Instruction Manual

DULCOMETER® 2401 CondI

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Software Version: 2.x

Safety Precautions

Be sure to read and observe the following requirements!

Before connecting the device to mains, make sure that the mains voltage lies within the range 20 – 253 Vac/dc.

Opening the device exposes live parts, it should not be opened in use. Care must be exercised when connecting signal and power supply cables. If a repair should be required, return the device to our factory.

If opening the device is inevitable, it shall first be disconnected from all voltage sources.
Make sure that the mains supply has been disconnected.

Repair or adjustment of an opened device under voltage shall be carried out only by a skilled person who is aware of the hazards involved.

Remember that the voltage across accessible parts of the open device may be dangerous to life.

Whenever it is likely that the protection has been impaired, the device shall be made inoperative and secured against unintended operation.
The protection is likely to be impaired if, for example:

- ❏ the device shows visible damage
- ❏ the device fails to perform the intended measurements
- ❏ after prolonged storage at temperatures above 70 °C
- ❏ after severe transport stresses

Before recommissioning the device, a professional routine test in accordance with EN 61010-1 must be performed. This test should be carried out at our factory.

The device shall not be used in a manner not specified by this manual.

Information on this Instruction Manual

ITALICS are used for texts which appear in the display.

Bold print is used to represent keys, e.g. **cal**.

Keys for which the functions are explained are frequently shown in the left-hand column.

Note

Notes provide important information that should be strictly followed when using the device.

Warning

Warning means that the instructions given must always be followed for your own safety. Failure to follow these instructions may result in injuries.

Mode Codes

With **conf**/**cal** and input of a mode code you can activate one of the following modes:

conf, 0000: Error info
conf, 1200: Configuration mode
conf, 5555: Current source

cal, 0000: Cal info
cal, 1001: Zero point calibration
cal, 1015: Temp probe adjustment
cal, 1100: Cell factor calibration
cal, 1125: Input/adjustment of transfer ratio
cal, 2222: Test mode

Contents

1 Assembly

Package Contents and Unpacking

Unpack the device carefully and check the shipment for transport damage and completeness.
The package contains:

– Front unit of DULCOMETER® 2401 CondI

– Lower case

– Short instruction sheet

– This instruction manual

– Bag containing:

①	2 sealing plugs	⑦	1 hinge pin
②	5 hexagon nuts	⑧	3 cable ties
③	3 cable glands	⑨	3 filler plugs
④	1 rubber reducer	⑩	3 gaskets
⑤	1 sealing insert	⑪	1 washer
⑥	4 enclosure screws	⑫	1 jumper

Assembly

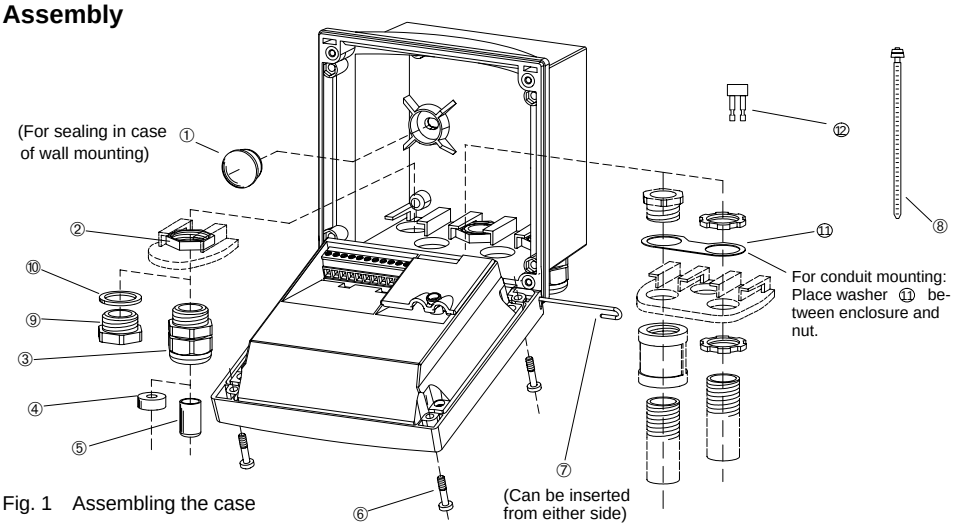


Fig. 1 Assembling the case

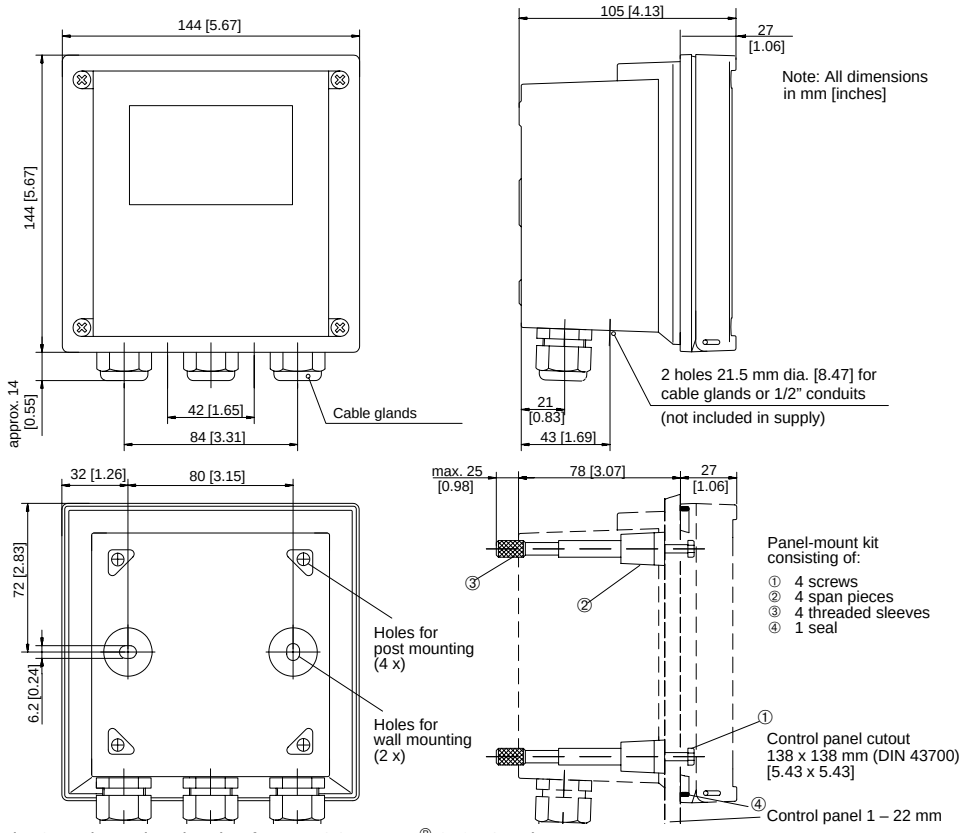


Fig. 2 Dimension drawing for DULCOMETER® 2401 CondI, mounting diagram and panel-mount kit (Order No. 1008708)

