

METROHM Ltd. CH-9101 Herisau (Switzerland)

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**pH Meter**

**691**

Series 01 ...

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# Instructions for Use for 691 pH Meter

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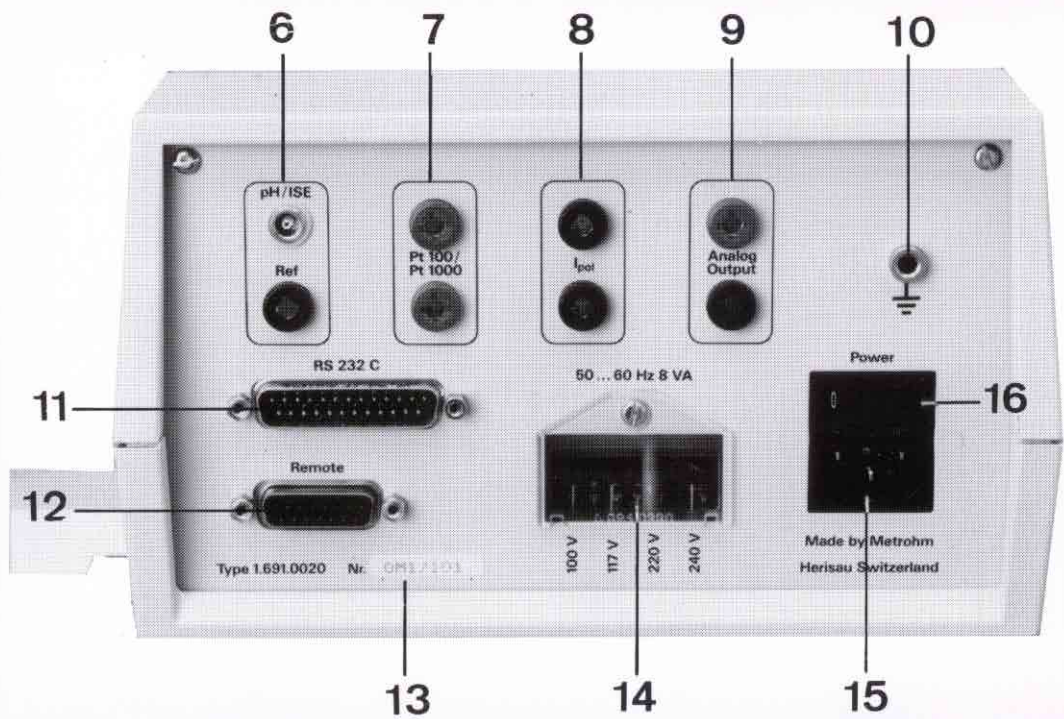
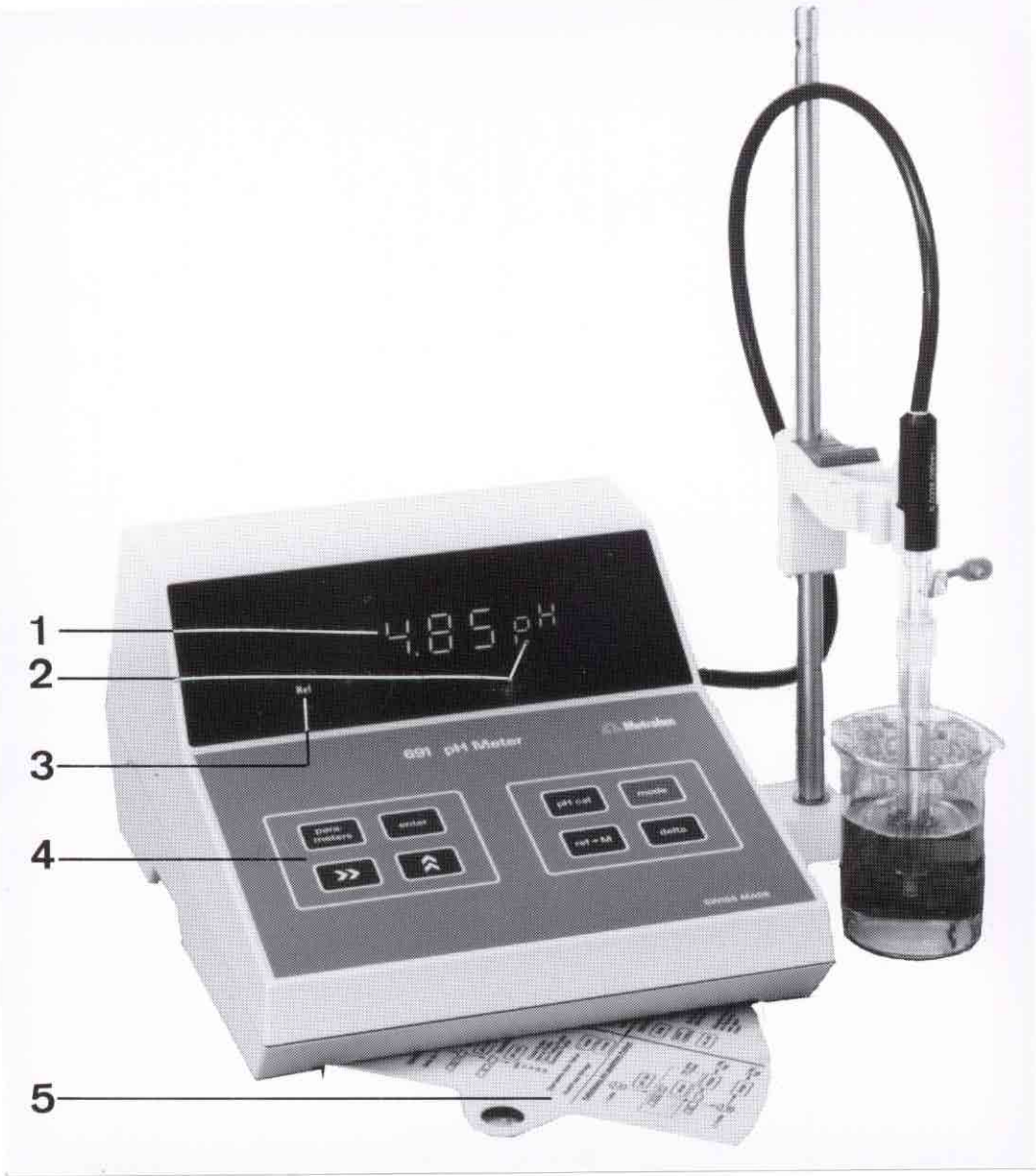
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## 1. Control elements and their function

### Front:

- ① **Digital display**
- ② **Display of units** (mV, °C, pH)
- ③ **Status display**
- ④ **Keypad**
- ⑤ **Short Instructions for Use**

### Rear:

- ⑥ **Connection for indicator and reference electrode**  
Socket F for indicator electrode (adapter connector E → connector F: 6.2104.000), socket for reference electrode with banana plug. If a combined electrode assembly is used, the reference input is free.
- ⑦ **Connection for Pt100 or Pt1000 temperature sensor**  
2 sockets (red) for banana plugs.
- ⑧ **Connection for polarised electrodes**  
2 sockets for banana plugs, for measurement mode  $I_{p01}$ .  
Warning: Do not attach any glass electrodes (polarisation)!
- ⑨ **Analog output**  
2 sockets for banana plugs, connection for recorder, dispensing controller (Impulsomat)
- ⑩ **Earthing socket**
- ⑪ **RS232 interface**  
Connection for printer or computer, optional, with 2.691.0020 only, see Instructions for Use, Part II.
- ⑫ **Connection "Remote Control"**  
e.g. for sample changer.
- ⑬ **Rating plate**  
With series and manufacturing number.
- ⑭ **Mains voltage**  
Indication of the set operating voltage.
- ⑮ **Mains plug**  
Power consumption 8 VA.
- ⑯ **On/off switch**

## 2. Getting started

Before switching on the apparatus, make sure that it is set to the voltage of the power supply.

Attach your combined electrode to the "pH/ISE" socket (see page I-2).

If you measure with separate electrodes, attach the reference electrode to the "Ref" socket and the indicator electrode to the "pH/ISE" socket.

Do your electrodes have a different connector, the DIN or BNC connector? Then you need the 6.2104.000 or 6.2103.090 Adapter, respectively.

If you have an electrode with built-in Pt100 or Pt1000 temperature sensor, attach the two banana plugs of the temperature sensor to the red sockets "Pt100/Pt1000".

A separate temperature sensor is also attached here.

Switch the pH meter on. (The on/off switch is at the rear, above the mains plug.)

Immerse the electrode(s) in your sample. The pH meter measures .... The measured value is shown in the display and the unit (or measured variable) on the right, e.g. mV or pH.

### Changing the measured variable

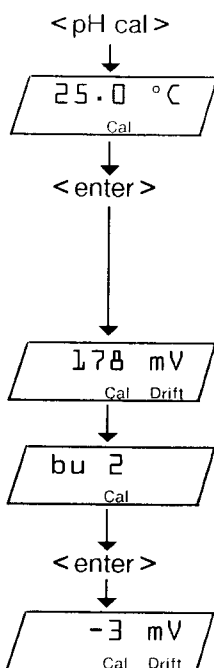
Do you wish to change the measured variable? Press the key

< mode >

the number of times required for the desired measured variable to appear in the display. You can use < mode > to switch the measured variable: pH, t/°C, U/mV and U(I<sub>pol</sub>)/mV.

### pH calibration

Do you wish to perform a pH calibration? You need to use the proper buffers for this. Metrohm buffers are preselected in the factory. If you have different buffers, you must first select the correct buffer series, see page I-5.



Immerse your electrode(s) in the first buffer and press < pH cal > .

The calibration temperature is shown in the display. Confirm it with < enter > . Set a different temperature with the < ← > and < ↑ > keys, see page I-8.

If you have attached a Pt100 or Pt1000 temperature sensor, the calibration temperature does not have to be confirmed with < enter > , it is measured automatically. Measurement of the voltage follows immediately.

The measured voltage value of the first buffer is displayed. If the measured value is sufficiently stable, i.e. if the drift is sufficiently small, the value is accepted and the display shows bu 2 (buffer 2).

