Metrohm METROHM Ltd. CH-9101 Herisau (Switzerland)

712 Conductometer

5.712.0012 program

Mains connection:

Mains voltage	*U*	=	100 ... 120 V, 220 ... 240 V (± 10%)
Mains frequency	*f*	=	50 ... 60 Hz
Power consumption	*S*	=	13 VA

8.712.1003 Instructions for Use

07.10.1994 / dö

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1. Introduction

The 712 Conductometer is a modern conductivity measuring instrument with a dynamic measurement range of 0 µS/cm... 2000 mS/cm, an autozero and a compensation function. The measured conductivity is automatically converted to a freely selectable reference value (usually 20 °C or 25 °C) using the specified or experimentally determined temperature coefficient. Both the cell constant and the temperature coefficient can be calibrated automatically. With the TDS (Total Dissolved Solids) function, the total conductivity can be expressed in terms of the salt content (mg/L NaCl). In addition to the conductivity, measurement of the temperature using a Pt100 or Pt1000 sensor is possible in the range –170 ... + 500 °C.

Both the conductivity and the temperature have a freely configurable analogue output available. Communication with a printer, a PC or other devices is possible via remote control I/O lines and an RS232 interface.

These Instructions for Use provide a comprehensive overview of the parts and controls, installation, operation, error rectification and technical data of the instrument. The contents of the green pages are of interest to you only if you wish to remote control your 712 Conductometer using the built-in RS232 or remote interface. To find any particular information regarding the instrument, please consult the Contents table or the Index at the back.

For a rapid overview of the key functions and parameters, you have available Short-form Instructions for Use affixed to the instrument and the 8.712.1023 Short Operating Guide.

You will find additional information on measurement of the conductivity and the measuring cells required in the following Metrohm documents:

- Application Bulletin No. 102 «Conductometry»
- Application Bulletin No. 64 «Platinisation of platinum electrodes and conductivity measuring cells»
- Instruction sheet enclosed with all conductivity cells supplied
- Brochure «Metrosensor electrodes»
- Electrode catalogue

2. Parts and controls

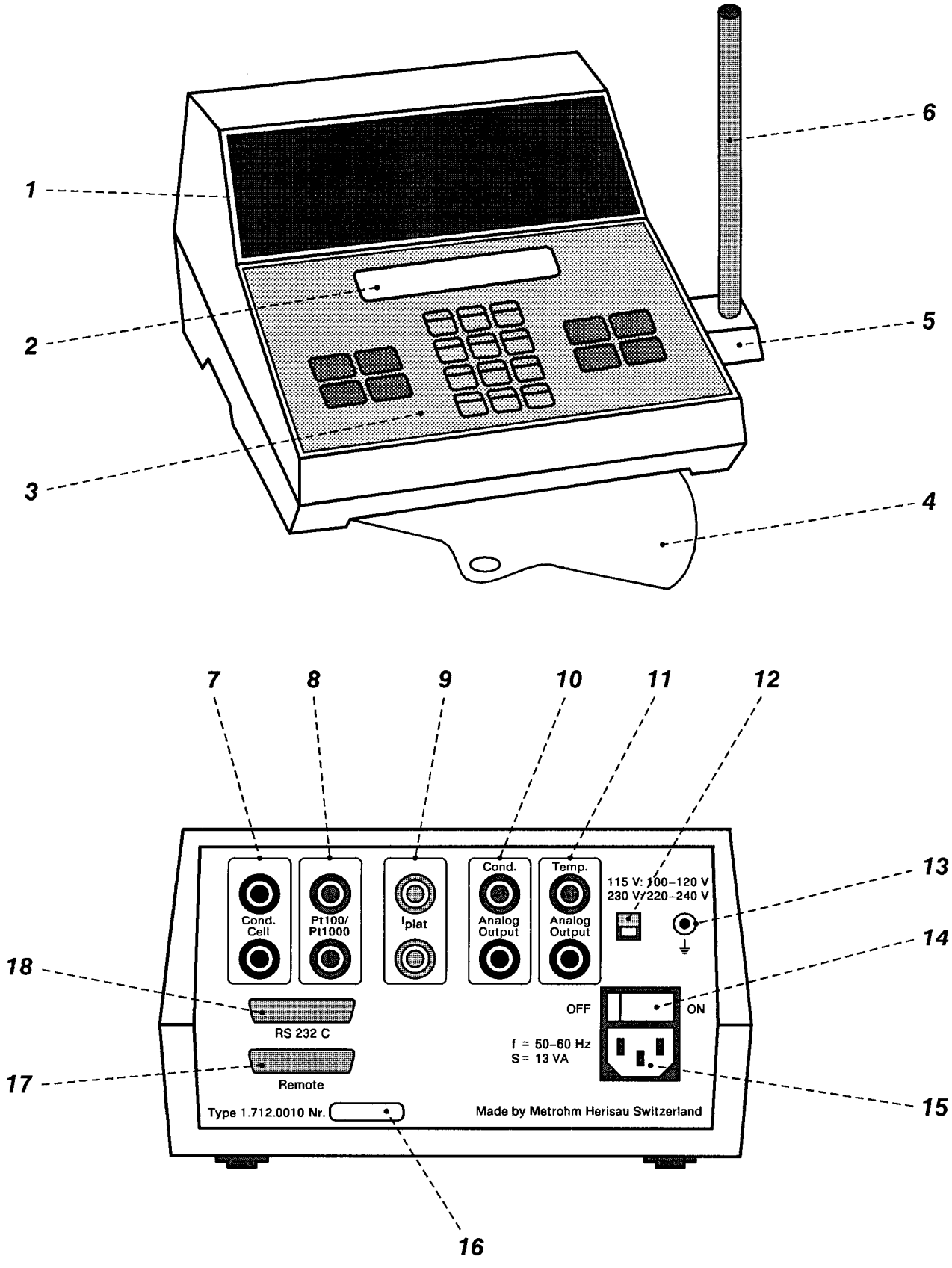


Fig. 1: Front and rear of the 712 Conductometer

1 **Main display (gas discharge display)**
with measured value, unit and status display

2 **Dialogue display (LCD)**
comprising 2 lines, each of 24 characters

3 **Keypad**
with operating and numeric keys

4 **Short-form Instructions for Use**

5 **6.2001.030 Stand Support**
For fastening stand rod **6**,
can be mounted on the left or the right (see *section 3.2*)

6 **6.2016.050 Stand Rod**
for holding 6.2013.010 Clamping Ring and 6.2021.020 Electrode Holder

7 **Connection for conductivity cell** (black sockets)

8 **Connection for Pt100 or Pt1000 temperature sensor** (red sockets)

9 **Connection for platinisation of conductivity cells** (green sockets)

10 **Analogue output for conductivity**
red socket: live
black socket: common

11 **Analogue output for temperature**
red socket: live
black socket: common

12 **Mains voltage selector**
115V: 100...120 V ± 10%
230V: 220...240 V ± 10%

13 **Earthing socket**
Earthing, see *section 3.3.3*

14 **Mains switch**
Switch for switching instrument on and off:
I = ON 0 = OFF
The operational readiness is shown by displays **1** and **2** lighting up.

15 **Mains connection plug**
Cold appliance plug, type CEE(22), VI; mains connection, see *section 3.3.3*

16 **Model plate with serial and manufacturing number**

17 **Remote interface**
Remote I/O lines for the remote control of a sample changer or other external devices

18 **RS232 interface**
RS232C interface for the attachment of a printer or a PC

3. Installation

*This section describes the installation of the 712 Conductometer. Safe operation of this instrument is assured only if you follow the instructions specified here exactly. Bold, underlined numbers in the text (e.g. **15**) refer to the parts and controls numbered in the illustrations in section 2.*

3.1 Setting up the instrument

The 712 Conductometer is supplied together with the separately packed accessories in an extremely well protected special package. This contains two shock-absorbing foam linings. The instrument itself is packed in a dustproof, evacuated polyethylene bag. It is advisable to keep this special packing since if for any reason the instrument has to be returned only such packing guarantees indemnified transport.

Immediately after receipt, a check must be made to ensure completeness of the shipment and the absence of any damage (compare with delivery note and accessories list in *Section 9*). In the case of transport damage, see instructions in *Section 10*, "Warranty".

The 712 Conductometer should be set up in the laboratory at a location free from vibrations and suitable for the intended operation. It must be protected against corrosive atmospheres and contamination by chemicals.

3.2 Mounting the accessory for holding the sensors

The accessory enclosed with the 712 Conductometer for holding the conductivity cells and/or temperature sensors is mounted as follows:

1. Fasten stand rod **6** using the enclosed hex screw to stand support **5**.
2. Screw stand support **5** to the two screws on the underside of the 712 Conductometer using the enclosed washers and knurled nuts. The stand support can be mounted so that the stand rod is on the left or the right of the instrument.
3. Fasten the 6.2013.010 Clamping Ring to stand rod **6** so that it limits the lowest position of the electrode holder.
4. Fasten the 6.2021.020 Electrode Holder to stand rod **6**. Press the red lock button to shift it to any position you wish.

If you wish to stir the analysis solution, you can use the 728 Magnetic Swing-out Stirrer (see *section 9.2*) available from Metrohm as an option. This stirrer can be mounted directly on stand rod **6**.

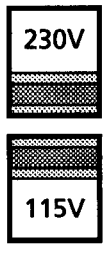
3.3 Mains connection and switching on the instrument

Note: *If the 712 Conductometer is connected to the power supply, the 712 Conductometer may be opened or parts removed as there is a danger of contact with live components. Before the 712 Conductometer is opened to change components or for maintenance or repair work, the mains cable must thus always be disconnected from the mains connection plug 15 of the 712 Conductometer.*

3.3.1 Setting the instrument supply voltage

Before switching on the 693 VA Processor for the first time, check that the mains voltage set on the instrument (visible in mains voltage selector 12) matches the local power supply voltage. If this is not the case, you must change the voltage set on the instrument by moving the mains voltage selector 12 with a screwdriver.

Positions of mains voltage selector 12:



230V: 220 ... 240 V ± 10%

115V: 100 ... 120 V ± 10%

3.3.2 Fuse

The mains transformer of the 712 Conductometer is protected by a non-reversible fusible cutout. If this blows, please inform Metrohm service.

3.3.3 Mains cable and mains connection

One of three mains cables is supplied with the instrument:

- 6.2122.020 with plug SEV 12 (Switzerland ...)
- 6.2122.040 with plug CEE(7), VII (Germany ...)
- 6.2122.070 with plug NEMA 5–15 (USA ...)

The cable is three-cored and fitted with a plug with an earthing pin. If a different plug has to be attached, the yellow/green lead (IEC standard) must be connected to the protective earth (instrument protection class 1).

Note: *Each break in the earthing inside or outside the instrument can make it a hazard.*

Plug the mains cable into mains connection plug 15 of the 712 Conductometer (see *Fig. 1*).

3.3.4 On/off switching of the instrument

The 712 Conductometer is switched on and off with mains switch 14.

When the instrument is switched on, all segments of displays 1 and 2 light up for a few seconds and the instrument is then ready for measurement.

3.4 Attachment of sensors

Conductivity cells and Pt100 or Pt1000 resistance thermometers can be attached to the 712 Conductometer. The 6.0908.110 Conductivity Cell will be found particularly practical as it has a built-in Pt100 temperature sensor.

The black banana plugs of the conductivity cells are connected to the black connection sockets 7, the red banana plugs of the temperature sensors to the red connection sockets 8 (see also *Fig. 1*).

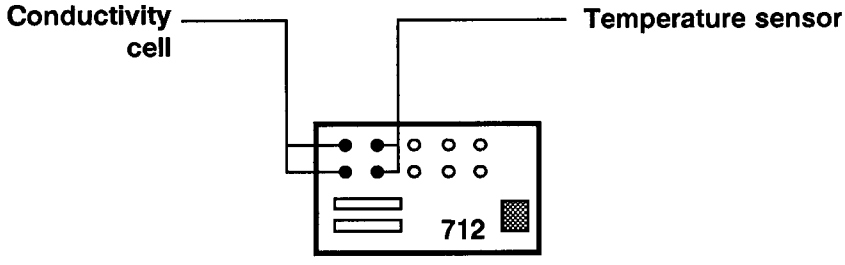


Fig. 2: Attachment of sensors to the 712 Conductometer

The following Table shows a selection of the most important conductivity cells and temperature sensors available from Metrohm. In addition to the immersion cells listed here, Metrohm also offers pipette, titration and Jones measuring cells. You will find detailed information in the brochure "Metrosensor Electrodes" and in the Electrode Catalogue.

Order No.	*Description*	*Cell constant*	*Min. immersion depth*
6.0908.110	Immersion cell with integrated Pt100 temperature sensor	0.8	40 mm
6.0907.110	Immersion cell	0.8	40 mm
6.0910.120	Immersion cell for sample changer	0.9	20 mm
6.0901.040	Immersion cell	0.1	50 mm
6.0901.110	Immersion cell	0.8	50 mm
6.1103.000	Pt100 resistance thermometer; application range –50 ... 100°C		
6.1103.040	Pt100 resistance thermometer for sample changer; application range –50 ... 100°C		
6.1110.100	Pt1000 resistance thermometer; application range –50 ... 180°C; also requires 6.2104.080 Cable (1 m) or 6.2104.110 Cable (2 m)		

The choice of conductivity cell depends on the expected conductivity of the analysis solution. The most important parameter here is the cell constant. The conductivity measurement ranges for various cell constants are shown in *Fig. 3*. The following rules of thumb apply:

c = 0.1 cm^{-1}: for poorly conducting solutions such as distilled water, fully or partially demineralised water, etc.

c = 1 cm^{-1}: for moderately conducting solutions such as drinking water, surface water, wastewater, etc.

c = 10 cm^{-1}: for solutions with good conductivity such as sea water, rinsing water, physiological solutions, etc.

c = 100 cm^{-1}: for solutions with very good conductivity such as electroplating baths, brine, etc.

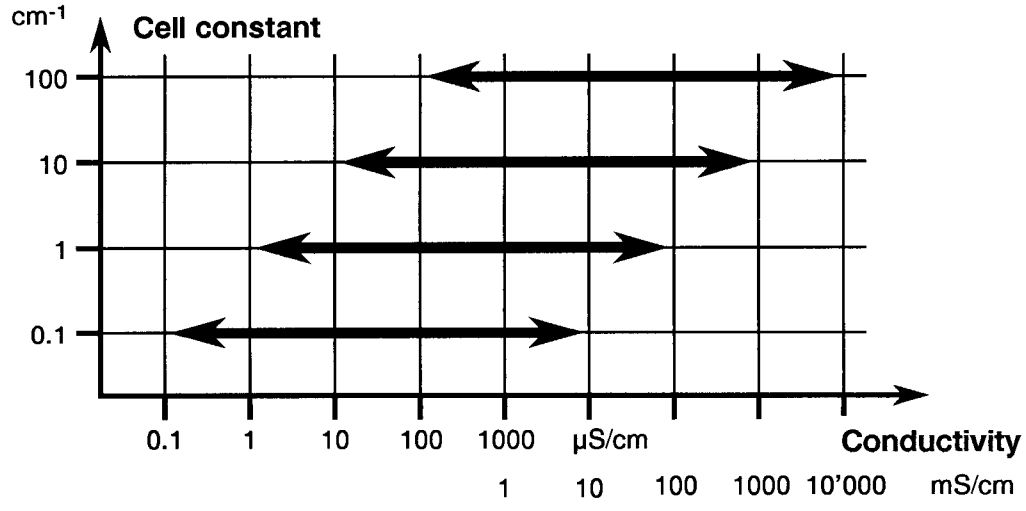


Fig. 3: Conductivity measurement ranges as a function of the cell constant

Notes on handling conductivity cells

- Degrease conductivity cells which have been stored dry by placing in acetone for 1...2 h before use. Then rinse well with dist. water and place in dist. water for 1...2 h.
- Conductivity cells in frequent use must always be stored in dist. water.
- During measurement, ensure that no air bubbles adhere to the electrode.
- The cell constant value printed on the cell can change on dry storage or in measurements in which the platinum surface is contaminated. For accurate absolute measurements, it is thus necessary to redetermine the cell constant (see *section 4.4.3*).
- The platinum electrodes are platinised to reduce the polarisation, i.e. coated with extremely finely divided platinum black. This platinisation must not be touched or damaged. Damaged electrodes or those changed by ageing can be replatinised (see *section 7.3*).

3.5 Attachment of devices to the analogue output

3.5.1 Details of the analogue outputs

The 712 Conductometer has two analogue outputs **10** for the conductivity and **11** for the temperature which are configured and operated via dialogue (see *sections 4.4.2* and *4.5.2*). The circuitry of the two analogue outputs is as follows:

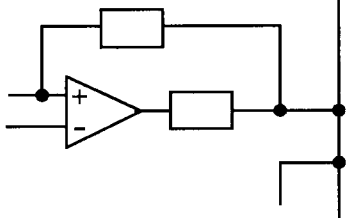
3.712.0100	*External*	*Comments*
	Output (red) 0 V (black) R_{ext} > 1 kΩ	Voltage range of the analogue output: 0 ... 2000 mV Resolution: 0.5 mV (12 bit)

Fig. 4: Analogue output circuitry of the 712 Conductometer

3.5.2 Attachment of a recorder

Any laboratory recorder can be connected to the two analogue outputs **10** for the conductivity and **11** for the temperature. The 586 Labograph recorder available as an option from Metrohm is attached to the conductometer as follows:

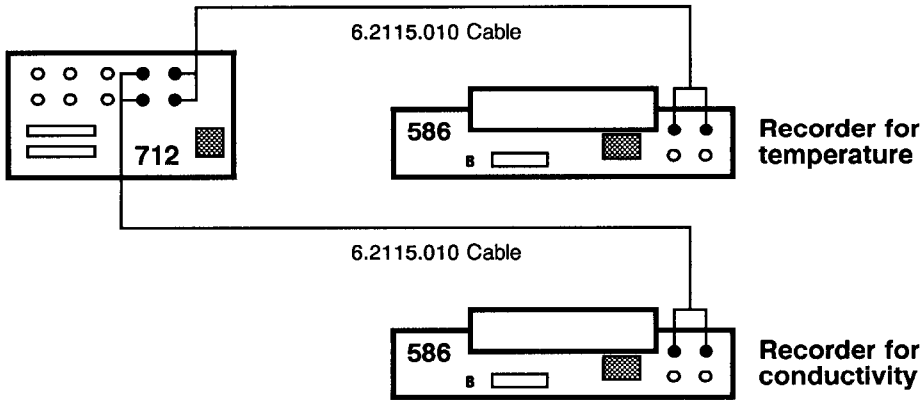


Fig. 5: Attachment of recorders to the 712 Conductometer

3.5.3 Attachment to 536 Potentiograph

The analogue output signal of the 712 Conductometer can be used as an input signal for the 536 Potentiograph. This instrument combination can be used to perform conductivity titrations which have to be evaluated manually. The 712 Conductometer is attached to the 536 Potentiograph as follows:

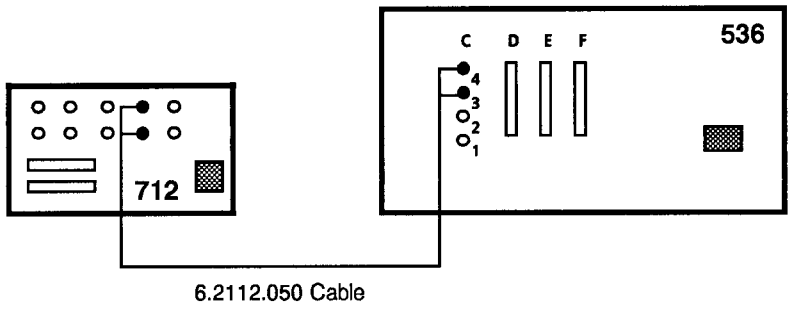


Fig. 6: Attachment of the 712 Conductometer to the 536 Potentiograph

3.5.4 Attachment to Titrinos

The analogue output signal of the 712 Conductometer can be used as an input signal for Titrinos to transfer measured conductivity values or to perform conductivity titrations. The transfer of measured values is possible with all Titrinos, the performance and evaluation of titrations only with the 702 and 716 Titrinos together with the 6.6015.000 Metrodata program "Titrino Workcell".

If only measurement of the conductivity of the analysis solution is required, the 712 Conductometer can be attached to measuring input 1 of the Titrino (see *Fig. 7*, upper drawing). If, on the other hand, other high resistance sensors such as pH glass electrodes are used in addition to the conductivity cell, electrical isolation must be ensured. This is achieved by connecting the conductivity signal to the "Pol" input (with $I_{pol} = 0$), whereas the pH is measured differentially. In such a case, the conductivity cell also serves as an auxiliary electrode for the differential analysis solution (see *Fig. 7*, lower drawing).

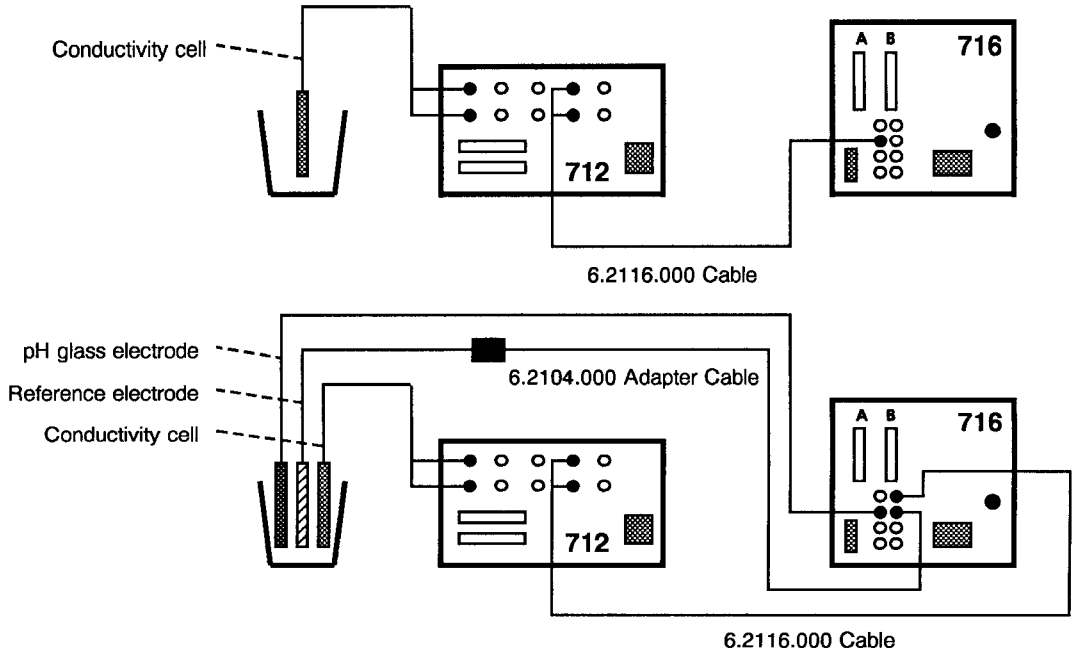


Fig. 7: Attachment of the 712 Conductometer to Titrinos

3.6 Attachment of devices to the RS232 interface

Note: Before an external device is attached to RS232 interface 18, the 712 Conductometer must always be ***switched off*** *using mains switch 14!*

Fig. 8: Attachment of external devices to the RS232 interface

3.6.1 Attachment of a computer

The below Table provides information on the attachment of IBM-compatible PCs to RS232 interface 18 and shows the cables required as well as details of the Conductometer and PC configuration.

PC	*Cable*	*Settings on 712 Conductometer*	*Settings on PC*
Computer with 25-pin RS232 connector	6.2125.060	>config/print sent to: IBM >config/RS232 settings baud rate: data bit: stop bit: parity: handshake: } Settings same as on PC	Setting of the RS parameters depends on control program
Computer with 9-pin RS232 connector	6.2125.060 + 6.2125.010		

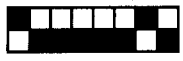
Remote control of the 712 Conductometer via the RS interface is described in *section 5*. For the transfer of experimental data of the 712 Conductometer to a PC, Metrohm offers the optional PC program VESUV 2.0 (order number 6.6008.010).

3.6.2 Attachment of a printer

Any external printer with a serial interface and which is compatible with one of the following printer drivers can be attached to the RS232 interface of the 712 Conductometer (see also *section 4.3*):

IBM	IBM Proprinter and compatible printers
Epson	EPSON printers and compatible printers
Seiko	Seiko printer DPU-411
Citizen	Citizen printer IDP560 RS
HP	HP printers such as HP DeskJet ..., HP LaserJet ..., etc.

The below Table provides information on the attachment of several selected printers and shows the cables required as well as details of the Conductometer and printer configuration. If you attach a printer not included in the list of printers below, please ensure that it can emulate a printer mode supported by the 712 Conductometer. If possible, select the same settings for printer and 712 Conductometer as for the emulated printer type.

Printer	*Cable*	*Settings on 712 Conductometer*	*Settings on printer*
SEIKO DPU411-11B (E/U) SEIKO DPU411-20B (E/U)	6.2125.020	>config/print send to: Seiko >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 1.0 length 1.0	DIP switch settings:  The printer has only a switchable 7-bit ASCII character set available which can be changed automatically by the 712 Conductometer in accordance with the set dialogue language: german: ISO21 (german) english: ISO 6 (ANSI) french: ISO69 (french) spanish: ISO 7 (spanish)
CITIZEN IDP-560-RS	6.2125.050	>config/print send to: Citizen >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 1.0 length 1.0	DIP switch settings:  The printer has only a switchable 7-bit ASCII character set available and changeover to the national character sets is possible only through changing the positions of jumpers 1 and 2 of the printer: *J1* / *J2* / *character set* open / closed / ISO21 (german) open / open / ISO 6 (ANSI) closed / open / ISO69 (french) Spanish does not have its own character set (it is best to use "french").
KODAK Diconix 180 si	6.2125.050	>config/print send to: Epson >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 0.7 length 0.7	Settings via dialogue-guided setup procedure: Baud rate 9600 Data bits 8 Stop bit 1 Parity none XON off DTR high
EPSON P-40	6.2125.040	>config/print send to: Epson >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 0.4 length 0.4	DIP switch settings: 
EPSON LQ-... (with 6-pin circular connector)	6.2125.040	>config/print send to: Epson >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 0.7 length 0.7	DIP switch settings: SW1  SW2 

Printer	*Cable*	*Settings on 712 Conductometer*	*Settings on printer*
EPSON LQ-... EPSON LX-... EPSON FX-... (with serial interface #8148)	6.2125.040	>config/print send to: Epson >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 0.7 length 0.7	DIP switch settings: SW1  SW2 
IBM Proprinter	6.2125.050	>config/print send to: IBM >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 1.0 length 1.0	Baud rate 9600 Data bits 8 Stop bit 1 Parity none XON off DTR high
HP Deskjet ...	6.2125.050 (for printers without serial interface, a serial/parallel converter is also needed)	>config/print send to: HP >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 1.0 length 1.0	DIP switch settings: 
HP Laserjet 3...	6.2125.050	>config/print send to: HP >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 1.0 length 1.0	FONT SOURCE = E* FONT NUMBER = 2 PAPER = A4 ORIENTATION = P FORM = 64 LINES SYM SET = PC-8 I/O = SERIAL SERIAL = RS-232 BAUD RATE = 9600 ROBUST XON = OFF DTR POLARITY = HI RET = MEDIUM PAGEPROTECT = LGL
HP Laserjet 4...	Adapter cable, 25-pin neg. / 9-pin pos. (e.g. HP C2933A)	>config/print send to: HP >config/RS232 settings baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs >graphics width 1.0 length 1.0	PRINTING MENU PAPER = A4 ORIENTATION = P FORM = 64 LINES RET = MEDIUM PCL MENU FONT SOURCE = I FONT NUMBER = 0 SYM SET = PC-8 SERIAL MENU PACING = DTR/DSR BAUD RATE = 9600 DTR POLARITY = HI

3.7 Attachment of devices to the remote interface

3.7.1 Details of the remote interface

Any external devices can be attached to the 25-pin remote interface **17**. The 712 Conductometer can be remote controlled via the 8 input lines, whereas the 8 output lines can be used to control external devices.

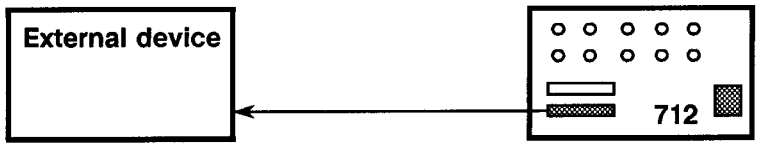


Fig. 9: Attachment of external devices to the remote interface

The pin assignment of the remote interface, its functions as well as the electrical conditions and statuses are described in *section 6.*

3.7.2 Attachment of a sample changer

The Metrohm 673/674 Sample Changer or the associated control unit is attached to remote interface **17** of the 712 Conductometer as follows:

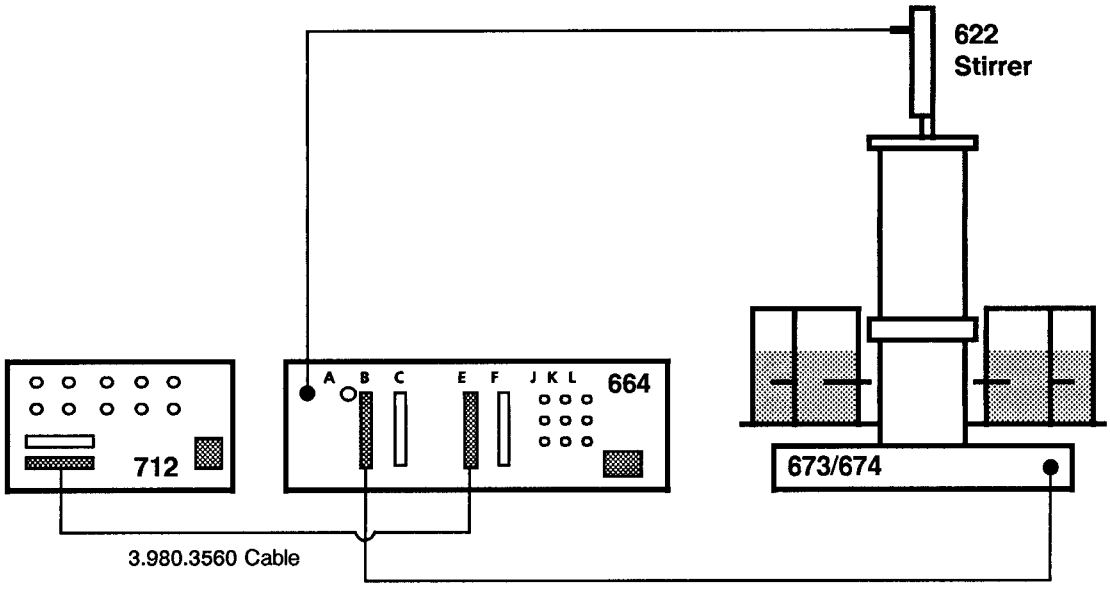


Fig. 10: Attachment of the 712 Conductometer to the 664 Control Unit

The following settings are needed for the above interconnection for measurement of the conductivity on the sample changer:

664 Control Unit: Mode 4
Δt1 = Wait time until the measurement (0...5 min).
On elapse of this wait time, the <print> command is initiated on the 712 Conductometer.

