5: Electrical connection Mycom CUM 121 with junction box and sensor CUS 3

Caution:

When connecting CUS 3 turbidity sensor to Mycom CUM 121 or 151, a **wiring jumper between terminal 0 and terminal 12** is mandatory! The wiring jumper is supplied with the CUS 3 sensor.

The yellow sensor connecting wire (pin 1 of receptacle) must be connected to terminal 83 of the instrument.

Incorrect placement or missing of wiring jumpers causes instrument malfunction!

Note:

Connection diagrams 6.5 and 6.6 show the fully equipped instrument!

1) Instrument version optionally with temperature signal output or serial digital interface according ot order code (see chapter 1.3).

Connection of turbidty sensor CUS 3 to Mycom CUM 151

(do not extend or shorten original cable on sensor)

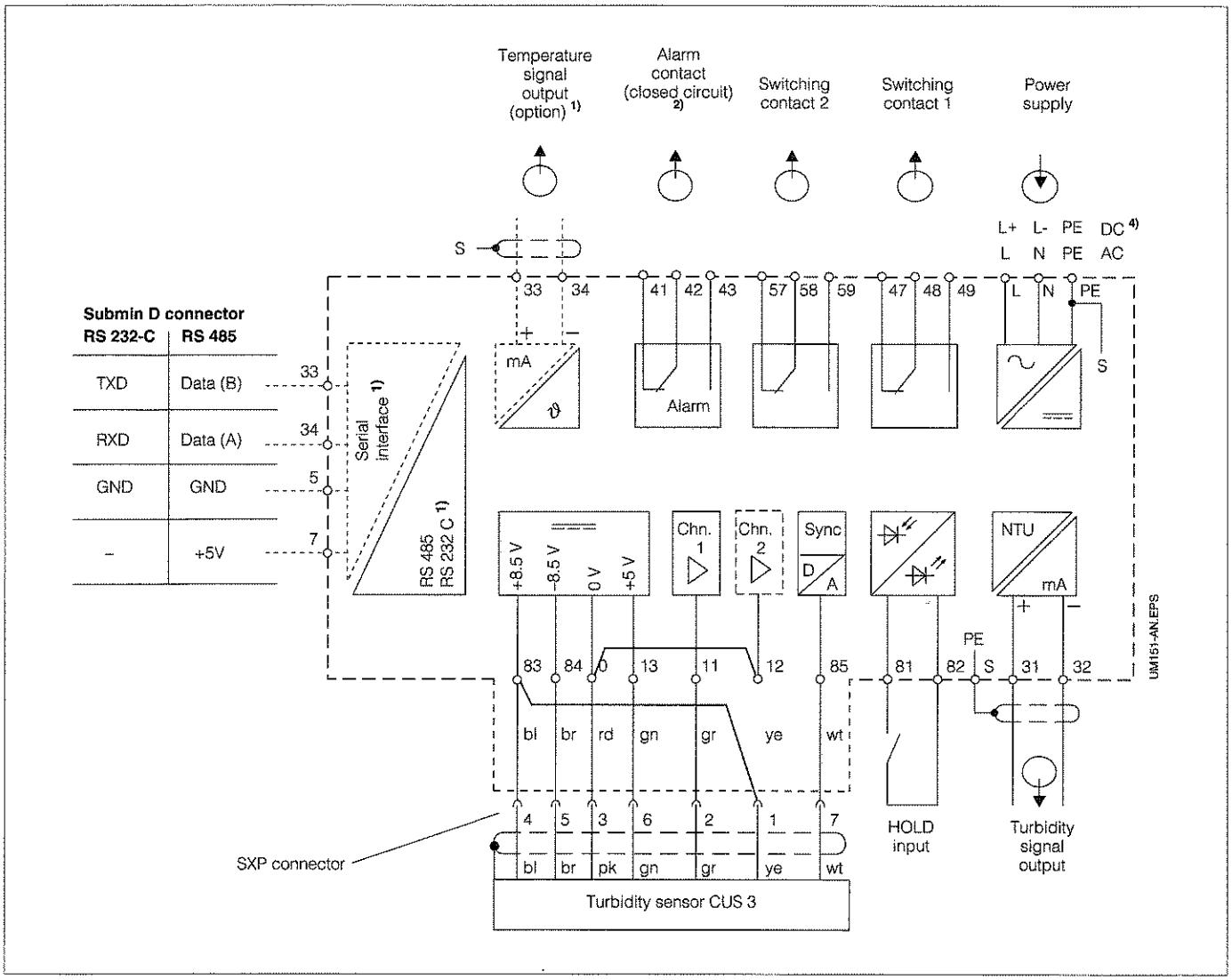


Fig. 6.6: Electrical connection Mycom CUM 151 and sensor CUS 3

2) Contact status shown:
no current or fault present

All switching contacts are interference-suppressed by varistors. External loads connected may have to be additionally interference-suppressed.

3) Use junction box VS with the matching plug-in connector for turbidity sensors or remove connector on sensor cable.

4) 24 V DC floating or minus pole grounded.

Caution:

The DC power supply connection is different for the CUM 121 and CUM 151. Pay attention to the connection diagrams!

Connection of turbidity sensor CUS 3-W

When connecting the CUS 3-W sensor (with the wiper) to the Mycom CUM 121 / 151, two jumpers must be connected in addition to the status shown on the basic wiring diagram, and the yellow wire must be connected to terminal 58.
The jumpers required are supplied with the sensor.

Caution:

Exchanging the jumpers causes instrument mulfunction!

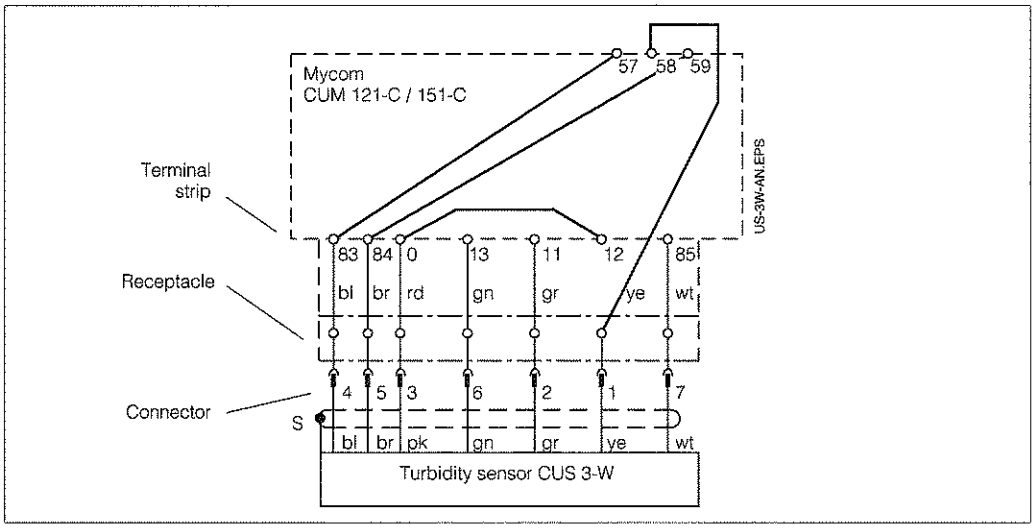


Fig. 6.7: Connection of turbidity sensor CUS 3-W to Mycom CUM 121-C / 151-C

6.2.3 Start-up with CUD 3

Operating steps for start-up with CUD 3 (sensor CUS 3 with flow assembly)

	Turbidty sensor system CUD 3	
	CUS 3	**CUS 3 - W**
1	**Install the sensor system**	
2	**Run water for approx. 10 min.**, in order to adapt the sensor temperature and establish stable flow conditions (e.g., deassing, flushing dirt out of pipes, etc.).	
3	**Power-up** (see chapter 4.4)	
4	**CODE - entry** to unlock level 2 (see chapter 5.2)	
5	**Sensor variant check or change** Matrix postion V8 / H3, see chapter 6.4. **Only if sensor variant is changed:** Select sensor variant in matrix position V8 / H3 (see chapter 6.4), confirm with [E] (make sure the sensor is wired correctly!). When the instruments displays "END", press [V] and [H] simultaneously. The instrument is restarted. The default settings are retrieved. Repeat code entry to access level 2.	
6	**Retrieve sensor defaults** Press the [E] in matrix postion V9 / H6.	
7		After "END" - in matrix position V4 / H0 = 2: select wiper cleaning, confirm with [E] key.
8		Wait approx. 1 minute while the wiper operates and finally stops. If the wiper does not reach the rest position, select matrix position V4 / H5 and choose a shoreter wiper propulsion time setting.
9	**Measuring range (MR) selection** Select the desired measuring range in matrix position V1 / H1 (see chapter 6.4)	
10	**Sensor calibration** (see chapter 6.2.4) - with factory calibration data (see chapter 6.2.4.1), or - with formazine solution (see chapter 6.2.4.2), or - with user-specific samples (see chapter 6.2.4.2)	
11	**Enter the limit function and alarm values** (see chapter 6.2.1)	

6.2.4 Calibration of sensor system CUD 3

This chapter descibes the following calibration procedures:

- **Measurement in NTU units**
  Measuring ranges 0 and 1
  Initial installation with factory calibration data (referred to formazine),
  chapter 6.2.4.1

- **Measurement in NTU units**
  Measuring ranges 0 and 1
  Recalibration with formazine solution and ultrapure water,
  chapter 6.2.4.2

- **Concentration measurement in ppm**
  Measuring range 2
  Calibration to user-specific sample,
  chapter 6.2.4.2

When to calibrate and frequency of calibration?

- **Mandatory:**
  The turbidity measuring system must be calibrated
  – before first-ime operation
  – following replacement of sensor

- **Other times:**
  Periodically at intervals of approx. 1 year or
  – depending on experience and
  – environmental conditions

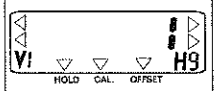
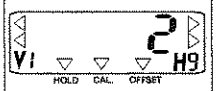
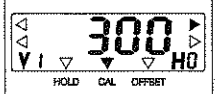
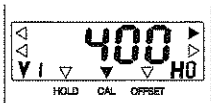
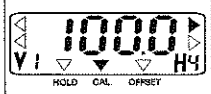
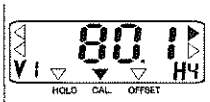
Calibration of sensor characteristic

Select the calibration type and measuring range according to the measuring task at hand. Always calibrate in the measuring range selected,

- **Calibration with factory calibration data:**
  Wet calibration values determined at the factory with the aid of zero solution and formazine are entered.
  – For example, for measurement in drinking water.
  – If the results of the measurement are to be reproducible and comparable, and the factory caliration points 0 / 2.000 / 8.00 / 40.00 NTU have been assigned to the application range (e.g., process water mesurement). See chapter 6.2.4.1 for calibration procedure.

- **Calibration with standard formazine solution or user-specific samples:**
  – Recalibration of sensor system
  – The undissolved constituents of the water are to be measured, rendering absolute values referred to the selected calibration standard. See chapter 6.2.4.2 for calibration procedure.

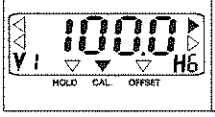
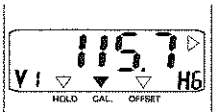
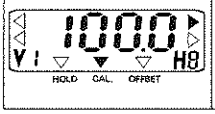
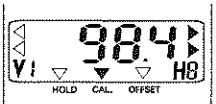
6.2.4.1 Calibration of CUD 3 with factory calibration data

Operating steps	Procedure	Matrix field	Instument display	Notes
Selecct calibration type	Select matrix field	V1 / H9		1 = factory settings
	Press ↑ key Confirm with E key			Select calibration type 2 = edit factory values for value enty.
Enter zero calibration value	Select matrix field	V1 / H0		
	Factory calibration for zero Read from "Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → Confirm with E key			Zero calibration value is stored.
Enter calibration value 1	Select matrix field	V1 / H4		Facotry setting: 100.0 (only appears during first start-up)
	Factory calibration value 1 Read from "Quality certificate for tubidity sensor" or sensor tag			
	Value entry with ↑ ↓ → Confirm with E keys.			Calibration value 1 is stored.
Calibration with factory calibration data is complete for measureing range 0.				

Note:

▽ Status / indication arrow invisible

▼ Status / indication arrow visible

Operating step	Procedure	Matrix field	Instrument display	Notes
Enter calibration value 2	Select matrix field	V1 / H6		Factory setting: 100.0 (only appears during first start-up)
	Factory calibration value 2 Read from "Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → keys. Confirm with E key			Calibration value 2 is stored.
Enter Calibration value 3	Select matrix ifeld	V1 / H8		Factory setting: 100.0 (only appears during first start-up)
	Factory calibration value 3 Read from "Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → keys. Confirm with E key.			Calibration value 3 is stored.
Calibration with factory calibration data is complete for measuring range 1.				

Note:

▽ Status / indication arrow invisible

▼ Status / indication arrow visible

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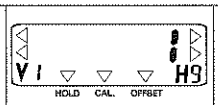
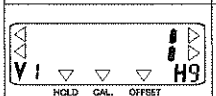
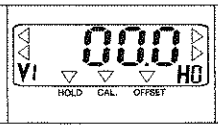
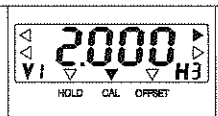
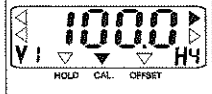
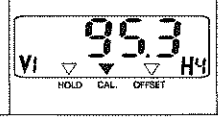
6.2.4.2 Calibratin of CUD 3 with standard solutions or user-specific samples

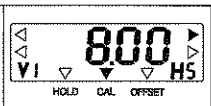
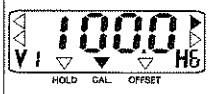
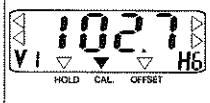
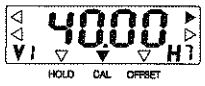
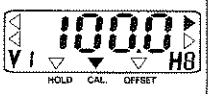
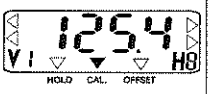
Wet calibration

Note:

- The sensor optics must be clean.
- The CUS 3 sensor must be installed in the flow assembly.
- Perform the zero calibration with ultrapure water. Rinse and fill the assembly with ultrapure water (see notes in chapter 10.2).