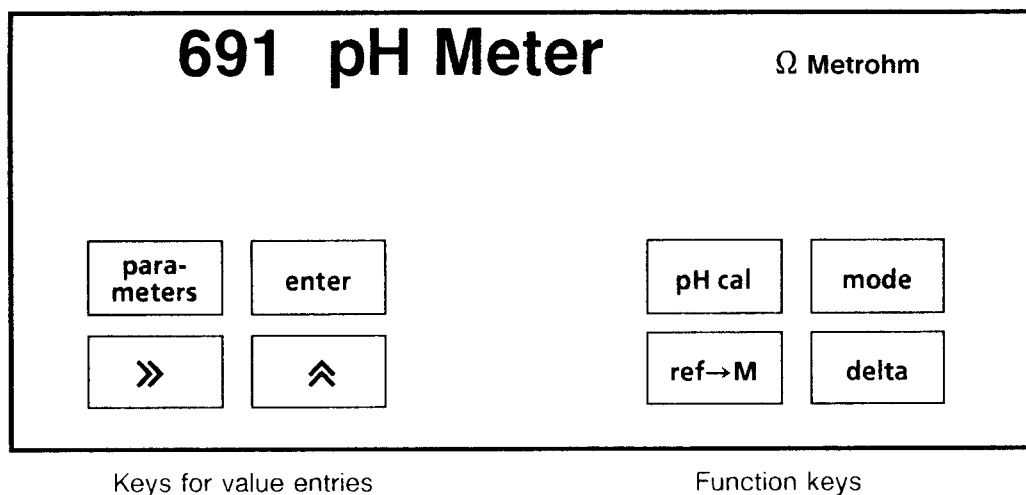
This is a prompt to immerse the electrode(s) in the second buffer. Do this after you have cleaned your electrode(s) and then press < enter > .

The second buffer is measured. When the drift condition has been met for this measurement, the value is accepted. The calibration parameters "pH<sub>as</sub>" and "slope" are displayed briefly. The pH meter is now calibrated and ready for pH measurements.

**Note measurement temperature** if you work without temperature sensor!

## 3. Operation

### 3.1 Keypad



#### Function keys:

- <pH cal>: Starts the pH calibration.
- <mode>: Switches the mode. Repeated pressing switches from the measured variable pH successively to temperature ( $t/^{\circ}\text{C}$ ), voltage ( $\text{U}/\text{mV}$ ), and voltage measurement with polarised electrodes ( $\text{U}(\text{I}_{\text{pol}})/\text{mV}$ ); then back again to pH. etc. This key also serves as an **exit key** from operations such as calibration, rolling inquiries, error messages.
- <ref→M>: Stores the current measured value as a reference value. Reference values are stored under the <parameters> key and are used in the delta measurement.
- <delta>: On/off switching of the delta measurement. In the delta measurement the difference between the current measured value and a reference value is displayed.

#### Keys for value entries:

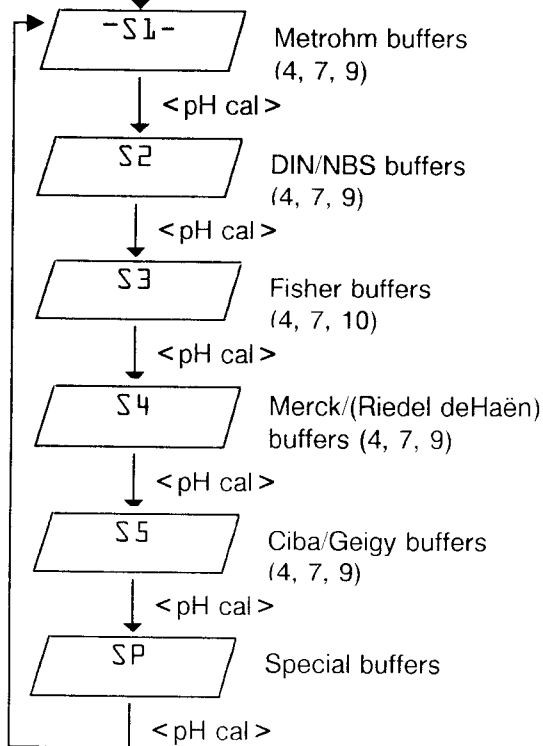
- <parameters>: Parameters for the individual modes.
- <enter>: Used to accept values and to advance operations.
- <→>: For the entry of values. Used to select a position at which a digit should be changed; runs from left to right.
- <↑>: For the entry of values. Used to change the value at the selected position.

### 3.2 pH calibration, <pH cal> key

The condition of the electrode assembly changes with time and usage. A pH calibration should thus be performed at intervals that reflect the accuracy requirements, e.g. daily.

Various buffer series can be used for the pH calibration. If you have preselected a buffer series, the pH meter recognizes the appropriate buffer automatically. The buffer series can be selected as follows:

Switch on + <pH cal>: **Buffer selection**



When switching on the instrument press and hold the <pH cal> key. This transfers you to "buffer selection".

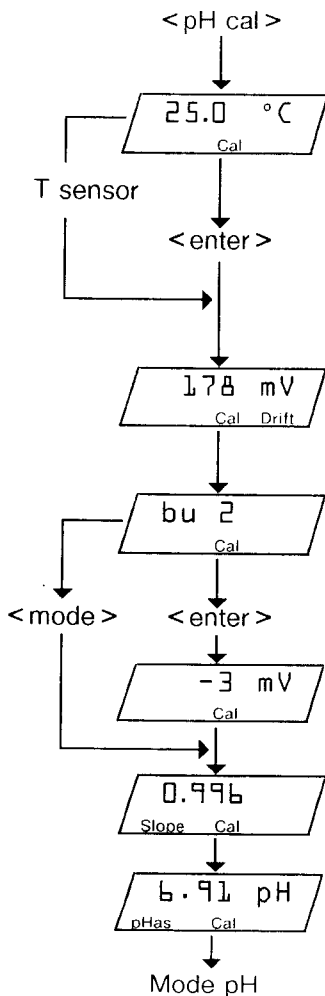
The selected buffer series is marked with two horizontal dashes: **-SX-**. Metrohm buffers (S1) are set in the factory.

The selection cycle can be switched with <pH cal>.

A buffer series is **selected** with <enter>. Automatic exit from the "buffer selection" to the measurement program.

Exit can also be effected with <mode> without acceptance of a new buffer series.

**Sequence of calibration with a preselected buffer series**



Immerse electrode assembly in the first buffer and press <pH cal>.

The calibration temperature is displayed. If you wish to change the value, use <=> to select the position at which you wish to change the digit and set this with <↑> (see page I-8). Select next position with <=> and set the value with <↑>, etc. Accept the set temperature with <enter>

If you have attached a temperature sensor, the temperature is measured automatically, the value accepted as soon as the drift is < 1.60 °C/min and the inquiry skipped.

The first buffer is measured. The measured value is accepted as soon as the drift is < 3.5 mV/min.

...finished. The instrument is now ready for measurement of the 2nd buffer (bu2 = buffer 2). The calibration can be quit with <mode> (1-point-calibration) or the electrode assembly immersed in the 2nd buffer and <enter> pressed.

The 2nd buffer is measured (if a temperature sensor is attached: first the temperature, then the voltage).

At the end of the calibration the calibration parameters are displayed briefly: the slope of the electrode, "slope".

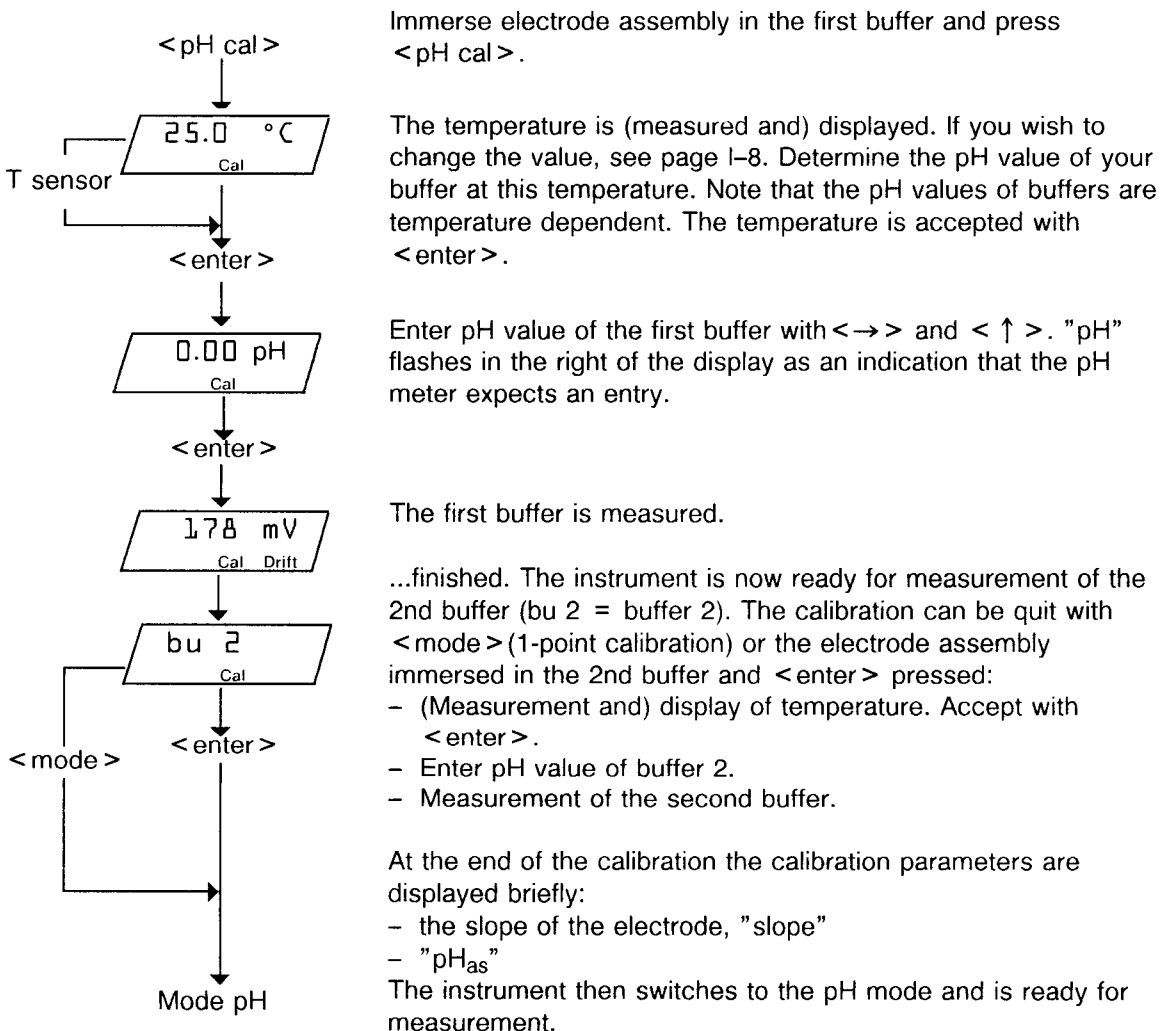
and the asymmetry pH, "pH<sub>as</sub>".