712 Conductometer: Parameter "`config/print meas.value/print crit.: = immed.`".
Following the measured value printout initiated by the <print> command, the advance pulse (EOD) is outputted to the 664 Control Unit.

4. Manual operation

4.1 Introduction to operation by means of examples

For you to perform the examples described in this section, the 712 Conductometer must be put into operation properly. If this has not already been done, please proceed in the following sequence (you will find more detailed information in the specified sections):

1▸	Setting up instrument	*Section 3.1*
2▸	Mounting accessory	*Section 3.2*
3▸	Setting correct mains voltage	*Section 3.3.1*
4▸	Mains connection	*Section 3.3.3*
5▸	Switching on instrument	*Section 3.3.4*
6▸	Attaching sensors *(Please also consult the notes regarding handling of conductivity cells!)*	*Section 3.4*

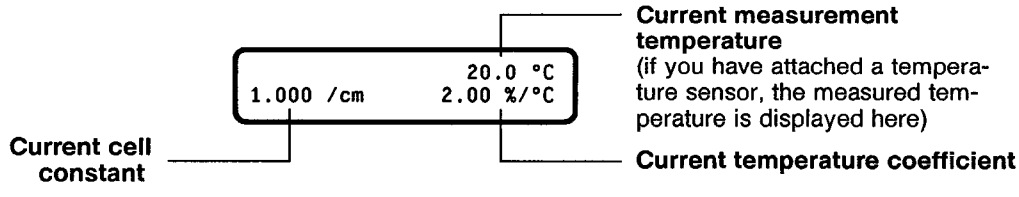
The only thing still missing is an analysis solution. Fill the measuring vessel with tap water and immerse the conductivity cell in the analysis solution until the vent holes are covered. Ensure that no air bubbles adhere to the platinum electrodes.

We can now proceed with our short training course. Note that all displays of the examples refer to the condition in which the instrument was first put into operation (initial condition). If you do not wish to run through these examples until later, differences in regard to dialogue language and parameter values may appear (please see *section 7.6* for how to return to the initial condition).

4.1.1 Basic instrument mode, main and auxiliary display

After the 712 Conductometer has been switched on, the instrument is always automatically in the basic mode for conductivity measurement. The measured conductivity value and the associated unit (either µS/cm" or "mS/cm") are shown in the main display 1. The magnitude of the displayed conductivity should not concern us at present as for an accurate measurement the cell constant of the measuring cell and the measurement temperature have to be set correctly (more about this later).

Below the main display you will see the dialogue display (the two-line LCD 2). In the basic mode, this shows 3 numeric values and their associated units with the following meaning:



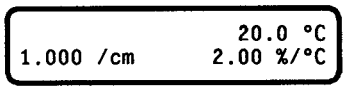
Before we concern ourselves further with the conductivity measurement, let us first examine the basic principles of data entry.

4.1.2 Data entry

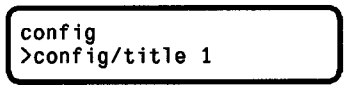
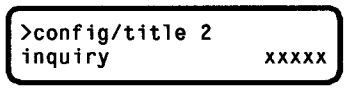
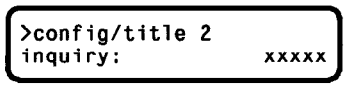
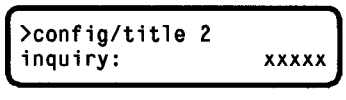
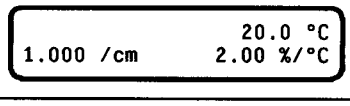
The basic principle of data entry will be illustrated using the entry of the date and time and switching the dialogue language to German. Process stepwise as described in the sequence below.

20.0 °C 1.000 /cm 2.00 %/°C	The 712 Conductometer is still in the measurement mode.
<config>	Now press the <config> key.
config >config/print	The dialogue display shows the title of the "print" group, which contains various inquiries concerning print output on an external printer. The <config> key contains several such groups of inquiries, which can be selected by repeated pressing of this key. Each group has a title marked by ">".
<config>	Press the <config> key again.
config >config/print meas.value	The display shows the title of the "print meas. value" group, which contains various inquiries concerning the printout of the measured values on an external printer.
<config>	Press the <config> key again.
config >config/report type	The display shows the title of the "report type" group, which contains various inquiries concerning the report printout on an external printer in calibrations.
<config>	Press the <config> key again.
config >config/auxiliaries	The display now shows the title of the "auxiliaries" group, which contains among other things the inquiries we seek concerning entry of the date, time and dialogue language.
<enter>	Now press the <enter> key to move from the title to the individual inquiries of the "auxiliaries" group. The title continues to be displayed in the first line.
>config/auxiliaries run number 0	The display shows the selection of the run number as the first inquiry. As we have no interest in this, let us proceed immediately to the next inquiry.
<enter>	Press the <enter> key.

>config/auxiliaries date 94-07-04	The display shows the date with the numeric data for year, month and day as the next inquiry. If the date shown matches the current date, all you need do is confirm it by pressing the <enter> key. However, should you wish to change this date, enter the new numeric values in the order year – month – day with the numeric keys, for example "94-09-05" for 5th September, 1994.
<enter>	Confirm the new date you have entered by pressing the <enter> key.
>config/auxiliaries time 16:03:51	The display shows the current time with the numeric data for hours, minutes and seconds as the next inquiry. If the time shown matches the current time, all you need do is confirm it by pressing the <enter> key. If you wish to change the displayed time, enter the new numeric values in the order hours – minutes – seconds with the numeric keys, for example "08:32:00".
<enter>	Confirm the new time by pressing the <enter> key.
>config/auxiliaries dialog: english	The next inquiry to appear concerns selection of the dialogue language whose default setting is "english". Please note the ":" character here. It always appears when values can not be entered using the numeric keys, but must be selected from preset values using the <select> key.
<select>	Press the <select> key to select the next language setting.
>config/auxiliaries dialog: deutsch	"deutsch" (german) is now selected as the dialogue language.
<enter>	Confirm the new language setting by pressing the <enter> key. The dialogue language is immediately switched to "deutsch".
>config/Verschiedenes Gerätebez.	The next inquiry, "Gerätebez." (the dialogue language has now been changed over to german), appears. However, we are not interested in this or the remaining inquiries in this group at the moment.
<quit>	Press the <quit> key to quit the inquiries and return to the title "Verschiedenes" ("auxiliaries" in german).

	The display shows the title of the "auxiliaries" group.
<quit>	Press the <quit> key again to return the basic instrument mode.
	The 712 Conductometer is now again in the basic mode for conductivity measurement. From now on, all dialogue texts will be displayed in German. If you want to change the dialogue language back to English proceed as described before selecting "english" instead of "deutsch".

Summary

<config>	The <config> key contains several groups of inquiries which can be selected by repeated pressing of the <config> key. Each group has a title marked by ">".
	The first line always shows the name of the key, the second line that of the group title.
<config>	
	Pressing <enter> advances through the individual inquiries of the group.
<enter>	
	With inquiries without ":", the values are entered using the numeric keys. The set value is confirmed by pressing <enter> and the next inquiry appears.
<enter>	
	With inquiries with ":", the admissible values are selected using the <select> key. The set value is confirmed by pressing <enter> and the next inquiry appears.
<enter>	
	Pressing the <quit> key exits the inquiries and effects a return to the title of the group containing the inquiries just run through.
<quit>	
	Pressing <quit> again effects a return to the basic mode.
<quit>	
	

4.1.3 Conductivity measurement

In what follows we shall examine the measurement of the conductivity of tap water and the basic settings required. Proceed stepwise following the sequence below. If you first wish to refresh your memory regarding the theory underlying conductivity measurements, we recommend glancing through *section 4.4.1.*

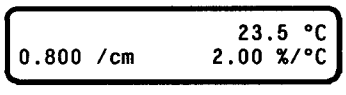
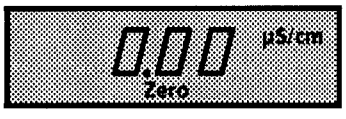
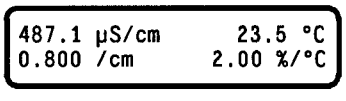
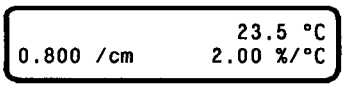
20.0 °C 1.000 /cm 2.00 %/°C	The 712 Conductometer is in the basic mode for conductivity measurement.
<cond param>	Now press the <cond param> key.
conductivity >cond/parameters	The dialogue display shows the title of the "cond/parameters" group, which contains the inquiries for the basic parameters of the conductivity measurement.
<enter>	Press the <enter> key to move to these inquiries.
>cond/parameters cell constant 1.000 /cm	The display shows the selection of the cell constant as the first inquiry. This constant is characteristic of each measuring cell and is printed on the cell. Enter the printed value using the numeric keys (e.g. "0.80"). **Note**: *The cell constant can change with time and must be checked at intervals (see section 4.4.3). See also the notes in section 3.4.*
<enter>	Confirm the entry with <enter>.
>cond/parameters meas.temp. 20.0 °C	The display shows the inquiry for the measurement temperature. If you have attached a temperature sensor to the 712 Conductometer, this parameter has no meaning as in this case the current temperature measured is used. If you are working without a temperature sensor, the current measurement temperature (e.g. "23.5" for 23.5 °C) must be entered here in °C.
<enter>	Confirm the entry with <enter>.
>cond/parameters ref.temp. 20.0 °C	The display shows the inquiry regarding the reference temperature. The measured conductivity is converted to this reference value using the measurement temperature and the temperature coefficient. The value of 20.0 °C already entered in the instrument is normally used as the reference temperature.
<enter>	Confirm the entry with <enter>.

>cond/parameters TC selection: const.	The display shows the inquiry for selection of the temperature coefficient, which specifies the percentage change in conductivity per °C. The <select> key can be used to switch between the two possibilities constant value "const." or stored function "cal.id.". In our case involving the measurement of tap water, we select "const.".
<enter>	Confirm the entry with <enter>.
>cond/parameters TC const. 2.00 %/°C	The display shows the inquiry for selection of the constant temperature coefficient. In the measurement of tap water, the preset value of 2.00 %/°C can be used.
<enter>	Confirm the entry with <enter>.
>cond/parameters frequency: auto	The inquiry for the selection of the measurement frequency now appears in the display. With the preset setting "auto", the better suited of the two possible measurement frequencies is automatically selected (300 Hz or 2.4 kHz).
<enter>	Confirm the entry with <enter>.
>cond/parameters meas.type: standard	The display shows the inquiry for the selection of the type of measurement. In our example, the preset measurement type "standard" is the correct selection for normal conductivity measurements.
<enter>	Confirm the entry with <enter>.
conductivity >cond/analog output	The title of the next group "analog output" now appears in the display. As neither this nor the remaining groups are important for our measurements, let us exit the inquiry.
<quit>	Press the <quit> key to return to the basic instrument mode.
23.5 °C 0.800 /cm 2.00 %/°C	The 712 Conductometer is in the measurement mode. The dialogue display now shows the new values of the cell constant (0.8), the measurement temperature (23.5 °C) and the temperature coefficient (2.00 %/°C).
	The actual measured value appears in the main display 1 and should be around 500 µS/cm for tap water.

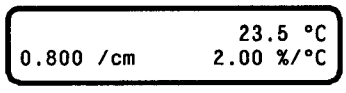
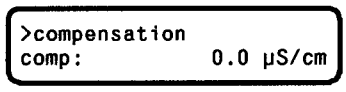
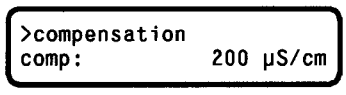
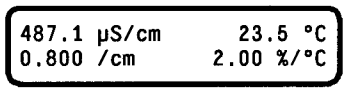
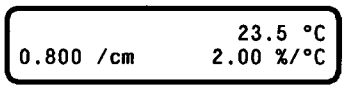
This concludes the entries for a normal conductivity measurement. As long as the 712 Conductometer remains switched on, the conductivity is measured and displayed continuously. The inputted parameters are also retained if the instrument is switched off so that measurements can be continued at the same point when it is switched on again. New parameter entries are necessary only

- if you are working without a temperature sensor and the measurement temperature changes (entry of the new measurement temperature)
- if the composition of the analysis solution changes drastically (entry of the new temperature coefficient)
- if you use a different measuring cell (entry of the new cell constant)

In addition to the measurement of the absolute conductivity, the 712 Conductometer also offers you two possibilities in automatic operation to set the conductivity to zero or to compensate it by a fixed amount. The first possibility of zero setting is called the **autozero function** and is initiated by the <auto zero> key. Proceed as follows:

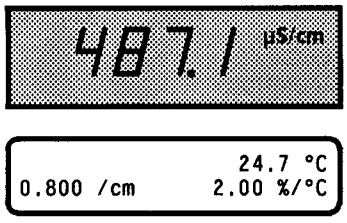
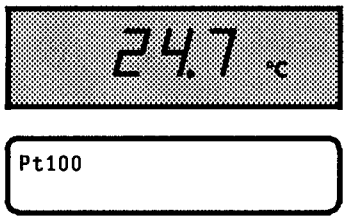
  <auto zero>	The 712 Conductometer is in the basic mode for conductivity measurement. The main display shows the measured conductivity value and the associated unit, the dialogue display the measurement parameters in force. Now press the <auto zero> key.
 	The current conductivity is set to 0.00 µS/cm in the main display, at the same time the status display "Zero" below the measured value lights up. From now on, the conductivity is measured relative to this zero point. The dialogue display shows not only the measurement parameters, but also the absolute conductivity at the top left, a value which is displayed continuously from now on.
<auto zero>	The <auto zero> key can be pressed as often as liked to reset the conductivity each time to 0.00 µS/cm.
<az off>	The autozero function can be switched off by pressing the <az off> key.
 	The main display again shows the current conductivity, at the same time the status display "Zero" fades. The display of the absolute conductivity disappears from the dialogue display.

The second possibility for **compensation** of the conductivity by a fixed amount is initiated by the <comp> key. Proceed as follows:

 	The 712 Conductometer is in the basic mode for conductivity measurement. The main display shows the measured conductivity value and the associated unit, the dialogue display the measurement parameters in force.
<comp>	Now press the <comp> key.
 	The inquiry regarding the compensation value appears in the dialogue display. The default value is 0.0 µS/cm. Enter the value here you wish to have subtracted from the conductivity, e.g. "200" for 200 µS/cm.
<enter>	Confirm the entry with <enter>.
	The main display now shows the conductivity reduced by the compensation value, at the same time the status display "Comp" below the measured value lights up.
	The dialogue display shows not only the measurement parameters, but also the absolute conductivity at the top left, a value which is shown continuously from now on.
<comp off>	The compensation can be switched off by pressing the <comp off> key.
	The main display again shows the uncompensated conductivity, at the same time the status display "Comp" fades.
	The display of the absolute conductivity disappears from the dialogue display.

4.1.4 Temperature measurement

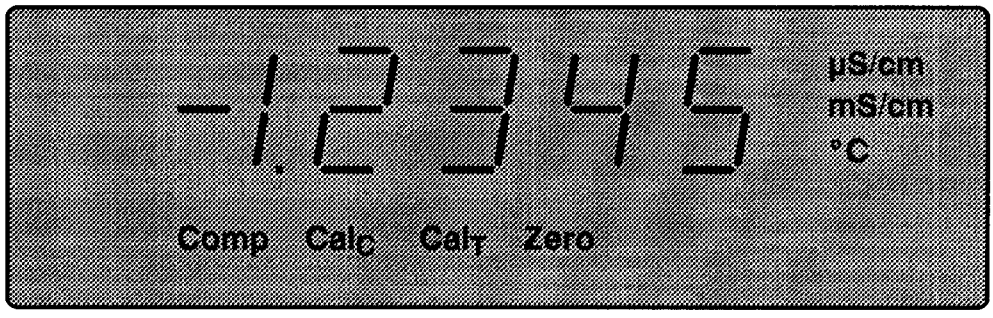
The 712 Conductometer can be used to measure not only conductivity, but also the temperature. A requirement for measurement of the latter is the attachment of a temperature sensor to input **8** "Pt100/Pt1000" (see *section 3.4*). In this case, the measured temperature is normally shown in dialogue display **2**, whereas the main display **1** shows the conductivity. To have the temperature shown in the main display, you must proceed as follows:

	The 712 Conductometer is in the basic mode for conductivity measurement. The main display shows the measured conductivity value and the associated unit, the dialogue display the measurement parameters in force and the measured temperature (here 24.7 °C).
<mode>	Now press the <mode> key.
	The 712 Conductometer is in the basic mode for temperature measurement. The main display shows the measured temperature value and the associated unit (°C), the dialogue display the type of temperature sensor (Pt100 or Pt1000) attached.
<mode>	Press the <mode> key to return to the basic mode of the conductivity measurement (see above).

As in conductivity measurement, the temperature measurement also offers the possibilities of automatic zero setting of the temperature and automatic compensation by a fixed amount. The **autozero function** is initiated by the <auto zero> key, the **compensation** by the <comp> key (see *section 4.1.3* for details).

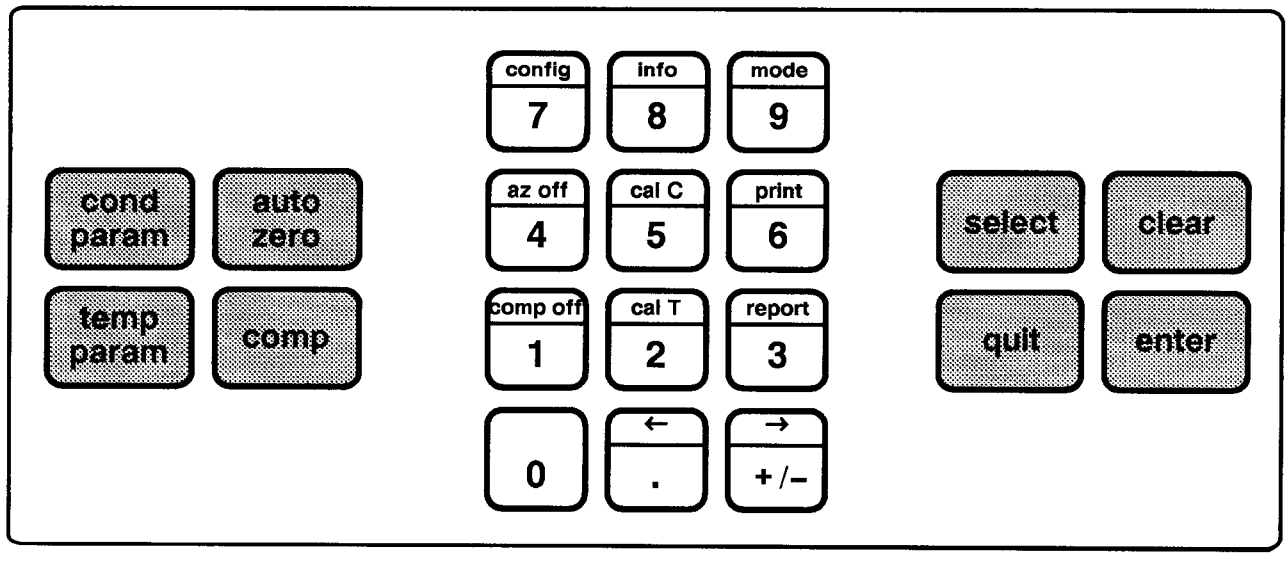
4.2 Fundamentals of operation

4.2.1 Main display

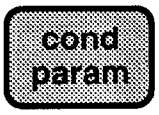


µS/cm	Unit for conductivity measurement
mS/cm	Unit for conductivity measurement
°C	Unit for temperature measurement
Comp	Compensation switched on
Cal_C	Calibration of cell constant running
Cal_T	Calibration of temperature coefficient running
Zero	Autozero function switched on

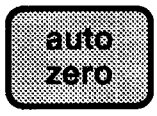
4.2.2 Overview of the key functions



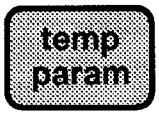
Main function keys



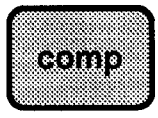
Entry of the parameters for the conductivity measurement (see *section 4.4.2*)



Automatic zeroing of conductivity or temperature (see *section 4.6.2*)



Entry of the parameters for the temperature measurement (see *section 4.5.2*)



Compensation of conductivity or temperature with preset value (see *section 4.6.4*)

Auxiliary functions of the numeric keys

Configuration (see *section 4.3*)

Selection of the main measurement mode (see *section 4.5.1*)

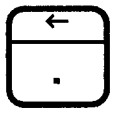
Switch off autozero (see *section 4.6.3*)

Printout of measured values or curves (see *section 4.7.3*)

Switch off compensation (see *section 4.6.5*)

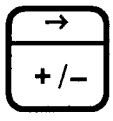
Printout of reports (see *section 4.7.2*)

Instrument information (see *section 4.7.1*)



Auxiliary key for entry of ASCII characters (see *section 4.2.5*)

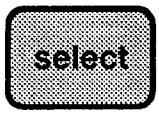
Calibration of the cell constant (see *section 4.4.3*)



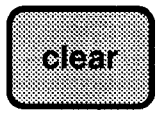
Auxiliary key for entry of ASCII characters (see *section 4.2.5*)

Calibration of the temperature coefficient (see *section 4.4.4*)

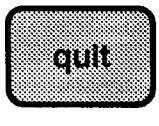
Auxiliary function keys



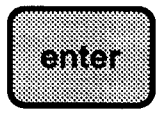
Selection of the entry or unit in dialogue options marked by a colon ":"



Overwriting of displayed parameter values and variables with the default values



Exit from rolling inquiries, print operations and error messages; returns to next higher program level



Confirmation of existing or keyed-in parameter values

4.2.3 Non-volatile main memory

After being switched on, the 712 Conductometer has exactly the same status as that immediately before the last instrument shutdown, i.e. all parameter settings, the configuration and the calibration data memory are retained when the instrument is switched off.

4.2.4 Instrument dialogue

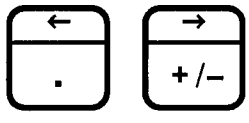
The instrument dialogue is organised in the form of so-called rolling inquiries which have a hierarchical arrangement and which are governed by the following rules:

- The inquiries are combined in groups. Repeated pressing of these keys displays the titles of these groups. All titles are marked by the character ">" before the dialogue text. The <enter> key is used to branch to the individual inquiries.
- Displayed values of these inquiries are confirmed with <enter> and the next inquiry appears.
- Entries can be made either with the numeric keys or by selecting from preset values using the <select> key. All entries in which the <select> key can be pressed are marked by a colon ":" following the dialogue text.
- The <quit> key can be used to exit the inquiries and move to the next higher level, i.e. return to the title of the inquiry group or to the initial condition.

The organisation of the rolling inquiries is shown schematically in *Fig. 11*.

4.2.5 Text entry

The following two keys can be used with certain inquiries to enter any ASCII characters and hence write texts.



1▸ First press the <←> key to enter a new text.

2▸ The character in the flashing position can be selected. Turn the character drum with the <←> and <→> keys until the correct character appears (numbers can also be entered directly with the numeric keys).

3▸ Confirm the character with <enter>.

4▸ Select the character for the next position and confirm with <enter> etc.

5▸ When your text is complete and is shorter than the input field in the display, press <quit> to exit the text entry, then <enter> to store the text. If your text occupies the entire input field, you need only press <enter> to store the text.

6▸ If you have made a keying error, you can delete one position backwards by pressing <clear>. If you press <clear> repeatedly, you delete one position after the other.

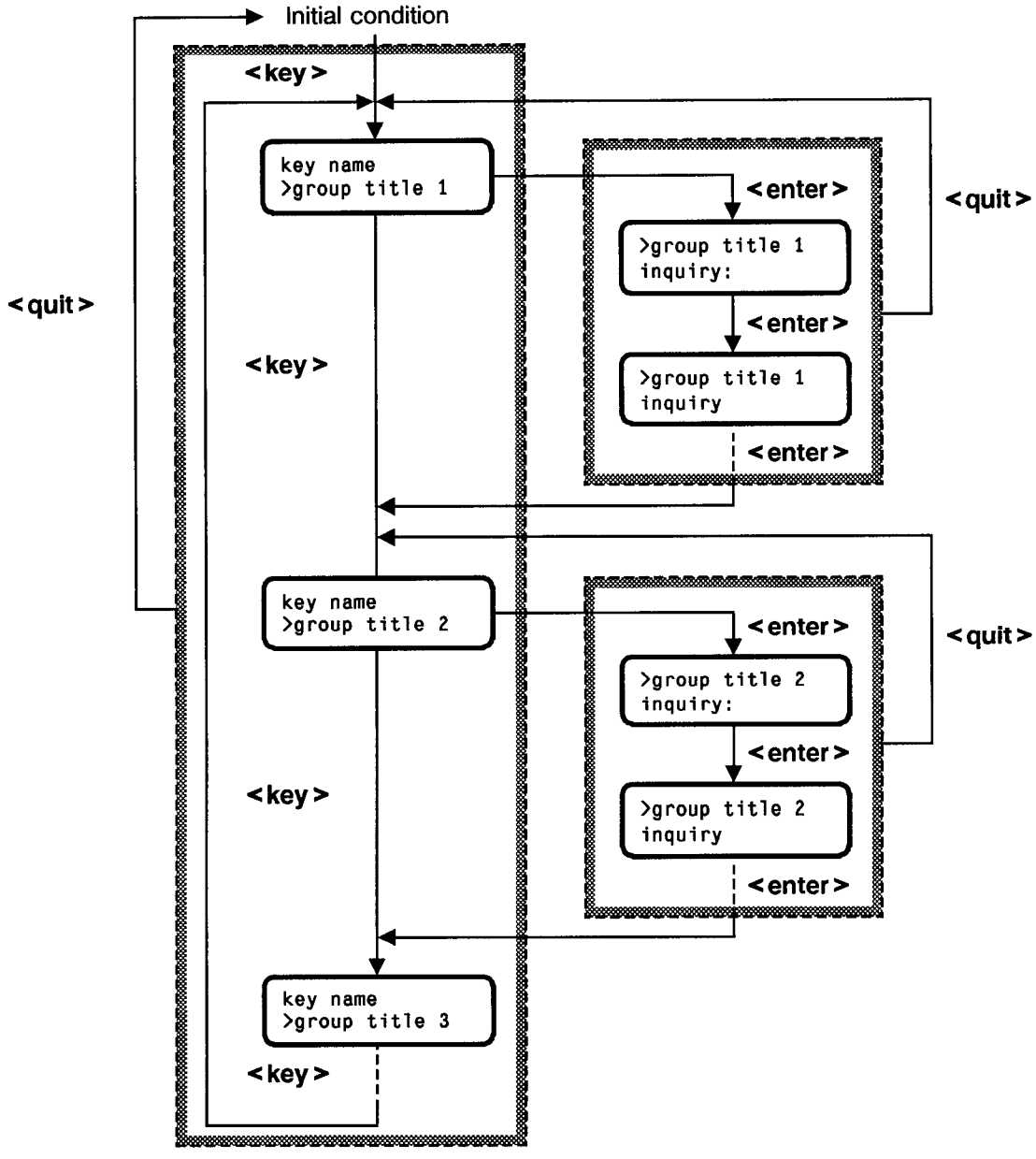


Fig. 11: Schematic representation of rolling inquiries

Correction of a stored text

If you have already stored a text, you can add characters to it or correct it:

1▸ To correct an old text, first press the < → > key. The stored text appears, the last position flashes to show it can be changed.

2▸ If you wish to correct the text from a different position, press <clear> until the desired position flashes.