Refer to the appendix (chapter 10.2) for instructions on how to prepare standard solutions or user-specific samples and notes on filling ultrapure water assemblies.

Operating step	Procedure	Matrix field	Instrument display	Notes
Rinse and fill assembly with ultrapure water.				
Select calibration type	Select matrix field	V1 / H9		1 = factory settings
	Only if display values differs: Press ↑ ↓ keys and confirm with E key.			Select calibration type 1 = wet calibration for calibration.
If ultrapure water has been used in step 6 of the procedure described in chapter 6.2.3, this step can be omitted since "Retrieve sensor defaults" in V9 / H6 automatically performs a zero calibration for all measuring ranges.				
Zero-point calibration	Select matrix field and press → key. Confirm with E key.	V1 / H0		Relative zero-point correction value. Error message: see chapters 6.4 and 8
Rinse and fill assembly with solution 1 or sample 1 (lowest concentration).				
Edit calibration value 1 (Enter solution or sample values manually)	Select matrix field	V1 / H3		Fac'tory setting see chapter 6.4
	Value entry with ↑ ↓ → keys. Confirm with E key.			Changed calibration value 1
Calibration with value 1	Select matrix field	V1 / H4		Calibration value 1
	Press → key Confirm with E key			Relative slope value. Error message: see chapters 6.4 and 8.
Calibration for measuring range 0 is complete.				

Operating step	Procedure	Matrix field	Instrument display	Notes
Rinse and fill assembly with solution 2 or sample 2 (medium concentration).				
Edit Calibration value 2 (Enter solution or sample values manually)	Select matrix field	V1 / H5		Factory setting see chapter 6.4)
	Value entry with ↑ ↓ → keys. Confirm with E key.			Changed calibration value 2.
Calibration with value 2	Select matrix field	V1 / H6		Calibration value 2
	Press → key. Confirm with E key.			Relative slope value. Error message: see chapters 6.4 and 8
Rinse and fill assembly with solution 3 or sample 3 (highest concentration).				
Edit calibration value 3 (Enter solution or sample values manually)	Select matrix field	V1 / H7		Factory setting (see chapter 6.4)
	Value entry with ↑ ↓ → keys. Confirm with E key.			Changed calibration value 3
Calibration with value 3	Select matrix field	V1 / H8		Calibration value 3
	Press → key Confirm with E key.			Relative slope value. Error meassage: see chapters 6.4 and 8
Calibration for measuring range 1 or 2 is complete.				

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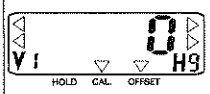
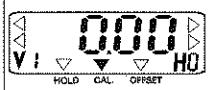
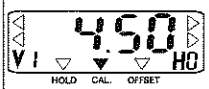
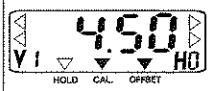
6.2.4.3 Offset entry for special cases

If an automatic zero-point calibration for wet calibration (see V1 / H0, chapter 6.4) cannot be performed, a zero-point correction may be performed using the following procedure:

Operating step	Procedure	Matrix field	Display value	Instruement display	Notes
Select calibration type 0	Select 0 with ↑ 0 key Confirm with E key	V1 / H9	Value selected		Calibration type 0 = editing function
Zero calibration offset entry	Select matrix field	V1 / H0			
	Value entry with ↑ ↓ → keys. Confirm with E key		Correction value in selected unit (NTU / ppm)		Enter offset value. Error message: see chapters 6.4 and 8
					

Note:

The display format for numbers depends on the measuring range selected (number of decimal places).

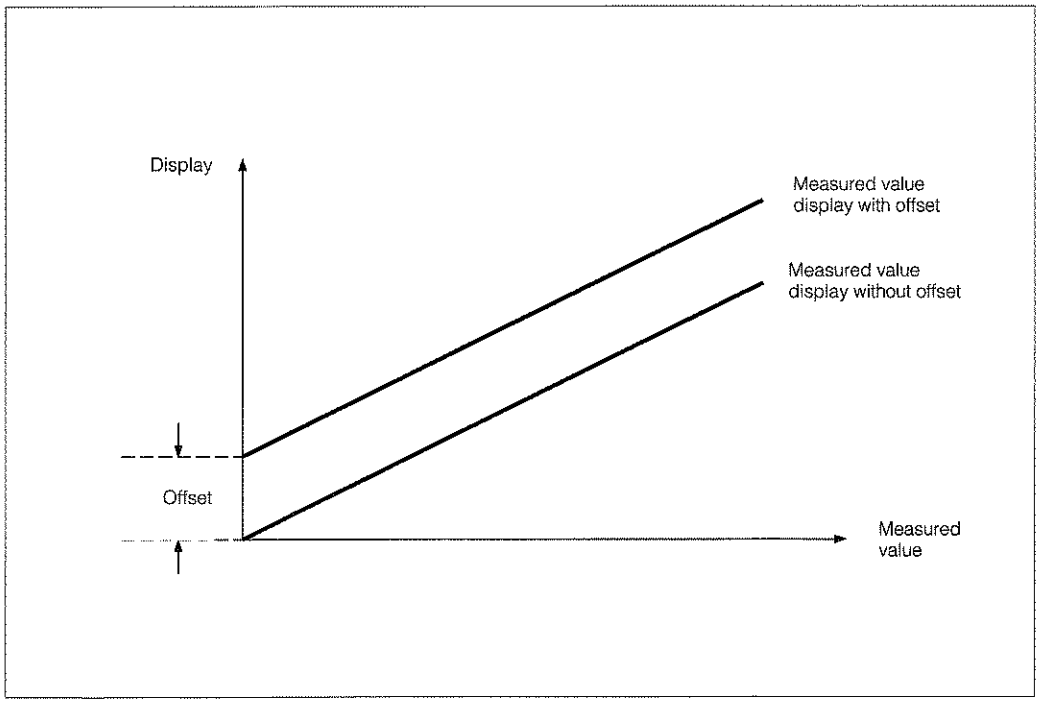


Fig. 6.8: Offset value entry:
All display values are shifed by the offset value.
wertes verändert.
The offset value may be positive or negative.

6.3 Turbidity sensor CUS 4

The sensor CUS 4 is suitable for continuous turbidity and solids content measurement in liquid media. However, contrary to the CUS 1 sensor, it employs a multi-channel push-pull method (refer to CUS 4 operating instructins for technical data).

6.3.1 Matrix for operation with CUS 4

(See chapter 6.4 for description of operating functions.)

	V \ H	0	1	2	3
Basic functions I	0	Measurement	Temperature display	HOLD ON / OFF	Toggle 0 to 20 mA / 4 to 20 mA
		0: 0 to 4000 NTU 1: 0.00 to 99.99 g/l 2: 0.0 to 200.0 %	– 10 to +70 °C	0 = OFF 1 = ON	0 = 0 to 20 mA 1 = 4 to 20 mA
Basic functions II	1	Zero-point calibration (CAL ZERO)	Selection of measuring range (SET RANGE)	Display of range (RANGE MAX)	Entry of calibration value 1
		0 = offset value entry 1 = auto; rel. offset	0: 0 to 4000 NTU 1: 0.00 to 99.99 g/l 2: 0 to 200 %	4000 NTU 99.99 g/l 200 %	MR 0, 2 to 100 NTU MR 1, 2: standard 1 = 1/10 standard 3
Limit value 1	2	Limit value entry	Toggle Manual / Auto	Manual OFF / ON	Pickup delay
		0: 0 to 4000 NTU 1: 0.00 to 99.99 g 2: 0.0 to 200.0 %	0 = manual 1 = auto	Measured value	0 to 6000 s
Limit value 2	3	Limit value entry	Toggle Manual / Auto	Manual OFF / ON	Pickup delay
		0: 0 to 4000 NTU 1: 0.00 to 99.99 g 2: 0.0 to 200.0 %	0 = manual 1 = auto	Measured value	0 to 6000 s
Sensor cleaning	4	Cleaning function	Type of cleaning	Manual cleaning	Cleaning period (auto)
		0: cleaning off 1: contact cleaning 2: wiper cleaning	0: manual 1: automatic	Key ↓ = off Key ↑ = cleaning	3 to 600 s
Substance-specific parameters	5		Conversion factor	Slope 1	Slope 2
			MR 0: – MR 1: 25 to 9999 MR 2: 25 to 9999	MR 0: – MR 1: 2.0 to 150.0 MR 2: 2.0 to 150.0	MR 0: – MR 1: 2.0 to 150.0 MR 2: 2.0 to 150.0
Alarm	7	Alarm threshold	Alarm delay	Toggle steady / fleeting contact	Alarm assignment
		0: 0 to 4000 NTU 1: 0.00 to 99.99 g	0 to 6000 s	0 = steady contact 1 = fleeting contact	0: both limit contacts 1: limit contact 1 only 2: limit contact 2 only
Configuration	8	Parity	Baud rate selection		Sensor variant selection
		0 = none 1 = odd 2 = even	0 = 4800 Bd 1 = 9600 Bd 2 = 19200 Bd		1 = CUS 1 4 = CUS 4
Service and simulation	9	Diagnostic code	Number of auto resets	Display instrument configuration	Software version
		E— to E145	0 to 255	0000 to 9999	0.00 to 99.99

Level 0 | 1111 Level 1 | 2222 Level 2

4	5	6	7	8	9
Rate of rise mA / s	Turbidity at 0 / 4 mA	Turbidity at 20 mA	Temperature at 0 / 4 mA	Temperature at 20 mA	Measured value filter
0.1 to 20.0 mA / s	0: 0 to 3200 NTU 1: 0.00 to 80.00 g/l 2: 0 to 160 %	0: 40 to 4000 NTU 1: 1.00 to 99.99 g/l 2: 2 to 200 %	- 10 to + 50 °C	10 ° to 70.0 °C	Time constant 0 to 120 S
Calibration with value 1	Entry of cal. vlaue 2	Calibration with value 2	Entry of cal. value 3	Calibration with value 3	Type of calibration
100 % (10 to 500 %)	MR 0:110 to 1000 NTU MR 1, 2: standard 2 = /s standard 3	100 % (10 to 500 %)	MR 0:1100 to 4000 NTU MR 1: 0.5 to 99.99 g/l MR 2: 1.0 % to 200.0 % = standard 3 (original sample)	100 % (10 to 500 %) MR 1, 2: initiate wet calibration	0: editing function 1: wet calibration
Dropout delay	Toggle MIN / MAX	Toggle normally closed / normally open contact	Hysteresis		
0 to 6000 s	0 = MIN 1 = MAX	0 = normally closed contact 1 = normally open contact	0: 0 to 4000 NTU 1: 0.00 to 99.99 g/l 2: 0.0 to 200.0 %		
Dropout delay	Toggle MIN / MAX	Toggle normally closed / normally open contact	Hysteresis		
0 to 6000 s	0 = MIN 1 = MAX	0 = normally closed contact 1 = normally open contact	0: 0 to 4000 NTU 1: 0.00 to 99.99 g/l 2: 0.0 to 200.0 %		
Pause period (auto)	Wiper propulsion	Display delay after cleaning			
1 to 1440 min	50 to 250 time units	0 to 300 s			
					Auto hold during calibration and wiper cleaning
					0: without 1: with
					Unlock / Lock
					0000 to 9999
Device addresses	Instrument defaults	Sensor defaults		Simulation ON / OFF	Output current simulation
Rackbus: 0 to 63 RS 232 / 485: 1 to 32				0 = simulation OFF 1 = simulation ON	0.00 to 20.00 mA