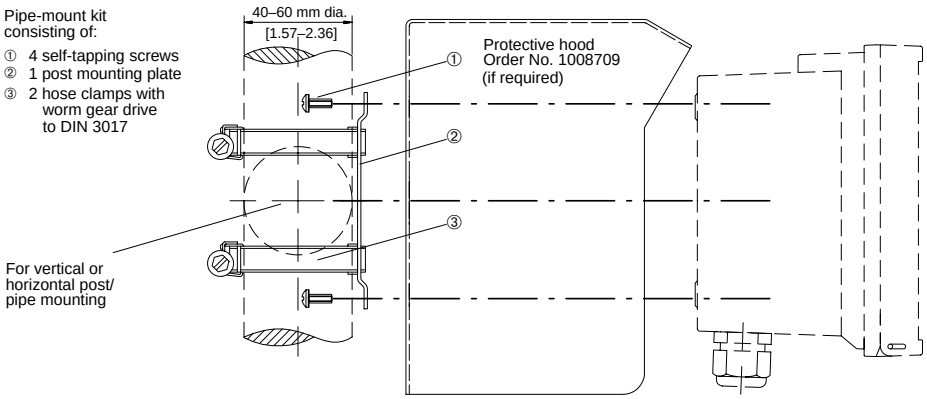


Fig. 3 Pipe-mount kit (Order No. 1008707)

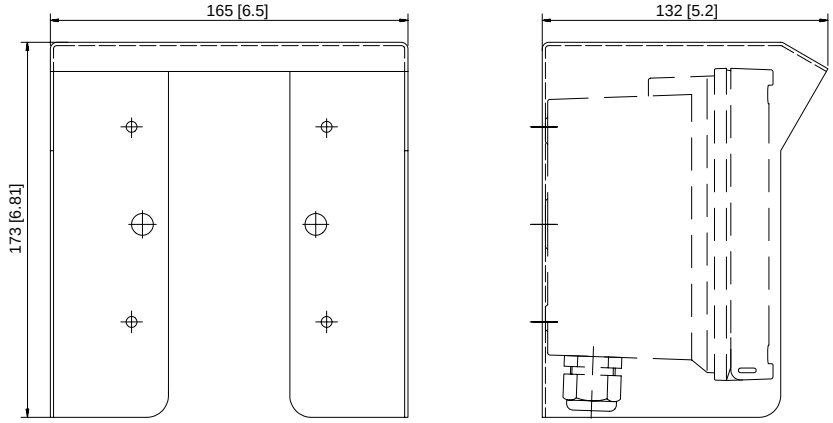
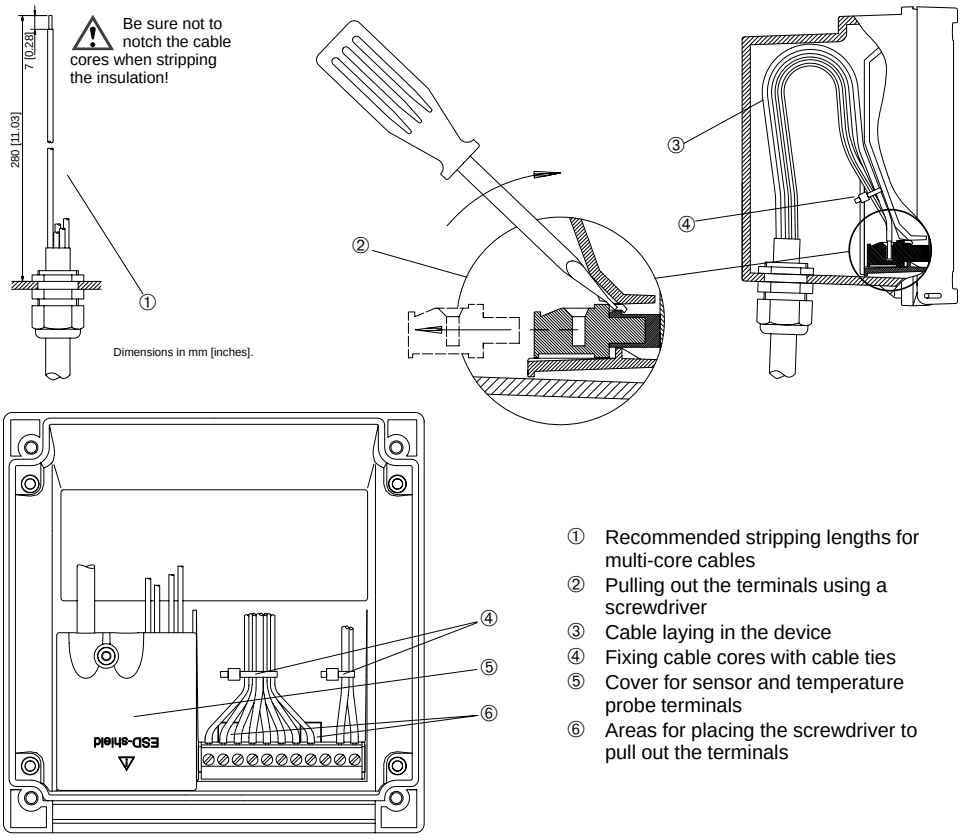


Fig. 4 Protective hood (Order No. 1008709) for wall and pipe mounting



① Recommended stripping lengths for multi-core cables
② Pulling out the terminals using a screwdriver
③ Cable laying in the device
④ Fixing cable cores with cable ties
⑤ Cover for sensor and temperature probe terminals
⑥ Areas for placing the screwdriver to pull out the terminals

Fig. 5 Installation information DULCOMETER® 2401 CondI

2 Installation, Connection and Commissioning

Proper Use

DULCOMETER® 2401 CondI is used for conductivity, concentration and temperature measurement in biotechnology, food processing, pharmaceutical and chemical industry, water and waste-water treatment. It can either be mounted on site or in a control panel.

Overview of DULCOMETER® 2401 CondI

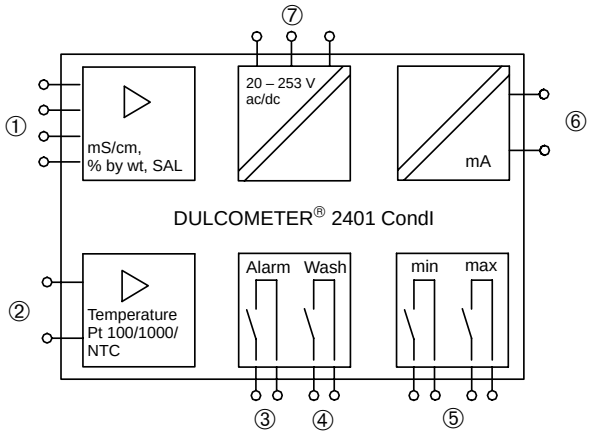


Fig. 6 System functions of DULCOMETER® 2401 CondI

① Input for LF 654 X electrodeless conductivity sensor
② Input for temperature probe
③ Alarm contact (closed circuit)
④ Wash contact
⑤ Limit contacts
⑥ Current output 0(4) – 20 mA
⑦ ac/dc varying-voltage supply unit (24 – 230 V ac/dc –15 % / +10 %, ac: 45 to 65 Hz)

Terminal Assignment

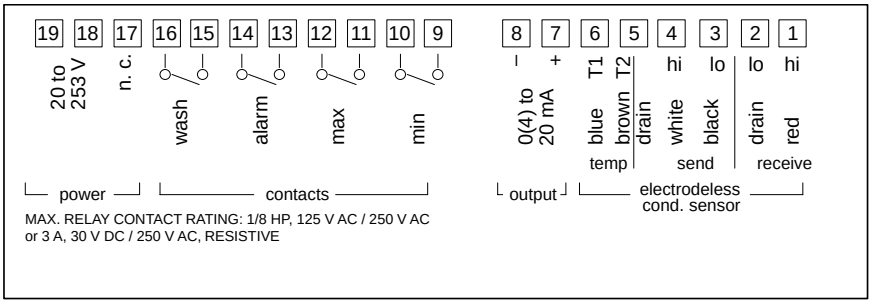


Fig. 7 Terminal assignment of DULCOMETER® 2401 CondI

Installation and Commissioning

Warning

Installation and commissioning of the DULCOMETER® 2401 CondI may only be carried out by trained experts in accordance with this instruction manual and per applicable local and national codes. Be sure to observe the technical specifications and input ratings.

