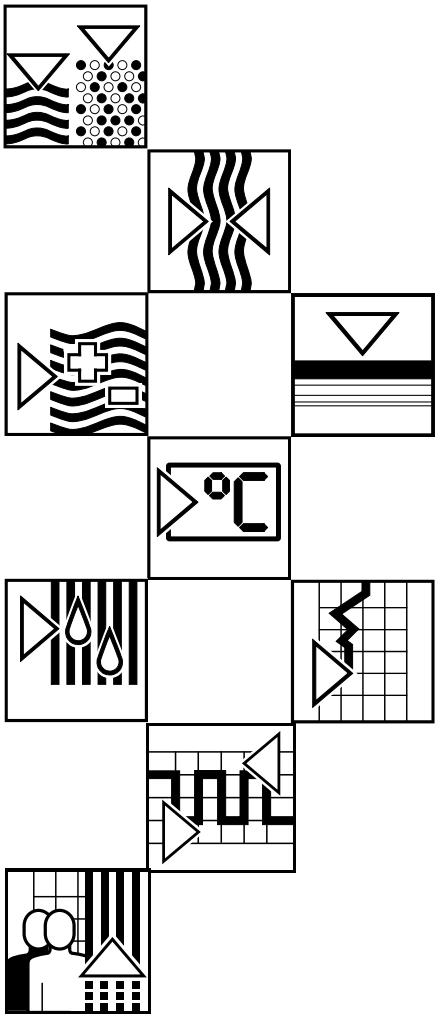
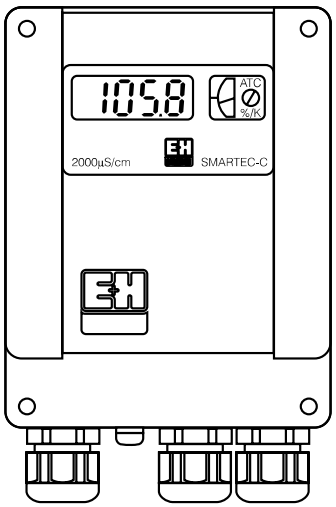
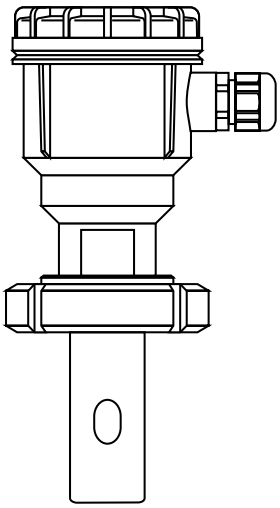
BA 001C/07/en/02.97
No. 50040314

smartec CLD 130 Conductivity Measurement

Operating Instructions







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1. General

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 if the delivery is complete and agrees with the shipping documents as well as your order:
- Delivered quantity
- Instrument type and version
- Accessories
- Operating instruction(s)
- Instrument identification card(s)

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

1.2 Application

Use:	Conductivity measurement
Measuring principle:	inductive
Application area:	in liquids
Measuring range:	medium to high conductivities
Special features:	sterilizable no influence of contamination on measurement, resistant to chemicals, fully encapsulated
Applications:	food industry, chemical industry, electroplating

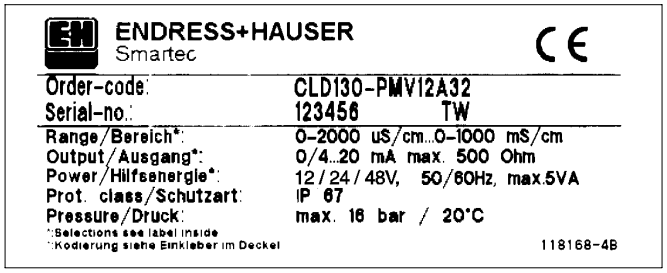


Fig. 1.1: Nameplate Smartec CLD 130

1.3 Order code

Inductive instrument Smartec CLD 130

Design
P Compact design with in situ measuring transmitter / PEEK
W Separate measuring transmitter with 5 m cable / PEEK
X Separate measuring transmitter with special cable length (max. 15 m) / PEEK

Version
MV1 Dairy fitting connection DN 50 to DIN 11851
RF1 Round flange DN40/PN10 and loose flange
TF1 Immersion sensor IP68 / loose fl. UP-GF DN50 / PN10 (W/X design only)
CS1 2" clamp fitting
ET1 Immersion version with round flange, l=2000mm
GE1 Internal thread G 1 $^1/_2$"
IF1 2" IDF flange
VA1 Varivent fitting for housing TN

Measuring ranges
0 0 ... 2000 µS/cm
1 0 ... 20 mS/cm
2 0 ... 200 mS/cm
3 0 ... 1000 mS/cm
4 20 / 2 mS/cm with remote switching
5 200 / 20 mS/cm with remote switching
6 1000 / 100 mS/cm with remote switching

ATC range
A ATC range 1 ... 3 %/K

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

Instrument output
0 0 ... 20 mA, max. 500 Ω
2 4 ... 20 mA, max. 500 Ω

CLD 130– ⇐ **complete order code**

2. Measuring system

2.1 Measuring principle

The test medium is a liquid conductor coupling the magnetic field of two magnetically isolated induction coils. The AC voltage U_1 applied to coil T_1 is transmitted to the second coil T_2 proportional to the conductance G of the test medium. This yields a linear relationship between the conductance G and the output voltage U_2 which is converted and rectified into a voltage proportional to the conductance.
This measuring principle offers following advantages:
- no electrodes, therefore no polarization
- faultless measurement in media or solutions with a tendency to form deposits

A Pt 100 temperature sensor is fitted inside the sensor to measure the temperature.

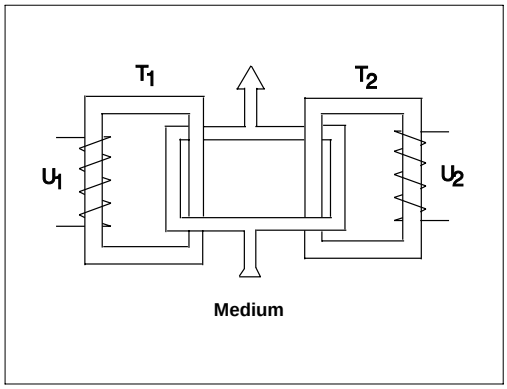


Fig. 2.1: The inductive conductivity measuring principle

2.2 Sensor

The sensor is injection-moulded of chemically, mechanically and thermally resistant PEEK (polyether ether ketone), ensuring that it is free of crevices and joints, and making it biologically safe.

The sensor shaft contains the two induction coils and a temperature sensor Pt 100 which is in direct contact with the test medium.

The use of special elements and materials makes the sensor suitable for continuous operation at temperatures of up to + 100 °C, and short-term operation at up to + 130 °C. Therefore, Smartec can be sterilized.

The sensor is available in different mounting variants with integrated or separate measuring transmitter.

2.3 Measuring transmitter

The measuring transmitter
- determines the conductivity of the liquid, and indicates the conductivity value based on reference temperature 25 °C and
- supplies this measured value as current (0 or 4 ... 20 mA) at the signal output.

The instrument requires power supply (see cover label).
The actual measured value and the set temperature coefficient can be read externally through a viewglass in the housing cover.

Four basic measuring ranges can be freely selected:

- 0 ... 2000 µS/cm
- 0 ... 20 mS/cm
- 0 ... 200 mS/cm
- 0 ... 1000 mS/cm

The zero point can be displaced within the selected measuring range, increasing the sensitivity, and thus spreading the range, considerably. This permits precise measurement even in media with slight conductivity changes.