4.3 Configuration, <config> key

config
7

The <config> key is used for the entry of data specific to the instrument. The key is organised as a rolling inquiry. The following summary shows all dialogue options which appear under <config>. The values shown in the displays are default values.

config >config/print	**Settings for external printers**
>config/print id.1 xxxxxxxxxxxxxxxxx	**Identification 1 for 1st line of the printout header** ASCII character string for the first line of the printout header (max. 18 characters, see *section 4.2.5* for entry)
>config/print id.2 xxxxxxxxxxxxxxxxx	**Identification 2 for 2nd line of the printout header** ASCII character string for the second line of the printout header (max. 18 characters, see *section 4.2.5* for entry)
>config/print print header: once	**Printout of the header** The header comprises a title line (with instrument name, manufacturing number and program number), identification 1 and 2 as well as the optional date and time and is printed out before a measured value, report or curve plot. `once` Printout of the header once only after the instrument has been switched on `always` Printout of the header before every measured value, report or curve plot `OFF` No printout of the header
>config/print date&time: ON	**Printout of date and time in the header** `ON` Date and time are printed out in the header `OFF` Date and time are not printed out in the header
>config/print send to: IBM	**Selection of the character set/printer type** `IBM` Character set 437 for IBM PC or printer type IBM Proprinter and compatible printers (see *section 3.6.1*) `Epson` EPSON printer `Seiko` Seiko printer DPU-411 `Citizen` Citizen printer IDP560 RS `HP` HP printers (DeskJet..., LaserJet..., etc.) You will find further details regarding the attachment of a printer in *section 3.6.2*.

```
config
>config/print meas.value
```

Settings for measured value printout
Output of measured values via RS232 interface

```
>config/print meas.value
print crit.:      immed.
```

Criterion for measured value printout

- `immed.` Measured value printout each time the <print> key is pressed
- `time` Timed measured value printout in selectable time intervals
- `plot` Printout of the measured values in curve form

```
>config/print meas.value
time interval      1.0 s
```

Time interval for measured value printout
This inquiry appears only with "print crit. = time" or "print crit. = plot"
Time interval between the measured value printout:
`0.08 ... 99999 s (27 h 47 min)`

```
>config/print meas.value
time scale       60 s/cm
```

Scaling of the time axis for plot
This inquiry appears only with "print crit. = plot"
Scaling of the time axis in s/cm
`5, 10, 30, 60, 120, 180 ... 99960 s/cm (27 h 46 min)`
The reciprocal of this quantity represents the paper feed in cm/s (the effective paper feed depends on the printer used).

```
>config/print meas.value
time scale label:    abs
```

Label of the time axis for plot
This inquiry appears only with "print crit. = plot"

- `abs` Label with absolute (current) time (e.g. "08:30")
- `rel` Label with relative time beginning at start of the curve plot (e.g. "2m40s" for 2 min 40 s)

The label is outputted at every main division.

```
>config/print meas.value
stop time          OFF
```

Stop time for measured value printout
This inquiry appears only with "print crit. = time" or "print crit. = plot"
Time until stop of the measured value printout:

- `OFF` no time limit (press <clear>)

`1 ... 99999 s (27 h 47 min)`

```
>config/print meas.value
date&time:         OFF
```

Printout of date and time
This inquiry appears only with "print crit. = immed." or "print crit. = time"

- `OFF` Date and time are not printed out
- `ON` Date and time are printed out for each measured value

```
config
>config/report type
```

Settings for calibration report

```
>config/report type
orig. cal.report:    OFF
```

Printout of the original calibration report

OFF	No automatic printout of the original report with calibrations
ON	Automatic printout of the original report with calibrations

```
>config/report type
cal.report format: short
```

Format of the calibration report for "cal T"

short	Calibration report without curve
full	Calibration report with curve

```
config
>config/auxiliaries
```

General instrument settings

```
>config/auxiliaries
run number           0
```

Run number

Each time a measured value printout is initiated by pressing the <print> key or automatically, the run number is incremented by 1.

0 ... 999	Start point for numbering
OFF	No numbering (press <clear>)

```
>config/auxiliaries
Date            YY-MM-DD
```

Date

Current date with numeric data for year (YY), month (MM) and day (DD)

```
>config/auxiliaries
Time            HH:MM:SS
```

Time

Current time with numeric data for hours (HH), minutes (MM) and seconds (SS). A new time entry becomes active when the <enter> key is pressed.

```
>config/auxiliaries
dialog:          english
```

Dialogue language

english	English
deutsch	German
francais	French
español	Spanish

```
>config/auxiliaries
device label    xxxxxxxx
```

Device label

ASCII character string for device label (max. 8 characters, see *section 4.2.5* for entry)

```
>config/auxiliaries
program         712.0012
```

Number of the program version

Display only (no input possibility).
Please quote this number in inquiries to Metrohm.

```
config
>config/RS232 settings
```

Settings for RS232 interface
See *section 5.6* for further details.

```
>config/RS232 settings
baud rate:          9600
```

Data transmission rate (baud rate)

9600, 4800, 2400, 1200, 600, 300 bit/s

```
>config/RS232 settings
data bit:              8
```

Data bits

7, 8

```
>config/RS232 settings
stop bit:              1
```

Stop bits

1, 2

```
>config/RS232 settings
parity:             none
```

Parity

none, odd, even

```
>config/RS232 settings
handshake:           HWs
```

Handshake

HWs	Reduced hardware handshake
HWf	Full hardware handshake
SWchar	Software handshake with character stop
SWline	Software handshake with line stop
none	No handshake

For further details of the handshake, see *section 5.6.2*.

```
>config/RS232 settings
RS control:           ON
```

Control via RS232 interface

ON	Data receipt via RS232 interface switched on
OFF	Data receipt via RS232 interface switched off (no external control via RS232 possible)

4.4 Conductivity measurement

4.4.1 General information on measuring the conductivity

Determination of the **electrical conductivity** κ of a solution (also known as conductometry) is effected indirectly by measuring its resistance R or the reciprocal of the resistance, the conductance G, and the **cell constant** c, which depends on the geometry of the experimental arrangement.

$$\kappa = \frac{1}{R} \cdot \frac{l}{A} = G \cdot c$$

κ	Conductivity	Unit: S cm^{-1}
R	Resistance	Unit: Ω
$G = 1/R$	Conductance	Unit: S (Siemens) = Ω^{-1}
l	Length of measurement path	Unit: cm
A	Cross sectional area	Unit: cm^2
$c = l/A$	Cell constant	Unit: cm^{-1}

The cell constant c for a particular measuring cell can be determined automatically by the 712 Conductometer by measurement of a solution of known conductivity (see *section 4.4.3*).

The electrical conductivity κ depends greatly on the temperature. The conductivity κ_T measured at a particular temperature T is thus automatically converted by the 712 Conductometer to the conductivity κ_R at the freely selectable reference temperature T_R (usually 20°C or 25°C). Conversion employs the **temperature coefficient** a_R.

$$\kappa_R = \frac{\kappa_T}{1 + \frac{a_R}{100}(T - T_R)}$$

$$a_R = \frac{100}{\kappa_R} \cdot \frac{\kappa_T - \kappa_R}{T - T_R}$$

κ_R	Conductivity at reference temperature T_R
κ_T	Conductivity at measurement temperature T
T	Measurement temperature
T_R	Reference temperature
a_R	Temperature coefficient (referred to reference temperature T_R); unit %/°C

The temperature coefficient a_R can either be entered manually as a constant on the 712 Conductometer or determined by automatic calibration as a function of the temperature (see *section 4.4.4*).

In normal conductivity measurements, it can be an advantage to **stir the analysis solution** to obtain a stable measured value. A stirrer is indispensable in measurements in which the conductivity changes rapidly (e.g. in conductivity titrations). The 728 Magnet Swing-out Stirrer available from Metrohm as an option is eminently suitable in such cases (see *section 9.2.1*).

On the other hand, for measurements in solutions of low conductivity stirring open measuring vessels can lead to increased absorption of atmospheric CO_2, which will result in a gradual increase in the measured conductivity.

4.4.2 Parameters for conductivity measurement, <cond param> key

cond param

The <cond param> key is used to enter the specific parameters for the conductivity measurement. The key is organised as a rolling inquiry. The following summary shows all dialogue options which appear under <cond param>. The values shown in the displays are default values.

conductivity >cond/parameters	**Parameters for conductivity measurement**
>cond/parameters cell constant 1.000 /cm	**Cell constant** Cell constant c of the measuring cell (unit cm^{-1}) 0.001 ... 500 /cm The cell constant can be entered manually or determined automatically by means of the cell constant calibration (see *section 4.4.3*). ***Note***: *The cell constant can change with time during dry storage or in measurements which contaminate the platinum surface and must therefore be checked at intervals (see notes in section 4.4.3). It may be necessary to replatinise the platinum electrode in some cases (see section 7.3).*
>cond/parameters meas.temp. 20.0 °C	**Measurement temperature** Temperature of the analysis solution -170.0 ... 500.0 °C If a temperature sensor is attached to the 712 Conductometer, this parameter has no meaning as in this case the temperature measured with the sensor is used.
>cond/parameters ref.temp. 20.0 °C	**Reference temperature** Reference temperature T_R for specification of the conductivity (the displayed conductivity κ_R refers to this temperature) -170.0 ... 500.0 °C In many cases, the value of 20.0 °C already preset in the instrument is used as the reference temperature.
>cond/parameters TC selection: const.	**Selection of the temperature coefficient α_R (TC)** const. TC constant over the entire temperature range cal.id. TC as a function of the temperature, recorded beforehand with the TC calibration (see *section 4.4.4*) and stored under an identification "cal.id.".

```
>cond/parameters
TC const.       2.00 %/°C
```

Temperature coefficient (constant)

This inquiry appears only with "TC selection = const."

Constant temperature coefficient α_R for automatic temperature correction

`0.00 ... 9.99 %/°C`

With "`0.0`" there is no temperature correction.

```
>cond/parameters
TC ident.:          DIN
```

Identification for TC calibration

This inquiry appears only with "TC selection = cal.id."

Selection of the TC calibration identification:

`DIN` Permanently stored TC function for natural ground, spring or surface water following DIN 38404-C8.

`cal.id.` TC function recorded beforehand with the automatic TC calibration and stored under the identification "`cal.id.`" (max. 9 TC functions can be stored)

```
>cond/parameters
frequency:          auto
```

Measurement frequency

`auto` Automatic selection of the better suited frequency of the two available

`300 Hz` Measurement frequency fixed at 300 Hz

`2.4 kHz` Measurement frequency fixed at 2.4 kHz

```
>cond/parameters
meas.type:       standard
```

Measurement type

`standard` Normal measurement mode for conductivity measurement; measurement interval 400 ms

`titration` Measurement mode for conductivity titrations; measurement interval 80 ms

`TDS` Measurement mode "Total Dissolved Solids"; measurement interval 400 ms.

In addition to the conductivity shown in the main display, the dialogue display outputs the TDS value instead of the cell constant. This value corresponds to the NaCl content in g/L or mg/L which a pure NaCl solution with this conductivity would have. The measured conductivity is converted to the corresponding NaCl content with a function stored in the instrument.

Note:

When "TDS" is selected, the TDS value is outputted instead of the conductivity on the measured value printout.

A graphical plot of TDS values (curve plot) is not possible.

```
conductivity
>cond/analog output
```

Parameters for analogue output

```
>cond/analog output
status:              OFF
```

Status of the analogue output

OFF	Analogue output switched off, 0 mV at output
ON	Analogue output switched on, output signal 0 ... 2 V, defined by the following parameters
cond.preset	A preset conductivity value is outputted at the analogue output (useful for recorder calibration)
mV preset	A preset mV value is outputted at the analogue output (useful for recorder calibration)

```
>cond/analog output
polarity:             +
```

Polarity of the output signal

This inquiry appears only with "status = ON" or "status = cond.preset"

+	Positive polarity
–	Negative polarity

```
>cond/analog output
1 V range:      10 mS/cm
```

Full scale range for 1 V

This inquiry appears only with "status = ON" or "status = cond.preset"

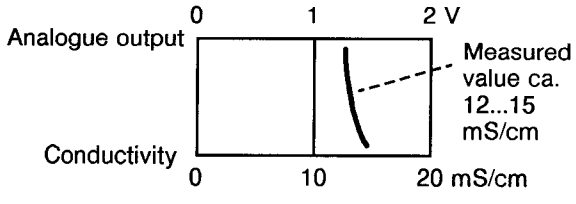
Conductivity range which should be shown within 1 V.

1.0 µS/cm ... 2 S/cm

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

Example:

```
"polarity:              +"
"1 V range:     10 mS/cm"
"0 V at:        0.0 µS/cm"
"offset                0 mV"
```




```
>cond/analog output
0 V at:         0.0 µS/cm
```

Conductivity for 0 V

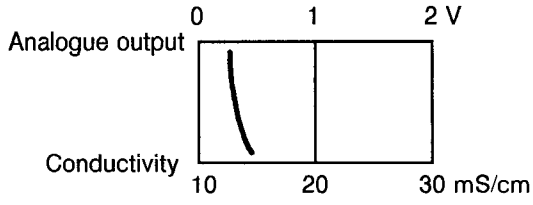
This inquiry appears only with "status = ON" or "status = cond.preset"

Selection of the conductivity for zero point (0 V), start value for conductivity range

-2 ... 2 S/cm

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

Example: "polarity: +"
"1 V range: 10 mS/cm"
"**0 V at: 10 mS/cm**"
"offset 0 mV"



>cond/analog output
offset 0 mV

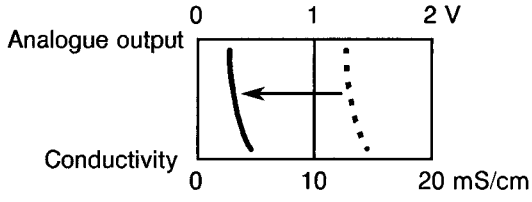
Offset

This inquiry appears only with "status = ON" or "status = cond.preset"

Offset of the zero point of the conductivity

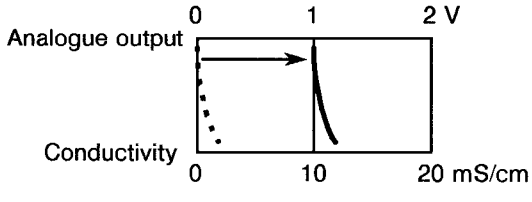
-2000... 2000 mV

Example: "polarity: +"
"1 V range: 10 mS/cm"
"0 V at: 0.0 µS/cm"
"**offset -1000 mV**"



The possibility to offset the zero point is particularly useful in autozero operation.

Example: "polarity: +"
"1 V range: 10 mS/cm"
"0 V at: 0.0 µS/cm"
"**offset 1000 mV**"



>cond/analog output
preset: 0.0 µS/cm

Preset conductivity value

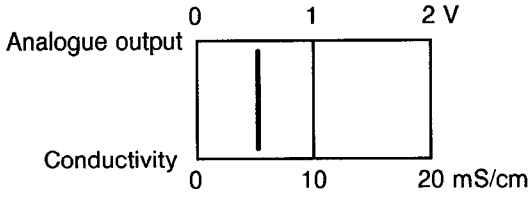
This inquiry appears only with "status = cond.preset"

Conductivity value that is outputted at the analogue output (useful for recorder calibration)

-2 ... 2 S/cm

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

Example: "polarity: +"
"1 V range: 10 mS/cm"
"0 V at: 0.0 µS/cm"
"offset 0 mV"
"**preset: 5.0 mS/cm**"



>cond/analog output
preset 0.0 mV

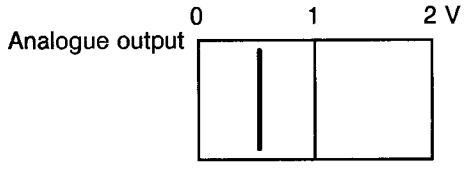
Preset mV value

This inquiry appears only with "status = mV preset"

Absolute signal that is outputted at the analogue output (useful for recorder calibration)

0... 2000 mV

Example: "**preset 500 mV**"



conductivity
>cond/limits

Parameters for limit control

>cond/limits
status: OFF

Status of limit control

OFF — Limit control switched off

ON — Limit control switched on.
If the limit values are exceeded, the corresponding output signals are set at the remote interface (see *section 6.3*). Simple on/off controls, e.g. for addition of solutions or triggering of alarms are thus possible.

>cond/limits
upper limit: 0.0 µS/cm

Upper limit

This inquiry appears only with "status = ON"

Upper limit value for limit control. If this value is exceeded, the corresponding signal for the upper limit is set to active (low) at the remote interface.

-2 ... 2 S/cm

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

```
>cond/limits
upper hyst.:   0.0 µS/cm
```

Hysteresis for upper limit

This inquiry appears only with "`status = ON`*"*

Hysteresis value for the upper limit value. The signal for the upper limit value is not set to inactive (high) at the remote interface until the value is lower than the upper limit value minus the hysteresis value.

`-2 ... 2 S/cm`

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

On entry of a negative value, the signal for the upper limit value at the remote interface oscillates in the range limit value + absolute value of the hysteresis at twice the measurement frequency.

```
>cond/limits
lower limit:   0.0 µS/cm
```

Lower limit

This inquiry appears only with "`status = ON`*"*

Lower limit value for limit control. If the actual value is lower than this limit, the corresponding signal for the lower limit value is set active (low) at the remote interface.

`-2 ... 2 S/cm`

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

```
>cond/limits
lower hyst.:   0.0 µS/cm
```

Hysteresis for lower limit

This inquiry appears only with "`status = ON`*"*

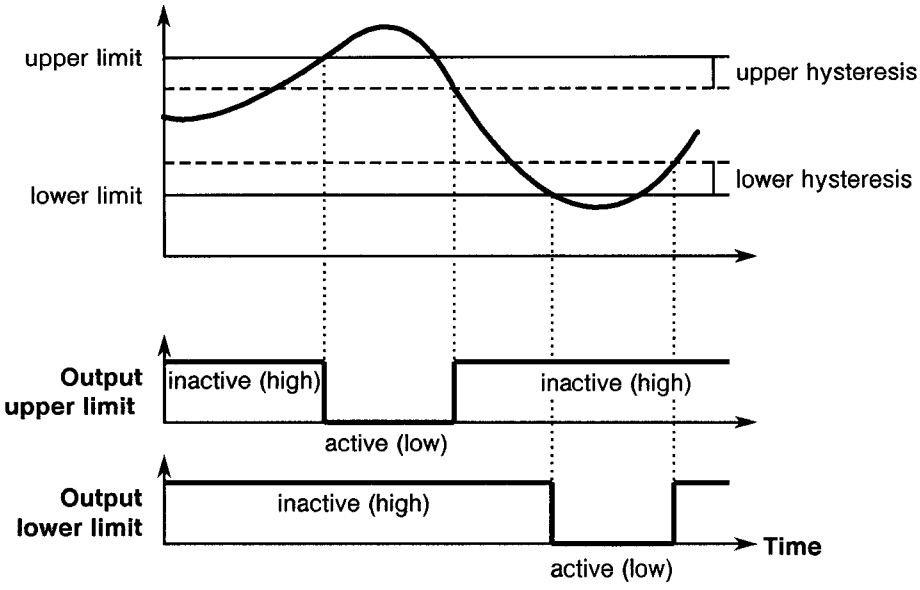
Hysteresis value for the lower limit value. The signal for the lower limit value is not set to inactive (high) at the remote interface until the value is higher than the lower limit value plus the hysteresis value.

`-2 ... 2 S/cm`

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

On entry of a negative value, the signal for the lower limit value at the remote interface oscillates in the range limit value – absolute value of the hysteresis at twice the measurement frequency.

Schematic representation of the limit control




```
conductivity
>cond/plot margins
```

Parameters for plot margins

```
>cond/plot margins
left:          0.0 µS/cm
```

Left margin of the plotting area
Left limit value for curve plot of the conductivity on an external printer (see also *section 4.7.3*)

`-2 ... 2 S/cm`

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

```
>cond/plot margins
right:         0.0 µS/cm
```

Right margin of the plotting area
Right limit value for curve plot of the conductivity on an external printer (see also *section 4.7.3*)

`-2 ... 2 S/cm`

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

4.4.3 Calibration of the cell constant, <cal C> key

cal C
5

The <cal C> key is used for the automatic determination of the cell constant with a known standard solution. The key is organised as a rolling inquiry. The following summary shows the course of the calibration and the dialogue options which appear. The values shown in the displays are the default values.

Note: *The <cal C> key is accessible only in the main measurement mode "Conductivity".*

Please also note the information on cell constant calibration on page 41.

```
cell const. calibration
standard:      0.0 µS/cm
```

Conductivity of the standard solution
Entry of the conductivity of the standard solution (at the reference temperature entered in the next step)

```
0 µS/cm ... 2 S/cm
```

The unit (µS/cm, mS/cm, S/cm) can be selected with the <select> key.

Selection of the standard solution depends on the attached conductivity cell or the cell constant. The conductivity of the standard solution must be within the conductivity measurement range admissible for this cell constant (see *Fig. 3* in *section 3.4*).

The 6.2301.060 Conductivity Standard is available from Metrohm as an option and comprises a potassium chloride solution with c(KCl) = 0.1000 ± 0.0005 mol/L. The following Table shows the temperature dependence of the reference data for the conductivity and the temperature coefficient for the solution c(KCl) = 0.1 mol/L as well as for a solution c(KCl) = 0.01 mol/L prepared by diluting the standard ten times. You will find additional reference data for aqueous electrolyte solutions in Application Bulletin 102 "Conductometry".

T	c(KCl) = 0.1 mol/L		c(KCl) = 0.01 mol/L	
	κ	α_{20}	κ	α_{20}
18 °C	11.19 mS/cm	2.06 %/°C	1.225 mS/cm	2.07 %/°C
19 °C	11.43 mS/cm	2.06 %/°C	1.251 mS/cm	2.11 %/°C
20 °C	11.67 mS/cm	–	1.278 mS/cm	–
21 °C	11.91 mS/cm	2.06 %/°C	1.305 mS/cm	2.11 %/°C
22 °C	12.15 mS/cm	2.06 %/°C	1.332 mS/cm	2.11 %/°C
23 °C	12.39 mS/cm	2.06 %/°C	1.359 mS/cm	2.11 %/°C
24 °C	12.64 mS/cm	2.07 %/°C	1.386 mS/cm	2.11 %/°C
25 °C	12.88 mS/cm	2.07 %/°C	1.413 mS/cm	2.11 %/°C

```
cell const. calibration
std.ref.temp.    20.0 °C
```

Reference temperature of the standard solution
Reference temperature T_R for the conductivity of the standard solution entered earlier.

-170.0 ... 500.0 °C

If the conductivity of the standard solution is known at the measurement temperature, a reference temperature the same as the measurement temperature should be selected so that no temperature correction is needed. This applies particularly when work is performed with a thermostatted standard solution.

If the reference temperature and the measurement temperature are not identical, the temperature coefficient applicable to the standard solution must be entered before the start of the cell constant calibration (<cond param>, see *section 4.4.2*).

```
cell const. calibration
std.meas.temp.   20.0 °C
```

Measurement temperature of the standard solution

-170.0 ... 500.0 °C

If a temperature sensor is attached to the 712 Conductometer, this parameter has no meaning as the temperature measured by the sensor is used.

After confirmation of the measurement temperature with the <enter> key, the status display "Cal_C" appears in the main display instead of the conductivity.

```
cell const. calibration
QUIT>break   ENTER>start
```

Start of the calibration

<quit> Termination of the calibration and return to the basic mode

<enter> Start of the calibration. As soon as the cell constant has been determined, the result appears in the main and dialogue display.

```
cell constant  0.814 /cm
QUIT>break  ENTER>accept
```

Confirmation of the cell constant

<quit> Termination of the calibration and return to the basic mode

<enter> Confirmation of the determined cell constant. From now on, the new value for the cell constant applies and is stored under the <cond param> key (the old value is overwritten). Following the confirmation, the instrument returns to the basic mode of the conductivity measurement.

If the automatic printout of the original calibration report is switched on (parameter "orig. cal.report = ON", <config> key, see *section 4.3*), the report of the cell constant calibration is then printed out. The double dashed line at the end of the report indicates that the printout is that of an original report.

The calibration report can also be printed out any time later under the <report> key (see *section 4.7.2*). In this case, however, there is only a single dashed line at the end of the report.

Examples of original reports

Calibration with temperature sensor (measurement temperature not shown)

```
calibration of cell constant
  cal.date    94-07-19  14:36
  standard:             11.67 mS/cm
  std.ref.temp.          20.0 °C
  cell constant         0.852 /cm
              ==============
```

Calibration without temperature sensor (measurement temperature is shown)

```
calibration of cell constant
  cal.date    94-07-19  15:07
  standard:             11.67 mS/cm
  std.ref.temp.          20.0 °C
  std.meas.temp.         23.5 °C
  cell constant         0.852 /cm
              ==============
```

Notes on cell constant calibration

- The cell constant printed on the conductivity cell can change with time. Possible reasons for this are
  - dry storage,
  - measurements in which the platinum surface is contaminated,
  - change in the platinum black layer through ageing or mechanical damage.

  The cell constant should thus be checked regularly and recalibrated if need be.
- After replatinisation (see *section 7.3*), the cell constant must always be recalibrated.
- Conductivity cells which are stored dry must be placed in acetone for 1...2 h to degrease them, then rinsed thoroughly with dist. water and immersed in dist. water for 1...2 h.
- On frequent use, always store conductivity cells in dist. water.
- During the measurement, ensure that no air bubbles adhere to the electrodes.

4.4.4 Calibration of the temperature coefficient, <cal T> key

The <cal T> key is used for the automatic determination of the temperature coefficient and to clear calibration data. The 712 Conductometer offers the two following possibilities to determine the TC:

- **Calibration <u>with</u> temperature sensor**
  Here, the **TC function** is determined automatically as a function of the temperature for a preset temperature range
- **Calibration <u>without</u> temperature sensor**
  Here, a constant TC value is determined for the temperature range between two different temperatures in the conductivity measurement

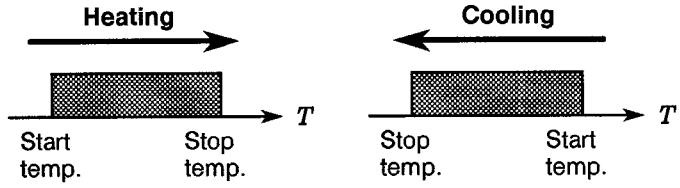
The <cal T> key is organised as a rolling inquiry. The following summary shows all dialogue options which appear under <Cal T> as well as the course of the calibration with and without temperature sensor. The values shown in the displays are the default values.

<u>Note</u>: *The <cal T> key is accessible only in the main measurement mode "Conductivity".*

Please also note the information regarding TC calibration on page 48.

temp.coeff. calibration >cal T/new calibration	**New TC calibration**
>cal T/new calibration new cal.id. xxxxxxxxxx	**New identification for calibration data** ASCII character string for identification of the calibration data determined subsequently (max. 10 characters, see *section 4.2.5* for entry). Max. 9 calibration data records can be stored in the instrument.
temp.coeff. calibration >cal T/new cal/auto	**Automatic calibration <u>with</u> Pt100/Pt1000** *This group of inquiries appears only if a temperature sensor is attached to the 712 Conductometer. The actual title is not shown, a direct switch to the next display is effected.*
>cal T/new cal/auto start temp. 20.0 °C	**Start temperature** Start temperature for the automatic determination of the temperature coefficient -170.0 ... 500.0 °C
>cal T/new cal/auto stop temp. 50.0 °C	**Stop temperature** Stop temperature for the automatic determination of the temperature coefficient -170.0 ... 500.0 °C

The start and stop temperature define the temperature range in which the TC function should be determined. If the start temperature is lower than the stop temperature, the analysis solution for the calibration must be heated, in the opposite case it must be cooled.



***Note**: Start and stop temperature should be selected so that the reference temperature lies within the calibration range. If the reference temperature is outside this range, depending on the profile of the TC function large errors can appear when the conductivity is converted to the reference temperature (see notes at the end of this section).*

After confirmation of the stop temperature with the <enter> key, the current temperature appears in the main display in place of the conductivity. At the same time, the status display "Cal_T" lights up.

```
>cal T/new cal/auto
QUIT>break   ENTER>start
```

Start of the TC calibration
Before the TC calibration can be started, the conductivity and temperature sensors must be immersed in the analysis solution. It is advisable to stir the analysis solution during the entire calibration. You will find further information on the TC calibration procedure at the end of this section.

The temperature of the analysis solution must be lower (with start temp. < stop temp.) or higher (with start temp. > stop temp.) than the start temperature.

<quit> Termination of the calibration and return to the basic mode

<enter> Start of the calibration

```
start temp.      20.0 °C
cal T waiting...
```

Instrument waits for attainment of start temperature
The analysis solution must now be heated or cooled. Note here the information at the end of this section.

As soon as the start temperature is reached, the automatic TC calibration starts with measurement of the conductivity and temperature.

```
temperature      25.8 °C
cal T running...
```

TC calibration
During the automatic TC calibration, the current conductivity value is shown continuously in the main display, whereas the dialogue display shows the current temperature.

The ongoing TC calibration can be terminated at any time by pressing the <quit> key.

```
TC range  2.07/2.16 %/°C
QUIT>break  ENTER>accept
```

Confirmation of the results
As soon as the stop temperature is reached, an approximation function for the temperature coefficient is calculated from the measured value pairs conductivity vs temperature. This is based on the Tschebyscheff method (polynomial of the 4th degree with the coefficients c0 ... c4). The minimum and maximum TC value of this function over temperature range investigated appear as the result in the dialogue display.

<quit> Termination of the calibration and return to the basic mode

<enter> Confirmation of the determined TC function, which is then stored under the identification entered at the start. After the confirmation, the instrument returns to the basic mode of the conductivity measurement.

Note: *To allow the newly recorded TC function to be used for the conductivity measurement, it must first be loaded under its identification as a conductivity parameter (parameter "*`TC ident.:`*", <cond param> key, see section 4.4.2).*

If the automatic printout of the original calibration report is switched on (parameter "`orig. cal.report = ON`", <config> key, see *section 4.3*), the report of the TC calibration is then printed out. The double dashed line at the end of the report signifies that the printout is that of an original report.