6.3.2 Connection diagrams for CUS 4, CUS 4-W

Connection of turbidity sensor CUS 4 to Mycom CUM 121

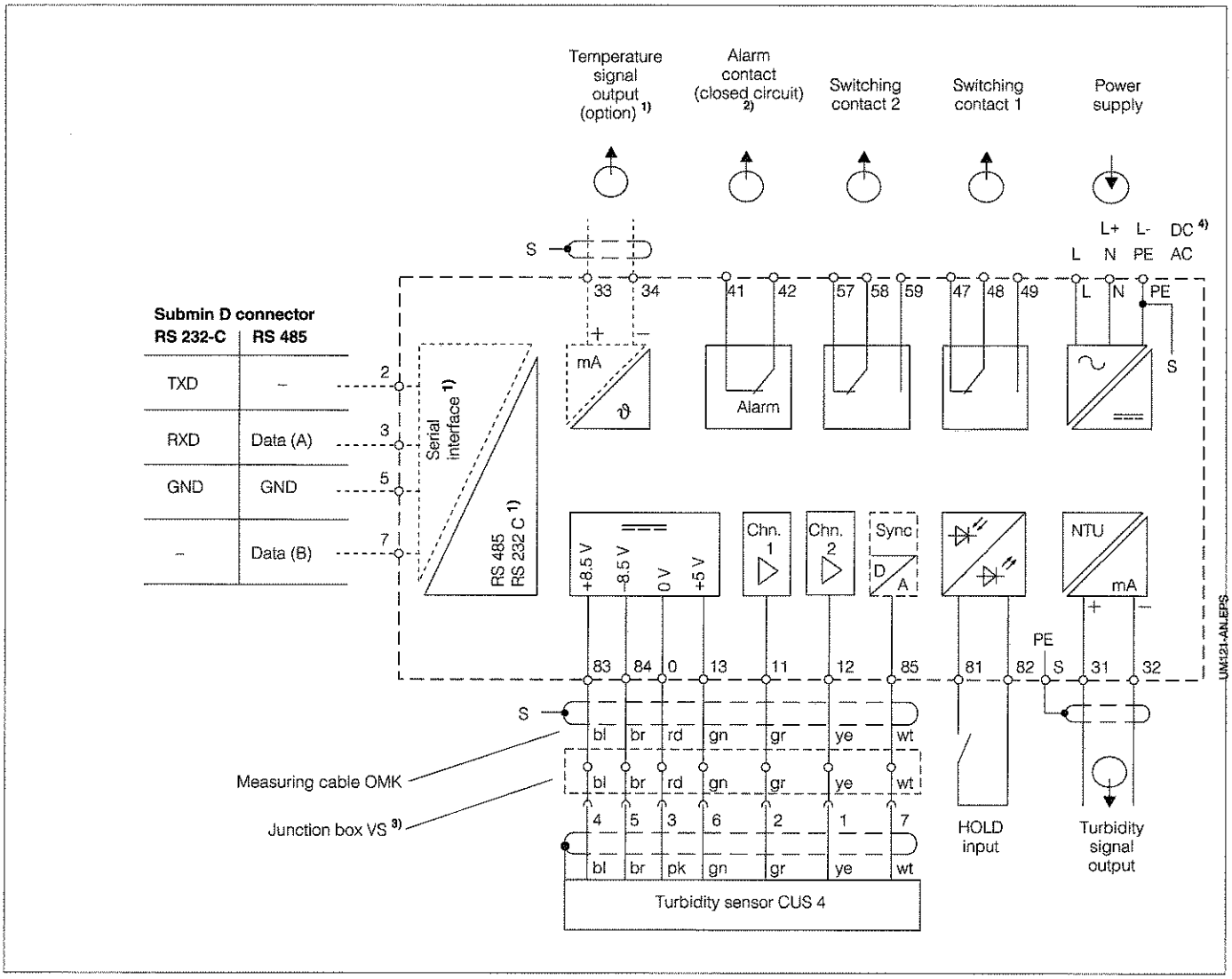


Fig. 6.9: Electrical connection Mycom CUM 121 with junction box and sensor CUS 4

Note:

Connection diagrams 6.9 and 6.10 show the fully equipped instrument!

1) Instrument version optionally with temperature signal output or serial digital interface according to order code (see chapter 1.3)

Connection of turbidity sensor CUS 4 to Mycom CUM 151

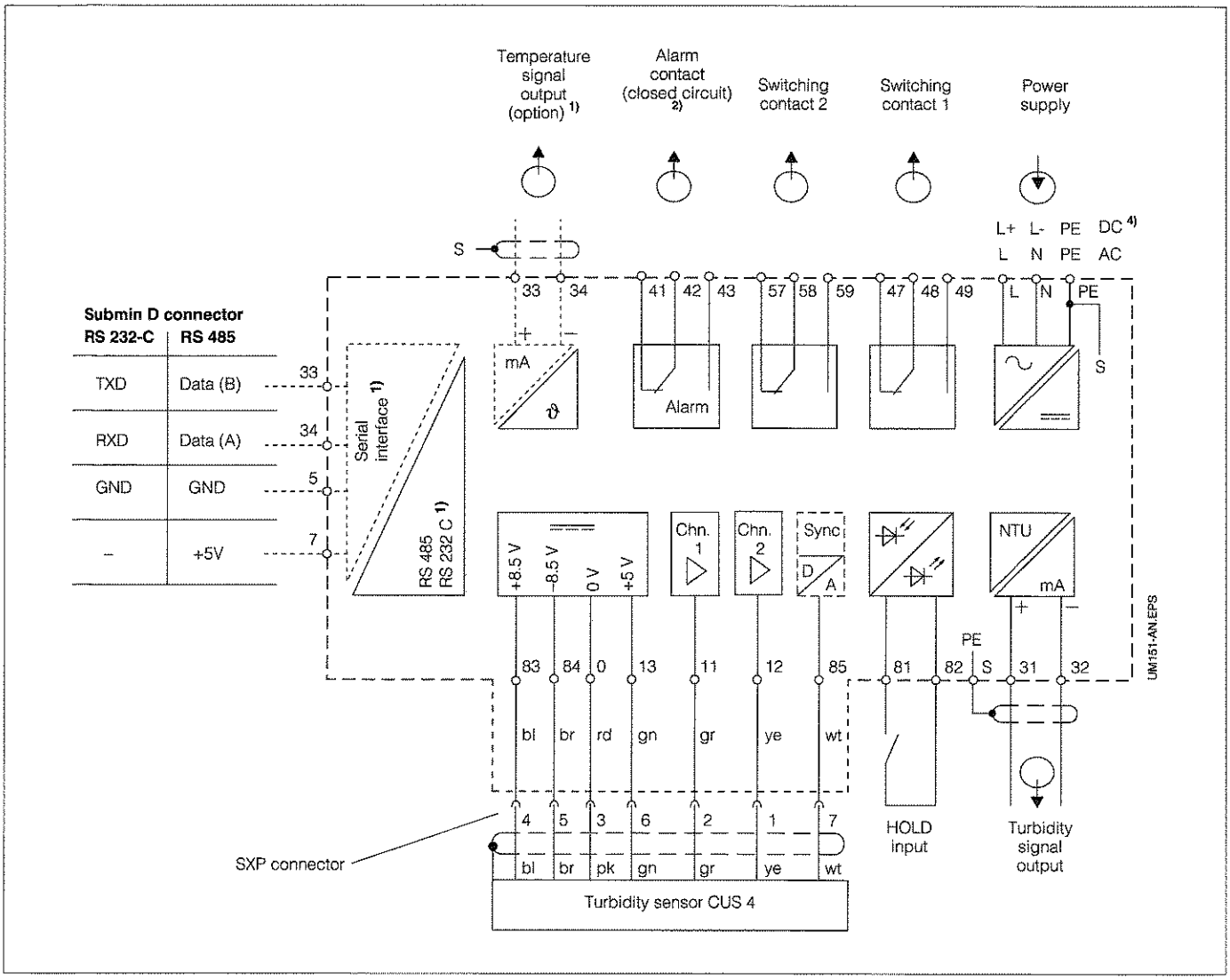


Fig. 6.10: Electrical connection Mycom CUM 151 and sensor CUS 4

2) Contact status shown:: no current or fault present

All switching contacts are interference-suppressed by varistors. External loads connected may have to be additionally interference-suppressed.

3) Use junction box VS with the matching plug-in connector for turbidity sensors or remove connector on sensor cable.

4) 24 V DC floating or minus pole grounded.

Caution:

The DC power supply connection is different for the CUM 121 and CUM 151. Please pay attention to the connection diagrams.

Connection of turbidity sensor CUS 4-W

When connecting the CUS 4-W sensor (with the wiper) to the Mycom CUM 121 / 151, two jumpers must be connected in addition to the status shown on the basic wiring diagram and the yellow wire must be connected to terminal 58.

The jumpers required are supplied with the sensor.

Caution:

Exchanging the jumpers causes instrument malfunction!

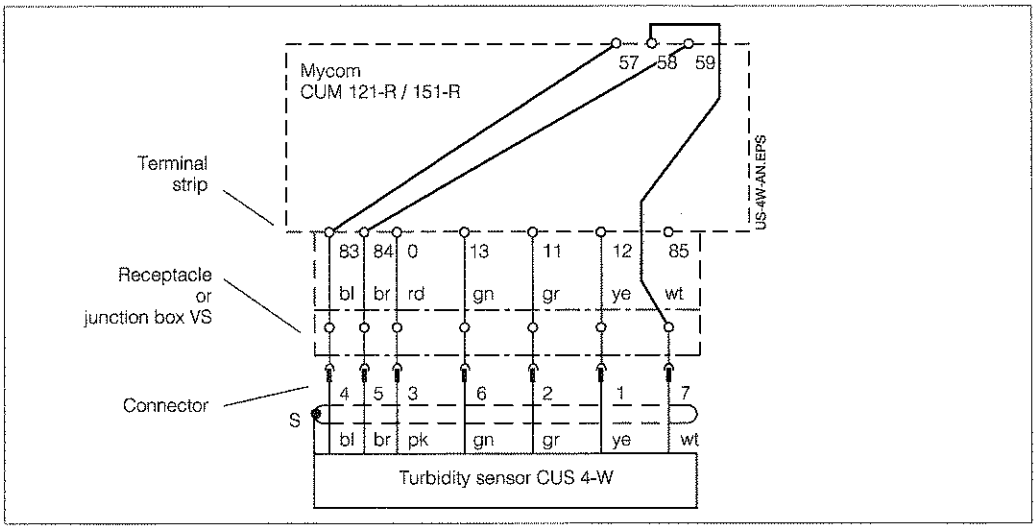


Fig. 6.11: Connection of turbidity sensor CUS 4-W to Mycom CUM 121-R / 151-R

6.3.3 Start-up with CUS 4

Operating steps for start-up with CUS 4

	Sensor type: CUS 4 and CUS 4-W	
		CUS 4-W only
1	**Sensor preparation** Connect the sensor but do not place it in the assembly yet. Remove the cap from the sensor and align the sensor in air at a min. distance of 1 m from all surrounding objects. Avoid direct exposure to light. Measured values below 5 NTU or smaller wall clearance at place of installation: Install sensor and maintain clear water flow.	
2		Position the sensor such that the wiper can operate without being obstructed.
3	**Power-up** (see chapter 4.4)	
4	**CODE entry** to unlock level 2 (see chapter 5.2)	
5	**Sensor variant check or change** Matrix postion V8 / H3, see chapter 6.4. **Only if sensor variant is changed:** Select sensor variant in matrix position V8 / H3 (see chapter 6.4), and confirm with [E] (make sure sensor is wired correctly!). When instrument displays "END", press [V] and [H] simultaneously. The instrument is restarted. The default settings are retrieved. Repeat code entry to access level 2.	
6	**Retrieve sensor defaults** Press the [E] in matrix postion V9 / H6.	
7		After „END" - in matrix position V4 / H0 = 2: select wiper cleaning, confirm with [E] key.
8		Wait approx. 1 minute while the wiper operates and finally stops. If the wiper does not reach the rest position, select matrix position V4 / H5 and choose a shorter wiper propulsion time setting.
9	**Measuring range (MR) selection** Select the desired measuring range in matrix position V1 / H1 (see chapter 6.4)	
10	**Sensor calibration** (see chapter 6.3.4) - with factory calibration data (see chapter 6.3.4.1), or - with formazine solution (see chapter 6.3.4.2), or - with user-specific samples (see chapter 6.3.4.2)	
11	**Install the sensor** in the assembly.	
12	**Enter the limit functions and alarm values** (see chapter 6.3.1)	

6.3.4 Calibration of sensor CUS 4

This chapter describes the following calibration procedures:

- **Measurement in NTU units**
  Measuring range 0
  Initial installation with factory calibration data (referred to formazine),
  chapter 6.3.4.1

- **Measurement in NTU units**
  Measuring range 0
  Recalibration with formazine solution,
  chapter 6.3.4.2.1

- **Concentration measurement in g/l or %**
  Measuring ranges 1 and 2
  Calibration to user-specific sample,
  chapter 6.3.4.2.2

- **Concentration measurement in g/l or %**
  Measuring ranges 1 and 2
  Transfer of calibration data when changing sensors,
  chapter 6.3.4.3

When to calibrate and frequency of calibration.

- **Mandatory:**
  The turbidity measuring system must be calibrated
  – before first-time oepration
  – following replacement of sensor

- **Other times:**
  Periodically at intervals of approx. 1 year or depending
  – on experience and
  – environmental conditions.

Sensor zero calibration

- **Zero-point calibration in air:**
  When measuring in the range above 5 NTU, the zero calibration can be performed in an empty corner of the room (distance 1 m from surrounding objects), avoiding direct exposure to light (sun or bright fluorescent lamp).
  Make sure there is no wall reflection, etc., that might increase the values measured.

Note:

The zero calibration is performed automatically when the sensor defaults are retrieved in matrix position V9 / H6.
An additional zero calibration via matrix field V1 / H0 is therefore only necessary due to special environmental conditions (e.g. wall reflection affecting sensor).

- **Zero-point calibration in zero solution:**
  When measuring in the range below 5 NTU, the zero calibration should be performed with zero solution under installation conditions (e.g., sensor in flow assembly).
  Demineralized or distilled water additionally filtered through a microfilter is suitable for the zero solution.
  Bubble-free handling of the zero or standard solutions is essential.

Calibration of sensor characteristic

Select the calibration type and measuring range according to the measuring task.

Note:

The calibration is valid for the selected measuring range only.

- **Calibration with factory calibration data:**
  (Wet calibration values with formazine determined at factory are entered)
  – For example, for turbidity measurement in sewage treatment plant effluent, in raw water or service water.
  – If the results of the measurement are to be reproducible and comparable, and the factory calibration points 40 / 800 / 2400 NTU have been assighned to the application range (e.g., process water measurement, backwater measurement, rinse water measurement). See chapter 6.3.4.1 for calibration procedure.

- **Calibration with standard formazine solution or user-specific samples:**
  – The undissolved constituents of the water are to be measured, rendering absolute values referred to the selected calibration standard.

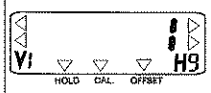
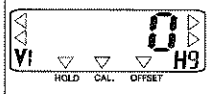
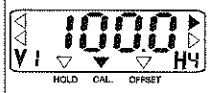
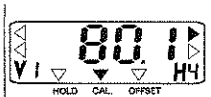
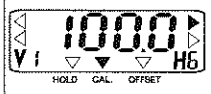
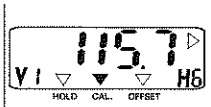
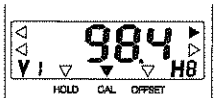
Note:

We recommend using our calibration vessel (order no. 50057944) for wet calibration.