Warning

The terminals must be fixed with cable ties as shown on page 9.

Warning

Before connecting the unit to the power supply, make sure that its voltage lies within the range 20 – 253 Vac/dc.

Warning

When commissioning, a *complete configuration* must be carried out.

For easier installation, the terminal strips are of a plug-in design. The terminals are suitable for single wires and flexible leads up to 2.5 mm^2 (see Pg. 9). A connection example is shown on Pg. 13.

Protective Wiring of Switching Contacts

Relay contacts are subjected to electrical erosion. Especially with inductive and capacitive loads, the service life of the contacts will be reduced.
For suppression of sparks and arcing, components such as RC combinations, nonlinear resistors, series resistors and diodes are used.

Typical protective wirings

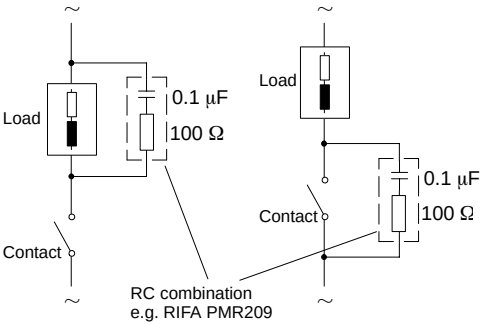


Fig. 8 AC applications with inductive load

Typical RC combination at 230 Vac:

Capacitor	0.1 µF / 630 V
Resistor	100 Ω / 1 W

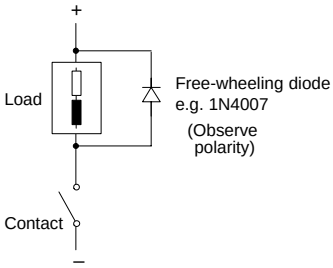


Fig. 9 DC application with inductive load

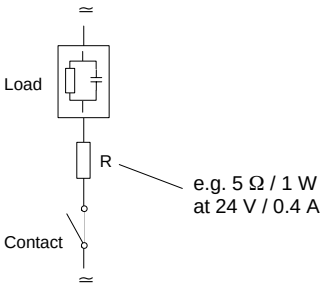


Fig. 10 AC / DC application with capacitive load

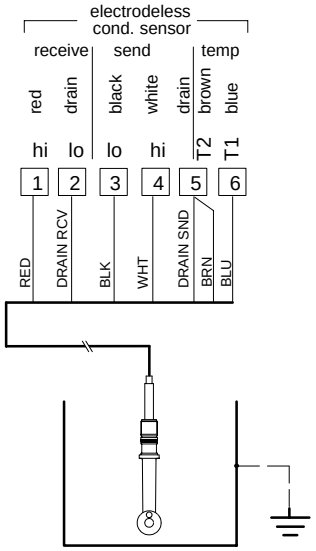
Connection of incandescent lamps

max. 120 W / 230 V
max. 60 W / 115 V

Typical Wiring

Conductivity measurement with LF 654 X electrodeless conductivity sensor

The LF 654 X electrodeless conductivity sensor is used to measure low to highest conductivity values.



Settings for LF 654 X electrodeless sensor

	Menu	Setting
Temp probe	conf 1200	NTC 100
Cell factor	cal 1100	2.15

Fig. 11 Conductivity measurement with LF 654 X electrodeless conductivity sensor

3 Operation

User Interface

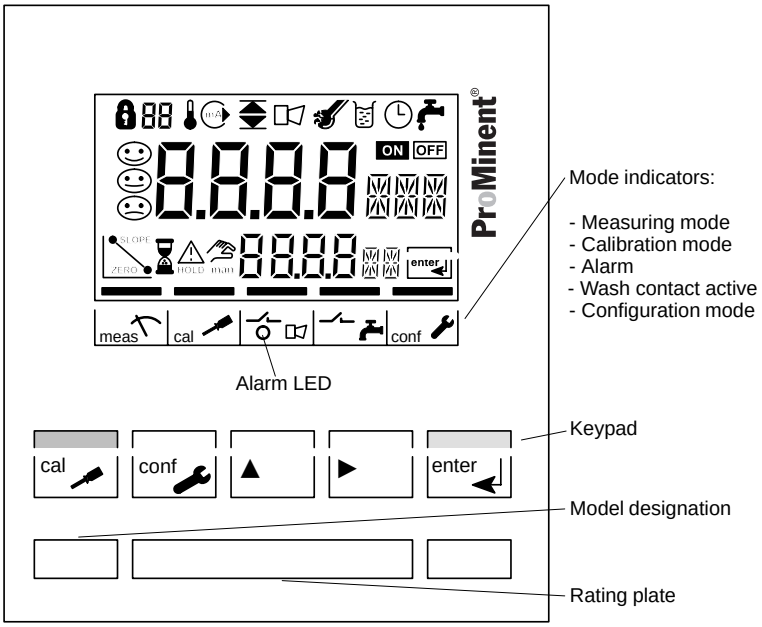


Fig. 12 Front view of DULCOMETER® 2401 CondI

Display

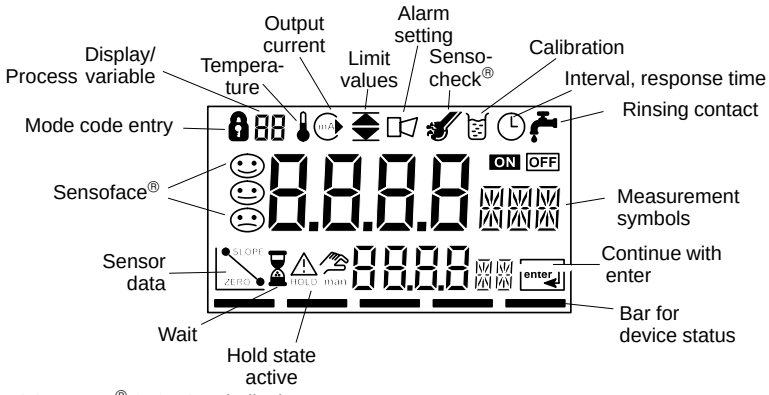


Fig. 13 DULCOMETER® 2401 CondI display

Keypad

cal — Start, end calibration

conf — Start, end configuration

▶ — Select digit position (selected position flashes)

▲ — Change digit

enter — Prompt in display: continue in program sequence, Configuration: Confirm entries, next configuration step, Measuring mode: Display output current

cal → enter — Cal info, display cell factor and zero point

conf → enter — Error info, display last output error message

▲ + ▶ — Start GainCheck® manual device self-test

Safety Functions

Sensoface® sensor monitoring

Sensoface® provides information on the sensor condition. A sad “Smiley” indicates that there is a Sensocheck® message. **Sensocheck**® signals a short circuit of the primary coil and its lines as well as an interruption at the secondary coil and its lines. Sensocheck® can be switched off. With Sensocheck® switched off, no friendly Smiley appears.

Manual device self-test GainCheck®

▲ + ▶ Simultaneously pressing ▲ and ▶ starts the manual device self-test.