Chemical attack			Resistance		
Medium	Concentr. (%)	Temp. (°C)	PVC-C	PVDF	PEEK
Nitric acid HNO_3	5	20	+	+	+
		60	+	+	+
	up to 40	20	+	+	+
		60	+	+	–
Phosphoric acid H_3PO_4	up to 10	20	+	+	+
		60	+	+	+
Caustic soda solution NaOH	3	20	+	+	+
		50	+	0	+
		90	+	–	+
sodium hypochlorite Labarraque's solution NaOCl	diluted aqueous	20	+	0	+
		50	+	0	+
		90	0	–	+

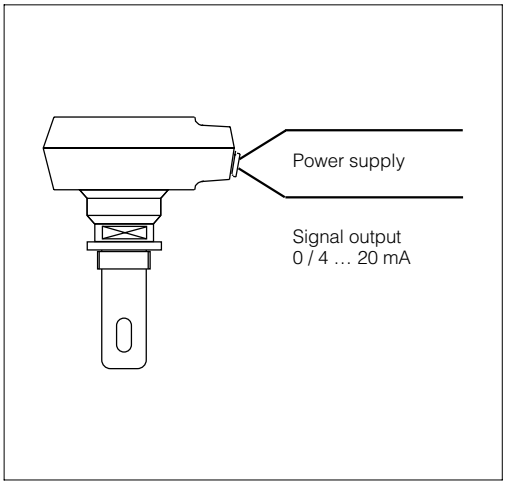
Fig. 2.2 Excerpt from resistance tables for PVDF, PEEK and PVC-C

Legend:
+ resistant
0 conditionally resistant
– not resistant

2.4 Designs

2.4.1 Sensor with integrated transmitter

The sensor with integrated measuring transmitter including screw connection, provides a complete measuring unit.



2.4.3 Immersion sensor with integrated transmitter

The measuring system comprises:
Measuring transmitter with immersion pipe, sensor and round flange.

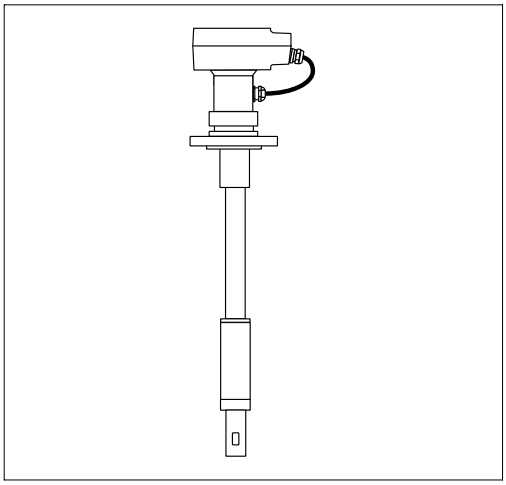
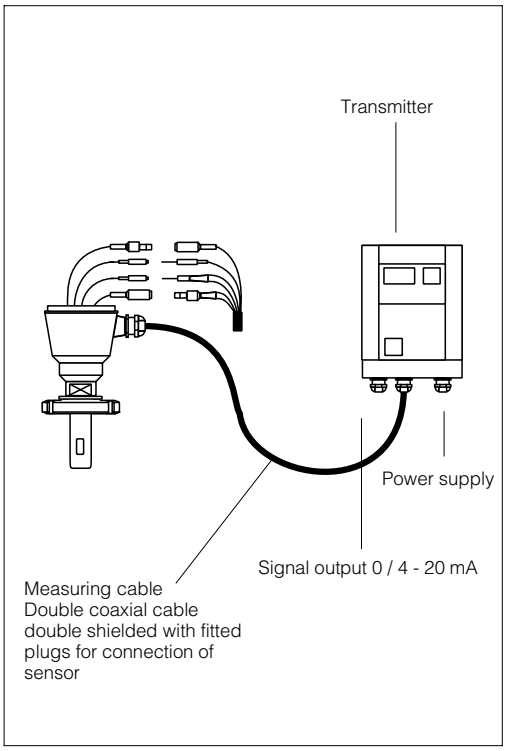


Fig. 2.3: (left) Sensor with integrated transmitter

Fig. 2.5: (right) Immersion sensor with integrated transmitter

2.4.2 Sensor with separate transmitter

The standard version provides the measuring transmitter with 5 m connected cable. The sensor is connected to the fitted cable plugs.



2.4.4 Immersion sensor with separate transmitter

The measuring system comprises:
Separate transmitter, immersion sensor IP 68 with connected cable, round flange with strain relief for freely suspended sensor.

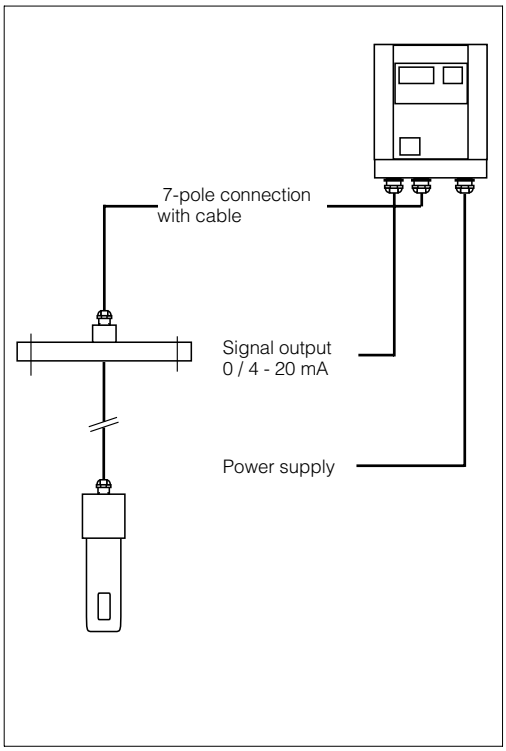


Fig. 2.4: (left) Measuring transmitter connected to separate sensor via 5 m cable

Fig. 2.6: (right) Immersion sensor with separate measuring transmitter

3. Installation

3.1 Sensor with integrated transmitter

The Smartec measuring system is available in different designs for all commonly used mounting and installation versions for industrial applications:

- Dairy fitting connection DN 50, DIN 11851
- Internal thread G 1 $^1/_2$"
- Varivent fitting
- 2" IDF flange
- 2" clamp fitting
- Round flange DN 40 / PN 10

The instrument is installed at the measuring point using the selected connections, i.e. dairy fitting connection (see fig. 3.1).
For installations in pipelines it must be ensured that the sensor is mounted at a point which is always fully flooded during the measuring process.
If the sensor is mounted vertically onto the pipeline, it should be installed in a culvert.
For measurements in high viscosity media (e.g. emulsions) the sensor should be installed in a pipe bend so that the media flows directly through the measuring channel.

The version with integrated measuring transmitter is suitable for use with continuous medium temperatures of up to 90 °C and ambient temperatures of up to 50 °C.

Note:
The suitable connection flange for pipe or tank has to be provided by customer.