BE5UM151.CHP

6.3.4.1 Calibration of CUS 4 with factory calibration data

This procedure applies to measuring range 0 (0 to 4000 NTU)

Operating step	Procedure	Matrix field	Instrument display	Notes
Select calibration type	Select matrix field	V1 / H9		1 = factory settings
	Press ↓ key Confirm with E key			Select calibration type 0 = editing function for value entry.
Enter calibration value 1	Select matrix field	V1 / H4		Factory setting 100.0 (only appears during first start-up)
	Factory calibration value 1 Read from „Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → keys. Confirm with E key.			Calibration value 1 is stored.
Enter calibration value 2	Select matrix field	V1 / H6		Factory setting 100.0 (only appears during first start-up)
	Factory calibration value 2 Read from „Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → keys Confirm with E key			Calibration value 2 is stored.
Enter calibration value 3	Select matrix field	V1 / H8		Factory setting: 100.0 (only appears during first start-up)
	Factory calibration value 3 Read from „Quality certificate for turbidity sensor" or sensor tag			
	Value entry with ↑ ↓ → keys Confirm with E key			Calibration value 3 is stored.
Calibration with factory calibration data is complete.				

Note:

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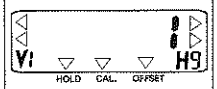
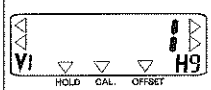
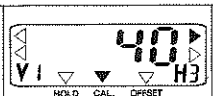
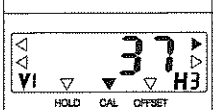
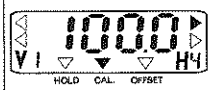
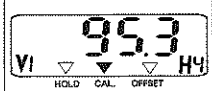
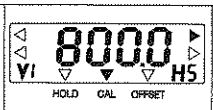
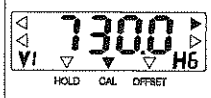
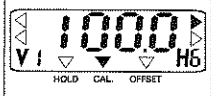
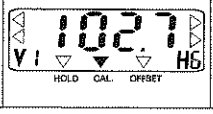
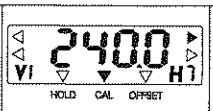
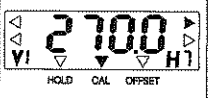
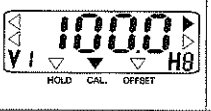
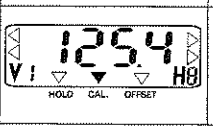
6.3.4.2 Calibration of CUS 4 with standard solutions or user-specific samples

6.3.4.2.1 Wet calibration in measuring range 0 with calibration vessel

Note:

- The sensor optics must be clean.
- Do not fill the calibration vessel more than 1 cm above the internal support mandrel. Insert the sensor in the calibration vessel such that the sensor rests on the internal support mandrel.
- Turn the sensor to obtain maximum immersion.
- Make sure the sensor is properly seated on the support mandrel and does not rest on the bottom of the calibration vessel. A dark container blackened or mat on the inside and sufficiently large to leave a distance of at least 15 cm between the walls and the sensor is also suitable for calibration.
- See the description in chapter 6.4.3 for the calibration value range limits.

Operating step	Procedure	Matrix field	Instrument display	Notes
Select calibration type	Select matrix field	V1 / H9		1 = factory settings
	Press ↓ key Confirm with E key			Select calibration type 1 = wet calibration for calibration.
Immerse sensor in standard solution 1 or user-specific sample 1 (lowest concentration)				
Edit calibration value 1 (Enter solution or sample values manually) (Lab value)	Select matrix field	V1 / H3		Factory setting (see chapter 6.4)
	Value entry with ↑ ↓ → keys Confirm with E key			Changed calibration value 1
Calibration with value 1	Select matrix field	V1 / H4		Factory sestting: 100.0 (only appears during first start-up)
	Press → key Confirm with E key			Relative slope value. Error message: see chapters 6.4 and 8.

Operating step	Procedure	Matrix field	Instrument display	Notes
Immerse sensor in standard solution 2 or user-specific sample 2 (medium concentration)				
Edit calibration value 2 (Enter solution or sample values manually)	Select matrix field	V1 / H5		See chapter 6.4 for default values.
	Value entry with ↑ ↓ → keys Confirm with E key			Changed calibration value 2
Calibration with value 2	Select matrix field	V1 / H6		Calibration value 2
	Press → key Confirm with E key			Relative slope value. For error messages see chapters 6.4 and 8.
Immerse sensor in standard solution 3 or user-specific sample 3 (highest concentration)				
Edit calibration value 3 (Enter solution or sample values manually)	Select matrix field	V1 / H7		See chapter 6.4 for default values.
	Value entry with ↑ ↓ → keys Confirm with E key			Changed calibration value 3
Calibration with value 3	Select matrix field	V1 / H8		Calibration value 3
	Press → key Confirm with E key			Relative slope value. For error messages see chapters 6.4 and 8.
Calibration is complete.				

Note:

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6.3.4.2.2 Calibration of CUS 4 with user-specific samples

Mandatory for **measuring ranges 1 and 2**

Note:

- If possible, the concentration of the original sample should be determined before starting wet calibration.
- Prepare the solutions required for calibration (see below).
- If the concentration of the original sample is unknown, enter an estimated value.
- After calibration, enter the correct value in the edit mode (e.g., value determined in laboratory).

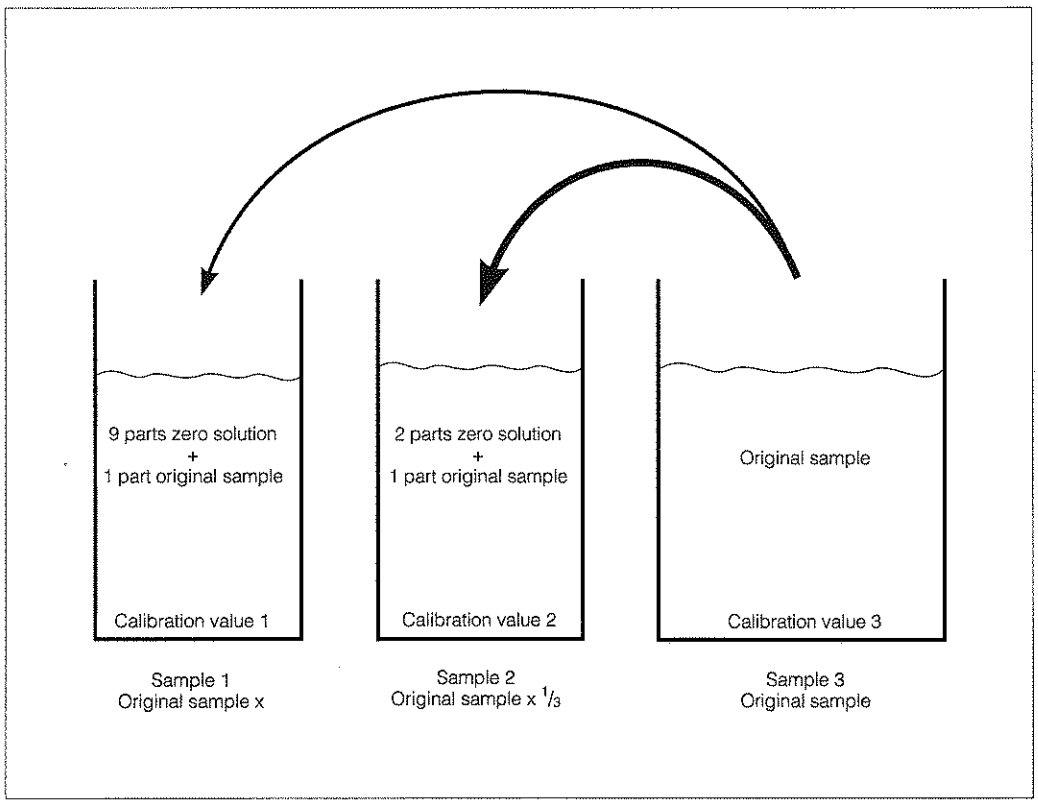
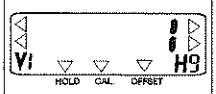
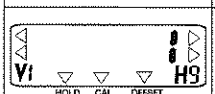
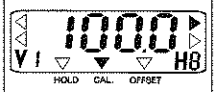
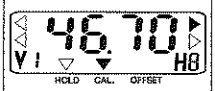
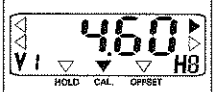
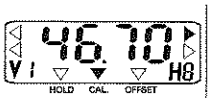
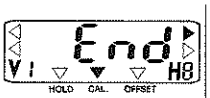


Fig. 6.12 Preparation of user-specific samples for calibration

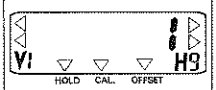
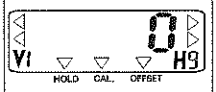
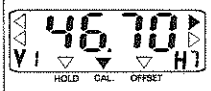
Note:

- Sludge samples have a tendency to sediment. Stir well before calibration!
- Normal buckets can be used as calibration vessels for sludge samples.

Operating step	Procedure	Matrix field	Instrument display	Notes
Select calibration type	Select matrix field	V1 / H9		1 = factory settings
	Press ↓ key Confirm with E key			Select calibration type 1 = wet calibration for calibration.
Wet calibration	Select matrix field	V1 / H8		Factory setting: 100 % (only appears during first start-up)
	Initiate with → or E key			Calibration set value (original sample) Factory setting: 12.50
	Value entry with ↑ ↓ → keys			Entry of value for original sample (exact or estimate)
	Confirm with E key			Display shows set value for sample 1 (lowest concentration)
Immerse sensor in sample 1 (lowest concentration)				
Calibration with sample 1	Initiate with → or E key			Display shows set value for sample 2 (medium concentration)
Immerse sensor in sample 2 (medium concentration)				
Calibration sample 2	Initiate with → or E key			Display shows set value for sample 3 (original sample)
Immerse sensor in sample 3 (original sample)				
Calibration with sample 3	Initiate with → or E key			Wet calibration is complete. For error messages see chapters 6.5 and 8.

Calibration of CUS 4 with user-specific samples (continued)

If an estimated value has entered for the original sample, the exact value (e.g., obtained in the lab) must be entered at a later point in time.

Operating step	Procedure	Matrix field	Instrument display	Notes
Select calibration type	Select matrix field	V1 / H9		
	Press ↓ key Confirm with E key			Select calibration type 0 = editing function for value entry.
Enter value of original samples	Select matrix field	V1 / H7		Factory setting: 12.5 (only appears during first start-up)
	Value entry with ↑ ↓ → keys Confirm with E key			The calibration set value is stored. The values in V1 / H3 and V1 / V5 are automatically adapted.

Note:

- The calibration can e restarted by pressing the → or E key.
- The calibration process can be interrupted anytime by pressing the V or H key. The previously valid calibration parameters are then used for operation.

6.3.4.2.3 Calibration of CUS 4 by means of user calibration data

When an instrument / sensor combination changes (e.g., in the case of test systems or when the instrument is replaced), the existing sensor calibration data can be re-entered

1. Select matrix fields V1 / H3 to V1 / H8 and V5 / H1 to V5 / H3 in turn and note the settings in these fields.
2. Change the measuring point assignment as required.
3. Select calibration type 0 (editing function) in matrix field V1 / H9. Subsequently enter the previously noted settings in the matrix fields V1 / H3 to V1 / H8 and V5 / H1 to V5 / H3.

This procedure eliminates the need to recalibrate (wet calibration) with samples.

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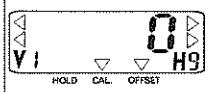
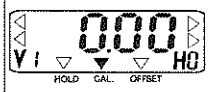
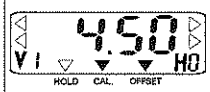
6.3.4.3 Offset entry for special cases

When measuring in pipes, cross reflections may occur in rare cases. These may result in inaccurate zero display.

If an automatic zero calibration for wet calibration (see V1 / H0, chapter 6.3.4) cannot be performed, a zero correction may be performed using the following procedure:

Operating step	Procedure	Matrix field	Display value	Instrument display	Notes
Selection calibration type 0	Select 0 with ↑ key Confirm with E key	V1 / H9	Value selected		Calibration type 0 = editing function
Zero-point calibration offset entry	Select matrix field	V1 / H0			
	Value entry with ↑ ↓ → keys Confirm with E key		Correction value in selected unit (NTU / ppm)		Enter offset value. Error message see chapters 6.4 and 8.
					

Note:

The display format for numbers depends on the measuring range selected (numbers of decimal places).

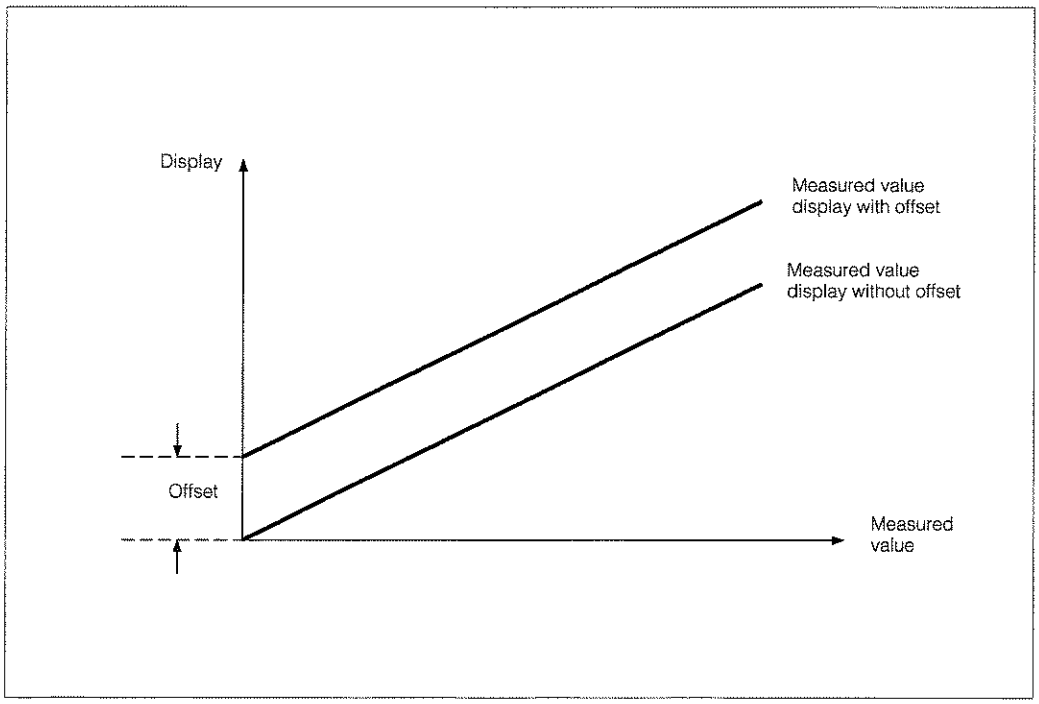


Fig. 6.13: Offset value entry:
All display values are shifed by the offset value.
The offset value may be positive or negative.

