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Conductivity-Meter LF 1010

Conductivity measurement with 2-and 4-electrode cells

Features

- LED-Display 14.2mm red
- Indicating range 2000(0) Digit
- Measuring ranges programmable from 0 ... 2.000µS/cm up to 0 ... 2000mS/cm
- Temperature compensation with RTD, Pt100 or Pt1000 Sensor
- Monitoring of ultra-pure water (pharmacoica) acc. to USP<645>
- Max. 2 alarm outputs, relay SPDT
- Fieldcase with snap lid, 2xM16x1.5 other cable glands see option 09 or on request
- Protection IP65

General

The Conductivity-Meter LF1010 has been designed for the measurement of conductivity, as a degree of the purity or concentration of a liquid. In connection with 4-electrode-conductivity-cells a high accuracy, and insensitivity of contaminations can be achieved. A further advantage is a broad range of application with only one cell. Only for measurements in ultra-pure water a special 2-electrode- conductivity-cell must be used.
We offer a broad line of conductivity cells. Please contact us for more information.

Short information

Programming	Parameters are programmed via front-side membrane keypad.
Digital filter	With activated digital filter last 16 measured values wil be averaged continuously and the result shown in the display
Alarm outputs	Switching performance of the alarm outputs is programmable as minimum or maximum function.
USP-alarm	Devices including option 14 are programmable for monitoring of ultra-pure water acc. to USP<645>. Setpoint settings of the alarm outputs are in accordance to the conductivity-temperature table (page 11). The switching performance is programmable for NC or NO contact.
USP calibration	Devices including option 14 have a special routine for USP calibration. Test-equipments in accordance to NIST are e.g. calibration solution EC23.8 and a precision thermometer type N63802.

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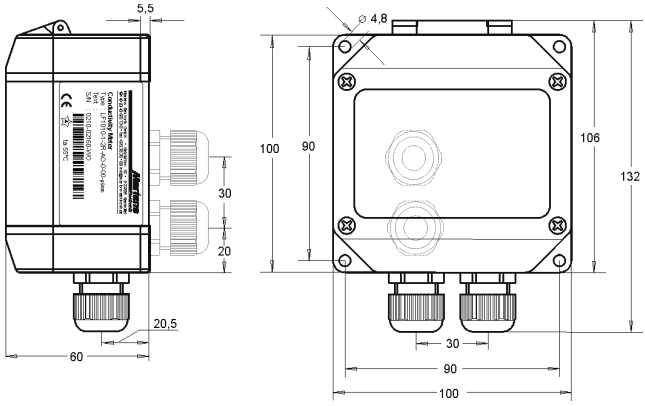
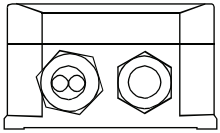
Technical data

Power supply		
Supply voltage	:	230V AC ±10%; 115V AC ±10%, 24V AC ±10% or 24 VDC ±15%
Power consumption	:	max. 3.5VA
Operating temperature	:	-10 ... +55°C
Rated voltage	:	250V~ acc. VDE 0110 between input / output / supply voltage Degree of pollution 2, over-voltage category III
Test voltage	:	4kV-, between input / output / supply voltage
CE - conformity	:	EN55022, EN60555, IEC1000-4-3/4/5/11/13
Input		
Conductivity input	:	0 ... 2.000(0) µS/cm to 0 ... 2000 / 200(0) mS/cm (at 25°C)
-Cell constant	:	0.080 ... 9.999
-Accuracy	:	0.5% of the measuring range, ±2 Digit
-Temperature compensation	:	non linear for pure and natural water or linear adjustable from 0.000 ... 9.999 %/K
-Temperature coefficient	:	0.02%/K
Temperature input	:	-50.0 ... 200.0°C; RTD Sensor Pt100 or Pt1000
-Accuracy	:	±0.2°C
-Linearize error:		±0.1%
Display :		14.2mm red
Display range	:	2000(0) digit with leading zero suppression
Parameter display	:	LED 2-digit red, 7mm (Parameter - and output indicator)
Output		
Relay	:	SPDT <250V AC<250VA<2A, <300V DC<50W<2A
Case	:	Fieldcase
Material	:	Case Polyamide with fibre-glass PA6-GF/GK 15/15 keypad polyester, UV-stable
Weight	:	max. 450g
Electrical connection	:	Clamp terminals, 2mm² single wire, 1mm² flexible wire, AWG14
Protection	:	IP65, terminals IP20, fingersafe acc. German BGV A2