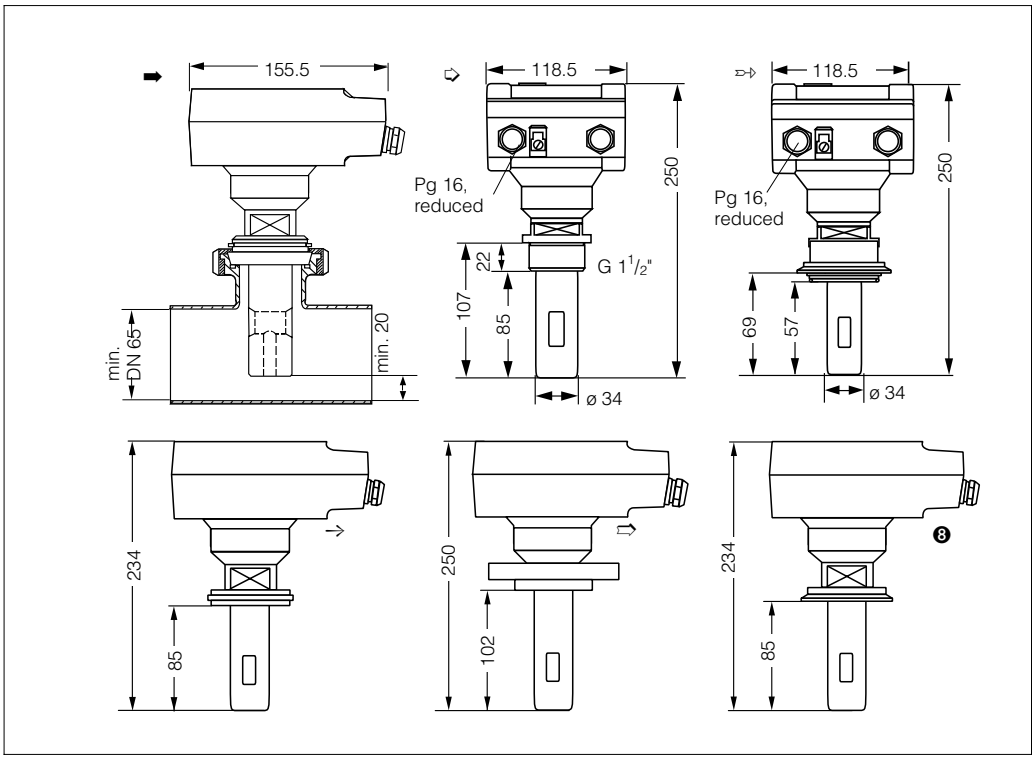


Fig. 3.1: Sensors with integrated transmitter in the connection head

➡ Sensor with dairy fitting connection DN 50, DIN 11851
⇨ Sensor with internal thread G 1 $^1/_2$"
⇨ Sensor with Varivent fitting
→ Sensor with 2" IDF flange
⇨ Sensor with round flange DN 40 / PN 10
❽ Sensor with 2" clamp fitting

3.2 Sensor with separate transmitter

Smartec with a separate measuring transmitter is available for industrial applications with high permanent temperatures (>90 °C) and hardly accessible measuring points.

The sensor is mounted at the measuring point.

The measuring transmitter is then mounted separately and connected to the sensor via a 5 metres long double shielded double coaxial cable.
The ambient temperature of the measuring transmitter may be max. + 60 °C.

Warning:
The ready-made cable must not be shortened in any case!

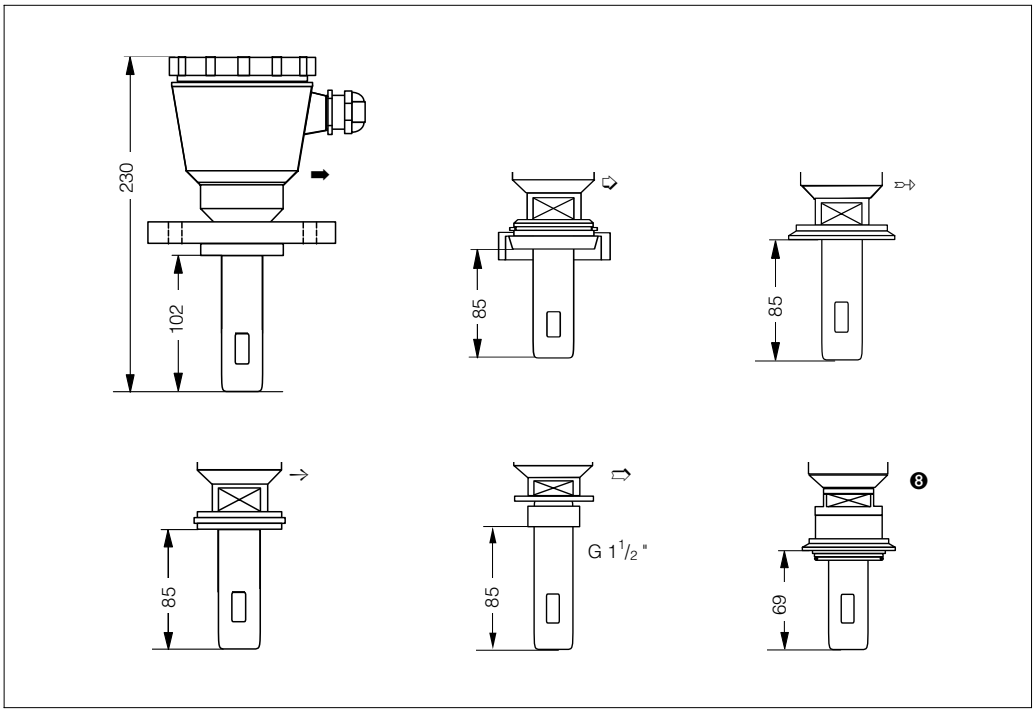
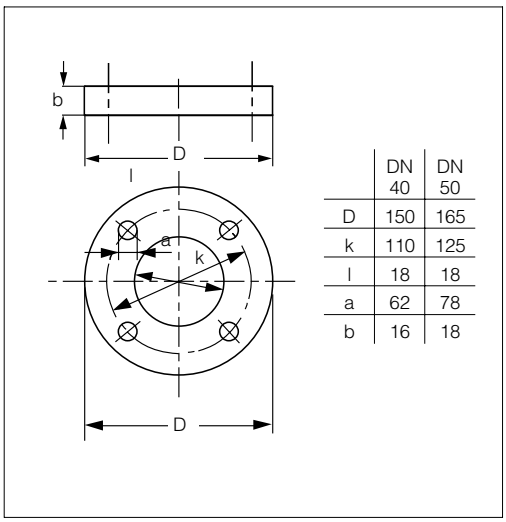


Fig. 3.2: Sensors with connection head without measuring transmitter

- ➡ Sensor with dairy fitting connection DN 40 / PN 10
- ⇨ Sensor with dairy fitting connection DN 50, DIN 11851
- ⇨| Sensor with 2" clamp connection
- → Sensor with 2" IDF flange
- ⇨ Sensor with internal thread G 1 1/2"
- ❽ Sensor with Varivent fitting (stainless steel adapter)



	DN 40	DN 50
D	150	165
k	110	125
l	18	18
a	62	78
b	16	18

Fig. 3.3: Dimensioned drawing of the used flanges for the corresponding installation versions

3.3 Immersion sensor with integrated transmitter

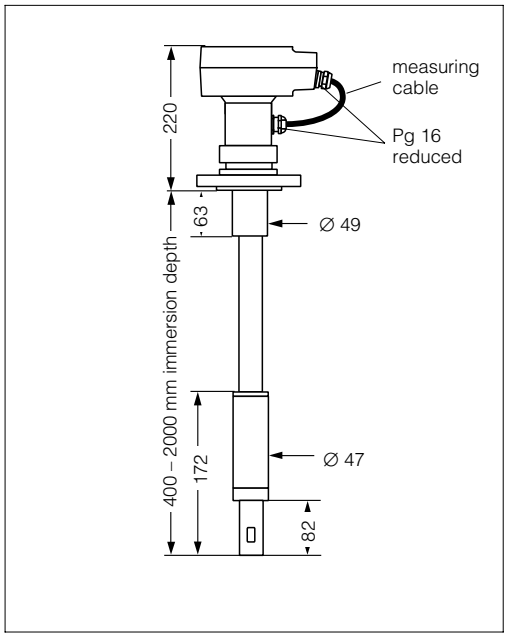


Fig. 3.4: Immersion sensor with integrated transmitter

Smartec as an immersion assembly with an integrated measuring transmitter is used in large basins or open channels.