A display test is carried out, the software version is displayed and the memory and measured value transfer are checked.

Automatic device self-test

The automatic device self-test checks the memory and the measured-value transfer. It runs automatically in the background at fixed intervals.

Outputs

Current output

The current output is controlled by the process variable selected in the configuration.
The current characteristic for conductivity can be configured as linear or logarithmic curve.
The current range can be set to either 0 – 20 mA or 4 – 20 mA. The current beginning and end can be set to any desired value.
If LIN (linear characteristic) is chosen, the minimum span is 5% of the selected process variable / measurement range. If LOG (logarithmic characteristic) is chosen, the minimum span is one decade within the chosen range.
To check connected peripherals (e.g. limit switches, controllers), the output current can be manually specified (see Pg. 27).

Limit contacts

The limit contacts report values below the lower limit and above the upper limit or are used, for example, to actuate valves or pumps (also see Pg. 12). One min and one max contact each can be configured as desired within the measurement range. If a value outside the limits is detected, ▲ or ▼ appears in the display.

Alarm contact

The alarm contact is closed during normal operation (closed circuit). It opens in the case of alarm or power outage. As a result, a failure message is provided even in the case of line breakage (also see Pg. 12).

Error messages can also be signaled with a 22 mA signal via the output current (see Configuration, Pg. 19).

Wash contact

With the wash contact the conductivity cell can be automatically cleaned with a suitable probe. The washing interval and duration can be configured as desired.

Configuration

Here the basic settings of the device are carried out. Symbols show which parameter is being configured.

Activate with **conf**
change parameter with ▲ and ▶,
confirm/continue with **enter**,
end configuration with **conf**

Mode code *"1200"*

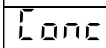
During configuration the device is in the Hold state, the output current is frozen, and the limit and alarm contacts are inactive.

When the configuration mode is exited, the device remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **enter**. After 20 sec. (measured value stabilization) the device returns to measuring mode.

Note 

The configuration parameters are checked during the input. In the case of an incorrect input "ERR" is displayed for 3 sec. The parameters cannot be stored with **enter** until the input has been repeated.

Configuration parameters

Pictograph	Parameter	Choices	Factory setting
	Process variable / meas. range Selected process variable and measuring range control current output and measured values. Complete configuration required after change.	oo.oo mS / ooo.o mS / oooo mS ooo.o % ooo.o SAL	**ooo.o mS**
	Concentration (only for %)	-01- NaCl (0 – 28 % by wt) -02- HCl (0 – 17 % by wt) -03- NaOH (0 – 22 % by wt) -04- H_2SO_4 (0 – 35 % by wt) -05- HNO_3 (0 – 28 % by wt) -06- H_2SO_4 (95 – 99 % by wt)	**-01-**
	Temperature display	°C °F	°**C**

	Temperature probe	Pt 100 / Pt 1000 / NTC 30 kΩ / NTC 100 kΩ	**NTC 100**
tc	Temperature compensation (not with % and SAL)	OFF LIN NLF (natural waters)	**OFF**
tc	Temperature coefficient (only with tc LIN)	xx.xx %/K	**02.00 %/K**
mA	Output current range	0 – 20 mA / 4 – 20 mA	**4 – 20 mA**
mA OUt	Output current characteristic (not with % and SAL)	LIN LOG	**LIN**
mA 4mA	Current beginning (0 / 4 mA) (only with LIN)	mS / % / SAL	**000.0 mS**
mA 20mA	Current end (20 mA) (only with LIN)	mS / % / SAL	**100.0 mS**
mA 4mA	Current beginning (0 / 4 mA) (only with LOG)	mS *	**0.1 mS**
mA 20mA	Current end (20 mA) (only with LOG)	mS *	**100 mS**
mA HoLd	Hold state	Last: Last output current value Fix: Output current specified	**Last**
mA F	Hold value (only with Fix)	xx.xx mA	**21.00 mA**
22mA	22 mA signal for error message	ON / OFF	**OFF**
	Limit values min	mS / % / SAL	**000.0 mS**
	Limit values max	mS / % / SAL	**100.0 mS**
CHEC	Sensocheck®	ON / OFF	**OFF**
	Washing interval	xxx.x hours	**000.0 (OFF)**
	Washing time	xxxx seconds	**0000 (OFF)**

* 0.1 / 1 / 10 /100 / 1000 mS

Configuration is cyclical. To stop, press **conf**.

Calibration

In the calibration mode the cell factor can be modified in two ways. If the cell factor of the sensor in use is known under consideration of the installation conditions, it can be entered directly. Furthermore, the cell factor can be determined with a known calibration solution under consideration of the temperature.

Warning

When using other Foxboro sensors, the transfer ratio of the sensor must be entered before starting calibration (see Pg. 22)

Activate with **cal**, confirm/continue with **enter**, abort with **cal ➜ enter**

HOLD

During calibration the device is in the Hold state. The output current is frozen, limit and alarm contacts are inactive.

When the calibration mode is exited, the device remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **enter** or repeat calibration with **cal.** If you end the Hold state, the device will return to measuring mode after 20 sec (measured value stabilization).

Calibration by input of cell factor

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **enter**.

Using the ▲ , ▶ keys enter the cell factor. The lower display shows the conductivity value.

A change in the cell factor also changes the conductivity value.

When there has not been an entry for approx. 6 sec, conductivity and temperature are displayed alternately.

Press **enter** to confirm the cell factor.

The device remains in the Hold state. You can end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

Calibration with calibration solution

Note

Be sure to use known calibration solutions and the respective temperature-corrected table values (see Calibration Solutions, Pg. 35).

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1100"* and then press **enter**.

Immerse the sensor in the calibration solution.

After approx. 6 sec the lower display alternately shows the conductivity and temperature values. Read the conductivity value corresponding to the displayed temperature from the table of the used calibration solution (for tables see Pg. 35).

Using the ▲ , ▶ keys change the cell factor until the display shows the conductivity value from the table.

Make sure that the temperature is stable during the calibration procedure.

Press **enter** to confirm the cell factor.

The device remains in the Hold state. You can end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

Zero point calibration in air

Note

Zero point calibration is only required when very low conductivity values are to be measured.

Note

Before you start calibration, remove the sensor from the process, clean it and dry it up.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1001"* and then press **enter**.

Using the ▲ , ▶ keys modify the zero point until the lower display reads 0 µS. If required, change the sign of the zero point!

When there has not been an entry for approx. 6 sec, the lower display alternately shows the zero-corrected conductivity value and the temperature value.

Press **enter** to confirm the zero point.

The device remains in the Hold state. You can end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

Input and adjustment of transfer ratio

Note

This function should only be used by experts. Incorrectly set parameters may go unnoticed, but change the measuring properties.

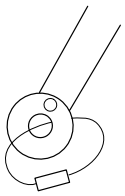
The device comes with a preset transfer ratio of 48.36 for the Model LF 654 X sensor. Should you use another sensor, you must enter another transfer ratio or determine it using a comparison resistor. After that, you can adjust the cell factor printed on the sensor.

Note

Resistance measurement in test mode can only show the correct value of the test resistor when the transfer ratio has been correctly determined.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1125"* and then press **enter**.

Using the ▲ , ▶ keys enter the transfer ratio of the sensor in the main display.



If you do not know the transfer ratio, it can be determined using a comparison resistor (recommended resistance value: 100 Ω). The transfer ratio must be adjusted until the corresponding resistance value is shown in the lower display.