The contents of the original calibration report depend on the selection of the parameter "`cal.report format`" (<config> key, see *section 4.3*):

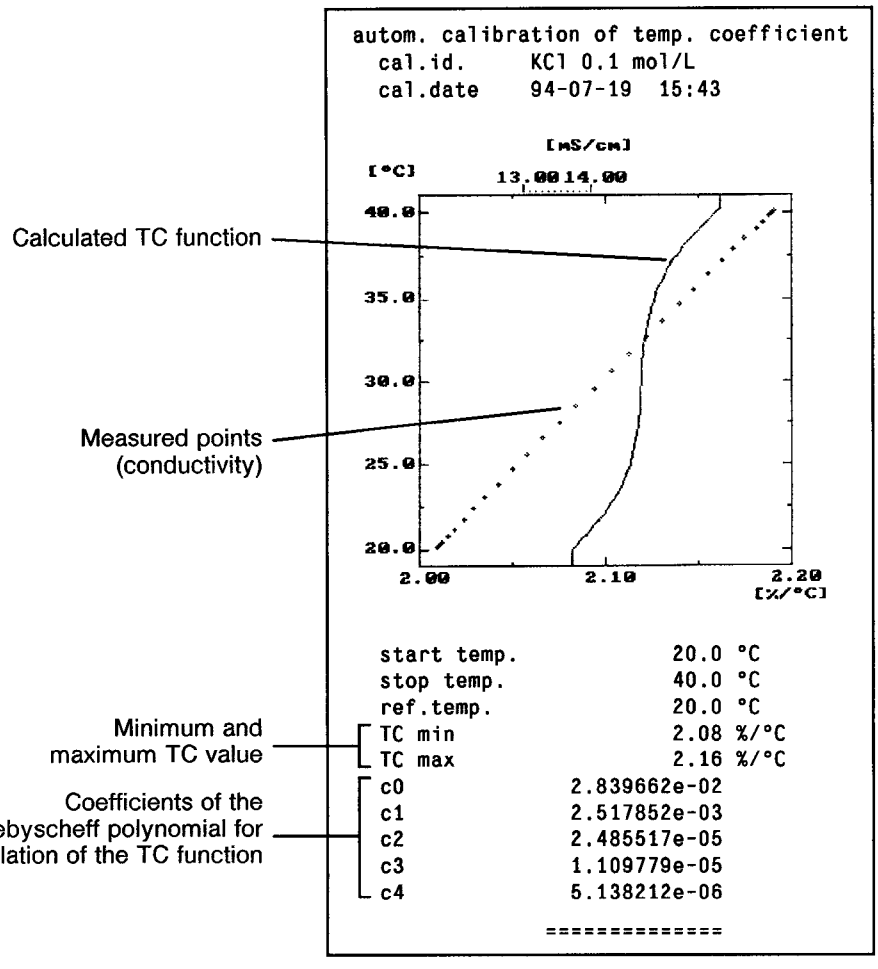
- `cal.report format = full`
  Report with parameters of the calibration and calibration curve (details, see example and *section 4.7.2*).
- `cal.report format = short`
  Report with parameters of the calibration (details, see *section 4.7.2*)

The calibration report can also be printed out any time later under the <report> key (see *section 4.7.2*). In this case, however, only a single dashed line is outputted at the end of the report. Further, in the curve representation only the TC function is plotted as the individual measured values are not stored.

Example of an original report

Calibration with temperature sensor

Solution: KCl 0.1 mol/L




```
temp.coeff. calibration
>cal T/new cal/man
```

Manual calibration without Pt100/Pt1000

This group of inquiries appears only if no temperature sensor is attached to the 712 Conductometer. The actual title is not shown, a direct switch to the next display is effected.

```
>cal T/new cal/man
temp.1          20.0 °C
```

1st measurement temperature

Measurement temperature of 1st calibration solution for the automatic determination of the temperature coefficient

-170.0 ... 500.0 °C

```
>cal T/new cal/man
temp.2          30.0 °C
```

2nd measurement temperature
Measurement temperature of 2nd calibration solution for the automatic determination of the temperature coefficient

-170.0 ... 500.0 °C

The two temperatures define the temperature range in which the linear TC value should be determined. While the first temperature can be higher or lower than the second, the TC value is always referred to the lower of the two temperatures.

Note: *The two temperatures for the TC calibration should be selected so that the reference temperature lies within the calibration range. If the reference temperature is outside this range, depending on the profile of the TC function large errors can appear when the conductivity is converted to the reference temperature (see notes at the end of this section).*

After confirmation of the 2nd temperature with the <enter> key, the status display "Cal_T" lights up in the main display. Before the TC calibration can be started, the conductivity sensor must be immersed in the desired analysis solution. It is advisable to stir the analysis solution during the entire calibration. You will find further information on the TC calibration procedure at the end of this section.

```
if temp.1 =      20.0 °C
CLEAR>new T ENTER>accept
```

Start of the 1st measurement
The display shows the 1st measurement temperature. As soon as the temperature of the analysis solution has reached this temperature, measurement of the 1st calibration solution can begin.

<clear> Entry of a new measurement temperature

<enter> Start of the conductivity measurement at the 1st measurement temperature

```
if temp.2 =      30.0 °C
CLEAR>new T ENTER>accept
```

Start of the 2nd measurement
The display shows the 2nd measurement temperature. As soon as the temperature of the analysis solution has reached this temperature, measurement of the 2nd calibration solution can begin.

<clear> Entry of a new measurement temperature

<enter> Start of the conductivity measurement at the 2nd measurement temperature

```
TC =              2.08 %/°C
QUIT>break  ENTER>accept
```

Confirmation of the results

As soon as the second measurement is at an end, the temperature coefficient is calculated for the two conductivity measurements as follows:

$$TC = \frac{100}{cond.1} \cdot \frac{temp.2 - temp.1}{cond.2 - cond.1}$$

<quit> Termination of the calibration and return to the basic mode

<enter> Confirmation of the determined temperature coefficient, which is then stored under the identification entered at the start. After the confirmation, the instrument returns to the basic mode of the conductivity measurement.

Note: *To allow the newly recorded TC to be used in the conductivity measurement, it must first be loaded under its identification as a conductivity parameter (parameter "TC ident.:", <cond param> key, see section 4.4.2).*

If the automatic printout of the original calibration report is switched on (parameter "orig. cal.report = ON", <config> key, see *section 4.3*), the report of the TC calibration is then printed out. The double dashed line at the end of the report signifies that the printout is that of an original report.

The calibration report can also be printed out any time later under the <report> key (see *section 4.7.2*). In this case, however, only a single dashed line is outputted at the end of the report.

Example of an original report

Calibration without temperature sensor

Solution: KCl 0.1 mol/L

```
manual calibration of temp. coefficient
  cal.id.      KCl 0.1 mol/L
  cal.date     94-07-19  13:51
  temp.1                  20.0 °C
  cond.1                 11.70 mS/cm
  temp.2                  30.0 °C
  cond.2                 14.13 mS/cm
  TC                      2.08 %/°C

              ==============
```

```
temp.coeff. calibration
>cal T/delete cal.data
```

Delete calibration data

```
>cal T/delete cal.data
delete:       xxxxxxxxxx
```

Selection of data to be deleted
Selection of the identification for TC calibration

`cal.id.` Identification under which the TC calibration has been stored

Note: *The TC calibration currently stored in the main memory can not be deleted.*

```
cal.id.: xxxxxxxxxx
QUIT>break  ENTER>delete
```

Confirmation of deletion

<quit> Termination of the deletion procedure and return to basic mode

<enter> Confirmation of the deletion procedure. The calibration data with the specified identification are deleted.

Notes on calibration of the temperature coefficient

- In both the automatic and manual TC calibration, the reference temperature must be within the calibration range determined by the start and stop temperature or the 1st and 2nd temperature as the profile of the TC function outside this range is unknown and hence large errors could appear when the conductivity is converted to the reference temperature.
- To avoid temperature differences within the analysis solution, this must be stirred during the TC calibration.
- To preclude unwanted changes in the conductivity due to evaporation of the analysis solution at elevated temperatures, the TC calibration should be performed in a closed measuring vessel.
- As the usual Pt100/Pt1000 temperature sensors react with a certain delay to temperature changes, the analysis solution should not be heated or cooled too quickly in the TC calibration. Optimum results are obtained with temperature changes of 1 ... 2°C/min.
- In the manual TC calibration, the TC determined over the entire temperature range (in other words, also outside the calibration range) is used for conversion to the reference temperature.
- In the automatic TC calibration, the TC function is defined only within the calibration range. Outside this temperature range, conversion to the reference temperature employs either the TC value at the start temperature or that at the stop temperature.
- The values determined with the TC calibration apply only to solutions whose composition exactly matches that of the calibration solution. If the concentration or composition changes, a new TC function must be recorded.

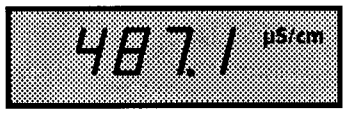
4.5 Temperature measurement

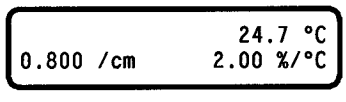
4.5.1 Selection of the main measurement mode, <mode> key

The <mode> key is used to switch between the two main measurement modes

- **conductivity** and
- **temperature**

After the 712 Conductometer has been switched on, the instrument is always automatically in the basic mode of the main measurement mode "Conductivity measurement". Pressing the <mode> key switches to the main measurement mode "Temperature measurement".

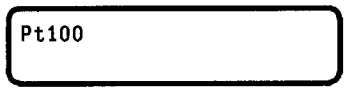




<mode>

Main measurement mode: Conductivity
The main display shows the measured conductivity value and the associated unit, the dialogue display shows the values currently valid for the parameters measurement temperature, cell constant and temperature coefficient.

Press the <mode> key to switch to the main measurement mode "Temperature".



Main measurement mode: Temperature
The main display shows the measured temperature value and the associated unit (°C), the dialogue display shows the type of temperature sensor attached (Pt100 or Pt1000). The <cal C> and <cal T> keys are not accessible in this measurement mode.

<mode>

Press the <mode> key again to return to the main measurement mode "Conductivity" (see above).

4.5.2 Parameters for temperature measurement, <temp param> key

temp param

The <temp param> key is used for the entry of the specific parameters for the temperature measurement. The key is organised as a rolling inquiry. The following summary shows all dialogue options appearing under <temp param>. The values shown in the displays are the default values.

```
temperature
>temp/analog output
```

Parameters for analogue output

```
>temp/analog output
status:              OFF
```

Status of the analogue output

OFF	Analogue output switched off, 0 mV at output
ON	Analogue output switched on, output signal 0 ... 2 V, defined by the following parameters
temp.preset	A preset temperature value is outputted at the analogue output (useful for recorder calibration)
mV preset	A preset mV value is outputted at the analogue output (useful for recorder calibration)

```
>temp/analog output
polarity:             +
```

Polarity of the output signal

This inquiry appears only with "status = ON" or "status = temp.preset"

+	Positive polarity
–	Negative polarity

```
>temp/analog output
1 V range         100 °C
```

Full scale range for 1 V

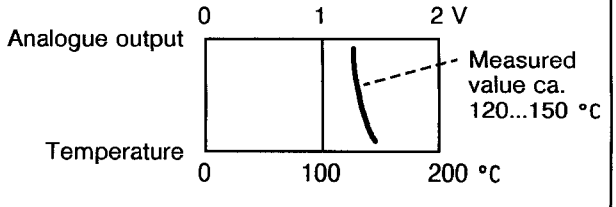
This inquiry appears only with "status = ON" or "status = temp.preset"

Temperature range which should be shown within 1 V.

0.1 ... 1000 °C

Example:

```
"polarity:              +"
"1 V range:     100.0 °C"
"0 V at:          0.0 °C"
"offset             0 mV"
```



```
>temp/analog output
0 V at              0.0 °C
```

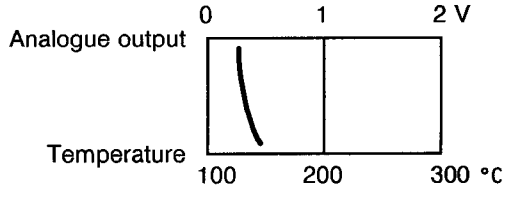
Temperature for 0 V

This inquiry appears only with "`status = ON`*" or "*`status = temp.preset`*"*

Selection of the temperature for zero point (0 V), start value for temperature range

`-1000 ... 1000 °C`

Example: `"polarity:  +"`
`"1 V range:  100.0 °C"`
`"0 V at:  100.0 °C"`
`"offset  0 mV"`




```
>temp/analog output
offset              0 mV
```

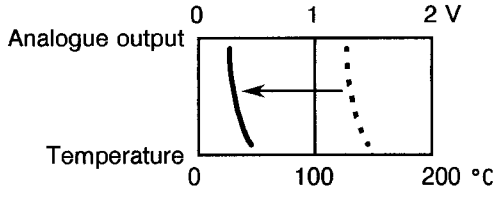
Offset

This inquiry appears only with "`status = ON`*" or "*`status = temp.preset`*"*

Offset of the zero point of the temperature

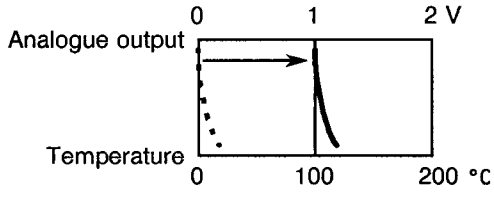
`-2000... 2000 mV`

Example: `"polarity:  +"`
`"1 V range:  100.0 °C"`
`"0 V at:  0.0 °C"`
`"offset  -1000 mV"`



The possibility to offset the zero point is particularly useful in autozero operation.

Example: `"polarity:  +"`
`"1 V range:  100.0 °C"`
`"0 V at:  0.0 °C"`
`"offset  1000 mV"`



```
>temp/analog output
preset              0.0 °C
```

Preset temperature value

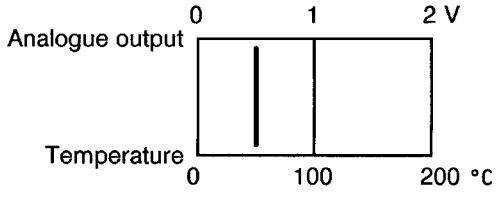
This inquiry appears only with "`status = temp.preset`*"*

Temperature value that is outputted at the analogue output (useful for recorder calibration)

`-1000 ... 1000 °C`

Example:

```
"polarity:              +"
"1 V range:     100.0 °C"
"0 V at:          0.0 °C"
"offset             0 mV"
"preset:         50.0 °C"
```




```
>temp/analog output
preset              0.0 mV
```

Preset mV value

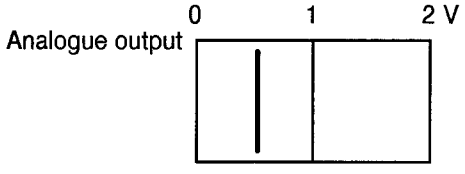
This inquiry appears only with "`status = mV preset`*"*

Absolute signal that is outputted at the analogue output (useful for recorder calibration)

`0... 2000 mV`

Example:

```
"preset          500 mV"
```




```
temperature
>temp/limits
```

Parameters for limit control

(schematic representation, see *section 4.4.2*)

```
>temp/limits
status:               OFF
```

Status of limit control

`OFF` Limit control switched off

`ON` Limit control switched on.
If the limit values are exceeded, the corresponding output signals are set at the remote interface (see *section 6.3*). Simple on/off controls, e.g. for addition of solutions or triggering of alarms are thus possible.

```
>temp/limits
upper limit         0.0 °C
```

Upper limit

This inquiry appears only with "`status = ON`*"*

Upper limit value for limit control. If this value is exceeded, the corresponding signal for the upper limit is set to active (low) at the remote interface.

`-170.0 ... 500.0 °C`

```
>temp/limits
upper hyst.        0.0 °C
```

Hysteresis for upper limit

This inquiry appears only with "`status = ON`*"*

Hysteresis value for the upper limit value. The signal for the upper limit value is not set to inactive (high) at the remote interface until the value is lower than the upper limit value minus the hysteresis value.

`-170.0 ... 500.0 °C`

On entry of a negative value, the signal for the upper limit value at the remote interface oscillates in the range limit value + absolute value of the hysteresis at twice the measurement frequency.

```
>temp/limits
lower limit        0.0 °C
```

Lower limit

This inquiry appears only with "`status = ON`*"*

Lower limit value for limit control. If the actual value is lower than this limit, the corresponding signal for the lower limit value is set active (low) at the remote interface.

`-170.0 ... 500.0 °C`

```
>temp/limits
lower hyst.        0.0 °C
```

Hysteresis for lower limit

This inquiry appears only with "`status = ON`*"*

Hysteresis value for the lower limit value. The signal for the lower limit value is not set to inactive (high) at the remote interface until the value is higher than the lower limit value plus the hysteresis value.

`-170.0 ... 500.0 °C`

On entry of a negative value, the signal for the lower limit value at the remote interface oscillates in the range limit value – absolute value of the hysteresis at twice the measurement frequency.

```
temperature
>temp/plot margins
```

Parameters for plot margins

```
>temp/plot margins
left               0.0 °C
```

Left margin of the plotting area

Left limit value for curve plot of the temperature on an external printer

`-170.0 ... 500.0 °C`

```
>temp/plot margins
right              0.0 °C
```

Right margin of the plotting area

Right limit value for curve plot of the temperature on an external printer

`-170.0 ... 500.0 °C`

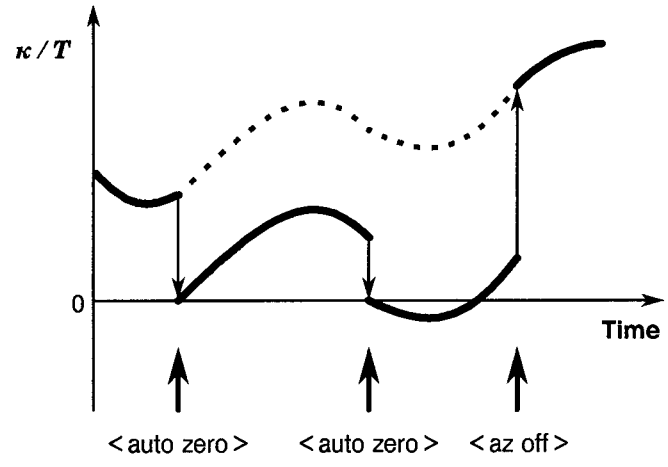
4.6 Auto zero and compensation

4.6.1 General

In addition to measurement of the absolute conductivity or temperature, the 712 Conductometer offers the following two possibilities:

Auto Zero

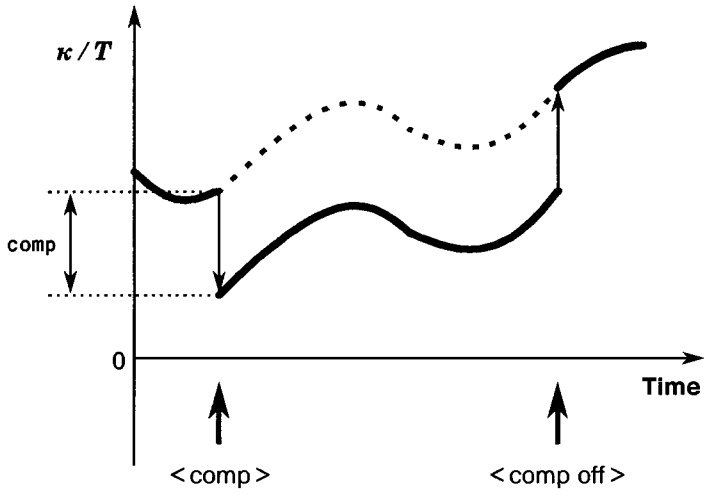
Automatic electronic background compensation, i.e. the current measurement signal is set to zero. This is useful, e.g. when interest is centred not on the absolute measurement value, but on the display of the relative change compared with a conductivity at a particular point in time.



The autozero function can be initiated repeatedly at any time, even if the compensation is switched on.

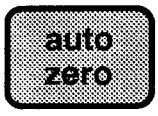
Compensation

Automatic electronic compensation of the current measurement signal by a freely selectable amount. This possibility will be found useful primarily in conductivity titrations.



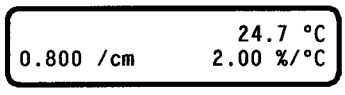
The compensation can be initiated only if the autozero function is switched off.

4.6.2 <auto zero> key



The <auto zero> key is used for the automatic zeroing of the current conductivity or temperature. The autozero function is initiated directly at a keystroke, no inquiries appear. Each additional keystroke resets the measurement signal to zero.

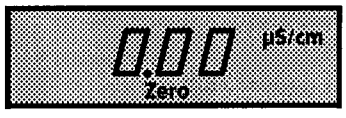
Sequence in conductivity measurement



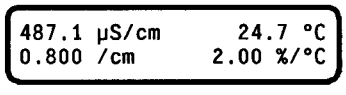
The 712 Conductometer is in the basic mode of the conductivity measurement. The main display shows the measured conductivity value and the associated unit, the dialogue display the measurement parameters in force.

<auto zero>

Pressing the <auto zero> key automatically resets the measurement signal to zero.



In the main display, the current conductivity is set to 0.00 µS/cm, at the same time the status display "Zero" below the measured value lights up. From now on, the conductivity is measured relative to this zero point.



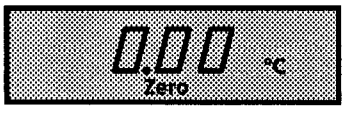
The dialogue display shows not only the measurement parameters but also the absolute conductivity at the top left. This is displayed continuously from now on.

Sequence in temperature measurement

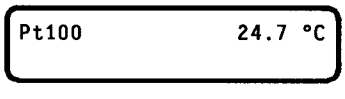
The 712 Conductometer is in the basic mode of the temperature measurement. The main display shows the measured temperature value in °C, the dialogue display the type of temperature sensor attached (Pt100 or Pt1000).

<auto zero>

Pressing the <auto zero> key automatically resets the measurement signal to zero.



In the main display, the current temperature is set to 0.00°C, at the same time the status display "Zero" below the measured value lights up. From now on, the temperature is measured relative to this zero point.



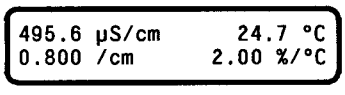
The dialogue display shows not only the type of temperature sensor but also the absolute temperature at the top right. This is displayed continuously from now on.

4.6.3 <az off> key

The <az off> key is used to switch off the autozero function. The autozero function is switched off directly at a keystroke, no inquiries appear.

Sequence in conductivity measurement

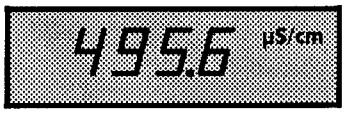
When the autozero function is active, the main display shows the current conductivity relative to the new set zero point, at the same time the status display "Zero" below the measured value lights up.



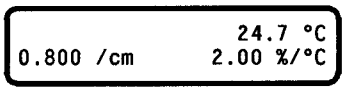
The dialogue display shows not only the measurement parameters, but also the absolute conductivity at the top left.

<az off>

Pressing the <az off> key switches autozero function off.

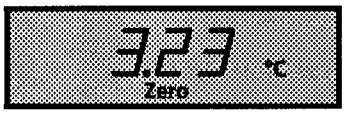


The status display "Zero" in the main display fades, the absolute conductivity value and the associated unit are again shown.

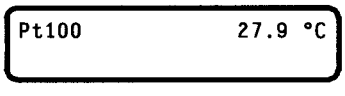


In the dialogue display the display of the absolute conductivity disappears.

Sequence in temperature measurement



When the autozero function is active, the main display shows the current temperature relative to the new set zero point, at the same time the status display "Zero" below the measured value lights up.

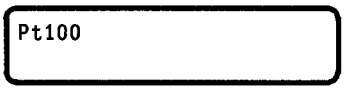


The dialogue display shows not only the type of temperature sensor attached, but also the absolute temperature at the top right.

<az off>

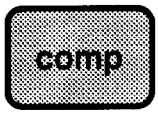
Pressing the <az off> key automatically switches the autozero function off.

In the main display, the status display "Zero" fades, the absolute temperature value is again shown.



In the dialogue display, the display of the absolute temperature disappears.

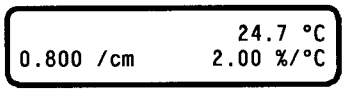
4.6.4 <comp> key



The <comp> key is used for the automatic compensation of the current conductivity or temperature by a specified value. The key contains the inquiry for the compensation value, the compensation is then started.

***Note**: The <comp> key is not accessible when the autozero function is switched on or in the "TDS" measurement mode.*

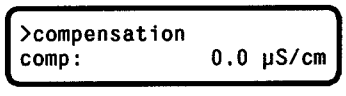
Sequence in conductivity measurement



The 712 Conductometer is in the basic mode for conductivity measurement. The main display shows the measured conductivity value and the associated unit, the dialogue display the measurement parameters currently in force.

<comp>

Pressing the <comp> key leads to the inquiry for the compensation value.



Compensation value (conductivity)
Entry of the conductivity which should be used for compensation (this value is subtracted from the current measured value).

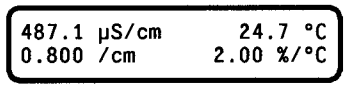
0 µS/cm ... 2 S/cm

The unit (µS/cm, mS/cm, S/cm) can be selected using the <select> key.

<enter>

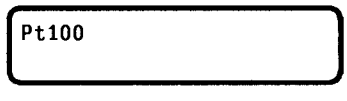
Pressing the <enter> key switches the compensation on.

The main display shows the conductivity reduced by the compensation value (200 µS/cm in this example), at the same time the status display "Comp" below the measured value lights up.



The dialogue display shows not only the measurement parameters, but also the absolute conductivity at the top left. This is displayed continuously from now on.

Sequence in temperature measurement



The 712 Conductometer is in the basic mode for temperature measurement. The main display shows the measured temperature value in °C, the dialogue display the type of attached temperature sensor (Pt100 or Pt1000).

<comp>

Pressing the <comp> key leads to the inquiry for the compensation value.

>compensation comp 0.0 °C	**Compensation value (temperature)** Entry of the temperature which should be used for compensation (this value is subtracted from the current measured value). -170.0 ... 500.0 °C
<enter>	Pressing the <enter> key switches the compensation on.
14.7 °C Comp	The main display shows the temperature reduced by the compensation value (10 °C in this example), at the same time the status display "Comp" below the measured value lights up.
Pt100 24.7 °C	The dialogue display shows not only the type of temperature sensor, but also the absolute temperature at the top left. This is displayed continuously from now on.

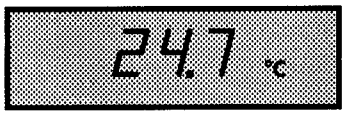
4.6.5 <comp off> key

The <comp off> key is used to switch off the compensation. The compensation is switched off directly at a keystroke, no inquiries appear.

Sequence in conductivity measurement

287.1 µS/cm Comp	When the compensation is active, the compensated conductivity is shown in the main display, at the same time the status display "Comp" below the measured value lights up.
487.1 µS/cm 24.7 °C 0.800 /cm 2.00 %/°C	The dialogue display shows not only the measurement parameters, but also the absolute conductivity at the top left.
<comp off>	Pressing the <comp off> key switches the compensation off.
487.1 µS/cm	The status display "Comp" in the main display fades, the absolute conductivity and the associated unit are again displayed.
24.7 °C 0.800 /cm 2.00 %/°C	The display of the absolute conductivity in the dialogue display fades.

Sequence in temperature measurement

	When the compensation is active, the compensated temperature is shown in the main display, at the same time the status display "Comp" below the measured value lights up.
	The dialogue display shows not only the type of temperature sensor, but also the absolute temperature at the top right.
<comp off>	Pressing the <comp off> key switches the compensation off.
	The status display "Comp" in the main display fades, the absolute temperature is again shown.
	The display of the absolute temperature in the dialogue display fades.

4.7 Data output

The 712 Conductometer can output the following data:

- **Instrument information** Output in dialogue display (<info> key)
- **Reports** Output on a printer or PC via RS232 interface (<report> key)
- **Measured values** Output on a printer or PC via RS232 interface (<print> key)
- **Curves** Output on a printer via RS232 interface (<print> key)

4.7.1 Display of instrument data, <info> key

The <info> key is used to display current instrument data. These data appear in the bottom line of the dialogue display. The key is organised as a rolling inquiry. The following summary shows all displays appearing under <info>.

frequency 300 Hz	**Measurement frequency** The current measurement frequency (300 Hz or 2400 Hz) is shown. If this display remains switched on during the measurement, any change in the measurement frequency is automatically shown.
cal.id. xxxxxxxxxx	**Identification of the loaded TC function** *This display appears only with "TC selection = cal.id."* The identification of the TC function loaded under the <cond param> key is shown.
method auto	**Method of TC calibration** *This display appears only with "TC selection = cal.id."* The method used to record the loaded TC function is shown: `auto` automatic TC calibration with temperature sensor `man` manual TC calibration without temperature sensor
date xx-xx-xx xx:xx	**Date of the TC calibration** *This display appears only with "TC selection = cal.id."* The date when the loaded TC function was recorded is shown.

start temp. 20.0 °C	**Start temperature** *This display appears only with "TC selection = cal.id." and "method = auto"* The start temperature for the determination of the temperature coefficient with temperature sensor is shown.
stop temp. 50.0 °C	**Stop temperature** *This display appears only with "TC selection = cal.id." and "method = auto"* The stop temperature for the determination of the temperature coefficient with temperature sensor is shown.
TC range 2.07/2.16 %/°C	**Minimum and maximum TC** *This display appears only with "TC selection = cal.id." and "method = auto"* The minimum and maximum temperature coefficients for the calibration range defined by the start and stop temperature are shown.
temp.1 20.0 °C	**1st measurement temperature** *This display appears only with "TC selection = cal.id." and "method = man"* The measurement temperature of the first calibration solution for the determination of the temperature coefficient without temperature sensor is shown.
temp.2 30.0 °C	**2nd measurement temperature** *This display appears only with "TC selection = cal.id." and "method = man"* The measurement temperature of the second calibration solution for the determination of the temperature coefficient without temperature sensor is shown.
TC const. 2.07 %/°C	**Constant temperature coefficient** *This display appears only with "TC selection = cal.id." and "method = man"* The temperature coefficient determined for the calibration range defined by the two measurement temperatures is shown.