The measuring signal (0/4 ... 20 mA) can be transmitted across larger distances (up to a maximum of 1000 m).

The immersion assembly is installed with a round flange DN 50 / PN 10. It is made of PVC-C and is available in different lengths (400 bis 2000 mm).

This assembly can be used in temperatures of up to 90 °C (permanent temperature 80 °C) and under pressures of up to 6 bar (at 20 °C) in closed containers.

3.4 Immersion sensor with separate transmitter

For installation in tanks or other closed containers, Smartec CLD 130 is available as an immersion assembly with a separate measuring transmitter.

The inductive sensor is mounted in the assembly using a bayonet lock. The assembly material PVC-C is resistant to aggressive chemicals. For application in CIP systems, the assembly is mounted in a V4A version using a DN 65 dairy pipe fitting.

For open containers and channels the sensor is mounted freely suspended with clamp connection and strain relief.

In case of the IP 68 immersion sensor the measuring cable is protected from the medium by a pressure-proof silicone hose. The cable gland in the immersion sensor is mounted by means of a bayonet lock.

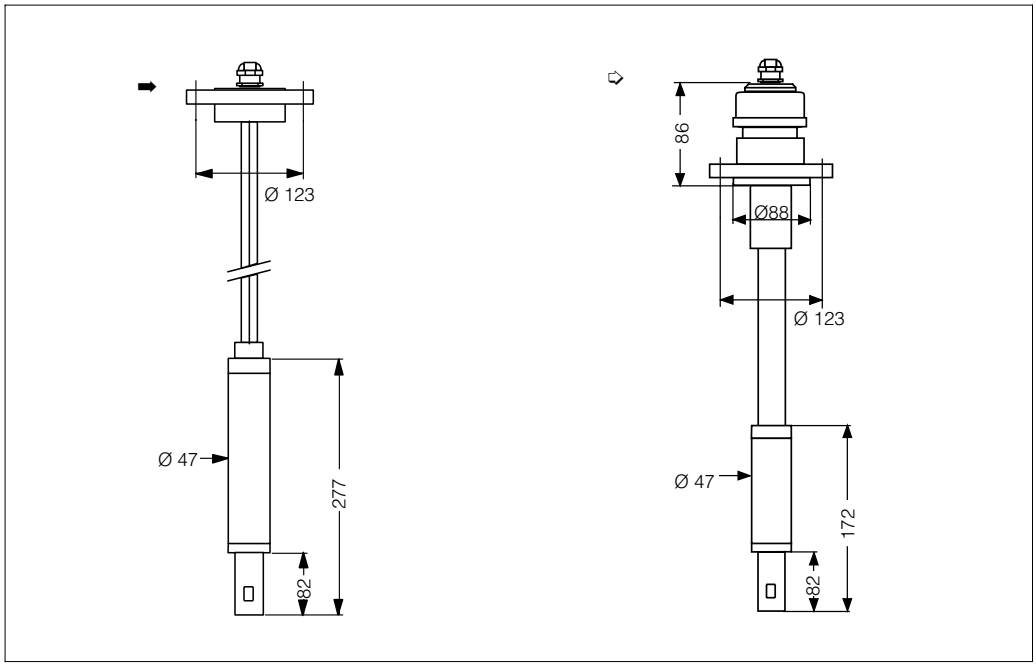


Fig. 3.5: Immersion sensors for measuring transmitters

➡ Immersion sensor TF1 (ingress protection IP 68) with PVDF sensor cap, 2 m silicone hose and round flange DN 50/PN 10

⇨ Immersion sensor ET 1 made of PVC in different lengths (400 to 2000 mm immersion depth) with round flange DN 50 / PN 10

Exchanging of the sensor

1. Unscrew Pg thread of cable duct on top of the assembly (see fig. 3.5, ➡ or ⇨).
2. Loosen sensor by turning it anticlockwise (bayonet lock ❽).
3. Withdraw the sensor part with protection sleeve → from immersion tube ➡.
4. Unscrew Pg thread ⇨ of protection sleeve.
5. Take sensor out of guide notch of protection sleeve and loosen plug connections ⇨, ⇨.
6. Assembe the sensor in reverse order.

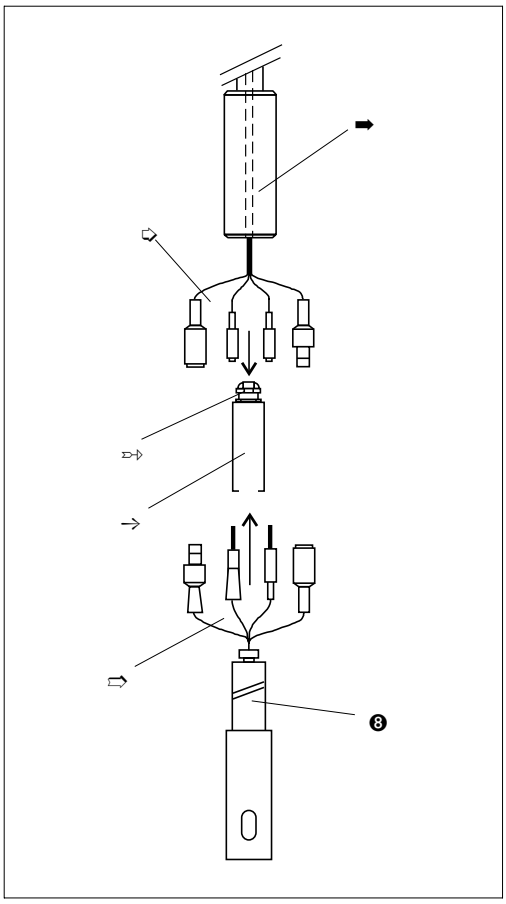


Fig. 3.6: Cable connection and assembling of sensor for immersion versions

Warning:
When assembling or disassembling the sensor the Pg thread must be unscrewed before pulling the measuring cable (see fig. 3.5).

3.5 Separate transmitter

The separate measuring transmitter can be easily installed on wall and posts using a mounting plate.

The mounting plate is secured to a wall using 3 screws and the supplied spacer bushes.

The transmitter is attached to pipes or posts by means of a retaining strap.

The sensor cable with 4 plugs is introduced in the sensor housing through the Pg thread.

Then put together the cable plugs, tighten Pg 16 thread and screw cover on the connection head.

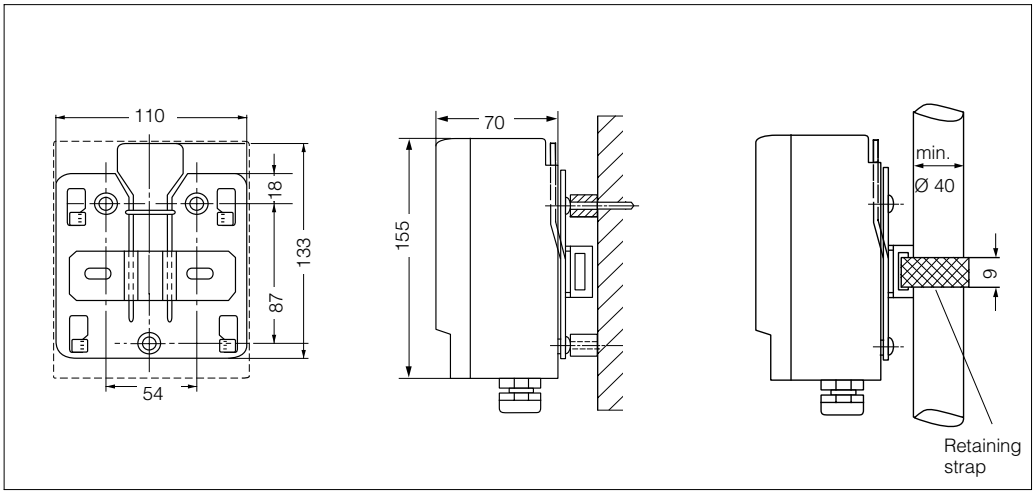


Fig. 3.7: Mounting plate for wall and post mounting of separate measuring transmitter

4. Electrical connection

4.1 Connection principles

Attention:
- The instrument must be grounded before operation!
- If malfunctions cannot be remedied, the instrument must be removed from service and protected against accidental start-up.
  Repair work can only be carried out directly by the manufacturer or by the Endress + Hauser service organization.