The instrument is ready for measurement in the pH mode. The calibration parameters are stored under <parameters>, see page I-8. Note measurement temperature if you work without temperature sensor

- In a 1-point calibration a new  $pH_{as}$  is entered, but the old slope is retained.
- The calibration parameters remain stored even if the instrument is switched off.
- The calibration can be quit at any time with `<mode>`. If such an exit is effected before the display `bu 2`, the old calibration parameters remain. After this display and before measurement of the 2nd buffer is finished, on exit the parameters of the 1-point calibration are displayed and stored.
- If the new calibration parameters "pH<sub>as</sub>" and "slope" are not within specified limits, the display stops and shows the flashing value. The new value must be confirmed with `<enter>` in order to be stored in the pH meter. If this value can not be accepted, exit with `<mode>`. The value is then not stored.  
Limits:  $0.900 \leq \text{slope} \leq 1.050$   
 $6.40 \leq pH_{as} \leq 8.00$
- If `<mode>` is pressed during the display of the calibration parameters, the new calibration parameters are not stored.
- In the pH calibration an isothermal (same temperature) voltage-pH line is defined. The buffers used for the calibration must therefore both be at **the same temperature**. If you have attached a Pt100/Pt1000 sensor, the temperature of both buffer solutions is measured in a 2-point calibration. If the temperature of the two buffer solutions differs by more than 2 °C, an error message is outputted. The measured temperature of the second buffer is used for the calculation of the slope. For accurate measurements, the calibration temperature must also be the same as the measurement temperature.

### Calibration with special buffers

If "special buffers" is selected instead of a buffer series, the procedure differs slightly from that with a preselected buffer series:



### 3.3 Measurement and drift condition, < mode > key

With < mode > the measured variable is switched. The unit is shown in the right of the display. In the pH mode the measurement temperature is updated every 3.6 s if a temperature sensor is attached. In the  $I_{\text{pol}}/\text{mV}$  mode " $I_{\text{pol}}$ " also lights up in the status display and the electrode must be attached to the " $I_{\text{pol}}$ " sockets.

The pH meter measures as long as it is not in an inquiry loop or an error message condition.

In the status display "Drift" lights up until the drift condition has been met. The drift condition depends on the measured variable and is defined as follows:

	<b>Drift, app.</b>
pH	0.059 pH/min (slope 59.16 mV)
U/mV	3.5 mV/min
t/°C	1.60 °C/min
$I_{\text{pol}}/\text{mV}$	3.5 mV/min

The < mode > key is used as an exit key from

- The calibration (1-point calibration or no acceptance of the new calibration parameters)
- Inquiries without acceptance of a new value
- Error messages

### 3.4 Delta measurement, < delta > key

In the delta measurement the difference

$$\text{current measured value} - \text{reference value}$$

is displayed. The delta function can be used, for example, to display the absolute temperature (reference value = -273) or if a specified measured value of a solution is desired (addition until the display shows "0").

The reference value can be entered and stored with the < parameters > key (see section 3.5) or the current measured value accepted directly with the < ref → M > key.

The delta measurement is switched on and off with the < delta > key. "Delta" lights up in the status display when the delta measurement is active.

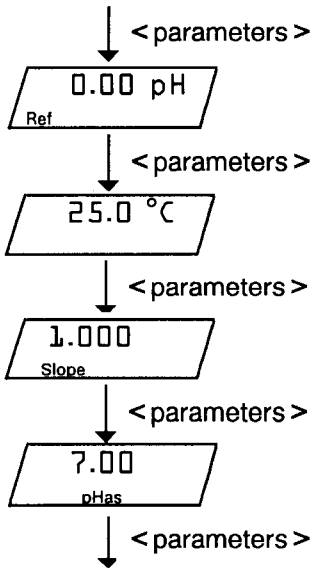
#### 3.4.1 < ref → M > key

With the < ref → M > key (reference value → Memory) the current measured value is stored directly as a reference value. The reference value can also be entered manually using the < parameters > key, see page 1-8.

### 3.5 Parameters, < parameters > key

The key contains the parameters of the individual modes. In the pH mode it is organised as an inquiry loop, i.e. if the key is pressed several times in succession, new inquiries constantly appear. At the end of the loop you are returned to the starting point. Exit can be effected at any time with < mode > . If new values have to be entered, the keys < → > , < ↑ > and < enter > are used: the value is accepted and the next inquiry appears.

**Parameters for pH mode:**



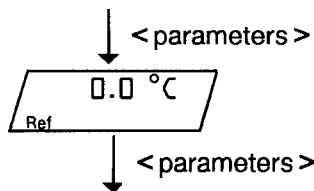
Reference value for the delta measurement

Measurement temperature. The unit "°C" flashes to draw your attention to the fact that an entry can be made here. If a temperature sensor is attached, the value is updated after every temperature measurement in the pH mode.

Calibration parameter "slope". Updated after every calibration.

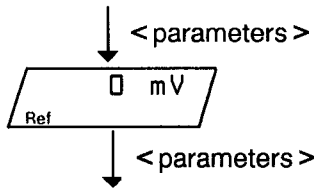
Calibration parameter "pH<sub>as</sub>". Updated after every calibration.

**Parameter for t/°C mode:**



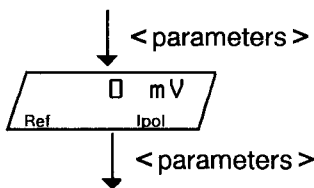
Reference value for the delta measurement

**Parameter for U/mV mode:**



Reference value for the delta measurement

**Parameter for I<sub>pot</sub>/mV mode:**



Reference value for the delta measurement

**3.5.1 Entry of numeric values, <→> and <↑> keys**

The <→> key is used to select the position at which a digit should be changed. The active position is always shown at the bottom right with a flashing decimal point.

With the <↑> key the digit in the selected position can be altered. The digits 0, 1...9 appear in succession as long as the key is pressed. The first position shows (space), 1, - (sign) and -1 in place of the series of digits.

## 4. Interconnections with other instruments

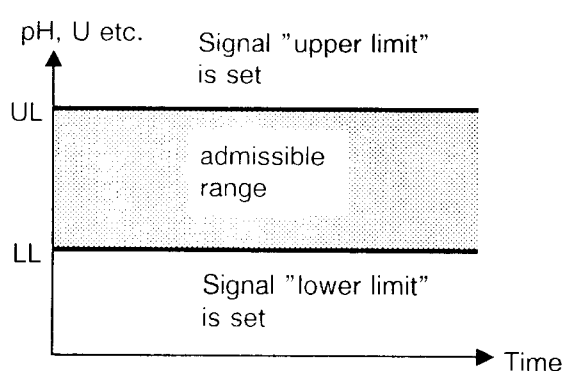
### 4.1 Preselections

If the following keys are kept pressed during switching on, various presettings can be performed:

- <parameters> Setting of the limits, see 4.1.1
- <ref→M> Configuration, see 4.1.2. With RS232 interface, see page II-1.
- <pH cal> Preselection of the buffer series, see page I-5
- <delta> Diagnostic program, see page I-15

Preselection loops are switched with <enter> or the appropriate preselection key. <mode> leads to the measurement program. A move from one preselection loop to another preselection loop can be effected by pressing another preselection key.

#### 4.1.1 Setting the limits



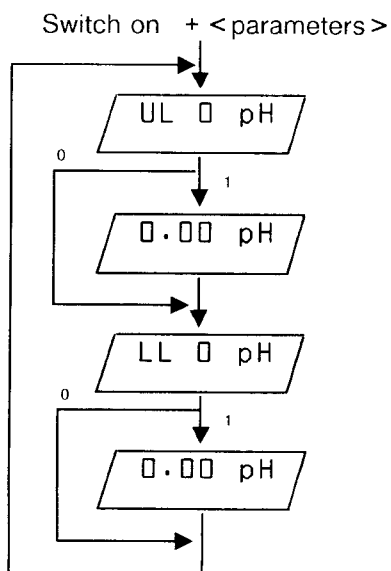
An upper and a lower limit value can be entered. If the measured value lies outside the admissible range, a static signal is set at the "Remote" output, see page I-12. The signal is reset when the measured value is

- 0.02 pH
- 0.2 °C
- 2 mV

above or below the set limit value.

The limits can be used to monitor measured values. If the delta function is switched on, the measured value (and not the displayed value) is monitored. An alarm clock, for example, can be connected for monitoring. In like manner slow processes can be "controlled" by attaching a Dosimat or a pump.

The limits can be set as follows:



Press <parameters> while switching on. The next inquiry appears when you press <parameters>. The value is accepted if you press <enter>.

Upper limit. Selection of the measured variable: pH, mV... with <←→>.

Monitoring active = 1, switched off = 0; setting with <↑>.

Enter the upper limit if monitoring is activated.

Lower limit. Monitoring active = 1, switched off = 0; setting with <↑>.

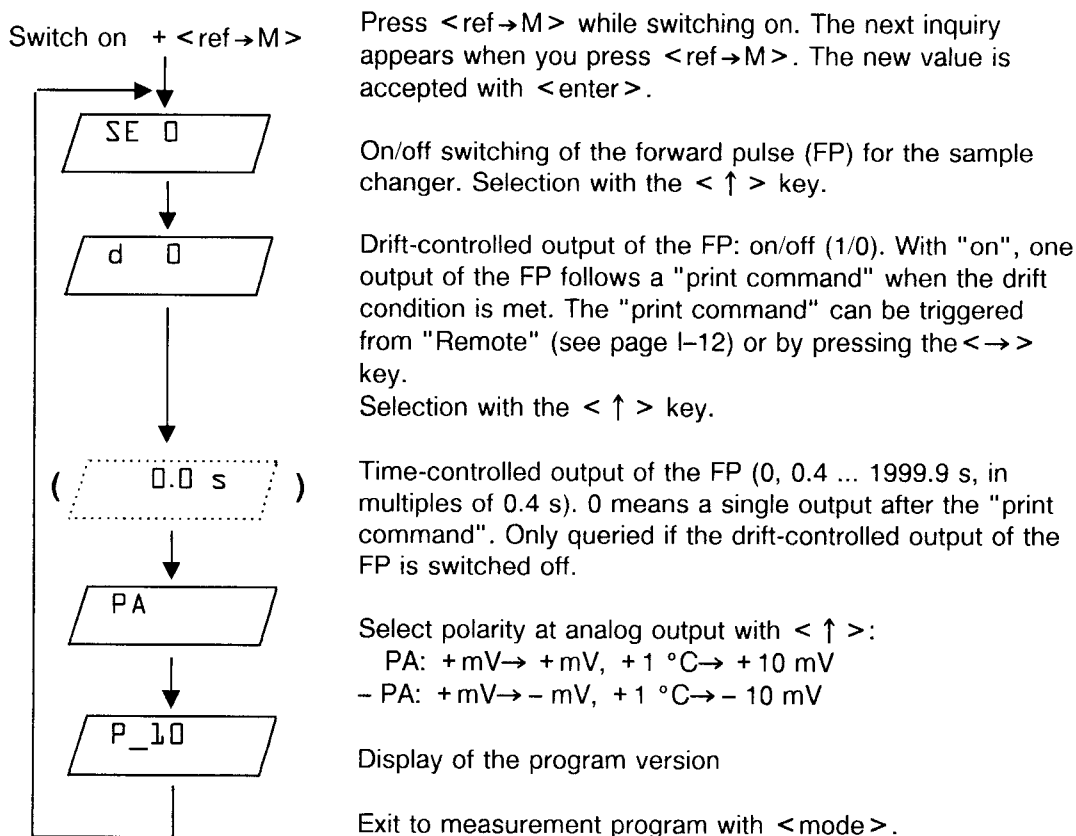
Enter the lower limit if monitoring is activated.