4.7.2 Report output, <report> key

The <report> key is used to output reports via the RS232 interface to a printer or a PC. The key contains the inquiry for the desired report, the output is then started.

```
print report:          all
```

Selection of the report

Selection of the report to be outputted:

`all`	All available reports in the order "`cond param`", "`temp param`", "`config`", "`cal C`", "`cal T`"
`cond param`	Report of the conductivity parameters
`temp param`	Report of the temperature parameters
`config`	Configuration report
`cal C`	Report of the cell constant calibration. This report is outputted only if the cell constant determined in the calibration has not been changed.
`cal T`	Report of the TC calibration. The contents of the calibration report depend on the selection of the parameter "`cal.report format`" (<config> key, see *section 4.3*):

- `cal.report format = full`
  Report with parameters of the calibration and calibration curve
- `cal.report format = short`
  Report with parameters of the calibration

```
cal.id.:        xxxxxxxxxx
```

Selection of the TC calibration

This display appears only with "`print report = cal T`"

Selection of the identification of the TC calibration whose report(s) should be outputted:

`DIN`	Permanently stored TC function for natural ground, spring or surface water following DIN 38404-C8
`xxxxxxxxxx`	TC function recorded beforehand with the automatic TC calibration and which has been stored under the identification "`xxxxxxxxxx`"
`actual`	TC function currently stored in the main memory
`all`	All stored TC functions

Examples of report "cond param"

```
conductivity
>cond/parameters
  cell constant          0.85 /cm
  meas.temp.             25.0 °C
  ref.temp.              20.0 °C
  TC selection:         const.
  TC const.              2.08 %/°C
  frequency:             auto
  meas.type:          standard
>cond/analog output
  status:                  ON
  polarity:                +
  1 V range:             100 mS/cm
  0 V at:                0.0 µS/cm
  offset                   0 mV
>cond/limits
  status:                  ON
  upper limit:            80 mS/cm
  upper hyst.:             5 mS/cm
  lower limit:            20 mS/cm
  lower hyst.:             5 mS/cm
>cond/plot margins
  left:                    0 mS/cm
  right:                 100 mS/cm

              --------------
```

```
conductivity
>cond/parameters
  cell constant          0.83 /cm
  meas.temp.             25.0 °C
  ref.temp.              20.0 °C
  TC selection:        cal.id.
  TC ident.:               DIN
  frequency:             auto
  meas.type:              TDS
>cond/analog output
  status:                 OFF
>cond/limits
  status:                 OFF
>cond/plot margins
  left:                    0 mS/cm
  right:                 500 mS/cm

              --------------
```

Example of report "temp param"

```
temperature
>temp/analog output
  status:                  ON
  polarity:                +
  1 V range             100.0 °C
  0 V at                  0.0 °C
  offset                   0 mV
>temp/limits
  status:                  ON
  upper limit            80.0 °C
  upper hyst.             2.0 °C
  lower limit            30.0 °C
  lower hyst.             2.0 °C
>temp/plot margins
  left                    0.0 °C
  right                 100.0 °C

              --------------
```

Example of report "config"

```
config
>config/printer
  id.1          solution TQ158
  id.2               charge 56B
  print header:          always
  date&time:                OFF
  send to:               Seiko
>config/print meas.value
  print crit.:           immed.
  date&time:                ON
>config/report type
  orig. cal.report:         ON
  cal.report format:      full
>config/auxiliaries
  run number                 0
  date                94-07-28
  time                14:06:49
  dialog:              english
  device label           712/1
  program             712.0012
>config/RS232 settings
  baud rate:              9600
  data bit:                  8
  stop bit:                  1
  parity:                 none
  handshake:               HWs
  RS control:               ON

              --------------
```

Examples of reports "cal C"

Calibration with temperature sensor
(measurement temperature not shown)

```
calibration of cell constant
  cal.date     94-07-19  14:36
  standard:              11.67 mS/cm
  std.ref.temp.           20.0 °C
  cell constant          0.852 /cm

              --------------
```

Calibration without temperature sensor
(measurement temperature shown)

```
calibration of cell constant
  cal.date     94-07-19  15:07
  standard:              11.67 mS/cm
  std.ref.temp.           20.0 °C
  std.meas.temp.          23.5 °C
  cell constant          0.852 /cm

              --------------
```

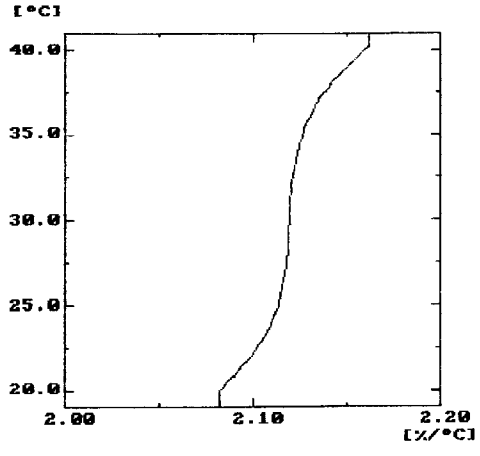
If the current cell constant has not been entered by a cell constant calibration but manually, the message "`no calibrated cell constant available`" appears in place of the report.

Examples of report "cal T"

Calibration with temperature sensor

"`cal.report format = full`"

```
autom. calibration of temp. coefficient
  cal.id.      KCl 0.1 mol/L
  cal.date     94-07-19  15:43
```




```
  start temp.             20.0 °C
  stop temp.              40.0 °C
  ref.temp.               20.0 °C
  TC min                  2.08 %/°C
  TC max                  2.16 %/°C
  c0              2.839662e-02
  c1              2.517852e-03
  c2              2.485517e-05
  c3              1.109779e-05
  c4              5.138212e-06

              --------------
```

In contrast to the original measured curve, here only the TC function is plotted (cf. *section 4.4.4*).

Calibration with temperature sensor

"`cal.report format = short`"

```
autom. calibration of temp. coefficient
  cal.id.      KCl 0.1 mol/L
  cal.date     94-07-19  15:43
  start temp.             20.0 °C
  stop temp.              40.0 °C
  ref.temp.               20.0 °C
  TC min                  2.08 %/°C
  TC max                  2.16 %/°C
  c0              2.839662e-02
  c1              2.517852e-03
  c2              2.485517e-05
  c3              1.109779e-05
  c4              5.138212e-06

              --------------
```

If the selected TC calibration is not stored in the main memory, here, in contrast to the full report, instead of the minimum and maximum TC value the TC value at the start temperature "`TC start`" and that at the stop temperature "`TC stop`" is printed out.

Calibration without temperature sensor

```
manual calibration of temp. coefficient
  cal.id.      KCl 0.1 mol/L
  cal.date     94-07-19  13:51
  temp.1                  20.0 °C
  cond.1                 11.70 mS/cm
  temp.2                  30.0 °C
  cond.2                 14.13 mS/cm
  TC                      2.08 %/°C

              --------------
```

4.7.3 Measured value output and curve plot, <print> key

The <print> key is used for the output of individual measured values or to start the continuous measured value output or the curve plot. The output is initiated directly by a keystroke, no inquiries appear.

Measured value output
For the output of measured values via the RS232 interface, the parameter ">config/print meas.value/print crit." must be set to either "immed." (individual measured value output) or to "time" (continuous measured value output) (see <config> key, *section 4.3*). Consideration must be given to the following points in the output of measured values:

- For the output on an external printer, the printer type and RS232 settings must be correctly selected (see *section 4.3*).
- For the output on a PC, the character set ("send to: IBM") and RS232 settings must be correctly selected (see *section 4.3*). For the receipt of data, a suitable program must be started on the PC (e.g. Metrohm VESUV 2.0 or Windows terminal program).
- Depending on the parameter settings and the measurement mode, the output of a single measured value can include:
  - Header with or without date
  - Run number
  - Conductivity measured value (with main mode "conductivity")
  - TDS value (with main mode "Conductivity" and "meas.type = TDS")
  - Measured temperature value (with attached temperature sensor)
  - Identification "AZREF":
    Non-compensated conductivity, non-compensated TDS value or non-compensated temperature before initiation of the autozero function
  - Identification "AZ":
    Conductivity, TDS value or temperature compensated by the value "AZREF"
  - Identification "COMPREF":
    Compensation value (conductivity or temperature)
  - Identification "COMP":
    Conductivity or temperature compensated by the value "COMPREF"
  - Date and time of the measured value output

Output of individual measured values
For the output of individual measured values, the parameter ">config/print meas.value/print crit." must be set to "immed." (see <config> key, *section 4.3*). Each time the <print> key is pressed, a measured value is outputted via the RS232 interface.

Continuous measured value output
For the continuous output of measured values, the parameter ">config/print meas.value/print crit." must be set to "time" (see <config> key, *section 4.3*). When the <print> key is pressed, the output of measured values defined by the parameters "time interval" and "stop time" is started via the RS232 interface.

Examples of measured value output

Individual measured value output:
Single output of header without date, run number, conductivity, date and time

```
config
>config/printer
  id.1                    KCl
  id.2            conductivity
  print header:           once
  date&time:               OFF
  send to:               Seiko
>config/print meas.value
  print crit.:          immed.
  date&time:                ON
>config/auxiliaries
  run number                 0
```

Parameters for measured value output

```
712 Conductometer     OP1/109   712.0012
id1 KCl
id2 conductivity
#1    14.71 mS/cm
      94-07-29  09:12:03
#2    14.75 mS/cm
      94-07-29  09:13:15
      14.75 mS/cm              AZREF
#3    0.000 mS/cm              AZ
      94-07-29  09:13:55
#4    0.225 mS/cm              AZ
      94-07-29  09:15:22
#5    14.75 mS/cm
      94-07-29  09:16:44
```

Measured value printout each time the <print> key is pressed

Autozero started

Autozero switched off

Continuous output of measured values:
Single printout of header with data, run number, conductivity and temperature, without date and time

```
config
>config/printer
  id.1                    KCl
  id.2     conduct. and temp.
  print header:           once
  date&time:                ON
  send to:               Seiko
>config/print meas.value
  print crit.:            time
  time interval             60 s
  stop time                600 s
  date&time:               OFF
>config/auxiliaries
  run number                 0
```

Parameters for measured value printout

```
712 Conductometer     OP1/109   712.0012
date 94-07-29   time 11:37:46
id1 KCl
id2 conduct. and temp.
#1    14.36 mS/cm    22.6 °C
#2    14.39 mS/cm    22.8 °C
      10.00 mS/cm              COMPREF
#3    4.381 mS/cm    22.7 °C   COMP
#4    4.373 mS/cm    22.7 °C   COMP
#5    4.385 mS/cm    22.8 °C   COMP
#6    4.405 mS/cm    22.9 °C   COMP
#7    4.411 mS/cm    22.9 °C   COMP
#8    14.40 mS/cm    22.8 °C
#9    14.38 mS/cm    22.7 °C
#10   14.39 mS/cm    22.8 °C
```

Automatic measured value output every 10 s

Compensation started

Compensation switched off

Curve plot

For the graphical output of the measured value curve to an external printer via the RS232 interface, the parameter ">config/print meas.value/print crit." must be set to "plot" (see <config> key, *section 4.3*). Consideration must be given to the following points with curve plots:

- For the output to an external printer, the printer type and RS232 settings must be correctly selected (see *section 4.3*).
- Direct output of curves to a PC is not possible.
- Depending on the parameter settings and measurement mode, the curve plot can include the following:
  - Header with or without date
  - Frame
  - Grid
  - Labelling of the y axis (conductivity and/or temperature)
  - Labelling of the x axis (absolute or relative time)
  - Measured conductivity value (solid line)
  - Measured temperature value (solid line with main measurement mode "Temperature", dotted line with main measurement mode "Conductivity" and attached temperature sensor)
  - Lower and upper limit value (dot-dash line either for conductivity limit values in the measurement mode "Conductivity" or for temperature limit values in the measurement mode "Temperature")
- The parameters for the curve plot are inputted at three different points:
  - <config> key — Parameters for header, time interval, time scale and its labelling, stop time (see *section 4.3*)
  - <cond param> key — Plot limits (see *section 4.4.2*)
  - <temp param> key — Plot limits (see *section 4.5.2*)
  - Setup — General graphics parameters

The general graphics parameters are part of the "Setup" and are accessible only when the <config/7> key is pressed at the same time as the instrument is switched on. The following summary shows all dialogue options appearing under <setup/graphics>. The values shown in the displays are default values.

```
setup
>graphics
```

General parameters for graphical plot

```
>graphics
grid:          OFF
```

Grid lines for plot

OFF	No grid lines are drawn in when graphics are plotted.
ON	Dotted grid lines are drawn in when graphics are plotted.

>graphics frame: OFF	**Frame for plot** OFF — On printout of the graphics, only the y and x axes are drawn in, but no frame. ON — On printout of the graphics, a frame is drawn in.
>graphics width 0.8	**Relative width of the graphical printout** 0.4 ... 1.0 The width of the graphical printout must be matched to the attached printer (see *section 3.6.2*).
>graphics length 1.0	**Relative length of the graphical printout** 0.4 ... 1.0 The length of the graphical printout must be matched to the attached printer (see *section 3.6.2*).

Examples of curve plots

Plot with frame and grid, absolute time scale

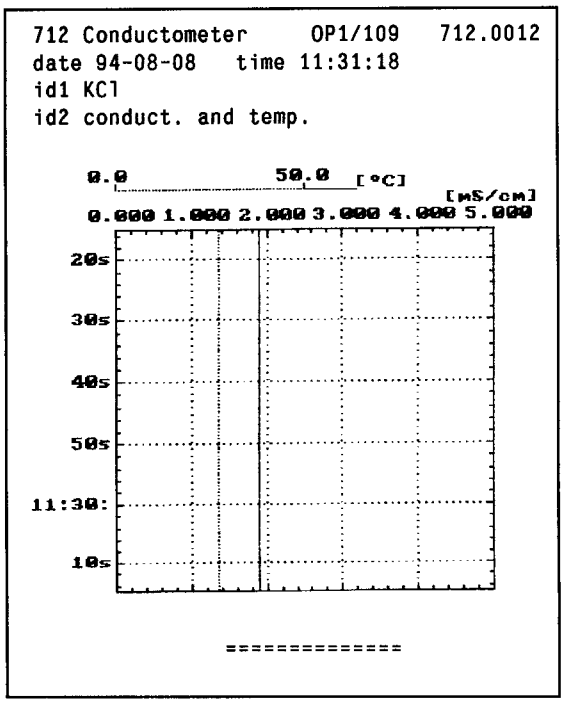
Parameters for curve plot

```
config
>config/printer
  id.1                    KCl
  id.2     conduct. and temp.
  print header:          once
  date&time:               ON
  send to:              Seiko
>config/print meas.value
  print crit.:           plot
  time interval           5.0 s
  time scale               10 s/cm
  time scale label:       abs
  stop time               600 s

conductivity
>cond/plot margins
  left:                     0 mS/cm
  right:                    5 mS/cm

setup
>graphics
  grid:                    ON
  frame:                   ON
  width                   1.0
  length                  1.0
```

Curve plot, started with the <print> key



Plot with frame without grid, relative time scale

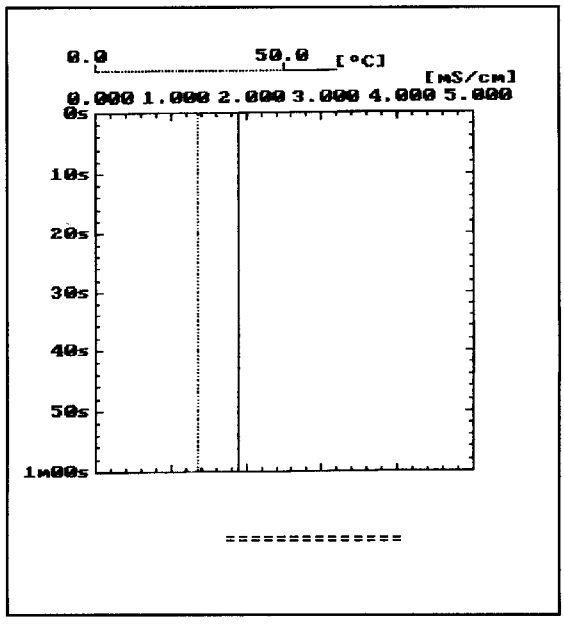
Parameters for curve plot

```
config
>config/printer
  print header:          OFF
  send to:             Seiko
>config/print meas.value
  print crit.:          plot
  time interval          5.0 s
  time scale              10 s/cm
  time scale label:      rel
  stop time              60 s

conductivity
>cond/plot margins
  left:                   0 mS/cm
  right:                  5 mS/cm

setup
>graphics
  grid:                 OFF
  frame:                 ON
  width                 1.0
  length                1.0
```

Curve plot, started with the <print> key



Plot without frame and without grid, relative time scale, with limit values

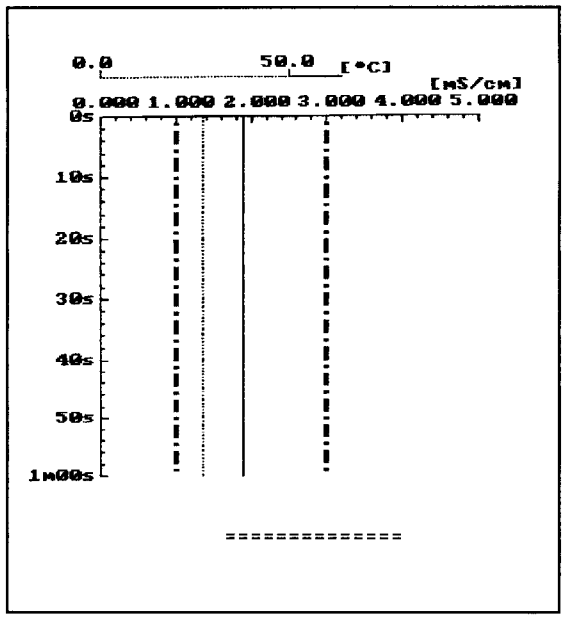
Parameters for curve plot

```
config
>config/printer
  print header:          OFF
  send to:             Seiko
>config/print meas.value
  print crit.:          plot
  time interval          5.0 s
  time scale              10 s/cm
  time scale label:      rel
  stop time              60 s

conductivity
>cond/limits
  status:                 ON
  upper limit:             3 mS/cm
  upper hyst.:           0.3 mS/cm
  lower limit:             1 mS/cm
  lower hyst.:           0.3 mS/cm
>cond/plot margins
  left:                   0 mS/cm
  right:                  5 mS/cm

setup
>graphics
  grid:                 OFF
  frame:                OFF
  width                 1.0
  length                1.0
```

Curve plot, started with the <print> key



5. Operation via RS232 interface

5.1 General rules

The 712 Conductometer has an extensive remote control facility that allows full control of the instrument via the RS232 interface, i.e. the pump can receive data from an external controller or it can send data to an external controller. C_R and L_F are used as terminators for the data transfer. The 712 Conductometer sends $2 \times C_R$ and L_F as termination of a data block, to differentiate between a data line which has C_R and L_F as terminator. The controller terminates its commands with C_R and L_F. If the controller sends more than one command per line, the character ';' is used as separator between the commands.

The commands are grouped logically and are simple to understand. Thus, e.g. for the selection of the dialogue language the command

```
&Config.Aux.Language"english"
```

must be sent, but only the boldface characters need be inputted, thus

```
&C.A.L"english"
```

All quantities of the 712 Conductometer are collected in groups. For example, the entries for the configuration are in the group

```
&Config
```

The "Config" group contains subgroups, e.g. for the setting of the RS232 interface parameters

```
&Config.RSset
```

This subgroup in turn contains the individual inquiries for the settings, e.g. the inquiry regarding the baud rate

```
&Config.RSset.Baud
```

or regarding the setting of the parity

```
&Config.RSset.Parity
```

The commands have a hierarchial structure (tree structure). The quantities that appear in this tree are called objects in what follows. The baud rate is an object that is called up with the command

```
&Config.RSset.Baud
```

If one is at the desired location in the tree, the value of the appropriate object can be queried, e.g. in the case of the inquiry regarding the baud rate:

```
&Config.RSset.Baud $Q      Q for Query
```

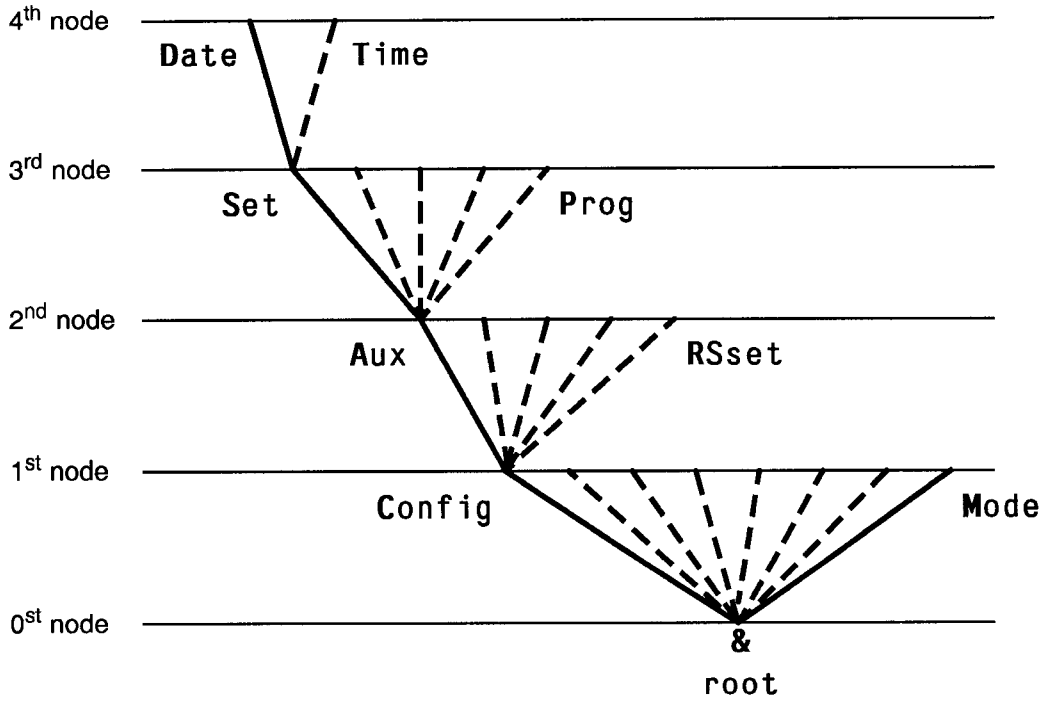
'$Q' triggers the output of the value from the 712 Conductometer. Entries that are introduced with the character dollar ($) trigger something. They are thus called **triggers** in what follows.

Values of objects can not only be requested, however, they can also be modified. Values are always entered in quotation marks ("), e.g.

```
&Config.RSset.Baud"9600"
```

5.2 Call up of objects

All objects of the 712 Conductometer are grouped hierarchically. They have a tree structure. A section of this tree is shown below:



Rules:

- The root of the tree is designated with "&".
- For the call up of an object the nodes (levels) of the tree are marked with a point ".".
- The call up of the objects requires as many letters as necessary to ensure unequivocal assignment of the object. If the call is not unequivocal, the first object in the series is recognised.

  Example Call up of the time:
  &Config.Aux.Set.Time or
  &C.A.S.T

- Upper- or lowercase letters can be used.

  Example **&C.A.S.T** or
  &c.a.s.t

- A value can be assigned to an object. Values are marked at the start and end by quotation marks ("). They can comprise maximum 24 ASCII characters. With parameters with specified text expressions (e.g. ON, OFF), only the English expressions may be used. Numeric values can contain up to 6 digits and a decimal point. In the case of numbers with more than 6 digits, the rest are cut off. With numbers <1, leading zeros must be entered.

  Example Entry of "08:15" for the time:
  &C.A.S.T "08:15"
  Correct entries of numbers:
  "-31.2273","0.1"

Incorrect entries:
"2,4", "+3", ".1"

- If a new object is not called up, the old object remains current.

  Example Entry of a new time: **"08:20"**

- New objects can also be addressed relative to old objects:
  A preceding point moves one node **forwards** in the tree.

  Example From the root to the node 'Aux': **&C.A**
  Forwards from the node 'Aux' to 'Set': **.S**

  More than one preceding point moves one node **backwards** in the tree.
  n nodes backwards require n + 1 preceding points.

  Example Jump from 'Set' onto the node 'Aux' and selection of a new object 'Prog' at this node: **..P**
  Jump from 'Prog' over the node 'Aux' to the node 'Config' and to the new node 'RSset': **...R**

- If a jump is to be made back to the root, a preceding '**&**' is entered.

  Example Jump from the node 'RSset' via the root into the node 'Mode': **&M**

5.3 Triggers

Triggers initiate an action at the 712 Conductometer, e.g. starting of a mode or sending of data. Triggers are marked with the introducer '$':

$G	Go:	Start sequences, e.g. start the calibration or switch the main measurement mode
$S	Stop:	Stop sequences, e.g. calibration
$Q	Query:	Used for inquiry of all information from the current node in the tree upwards up to and including the values
$Q.P	Path:	Used for inquiry of the path from the root of the tree up to the current node
$Q.H	Highest Index:	Used for inquiry of the number of son nodes of the current node
$Q.N"i"	Name:	Used for inquiry of the name of the son node with index i, i = 1...n
$D	Detailed Info:	Used for inquiry of the detailed status
$U	qUit:	Used to abort the data flow via RS232 interface, e.g. after $Q

The triggers '$G' and '$S' are linked to objects, see *section 5.5.*

The other triggers, however, can be used at anytime and at all locations on the object tree.

Examples:

Inquiry of the value of the baud rate:	`&Config.RSset.Baud $Q`
Inquiry of all values of the node 'RSset':	`&Config.RSset $Q`
Inquiry of the path of the node 'RSset':	`&Config.RSset $Q.P`
Start of the autozero function:	`&AutoZero $G`
Inquiry of the detailed status:	`$D`

5.4 Status and error messages

In order to have an efficient control by an external control device, it must also be possible to query status conditions; they provide information on the status of the 712 Conductometer. The trigger '$D' initiates output of the status. Status messages consist of the global status, the detailed status and eventual error messages, e.g. '$R.Cond;E120' The global status informs on the activity of the process, while the detailed status conditions show the exact activity within the process.

5.4.1 Global status conditions

The following global status conditions are possible:

$R	Ready:	The conductometer is in the measurement mode.
$G	Go:	A process (e.g. calibration) has been started.
$S	Stop:	A process has been stopped by "unnatural measures"

5.4.2 Detailed status conditions

Status conditions of the global '$R':

$R.Cond	Conductivity measurement (no temperature sensor attached)
$R.CondTemp	Conductivity and temperature measurement
$R.Temp	Temperature measurement
$R.***.Zero	Autozero function active, value not yet valid
$R.***.ZeroOK	Autozero function active, value valid
$R.***.Comp	Compensation active, value not yet valid
$R.***.CompOK	Compensation active, value valid
$R.Input	Change in the signal of an input line
$R.Output	Change in the signal of an output line
$R.Diagnosis	Instrument in diagnostic mode

*** = Cond, CondTemp or Temp

Status conditions of the global '$G':

$G.**.CalC.Req.Start	Calibration of the cell constant; instrument waiting for start command
$G.**.CalC.Req.Accept	Calibration of the cell constant; instrument waiting for confirmation of the determined cell constant
$G.**.CalT.Req.Temp1	TC calibration; instrument waiting for confirmation of the 1st temperature
$G.**.CalT.Req.Temp2	TC calibration; instrument waiting for confirmation of the 2nd temperature
$G.**.CalT.Req.Wait	TC calibration; instrument waiting for start temperature to be attained
$G.**.CalT.Req.Inac	TC calibration; calibration inactive
$G.**.CalT.Req.Meas	TC calibration; measurement running
$G.**.CalT.Req.Accept	TC calibration; instrument waiting for confirmation of the results

** = Cond or CondTemp

Status conditions of the global '$S':

The status shown is that when a stop was effected, e.g. "$S.**.CalT.Req.Temp1". The detailed status information is thus identical to that of the global status "$R".

5.4.3 Error messages

Error messages "EXXX" are appended to the status messages and separated from these by a ";".