Dimensions

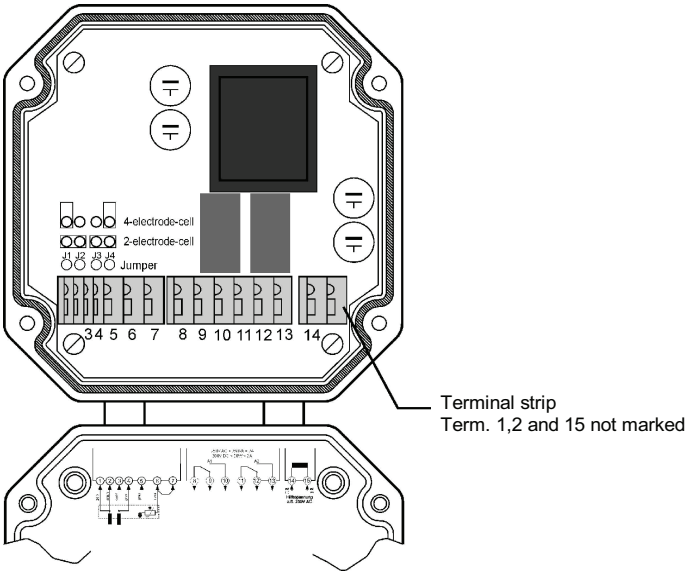


2 x M16x1.5 cable glands
in the base on request

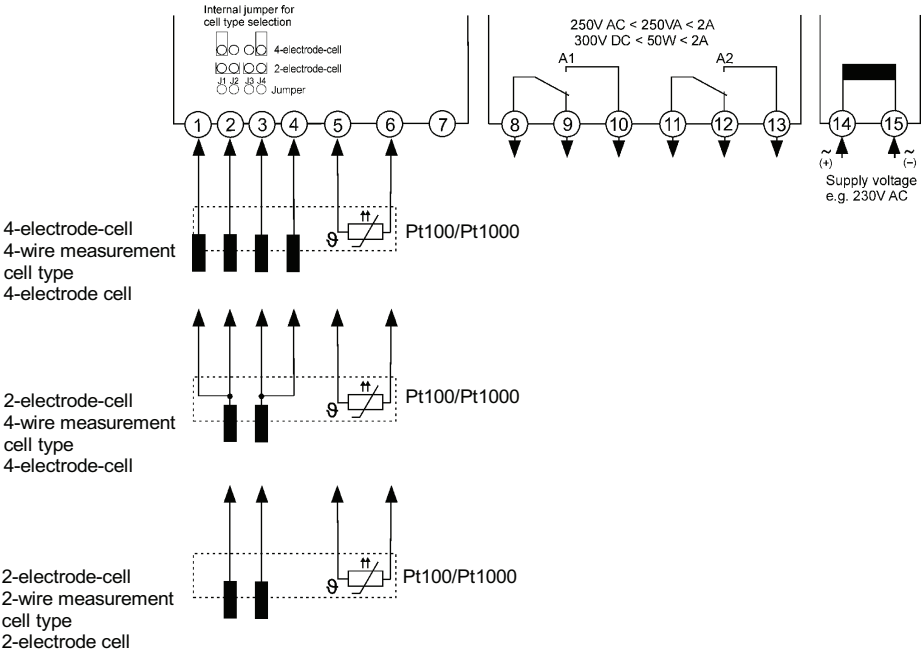


Option 09
1 x M20x1.5 Multi
(2xd=6mm)
1 x M20x1.5

Legend (open lid)