Press **enter** to confirm the transfer ratio.

The device remains in the Hold state. You can end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

Adjustment of temperature probe

Note

This function should only be used by experts. Incorrectly set parameters may go unnoticed, but change the measuring properties. Especially for Pt 100 temperature probe, it is advisable to perform an adjustment.

Activate calibration by pressing the **cal** key.
Using the ▲ , ▶ keys enter mode code *"1015"* and then press **enter**.

Measure the temperature of the process medium using an external thermometer.

Using the ▲ , ▶ keys enter the determined temperature value in the main display. If you take over the temperature value shown in the lower display, the correction is without effect.

Press **enter** to confirm the temperature value.

The device remains in the Hold state. You can end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

Measurement

Measuring mode

In the measuring mode the main display shows the configured process variable and the lower display the temperature.

Cal info

With **cal** and mode code *"0000"* you can activate the cal info. Cal info shows the current calibration data for approx. 20 sec. The 20 sec can be reduced by pressing **enter**. During cal info the device is not in Hold state.

Error info

With **conf** and mode code *"0000"* you can activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. The 20 sec can be reduced by pressing **enter**. During error info the device is not in Hold state.

Hold state

The device will enter the Hold state under the following conditions:

For calibration:	Mode code *1001*
	Mode code *1015*
	Mode code *1100*
	Mode code *1125*
	Mode code *2222*
configuration:	Mode code *1200*
	Mode code *5555*

The output current is frozen at *Last* or *Fix* (configuration Pg. 19), and the limit and alarm contacts are inactive.
If the calibration or configuration mode is exited, the device remains in the Hold state for safety reasons. This prevents undesirable reactions of the connected peripherals (e.g. limit switches, controllers) due to incorrect settings. The measured value and *Hold* are displayed alternately. Now you can check whether the measured value is plausible and specifically end the Hold state with **enter**. After 20 sec (measured value stabilization) the device returns to measuring mode.

4 Diagnostics, Maintenance and Cleaning

Sensoface®, Sensocheck®

Sensoface® provides information on the sensor condition. A sad “Smiley” indicates that there is a Sensocheck® message.

Sensocheck® signals a short circuit of the primary coil and its lines as well as an interruption at the secondary coil and its lines. Sensocheck® can be switched off. With Sensocheck® switched off, no friendly Smiley appears.

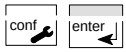
Error Messages

When one of the following error messages is output, the device can no longer correctly determine the process variable or output it via the current output.

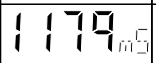
During an error message the alarm contact is open (fail-safe) and the alarm LED flashes. The alarm response time is permanently set to 10 sec.

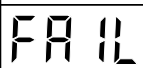
Error messages can also be signaled with a 22 mA signal via the current output (see Configuration, Pg. 19).

Error info



With **conf** and mode code *“0000”* you can activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. The 20 sec can be reduced by pressing **enter**. During error info the device is not in Hold state.

Error number	Display (flashing)	Problem	Possible causes
Err 01		Sensor	- Wrong cell factor - Outside measurement range - SAL > 45 ‰ - Sensor connection or cable defective
Err 02		Sensor	- Unsuitable sensor
Err 03		Temperature probe	- Outside temp range - Outside temp range for TC - Outside temp range for SAL - Outside temp range for concentration
Err 21		Output current	- Measured value below configured current beginning - Wrong configuration for current beginning (see Pg. 19)

Error number	Display (flashing)	Problem	Possible causes
Err 22		Output current	- Measured value above configured current end - Wrong configuration for current end (see Pg. 19)
Err 23		Output current	- Configured current span too small (Difference between current beginning and end)
Err 33		Sensocheck®	- Short circuit in primary coil - Short circuit of cable
Err 34		Sensocheck®	- Open circuit in secondary coil - Cable interrupted
Err 98		System error	- Configuration or calibration data defective; completely reconfigure and recalibrate the device - Measured value transmission defective - Memory error in unit program (PROM defective)
Err 99		Factory settings	- EEPROM or RAM defective - Error in factory settings This error message normally should not occur, as the data are protected from loss by multiple safety functions. Should this error message nevertheless occur, there is no remedy. The unit must be repaired and recalibrated at the factory.

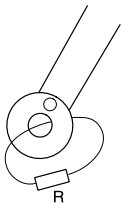
Diagnostics Functions

Cal info

Pressing **cal** and entering mode code *"0000"* is going to activate the cal info. Cal info shows the current calibration data for approx. 20 sec. During cal info the device is not in Hold state.

Test mode

Pressing **cal** and entering mode code *"2222"* is going to activate the test mode. In the test mode you can check the measuring equipment with a resistor. Sensoface® is disabled.



To do so, a comparison resistor is looped through the sensor. The comparison resistance value is indicated in the main display in kΩ. When the resistance value exceeds 2 kΩ, the display shows "– – – –".

R: e.g. 100 Ω

Pressing **enter** ends the test mode. The device goes to Hold state.

Error info

Pressing **conf** and entering mode code *"0000"* is going to activate the error info. Error info shows the most recent error message for approx. 20 sec. After that the message will be deleted. During error info the device is not in Hold state.

Display output current

Pressing **enter** in measuring mode displays the output current for a few seconds.

Current source

To check the connected peripherals (e.g. limit switches, controllers), the output current can be manually specified.

Warning

In the current source mode the output current no longer follows the measured value! It is manually specified. Limit and alarm contact are disabled.
Therefore, it must be ensured that the connected devices (control room, controllers, indicators) do not interpret the current value as a measured value!

Pressing **conf** and entering mode code "5555" is going to activate the current source mode. Specify the output current using ▶, ▲ and **enter**. The present output current is shown in the lower display. Pressing **conf** exits the current source mode again.

Manual device self-test GainCheck®

The manual device self-test is started by simultaneously pressing ▲ and ▶.

A display test is carried out, the software version is displayed and the memory and measured-value transmission are checked.

Automatic self-test

The automatic device self-test checks the memory and the measured-value transmission. It runs automatically in the background at fixed intervals.

Maintenance and Cleaning

Maintenance

The DULCOMETER® 2401 CondI contains no user repairable components.

Cleaning

To remove dust, dirt and spots, the external surfaces of the device may be wiped with a damp, lint-free cloth. A mild household cleaner may also be used if necessary.

5 Appendix

Product Line

Device

	Ref. No.
DULCOMETER® 2401 CondI	1008706

Mounting Accessories

	Ref. No.
Pipe-mount kit	1008707
Panel-mount kit	1008708
Protective hood	1008709

Specifications

CondI input	Input for LF 654 X electrodeless conductivity sensor
Process variable/range	00.00 to 99.99 mS/cm 000.0 to 999.9 mS/cm 0000 to 1999 mS/cm
Concentration	0.0 to 100.0 % by wt.
Salinity	0.0 to 45.0 ‰ (0 to 35 °C)
Accuracy[1)]	< 1 % of meas. value ± 0.02 mS/cm
Sensor monitoring	Sensocheck®: monitoring of primary and lines for short circuit and monitoring of secondary for open circuit (can be switched off)

Sensor standardization[*)]	– Entry of cell factor with display of conductivity and temperature – Zero point adjustment – Temperature probe adjustment – Input of transfer ratio
Permissible cell factor	00.100 to 19.999
Permissible transfer ratio	01.00 to 99.99
Permissible offset	± 0.5 mS/cm