6.4 Description of operating functions

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
0 / 0	**Measurement** Display of turbidity in physical units (NTU, ppm, g/l or %) Press the ENTER key for direct access to field V8 / H9 (Unlock / lock). Error message 13 is issued if the measuring range is exceeded.		
0 / 1	**Temperature display** Displays the temperature in °C – 10 ... + 70 °C If above or below measuring range, error message 19 or 20 is issued.		
0 / 2	**HOLD ON / OFF** Activation of HOLD function 0 = OFF 1 = ON (hold indication arrow is active) When the hold function is active, both current ouputs are frozen to their current value. With automatic operation, all contacts are set to the normal condition. Any alarm period accumulated is reset to 0.	0	
0 / 3	**Toggle 0 ... 20 mA / 4 ... 20 mA** Toggles sthe lower limit of the current outputs between 0 and 4 mA. 0 = 0 ... 20 mA 1 = 4 ... 20 mA This setting affects both current outputs.	1	
0 / 4	**Rate of rise mA / s (damping)** Sets the rate of rise of the current output for the measured value. 0.1 ... 20.0 mA / s This setting does not affect the temperature output.	20.0 mA/s	

<table>
<tr><th>Matrix
Pos.
V / H</th><th>Description of function</th><th colspan="2">Parameter settings</th></tr>
<tr><th></th><th></th><th>Factory</th><th>User</th></tr>
<tr><td>0 / 5</td><td>Turbidity at 0 / 4 mA
Entry of turbidity value for lower current limit.

Instrument variant I
MR | CUS 1
0: | 0.00 ... 80.00 NTU
1: | 0 ... 3200 NTU
2: | 0.0 ... 800.0 ppm

Instrument variant C
MR | CUS 3
0: | 0.000 ... 2.000 NTU
1: | 0.00 ... 80.00 NTU
2: | 0.00 ... 80.00 ppm

Instrument variant R
MR | CUS 4
0: | 0 ... 3200 NTU
1: | 0.00 ... 80 g/l
2: | 0.0 ... 160.0 %

If below a minimum difference of 1 % between the upper and lower current trubidity values, error message 31 is issued.</td><td>0.00 NTU
0 NTU
0.0 ppm

0.000 NTU
0.00 NTU
0.00 ppm

0 NTU
0.00 g/l
0.0 %</td><td></td></tr>
<tr><td>0 / 6</td><td>Turbidity at 20 mA
Entry of turbidity value for 20 mA current.

Instrument variant I
MR CUS 1
0: | 1.00 ... 99.99 NTU
1: | 40 ... 4000 NTU
2: | 10.0 ... 999.9 ppm

Instrument variant C
MR CUS 3
0: | 0.025 ... 2.5 NTU
1: | 1.00 ... 99.99 NTU
2: | 1.00 ... 99.99 ppm

Instrument variant R
MR CUS 4
0: | 40 ... 4000 NTU
1: | 1.00 ... 99.99 g/l
2: | 2.00 ... 200.0 %

If below a minimum difference of 1 % between the upper and lower current turbidity values, error message 31 is issued.</td><td>90.00 NTU
3600 NTU
900.0 ppm

2.250 NTU
90.00 NTU
90.00 ppm

3600 NTU
90.00 g/l
180.0 %</td><td></td></tr>
</table>

Description of operating functions (continued)

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
	Temperature output entries only for instruments with installed temperature output (see chapter 1.3, Order code).		
0 / 7	**Temperature at 0 / 4 mA** Entry of temperature value for 0 or 4 mA of 2nd current output. – 10 ... + 50 °C The minimum diference to the value at 20 mA is 20 K; if below, error message 34 is issued.	0 °C	
0 / 8	**Temperature at 20 mA** Entry of temperature value for 20 mA of 2nd current output. 10 ... 70 °C The minimum difference to the value at 0/4 mA is 20 K; if below, error message 34 is issued.	60 °C	
0 / 9	**Measured value filter / setting of filter time constant** Set of time constant 0 ... 120 s The final vlaue after a measuring signal jump is reached after approx. 6 time constants.	CUS 1: 10 s CUS 3: 40 s CUS 4: 10 s	
1 / 0	**Zero-point calibration** • **Calibrationtype 1 = wet calibration** – The zero-point correction value last stored is displayed. – Press → key to perform zero calibration. – Error message 141 is issued if the permissible correction range is exceeded. The error message is retained until a successful zero calibration has been performed or a manual zero calibration has been perfromed (see below) or the defaults (V9 / H6) are restored. • **Calibration type 0 = editing function** – Manual change of value with ↑ ↓ keys, max. ± 25% of selected measuring range, acknowledge with E key. – The OFFSET arrow is displayed. • **Calibration type 2 = zero value entry** – Manual change of value with ↑ ↓ keys (values in digits), acknowledge with E key. **Note:** Decreasing the value will increase the turbidity value and vice-versa.		

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
1 / 1	**Measuring range selection (MR)** Determines the turbidity measuring range a) Turbidity measurement referred to standard formazine solution Measured value display units: NTU MR 0/1 with sensor CUS 1 and CUS 3 (instrument variants I and C) MR 0 with sensor CUS 4 (instrument variant R) b) Concentration determination of samples (e.g. sludge) referred to user-specific sample (laboratory reference value) Measured value display units: ppm (CUS 1 / CUS 3) or g/l (CUS 4) MR 2 with sensor CUS 1 and CUS 3 (instrument variant I and C) MR 1 with sensor CUS 4 (instrument variant R) c) Turbidity limit monitoring of samples of unknown concentration or solid contents measurement Measured value display: % MR 2 with sensor CUS 4 (instruement variant R) Instrument variant I **MR CUS 1** 0: 0.00 ... 99.99 NTU 1: 0 ... 4000 NTU 2: 0.0 ... 999.9 ppm Instrument variant C **MR CUS 3** 0: 0.000 ... 2.500 NTU 1: 0.00 ... 99.99 NTU 2: 0.00 ... 99.99 ppm Instrument variant R **MR CUS 4** 0: 0 ... 4000 NTU 1: 0.00... 99.99 g/l 2: 0.0 ... 200.0 %	1 1 1	

Description of operating functions (continued)

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
1 / 2	**Display of measuring range** Displays the upper range value set with V1 / H1.		
1 / 3	**Entry of calibration value 1** Value used for calibration in next field (CUS 4: only MR 0) Instrument variant I **MR** **CUS 1** 0: 2.00 ... 99.99 NTU 1: 2 ... 100 NTU 2: 1.0 ... 10.0 ppm Instrument variant C **MR** **CUS 3** 0: 0.100... 2.500 NTU 1: 0.10 ... 2.50 NTU 2: 0.20 ... 6.50 ppm Instrument variant R **MR** **CUS 4** 0: 2 ... 100 NTU 1: Display $^1/_{10}$ × cal. value 3, value range 0.05 ... 9.99 2: Display $^1/_{10}$ × cal. value 3, value range 0.1 ... 20.0	40.00 NTU 40 NTU 4.0 ppm 2.000 NTU 2.00 NTU 5.00 ppm 40 NTU 1.00 10.0	
1 / 4	**Calibration with calibration value 1** Wet calibration: slope display in % Editing function: entry of slope in % Value range : 10 ... 500 % Display or entry refers to value specified in V1 / H3.	100.0 %	
1 / 5	**Entry of calibration value 2** Value used for calibration in next field (CUS 1 / CUS 3: only MR 1, 2; CUS 4 only MR 0) Instrument variant I **MR** **CUS 1** 1: 110 – 1000 NTU 2: 11.0 – 100.0 ppm Instrument variant C **MR** **CUS 3** 1: 3.000... 10.000 NTU 2: 7.00 ... 25.00 ppm Instrument variant R **MR** **CUS 4** 0: 110 ... 1000 NTU 1: Display $^1/_3$ × cal. value 3, value range 0.16 ... 33.30 2: Display $^1/_3$ × cal. value 3, value range 0.3 ... 66.6	800 NTU 80.0 ppm 8.00 NTU 20.00 ppm 800 NTU 3.33 33.3	

Matrix Pos. V / H	Display of function	Parameter settings Factory	User
1 / 6	**Calibration with calibration value 2** Wet calibration: slope display in % Editing function: entry of slope in % Value range: 10 ... 500 % (CUS 1 / CUS 3 only MR 1, 2; CUS 4 only MR 0) Display or entry refers to value specified in V1 / H5	100.0 %	
1 / 7	**Entry of calibration value 3** Value used for calibration in next field (CUS 1 / CUS 3 only MR 1, 2; CUS 4 only MR 0) Instrument variant I **MR CUS 1** 1: 1100 ...4000 NTU 2: 110.0... 999.9 ppm Instrument variant C **MR CUS 3** 1: 11.00 ... 99.99 NTU 2: 26.00 ... 99.99 ppm Instrument variant R **MR CUS 4** 0: 1100 ... 4000 NTU 1: 0.50 ... 99.99 g/l 2 1.0 ... 200.0 % (original sample) CUS 4 (MR 1, 2): This field can only be edited with calibration type 0 (V1 / H9 = 0). The values displayed in field V1 / H3 or V1 / H5 are referred to this value but cannot be edited. The calibration set value of the original sample for CUS 4 (MR 1, 2) is entered for wet calibration (V1 / H9 = 1) during the calibration process. **Note:** A turbidity value not known exactly at the time of wet calibration can be corrected by entering the precise value at a later point in time.	2400 NTU 240.0 ppm 40.00 NTU 99.99 ppm 2400 NTU 10.00 g/l 100.0 %	
1 / 8	**Calibration with calibration value 3** Wet calibration: slope display in % Editing function: entry of slope in % Value range: 10 ... 500 % (CUS 1 / CUS 3 only MR 1, 2; CUS 4 only MR 0) Display or entry refers to value specified in V1 / H7	100.0 %	
1 / 9	**Select type of calibration** 0 = Editing function, manual editing of slope values 1 = Wet calibration, automatic with standard solutions e.g. according to DIN / ISO 7027, or user-specific samples 2 = Editing function, manual editing of zero value	1	

Description of operating functions (continued)

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
	Matrix positions in brackets are valid for limit value 2.		
2 / 0 (3 / 0)	**Limit value for turbidity** Entry of turbidity limit value • **Limit contact 1 (V2 / H . . .)**		
	Instrument variant I **MR** | **CUS 1** 0: | 0.00 ... 99.99 NTU 1: | 0 ... 4000 NTU 2: | 0.0 ... 999.9 ppm	 20.00 NTU 800 NTU 200.0 ppm	
	Instrument variant C **MR** | **CUS 3** 0 | 0.000 ... 2.500 NTU 1 | 0.00 ... 99.99 NTU 2 | 0.00 ... 99.99 ppm	 0.500 NTU 20.00 NTU 20.00 ppm	
	Instrument variant R **MR** | **CUS 4** 0: | 0 ... 4000 NTU 1: | 0.00 ... 99.99 g/l 2: | 0.0 ... 200.0 %	 800 NTU 20.00 g/l 40.0 %	
	• **Limit contact 2 (V3 / H . . .)** **MR** | **CUS 1** 0: | 0.00 ... 99.99 NTU 1: | 0 ... 4000 NTU 2: | 0.0 ... 999.9 ppm	 90.00 NTU 3600 NTU 900.0 ppm	
	MR | **CUS 3** 0: | 0.000 ... 2.500 NTU 1: | 0.00 ... 99.99 NTU 2: | 0.00 ... 99.99 ppm	 2.250 NTU 90.00 NTU 90.00 ppm	
	MR | **CUS 4** 0: | 0 ... 4000 NTU 1: | 0.00 ... 99.99 g/l 2: | 0.0 ... 200.0 %	 3600 NTU 90.00 g/l 180.0 %	
2 / 1 (3 / 1)	**Toggle limit contact MANUAL / AUTO** In the MANUAL mode (MANUAL or AUTO controller switching), the relay LED MANUAL is red (= ON). 0 = MANUAL 1 = AUTO The contacts can then be actuated manually in the field V2 / H2 (V3 / H2). The contacts drop out upon return from MANUAL to AUTO.	1	
2 / 2 (3 / 2)	**Manual contact actuation OFF / ON** If MANUAL has been selected in field V2 / H1 (V3 / H1), the $\uparrow_+$, $\downarrow^-$ keys can be pressed in this field to activate / deactivate contact 1 (2). Display: measured value in selected range.		