Error	*Meaning*	*Exit/corrective action*
E26	Manual stop	Send $G or $S
E28	Wrong object call-up	Correct path
E29	Wrong value	Enter correct value or new path
E30	Wrong trigger	Enter correct trigger or new path
E36	RS232 receive error; parity	<quit>, set parity same for both devices
E37	RS232 receive error: stop bit	<quit>, set stop bit same for both devices
E38	RS232 receive error; overflow (at least 1 character could not be read)	<quit>, start transmitter again
E39	RS232 receive error; overflow of internal receive buffer (>82 characters)	<quit>

Error	*Meaning*	*Exit/corrective action*
E40	RS232 send error; DSR = OFF, handshake unsatisfactory for more than 1 s	<quit>, check receiver (switched on and ready?)
E41	RS232 send error; DCD = ON, handshake unsatisfactory for more than 1 s	<quit>, check receiver (switched on and ready?)
E42	RS232 send error; CTS = OFF, handshake unsatisfactory for more than 1 s	<quit>, check receiver (switched on and ready?)
E43	RS232 send error; transmission of the Conductometer was interrupted with XOFF for at least 3 s	<quit> or send XON
E44	RS232 send error; the RS parameters are no longer the same for both devices	<quit>, reset RS parameters for both devices
E45	RS232 send error; the receive buffer of the Conductometer contains an incomplete character string (L_F missing), the transmission is thus blocked	<quit> or send L_F
E60 ... E89	Error in RS232 test	<quit>, check connection between the RS interfaces
E120	Measurement range exceeded	<quit>, rectify fault
E147	Plot data overflow	<quit> (plot is terminated)
E200	Instrument adjustment invalid	Inform Metrohm service
E201	Internal clock faulty (battery change)	Inform Metrohm service
E220	No calibration data	<quit>, perform new calibration
E221	Cell constant too large	<quit>, start new cell constant calibration
E222	Temperature 1 same as temperature 2	<quit>, heat or cool solution
E223	Negative temperature coefficient	<quit>, start new TC calibration
E224	Temperature coefficient too large	<quit>, start new TC calibration
E225	Current temperature too high	<quit>, cool solution
E226	Current temperature too low	<quit>, heat solution
E227	Temperature range too small	<quit>, increase temperature range
E228	Temperature change too fast	<quit>, heat or cool solution more slowly
E229	Calibration memory full	<quit>, delete old calibration data
E240	Error on storage of EEPROM blocks	<quit>, reenter all values
E241 ... E260	Error on storage of a single EEPROM block	<quit>, reenter values for this EEPROM block

5.5 Remote control commands

Object	*Meaning*	*Input range (default values in boldface)*
&**Cond**uctivity	**Conductivity**	
.**P**arameter	Parameters for conductivity measurement	
.**C**ellConstant	Cell constant	0.001 ... **1.000** ... 500 /cm
.**M**easureTemp	Measurement temperature	-170.0 ... **20.0** ... 500.0 °C
.**R**eferenceTemp	Reference temperature	-170.0 ... **20.0** ... 500.0 °C
.**S**elTC	Selection of the temperature coefficient (TC)	**const.**, cal.id.
.**C**onstTC	Temperature coefficient (constant)	0.00 ... **2.00** ... 9.99 %/°C
.**I**dTC	Identification of the TC function	cal.id., DIN
.**F**requency	Measurement frequency	**auto**, 300 Hz, 2.4 kHz
.**M**eas**T**ype	Selection of the measurement type	**standard**, TDS, titration
.**A**nalogOutput	Analogue output	
.**S**tatus	Status of the analogue output	ON, **OFF**, cond.preset, mV preset
.**P**olarity	Polarity	**+**, -
.**R**ange	Full scale range for 1 V	0.001 µS/cm ... **1 mS/cm** ... 2 S/cm
.**Z**ero	Conductivity for 0 V	-2 ... **0** ... 2 S/cm
.**O**ffset	Offset	-2000 ... **0** ... 2000 mV
.**C**ondPreset	Set conductivity value	-2 ... **0** ... 2 S/cm
.**m**VPreset	Set mV value	**0** ... 2000 mV
.**L**imits	Limit values	
.**S**tatus	Status of the limit control	ON, **OFF**
.**U**pperLim	Upper limit value	-2 ... **0** ... 2 S/cm
.**U**Hysteresis	Hysteresis for upper limit value	-2 ... **0** ... 2 S/cm
.**L**owerLim	Lower limit value	-2 ... **0** ... 2 S/cm
.**L**Hysteresis	Hysteresis for lower limit value	-2 ... **0** ... 2 S/cm
.**P**lotPara	Parameters for plot limits	
.**L**eft	Left margin of plotting area	-2 ... **0** ... 2 S/cm
.**R**ight	Right margin of plotting area	-2 ... **0** ... 2 S/cm
&**T**emperature	**Temperature**	
.**A**nalogOutput	Analogue output	
.**S**tatus	Status of the analogue output	ON, **OFF**, temp.preset, mV preset
.**P**olarity	Polarity	**+**, -
.**R**ange	Full scale range for 1 V	0.1 ... **100** ... 1000 °C
.**Z**ero	Temperature for 0 V	-1000 ... **0** ... 1000 °C
.**O**ffset	Offset	-2000 ... **0** ... 2000 mV
.**T**empPreset	Set temperature value	-1000 ... **0** ... 1000 °C
.**m**VPreset	Set mV value	**0** ... 2000 mV
.**L**imits	Limit values	
.**S**tatus	Status of the limit control	ON, **OFF**
.**U**pperLim	Upper limit value	-170.0 ... **0.0** ... 500.0 °C
.**U**Hysteresis	Hysteresis for upper limit value	-170.0 ... **0.0** ... 500.0 °C
.**L**owerLim	Lower limit value	-170.0 ... **0.0** ... 500.0 °C
.**L**Hysteresis	Hysteresis for lower limit value	-170.0 ... **0.0** ... 500.0 °C
.**P**lotPara	Parameters for plot limits	
.**L**eft	Left margin of plotting area	-170.0 ... **0.0** ... 500.0 °C
.**R**ight	Right margin of plotting area	-170.0 ... **0.0** ... 500.0 °C
&**A**utoZero	**Start/stop of the autozero function**	$G, $S
.**S**tatus	Status of the autozero function: on, off	read only
.**C**ondRef	Compensated conductivity in S/cm	read only
.**T**empRef	Compensated temperature in °C	read only
.**TD**SRef	Compensated TDS value in g/L	read only
&**Com**pensation	**Start/stop of the compensation**	$G, $S
.**C**ondValue	Compensated conductivity	**0** ... 2 S/cm
.**T**empValue	Compensated temperature	-170.0 ... **0.0** ... 500.0 °C
&**M**ode	**Switching the main measurement mode**	$G
.**S**tatus	Status of the main measurement mode: conductivity or temperature	read only

Object	*Meaning*	*Input range (default values in **boldface**)*
&Calibration	**Calibration**	
.CellConst	**Start calibration of the cell constant**	$G
.StandardCond	Conductivity of the standard solution	**0** ... 2 S/cm
.StdRefTemp	Reference temperature for conductivity of the standard solution	-170.0 ... **20.0** ... 500.0 °C
.StdMeasTemp	Measurement temp. of the standard solution	-170.0 ... **20.0** ... 500.0 °C
.TempCoeff	**Calibration of the temperature coefficient**	
.New	Start new TC calibration	$G
.Select	Identification for storage of the calibration	10 ASCII characters
.Auto	Automatic calibration with Pt100(0)	
.StartTemp	Start temperature	-170.0 ... **20.0** ... 500.0 °C
.StopTemp	Stop temperature	-170.0 ... **50.0** ... 500.0 °C
.Manual	Manual calibration without Pt100(0)	
.FirstTemp	Temperature of 1st calibration solution	-170.0 ... **20.0** ... 500.0 °C
.SecondTemp	Temperature of 2nd calibration solution	-170.0 ... **30.0** ... 500.0 °C
.Delete	Deletion of calibration data	$G
.Id	Identification of calibration data to be deleted	cal.id.
&Config	**Configuration**	
.Printer	**External printer**	
.Id1	1st line of printout header	18 ASCII characters
.Id2	2nd line of printout header	18 ASCII characters
.PrintHead	Printout of header: once, always, never	**once**, always, OFF
.DateTime	Printout of date and time in header	**ON**, OFF
.CharSet	Selection of printer driver	**IBM**, Epson, Seiko, Citizen, HP
.PrintMeasVal	**Measured value printout** (Function as < print > key)	$G, $S
.PrintCrit	Criterion for measured value printout: immed. (ind. value), time (cont. output), plot (curve)	**immed.**, time, plot
.Time	Timed output of measured values	
.Interval	Time interval for output of measured values	0.08 ... **1** ... 99999 s
.StopTime	Stop time (OFF = infinite)	1 ... 99999 s, **OFF**
.Plot	Printout of experimental curves	
.Interval	Time interval for printout of measured values	0.08 ... **1** ... 99999 s
.TimeScale	Scaling of the time axis for curve plot	5, 10, 30, **60**, 120, 180 ... 99960 s/cm
.TLabel	Labelling of the time axis with absolute or relative time	**abs**, rel
.StopTime	Stop time (OFF = infinite)	1 ... 99999 s, **OFF**
.DateTime	Output of date and time of measured value	ON, **OFF**
.Calreporttype	**Settings for calibration reports**	
.Select	Printout of the original report	ON, **OFF**
.Format	Selection of the format for cal. report "cal T" (short = without curve; full = with curve)	**short**, full
.Aux	**General instrument settings**	
.RunNo	Current run number (incremented by 1 after every measured value printout)	**1** ... 999, OFF
.Set	Setting of date and time	$G
.Date	Date	JJ-MM-TT
.Time	Time	HH:MM:SS
.Language	Selection of the dialogue language	**english**, deutsch, francais, español
.DevName	Device label	8 ASCII characters
.Prog	Program version number	read only
.RSset	**Settings for RS232 interface**	
.Baud	Baud rate in bit/s	**9600**, 4800, 2400, 1200, 600, 300
.DataBit	Data bits	7, **8**
.StopBit	Stop bits	**1**, 2
.Parity	Parity: none, odd, even	**none**, odd, even
.Handsh	Handshake: hardware simple, hardware full, software character, software line, none	**HWs**, HWf, SWchar, SWline, none

Object	*Meaning*	*Input range (default values in **boldface**)*
&Info	**Instrument information**	
.Report	**Send formatted reports**	$G
.Select	Selection of the reports	**all**, cond param, temp param, config, cal C, cal T
.CalT	Report "cal T"	
.Id	Selection of the TC calibration data	cal.id.
.ActualInfo	**Current information**	
.Inputs	Remote inputs	
.Status	Status of the input lines in byte form (1 = ON, low, active; 0 = OFF, high, inactive): Status |0|0|0|0|1|0|1|0| Input No. 8 7 6 5 4 3 2 1 Output for this example: $2^1 + 2^3 = 10$	read only
.Change	Change in the status of the input lines since the last "clear", in byte form (1 = change, 0 = no change, see above)	read only
.Clear	Reset "Change" byte to zero	$G
.Outputs	Remote outputs	
.Status	Status of the output lines in byte form (1 = ON, low, active; 0 = OFF, high, inactive): Status |0|0|0|0|0|1|1|0| Output No. 8 7 6 5 4 3 2 1 Output for this example: $2^1 + 2^2 = 6$	read only
.Change	Change in the status of the output lines since the last "clear", in byte form (1 = change, 0 = no change, see above)	read only
.Clear	Reset "Change" byte to zero	$G
.MeasValue	Measured values	
.Conductivity	Current conductivity in S/cm	read only
.Temperature	Current temperature in °C	read only
.TempCoeff	Current temperature coefficient in %/°C	read only
.Display	Display	
.Value	Measured value in main display	-1999.9 ... **0** ... 1999.9
.Unit	Unit in main display	µS/cm, mS/cm, °C
.Ind	Status of the indicator displays in byte form (1 = ON, 0 = OFF): No. | 7 |6|5| 4 | 3 |2| 1 |0| Indicator |Cal_T| | |Zero|Comp| |Cal_C| | Status | 0 |0|0| 1 | 0 |0| 0 |0| Decimal value for this example: $2^4 = 16$	0, 2, 8, 16, 128
.L1	Display in LCD line 1	24 ASCII characters
.L2	Display in LCD line 2	24 ASCII characters
.Button	"Info" key	
.Frequency	Current measurement frequency in Hz	read only
.CalDat	Current TC calibration	
.Id	Identification of the calibration data (cal.id)	read only
.Type	Calibration method (man, auto)	read only
.Date	Date of the calibration	read only
.FirstTemp	Temperature of the 1st cal. solution in °C	read only
.SecondTemp	Temperature of the 2nd cal. solution in °C	read only
.TCConst	Determined TC value in %/°C	read only
.StartTemp	Start temperature in °C	read only
.StopTemp	Stop temperature in °C	read only
.TCRange	TC range (min. and max. TC value) in %/°C	read only

Object	*Meaning*	*Input range (default values in **boldface**)*
&Setup		
.IdReport	**Send report identification before report** cp cond param tp temp param co config ce cal C tc cal T mp measured value output with <print>	ON, **OFF**
.Keycode	**Send key code of pressed key** Elements of key code message: 'Space (dec 32), #, two-digit key code' 0 9 (mode) 12 clear 1 8 (info) 13 select 2 7 (config) 14 3 (report) 3 auto zero 15 2 (cal T) 4 cond param 16 1 (comp off) 6 6 (print) 18 enter 7 5 (cal C) 19 quit 8 4 (az off) 20 +/– (→) 9 comp 21 . (←) 10 temp param 22 0	ON, **OFF**
.Trace	**Send path and value on changes** Elements of the change message: 'Space (dec 32), path, "value"'	ON, **OFF**
.Lock	**Lock functions**	
.Keyboard	Lock all keys	ON, **OFF**
.Mode	Lock <mode> key	ON, **OFF**
.Config	Lock <config> key	ON, **OFF**
.CondPara	Lock <cond> key	ON, **OFF**
.TempPara	Lock <temp> key	ON, **OFF**
.Autozero	Lock <auto zero> key	ON, **OFF**
.AutozeroOff	Lock <az off> key	ON, **OFF**
.Comp	Lock <comp> key	ON, **OFF**
.CompOff	Lock <comp off> key	ON, **OFF**
.CalC	Lock <cal C> key	ON, **OFF**
.CalT	Lock <cal T> key	ON, **OFF**
.Print	Lock <print> key	ON, **OFF**
.Report	Lock <report> key	ON, **OFF**
.Info	Lock <info> key	ON, **OFF**
.Display	Lock main display and LCD (measured values are no longer displayed)	ON, **OFF**
.Remote	Lock all remote lines	ON, **OFF**
.AutoInfo	**Automatic message on change**	
.Message	Elements of the automatic message: 'Space (dec 32), !, device label, "subnodes of AutoInfo", date (opt.), time (opt.)' Example: `' !712-1".E;.O"94-05-04 16:30:47'`	
.DateTime	Output of date and time of occurrence	ON, **OFF**
.Error	Message on error	ON, **OFF**
.Ready	Message when basic mode attained	ON, **OFF**
.Stopped	Message on stop of a sequence	ON, **OFF**
.Wait	Message on entry into wait condition	ON, **OFF**
.PowerOn	Message when instrument switched on	ON, **OFF**
.Inputs	Message on change of an input line	ON, **OFF**
.Outputs	Message on change of an output line	ON, **OFF**
.Save	**Storage of all parameters in EEPROM** (without storage, the modified parameters are lost when the instrument is switched off)	$G

Object	*Meaning*	*Input range (default values in boldface)*
.ExtCalT	**External entry of calibration data**	
.Id	Identification of calibration data (cal.id.)	10 ASCII characters
.StartTemp	Start temperature in °C	-170.0 ... 500.0 °C
.StopTemp	Stop temperature in °C	-170.0 ... 500.0 °C
.c0	Coefficient C0 for Tschebyscheff polynomial	-1E-38 ... 1E38
.c1	Coefficient C1 for Tschebyscheff polynomial	-1E-38 ... 1E38
.c2	Coefficient C2 for Tschebyscheff polynomial	-1E-38 ... 1E38
.c3	Coefficient C3 for Tschebyscheff polynomial	-1E-38 ... 1E38
.c4	Coefficient C4 for Tschebyscheff polynomial	-1E-38 ... 1E38
.InstrNo	**Instrument number**	
.Value	Serial and manufacturing number	8 ASCII characters
.InputAssign	**Assignment of remote input lines**	
.AzOn	Autozero on (= <auto zero> key)	**1** ... 15
.AzOff	Autozero off (= <auto zero> key)	1 ... **2** ... 15
.CompOn	Compensation on (= <comp> key)	1 ... **4** ... 15
.CompOff	Compensation off (= <comp> key)	1 ... **8** ... 15
.ModeCond	Switching to main mode conductivity	1 ... **5** ... 15
.ModeTemp	Switching to main mode temperature	1 ... **6** ... 15
.CalC	Start of the cell constant calibration	1 ... **3** ... 15
.CalT	Start of the TC calibration	1 ... **7** ... 15
.200uS	Set full scale range for conductivity analogue output to 200 µS	1 ... **9** ... 15
.2mS	Set full scale range for conductivity analogue output to 2 mS	1 ... **10** ... 15
.20uS	Set full scale range for conductivity analogue output to 20 µS	1 ... **11** ... 15
.20mS	Set full scale range for conductivity analogue output to 20 mS	1 ... **12** ... 15
.200mS	Set full scale range for conductivity analogue output to 200 mS	1 ... **13** ... 15
.2S	Set full scale range for conductivity analogue output to 2 S	1 ... **14** ... 15
.Enter	Confirmation (= <enter> key)	1 ... **15** ... 15
.Graphics	**Plot parameters for curve plot**	
.Grid	Grid lines when curve plotted	ON, **OFF**
.Frame	Frame when curve plotted	ON, **OFF**
.Recorder	Setting of the printout	
.Right	Relative width of printout	0.4 ... **0.8** ... 1.0
.Feed	Relative length of printout	0.4 ... **1.0**
&Assembly	**Basic elements of assemblies**	
.Meas	Measurement	
.Status	Switch measurement on/off	**ON**, OFF
.Outputs	Remote lines	
.SmplX	Activate (ON) or deactivate (OFF) remote input lines	**ON**, OFF
.AutoEOD	Automatic output of EOD with <print>	**ON**, OFF
.SetLines	Set remote outputs 1 ...8: active Setting of a static signal inactive Resetting of the static signal pulse Output pulse (length ca. 150 ms) OFF Do not set line	$G
.L1	Signal of output line 1 (pin 5)	active,inactive,pulse,**OFF**
.L2	Signal of output line 2 (pin 18)	active,inactive,pulse,**OFF**
.L3	Signal of output line 3 (pin 4)	active,inactive,pulse,**OFF**
.L4	Signal of output line 4 (pin 17)	active,inactive,pulse,**OFF**
.L5	Signal of output line 5 (pin 3)	active,inactive,pulse,**OFF**
.L6	Signal of output line 6 (pin 16)	active,inactive,pulse,**OFF**
.L7	Signal of output line 7 (pin 1)	active,inactive,pulse,**OFF**
.L8	Signal of output line 8 (pin 2)	active,inactive,pulse,**OFF**
.ResetLines	Set remote outputs 1 ... 8 to "OFF"	$G

Object	*Meaning*	*Input range (default values in boldface)*
&Diagnose	**Diagnostic test** Entry into diagnostic program stops measurement	
.EEPROMInit	Initialisation of the EEPROM	$G
.BlockSelect	Selection of block to be initialised USER: Initialisation of all parameter blocks AUX...ASSEMBLY: Initialisation of individual parameter blocks CALDAT: Deletion of all TC calibration data OUTPUT: Deletion of the recorder calibration EEPROM: Initialisation of the entire EEPROM (possible only with security code)	**USER**, AUX, PRINT, REPORTTYPE, SETTINGS, COND, CONDANAOUT, CONDLIMIT, CONDPLOT, TEMPANAOUT, TEMPLIMIT, TEMPPLOT, CELLCOEFF, TEMPCOEFF, COMP, INFO, SETUP, ASSEMBLY, OUTPUT, CALDAT, EEPROM
.RAMTest	Start RAM test	$G
.PlasmaTest	Start test of the main plasma display	$G, $S
.LCDTest	Start test of the LCD	$G, $S
.IOTest	Test of the remote lines (possible only with 3.496.8510 Test Plug, see diagnostic test)	$G, $S
.RSTest	Test of the RS232 interface (possible only with 3.496.8480 Test Plug, see diagnostic test)	$G, $S
.KeyTest	Keypad test	$G, $S
.SimulateKey	Simulate keystroke 0 9 (mode) 12 clear 1 8 (info) 13 select 2 7 (config) 14 3 (report) 3 auto zero 15 2 (cal T) 4 cond param 16 1 (comp off) 6 6 (print) 18 enter 7 5 (cal C) 19 quit 8 4 (az off) 20 +/– (→) 9 comp 21 . (←) 10 temp param 22 0	0 ... 22
.Adjust	Set adjustment data	$G, $S
.DiagReport	Adjustment report	ON, OFF
.OutputAdjust	Adjust analogue outputs	$G, $S
.CondOut	Analogue output for conductivity	
.Offset	Offset	-100 ... **0** ... 100 mV
.Slope	Slope	1500.0 ... **1800.0** ... 2000.0 mV
.TempOut	Analogue output for temperature	
.Offset	Offset	-100.0 ... **0.0** ... 100.0 mV
.Slope	Slope	1500.0 ... **1800.0** ... 2000.0 mV
.PowerOn	Simulation power on	$G
.DACTest	Test of the digital-analogue converter	$G
.CondOut	Digital value for conductivity	**0** ... 4095
.TempOut	Digital value for temperature	**0** ... 4095
.COMPTest	Compensation test	$G
.CompOut	Digital value for compensation value	**0** ... 4095

5.6 Characteristics of the RS232 interface

5.6.1 Data transfer protocol

The RS232 interface of the 712 Conductometer is configured as DTE (Data Terminal Equipment) and has the following technical specifications:

Standard:	Data interface in accordance with EIA RS232C, CCITT V.24, ISO 2110, DIN 66020
Code:	8 Bit World Trade Character Set 437 (USA)
Baud rate:	300, 600, 1200, 2400, 4800, 9600 (adjustable)
Handshake:	HWshort, HWfull, SWchar, SWline, none (details, see *section 5.6.2*)
Parity:	even, odd, none
Stop bits:	1 or 2
Data bits:	7 or 8
Max. line length:	80 characters + C_R L_F

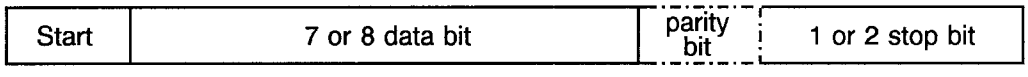
Control characters:

C_R	Carriage Return	DEC 13	HEX 0D
L_F	Line Feed	DEC 10	HEX 0A
XON	Data transmission start	DEC 17	HEX 11
XOFF	Data transmission stop	DEC 19	HEX 13

Mode: Full duplex (send and receive simultaneously)
Restriction: *If data are first received by the interface, sending does not commence until the receipt is at an end.*

Cable: Only a shielded data cable may be used. The cable shielding must be faultlessly earthed at both units (pay attention to current loops; always use star-head earthing). Only connectors with adequate shielding may be used (e.g. METROHM K.210.0001 with K.210.9004).

Cable length: max. ca. 15 m



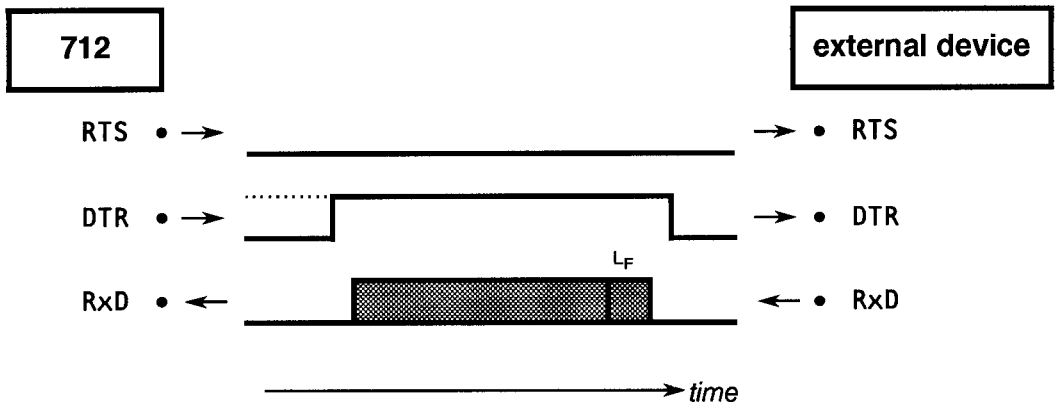
5.6.2 Handshake

The 712 Conductometer offers the following possibilities to set the handshake (see *section 5.3.1*):

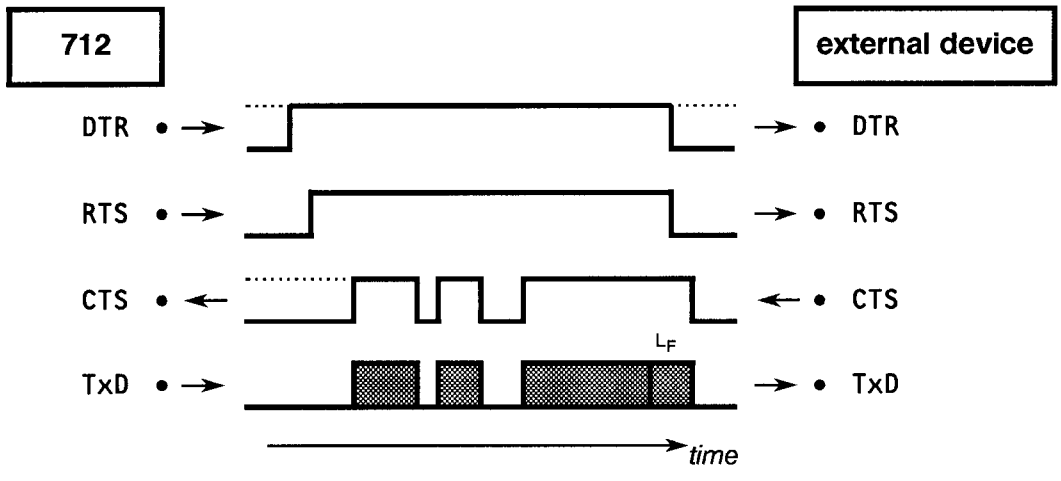
- **none – no handshake**
  Neither handshake inputs (CTS, DSR, DCD) nor handshake outputs (DTR, RTS) are checked by the 712 Conductometer.

- **HWs – reduced hardware handshake**

  712 Conductometer as **receiver**:



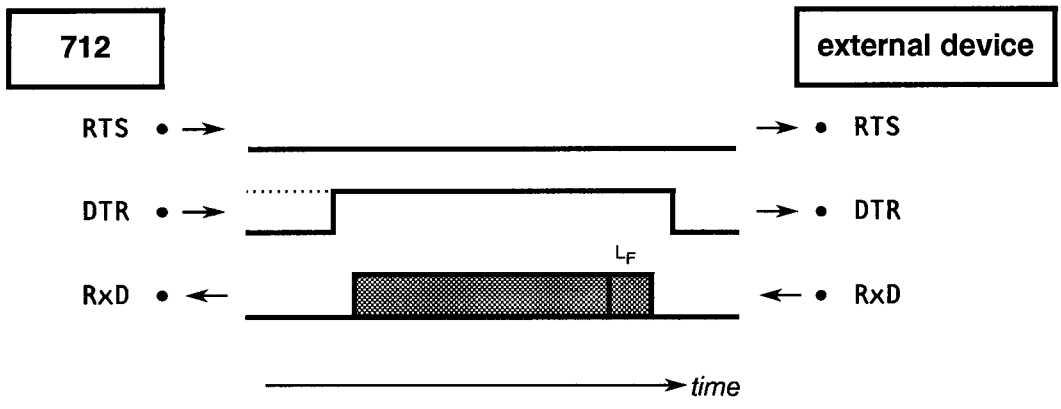
712 Conductometer as **sender**:



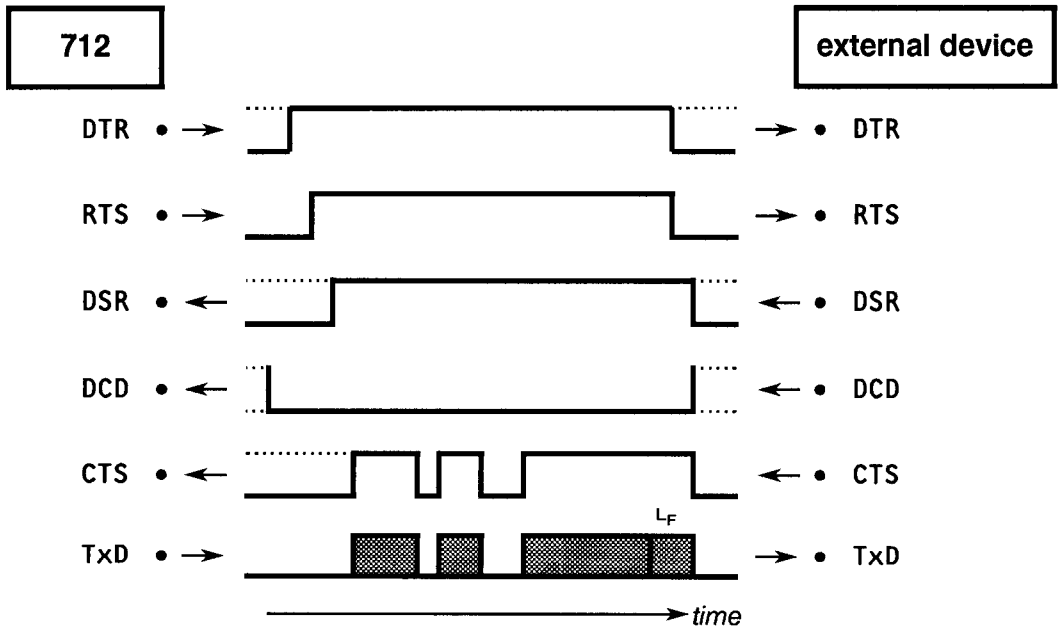
The data flow can be interrupted by deactivation of the CTS line.

- **HWf – full hardware handshake**
  All handshake inputs at the 712 Conductometer are checked, all handshake outputs are set.

  712 Conductometer as **receiver**:



712 Conductometer as **sender**:



The data flow can be interrupted by deactivation of the CTS line.

- **SWchar – software handshake with character stop**
  Handshake inputs at the 712 Conductometer (CTS, DSR, DCD) are not tested.

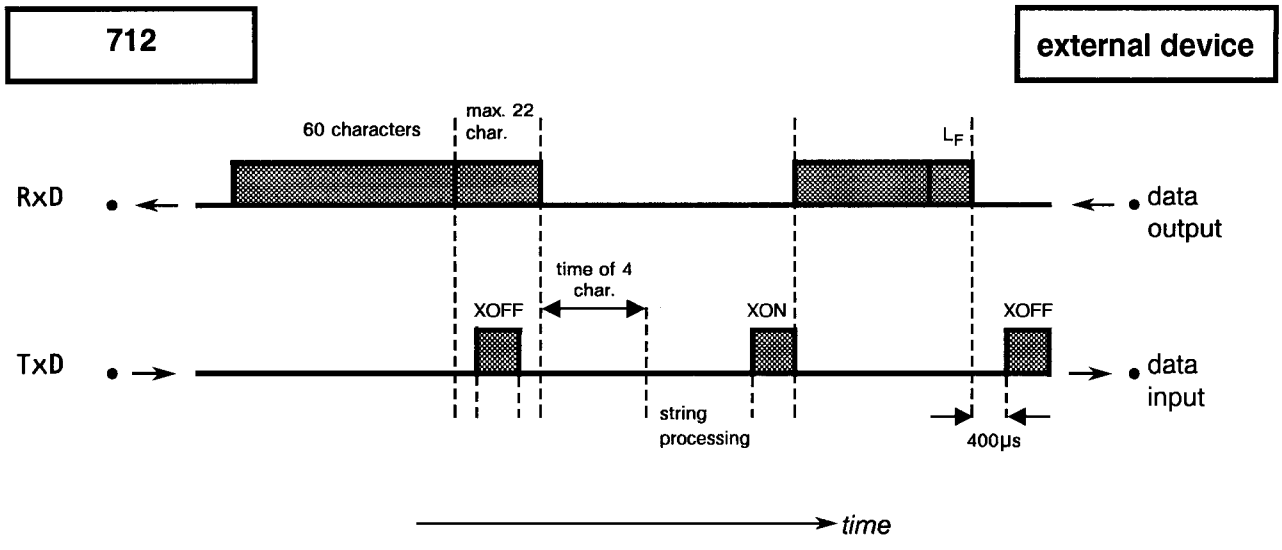
  Handshake outputs (DTR, RTS) are set by the 712 Conductometer.