Warning:
- Notes and warnings of these operating instructions must be strictly adhered to! Maintenance work can only be carried out by qualified personnel if the instrument remains connected to the power supply!
- The instrument is protected against interference, pulse-shaped transients, high frequency and electrostatic discharges according to the Namur recommendations, IEC 801 und DIN VDE 0843. However, this is only valid for a properly grounded instrument with a screened measured value output line.
- For the separate version of the instrument we recommend not to wire the measuring line to the sensor directly next to a high-voltage line. If this is unavoidable, embed measuring line in a grounded steel pipe.

Note:
- This instrument has been built and tested in accordance with VDE 0411, part 100, and left the manufacturer's works in perfect condition concerning safety regulations.
- This instrument has been tested under reference conditions concerning electromagnetic compatibility according to EN 50081-2.
- Malfunctions of the instrument can be remedied by means of the error list in chapter 7.2 without requiring intervention in the instrument itself. Alterations to the instrument are not allowed and make any guarantee claim invalid.
- After installing and connecting the instrument and sensors the whole measuring system has to be checked for function.

Instrument connection to direct voltage mains
(24 V AC version)
Smartec CLD 130 can be operated in the direct voltage mains by inserting of a DC/AC converter:

DC/AC converter	
Input voltage	15 bis 32 V DC
Output voltage	24 V AC (2 %
Output frequency	50 Hz
Output power	4.5 VA
Order no.	50038935

4.2 Sensor with integrated transmitter

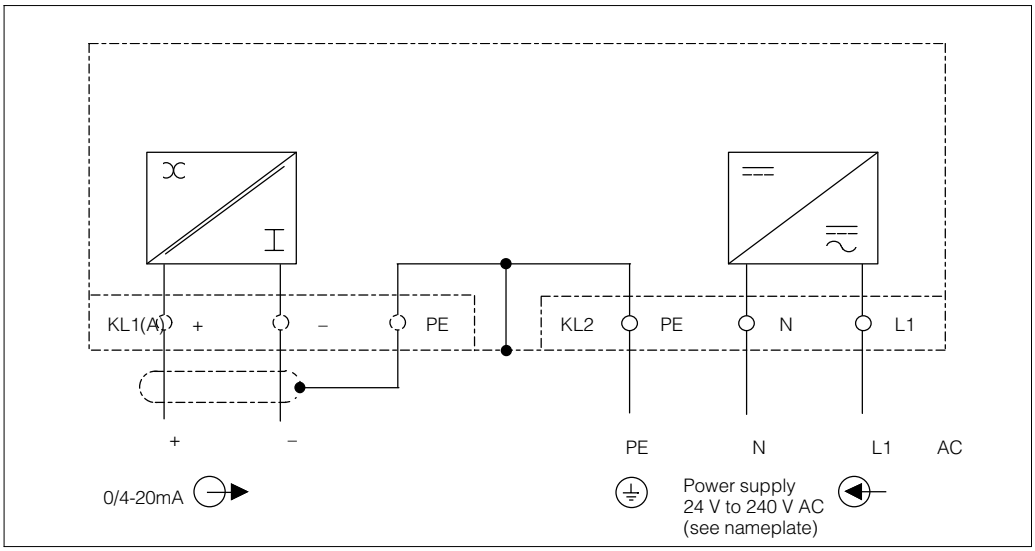


Fig. 4.1: Connection diagram for sensor with integrated transmitter

4.3 Sensor with separate transmitter

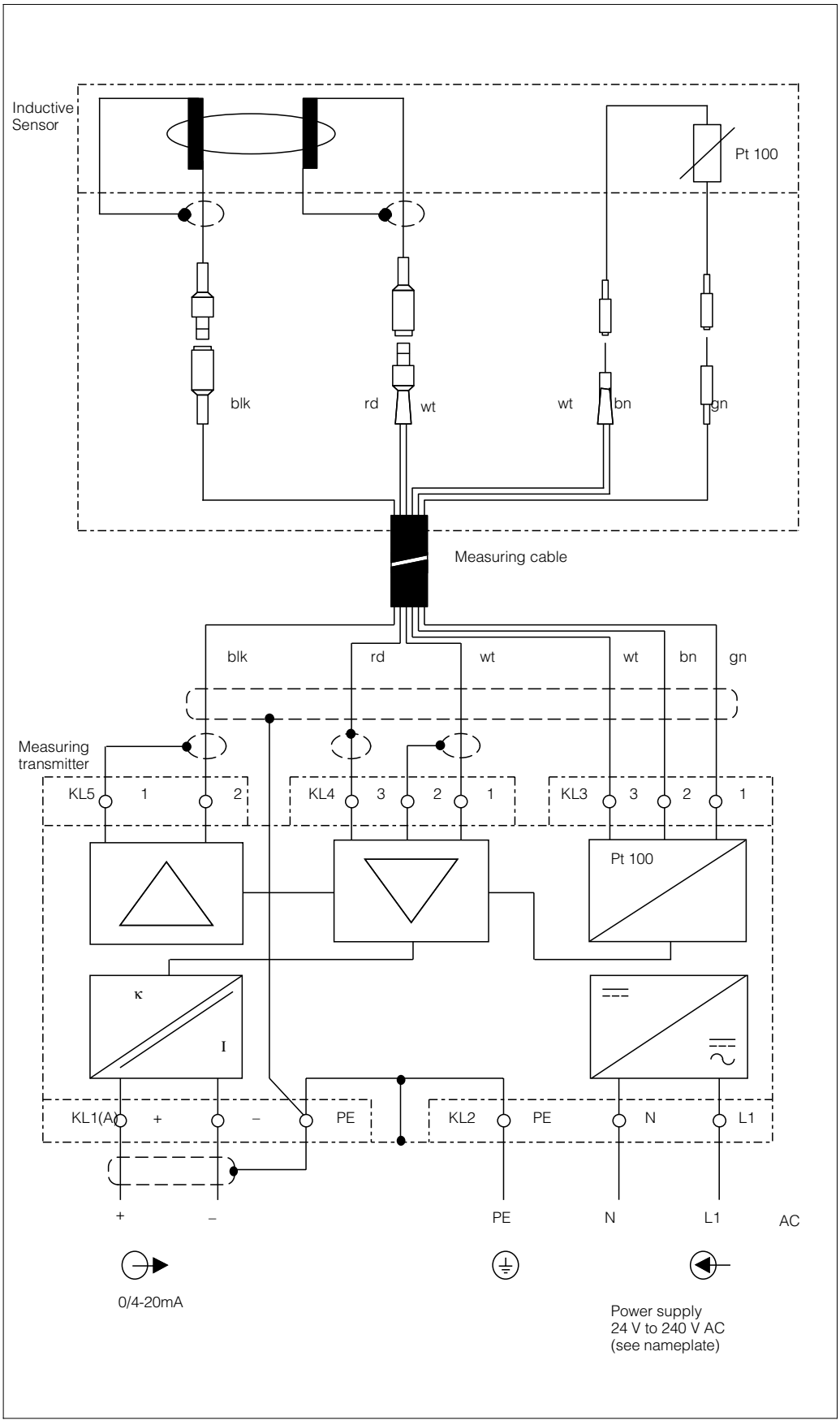


Fig. 4.2: Connection diagram for sensor with separate transmitter

5. Start-up

5.1 Power-up

Before switching on, ensure that all connections have been correctly made according to chapter 4.