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
2 / 3 (3 / 3)	**Pickup delay** Entry of pickup delay for switching contact 1 (2). Terminal assignments: see figure 4.2, section 4.4. 0 ... 6000 s	0 s	
2 / 4 (3 / 4)	**Dropout delay** Entry of dropout delay for switching contact 1 (2). Terminal assignments: see figure 4.2, section 4.4. 0 ... 6000 s	0 s	
2 / 5 (3 / 5)	**Toggle MIN / MAX** Determines function of contact 1. 0 = MIN 1 = MAX **MIN** setting means: the contact is enabled when the value drops below the sepoint. **MAX** setting means: the contact is enabled when the value exceeds the setpoint.	1 (1)	
2 / 6 (3 / 6)	**Toggle normally closed / normally open contact** Defines contact 1 (2) as a normally closed or normally open contact. 0 = nromally closed contact 1 = normally open contact	1	
2 / 7 (3 / 7)	**Hysteresis** Determines the hysteresis for limit contacter 1 (2) Instrument variant I **MR** | **CUS 1** 0: | 0.00 ... 99.99 NTU 1: | 0 ... 4000 NTU 2: | 0 ... 999.9 ppm Instrument variant C **MR** | **CUS 3** 0: | 0.000 ... 2.500 NTU 1: | 0.00 ... 99.99 NTU 2: | 0.00 ... 99.99 ppm Instrument variant R **MR** | **CUS 4** 0: | 0 ... 4000 NTU 1: | 0.00 ... 99.99 g/l 2: | 0.0 ... 200.0 % **MAX** contact function: contact is enabled when the setpoint is exceeded and disabled when the value drops below the setpoint minus hysteresis. **MIN** contact function: contact is enabled when the value drops below the setpoint and disabled when the setpoint plus hysteresis is exceeded.	1.00 NTU 40 NTU 10.0 ppm 0.025 NTU 1.00 NTU 1.00 ppm 40 NTU 1.00 g/l 2.0 %	

Description of operating functions (continued)

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
4 / 0	**Cleaning function for sensor** 0 = cleaning off (contact 2 is used as a limit) 1 = cleaning contact for external control 2 = wiper function 1: switching contact 2 works as a cleaning timer 2: switching contact 2 works as a timer for the wiper with sensor version CUS 1-W / CUS 3-W / CUS 4-W **Caution:** The displayed turbidity and temperature values are frozen during the cleaning phase and during wiper operation.	0	
4 / 1	**Type of cleaning** 0 = manual trigger 1 = trigger by timer see V4 / H3 or V4 / H4	1	
4 / 2	**Manual cleaning trigger** (only if V4 / H1 = 0) key ↓ = off key ↑ = clean	0	
4 / 3	**Cleaning period** (only if V4 / H1 = 1) 3 ... 600 s	60 s	
4 / 4	**Pause between cleaning cycles** (only if V4 / H1 = 1) 1 ... 1440 min	119	
4 / 5	**Wiper propulsion** (only if V4 / H0 = 2) **CUS 1 / CUS 4** 50 ... 250 time units **CUS 3** 230 ... 320 time units	78 290	
4 / 6	**Display delay after cleaning** The hold function for measured values and temperature enabled during cleaning is disabled upon expiration of the delay after cleaning. 0 ... 300 s	0	
	Sensor CUS 3 only		
4 / 9	**Soiling detection** 0 = off 1 = fine 2 = medium 3 = coarse Dirt films on the windows are detected in accordance with the soiling detection setting.	0	

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
	Sensor CUS 4 (MR 1, 2) only Substance-specific parameters for calibration		
5 / 1	**Conversion factor** 1 ... 9999 NTU / MR unit Conversion factor for measuring range 1: from g/l to NTU units Conversion factor for measuring range 2: from % values to NTU units multiplied by a factor 10 If calibration mode 1 is selected in matrix field V1 / H9, this matrix field is not accessible for value entry.	MR 1: 400 MR 2: 4	
5 / 2	**Slope 1** 2.0 ... 150.0	20	
5 / 3	**Slope 2** 2.0 ... 150.0	20	

Note:

The calibration of the CUS 4 sensor in measuring ranges 1 and 2 is defined completely by the values in matrix fields V1 / H7 , V1 / H4 , V1 / H 6 , V1 / H8 and V5 / H1 to V5/ H3 (zero-point calibration V1 / H0).

These values cannot be edited with calibration type 1 (V1 / H9 = 1).

Description of operating functions (continued)

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
7 / 0	**Alarm threshold** Determines the threshold in turbidity values where an alarm condition starts if a limit is exceeded. Instrument variant I MR | CUS 1 0: | 0.00 ... 50.00 NTU 1: | 0 ... 2000 NTU 2: | 0.0 ... 500.0 ppm Instrument variant C MR | CUS 3 0: | 0.000 ... 2.500 NTU 1: | 0.00 ... 99.99 NTU 2: | 0.00 ... 99.99 ppm Instrument variant R MR | CUS 4 0: | 0 ... 4000 NTU 1: | 0.00 ... 99.99 g/l 2: | 0.0 ... 200.0 % **Example:** Limit setting is 2200 NTU , MAX function of contact is selected, an alarm tolerance is 200 NTU; an alarm situation exists at 2400 NTU or above.	4.00 NTU 160 NTU 40.0 ppm 0.100 NTU 4.00 NTU 4.00 ppm 160 NTU 4.00 g/l 8.0 %	
7 / 1	**Alarm delay** Determines the delay period in seconds after which, following the occurrence of an alarm condition (see V7 / H0), an alarm is signalled (LED and alarm contact). 0 ... 6000 s If the alarm condition ceases to exist before expiration of the delay period, the timer is reset to 0. When the HOLD function is enabled, the timer is also reset to 0.	0 s	
7 / 2	**Toggle steady / fleeting contact** Defines the alarm relay as a steady of fleeting contact. 0 = steady contact 1 = fleeting contact If defined as a fleeting contact, the closing time is 1 s.	0	
7 / 3	**Alarm assignment for alarm trigger** 0 = both limit contacts 1 = limit contact 1 only 2 = limit contact 2 only	0	
7 / 9	**Automatic HOLD during calibration** 0 = without HOLD 1 = with HOLD An entry of 1 enables the HOLD function after calibration is started.	0	

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
8 / 0	**Parity** Determines the parity bit for the RS interface. 0 = none 1 = odd 2 = even	2	
8 / 1	**Baud rate selection** For RS 232, the transfer rate can e switched betweea 4800 und 9600 baud. 0 = 4800 Bd 1 = 9600 Bd 2 = 19200 Bd For RS 485, baud rates of 9600 und 19200 baud can be selected. The E+H Rackbus protocol uses a fixed rate of 19200 baud.	1 2	
8 / 3	**Sensor variant selection** Selects the sensor type connected: 1 = CUS 1 3 = CUS 3 4 = CUS 4 **Caution:** Check that the sensor is connected accoring to the connection diagram before changing this setting. When this selection is confirmed by pressing the [E] key, the factory parameter settings are atuomatically retrieved. "Setd" flashes on the display. Following display on "End", you can only leave this matrix field by pressing the [V] and [H] keys at the same time. This switches the instrument to the measuring mode (V0 / H0) and locks levels 1 and 2.	1	
8 / 9	**Unlock / lock** Entry of access code. 0000 ... 9999 **Level 0** (measuring mode) **no code** requireed, fields are restricted to read access. **Level 1** (operating mode) is accessed with **code 1111**. **Level 2** (start-up mode) is accesssed with **code 2222**. **Note:** – The access code is always 0000 after power-up. Field V8 / H9 can be selected directly from V0 / H0 (measurement) by pressing the E-key. – If level 2 is unlocked, all function available at level 1 are also accessible to the operator. – Levels 1 and 2 can be locked by entering any number, **except 1111 or 2222**. – Locking affects only the keyboard, not the interface!	0000	

Description of operating functions (continued)

Matrix Pos. V / H	Description of function	Parameter settings Factory	User
9 / 0	**Diagnostic code** Displays the current diagnostic code E- - - ... E145 The error with the highest priority, i.e. the error wiht the lowest number, is displayed. More errors can be displayed by pressing the ↑ or ↓ key. Errors are atuomatically cancelled when the error condition ceases to exist.		
9 / 1	**Number of auto resets** 0 ... 255 Reserved for use by the Endress + Hauser Service organization.		
9 / 2	**Instrument configuration display** Displays the instrument configuration according to the Endress+Hauser Conducta - standard. X X X X └0 = no option card present 1 = 2nd current output present 3 = serial RS-232-C interface present 4 = serial RS-485 interface present 6 = serial RS-485interface with E+H-Rackbus protocol present 9 = dual function serial RS-232-C interface plus 2nd current output (service / adjustment) └0 = no contacts 1 = with alarm signalling contact 2 = with alarm signalling contact and 1 contr. 3 = with alarm signalling contact and 2 contr. 4 = w. alarm sign. contact and 3-point step contr. └0 = no parameter-speacific special feature └0 = unused		
9 / 3	**Software version** Displays the software version of the instrument according to the E+H Conducta standard. 0 ... 99.99		
9 / 4	**Divice addresses** Determines the device address when operated via an RS interface 1 ... 32: RS 232-C 1 ... 32: RS 485 0 ... 63 bei E+H Rackbus	1	

Matrix Pos. V / H	Description of funciton	Parameter settings Factory	User
9 / 5	**Instrument defaults (Set Default)** Press the ENTER key to write the factory parameter settings as indicated for the individual fields. Restoring the default values is mandatory for 1st start-up and following replacement of CUS 1 / CUS 3 / CUS 4 sensor. When this field is selected, the text "SEt d" appears. The display flashes when the ENTER key is pressed. "End" appears when the defaults have been restored. **Notes:** Press the V and H keys simultaneously to restart the instrument in measuring mode. this function overwrites all parameter settings made by the user. This does not affect display fields V1 / H1, V1 / H2 and V1 / H3 to V1 / H8 and field V8 / H9 (Unlock / Lock). Instrument variant R with CUS 4 sensor): fields V5 / H1 to V5 / H3 (calibration parameters) also remain unaffected. This function is not accessible via the interface.		
9 / 6	**Sensor defaults (Set Sensor)** Press the ENTER key to write the default values indicated for the individual fields to fields V1 / H3 to V1 / H8 and V5 / H1 to V 5 / H3 und V1 / H0. When this field is selected, the text „SEt S" appears. The display flashes when the ENTER key is pressed. "End" appears when the defaults have been restored. **Notes:** This function overwrites all parameter settings made by the user. This function is not accessible via the interface.		
9 / 8	**Simulation ON / OFF** 0 = simulation OFF 1 = simulation ON If the entry value is 0, the simulation is disabled. If the entry value is 1, the current value set in field V9 / H9 is applied to the turbidity and temperature signal outputs.	0	
9 / 9	**Output current simulation** Entry of a current value not affected by measurement which is applied to the turbidity and temperature outputs if field V9 / H8 has been set to 1 (= ON). 0.00 ... 20.00 mA The new value takes effect after pressing the E key (ENTER).	10.00 mA	

Note:

- When the sensor defaults are retrieved (V9/H6), a zero calibration for all measuring ranges is automatically performed. Furthermore, the internal sensor reference value is transferrred to the measruing transmitter. For this reason, this function must be used **whenever the sensor is changed**.

7. Limit contacter

7.1 Limit contacter function

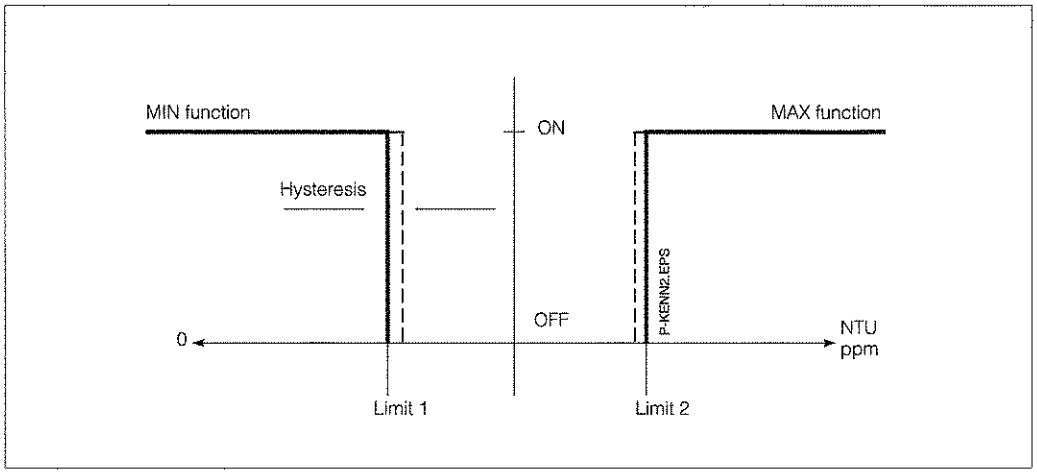


Fig. 7.1: Characteristic curve of limit contacter

Sequence of parameter settings		Matrix position V / H Limit 1	V / H Limit 2
Limit contacter adjustment			
1.	Setpoint	2 / 0	3 / 0
2.	Pickup delay **or** dropout delay	2 / 3 2 / 4	3 / 3 3 / 4
3.	Switching function MIN / MAX	2 / 5	3 / 5
4.	Relay contact normally closed or normally open function	2 / 6	3 / 6
5.	Hysteresis	2 / 7	3 / 7

Limit contacter operating conditions

The diagram below shows all operating conditions for the instrument's limit contacter function. The measured or displayed value (actual value) lies between approx. 0 % (> setpoint 1) and approx. 100 % (< setpoint 2).

The contact position (0 = OFF, 1 = ON) of the switching contacts will be different depending on the switching function (MIN / MAX) and the operating mode of the output contact (normally closed / open circuit).