Connection diagram



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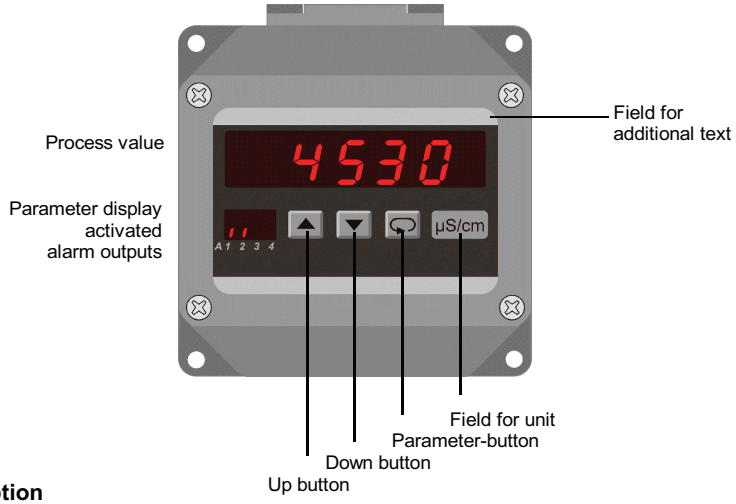
Controls- and indicators



Description

Operation of the device is arranged in 2 levels. The requested parameter can be called by the button . Selection within a parameter or entering data, use buttons and .

Button combinations:
+ one parameter back.
+ setting parameter to zero or minimum value.

After turn on the supply voltage, the device initialize itself and is operating in the **Working level**. Temperature and peak memory can be called back, set points of the alarm outputs can be programmed.
Activating the button for more than 2 seconds, the program is jumping into the **Configuration level**. Now all parameters, defining the function of the device can be programmed. These maybe the measuring input, switching performance of alarm outputs and the analog output signal.
After finishing the configuration or when longer than 2 minutes no button was pushed, the program jumps back to the working level. Leaving the configuration level is possible at any time when pushing the button for 2 seconds.

Option 14:
For monitoring of ultra-pure water acc. to USP<645>, the selected alarm output must be configured. The device offers a calibration routine for continuos calibration. With suitable applications all defaults acc to USP<645> are fulfilled (see information on page 10).

After finishing the configuration or when longer than 2 minutes no button was pushed, the program jumps back to the working level. Leaving the configuration level is possible at any time when pushing the button for 2 seconds.

Error codes:

Display flashes	If the input signal is more than 3% outside of the programmed measurement range the A/D- converter is over driven and the display flashes with appr. 1Hz
Error1	EEPROM test. Reading this message, a program error has been occurred. When pushing the button a copy of the EEPROM will be reloaded and the device will work with the factory settings. If this copy does not work, please ship the device to factory for repair service.
Loc	Program lockout. See configuration page 7.
rAnGE	The calibration could not be finished during the USP-calibration because the conductivity is to high.

Start-up note: Before the device can be used, it must be configurated for the intended use → see page 6

Notes to representation

Parameter is only displayed when configurated

Parameter is only displayed when feature is included (see order code)

Please note: All parameters can be called if they are not blocked by other programmed parameters and if they are available. Factory settings are shown in **[ ]**.

Working level

Button	Display	Description
	1823 ▮▮▮▮	Actual conductivity value Output indication (only if installed and activated).
	1500 PP	**Display peak reading** (option 01) Maximum value Reset with buttons ▲ or ▼ , or at every power off.
	15 nP	**Display peak reading** (option 01) Minimal value Reset with buttons ▲ or ▼ , or at every power off.
	25.3°C t	Actual temperature value
	noCAL. CA	**Calibration acc. to USP<645>** noCAL. or CAL. This Parameter only appears for devices with option 14. Parameter for USP<645> calibration, see page 9 Selection with buttons ▲ and ▼ . ⚠ After selection of CAL calibration USP<645>, the previous parameter values are deleted.
	125 A1.	**Setpoint output A1** Setting possible from St (start value) ... En (end value), or 50...100% (for USP-contact) with buttons ▲ and ▼ .

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Button	Display	Description
↓	745 / A2.	**Setpoint output A2** Setting possible from St (start value) ... En (end value), or 50...100% (for USP-contact) with buttons ▲ and ▼.
↻		
	1823 / ' ' ' '	Back to the process display.