5.2 Instrument settings

Normally no settings need to be made since the instrument has been preset at the factory according to the order code.
The settings concerned are as follows:

- Measuring range and decimal point of display,
- Signal output function (0 or 4 ... 20 mA),
- Mains voltage coding,
- Signal output variation and zero point suppression, if ordered.

The settings are recorded on the inside of the cover (see figure 6.1).
Any changes required should be made according to chapter 6.

5.3 ATC setting

The automatic temperature compensation (ATC) factor can be set externally on the scaled ATC control (see chapter 6.2). If the factor is not known refer to chapter 6.2.

5.4 Measuring mode

After applying the mains voltage, the instrument must operate correctly and display a temperature-compensated conductivity value in mS/cm or µS/cm.

6. Operation

All information in the following chapters relates to the items in figures 6.1 and 6.2.

6.1 Measuring range change-over

The instrument has four measuring ranges which can be changed over by means of coding switches S 101 and S 401.

The decimal point in the display must be adjusted with switch S 102 whenever the measuring range is changed.

A corresponding measuring range plate can be removed from the label in the cover and inserted into the pocket on the rear of the transparent front panel. The measuring range plates are self-adhesive.

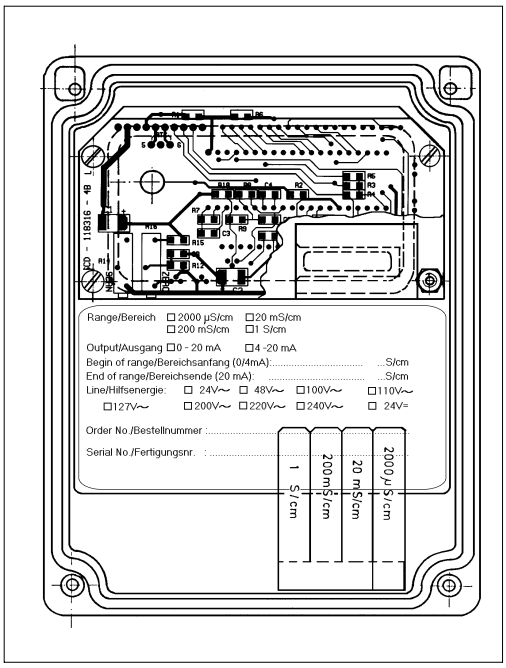


Fig. 6.1 Inside view of cover with measuring range plates

Measuring range	Switch S 101		Switch S 102			Switch S 401	
	1	2	1	2	3	1	2
0 ... 2000 µS/cm	–	–	–	–	–	–	–
0 ... 20 mS/cm	–	–	–	on	–	on	–
0 - 200 mS/cm	–	–	–	–	on	on	on
0 - 1000 mS/cm	on	on	–	–	–	on	on

Table 6.1: Switching of measuring range

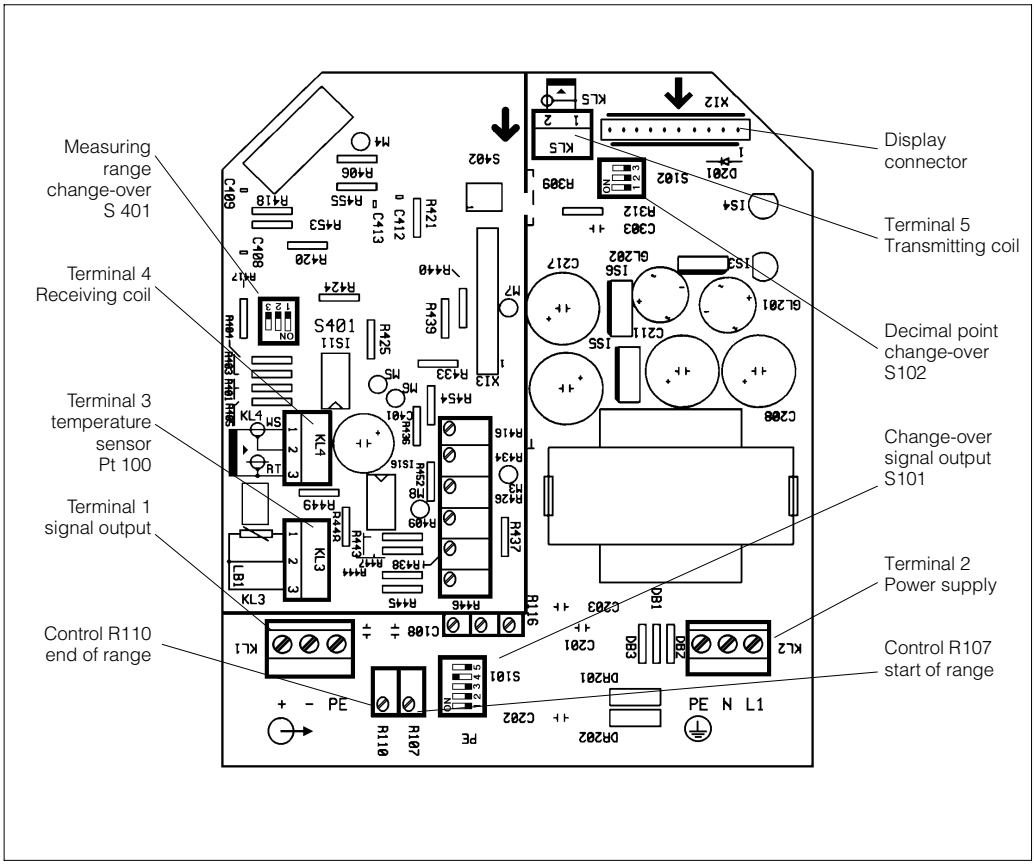


Fig. 6.2: Inside view Smartec CLD 130 - componentry with terminals and plugs for measuring range change-over

6.2 ATC adjustment (automatical temperature compensation)

- If the temperature coefficient is known it is set on the scaled ATC control on the front panel using a screwdriver.
  Typical temperature coefficients are:

Water	> 1 µS/cm:	2.1 % / °C
Lye (NaOH)	approx. 2 %:	1.9 % / °C
Acid (HNO_3)	up to 2 %:	1.6 % / °C
Salty solutions:		2.2 % / °C
Milk, beverages:		2.0 % / °C

- If the temperature coefficient is unknown determine the coefficient as follows:

Determination of actual temperature coefficient:
The reference temperature of automatic temperature compensation is 25 °C. At this temperature the setting of the ATC control has no influence, this means the ATC is virtually switched off.
- Carry out a measurement in the test medium at 25 °C
- Note the display value
- Heat the test medium to operating temperature
- Wait until the value of the measurement has stabilized (adjustment time of temperature sensor)
- Set the display to the value noted previously (at 25 °C) using the ATC control.

The actual temperature coefficient for the medium used is now indicated on the ATC scale.

Note:

The temperature sensor in the sensor requires approx. 10 minutes to adjust to the changed temperature. Therefore wait until display has stabilized when the temperature of the test medium has changed.