Exit to measurement program with <mode>.

### 4.1.2 Configuration

If the pH meter is equipped with an RS232 interface (the 25-pin socket at the rear of the instrument is present), see page II-1.

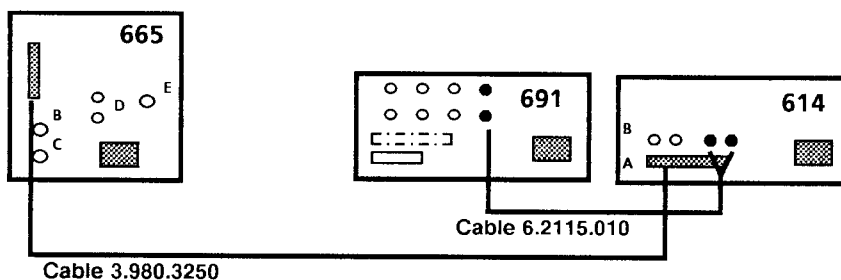
The pH meter can be configured as follows:



### 4.2 Combi-Titrator

The 691 pH meter can be expanded to a Combi-Titrator. Setting of the polarity at the analog output – PA, see 4.1.2.

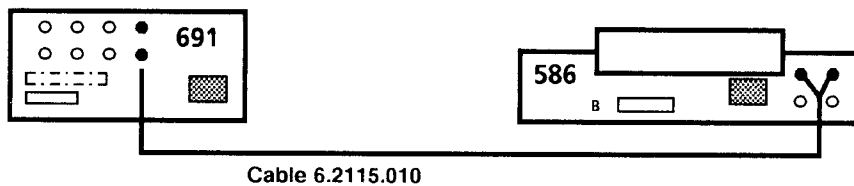
The instruments are connected as follows:



If the 586 Labograph also has to be connected, instead of the 3.980.3250 Cable the 3.980.3200 Cable should be used for the connection 665 Dosimat – 614 Impulsomat – 586 Labograph.

### 4.3 Recorder, analog output

The Labograph can be connected to the 691 pH meter as follows:



Other laboratory recorders can be connected in place of the 586 Labograph. The recorder can be "calibrated" with the aid of the diagnostic program, see page I-17.

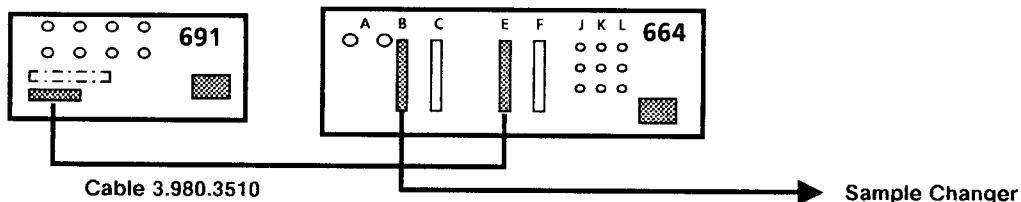
If the fluctuations of the recorder during sample change are disturbing, the measurement can be held by pressing the <ref→M> and <parameters> keys. <mode> is used to continue the measurement.

#### Analog output:

3.691.0110	external	Function		
		Display	Analog output	
			PA	-PA
	live (red) 0 V (black) $R_{ext} > 1\text{ k}\Omega$	pH 0	- 700 mV	- 700 mV
		7	0 mV	0 mV
		14	+ 700 mV	+ 700 mV
		$\Delta\text{pH}$	100 mV	100 mV
		$\Delta t = +1\text{ }^\circ\text{C}$	+ 10 mV	- 10 mV
		$t = 0\text{ }^\circ\text{C}$	0 mV	0 mV
$\Delta U = +1\text{ mV}$	+ 1 mV	- 1 mV		
		$U \leq \pm 700\text{ mV}$ $I_{max} = 5\text{ mA}$ $U: \pm 700 \dots \pm 2000\text{ mV}$ $I_{max} = 2\text{ mA}$		

### 4.4 Sample Changer

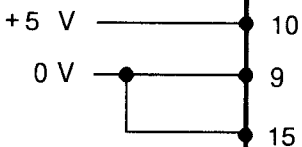
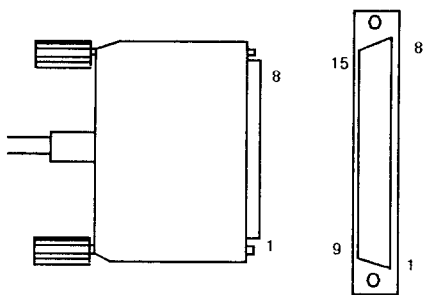
The Sample Changer can be connected to the 691 pH Meter as follows:



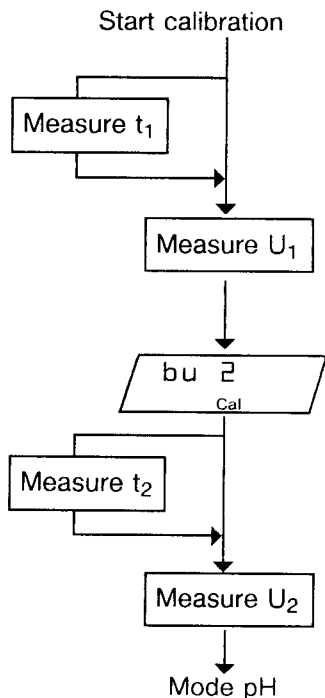
If calibrations are also desired with the sample changer, instead of the 3.980.3510 Cable the 3.980.3520 Cable should be used together with a special PROM in the 664 Control Unit. The sequence of the calibration has been matched for work with the sample changer, see page I-13.

### 4.5 Pin assignment of the "Remote" connection

3.691.0110	external	Function																																								
<p><b>Remote control</b></p>	<p>13</p> <p>12</p> <p>11</p>	<table border="1"> <thead> <tr> <th></th> <th></th> <th>11</th> <th>12</th> <th>13</th> </tr> </thead> <tbody> <tr> <td>Inactive</td> <td>0</td> <td>H</td> <td>H</td> <td>H</td> </tr> <tr> <td>Mode pH</td> <td>1</td> <td>H</td> <td>H</td> <td>L</td> </tr> <tr> <td>Mode t/°C</td> <td>2</td> <td>H</td> <td>L</td> <td>H</td> </tr> <tr> <td>Mode U/mV</td> <td>3</td> <td>H</td> <td>L</td> <td>L</td> </tr> <tr> <td>Mode I<sub>po</sub>/mV</td> <td>4</td> <td>L</td> <td>H</td> <td>H</td> </tr> <tr> <td>pH cal</td> <td>5</td> <td>L</td> <td>H</td> <td>L</td> </tr> <tr> <td>enter</td> <td>7</td> <td>L</td> <td>L</td> <td>L</td> </tr> </tbody> </table> <p>Function:            dec.            binary</p> <p>The above functions can be operated by means of the "remote" lines. If one of these lines is active (=L), the keypad entries are blocked.</p>			11	12	13	Inactive	0	H	H	H	Mode pH	1	H	H	L	Mode t/°C	2	H	L	H	Mode U/mV	3	H	L	L	Mode I <sub>po</sub> /mV	4	L	H	H	pH cal	5	L	H	L	enter	7	L	L	L
		11	12	13																																						
Inactive	0	H	H	H																																						
Mode pH	1	H	H	L																																						
Mode t/°C	2	H	L	H																																						
Mode U/mV	3	H	L	L																																						
Mode I <sub>po</sub> /mV	4	L	H	H																																						
pH cal	5	L	H	L																																						
enter	7	L	L	L																																						
<p><b>Print</b></p>	<p>6</p>	<p>Print out of results and output of FP = L, see pages I-10, II-2. If controlled via the RS232 the FP is not outputted automatically!</p> <p><math>t_p \geq 150 \text{ ms}</math></p>																																								
<p><b>Initialization</b></p>	<p>1</p>	<p>Initialize instrument = L on switching on. Moves automatically into the diagnostic program. Warning: Instrument calibration!</p>																																								
<p><b>Sample Changer: forward pulse (FP)</b></p>	<p>5</p>	<p>Measured value ok = L</p> <p><math>t_p = 20 \text{ ms}</math> <math>V_{CE0} = 40 \text{ V}</math> <math>I_C = 20 \text{ mA}</math></p>																																								
<p><b>Upper limit</b></p>	<p>4</p>	<p>Above upper limit = L</p> <p><math>V_{CE0} = 40 \text{ V}</math> <math>I_C = 20 \text{ mA}</math></p>																																								
<p><b>Lower limit</b></p>	<p>3</p>	<p>Below lower limit = L</p> <p><math>V_{CE0} = 40 \text{ V}</math> <math>I_C = 20 \text{ mA}</math></p>																																								

3.691.0110	external	Function 691
<p><b>Voltages</b></p> 		$I \leq 40 \text{ mA}$ $R_i = \text{app. } 12 \Omega$
		<p>Contact arrangement at the connector (male) for socket "Remote" (female)</p>  <p style="text-align: center;">View from connector solder side</p> <p>Ordering number for cable with open end: 6.2131.000</p>
<p>No liability whatsoever is accepted for damage due to improper interconnection of instruments.</p>		

**Sequence of calibration in "Remote" operation:**



Immerse electrode assembly in the first buffer and start calibration (lines 13 and 11 = L, 12 = H)

If a temperature sensor is attached, temperature  $t_1$  of the first buffer is measured and the value accepted as soon as the drift condition is met. Without a temperature sensor the set temperature is assumed.

The voltage  $U_1$  of the first buffer is measured and accepted as soon as the drift condition is met.