  As soon as an L_F is recognised, the 712 Conductometer sends XOFF. After this point, it can receive 6 more characters and store them temporarily.

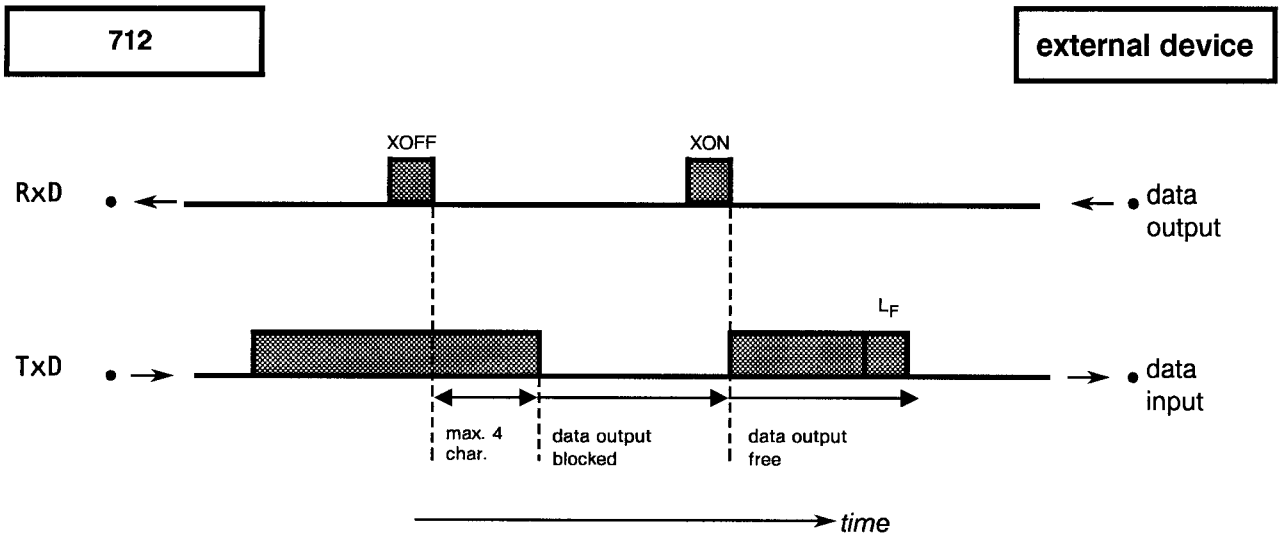
  However, the 712 Conductometer also sends XOFF when its input buffer contains 60 characters. After this point, it can receive maximum 22 more characters (incl. L_F).

  If the transmission is interrupted for the time of 4 characters after the 712 Conductometer has sent XOFF, the string received beforehand is processed even if no L_F has been sent.

  712 Conductometer as **receiver**:



  712 Conductometer as **sender**:

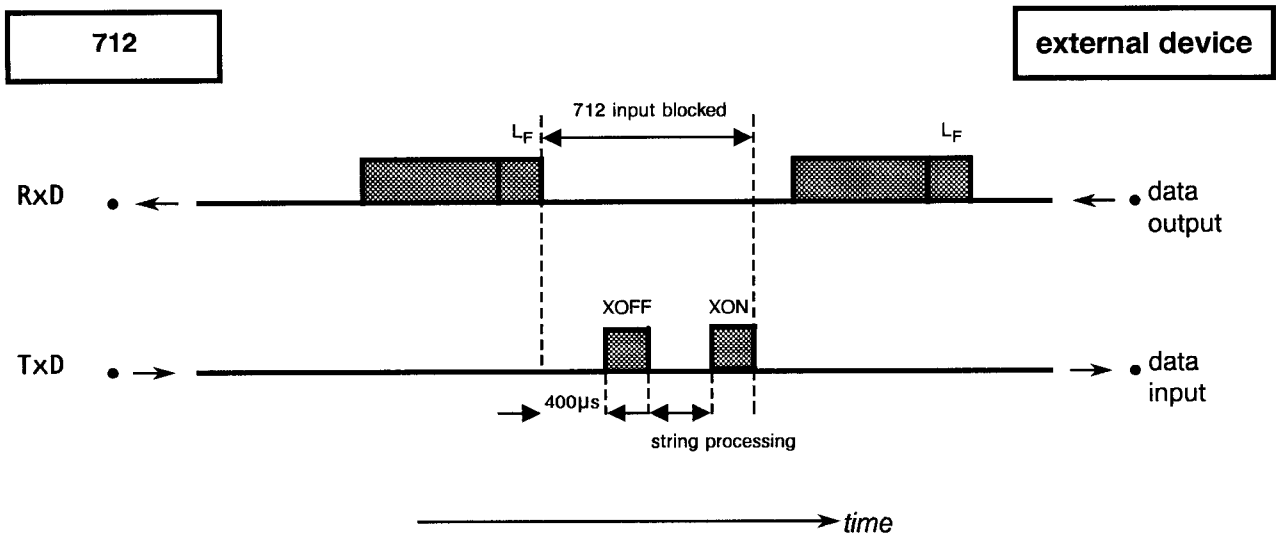


- **SWline – software handshake with line stop**
  Handshake inputs at the 712 Conductometer (CTS, DSR, DCD) are not tested.

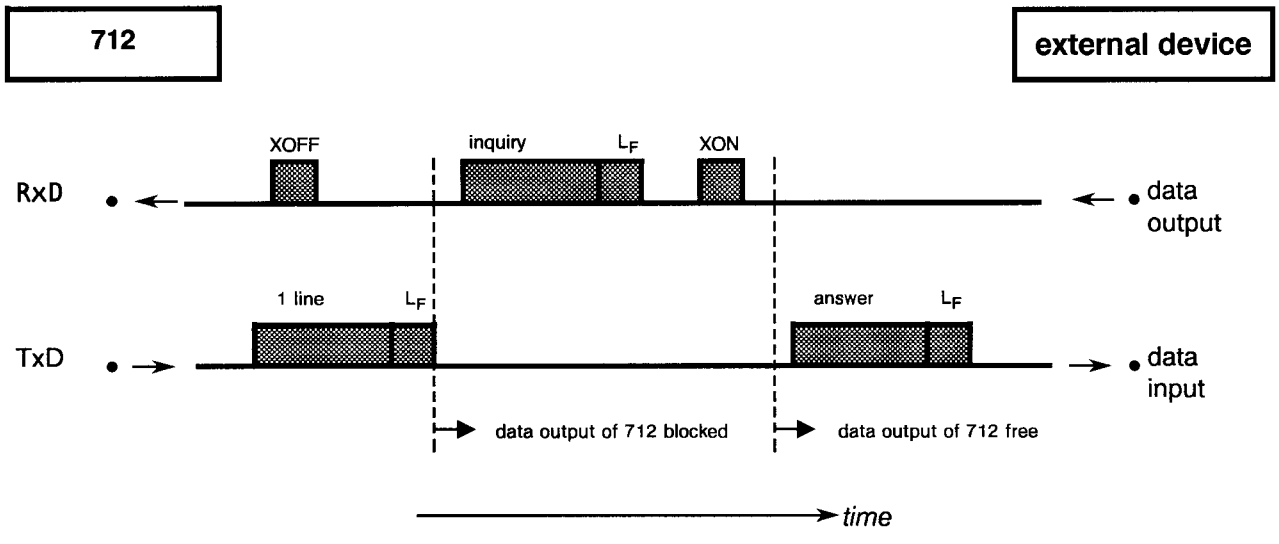
  Handshake outputs (DTR, RTS) are set by the 712 Conductometer.

  The 712 Conductometer has an input buffer which can accept a string of up to 80 characters + C_R L_F. As soon as an L_F is recognised, the 712 Conductometer sends XOFF. After this point, it can receive maximum 6 more characters and store them temporarily. The string sent beforehand is now processed by the 712 Conductometer. The 712 Conductometer then sends XON and is again ready to receive.

  712 Conductometer as **receiver**:

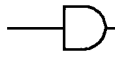
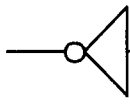
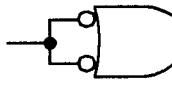
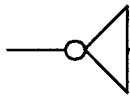
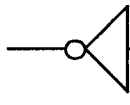
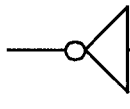
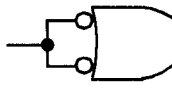


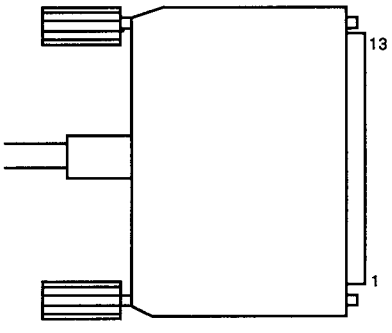
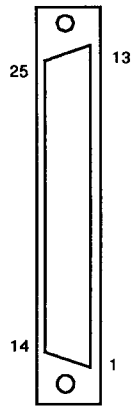
  712 Conductometer as **sender**:



  Transmission of the 712 Conductometer can be stopped by the external device with XOFF. After the receipt of XOFF, the 712 Conductometer finishes sending the line it has started. If the data output is blocked by XOFF for more than 10 s, the error message "RS error 43" appears.

5.6.3 Pin assignment

		external
RS232C Interface		
Transmitted data (TxD). If no data are transmitted, the line is held in the "ON" condition. Data are transmitted only when CTS and DSR are in the "ON" condition and DCD is in the "OFF" condition.		E 2 Transmitted Data
Received data (RxD) Data are received only when DCD is "ON".		E 3 Received Data
Request to Send (RTS) ON condition: 712 Conductometer is ready to send data.		E 4 Request to Send
Clear to Send (CTS) ON condition: Remote station is ready to receive data.		E 5 Clear to Send
Data Set Ready (DSR) ON condition: The transmission line is connected.		E 6 Data Set Ready
Signal Ground (GND)		E 7 Signal Ground
Data Carrier Detect (DCD) ON condition: The level of the received signal is within the tolerance range (remote station is ready to send data).		E 8 Data Carrier Detect
Data Terminal Ready (DTR) ON condition: 712 Conductometer is ready to receive data.		E 20 Data Terminal Ready

		external
RS232C (continued) **Protective earth** Direct connection from cable connector to protective earth of instrument. **Polarity allocation of the signals** – Data lines (TxD, RxD) Voltage negative (<–3 V): signal status "one" Voltage positive (> +3 V): signal status "zero" – Control or message lines (CTS, DSR, DCD, RTS, DTR) Voltage negative (<–3 V): Off status Voltage positive (> +3 V): On status In the transition region from +3 V to –3 V the signal status is undefined. Driver 14C88 Receiver 14C89 } in compliance with EIA RS232C specification **Contact arrangement at connector (female) for RS232 C socket (male)**  Ordering numbers: K.210.9004 and K.210.0001  View from solder side of connector		

No liability whatsoever will be accepted for damage or injury caused by improper interconnection of instruments.

5.7 What can you do if the data transfer does not work?

Problem	*Questions for remedial action*
No characters can be received on a connected printer	– Are the instruments and the connection cables plugged in properly? – Is the printer set to "on-line"? – Are baud rate, data bit and parity settings the same for both devices? – Is the handshake set properly? If everything appears to be in order, try to print out a report with the <report> key.
No data transmission occurs and the display of the 712 Conductometer shows an error message	– **RS error 40...42**: Transmission error. Is the cable properly wired and connected? Is the printer switched on and set to "on-line"? – **RS error 43**: Data output of the 712 Conductometer disabled for longer than 3 s by XOFF. – **RS error 36...39**: Receive error. Are the settings of the RS232 data transmission parameters the same for both devices?
The received characters are garbled	– Are the data bit and the parity settings the same for both devices? – Is the baud rate setting the same for both devices? – Has the correct printer been selected? – Data transfer has been interrupted on the hardware side during the printout of a curve. Re-establish connections and switch printer off/on.
Printout of curve is not ok. Other reports are printed correctly	Handshake is necessary for the printout of a curve. – Is your cable correctly wired? (The DTR of the printer has to be connected to the CTS of the 712 Conductometer.) – Set "HWs" for the handshake at the 712 Conductometer. Configure the printer such that its DTR is set (normally with DIP switches).

6. Remote interface

6.1 Functions

The remote interface of the 712 Conductometer has 8 input lines for control of the Conductometer via external devices and 8 output lines for the output of control signals to external devices. The following inputs and outputs are assigned permanently defined functions:

Inputs	**1**	Print
	2 ... 5	Programmable lines (see *section 6.2*)
Outputs	**1**	Ready
	2	Upper limit value conductivity
	3	Lower limit value conductivity
	4	Advance pulse (EOD)
	6	Error
	7	Upper limit value temperature
	8	Lower limit value temperature

You will find detailed information on the control inputs and outputs and their functions in *section 6.3*, the assignment of the programmable inputs lines is described in *section 6.2*. The status of all inputs and output lines can be inquired and monitored via the RS232 interface, the output lines can also be set via the RS232 interface (see remote control commands, *section 5.5*).

6.2 Assignment of the programmable input lines

A total of 15 different instrument functions can be initiated at the 712 Conductometer via the 4 programmable input lines (see *section 6.3*). The Table opposite shows the standard assignment of these functions to the status of the 4 programmable lines, which is defined by the status of the individual lines (H = high, L = low) or the derived decimal code.

Input line				*Decimal code*	*Function*
5 2^3	**4** 2^2	**3** 2^1	**2** 2^0		
H	H	H	H	0	Inactive
H	H	H	L	1	Autozero on
H	H	L	H	2	Autozero off
H	H	L	L	3	Cal_C
H	L	H	H	4	Comp on
H	L	H	L	5	Mode Cond
H	L	L	H	6	Mode Temp
H	L	L	L	7	Cal_T
L	H	H	H	8	Comp off
L	H	H	L	9	200 µS/cm / 2V
L	H	L	H	10	2 mS/cm / 2V
L	H	L	L	11	20 µS/cm / 2V
L	L	H	H	12	20 mS/cm / 2V
L	L	H	L	13	200 mS/cm / 2V
L	L	L	H	14	2 S/cm / 2V
L	L	L	L	15	Enter

The standard assignment of the individual functions to the status of the 4 input lines 2...5 (defined by the corresponding decimal code 1...15) can be changed if need be. It is also possible to assign several functions to the same status.

The assignment is part of the "Setup" and is accessible only if the <config/7> key is pressed at the same time as the instrument is switched on. The following summary shows all dialogue options which appear under "setup/input assign". The values shown in the displays are the default values.

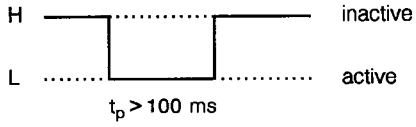
setup >input assign	**Assignment of the input lines 2...5**
>input assign az on 1	**Switch on autozero** Corresponds to pressing the <auto zero> key 1 ... 15
>input assign az off 2	**Switch off autozero** Corresponds to pressing the <az off> key 1 ... 15
>input assign comp on 4	**Switch on compensation** The compensation is switched on (corresponds to pressing the <comp> key followed by confirmation of the compensation value) 1 ... 15
>input assign comp off 8	**Switch off compensation** Corresponds to pressing the <comp off> key 1 ... 15
>input assign mode cond 5	**Mode conductivity measurement** Switches to the conductivity measurement mode 1 ... 15
>input assign mode temp 6	**Mode temperature measurement** Switches to the temperature measurement mode 1 ... 15
>input assign cal C 3	**Start of the cell constant calibration** Corresponds to pressing the <cal C> key 1 ... 15
>input assign cal T 7	**Start of the TC calibration** Corresponds to pressing the <cal T> key 1 ... 15

>input assign 200µS/cm/2V 9	**Full scale range for 2 V = 200 µS/cm** As long as this status is active, the full scale range of the conductivity analogue output is set to 200 µS/cm 1 ... 15
>input assign 2mS/cm/2V 10	**Full scale range for 2 V = 2 mS/cm** As long as this status is active, the full scale range of the conductivity analogue output is set to 2 mS/cm 1 ... 15
>input assign 20µS/cm/2V 11	**Full scale range for 2 V = 20 µS/cm** As long as this status is active, the full scale range of the conductivity analogue output is set to 20 µS/cm 1 ... 15
>input assign 20mS/cm/2V 12	**Full scale range for 2 V = 20 mS/cm** As long as this status is active, the full scale range of the conductivity analogue output is set to 20 mS/cm 1 ... 15
>input assign 200mS/cm/2V 13	**Full scale range for 2 V = 200 mS/cm** As long as this status is active, the full scale range of the conductivity analogue output is set to 200 mS/cm 1 ... 15
>input assign 2S/cm/2V 14	**Full scale range for 2 V = 2 S/cm** As long as this status is active, the full scale range of the conductivity analogue output is set to 2 S/cm 1 ... 15
>input assign enter 15	**Enter** Corresponds to pressing the <enter> key 1 ... 15

6.3 Control inputs and outputs

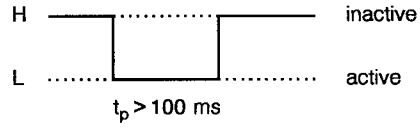
712 Conductometer	Pin No.	Function
Inputs		
+5V, 1	21	**Print**
+5V, 2	9	2^0
+5V, 3	22	2^1
+5V, 4	10	2^2
+5V, 5	23	2^3
+5V, 6	11	**not assigned**
+5V, 7	24	**not assigned**
+5V, 8	12	**not assigned**
Outputs		
1	5	**Ready**
2	18	**Upper limit of the conductivity violated**

Initiation of the print command
Corresponds to pressing the <print> key (see *section 4.7.3*). At the same time as initiation of the print command at input 1, the EOD signal is set at output 4.



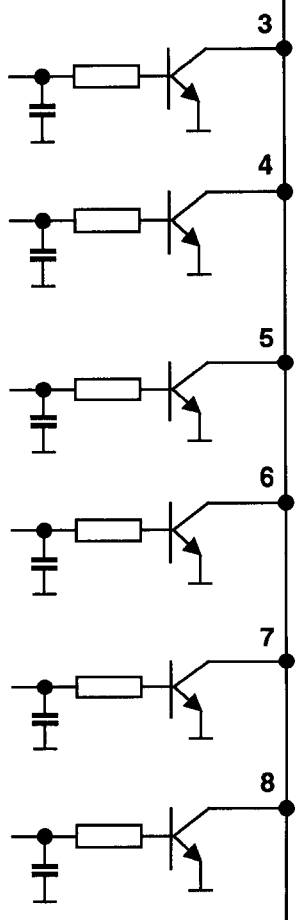
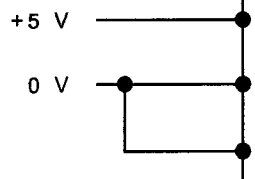
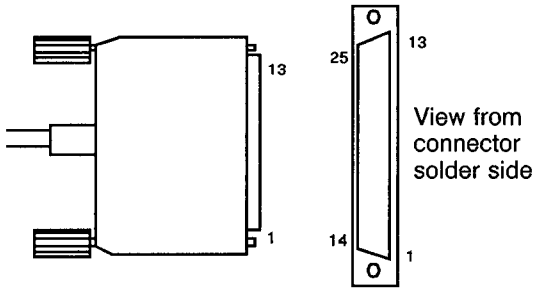
Initiation of functions (remote control)
For details of the functions which can be initiated, see *section 6.2*

5	4	3	2	Decimal	Function
H	H	H	H	0	Inactive
H	H	H	L	1	Autozero on
H	H	L	H	2	Autozero off
H	H	L	L	3	Cal_C
H	L	H	H	4	Comp on
H	L	H	L	5	Mode Cond
H	L	L	H	6	Mode Temp
H	L	L	L	7	Cal_T
L	H	H	H	8	Comp off
L	H	H	L	9	200 µS/cm / 2V
L	H	L	H	10	2 mS/cm / 2V
L	H	L	L	11	20 µS/cm / 2V
L	L	H	H	12	20 mS/cm / 2V
L	L	H	L	13	200 mS/cm / 2V
L	L	L	H	14	2 S/cm / 2V
L	L	L	L	15	Enter



Ready
L = ready (measurement mode, start of sequences possible) V_{CEO} = 40 V, IC = 20 mA
H = not ready (instrument not in measurement mode)

Upper limit of the conductivity violated
L = conductivity above upper limit value V_{CEO} = 40 V, IC = 20 mA
H = conductivity below upper limit value

712 Conductometer	*Pin No.*	*Function*
		**Lower limit of conductivity violated** L = conductivity below lower limit value H = conductivity above lower limit value V_{CEO} = 40 V IC = 20 mA **Advance pulse (EOD)** An advance pulse is outputted in the following cases: – each time the <print> key is pressed – at the end of the cell constant calibration – at the end of the TC calibration H / L t_p > 20 ms **not assigned** **Error** L = instrument error (for as long as it exists) H = instrument OK V_{CEO} = 40 V I_C = 20 mA **Upper limit of temperature violated** L = Temperature above upper limit value H = Temperature below upper limit value V_{CEO} = 40 V I_C = 20 mA **Lower limit of temperature violated** L = Temperature below lower limit value H = Temperature above lower limit value V_{CEO} = 40 V I_C = 20 mA
Voltages 		I ≤ 40 mA R_i ≈ 12 Ω 0 V: active Low (L) 5 V: inactive High (H)
		Contact arrangement at connector (male) for «remote» socket (female)  Order numbers: K.210.9060 (sleeve) and K.210.0002

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7. Safety, errors, maintenance, GLP, diagnostic test

7.1 Electrical safety

The electrical safety during handling of the 712 Conductometer conforms with the regulations of IEC 1010 (instrument protection class 1). The following two points must be noted in this connection:

- *The **mains connection** must be made as described in section 3.3.*
- *If the 712 Conductometer is connected to the power supply, it must neither be opened nor parts removed from it, otherwise there is a danger of contact with live components. Before the 712 Conductometer is opened to change assemblies or for maintenance and repair work, the **mains cable must always be disconnected from mains connector plug 15**.*

7.2 Error messages

If errors of whatever type appear during operation of the 712 Conductometer, this is shown by error messages which appear either in the main display 1 or in the 1st line of the dialogue display 2. You will find further details of the error messages, their possible causes and how to rectify them in the alphabetical list of error messages in the following Tables. If the errors can not be rectified, please refer to the procedure described in *sections 7.5* and *7.6*.

Error messages in the main display

Error message	*Meaning/Causes*	*Rectification*
Flashing display	Measurement range exceeded	Rectify error
Err 1	Program checksum wrong	Inform Metrohm service
Err 3	Instrument adjustment faulty	<quit>, if new instrument adjustment necessary, inform Metrohm service
Err 4	Timer interrupt for multitasking missing	Inform Metrohm service
Err 5	RS232 module test faulty	Inform Metrohm service
Err 6	Clock faulty	Inform Metrohm service
Err 7	LCD write/read error	Inform Metrohm service
Err 8	AD converter faulty	Inform Metrohm service

Error messages in the dialogue display

Error message	*Meaning/Causes*	*Rectification*
current temp. too high	Current temperature in TC calibration too high	<quit>, cool solution
current temp. too low	Current temperature in TC calibration too low	<quit>, heat solution
EEPROM error 240	Error on storage of the EEPROM blocks	<quit>, reenter all values
EEPROM error 241 ... 260	Error on storage of a single EEPROM block	<quit>, reenter values for this EEPROM block

Error message	*Meaning/Causes*	*Rectification*
adjustment error	Instrument adjustment invalid	Inform Metrohm service
no calibration data	Calibration data in EEPROM no longer available	<quit> , reenter calibration data or start new TC calibration
calib.memory full	Calibration memory full	<quit>, delete old calibration data
short circuit Pt sensor	Pt100/Pt1000 temperature sensor faulty (short circuit)	Change Pt100/Pt1000 temperature sensor
plot data overflow	Plot data overflow	<quit>, (plot is terminated)
check Pt sensor	Pt100/Pt1000 temperature sensor not plugged in or faulty	Plug in or change Pt100/Pt1000 temperature sensor
RS error 36	RS232 receive error; wrong parity	<quit>, set parity same for both devices
RS error 37	RS232 receive error: wrong stop bit	<quit>, set stop bit same for both devices
RS error 38	RS232 receive error; overflow (at least 1 character could not be read)	<quit>, start transmitter again
RS error 39	RS232 receive error; overflow of internal receive buffer (>82 characters)	<quit>
RS error 40	RS232 send error; DSR = OFF, handshake unsatisfactory for more than 1 s	<quit>, check receiver (switched on and ready?)
RS error 41	RS232 send error; DCD = ON, handshake unsatisfactory for more than 1 s	<quit>, check receiver (switched on and ready?)
RS error 42	RS232 send error; CTS = OFF, handshake unsatisfactory for more than 1 s	<quit>, check receiver (switched on and ready?)
RS error 43	RS232 send error; transmission of the Conductometer was interrupted with XOFF for at least 3 s	<quit> or send XON
RS error 44	RS232 send error; the RS parameters are no longer the same for both devices	<quit>, reset RS parameters for both devices
RS error 45	RS232 send error; the receive buffer of the Conductometer contains an incomplete character string (L_F missing), the transmission is thus blocked	<quit> or send L_F
RS error 60 ... 89	Error in RS232 test	<quit>, check connection between the RS interfaces
temp.range < 5 °C	Temperature range for TC calibration is too small	<quit>, increase temperature range
temp.1 = temp.2	Temperature 1 is the same as temperature 2	<quit> heat or cool solution
temp.change too fast	Temperature change too fast	<quit> heat or cool solution more slowly
TC negative	Negative temperature coefficient	<quit>, start new TC calibration
TC overflow	Temperature coefficient too large	<quit>, start new TC calibration
cell.const. overflow	Cell constant too large	<quit>, start new cell constant calibration

7.3 Platinisation of conductivity cells

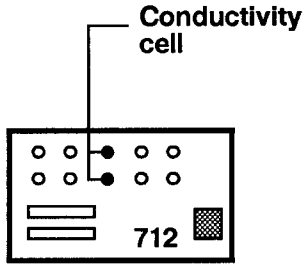
Platinisation is understood to mean the electrolytic deposition of extremely finely divided platinum on bare platinum electrodes. Platinisation greatly reduces the danger of polarisation of the electrodes. The deposited platinum black layer and hence the cell constant changes due to ageing (see *section 4.4.3*) thus necessitating replatinisation from time to time.

The 712 Conductometer has a connection for the platinisation of conductivity cells with an amperage of 20 mA. The platinisation procedure is as follows:

1▸ **Pretreatment**
Degrease new conductivity cell and scour surface by immersing in hot aqua regia (3 parts by volume conc. HCl and 1 part by volume HNO_3) for a few minutes to ensure good adhesion for the platinum layer. Also use aqua regia to remove old platinum layer. Then rinse thoroughly with dist. water.

2▸ **Preparing the platinisation solution**
(following Lummer-Kurlbaum)
Dissolve 3 g chloroplatinic acid $H_2(PtCl_6) \cdot 6H_2O$ and 30 mg lead acetate in 100 mL dist. water.

3▸ **Attachment of the conductivity cell**
Attach conductivity cell to connection socket **9** (I_{plat}) as shown in the diagram opposite.



4▸ **Platinisation**
Switch on 712 Conductometer and wait until the electrode being platinised starts to turn black and a slight gas evolution can be seen. After ca. 5 min, when the platinisation already appears deep black, reverse polarity of measuring cell and perform platinisation for the second electrode in exactly the same manner. On completion, rinse with dist. water.

5▸ **After-treatment**
Finally, electrolysis is performed in a 2% ultrapure sulphuric acid solution in the same manner as for the platinisation. Rinse well and soak for at least several hours in dist. water.

7.4 Standard operating procedure in the context of GLP/ISO 9001 guidelines

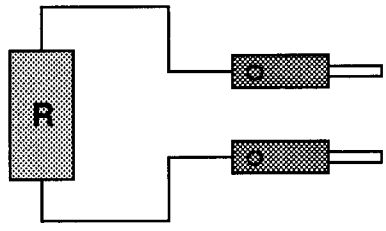
*The requirements of **GLP** (Good Laboratory Practice) include the periodic checking of the reproducibility and accuracy of analytical instruments using **standard operating procedures**. Metrohm proposes the procedure described below for the standard operating procedure to check the 712 Conductometer.*

The standard operating procedure comprises two parts:

- *In a first step the correct functioning of the 712 Conductometer is checked using resistors.*
- *The 712 Conductometer and the conductivity cell are then checked by measuring a standard KCl solution of defined conductivity.*

7.4.1 Accessories required

- 5 **resistors** of accuracy class 0.1% or 1% connected by banana plugs
  10 Ω
  100 Ω
  1 kΩ
  10 kΩ
  100 kΩ



or

Resistance decade of accuracy class 0.1% or 1% with appropriate cable connections

Please ensure that the plug contacts are in perfect condition.

- **Potassium chloride solution**: $c(KCl) = 0.1000 \pm 0.0005$ mol/L
  e.g. Metrohm 6.2301.060 Conductivity Standard

7.4.2 Test of the 712 Conductometer with resistors

To test the 712 Conductometer with resistors, the following steps are necessary:

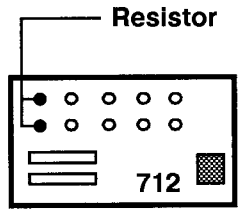
1▸ Switch on the Conductometer
Switch on the 712 Conductometer with mains switch **14**.

2▸ Set the conductivity parameters
Press the <cond param> key and set the parameters opposite for the conductivity measurement (details, see *section 4.4.2*). As the temperature compensation is switched off ("TC = 0.0 %/°C"), the measurement and reference temperature are not important.

```
conductivity
>cond/parameters
  cell constant          1.00 /cm
  meas.temp.             20.0 °C
  ref.temp.              20.0 °C
  TC selection:         const.
  TC const.               0.0 %/°C
  frequency:             auto
  meas.type:         standard
```

3▸ Connect the resistors and measure the conductivity

Connect the 5 resistors in sequence to connection sockets 7 (Cond. cell), read off the measured values and record.