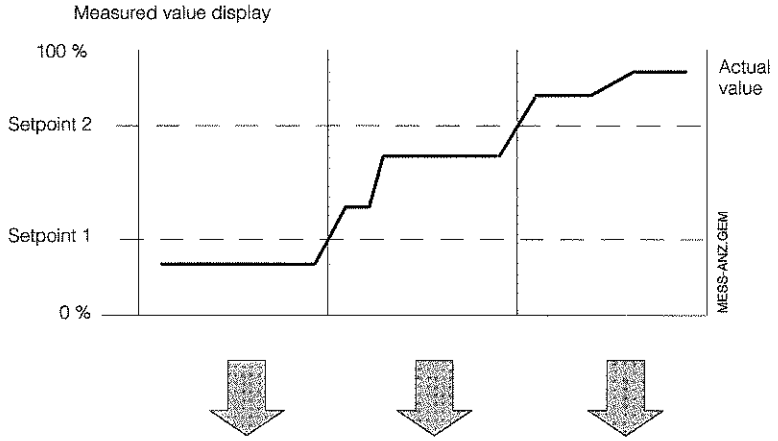


Fig. 7.2: Status diagram for automatic operation of Mycom CUM 151 with limit contacter function

Function V2 / H5 V3 / H5	Principle V2 / H6 V3 / H6	Switching contacts LED	Cont.	LED	Cont.	LED	Cont.	Contact at power failure
Setpoint MIN	Closed circuit	red	OFF	green	ON	green	ON	OFF
	Open circuit	red	ON	green	OFF	green	OFF	OFF
Setpoint MAX	Closed circuit	green	ON	green	ON	red	OFF	OFF
	Open circuit	green	OFF	green	OFF	red	ON	OFF

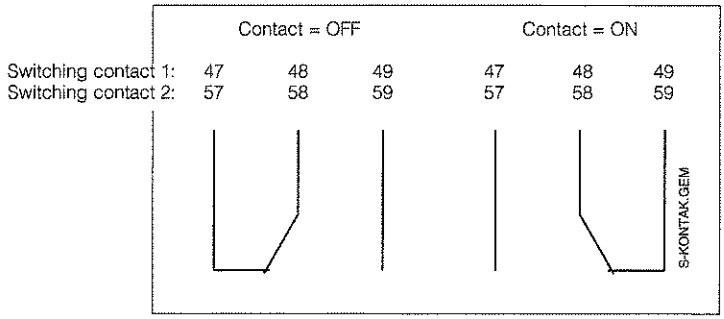
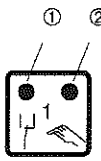


Fig. 7.3: Contact position for switching contacts 1 and 2 with the corresponding terminal assignments (acc. to fig. 4.2, chapter 4.4)

LED function



① Set LED red / green for limit contact switching state:
green = normal position = OFF
red = working position = ON

② Red LED for manual operation
Automatic operation: LED OFF
Manual operation: LED ON

7.2 Alarm contact

Sequence of parameter settings		Matrix position V / H
1.	Setpoint entry	2 / 0 (contr. 1) 3 / 0 (contr. 2)
2.	Alarm threshold	7 / 0
3.	Alarm delay	7 / 1
4.	Steady or fleeting contact	7 / 2

	Alarm contact		
Operating condition	LED	Cont.	Contact at power failure
Normal	–	OFF	ON
Alarm	red, flash-ing	ON	ON

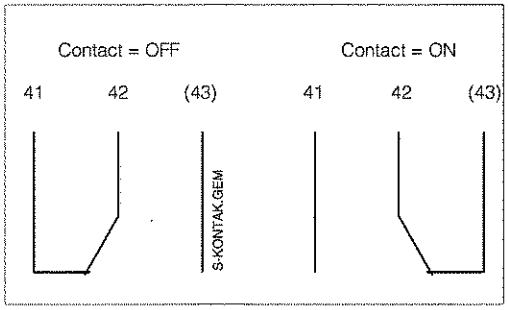


Fig. 7.4: Contact positions for alarm contact with the corresponding terminal assignments

An alarm condition (alarm LED flashes) enables the alarm signalling contact and displays an error number (see chapter 7.3) on:

- Instruments **without** controller in the case of
  - System errors (errors 1 to 9 ; chapter 8),
  - Disturbances (errors 10 to 29 ; chapter 8)
  - Power failure

- Instruments **with** controller in the case of
  - System errors (errors 1 to 9 ; chapter 8)
  - Disturbances (errors 10 to 29 ; chapter 8)
  - Power failure and additionally when the
  - alarm threshold is exceeded upon expiration of the alarm delay period.

7.3 Sensor cleaning function

In place of a limit contacter function, switching contact 2 can be assigned a timer function for sensor cleaning intervals. Optionally, a separate cleaning mechanism (contact 2 = cleaning contact) or the wiper installed in sensor version CUS 1-W / CUS 3-W / CUS 4-W (contact 2 = wiper cleaning) can be controlled.
The cleaning interval control can be executed continuously, or the cleaning function can be triggered manually via matrix field V4 / H1.
When the continuous (automatic) interval control is active during cleaning phases, the turbidity and temperature value displays are frozen to their current value and the "HOLD" indicator arrow is enabled on the display.

Sequence of parameter settings		Matrix position V / H
1.	Cleaning function	4 / 0
2.	Type of cleaning	4 / 1
3.	Cleaning period	4 / 3
4.	Pause period	4 / 4
5.	Wiper propulsion	4 / 5

7.3.1 Cleaning with separate device (e.g., cleaning facility)

Required settings:

- **for cleaning interval control**

Sequence of parameter settings		Matrix position	Setting
1.	Cleaning function (contact 2 = cleaning contact)	V4 / H0	1
2.	Type of cleaning = timer	V4 / H1	1
3.	Cleaning period	V4 / H3	3 to 600 s
4.	Pause period	V4 / H4	1 to 1440 min

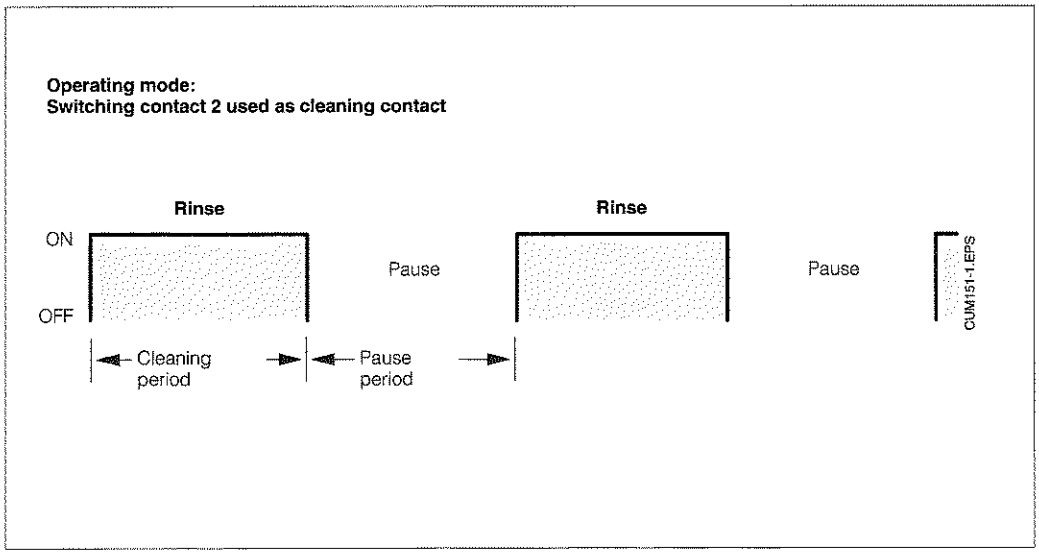


Fig. 7.5: Example of an interval control sequence for periodic rinsing of sensor

Required settings:

- **for manual cleaning control**

	Sequence of parameter settings	Matrix position	Setting
1.	Cleaning function – Contact 2 = cleaning contact – Contact 2 = wiper contact	V4 / H0	 1 2
2.	Type of cleaning = manual	V4 / H1	0
3.	Manual cleaning trigger Key ↑ = cleaning on Key ↓ = cleaning off	V4 / H2	

7.3.2 Cleaning with wiper sensors CUS 1-W / CUS 3-W / CUS 4-W

	Sequence of parameter settings	Matrix position	Setting
1.	Cleaning function (contact 2 = cleaning contact)	V4 / H0	2
2.	Type of cleaning = timer	V4 / H1	0 = wiper off 1 = wiper on
3.	Cleaning time CUS 1-W / CUS 3-W / CUS 4-W	V4 / H3	3 to 600 sec
4.	Pause period	V4 / H4	1 to 1440 min
5.	Wiper propulsion CUS 1-W / CUS 4-W Wiper propulsion CUS 3-W	V4 / H5	50 to 250 time units 230 to 320 time units

Note:
The „wiper propulsion" setting in matrix field V4 / H5 can be used to change the wiper motion (angle covered by the wiper) continuously up to full-circle wiper rotation.

Recommended settings:
- CUS 1-W / CUS 4-W: 78
- CUS 3-W: 290 (factory setting for wiper rotation).

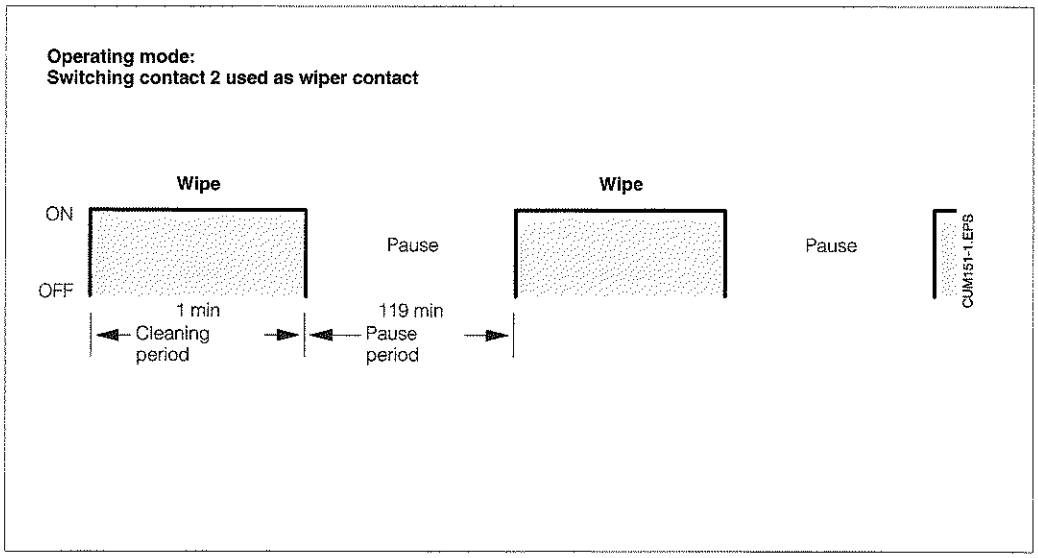


Fig. 7.6: Sequence of wiper control for CUS 1-W

8. Error handling

8.1 Troubleshooting

Measuring system errors

Symptom	Possible cause	Remedy
No display, no sensor response	Measuring transmitter is not supplied with power	Check power connection
	Connecting line from sensor to measuring transmitter interrupted	Establish connection
Sensor alarm	Connecting line from sensor to measuring transmitter interrupted	Establish connection
	Pre-amplifier or optics defective	Replace sensor
	Fixed display value	Check sensor connections, turn power off and back on
Meas. value excessive	Incorrect sensor installation	Check installation
	Sensor soiled	Clean sensor
Inplausibly high sensor values or fixed excessvie value	Sensor soiled	Clean sensor
	Installed too close to wall	Positoin sensor correctly
	Air bubbles	Build up counterpressure
	Optics defective	Visual inspection
		Return sensor to E+H Service
Measured value drops with visible increase in turbidity	Measuring range too high	Use suitable sensor
	Incorrect sensor installation	Check installation
	Sensor located in foam or air cushion	Check installation
	Medium too turbid, total reflection or absorption	
No wiper function	Cable broken	Examine cable and connections

8.2 Error classes and error numbers

Errors are numbered and grouped into 3 classes:

Error class	Priority	Error no.
No error occurred		. . .
System error	1 = high	1 ... 9
Disturbance	2 = medium	10 ... 29
Warning	3 = low	30 ... 255

System errors
are error conditions where proper operation of the entire measuring system is no longer guaranteed (e.g., parameter storage EEPROM cannot be read correctly). These errors require servicing since they cannot be erased.

Disturbances
are error conditions where

a) the process parameter to be measured and controlled exceeds the selected limit conditions (process error),
or
b) display and / or current output are outside the specified accuracy range,
or
c) the measuring ransmitter receives incorrect signals.

These errors are cancelled as soon as the error condition in question ceases to exist.

Warnings
are error conditons where:

a) an operator error must be corrected,
or
b) maintenance will be required shortly.

These error s are cancelled as soon as the error condition in question ceases to exist.

Note:

If a warning is ignored, a disturbance may result.

8.3 Error indication and handling

Errors that occur are entered in an error list which is sorted by error numbers (ascending). The error list (see chpater 8.4) has exactly one space for each error number. Multiple occurrences of an error are therefore not recognized.

Any occurrence of an error activates the alarm LED (flashes at intervals of one second). System errors and disturbances also activate the alarm contact (which may be selected to be a steady or a fleeting contact).

When field V9 / H0 is selected, the display shows the number of the error with the lowest number which has occurred in the format "E001" up to "E255". The error list can be searched for other errors which have occurred using these keys:

 ascending

and

 descending

These error messages are deleted from the error list as soon as the error condition ceases to exist. If the error list is empty, "E- - -" is displayed.