For a 1-point calibration abort (e.g. pH mode: line 13 = L, 11 and 12 = H).

For a 2-point calibration immerse electrode assembly in the second buffer and continue calibration with enter (lines 11, 12 and 13 = L).

If a temperature sensor is attached, temperature  $t_2$  and voltage  $U_2$  of the second buffer are measured.

The calibration data are displayed briefly and the instrument is ready for measurement in the pH mode.

If the calibration data are outside the range

$$0.900 \leq \text{slope} \leq 1.050$$

$$6.40 \leq \text{pH}_{\text{as}} \leq 8.00$$

the sequence is held and the corresponding value remains flashing in the display of the 691 pH Meter.

## 5. Troubleshooting

### 5.1 Malfunctions and error messages

Flashing measured value	Measurement range exceeded or no measuring sensor attached in the t/°C or Ipol/mV mode.				
Flashing calibration parameters	<p>Parameter is outside the limits:  <math>0.900 \leq \text{slope} \leq 1.050</math>  <math>6.40 \leq \text{pH}_{\text{as}} \leq 8.00</math></p> <p>At measurement temperatures above 60 °C, the recognition windows of two buffers can overlap in extreme cases. Wrong calibration parameters are then calculated. In this case use special buffers for the calibration. Accept value with &lt;enter&gt; .  Exit without acceptance of the value: &lt;mode&gt; .</p>				
The drift condition takes too long to be met. Calibration takes too long.	<ul style="list-style-type: none"> <li>- Perform measurements without stirring.</li> <li>- Check electrode. Is the diaphragm blocked?</li> </ul>				
"Funny" pH values after calibration.	Check measuring temperature. (Measuring and calibration temperature are different!)				
No display	Switch instrument on and take display to a strong light source (lamp, sun). If there is still no display, call Metrohm service.				
E1	<p>In the calibration the buffer has not been changed. The instrument detects buffer 2 = buffer 1.  Exit: &lt;mode&gt;, leads to the display / bu 2/.</p>				
E2	<p>Appears after E1 has already appeared. The instrument still detects buffer 2 = buffer 1. Check your electrode assembly and your buffers.  Exit: &lt;mode&gt;, leads to the display / bu 2/.</p>				
E3	<p>In the calibration, the buffer can not be recognized automatically. It lies outside the set limits.  Exit: &lt;mode&gt;, leads to the measurement program; no new calibration data are stored.</p>				
E4	<p>In the calibration the temperature difference between buffer 1 and buffer 2 is larger than 2°C.  Exit: &lt;mode&gt;, leads to the measurement program; no new calibration data are stored.</p>				
E11	<table border="0" style="margin-left: 20px;"> <tr> <td>ROM checksum error</td> <td rowspan="2" style="font-size: 3em; vertical-align: middle;">}</td> <td rowspan="2" style="vertical-align: middle;">call Metrohm service</td> </tr> <tr> <td>RAM test error</td> </tr> </table>	ROM checksum error	}	call Metrohm service	RAM test error
ROM checksum error		}			call Metrohm service
RAM test error					
E12					
E13	<p>Backup error  Exit: &lt;mode&gt; . The initialization values are loaded automatically. The instrument thus remains capable of measurement. However, possibly a slightly lower accuracy must be anticipated. If a new calibration is performed in the pH mode, the initialization data no longer have an influence. A new optimum adjustment can be performed only by Metrohm service. Error message E13 always appears after the instrument has been switched on until this adjustment has been performed.  The display now shows /init /. With</p> <ul style="list-style-type: none"> <li>- &lt;enter&gt; the instrument is initialized</li> <li>- &lt;mode&gt; exit to the measurement program follows</li> <li>- &lt;ref→M&gt;, &lt;parameters&gt;, &lt;pH cal&gt; or &lt;delta&gt; entry into the appropriate preselection loop follows.</li> </ul>				

**For instruments with RS232 interface:**

E20	DSR	}	RS232 transmission error: Appropriate line has not been supplied for more than 3 s. Exit: < mode >
E21	DCD		
E22	CTS		
E23	XOFF		
E25	parity	}	RS232 reception error:  Exit: < mode >
E26	stop bit		
E27	receive buffer overflow, more than 6 characters after L <sub>F</sub>		
E28	receive buffer full more than 82 characters		

**5.2 Diagnostic instructions** (for P\_\_10 program)

The 691 pH Meter is a very precise and reliable instrument. Thanks to its rugged construction it is virtually impossible for external mechanical or electrical influences to have an adverse effect on its functions.

Although the occasional fault in the instrument can not be excluded completely, it is certainly much more likely that malfunctions are caused by wrong operation or handling or through improper connections and the operation with non-Metrohm instruments.

It is thus advisable in each case to isolate the fault with the rapid and easy to perform diagnostic tests. The customer thus need not call METROHM service until there is a true fault in the instrument. In addition, with the aid of the numbering in the diagnostic program he can provide the service engineer with much more accurate information.

**Procedure**

- The diagnostic steps must be performed in sequence and compared with the reactions of the 691 pH Meter (indented). In the "yes" case, continue with the next instruction.
- If the instrument does not show the expected reaction ("no" case), the appropriate diagnostic step must be repeated to exclude an operating error. With repeated wrong reactions, however, there is a strong possibility that a malfunction exists.
- The diagnostic marked with a triangle (≥) allow re-entry into the test routine on repetition under the following condition:

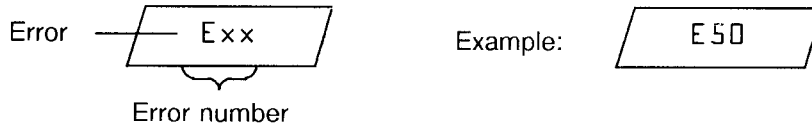
d-01

If not: press the < mode > key.

If need be, switch the power off then on again after a few seconds. At the same time press the "delta" key until 'd-01' appears in the display.

- After pressing the < mode > key during the display of 'd-01' the instrument jumps back into the user program. For re-entry into the diagnostic program, see above point.

- Error display: An error is shown in the display as follows:



*In some cases, direct error particulars are given.*

**Instruments needed:**

- Reference voltage generator, e.g. Metrohm 2.642.0010 pH Simulator (or any voltage source + accurate DVM, class 0.1 mV)
  - Voltage measuring instrument (voltmeter, DVM, recorder)
  - Resistor switchbox class 0,1 %
  - Pt100 or Pt1000 simulator
- } a resistor 1k/1‰  
} also suffices

If external functions also require checking:

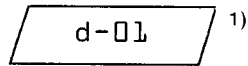
- 3.496.8490 Test Plug (at 'Remote' connector)
- 3.496.8480 Test Plug (at 'RS232' connector)

➤ 1. **Prepare instruments for diagnostic test**

Power off

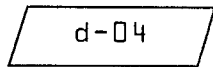
Disconnect all external connections (cables at rear, except mains cable)

Power on and immediately press and hold the <delta> key until the powerup test pattern disappears.



➤ 2. **Perform display test**

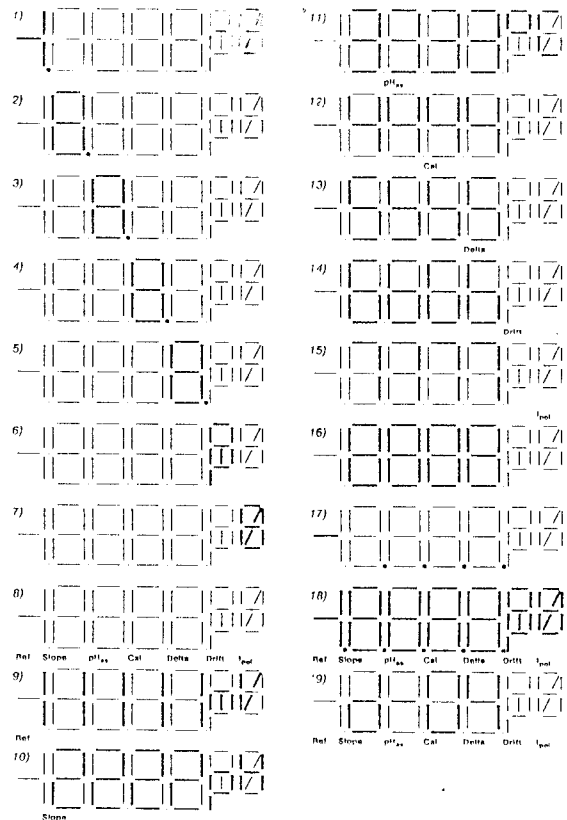
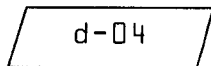
Press <delta> (several times) until



appears, then press <enter>.

The display test runs automatically through the steps 1-19 shown in Fig. 1.

*The test can be held at any time with <delta> and then continued. At the end of the test, the display shows*



*Fig. 1 Sequence of the display test*

1) If an error message Exx appears, see page I-14.

### » 3. Keypad test

Press <delta> (several times) until

d-03

appears, then press <enter>

0.

Press the keys in the order of their associated key number (see Fig.2):

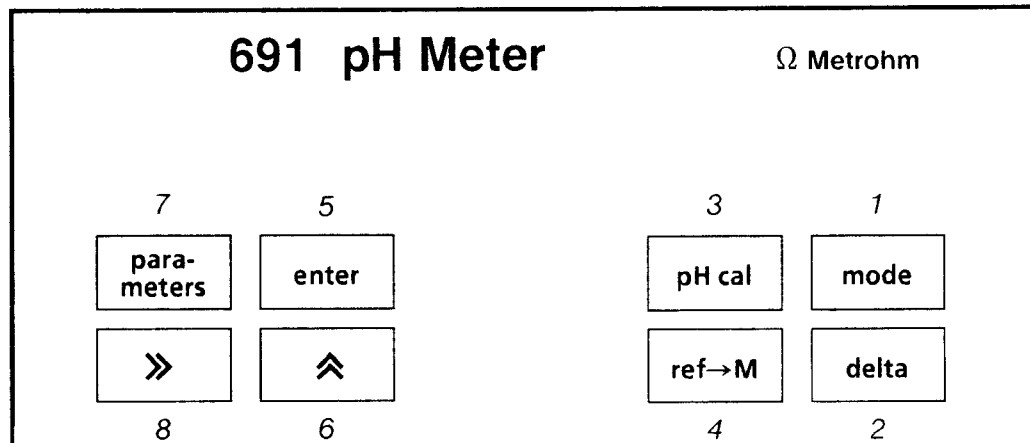


Fig. 2 Keypad with key numbers

If a wrong key number is pressed, this is displayed automatically with Ex (x = number of wrong key pressed).