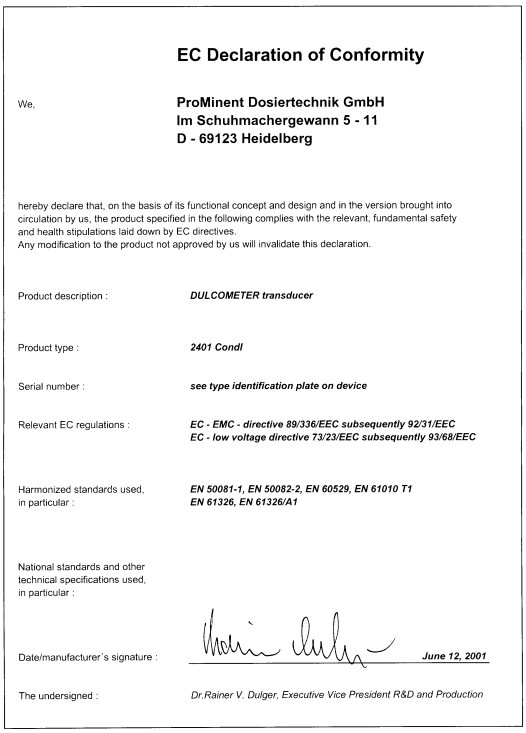
Temperature input	Pt 100 / Pt 1000 / NTC 30 kΩ / NTC 100 kΩ	
Ranges	NTC	-20.0 to +130.0 °C -4 to +266 °F
	Pt	-20.0 to +200.0 °C -4 to +392 °F
Resolution	0.1 °C / 1 °F	
Accuracy	± 0.5 K[2)]	
Temperature compensation[*)] (Ref. temp 25 °C)	LIN	00.00 to 19.99 %/K
	NLF	Natural waters to EN 27888 (0 to 36 °C)
Concentration determination	-01- NaCl	0-26.3 % by wt (0 °C) ... 0-28.1 % by wt (100 °C)
	-02- HCl	0-17 % by wt (-20 °C) ... 0-17 % by wt (50 °C)
	-03- NaOH	0-12 % by wt (0 °C) ... 0-22 % by wt (100 °C)
	-04- H_2SO_4	0-25 % by wt (-17 °C) ... 0-35 % by wt (110 °C)
	-05- HNO_3	0-28 % by wt (-20 °C) ... 0-28 % by wt (50 °C)
	-06- H_2SO_4	95-99 % by wt (-10 °C) ... 95-99 % by wt (110 °C)
Display	LC display, alarm LED	
Current output[*)]	0 to 20 mA or 4 to 20 mA, max. 10 V, floating 22 mA for error message[*)]	
Characteristic[*)]	Linear or logarithmic	

Output current accuracy	< 0.3 % of current value ± 0.05 mA	
Start/End of scale[*)]	As desired within ranges for mS, %, SAL	
Min. span	LIN	5 % of selected range
	LOG	1 decade
Current source	0.00 mA to 22.00 mA	
Switching contacts[*)]	4 switching contacts, floating	
	Min. limit contact	N/O
	Max. limit contact	N/O
	Alarm contact	N/C
	Wash contact	N/O
	Hysteresis of limit contacts 0.2 % of range[3)]	
Loadability	ac < 250 V / < 3 A / < 750 VA dc < 30 V / < 3 A / < 90 W (resistive load)	
Data retention	> 10 years (EEPROM)	
EMC	Emitted interference: EN 61 326 Class B Immunity to interference: EN 61 326, EN 61 326/A1	
Power supply	24 to 230 Vac/dc –15 % / +10 %, ac: 45 to 65 Hz, approx. 2 VA	
Protection class	II	
Overvoltage category	II	

Temperature	Operating/environmental temp -20 to +55 °C Transport and storage temp -20 to +70 °C
Enclosure	Material: thermoplastic polyester, reinforced (polybutylene terephthalate) Protection: IP 65 Color: bluish gray RAL 7031
Cable glands	3 breakthroughs for included cable glands 2 breakthroughs for cable glands, NPT 1/2 “ or Rigid Metallic Conduit
Dimensions	See Dimension drawings, Pg. 7 ff
Weight	Approx. 1 kg

*) user defined
1) ± 1 count
2) with Pt 100 ± 1 K, with NTC > 100 °C < 1 K
3) with % by wt fixed at 0.2%,
with SAL fixed at 0.2 ‰

EC Declaration of Conformity



EC Declaration of Conformity

We,

ProMinent Dosiertechnik GmbH
Im Schuhmachergewann 5 - 11
D - 69123 Heidelberg

hereby declare that, on the basis of its functional concept and design and in the version brought into circulation by us, the product specified in the following complies with the relevant, fundamental safety and health stipulations laid down by EC directives.
Any modification to the product not approved by us will invalidate this declaration.

Product description :	***DULCOMETER transducer***
Product type :	***2401 CondI***
Serial number :	***see type identification plate on device***
Relevant EC regulations :	***EC - EMC - directive 89/336/EEC subsequently 92/31/EEC*** ***EC - low voltage directive 73/23/EEC subsequently 93/68/EEC***
Harmonized standards used, in particular :	***EN 50081-1, EN 50082-2, EN 60529, EN 61010 T1*** ***EN 61326, EN 61326/A1***
National standards and other technical specifications used, in particular :	
Date/manufacturer´s signature :	***June 12, 2001***
The undersigned :	*Dr.Rainer V. Dulger, Executive Vice President R&D and Production*

ATE_Doku, EG-Konf_Erklärung KE 2401 Cond I e 01-06-12.xls 12.06.01 14:37

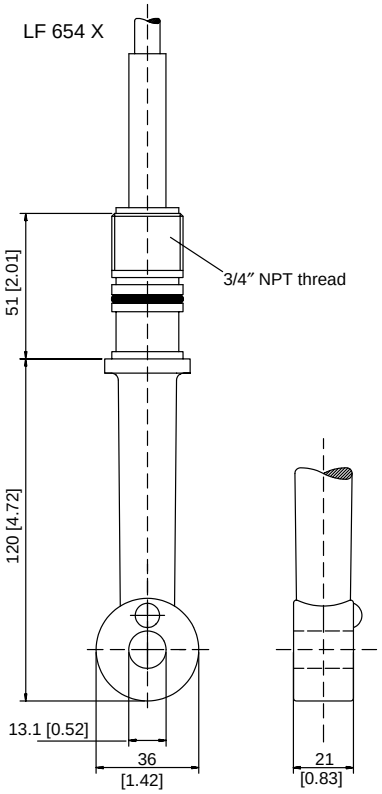
Sensors

LF 654 X

The LF 654 X electrodeless conductivity sensor is suitable for general measurements as well as for measurements in aggressive media.
The sensor material (PEEK) displays excellent chemical resistance to most aqueous solutions of acids, bases and salts. It is also excellent for organic solvents such as toluene, ethyl acetate, acetone, gasoline and carbon tetrachloride.
It is not recommended for sulfuric or nitric acid solutions above 70 %, nor is it recommended for Oleum applications.
The LF 654 X electrodeless conductivity sensor can be used in hazardous or safe areas.