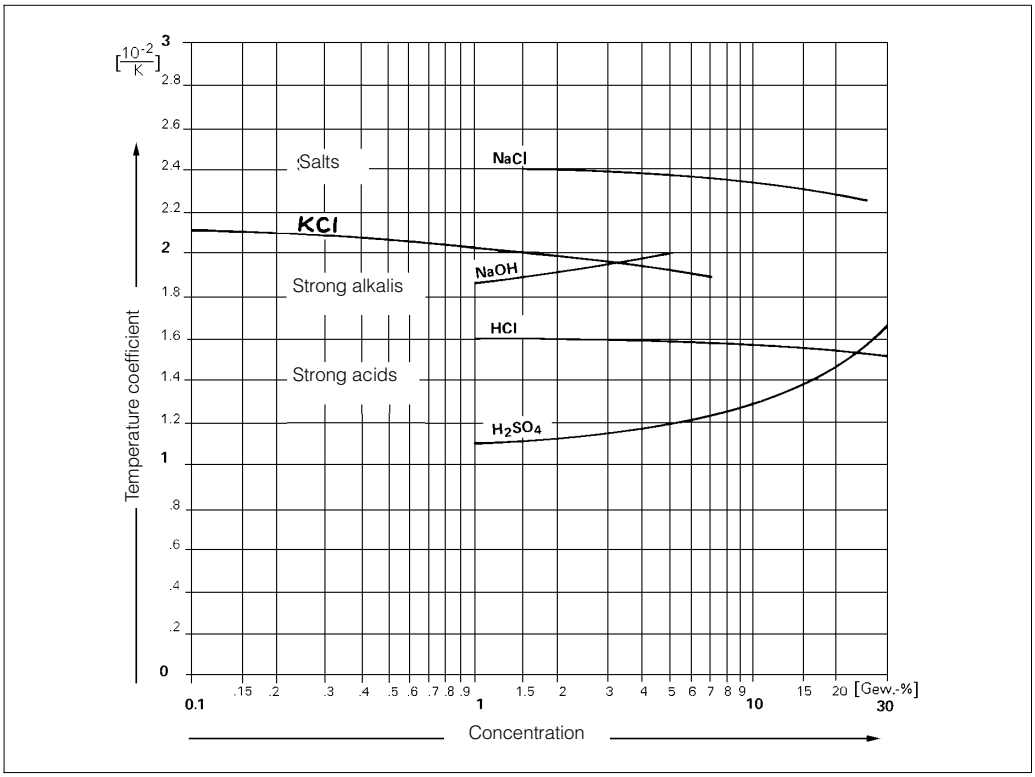


Fig. 6.3: Concentration dependency of the temperature coefficient for several electrolyte solutions

6.3 Signal output change-over

The signal output can be switched to 0 ... 20 mA or 4 ... 20 mA using switch S 101 (see fig. 6.2).

Output range	Switch S 101		
	3	4	5
0 ... 20 mA	–	on	–
4 ... 20 mA	on	–	on

Table 6.2: Switching of output range

6.4 Signal output assignment

(MR versions 0/1/2/3)

The signal output can be spread continuously. Also the beginning of the signal output can be continuously set within 0 ... 80 % of the measuring range.
This enables to extract virtually any window from the measuring range and output it as a current signal.

Procedure:
- Connect an ammeter 0 ... 20 mA to the signal output.
- Simulate the conductance at which the signal output should be 0 or 4 mA (conductance simulation see chapter 7.3).
- Set 0 or 4 mA with control R 107 (see fig. 6.2).
- Simulate the conductance at which the signal output should be 20 mA.
- Set 20 mA with control R 110 (see fig. 6.2).

Example:
A signal output of 0 ... 20 mA corresponding to 100 ... 150 mS / cm is to be set in the range 0 ... 200 mS / cm.
This is possible following the above instructions. The spread is factor 4 which equals 25 % of the measuring range, the zero point suppression corresponding to 50 % of the measuring range.
Then align the equipment at 0 mA for 50 Ohm and 20 mA for 33.3 Ohm (see chapter 7.3.)

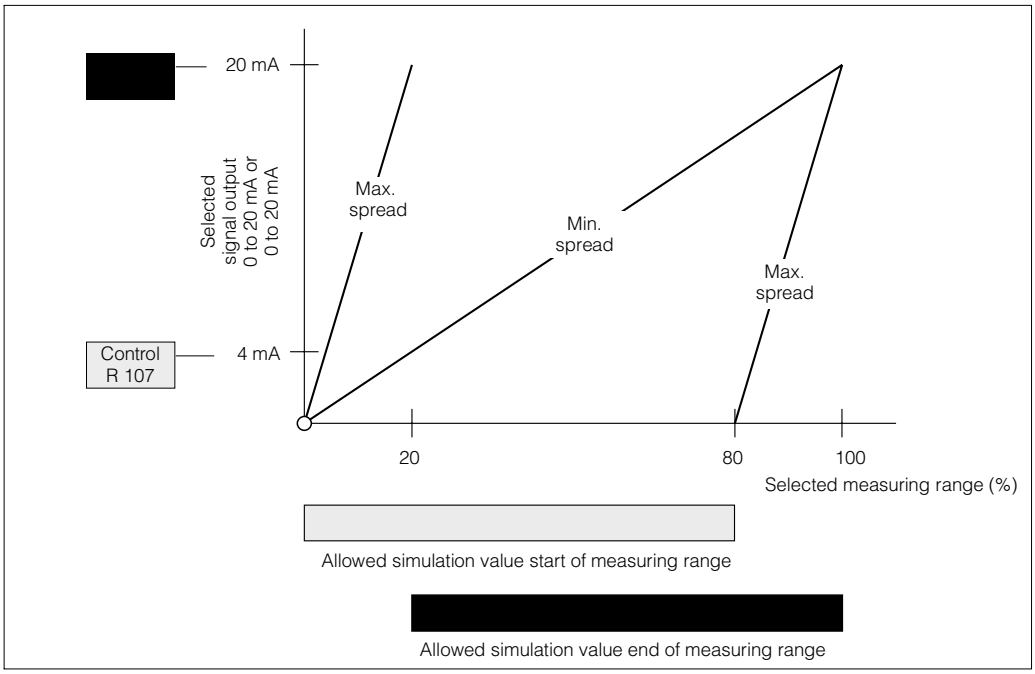


Fig. 6.4: Assignment of measuring range - current output

6.5 Remote switching of current output

(MR versions 4/5/6)

With the option remote switching of current output the following measuring ranges are usable:

- 1000 mS / cm
- 200 mS / cm
- 20 mS / cm

Remote switching spreads current output and measuring range by factor 10, e.g. the original indication range from

- 0 or 4 ... 20 mA
  corresponding to 0 ... 200 mS / cm

changes to

- 0 or 4 ... 20 mA
  corresponding to 0 ... 20 mS / cm.

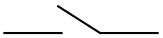
Control connection remote switching	Assigned current output 0 / 4 - 20 mA)
	Selected measuring range
	Selected measuringrange 10

Table 6.3: Measuring range assignment for remote switching

Note:
Zero-point adjustment of measured value output is not possible by remote switching!