### » 4. Check analogue output

A voltage can be set at the analogue output <sup>Ⓢ</sup> via the keypad irrespective of the input voltage. But this should not exceed 2000 mV [Warning: The configuration of the analogue output is also effective here (see page I-10)]. This voltage can also be used for the calibration of an attached recorder.

Attach a voltage measuring instrument (voltmeter, DVM, recorder) to the analogue output.

Press the <delta> key several times until

d-01

appears, then press <enter>

0 mV

(mV flashes)

With the <→> and <↑> keys set a number on the display between 0 and 2000, press <enter> and check with the attached voltmeter (tolerance ± 2 mV).

Exit: <mode>

### » 5. External inputs and outputs

This test is meaningful only if the 691 pH Meter is used interconnected with other instruments via the connector a: the 'Remote' connection. In addition, a 3.496.8490 Test Plug normally used in the repair service is required for this test. However, this plug can also be purchased by the customer under the above number.

For the sake of completeness the procedure is described here.

(If a diagnostic test of the external inputs and outputs is not required, continue with point 6.)

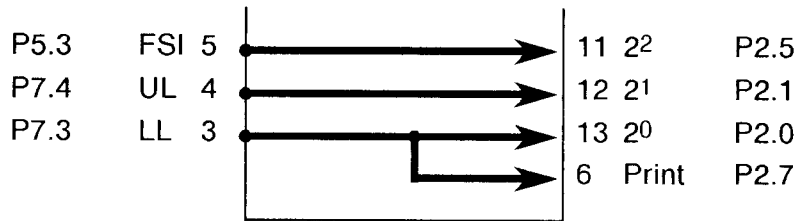
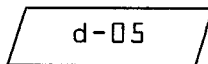


Fig. 3 Connections in 3.496.8490 Plug

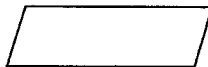
The above mentioned inputs and outputs are checked.

Insert 3.496.8490 Plug in 'Remote' socket (do not switch off instrument, pay attention to alignment of the plug!).

Press the <delta> key several times until



<enter>



The test runs automatically. If no error is found, a moving '-' appears in the display. Otherwise, the malfunctioning port (see Fig. 3) is displayed (e.g. 'P2.5').

Remove test plug.

➤ 6. **RS 232 Test** (applies only to 2.691.0020 instruments with RS232 interface)

This test is meaningful only if the 691 pH Meter is used interconnected with other instruments via the connector 'RS 232C'. In addition, a 3.496.8480 Test Plug normally used in the repair service is required for this test. However, this plug can also be purchased by the customer under the above number.

For the sake of completeness the procedure is described here.

(If a diagnostic test of the RS 232C interface is not required, continue with point 7.)

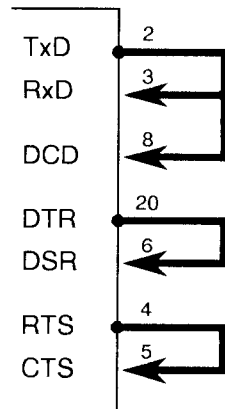
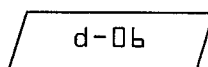


Fig. 4 Connections in the 3.496.8480 Plug

Insert 3.496.8480 Plug in 'RS 232 C' port (do not switch off instrument, pay attention to alignment of the plug!).

Press the <delta> key several times until



<enter>



The test runs automatically. If no error is found, a moving '-' appears in the display. Otherwise, an error code E61 ÷ E89 is shown. In case of error, initialize instrument, switch off and on, then repeat test.

Remove test plug.

## ➤ 7. Check instrument calibration

< mode >

The method last selected before switching off reappears in the display.

### 7.1 Check potential measurement

Press < mode > (several times if need be) until the mV range (mV without I<sub>pol</sub>) appears in the display.

Connect a voltage calibrator (mV generator, pH Simulator, etc.) of accuracy class 0.1 mV or a less accurate source with an accurate voltmeter (0.1 mV) connected in parallel to measuring input ⑥ of the 691 by means of a highly insulated (high impedance) and shielded cable. Set voltage < 2000 mV and compare with display (tolerance ± 1 mV).

Check high impedance of input:

(if the generator allows this). Switch source to "high impedance" (R<sub>i</sub> ≃ 1000 M) and compare display with the value read off previously. The value may change by maximum 1 digit.

Disconnect calibrator.

### 7.2 Check I<sub>pol</sub> input

Press < mode > (several times if need be) until 'mV' and 'I<sub>pol</sub>' light up at the same time.

Attach a resistor switchbox of accuracy class 1% (or any resistor 1% between 1 kΩ and 100 kΩ) to the 'I<sub>pol</sub>' socket and read off the voltage on the display. The value must be ca. 1 mV/kΩ<sup>1)</sup> (= I<sub>pol</sub> 1 μA) (tolerance ± 10 %).

Disconnect resistor switchbox.

### 7.3 Check temperature measurement

Press < mode > (several times if need be) until '°C' appears in the display.

Attach Pt100 or Pt1000 simulator (or appropriate resistors 100 Ω or 1 kΩ/0.1%) to connector 'Pt100/Pt1000' ⑦ and read off the temperature (100Ω or 1000Ω give 0 °C, tolerance ± 1 °C).

Disconnect Pt100 simulator (or resistor)

## End of the diagnostic test

## 8. Setting the original position

Plug in the connections to the peripheral instruments disconnected at the start of the diagnostic test and perform a brief function check with these.

## ➤ 9. Initialize RAM

On the odd occasion large disturbing signals (e.g. mains spikes, lightning, etc.) can have an adverse effect on the processor functions and hence lead to a system crash. After such a crash the RAM area must be initialized. Although the basic instrument data remain stored, the RAM initialization should be performed only when necessary since the stored user data (electrode calibration data, selected buffers, configurations, etc.) are cleared as a result.

---

<sup>1)</sup> Warning: The I<sub>pol</sub> current can be selected by the customer by resoldering a resistor (see page I-21). This must be taken into account when calculating the voltage.

Proceed according to point 1. Display shows:

d-01

press <delta> again

d-02

press <enter>

init

(if an initialisation can not be avoided):

press <enter>.

Otherwise quit with <mode>.

The sequence of the initialisation is shown by the moving dash. Standard parameters are now loaded, see page I-25.

The lost data of the user memory must now be reentered, see Presettings (power on + key x) of the keys <pH cal>, <ref → M>, <parameters>.

Perform point 8.

## Summary of the key assignment in the diagnostic tests

(via key <delta> with power on)

For repeat observations and special applications, it may be an advantage to perform a particular check directly. In what follows, the numerical assignment is thus given.

Press the <delta> key repeatedly.

- 01 analogue output (D/A converter test)
- 02 RAM initialisation → only when necessary!
- 03 Keypad test
- 04 Display test
- 05 Test ext. inputs and outputs
- 06 RS 232 test (only for instruments with RS232 interface).

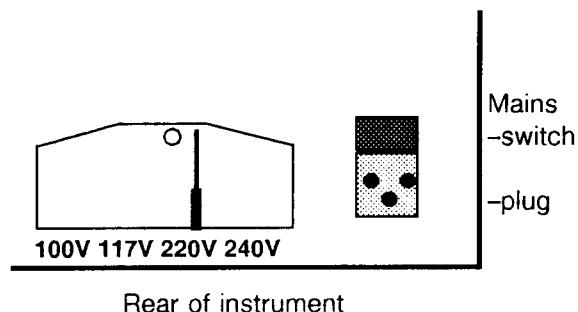
## 6. Appendix

When the apparatus is connected to its supply, terminals may be live, and the opening of covers or removal of parts is likely to expose live parts. The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

### 6.1 Mains connection

The setting of the operating voltage is visible in the voltage window at the rear of the instrument. Matching to a different mains voltage can be performed as follows:

- Disconnect mains cable
- Unscrew plastic cover of the voltage selector window
- Insert plug for the voltage selection using a small pair of pliers in the desired voltage
- Screw on plastic cover.



The mains cables supplied with the instrument are of the three-core type and are fitted with a plug carrying an earthing pin. If a different plug has to be mounted, the yellow/green lead must be connected to the protective earth. If no socket with earthing is available, the instrument must be connected to a perfect earthing conductor via the earthing socket.

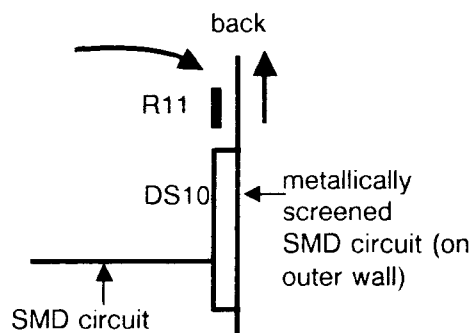
The instrument is protected by an irreversible thermal fuse. If this blows, inform Metrohm service.

### 6.2 Changing the polarisation current

The permanently set polarisation current is 1  $\mu\text{A}$ . If a different polarisation current is required, the resistor R11 on the PC board can be resoldered by a specialist (do not forget earthing!):

- Disconnect mains cable.
- Undo the 2 screws at rear (top).
- Undo the 4 outer screws on the underside.
- Lift off top part. The PC board is now free.
- Unsolder resistor R11
- Solder in new resistor:
 

for 1 $\mu\text{A}$	12 M $\Omega$
3 $\mu\text{A}$	4 M $\Omega$
5 $\mu\text{A}$	2.4 M $\Omega$
10 $\mu\text{A}$	1.2 M $\Omega$
- Screw instrument back together



open instrument from above

## 6.3 Technical specifications

### Measuring range

pH value	pH = 0.00 ... 14.00
Voltage	U = -2000 ... +2000 mV
Temperature	t = -170.0 ... +500.0 °C
$I_{pol}$	U = 0 ... +2000 mV

### Resolution

pH value	$\Delta pH = 0.01$
Voltage	$\Delta U = 1 \text{ mV}$
Temperature	$\Delta t = 0.1 \text{ °C}$
$I_{pol}$	$\Delta U = 1 \text{ mV}$

### Errors

absolute	
pH value, voltage	$\pm 10^{-4} \pm 1 \text{ digit}$
Temperature	$\leq 0.2 \text{ °C}$ in the range 0 ... + 100 °C
as a function of the ambient temperature	
pH value, voltage	typically 40 $\mu\text{V/K}$
Temperature	typically 0.02 °C/K

### Calibration

Number of buffer solutions used for the calibration	2
Possible buffer solutions for the automatic buffer recognition:	
Metrohm	Buffers pH 4, 7, 9
DIN/NBS	Buffers pH 4 (C), 7 (D), 9 (F)
Fisher	Buffers 4 (red), 7 (yellow), 10 (blue)
Merck/(Riedel deHaën)	Buffers pH 4, 7, 9
Ciba/Geigy	Buffers 4 (P01), 7 (P10), 9 (P12)
Special buffers	Without automatic recognition