Configuration level

Button	Display	Description	*[Factory settings]*
↻ press 2s			
↓	oFF / F'	**Digital filter** oFF, on averaging of the last 16 measured values. Selection with buttons ▲ and ▼.	*[oFF]*
↻			
↓	EP-6 / Un	**Unit** EP-6 → µS/cm EP-3 → mS/cm Selection with buttons ▲ and ▼.	*[EP-6]*
↻			
↓	no / F0	**Fixed zero** 0, e.g. 2000*0 no; YES Selection with buttons ▲ and ▼.	*[no]*
↻			
↓	0 / dP	**Decimal point position** if F0 = no 0. .0 .00 .000. if F0 = YES 0. .00 .000 .0000 Selection with buttons ▲ and ▼.	*[0.]*
↻			
↓	0 / St	**Start value** for indicating range Setting possible from 0 ... En (end value) with buttons ▲ and ▼. In case of modification a new configuration of the alarm outputs is necessary.	*[0]*
↻			
↓	1000 / En	**End value** for indicating range. Setting possible from St (start value) ... 2000 with buttons ▲ and ▼. In case of modification a new configuration of the alarm outputs is necessary.	*[1000]*
↻			

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Button	Display	Description	*[Factory settings]*
	0.500 C	**Cell constant C** of the used cell. Settings possible from 0.080 ... 9.999 with buttons ▲ and ▼.	*[0.500]*
	4-Pol. Ct	**Cell type / measurement system** 2-Pol. or 4-Pol. measurement Selection with buttons ▲ and ▼.	*[4-Pol.]*
	H2o tc	**Temperature compensation**. **H2o**, setting for all natural waters to consider the characteristic of pure water acc. to ASTM and non linear curve acc. to DIN EN27888. **Lin**, Setting for salted solutions, acid, thindowned or lye and suds. Selection with buttons ▲ and ▼.	*[H2o]*
	2.160 tc.	**Temperature coefficient** [%/K] Measuring value correction with diverging to 25°C. Setting possible from 0.000 ... 9.999 with buttons ▲ and ▼.	*[0.000]*
	0 Sc	**Sensor correction** Setting possible from -9.9 ... 9.9 °C with buttons ▲ and ▼.	*[0]*
	oFF A1	**Switching performance output A1** Function oFF; on L (min), on H (max), USP' (N.C.) or USP' (N.O.) If activated the start value will be loaded for setpoint, at USP = 100%. Selection with buttons ▲ and ▼.	*[oFF]*
	0 A1.	**Setpoint output A1** Setting possible from St (start value) ... En (end value) or 50 ... 100% in accordance to the USP-table, with buttons ▲ and ▼. Display characters at USP-contact: A1. 100 Pro	*[0]*

Sense correction Sc

cable length	Pt100	Pt100 0
2m	-0.7°	-0.1°
5m	-1.8°	-0.2°
10m	-3.6°	-0.4°
25m	-8.9°	-0.9°

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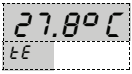
Button	Display	Description	*[Factory settings]*
↓	10 / HI	**Hysteresis output A1** (disabled at USP<645>) Setting possible from 1 ... 9999 (0) Digit with buttons ▲ and ▼ . (If USP is selected, the hysteresis is fixed to 0.10µS/cm)	*[10]*
↻		**Note**: Function, switching performance and hysteresis for alarm output AL1 and AL2 are identically.	
↓	00 / Co	**Code for factory settings**.	*[00]*
↻			
↓	oFF / Lc	**Programming lock** oFF = no lock Conf. = configuration level locked ALL = all parameters locked Selection with buttons ▲ and ▼ .	*[oFF]*
↻			
	1823	Back to the process value	

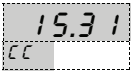
USP<645> Calibration (Option 14)

Following parameters are displayed if USP<645> calibration is selected. Operating with the following parameter makes it sure, that the whole measuring system is calibrated.

⚠ After selection of parameter for USP<645> calibration, the previous parameter values are deleted. During the calibration procedure the alarm outputs are fixed to their current values.



Temperature measurement
Immerse the ultra-pure water cell into the calibration solution (e.g. EC 23.8). Determine the temperature with a thermometer (e.g. N63802). The cell and the thermometer must be immersed at least 6cm. Wait until the measured temperature does not change. The determined temperature can be set with buttons ▲ and ▼ to .
This parameter will **not** be left automatically after 120s.