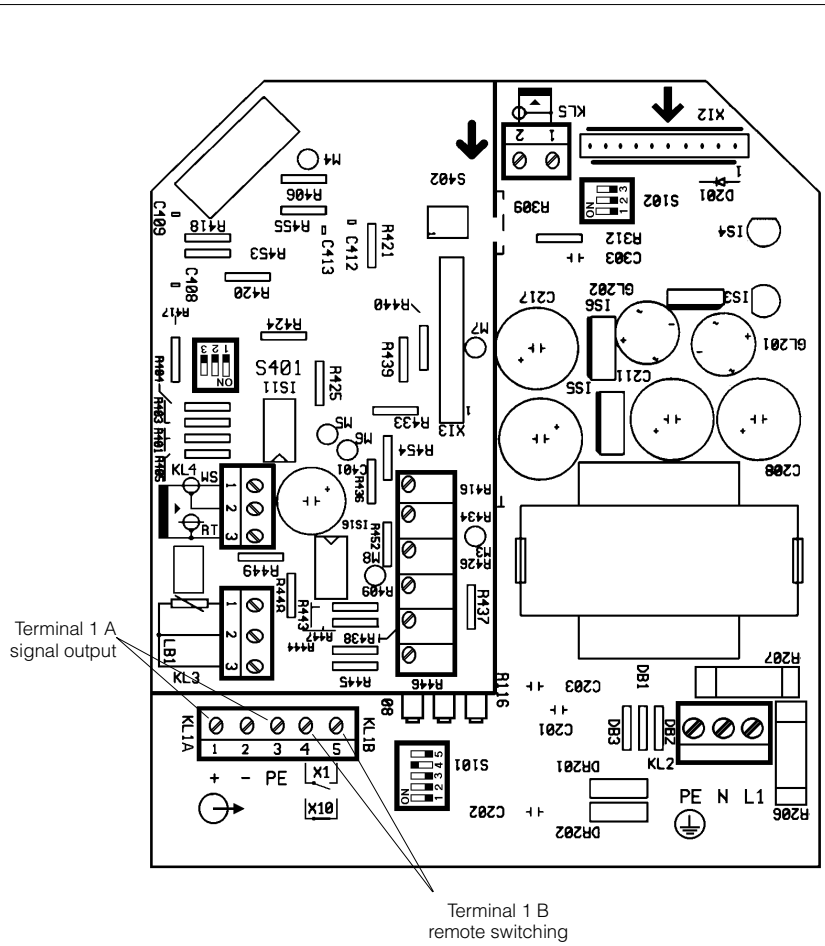


Fig. 6.5: Inside view of Smartec CLD 130 - remote switching connection

7. Maintenance and troubleshooting

7.1 Maintenance

Measuring transmitter and sensor are maintenance-free. No parts wear out.

7.2 Troubleshooting

Error	Possible cause	Remedy
No display	No power supply	Check mains supply
No signal output (display present)	Output line interrupted	Check line, terminals and connected analyzer
Display unsteady, flickers, susceptible to faults	Grounded conductor not connected and / or shield of output line not connected	Check grounded conductor connection (should be short and have a large cross-section) use a shielded cable and connect shield to grounded conductor
Display 1---	Measuring range exceeded	Select the next higher range (see chapter 6.1)
Display 000	Sensor does not immerse into the medium	Check flow of pipe system or level at tank installation as well as installation position (air bubbles)

Table 7.1: Troubleshooting, cause and remedy

7.3 Instrument function test

Simulation values for simulating the conductance of the medium

Conductance	Simulation value
100 µS/cm	50 kOhm
200 µS/cm	25 kOhm
500 µS/cm	10 kOhm
1000 µS/cm	5 kOhm
2000 µS/cm	2.5 kOhm
5 mS/cm	1 kOhm
10 mS/cm	500 Ohm
20 mS/cm	250 Ohm
50 mS/cm	100 Ohm
100 mS/cm	50 Ohm
200 mS/cm	25 Ohm
500 mS/cm	10 Ohm
1000 mS/cm	5 Ohm

Attention:

The displayed value will only correspond with the siumulation value if

- the temperature is 25 °C or
- a simulation resistance of 109.72 ohm is connected to terminal 3 instead of the Pt 100 sensor.
- Precision resistances must be used for simulation, allowed tolerance 0.1 %.
- The transition resistances for wire coil and soldering joint must be considered for the allowed tolerance value.

For simulation purposes a wire is looped through the sensor (looped through the central hole and out through one of the holes at the side).
The simulation resistance is connected to this wire loop, either as an individual resistance or using a resistance decade.
A large wire cross-section and low transition resistances must be ensured when high conductance values, i.e. low resistance are involved (short connections, solder carefully!).
For intermediate values, the simulation resistance is calculated according to the following fomula:

$$R = \frac{1}{\text{Conductance}} \cdot k$$

Conductance in S/cm yields R in ohm
Conductance in mS/cm yields R in kohm
Conductance in µS/cm yields R in Mohm
k (cell constant) = 5

8. Technical data

Measuring transmitter

Measuring ranges (switchable)	0 ... 2000 µS/cm; 0 ... 20/200/1000 mS/cm
ATC range (standard)	1.0 ... 3 %/K (–5 ... +105 °C)
(option)	0.5 ... 3 %/K (–5 ... + 105 °C); 2.1 ... 6 %/K (0 ... +40 °C)
ATC reference temperature	25 °C
Measured value deviation	
Display	1 % of meas. range final value
Signal output	1 % of meas. range final value
Smallest measured value	100 µS/cm
Power supply AC	110/127/220 V, 50 ... 60 Hz; 100/200/240 V, 50 ... 60 Hz
	12/24/48 V, 50 ... 60 Hz; –10 % ... +15 %
Power supply DC	with seperate DC-AC converter
Power consumption	approx. 4.5 VA
Signal output	0 / 4 ... 20 mA, switchable
Load	max. 500 Ohm
Measured value output spread	20 % ... 100 % of MR
Measured value zero shift	0 % ... 80 % of MR
Display	13.5 mm LC display, 3 $^1/_2$ digits;
Permissible operating temperature (with integrated transmitter)	–10 ... +50 °C
Permissible operating temperature (with separate transmitter)	–10 ... +60 °C
Permissible storage temperature	–25 ... +80 °C
Permissible humidity	5 % ... 95 % rel.
Ingress protection (DIN 40050)	IP 67
Dimensions	160 x 120 x 70 mm (HxWxD)
Housing material	coated aluminium,
Terminal wire cross section	terminals 2.5 mm^2; sensor 1.5 mm^2
Housing ducts	2 x Pg 9 glands; (replaceable by Pg 16)
Sensor connection Pg 16 (only for separate sensor)	

Sensor with integrated transmitter

Sensor material	PEEK (Polyether-ether-ketone)
Operating temperature	– 5 ... +110 °C (permanent temp.)
Temperature sensor	Pt 100, built-in
Pressure	max. 16 bar (20 °C)
Shaft immersion length	85 mm
Pipe cross section	min. DN 65
Weight	0.5 kg
Mounting versions	dairy pipe fitting DN 50, DIN 11851
	internal thread G 1 $^1/_2$"; 2" IDF flange
	2" clamp fitting
	round flange DN 40 / PN 10
	immersion sensor IP 68

Sensor with separate transmitter

Mounting versions	as above, add. immersion sensor IP 68
Cable length and type	5 m long, pre-assembled
Cable connection	permanently connected to sensor;
	with terminals in meas. instrument

Immersion sensor (integrated and separate measuring transmitter)

Pipe material	PVC-C
Pipe length	400 ... 2000 mm
Installation (compact version)	round flange DN 50 / PN 10
Installation (separate version)	round flange DN 50 / PN 10; dairy pipe fitting DN 65
Temperature	max. 80 °C
Pressure	max. 6 bar (20 °C)

Immersion sensor

Ingress protection	IP 68
Material of protection cap	PVDF
Material protection hose	silicone
Length	2000 mm
Installation	flange DN 50 / PN 10 with strain relief
	oval flange or mounting bracket