### Signal amplifier

Input resistance	$> 10^{13} \Omega$
Offset current	$< 3 \cdot 10^{-13} \text{ A}$
Offset voltage deviation as a function of the ambient temperature	15 $\mu\text{V/K}$

### Analog output

Output signal	-2000 mV ... +2000 mV
pH value	0 mV at pH = 7
Voltage, $I_{pol}$	+ 1 mV $\rightarrow$ $\pm 1 \text{ mV}$
	depends on the setting of the polarity PA
Temperature	- 170.0 ... + 199.9 °C $\rightarrow$ -1700 ... + 1999 mV
	+ 200.0 ... + 500.0 °C $\rightarrow$ -2000 ... + 1000 mV
	$\Delta t = 1 \text{ °C} \rightarrow \pm 10 \text{ mV}$
	depends on the setting of the polarity PA

Resolution	
pH value	0.01
Voltage, $I_{pol}$	1 mV
Temperature	0.1 °C
Error as a function of the ambient temperature	$\pm 20 \mu\text{V/K}$

### Connection "Remote"

Inputs	pH cal, enter, mode pH, mode U/mV, mode t/°C,
	mode $I_{pol}$ /mV, print, init
Outputs	Forward Pulse, Upper Limit, Lower Limit

### Polarisation current

Setting	1 $\mu\text{A}$ , can be changed to other values, see page I-21
---------	---

<b>Display</b>	Gas discharge display
Digit height	15 mm
<b>Housing</b>	Light metal injection moulding, multiple stove- enamelled
Keypad	Chemically resistant plastic film (polyester)
<b>Ambient temperature</b>	
Nominal operational range	5 ... 40 °C
Storage, transport	- 20 ... 70 °C
<b>Safety specifications</b>	Designed and tested in accordance to IEC publication 348, safety class I. Apparatus for indoors use. This manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.
<b>Mains connection</b>	
Voltage	100, 117, 220, 240 V ± 10% (selectable)
Frequency	50 ... 60 Hz
Power consumption	8 VA
Fuse	Thermal fuse
<b>Dimensions</b>	
Width	
without stand rod	205 mm
with stand rod	235 mm
Height	
without stand rod	120 mm
with stand rod	315 mm
Depth	240 mm
<b>Weight</b>	
including standard accessories	app. 3.1 kg

### 6.4 pH values of buffer solutions

**Metrohm buffers**

Buffer t/°C	pH 4.00 ± 0.02	pH 7.00 ± 0.02	pH 9.00 ± 0.02
0	3.99	7.11	9.23
5	3.99	7.08	9.18
10	3.99	7.06	9.13
15	3.99	7.04	9.08
20	3.99	7.02	9.04
<b>25</b>	<b>4.00</b>	<b>7.00</b>	<b>9.00</b>
30	4.00	6.99	8.96
35	4.01	6.98	8.93
38	4.02	6.98	8.91
40	4.02	6.98	8.90
45	4.03	6.97	8.87
50	4.04	6.97	8.84
55	4.06	6.97	8.81
60	4.07	6.97	8.79
65	4.09	6.98	8.76
70	4.11	6.98	8.74
75	4.13	6.99	8.73
80	4.15	7.00	8.71
85	4.18	7.00	8.70
90	4.20	7.01	8.68
95	4.23	7.02	8.67

pH 4: potassium hydrogen phthalate  
 pH 7: potassium sodium hydrogen phosphate  
 pH 9: borax

**DIN/NBS buffers**

Buffer t/°C	C	D	F
0	4.01	6.98	9.46
5	4.00	6.95	9.40
10	4.00	6.92	9.33
15	4.00	6.90	9.28
20	4.00	6.88	9.23
<b>25</b>	<b>4.01</b>	<b>6.87</b>	<b>9.18</b>
30	4.01	6.85	9.14
35	4.02	6.84	9.10
38	4.03	6.84	9.08
40	4.03	6.84	9.07
45	4.04	6.83	9.04
50	4.06	6.83	9.01
55	4.07	6.83	8.99
60	4.09	6.84	8.96
65	4.11*	6.84*	8.94*
70	4.13	6.85	8.92
75	4.14*	6.85*	8.90*
80	4.16	6.86	8.89
85	4.18*	6.87*	8.87*
90	4.21	6.88	8.85
95	4.23	6.89	8.83

C: potassium hydrogen phthalate  
 D: phosphate  
 F: borax  
 following DIN 19266 (1979)

**Fisher buffers**

Buffer t°C	pH 4.00 red	pH 7.00 yellow	pH 10.00 blue
0	4.01	7.13	10.34
5	3.99	7.10	10.26
10	4.00	7.07	10.19
15	3.99	7.05	10.12
20	4.00	7.02	10.06
<b>25</b>	<b>4.00</b>	<b>7.00</b>	<b>10.00</b>
30	4.01	6.99	9.94
35	4.02	6.98	9.90
38	4.02*	6.98*	9.87*
40	4.03	6.97	9.85
45	4.04*	6.97*	9.81*
50	4.06	6.97	9.78
55	4.07*	6.97*	9.74*
60	4.09	6.98	9.70
65	4.11*	6.99*	9.68*
70	4.13*	7.00*	9.65*
75	4.14*	7.02*	9.63*
80	4.16*	7.03*	9.62*
85	4.18*	7.06*	9.61*
90	4.21*	7.08*	9.60*
95	4.23*	7.11*	9.60*

pH 4: potassium hydrogen phthalate (SB 101)

pH 7: potassium dihydrogen phosphate/NaOH (SB 107)

pH 10: potassium borate/carbonate/KOH (SB 115)

**Merck/(Riedel-deHaën<sup>1)</sup>) buffers**

Buffer t°C	pH 4.00	pH 7.00	pH 9.00
0	4.05	7.13	9.24
5	4.04	7.07	9.16
10	4.02	7.05	9.11
15	4.01	7.02	9.05
<b>20</b>	<b>4.00</b>	<b>7.00</b>	<b>9.00</b>
25	4.01	6.98	8.95
30	4.01	6.98	8.91
35	4.01	6.96	8.88
38	4.01*	6.96*	8.86*
40	4.01	6.95	8.85
45	4.00*	6.95*	8.82*
50	4.00	6.95	8.79
55	4.00*	6.95*	8.76*
60	4.00	6.96	8.73
65	4.00*	6.96*	8.71*
70	4.00	6.96	8.70
75	4.00*	6.96*	8.68*
80	4.00	6.97	8.66
85	4.00*	6.98*	8.65*
90	4.00	7.00	8.64
95	4.00*	7.02*	8.63*

pH 4: sodium citrate/sodium chloride

pH 7: potassium/sodium dihydrogen phosphate

pH 9: boric acid/KCl/NaOH

1): The values indicated by Riedel deHaën may vary until up to  $\Delta$ pH 0.02.**Ciba/Geigy buffers**

Buffer t°C	pH 4.00 (P01)	pH 7.00 (P10)	pH 9.00 (P12)
0	4.01	7.11	9.20*
5	4.00	7.08	9.15
10	4.00	7.05	9.10
15	4.00	7.02	9.05
<b>20</b>	<b>4.00</b>	<b>7.00</b>	<b>9.00</b>
25	4.01	6.98	8.96
30	4.01	6.97	8.91
35	4.02	6.96	8.88
38	4.03	6.95*	8.85
40	4.03	6.95	8.84
45	4.04	6.94	8.80
50	4.06	6.94	8.77
55	4.07	6.93	8.74
60	4.09	6.93	8.71
65	4.11*	6.93*	8.69
70	4.13	6.94	8.67
75	4.14*	6.94*	8.65
80	4.16	6.95	8.63
85	4.18*	6.96*	8.61
90	4.21	6.97	8.60
95	4.23	6.98*	8.59

pH 4: potassium hydrogen phthalate

pH 7: potassium/sodium hydrogen phosphate

pH 9: borax/potassium dihydrogen phosphate

\* : interpolated or extrapolated values

The values without \* correspond to the manufacturer's specifications.

## 6.5 Standard parameters

Parameter, meaning	Input range	Initial value
<b>pH:</b>		
Reference value	-199.99 ... 199.99	0.00
Measurement temperature	-1999.9 ... 1999.9 °C	25.0 °C
Slope	-19.999 ... 19.999	1.000
pHas	-199.99 ... 199.99	7.00
<b>pH cal:</b>		
Calibration temperature	0 ... 99.9 °C	25.0 °C
Buffer series	S1, S2, S3, S4, S5, SP	S1 (Metrohm buffers)
Special buffer 1	-199.99 ... 199.99	0.00
Special buffer 2	-199.99 ... 199.99	0.00
<b>U:</b>		
Reference value	-19999 ... 19999 mV	0 mV
<b>t:</b>		
Reference value	-1999.9 ... 1999.9 °C	0.0 °C
<b>Ipol:</b>		
Reference value	-19999 ... 19999 mV	0 mV
<b>Limits:</b>		
Upper Limit	0, 1 (no, yes)	0
Value	as ref., depending on meas. var.	pH = 14.00
Lower Limit	0, 1 (no, yes)	0
Value	as ref., depending on meas. var.	pH = 0.00
<b>Configuration:</b>		
Send	0, 1 (no, yes)	0
Baud rate*	300, 600, 1200, 2400, 9600 baud	9600 baud
Bit*	7, 8	7
Hardware Handshake*	0, 1 (no, yes)	0
Drift-controlled output	0, 1 (no, yes)	0
Time-dependent output	0.0 ... 1999.9 s	0.0
Polarity at analog output	+, -	+
Program number	no entry	Program

\* : Inquiry only with 2.691.0020 instruments with RS232 interface

## 6.6 Warranty

The warranty regarding our products is restricted to the free repair in our workshops of defects which can be proven to result from material, construction or manufacturing faults and which occur within 12 months from the date of delivery. Transport costs must be borne by the customer.

In the case of day and night operation the warranty lasts 6 months.

Glass breakage in the case of electrodes or other glass parts is not included in this warranty. Inspections not necessitated by material or manufacturing faults are charged for even during the warranty period. For components of non-METROHM manufacture in so far as these constitute as major part of our instrument, the warranty provisions of the manufacturer in question apply.

In regard to the guarantee of accuracy, the technical data given in these Instructions for Use are authoritative.

The customer has no rights and claims except those mentioned above in regard to defects in material, construction or design or in regard to the lack of assured features.

If on receipt of a shipment visible damage to the packaging is found or if the goods show signs of transport damage after unpacking, the carrier must be informed at once and a damage report demanded. Lack of an official damage report absolves METROHM from any replacement liability.