4▸ Assess the results

The admissible deviation of the results is determined by the sum of the resistance error (e.g. 0.1% or 1%) and measurement error of the Conductometer, which depends on the measurement range as follows:

Measurement range	*712 Measurement error*
20 ... 200 mS/cm	±0.8 % of measured value
2 ... 20 mS/cm	±0.5 % of measured value
0.2 ... 2 mS/cm	±0.5 % of measured value
20 ... 200 µS/cm	±0.5 % of measured value
2 ... 20 µS/cm	±0.5 % of measured value
0 ... 2 µS/cm	±1.3 % of measured value

As an example, the Table below shows the admissible results of the conductivity measurement with 5 resistors of accuracy class 1% and 0.1%.

Resistor	*Theoretical conductivity*	*Admissible measured value for resistor 1%*	*Admissible measured value for resistor 0.1%*
10 Ω	100.0 mS/cm	98.20 ...101.8 mS/cm	99.10 ...100.9 mS/cm
100 Ω	10.00 mS/cm	9.850 ...10.15 mS/cm	9.940 ...10.06 mS/cm
1 kΩ	1.000 mS/cm	0.985 ...1.015 mS/cm	0.994 ...1.006 mS/cm
10 kΩ	100.0 µS/cm	98.50 ...101.5 µS/cm	99.40 ...100.6 µS/cm
100 kΩ	10.00 µS/cm	9.850 ...10.15 µS/cm	9.940 ...10.06 µS/cm

If your measured values are clearly outside the range specified, a readjustment of the 712 Conductometer is necessary. Inform Metrohm service in this case.

7.4.3 Test of the 712 Conductometer with conductivity standard

To test the 712 Conductometer with the conductivity cell using a standard solution of known conductivity, the following steps are necessary:

1▸ Prepare the measuring cell

- Rinse cells which have been stored dry with ethanol and place in dist. water for 1 h.
- Rinse conductivity cells already in use thoroughly with dist. water and free from adhering water drops as far as possible (shake, wipe outside with a Kleenex).

2▸ Add the analysis solution

- First rinse the measuring cell thoroughly with dist. water and then with conductivity standard. Then fill the measuring vessel with 6.2301.060 conductivity standard, c(KCl) = 0.1000 ± 0.0005 mol/L.
- Ensure that the temperature of the analysis solution remains constant during the measurement (it is best to thermostat at 20 °C).

3▸ Insert the measuring cell
Immerse the measuring cell several times in the measuring vessel filled with conductivity standard so that the upper, lateral openings are completely covered by analysis solution. Remove air bubbles within the measuring cell by swirling around and tapping.

4▸ Switch on the Conductometer
Switch on the 712 Conductometer with mains switch **14**.

5▸ Set the conductivity parameters
Press the <cond param> key and set the parameters for the conductivity measurement (for details, see *section 4.4.2*) as follows:

	Example	
`cell constant`	`0.851 /cm`	Enter here the cell constant printed on the measuring cell.
`meas.temp.`	`25.0 °C`	The exact measurement temperature has to be entered only if no temperature sensor is attached to the 712 Conductometer.
`ref.temp.`	`20.0 °C`	At 20 °C, the conductivity of the standard KCl solution is 11.67 mS/cm (conductivity at other temperatures, see Table *p. 40*).
`TC selection:`	`const.`	You should select "`cal.id.`" only if you have performed a TC calibration with the standard solution beforehand (details, see *section 4.4.4*).
`TC const.`	`2.07`	Enter here the temperature coefficient between measurement and reference temperature (values between 18 ... 25 °C, see Table on *p. 40*). If the measurement and reference temperature are the same, "`0.0`" must be entered.
`frequency:`	`auto`	Automatic switching of the measurement frequency.
`meas.type:`	`Standard`	Standard measurement mode.

6▸ Measure the conductivity
Wait until the temperature is constant and then read off the measured conductivity value.

7▸ Assess the result
The displayed conductivity should be **11.67 ± 0.15 mS/cm**.

If the measured conductivity lies outside this range, the cell constant must be reset (procedure, see *section 4.4.3*) and the measurement of the conductivity repeated as described above. To be absolutely sure, then measure another standard solution of known conductivity.

If the results are unsatisfactory even after the cell constant calibration, check the conductivity sensor.

7.5 Diagnostic test

The 712 Conductometer is a very precise and dependable measuring instrument. Thanks to its rugged construction, its functions are virtually unaffected by outside mechanical or electrical influences.

Although it is not impossible that the instrument may suffer a malfunction, it is much more likely that this is caused by errors due to faulty operation or handling or through improper connections and operation with third-party devices.

It is always advisable to isolate the fault using the diagnostic test, which is simple and quick to perform. The customer need call Metrohm service only when the fault actually lies with the instrument. Further, he or she can provide the service engineer with much more detailed information based on the numbering in the diagnostic program.

On inquiries, please do not forget to specify the manufacturing number (*page 3*) and program number (see configuration, *page 29*) and any error displays.

Procedure

- The diagnostic steps must be performed in sequence and compared with the reactions of the 712 Conductometer (indented). In the "Yes" case, continue with the next instruction.

- If the instrument does not show the expected reaction ("No" case), repeat the diagnostic step in question to exclude operating errors. Note, however, that several wrong reactions in succession are highly indicative of a malfunction.

Instruments required

- Resistance decade, class 0.1%

Required only when external functions also need to be checked:
- 3.496.8510 Test Plug (at 'Remote' plug socket)
- 3.496.8480 Test Plug (at 'RS232' plug socket)

1. Prepare instrument for diagnostic test

The following display dialogues are in English (the dialogue language can be selected under <config>, see *page 29*).

Power off.

Disconnect all external connections (cables at rear panel, except mains cable).

Switch power on and immediately press and hold the <9> key until the power-on test pattern disappears. The following display appears on the LCD:

```
diagnosis
>EEPROM initialization
```

2. RAM test

The following test is a non-destructive RAM test of the entire area.

If necessary, press <9> repeatedly until

```
diagnosis
>RAM test
```

press <enter>

```
>RAM test
RAM test ok
```

press <enter>

```
diagnosis
>plasma display test
```

3. Plasma display test

If necessary, press <9> repeatedly until

```
diagnosis
>plasma display test
```

press <enter>.

After the <enter> key has been pressed, characters for a visual check are generated in the display *(see Fig. 1)*.

The test sequence can be halted by pressing the <5> key and then continued.

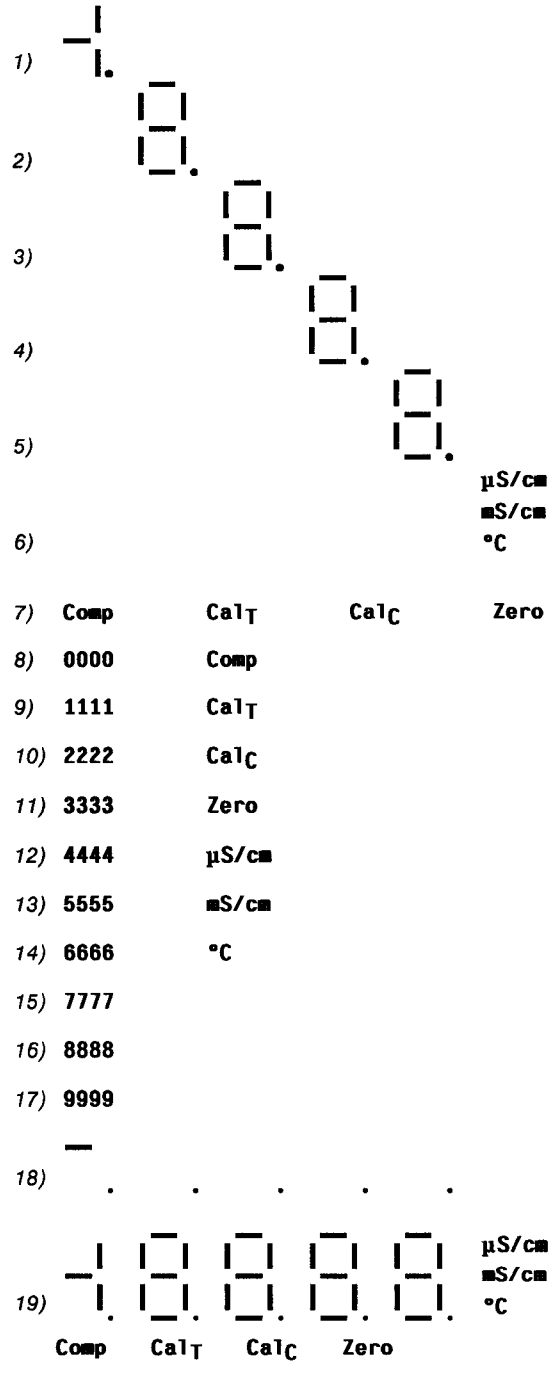


Fig. 1 Course of the display test

When the individual test patterns are at an end, the following display appears:

```
diagnosis
>LCD test
```

4. LCD test

If necessary, press <9> repeatedly until

```
diagnosis
>LCD test
```

press <enter>

After the <enter> key has been pressed, characters for a visual check of the display are generated on both lines.

The test sequence can be held by pressing the <5> key and then continued.

Test sequence:

- Each pixel of the display is activated.
- Display is cleared, first with '#' then with 'H' and finally written to with 'I'.
- The complete character set is shown as a moving display 0, 1, ..., 9, A, B, ..., Y, Z).
- The test is quit with the <9> key.

```
diagnosis
>input/output test
```

5. External inputs and outputs

This test is meaningful only if the 712 Conductometer is used when connected to other devices via the connector at the 'Remote' connection. Further, the 3.496.8510 Test Plug is needed for this test, which is normally used by the repair service. However, this connector can be acquired by the customer under the above number. For the sake of completeness, the process is described below.
(If a diagnostic test of the external inputs and outputs is not required, continue with point 6.)

PIN		PIN	PIN		PIN
1	———	24	5	———	21
2	———	12	9	———	18
3	———	23	10	———	17
4	———	22	11	———	16

Connections in 3.496.8510 Test Plug

If necessary, press <9> repeatedly until

```
diagnosis
>input/output test
```

press <enter>

```
>input/output test
IO connector ?
```

Plug 3.496.8510 Plug into the 'Remote' socket. (Do not switch off instrument, ensure correct connector positioning.)

Press <enter>

The test runs automatically. If no error is found, the following appears:

```
>input/output test
IO test ok
```

Otherwise, an error message is shown.
(If no test plug is connected, 'IO error 50' appears.)

Remove test plug

Press <enter>

```
diagnosis
>RS232 test
```

6. RS232 test

This test is meaningful only if the 712 Conductometer is used when connected to other devices via the connector at the 'RS232' connection. Further, the 3.496.8480 Test Plug is needed for this test, which is normally used by the repair service. However, this connector can be acquired by the customer under the above number. For the sake of completeness, the process is described below.
(If a diagnostic test of the RS232 interface is not required, continue with point 7.)

PIN		PIN	PIN		PIN
2	———	3	20	———	6
2	———	8	4	———	5

Connections in 3.496.8480 Test Plug

If necessary, press <9> repeatedly until

```
diagnosis
>RS232 test
```

Press <enter>

```
>RS232 test
RS connector ?
```

Plug 3.496.8480 Plug into the 'RS232C' socket. (Do not switch off instrument, ensure correct connector positioning.)

Press <enter>

```
>RS232 test
RS testing...
```

The test runs automatically. If no error is found, the following appears:

```
>RS 232 test
RS test ok
```

Otherwise, an error message is shown.
(If no test plug is connected, 'RS error 68' appears.)

Remove test plug

Press <enter>

```
diagnosis
>keyboard test
```

7. Keypad test

If necessary, press <9> repeatedly until

```
diagnosis
>keyboard test
```

Press <enter>

```
>keyboard test
```

If any key is now pressed, the matrix code corresponding to Fig. 2 appears in the display (0...22).

Press all keys in succession and check the displayed code.

```
>keyboard test
code: XX
```

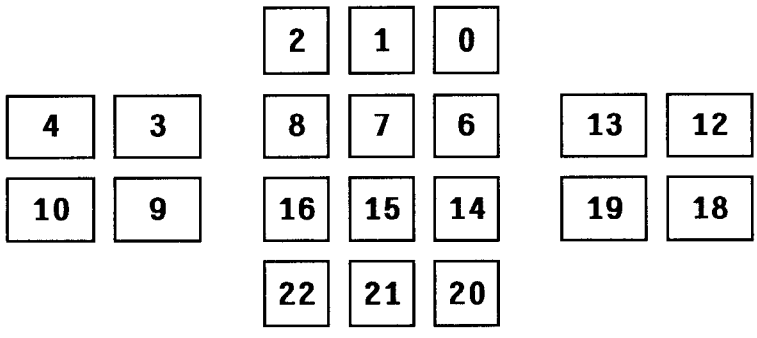


Fig. 2 Keypad with matrix code

The test is quit by pressing the <mode> key twice.

```
diagnosis
>instrument adjustment
```

8. Checking instrument calibration

If necessary, press <quit> repeatedly until the instrument is in the basic mode (measurement mode).

8.1 Checking conductivity

Attach resistance decade or individual resistor (10 Ω) to the "Cond. Cell" sockets.

If necessary, press <mode> repeatedly until "**µS/cm**" or "**mS/cm**" lights up.

Set the parameters according to the Table below.

```
>cond/parameters
  cell constant          1.000 /cm
  meas.temp.              20.0 °C
  ref.temp.               20.0 °C
  TC selection:         const.
  TC const.                0.0 %/°C
  frequency:              auto
  meas.type:           standard
```

Vary the resistance decade or individual resistors as shown in the following Table and check the displayed measured values.

Resistance	Admissible range
10 Ω	99.1 ... 100.9 mS/cm
1000 Ω	994 ... 1006 µS/cm
100 kΩ	9.94 ... 10.06 µS/cm

The errors in the resistors used (0.1%) are included in these tolerance data.

Remove resistance decade.

8.2 Checking temperature measurement

Attach resistance decade or individual resistor (100 Ω) to the "Pt100" sockets.

If necessary, press <mode> until "**°C**" lights up.

Vary the resistance decade or individual resistors as shown in the following Table and check the displayed measured values.

Resistance	Admissible range
100 Ω	-0.4 ... +0.4 °C
1000 Ω	-0.4 ... +0.4 °C

The errors in the resistors used (0.1%) are included in these tolerance data.

Remove resistance decade.

8.3 Checking analogue output "Cond."

Attach DVM to analogue output "Cond.".

Set the parameters according to the following Table.

```
>cond/analog output
  status:          cond.preset
  polarity:                  +
  1 V range:             1 S/cm
  0 V at:          0.0 µS/cm
  offset                 0 mV
  preset:                0 mS/cm
```

Vary the parameter "preset" as shown in the following Table and check the voltage at the analogue output with the DVM.

Set value [mS/cm]	Voltmeter [mVDC]
0	0 ±2
100	100 ±2
500	500 ±2
1000	1000 ±2
1500	1500 ±2
1900	1900 ±2

The errors associated with the voltmeter used (DVM) are not included in these tolerance data.

8.4 Checking analogue output "Temp."

Attach DVM to analogue output "Temp.".

Set the parameters according to the following Table.

```
>temp/analog output
  status:          temp.preset
  polarity:                  +
  1 V range            100.0 °C
  0 V at                 0.0 °C
  offset                   0 mV
  preset:                  0 °C
```

Vary the parameter "preset" as shown in the following Table and check the voltage at the analogue output with the DVM.

Set value [°C]	Voltmeter [mVDC]
0	0 ±2
10.0	100 ±2
50.0	500 ±2
100.0	1000 ±2
150.0	1500 ±2
190.0	1900 ±2

The errors associated with the voltmeter used (DVM) are not included in these tolerance data.

7.6 Initialisation of the EEPROM memory

As a result of powerful interference signals (e.g. line spikes, lightning) or changes to the instrument parameters of the Conductometer using a PC, the EEPROM (data memory) may contain data which prevents operation of the instrument or even leads to a system crash.

The initialisation of the EEPROM described below sets default values of the data.

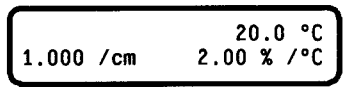
Although the adjustment data are retained, the initialisation should be performed only when necessary as the stored user data (temperature coefficient, cell constant, etc.) are deleted.

Perform point 1 of the diagnostic test (see page 101).

Press <enter>

Press <enter>

The initialisation runs automatically. On completion, the instrument returns to the measurement mode.



8. Technical data

- **Sensor connections**

Conductivity	1 input for conductivity cells (2 banana sockets 4 mm)
Temperature	1 input for Pt100 or Pt1000 temperature sensor (2 banana sockets 4 mm)
Platinisation	1 input for conductivity cells (2 banana sockets 4 mm)

- **Measurement types**

Conductivity	Standard; TDS = Total Dissolved Solids, expressed as NaCl content in mg/L or g/L; Titration
Temperature	

- **Measurement ranges**

Conductivity	0 ... 2000 µS/cm 0 ... 20 000 mS/cm (switched automatically)
Temperature	–170.0 ... 500.0 °C

- **Resolution**

Conductivity (standard)	4½ digits ± 1 digit
Conductivity (titration)	3½ digits ± 1 digit
Temperature	0.1 °C

- **Measurement frequencies** 300 Hz or 2.4 kHz; switched manually or automatically

- **Measurement intervals**

	Conductivity	Temperature
Standard	400 ms	2000 ms
TDS	400 ms	2000 ms
Titration	80 ms	400 ms
Temperature mode	–	80 ms

- **Compensation ranges**

Conductivity	0 ... 2000 µS/cm 0 ... 2000 mS/cm (0 ... 2 S/cm)
Temperature	–170.0 ... 500.0 °C

- **Measurement error for conductivity (with cell constant = 1)**

0 ... 2 µS/cm	± 1.3 % of measured value
2 µS/cm ... 20 mS/cm	± 0.5 % of measured value
20 ... 200 mS/cm	± 0.8 % of measured value

- **Measurement error for temperature**

–170 ... 0 °C	± 0.1 °C/100 °C
0 ... 100 °C	± 0.1 °C
100 ... 500 °C	± 0.1 °C/100 °C

- **Cell constant**

Entry	Via determination or manually
Determination	Dialogue-guided; automatic calculation
Range	0.001 ... 500 /cm

- **Temperature coefficient (TC)**

Entry	Via determination or manually
Range	0.00 ... 9.99 %/°C
Determination	With attached Pt100 or Pt1000 temperature sensor: automatically; TC = *f*(T) calculated as a polynomial; No temperature sensor attached: Conductivity measurement at two temperatures and calculation of the TC

- **Reference temperature** — Freely selectable reference temperature for automatic temperature compensation; 20 °C or 25 °C is usually used

- **Analogue output for the conductivity**

Purpose	Attachment of a laboratory recorder for recording the conductivity; attachment of a titrator to perform conductivity titrations
Output signal	0 ... 2000 mV
Resolution	0.5 mV (12 bit)

- **Analogue output for the temperature**

Purpose	Attachment of a laboratory recorder for recording the temperature
Output signal	0 ... 2000 mV
Resolution	0.5 mV (12 bit)
Absolute error	± 1.5 mV (at adjustment temperature)
Error as a function of the operating temperature	± 0.005 % of the selected range/°C ± 50 µV/°C

- **Output for platinisation**

Amperage	20 mA

- **Main display**
  - *Type*: Gas discharge display
  - *Character height*: 15 mm
- **Dialogue display**
  - *Type*: LCD, 2 lines each of 24 characters
  - *Character height*: 5 mm
- **Storage of the entries**: Non-volatile (EEPROM)
- **Remote control**
  - *Interfaces*: RS232 (see *section 5*)
Remote (see *section 6*)
- **RS232 interface**
  - *Purpose*: Attachment of a printer for the output of results and reports and the real-time plot of experimental data
Attachment of a computer; full control of the 712 Conductometer via computer keyboard
  - *Features*: See *section 5*
- **Remote interface**
  - *Purpose*: Attachment of a sample changer or other external devices
  - *Features*: Limit value applications: Simple on-off control of conductivity or temperature as well as triggering of all types of alarms
See *section 6*
- **Ambient temperature**
  - *Nom. operating range*: +5 ... +50°C
(at rel. humidity 5%...85%)
  - *Storage, transport*: –20 ... +70°C
- **Mains connection**
  - *Mains voltage*: 115 V (100...120 V ± 10 %)
230 V (220...240 V ± 10 %)
switchable
  - *Mains frequency*: 50...60 Hz
  - *Power consumption*: ca. 13 VA
  - *Fuse*: Fusible cut-out

- **Safety specifications**

Construction, testing	Construction and testing according to IEC 1010, instrument protection class 1
Warnings	These instructions for use contain information and warnings which must be heeded by the user if safe operation of the instrument is to be assured

- **Diagnostic test**

Self-diagnostic test	The instrument automatically performs a self-diagnostic test when switched on
User diagnostic test	The built-in diagnostic program allows the user to isolate or eliminate instrument faults

- **Interference suppression**

Testing	Tested following EN 55011 or VDE 871

- **Materials**

Housing	Light metal alloy, multicoat stove enamel
Keypad	Chemically resistant plastic film (polyester)

- **Dimensions**

	Without stand	With stand
Width	205 mm	235 mm
Height	120 mm	315 mm
Depth	240 mm	240 mm

- **Weight** (incl. accessories) 3.3 kg

9. Standard equipment, options, warranty

Note: *Subject to changes!*
All dimensions given in mm.

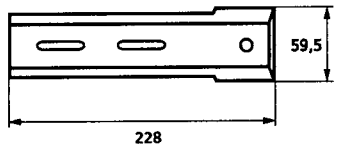
9.1 Standard equipment of the 712 Conductometer

including the following accessories:

1 × **6.2001.030** **Stand Support**

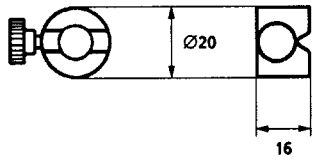
For holding the 6.2016.050 Stand Rod

incl. two washers, 2 knurled nuts, 1 hex screw



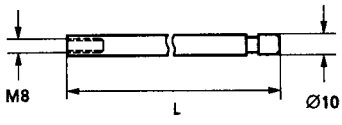
1 × **6.2013.010** **Clamping Ring**

For 6.2016.050 Stand Rod



1 × **6.2016.050** **Stand Rod**

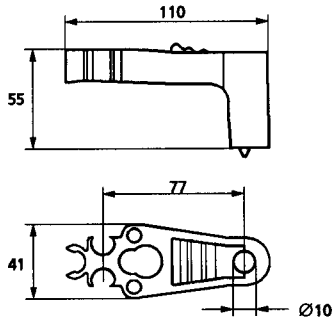
Stainless steel 18/8



1 × **6.2021.020** **Electrode Holder**

Plastic

With 4 SGJ 14/15 openings and 2 openings for burette tips (without socket joint)



1 × **6.2122.0X0** **Mains cable**, according to customer's specifications:

cable socket	cable plug	
type IEC 320/C 13	type SEV 12 (CH ...)	6.2122.020
type IEC 320/C 13	type CEE (7), VII (D ...)	6.2122.040
type CEE (22), V	type NEMA 5–15 (USA ...) .	6.2122.070

1 × **6.2723.270** **Dust cover**
for 712 Conductometer

1 × **8.712.1003** **Instructions for use**
for 712 Conductometer (english)

1 × **8.712.1023** **Short operating guide**
for 712 Conductometer (english)

9.2 Optional accessories

9.2.1 Stirrers

2.728.0024 **728 Magnetic Swing-out Stirrer**
without baseplate and without stand;
including mains adapter 220...240 V; with Euro plug

2.728.0021 **728 Magnetic Swing-out Stirrer**
without baseplate and without stand;
including mains adapter 100...120 V; with US plug

9.2.2 Conductivity cells and temperature sensors

In addition to the immersion cells listed here, Metrohm also offers pipette cells, titration cells and Jones cells for flowthrough measurements. You will find detailed information in the brochure «Metrosensor Electrodes» and in the Electrode Catalogue.

6.0901.110 **Immersion Cell** with fixed cable (1 m, 2×connector B);
cell constant $c \approx 0.8\ cm^{-1}$; largest diameter 20 mm;
for general applications

6.0901.040 **Immersion Cell** with fixed cable (1 m, 2×connector B);
cell constant $c \approx 0.1\ cm^{-1}$; largest diameter 20 mm;
for analysis solutions of low conductivity

6.0908.110 **Immersion Cell** with integrated Pt100 temperature sensor and fixed cable (1 m, 4 x connector B); cell constant $c \approx 0.8\ cm^{-1}$; shaft diameter 12 mm

6.0907.110 **Immersion Cell** with fixed cable (1 m, 2×connector B);
cell constant $c \approx 0.8\ cm^{-1}$; shaft diameter 12 mm;
minimum immersion depth 40 mm

6.0910.120 **Immersion Cell for sample changer** with plug-in head and rinsing joint; cell constant $c \approx 0.9\ cm^{-1}$; shaft diameter 12 mm;
minimum immersion depth 20 mm

6.2104.110 **Cable** for 6.0910.120 Immersion Cell (length 2 m; 2×connector B)

6.1103.000 **Pt100 Resistance Thermometer** with standard ground-glass joint and fixed cable (length 1 m, 2×connector B)

6.1103.040 **Pt100 Resistance Thermometer for sample changer** with standard ground-glass joint and fixed cable (length 1.5 m, 2×connector B)

6.1110.100 **Pt1000 Resistance Thermometer**
with plug-in head and movable ground-glass stopper

6.2104.080 **Cable** for 6.1110.100 Pt1000 Resistance Thermometer
(length 1 m, 2×connector B)

6.1236.040 **Taper Sleeve** made of silicone rubber for electrodes without standard ground-glass joint 14/15

9.2.3 Measuring vessels

6.1414.010 **Measuring Vessel upper half**
with five SGJ 14/15 openings; suitable for immersion cells with shaft diameter 12 mm and 6.1236.040 Taper Sleeve (option)

6.1415.220 **Measuring Vessel** with volume 20 ... 90 mL

6.1415.250 **Measuring Vessel** with volume 50 ... 150 mL

6.1415.310 **Measuring Vessel** with volume 70 ... 200 mL

6.1418.220 **Measuring Vessel** with thermostat jacket with volume 20 ... 90 mL

6.1418.250 **Measuring Vessel** with thermostat jacket with volume 50 ... 150 mL

9.2.4 Conductivity standard

6.2301.060 **250 mL Conductivity Standard**
c(KCl) = 0.1000 ± 0.0005 mol/L; κ(20°C) = 11.67 mS/cm

9.2.5 Connecting cables

6.2125.020 **Connecting Cable** 712 Conductometer – Seiko printer DPU-411-11BX [X = U(USA), E(Europe) or J(Japan)]

6.2125.050 **Connecting Cable** 712 Conductometer – Citizen printer iDP 560 RS, Epson FX, LX, LQ or Kodak Diconix 180 si

6.2125.040 **Connecting Cable** 712 Conductometer – Epson printers with 6-pin round connector (DIN 45 322; 60 °)

6.2125.060 **Connecting Cable** 712 Conductometer – IBM PC/XT/PS-2 and compatibles with 25-pin connector (DB 25)

6.2125.010 **Adapter Cable** RS 232C 25-pin – 9-pin for IBM AT and compatibles fitted with a 9-pin connector

6.2115.010 **Connecting Cable** 712 Conductometer – 586 Labograph

6.2112.050 **Connecting Cable** 712 Conductometer – 536 Potentiograph

6.2116.000 **Connecting Cable** 712 Conductometer – 702/716 Titrino

3.980.3560 **Connecting Cable** 712 Conductometer – 664 Control Unit for sample changer

9.2.6 VESUV

6.6008.010 **PC program VESUV 2.0**
for the transfer of experimental data to a PC. User dialogue can be configured in English or German. Data from up to 8 Metrohm instruments can be received, stored as ASCII text files and printed out.

9.3 Warranty

The warranty regarding our products is limited to rectification free of charge in our workshops of defects that can be proved to be due to material, design or manufacturing faults which appear within 12 months from the day of delivery. Transport costs are chargeable to the purchaser.

For day and night operation, the warranty is valid for 6 months.

Glass breakage in the case of electrodes or other glass parts is not covered by the warranty. Checks which are not a result of material or manufacturing faults are also charged during the warranty period. For parts of outside manufacture insofar as these constitute an appreciable part of our instrument, the warranty stipulations of the manufacturer in question apply.

With regard to the guarantee of accuracy, the technical specifications in the Instructions for Use are authoritative.

Concerning defects in material, construction or design as well as the absence of guaranteed features, the purchaser has no rights or claims except those mentioned above.

If damage of the packaging is evident on receipt of a consignment or if the goods show signs of transport damage after unpacking, the carrier must be informed immediately and a written damage report demanded. Lack of an official damage report releases METROHM from any liability to pay compensation.

If any instruments and parts have to be returned, the original packaging should be used if at all possible. This applies above all to instruments, electrodes, burette cylinders and PTFE pistons. Before embedment in wood shavings or similar material, the parts must be packed in a dustproof package (for instruments, use of a plastic bag is imperative). If open assemblies are enclosed in the scope of delivery that are sensitive to electromagnetic voltages (e.g. data interfaces etc.) these must be returned in the associated original protective packaging (e.g. conductive protective bag). (Exception: assemblies with built-in voltage source belong in a non-conductive protective packaging). For damage which arises as a result of non-compliance with these instructions, no warranty responsibility whatsoever will be accepted by METROHM.

10. Index

S

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U

V

W

Ionenanalytik • Analyse des ions • Ion analysis • Análisis iónico
712 Conductometer

CE

Metrohm

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Fax +41 71 53 89 01

EC Declaration of Conformity

The METROHM AG company, Herisau, Switzerland hereby certifies, that the instrument:

712 Conductometer

meets the requirements of EC Directives 89/336/EWG and 73/23/EWG.

Source of the specifications:

EN 50081-1	Electromagnetic compatibility, basic specification Emitted Interference
EN 50082-1	Electromagnetic compatibility, basic specification Interference Immunity
EN 61010	Safety requirements for electrical laboratory measurement and control equipment

Description of the instrument:

Measuring instrument for determination of conductivity and temperature

---

Herisau, December 4, 1995

Dr. J. Frank	Ch. Buchmann
Development Manager	Production and Quality Assurance Manager

Ionenanalytik • Analyse des ions • Ion analysis • Análisis iónico
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