Conductivity calibration
The conductivity of the calibration solution will be determined in accordance to the measured temperature (see label on the bottle of the calibration solution).
The determined conductivity can be set with the buttons ▲ and ▼ to .
This parameter is **not** be left automatically after 120s.

End of USP <645> calibration
Back to the process value

Measurement of the conductivity of ultra-pure water acc. to USP<645>

Special requirements are demanded in the pharmaceutic industry to the used ultra-pure water. The U.S. Pharmacopeia defines the limit values for conductivity in the chapter <645> for monitoring devices. These directives are acknowledged in the EU, too.
This supervising is subdivided in 3 stages. Stage 2 and stage 3 are external tests and stage 1 is an inline test and specified for low cost and permanent monitoring of the ultra-pure water quality.

USP<645> stage 1
According to stage 1 only the conductivity and temperature has to be measured without temperature compensation. The limit value of the conductivity is defined in the temperature-conductivity table. For all the 5°°C steps of the temperature is one limit value valid.

Limit table for conductivity of ultra-pure water acc. to USP<645> stage 1

Temperature [°C]	Conductivity [µScm]
0.0 ... 4.9	0.6
5.0 ... 9.9	0.8
10.0 ... 14.9	0.9
15.0 ... 19.9	1.0
20.0 ... 24.9	1.1
25.0 ... 29.9	1.3
30.0 ... 34.9	1.4
35.0 ... 39.9	1.5
40.0 ... 44.9	1.7
45.0 ... 49.9	1.8
50.0 ... 54.9	1.9

Temperature [°C]	Conductivity [µS/cm]
55.0 ... 59.9	2.1
60.0 ... 64.9	2.2
65.0 ... 69.9	2.4
70.0 ... 74.9	2.5
75.0 ... 79.9	2.7
80.0 ... 84.9	2.7
85.0 ... 89.9	2.7
90.0 ... 94.9	2.7
95.0 ... 99.9	2.9
≥ 100	3.1

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Requirements to a conductivity measuring system acc. to USP<645>

A conductivity measuring system must fulfill following requirements:

Calibration

Conductive-measuring device	
Accuracy	±0.1µS/cm (@ 1,3µS/cm)
Resolution	±0.1µS/cm
Temperature measurement	±1°C
Temperature compensation	without
Dynamic range	10^2
Setpoint	1,3µS/cm @ 25°C ±0.1µS/cm
Hysteresis	0.1µS/cm
Conductive-cell	
Cell-constant	Accuracy ±2%
Temperature sensor	not intended
Surface roughness of the electrodes	< 0.8µm EHEDG-Recommendation (European Hygienic Engineering & Design Group, brussel)

All equipments and conductivity cells from Martens Elektronik for measuring of ultra-pure water fulfills these requirements. For the realization of an pre-alarm the setpoints for Alarm AL1 and AL2 are programmable in the range 50 ... 100% of the allowable limit value (acc. to table stage 1).

Parameter settings for USP<645>
For the right switching performance of the alarm contact, it is necessary to configure the wanted alarm output. Following parameter settings are necessary:

Parameter Un	Unit	: EP-6
Parameter F0	Fixed zero	: no
Parameter dP	Decimal point position	: 0.00
Parameter St	Start value	: 0.000
Parameter En	End value	: 20.0
Parameter C	Cell constant	: label at cell
Parameter Ct	Cell type / measurement system	: 2-Pol
Parameter tc	Selection temp compensation	: Lin
Parameter tc.	Temperature coefficient	: 0.000

Calibration of conductive measuring systems acc to USP<645>
Conductivity systems for ultra-pure water monitoring must be calibrated in regular time intervals. In accordance to USP<645> a calibration has to be traceable according. to NIST (National Institute of Standards and Technology U.S.) -measuring device- or according. ASTM (American Society for Testing and Materials) -conductivity cell- .
All delivered measuring equipments for ultra-pure water measurement of Martens Elektronik are factory calibrated with precision resistence (treaceable to NIST). The cell constant was found out with calibration solution (traceable to ASTM) and printed on the label. This way of calibration is in accordance with the recommendation of USP<645>.