Model LF 654 X (electrodeless sensor) by Foxboro		
Cell factor[1)]	2.15	
Transfer ratio[2)]	48.36	
Measurement range	0 to 1,999 mS/cm	
Resolution	0.01 mS/cm	
Material	Sensor O-rings	PEEK, glass-filled EPR
Process temp	-5 to +120 °C	
Process pressure[3)]	0 to 17.5 bar	
Temp probe	NTC 100 kΩ	
Installation	3/4″ NPT thread	
Cable	Length Connection	6 m wire end ferrules
Weight	Approx. 150 g	
Dimensions	See dimension drawing Fig. 14	

1) This value may differ for each individual sensor and depends on the installation conditions. The exact value must be determined with a calibration.
2) This typical value may differ for each individual sensor. The exact value must be determined with a calibration.
3) The combination of high pressure, high temperature and/or aggressive process medium reduces the sensor life span.



Note: All dimensions in mm [inches].

Fig. 14 Dimension drawing of Model LF 654 X electrodeless conductivity sensor

Calibration Solutions

Potassium Chloride Solutions
Electrical Conductivity in mS/cm

Temperature [°C]	Concentration 0.01 mol/l	0.1 mol/l	1 mol/l
0	0.776	7.15	65.41
5	0.896	8.22	74.14
10	1.020	9.33	83.19
15	1.147	10.48	92.52
16	1.173	10.72	94.41
17	1.199	10.95	96.31
18	1.225	11.19	98.22
19	1.251	11.43	100.14
20	1.278	11.67	102.07
21	1.305	11.91	104.00
22	1.332	12.15	105.94
23	1.359	12.39	107.89
24	1.386	12.64	109.84
25	1.413	12.88	111.80
26	1.441	13.13	113.77
27	1.468	13.37	115.74
28	1.496	13.62	
29	1.524	13.87	
30	1.552	14.12	
31	1.581	14.37	
32	1.609	14.62	
33	1.638	14.88	
34	1.667	15.13	
35	1.696	15.39	
36		15.64	

Data source: K. H. Hellwege (Editor), H. Landolt, R. Börnstein: Zahlenwerte und Funktionen .... Volume 2, Part. Volume 6

Sodium Chloride Solutions
Electrical Conductivity in mS/cm

Temperature [°C]	Concentration saturated*)	0.1 mol/l**)	0.01 mol/l**)
0	134.5	5.786	0.631
1	138.6	5.965	0.651
2	142.7	6.145	0.671
3	146.9	6.327	0.692
4	151.2	6.510	0.712
5	155.5	6.695	0.733
6	159.9	6.881	0.754
7	164.3	7.068	0.775
8	168.8	7.257	0.796
9	173.4	7.447	0.818
10	177.9	7.638	0.839
11	182.6	7.831	0.861
12	187.2	8.025	0.883
13	191.9	8.221	0.905
14	196.7	8.418	0.927
15	201.5	8.617	0.950
16	206.3	8.816	0.972
17	211.2	9.018	0.995
18	216.1	9.221	1.018
19	221.0	9.425	1.041
20	226.0	9.631	1.064
21	231.0	9.838	1.087
22	236.1	10.047	1.111
23	241.1	10.258	1.135
24	246.2	10.469	1.159
25	251.3	10.683	1.183
26	256.5	10.898	1.207
27	261.6	11.114	1.232
28	266.9	11.332	1.256
29	272.1	11.552	1.281
30	277.4	11.773	1.306
31	282.7	11.995	1.331
32	288.0	12.220	1.357
33	293.3	12.445	1.382
34	298.7	12.673	1.408
35	304.1	12.902	1.434
36	309.5	13.132	1.460

Data source: *) K. H. Hellwege (Editor), H. Landolt, R. Börnstein: Zahlenwerte und Funktionen .... Volume 2, Part. Volume 6
**) Test solutions calculated according to IEC 746-3

Concentration Curves

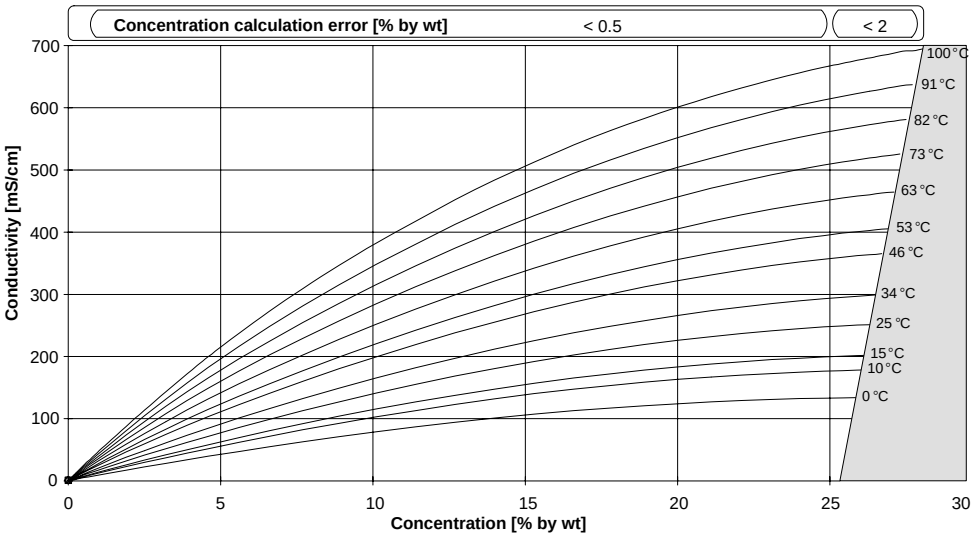


Fig. 15 Concentration curves NaCl (configuration: concentration -01-)

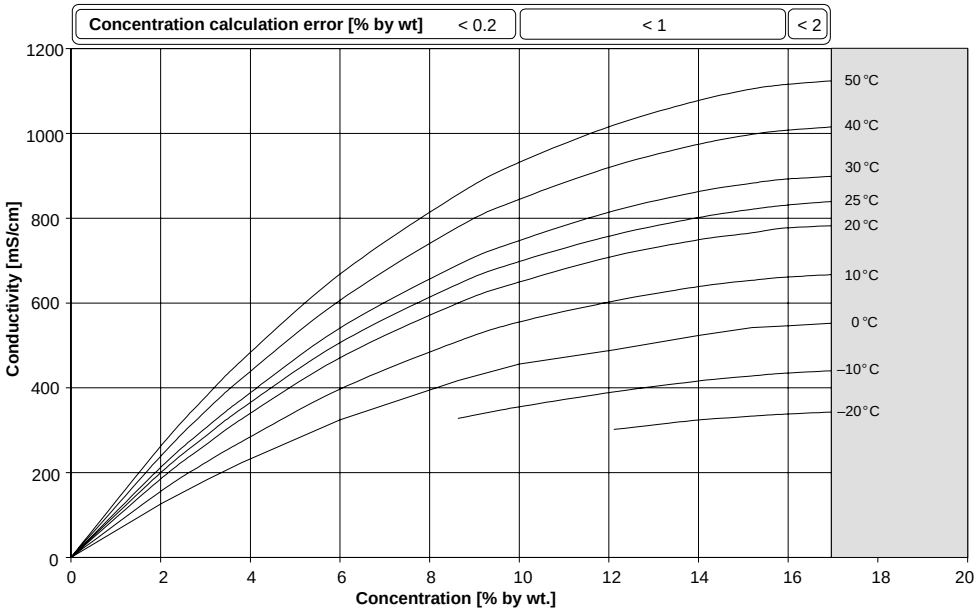


Fig. 16 Concentration curves HCl (configuration: concentration -02-)