8.4 Error list

No.	Meaning	Field V / H	Measures for maintenance / troubleshooting
	System errors		
1	Data exchange error in processor		Check electrical installation, correct if necassary, switch power off and on. If this does not help, check sensor installation (see installation and operating instructions for CUS 1 ... CUS 4). Return instrument to your Endress+ Hauser sales agency for repair
2	Interner Konfigurationsfehler		Return instrument to your Endress+ Hauser sales agency for repair.
	Disturbances		
10	Limit value exceeded and selected delay period expired.	7 / 0	Check actuator, limit function and limit parameters.
13	Turbidity display range exceeded or below turbidity measuring range (example for CUS 4: < 0.02 g/l)	0 / 0	Check measurement, control and connections, immerse sensor in calibration solution or suitable user sample.
14	Sensor- synchronisation error	0 / 0	Check installation. If this does not help, retrun sensor and instrument to Endress+Hauser Service organization.
15	Sensor signal transmission error	0 / 0	Check that cabling is correct and that cable type OMK is being used. Run sensor cable and mains lines separately.
16	Sensor LED error	0 / 0	Return sensor to Endress+Hauser Service organization or replace sensor.
19	Below temperature measuring range	0 / 1	Assure correct temperature application range. If this does not help, return sensor and instrument to your Endress+ Hauser sales agency for repair.
20	Temperature measuring range exceeded	0 / 1	

Error list (continued)

No.	Meaning	Field V / H	Measures for maintenance / troubleshooting
	Warnings		
22	Below permissible minimum current value of 0 / 4 mA (output 1)	0 / 5	Check 0 / 4 mA measuring range assignment and change if necessary Check measurement.
23	Permissible maximum current value of 20 mA exceeded (output 1)	0 / 6	Check 20 mA measuring range assignment and change if necessary Check measurement.
25	Below permissible minimum current value of 0 / 4 mA (output 2)	0 / 7	Check 0 / 4 mA measuring range assignment and change if necessary Check measurement.
26	Permissible maximum current vlaue of 20 mA exceeded (ouput 2)	0 / 8	Check 20 mA measuring range assignment and change if necessary Check measurement.
31	Parameter range for current output 1 too small	0 / 5 0 / 6	Increase difference
34	Temperature range for current output 2 too small	0 / 7 0 / 8	Increase difference (min. 20 °C)
35	Temperature range for current ouput 2 interchanged	0 / 7 0 / 8	Re-enter temperature values.
141	Offset for ZERO-CAL exceeded	1 / 0	Use clean zero solution free of particles. Make sure sensor is installed correctly and zero calibration is performed correctly in suitable vessel. Make sure sensor optics are clean and intact (also see notes in installation and operating instructions for CUS 1 / CUS 4).
143	Outside standard slope range	1 / 4 1 / 6 1 / 8	If editing function calibration type (V1 / H9 = 0) is selected: outside permissible calibration range, see chapter 6.4 (V1 / H9 = 1): make sure wet calibration is performed correctly in suitable vessel and use suitable calibration solutions, see chapter 6.4.
144	Calibration solution too concentarated		Dilute original sample
145	Sensor optics soiled	1 / 8	Turbidity sensor system CUD 3 only: The soiling detection function triggers this error message according to the setting in matrix field V4 / H9.

9. Technical data

9.1 Electrical data

Turbidity measurement

Turbidity indicating range	
CUS 1 / CUS 1-W	0 ... 99.99 NTU or 0 ... 4000 NTU, 0 ... 999.9 ppm
CUS 3 / CUS 3-W	0 ... 2.500 NTU or 0 ... 99.99 NTU, 0 ... 99.99 ppm
CUS 4 / CUS 4-W	0 ... 4000 NTU or 0.3 ... 99.99 g/l, 0.2 ... 200.0 %
Measured value resolution	<0.5 % of upper range value
Zero point	adjustable plus additional offset function
Temperature sensor	NTC
Turbidity signal input	multi-channel, serial transfer
Slope adjustment	10 ... 500 % referred to normal condition
Turbidity signal output current range (galvanically separated)	0 / 4 ... 20 mA
Load	max. 600 Ω
Turbidity signal output range	adjustable
	from 1 ... 100 % of measuring range

Temperature measurement

Temperature measuring range	–10 ... +70 °C
Temperatur signal output	0 / 4 ... 20 mA
Load	max. 400 Ω
Temperature output range	adjustable from Δ 20 to Δ 80 K

Limit, timer and alarm functions

Limit contacter / interval timer control	2 contact outputs
Type of function	MIN or MAX (direct / inverted)
Setpoint adjustment	
CUS 1 / CUS 1-W	0 ... 99.99 NTU or 0 ... 4000 NTU, 0 ... 999.9 ppm
CUS 3 / CUS 3-W	0 ... 2.500 NTU or 0 ... 99.99 NTU, 0 ... 99.99 ppm
CUS 4 / CUS 4-W	0 ... 4000 NTU or 0.00 ... 99.99 g/l, 0.0 ... 200.0 %
Hysteresis for limit contacts	adjustable, 0 ... 100.0 % of URV
Cleaning contact period	0 ... 15 min
Cleaning interval period	1 ... 1440 min
Contact delay	pickup / dropout
Delay time	0 ... 6000 s
Alarm threshold	
CUS 1 / CUS 1-W	0.00 ... 50.00 NTU or 0 ... 2000 NTU, 0 ... 500.0 ppm
CUS 3 / CUS 3-W	0.000 ... 2.500 NTU or 0.00 ... 99.99 NTU, 0.00 ... 99.99 ppm
CUS 4 / CUS 4-W	0 ... 4000 NTU or 0.00 ... 99.99 g/l, 0.0 ... 200.0 %
Alarm delay time	0 ... 6000 s

General technical data

Measured value display	7-segment LCD, 4 digits, height = 10 mm
Operational error of measurement (acc. to DIN IEC 746)	max. 0.5 %
Status indication	LEDs, red or red / green
RF interference suppression (DIN VDE 0871, IEC: CISPR11, EN 55011)	limit class B
Interference resistance	acc. to IEC 801 or Namur
Ambient temperature, nominal operating range	–10 ... +55 °C
Ambient temperature, limit operating range	–20 ... +60 °C
Ambient temperature, storage and transport	–25 ... +85 °C
Relative humidity	10 ... 90 %

Electrical data (continued)

Electrical data and connections

Voltage supply, AC	24, 100, 110, 127, 200, 220, 230, 240 V, –15 ... +10 %
Frequency	50 ... 60 Hz, ± 6 %
Voltage supply, DC	24 V, 15 / –20%
Power consumption	max. 12 VA
Contact outputs	floating, 2 changeover contacts, 1 NO contact
Switching voltage	max. 250 V AC
Switching current	max. 3 A
Switching power	max. 500 VA
Signal outputs	1 or 2 x 0 / 4 ... 20 mA, galvanically separated
Insulation voltage	max. 650 Vp-p
Terminals	terminal block
Max. conductor cross section	4 mm^2
Digital interface	optional, RS 232-C or RS 485

Turbidity sensor

Type	CUS 1 / CUS 1-W CUS 3 / CUS 3-W CUS 4 / CUS 4-W
Power supply	5 V, ± 8.5 V
Connection	7-pin connector (type SXP)
Measuring cable length	1.5 m, 7 m or 15 m

9.2 Physical data

Dimensions / weight / ingress protection

Dimensions CUM 121	96 x 96 x 176.5 mm (HxWxD)
Dimensions CUM 151	247 x 167 x 111 mm (HxWxD)
Weight CUM 121	1.1 kg
Weight CUM 151	3.5 kg
Ingress protection CUM 121	IP 54
Ingress protection CUM 151	IP 65

Materials

Housing CUM 121	polycarbonate
Housing CUM 151	GD-AlSi 12 (Mg part < 0.05%)
Coat of lacquer CUM 151	2-component PU-lacquer
Front CUM 121	polyester
Front CUM 151	polyester, UV-resistant

10. Appendix

10.1 Cleaning

Use commercial cleansers to clean the instrument front panel.

The front panel is resistant (test method: DIN 42 115) to:
- Alcohol
- Diluted acids
- Diluted bases
- Ester
- Hydrocarbons
- Ketones
- Household cleansers

Caution:
- We do not guarantee resistance to concentrated mineral acids or concentrated lyes, benzyl alcohol, methylene chloride and high-pressure steam with temperatures above 100 °C.

- Avoid long-term exposure to solar radiation. Use the weather protection cover.

10.2 Preparation of samples

Preparation of standard suspension (acc. to ISO 7027/DIN 38404 part 2)
The turbidity of a formazine standard suspension is used for comparative pruposes to calibrate scattered light instruments.
The values obtained are specified in turbidity units (abbreviation: NTU) referred to calibration with the formazine standard suspension.

Water for preparation of standard solutions:
- Place a membrane filter with a pore size of 0.1 µm (for bacteriological examinations) in 100 ml distilled water for one hour.
- Filter 250 ml water and discard the water.
- Then filter 500 ml of distilled water through the same filter and use this water to prepare the standard solutions.

This type of water can be used directly for zero calibration of the CUS 3 (required quantity: approx. 1.5 l).

Standard solutions:

Formazine ($C_2H_4N_2$) is not commercially available. It is prepared from the following solutions:

Solution 1:
50.0 g hexamethylenetetramine ($C_6H_{12}N_4$) for analysis are dissolved in distilled water;; add distilled water to the solution to obtain 500 ml.

Solution 2:
5.0 g hydrazine sulphate ($N_2H_6SO_4$) are dissolved in distilled water; add distilled water to the solution to obtain 500 ml.

Procedure:
500 ml of solution 1 are mixed with 500 ml of solution 2 and subjected to a residence time of 24 hours at 25 ± 3 °C.
The turbidity value of this standard suspension is 4000 NTU; the quantity is 1000 ml.

Preparation of 2400 TEF:
Mix 600 ml of standard suspension with 400 ml distilled water; this produces 1000 ml of 2400 NTU solution.

Preparation of 800 TEF:
Mix 200 ml of stndard suspension with 800 ml distilled water; this produces 1000 ml of 800 NTU solution.

Preparation of 40 TEF:
Mix 10 ml of standard suspension with 990 ml distilled water;
this produces 800 ml of 40 NTU solution.
The diluted suspensions will be useable for approx. 2 days.

Calibration of CUS 1 / CUS 4 must always be performed in a black vessel with a min. hight of 200 mm and a min. inside diameter of 100 mm.
We recommend using out calibration vessel (see accessories, chapter 10.3)

The CUS 3 sensor is calibrated in a flow assembly.
It is extremely important to avoid gas bubble formation when filling the CUD 3 turbidity sensor system. We recommend using a funnel with a hose extension of approx. 40 cm reaching all the way down to the bottom of the flow assembly.

Note:

- A 3-point calibration must be performed in all cases.
  This requires preparation of 3 calibration solutions within the selected measuring range (units: NTU or pm).
- Ideally, the calibration solutions should match the factory settings in matrix fields V1 H3, V1 H5 and V1 H7(see chapter 6.4).
- If you need to use samples with different measured values, you can edit the values in these matrix fields to enter the corresponding calibration values.
- However, the values of your samples must lie within the limit that apply to these matrix fields.

10.3 Accessories

The following accessories Mycom CUM 121 / 151 can be ordered separately:

- Assembly holder CYH 101 - A
  This usspension assembly holder with an upright post and transverse pipe for turbidity sensors is used primarily for open channels, basins or tanks.
  (order no. CYH 101-A)

- Weather protection cover CYY 101
  Weather protection cover for installation on Mycom CUM 151;
  Dimensions: 320 x 300 x 300 mm (L x W x D)
  Material: stainless steel
  (order no. CYY 101)

- Upright post CYY 102
  For post mounting of Mycom CUM 151 in conjunction with weather protection cover CYY 101
  Material: steel, hot-dip galvanized
  (order no. CYY 102)

- Post mounting kit
  Kit for installation of Mycom CUM 151 on horizontal or vertical tubing (max. Ø 70 mm)
  Material: steel, galvanized
  (order no. 50003244)

- Flat packing
  To seal the mounting panel cutout for panel installation of Mycom CUM 151
  (order no. 126 480 - 0000)

- Junction box VS
  Junction box with receptacle and type SXP plug for plug-in connection between turbidity sensor and connecting line to the measuring instrument. Suitable for turbidity sensors CUS 1.
  Dimensions:
  - without SXP plug:
    82 x 80 x 55 mm (L x W x H)
  - with SXP plug:
    160 x 80 x 55 mm (L x W x H)

  Material: plastic
  Ingress protection: IP 65
  (order no. 50001054)

- Spray head CUR 4-A
  Used in conjunction with immersion assemblies in open channels or tanks. Mounted on sensor CUS 1 or CUS 4. Equipped with a special spray nozzle for optimal sensor window cleaning. Includes all installation materials, including those required for retrofitting.
  Additionally required: Ø ½ ".hose.
  Material: PVC

- Cable OMK
  Special cable to extend the connecting line between the turbidity sensor and the turbidity measuring transmitter; low-noise coaxial cable with 7 auxiliary cores (0.38 mm^2 jper core) and outer screen, cable sheath made of smooth PUR; cable diameter: approx. 8.6 mm
  (order no. 50004124)

- Receptacle SXK
  Moisture-proof 7-pin measuring cable socket suitable for connection of SXP plug. Required for cable extensions.
  (order no. 50001338)

- Calibration vessel for sensor CUS 1
  Calibration essel with meachanism for locating and fixing sensors CUS 1 and CUS 1-W.
  Material: PVC, black
  (order no. 50057944)

- Dry substance for preparation of test solutions for sensors CUS 1 and CUS 4:
  - CUY 21-A
    for low turbidity, approx. 40 NTU
  - CUY 21-B
    for high turbidity, approx. 800 NTU

Supplementary documentation

☐ Installation and operating instructions
Mycom interfaces
BA 078C/07/e

☐ Installation and operating instructions
Turbidity sensor CUS 1, CUS 4
BA 117C/07/e

☐ Installation and operating instructions
Turbidty sensor CUS 3, CUS 3-W
BA 116C/07/e

☐ Technical Information
Universal suspension assembly holder CYH 101
TI 092C/07/e

☐ Technical Information
Universal suspension assembly holder CUA 120 / 250
TI 096C/07/e

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