Field calibration
For the calibration in the field the method how it is carried out before the delivery is not practicable. The calibration of the complete system is simpler and safer. Martens Elektronik recommends the calibrating solution EC23.8 and the precision thermometer N63802 for the calibration.
If other calibrating solutions should be used, it is to consider that at pure-water measuring cells can come to a polarization effect at the electrodes if the calibrating solution has a conductivity of more than 50µµS/cm. This leads to an additional measuring error and the demanded precision can not be adhered to by 2% for certain. So such solutions should not to be used.
Devices including option 14 have a special routine for USP calibration for the whole measuring-system. During the calibration procedure the analog outputs for conductivity, temperature and the alarm outputs are fixed to their current values. To be able to extend the measuring cell for the calibration, a lockable bypass must be installed.

Importantly information of the calibration solution EC23.8.

The calibration solution has a conductivity of 23.8µS/cm at 25°C and is traceable to the standard of the ASTM D-1125 Method A. Each bottle has a label with the temperature-conductivity table and the expiry date. Ideal storage conditions for a storage time of 12 month are a dark room and ambient temperature. For the calibration it is possible to use clean and big vessels. The minimum immersing depth must be at least 60mm. Used solutions have to be wasted after the calibration (danger of soiling).

Temperature-conductivity-table calibration solution EC23.8

Temperature [°C]	Conductivity [µS/cm]
15	19.17
16	19.64
17	20.10
18	20.56
19	21.03
20	21.49

Temperature [°C]	Conductivity [µS/cm]
21	21.94
22	22.41
23	22.87
24	23.34
25	23.80
30	26.12

Temperature compensation

For accurate conductivity measurement a well matched temperature compensation is needed. The LF1010 offers two modes of temperature compensation:

Water Use this setting for "natural water" like ground water, spring water, above ground water and ultra-pure water. The temperature compensation will be calculated by considering the measured temperature and conductivity. The method of calculation is based on the "non-linear characteristic of natural water" according EN27888 and the electrical conductivity of ultra-pure water according ASTM D11245-95 (ASTM=American Society of Testing and Materials). In the temperature range from 0°C to 100°C good results are effected.

Linear Use this setting for saline solution, dilute acid, caustic solution and cleansing solution. This solution will be compensated by using a "linear characteristic". By factory setting the temperature coefficient is set to compensate a NaCl solution. Other solutions needs a special TC. Use the data sheet of the suppliers to define the TC. If there is no information about the TC available, use following procedure:

① Dip the conductivity cell into the solution
② Stir the solution constantly and heat it to a temperature of 25°C (watch temperature on the display)
③ Notice the measured conductivity at 25°C
④ Heat the solution to the working temperature (minimum difference 10°C)
⑤ Use button to select "tc" parameter.
⑥ Use the buttons and to change the parameter until the displayed conductivity is the same as shown at 25-°C

If there is no way to use this procedure, following values can be used approximately:

NaCl-solution	(20% weight of electrolyte)2,160%/°C (factory setting)
NaOH-solution	(20% weight of electrolyte)2,990%/°C
KOH-solution	(20% weight of electrolyte)1,980%/°C
H_3PO_4-solution	(20% weight of electrolyte)1,140%/°C
H_2SO_4-solution	(20% weight of electrolyte)1,450%/°C
NH_4NO_3-solution	(20% weight of electrolyte)1,790%/°C

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Order code

LF1010 - 1. ☐ - 2. ☐ - 3. ☐ - 4. ☐ - 5. ☐ - 6. ☐

1. Input
- 1 Input 2- or 4- electrode cell
  temperature compensation with Pt100 sensor
- 3 as 1, but temperature compensation with Pt1000 sensor

2. Alarm output
- 00 not installed
- 2R 2 alarm outputs relay

3. Supply voltage
- 0 230V 50/60Hz ±10%
- 1 115V 50/60Hz ±10%
- 4 24V 50/60Hz ±10%
- 5 24V DC ±15%

4. Option
- 00 without option
- 01 min- and max-peak hold
- 09 1x M20x1.5 Multi (2x6mm⌀); 1x M20x1.5
- 14 measuring and monitoring of ultra-pure water acc. to USP<645>

5. Unit (appears on the unit field)

6. Additional text (appears on the face plate in the field for additional text max 3mm x 70mm)