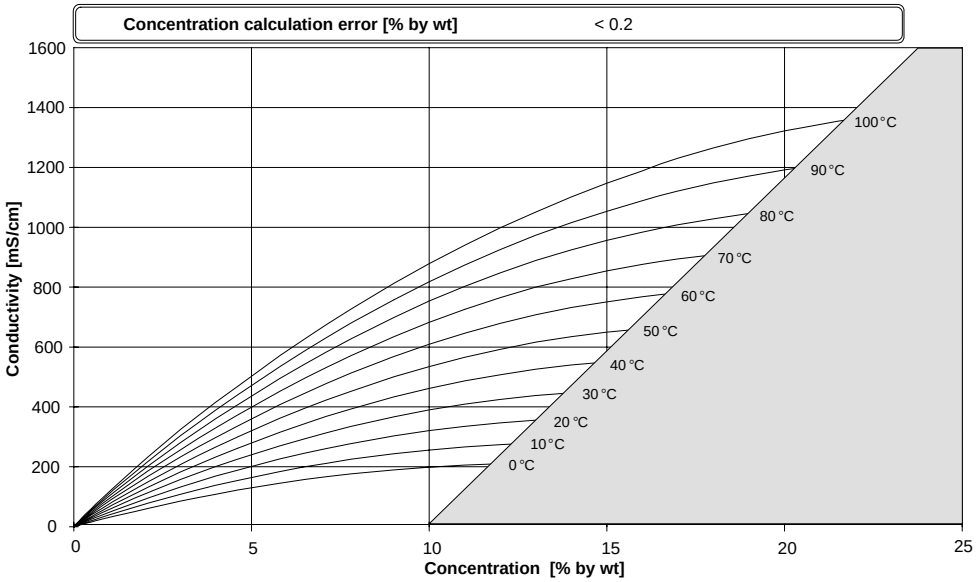


Fig. 17 Concentration curves NaOH (configuration: concentration -03-)

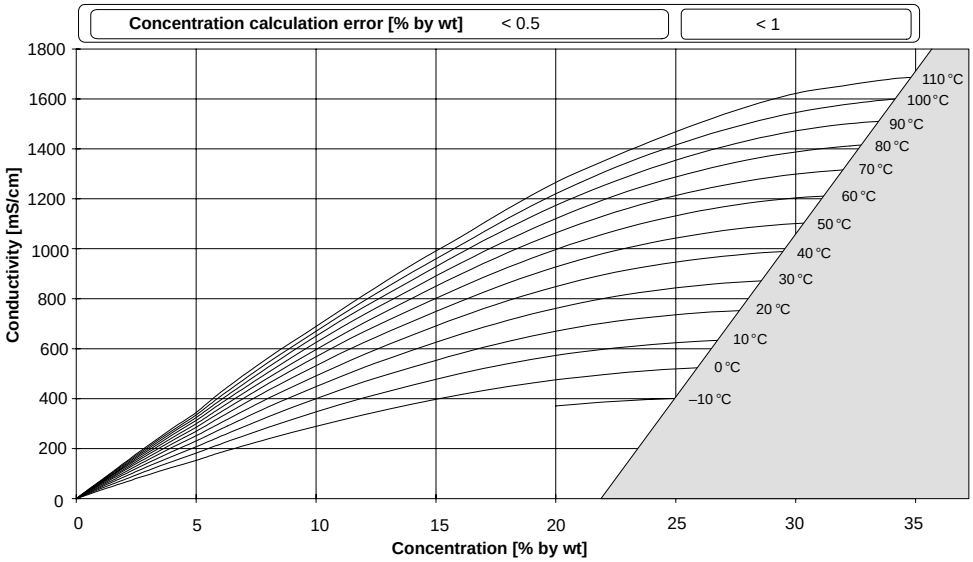


Fig. 18 Concentration curves H_2SO_4 (configuration: concentration -04-)

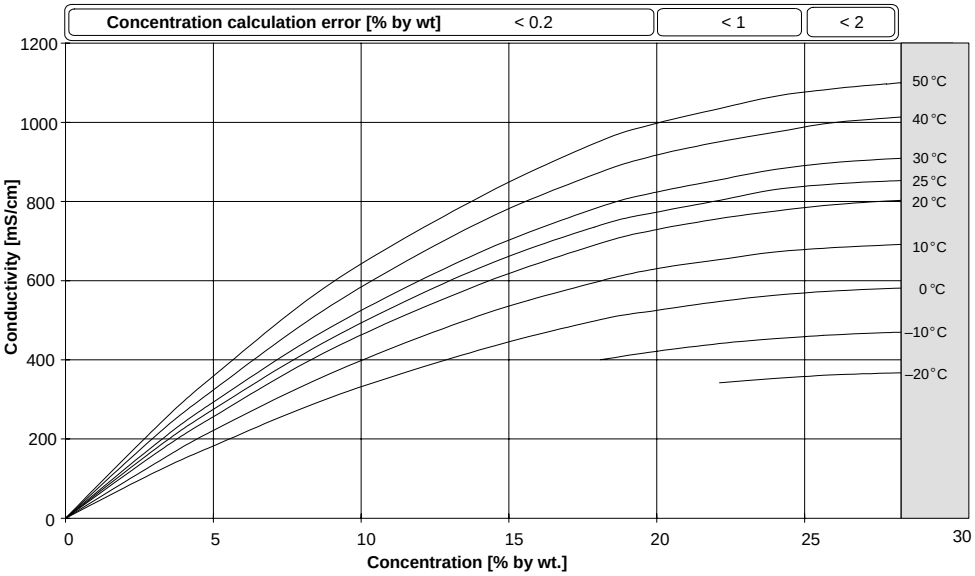


Fig. 19 Concentration curves HNO_3 (configuration: concentration -05-)

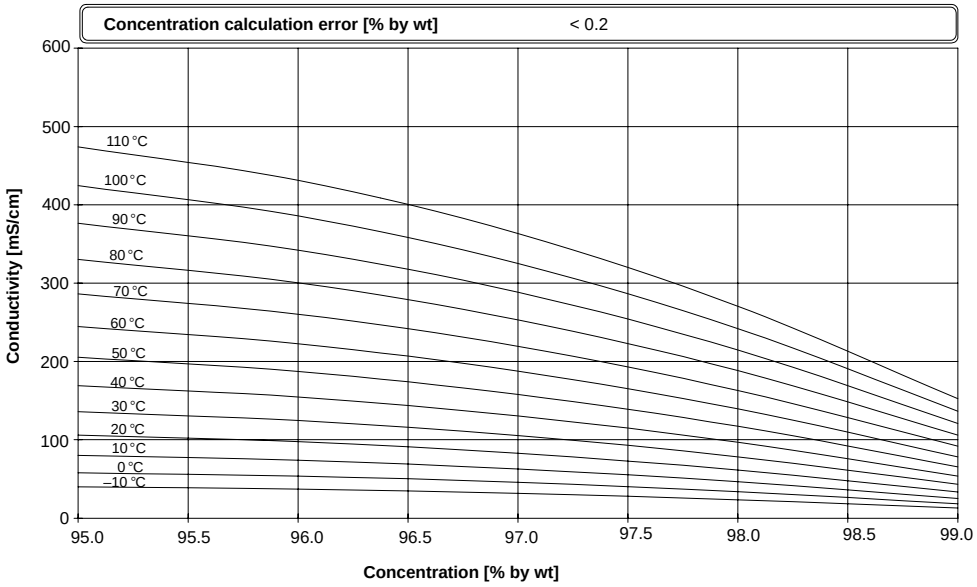


Fig. 20 Concentration curves H_2SO_4 (range 95 to 99 % by wt), (configuration: concentration -06-)

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