When any instruments and parts are returned, the original packing should be used if at all possible. This applies particularly to instruments, electrodes, burette cylinders and PTFE pistons. Before imbedment in shavings or similar material, the parts must be enclosed in dustproof packages (for instruments use of a plastic bag is obligatory). 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.

## 6.7 Scope of delivery and ordering designations, Accessories

### 691 pH Meter 2.691.0010

including the following accessories:

1 Stand rod support	6.2001.030
1 Clamping ring	6.2013.010
1 Stand rod, 30 cm	6.2016.050
1 Electrode holder	6.2021.020
1 Mains cable with cable socket type CEE(22),V	
Cable plug to customers's specifications:	
Typ SEV 12 (Switzerland...)	6.2122.020
Typ CEE(7),VII (Federal Republic of Germany...)	6.2122.040
Typ NEMA/ASA (USA...)	6.2122.070
1 Dust cover	6.2723.270
1 Instructions for Use for 691 pH Meter	8.691.1003

### 691 pH Meter with RS232 interface 2.691.0020

Accessories as for 2.691.0010

### Options

The Metrohm Monography "Electrodes in Potentiometry" gives a summary about pH measurements and electrodes. It is available at Metrohm's and is free of charge.

Accessories to separate order and on payment of extra charge:

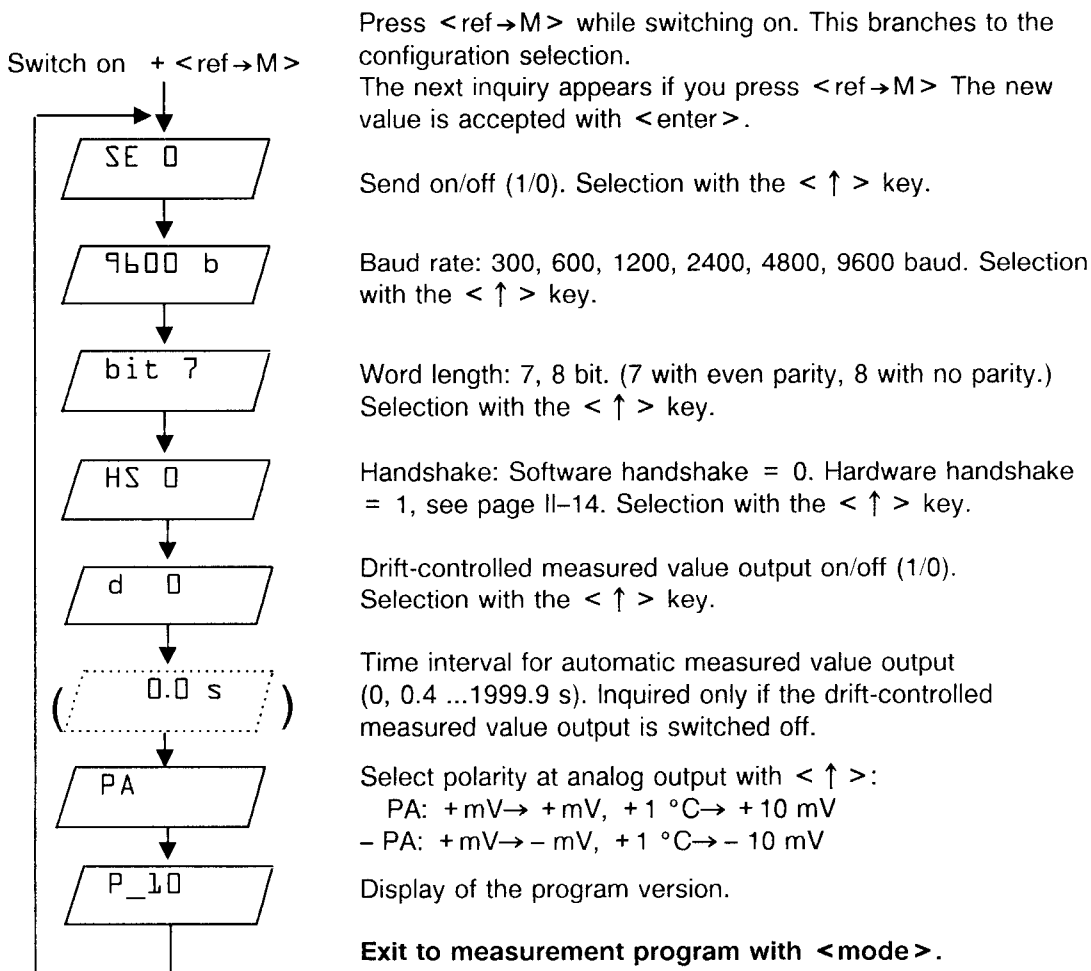
Combined pH glass electrode	6.0202.100
Combined pH glass electrode with built-in Pt100 temperature sensor	6.0218.010
Temperature sensor Pt100	6.1103.000
Adapter DIN connector (E) – connector F	6.2104.000
Adapter BNC connector – connector F	6.2103.090
Stand rod 48 cm, e.g. for work with a stirrer	6.2016.060
Metrohm buffer set, pH = 4, pH = 7 and c(KCl) = 3mol/l	6.2302.010
Metrohm buffer set, pH = 4, pH = 7 and pH = 9	6.2304.000
Additional electrodes and buffer solutions, see "Electrode Catalogue".	
Cable 691 pH Meter – Epson P40/P80 printer	6.2125.040
Cable 691 pH Meter – Seiko DPU-411 printer	6.2125.020
Cable 691 pH Meter – Citizen iDP560 RS printer	6.2125.050
Cable 691 pH Meter – IBM PC/XT/PS-2	6.2125.060
Cable 691 pH Meter – IBM AT	6.2125.060 + 6.2125.010
Program for data transfer pH Meter – PC, 5¼" and 3½" diskette	6.6006.000
Cable 691 pH Meter – 614 Impulsomat	6.2115.010
Cable 691 pH Meter – 586 Labograph	6.2115.010
Cable 691 pH Meter – 664 Control Unit for Sample Changer	
measurement only	3.980.3510
measurement and calibration	3.980.3520
Cable 691 pH Meter "Remote" – open end	6.2131.000

**Part 2: Instructions for Use for 2.691.0020 Instruments  
with RS232 Interface**

# 1. Interconnection with instruments via RS232 interface

## 1.1 Configuration of the pH Meter

The pH Meter is configured as follows:



### Send

Send "on" (1) is needed for:

- output of the calibration report on a printer.
- output of measured values on a printer.
- output of the forward pulse (FP) for the sample changer if the instrument is not controlled via the RS232 interface.

Send "off" (0) is needed for:

- work with a computer. The forward pulse (FP) for the sample changer is transmitted by the computer separately.
- no data output on a printer.

### Drift-controlled measured value output

Drift-controlled measured value output "on":

- after a print command (see page II-2) the measured value is outputted as soon as the drift condition is met.

Drift-controlled measured value output "off" when:

- the measured value output should be triggered manually.
- the measured value should be outputted at fixed time intervals.

**Time interval for measured value output**

Time interval 0:

- after a print command a single measured value is outputted.

Time interval 0.4 ... 1999.9 s:

- the measured value is outputted at specified time intervals. The print command is inactive here. Possible time intervals are multiples of 0.4 s. Intermediate values are rounded off:

0.1 s→0.4 s

1.0 s→1.2 s

1.3 s→1.6 s

**Print command**

The print command can be triggered through

- pressing the <→> key on the pH Meter
- a signal via connection "Remote" (pin 6, see page I-12).

**Data format**

Measurement data

```
# 01 pH= 4.88
# 02 pH= 5.25
# 03 20.5°C
# 04 95mV
# 05 667mV
```

Calibration report

```
buffer1 pH= 3.99 150mV 21.9°C
buffer2 pH= 7.01 -24mV 21.5°C
slope= 0.985 pHase= 6.59
```

Printed out are

- current number
- measured value

The current number is set to 01 on switching on.

In 2-point calibrations the measured temperature is outputted for every buffer. If the temperature has been entered manually, however, it appears only for buffer 1.

The current number is not incremented in calibrations.

**1.2 Connection of a printer**

Printers with an RS232 interface can be attached to the pH Meter. Several printers with 40 characters line are mentioned below:

Printer model	Cable	Settings at the pH Meter	Settings at the printer
Epson P40	6.2125.040	SE 1 9600 baud bit 7 HS 1	<b>DIP-Schalter:</b> 1 off auto feed 2 on with polarity 3 on even polarity 4 on } 7 bit 5 off } 6 on } 9600 baud 7 off }

Printer model	Cable	Settings at the pH Meter	Settings at the printer	
<b>Citizen iDP560 RS</b>	6.2125.050	SE 1 9600 baud bit 8 HS 1	<b>DIP switches:</b> 1 - 2 off } 3 off } 9600 baud 4 off } 5 off 8 bit 6 - 7 on no parity 8 -	
			<b>Jumpers:</b> 1 open 2 open 3 open 4 open 5 closed	
<b>Seiko DPU-411</b>	6.2125.020	SE 1 9600 baud bit 8 HS 0	<b>DIP switches:</b> <b>DIP01</b> 1 off serial 2 off no auto LF 3 on 40 characters 4 on character type 5 off zero represent. 6 off } 7 on } USA 8 on } character set <b>Set printer to "on-line"</b>	
			<b>DIP02</b> 1 on 8 bit 2 on no parity 3 off even parity 4 off } 5 off } 9600 baud 6 off }	

Other printers can be attached:

Epson printer with built-in RS232 interface and 8-pole plug: Cable 6.2125.040.

Epson printer with interface #8148, HP Think Jet: 6.2125.050 Cable

Settings on pH Meter: 8 bit, HS 1.

Connect the two units. switch on and if need be set printer to "on-line". The output of a measured value is triggered at the pH Meter with the <-> key see page II-2.

### 1.3 Connection of a computer

For the connection of a computer the 691 pH Meter should be configured as follows (see page II-1):

SE:	0	} dependent on control program
recommended baud rate:	9600	
word length parity:	7 bit. even parity	
	or 8 bit. no parity	
handshake:	1 or 0	

An IBM PC or compatible computer can be connected to the 691 pH Meter with the following cables:

Cable 691 pH Meter – IBM PC,XT PS-2

6.2125.060

Cable 691 pH Meter – IBM AT

6.2125.060 + 6.2125.010 Adapter

Program package for data transfer 691 pH Meter – IBM compatible computer, basic and pascal.

5¼" or 3½" diskette

6.6006.000

## 2. Remote control of the pH Meter via RS232 interface

### 2.1 General rules

The 691 pH Meter has an extensive remote control facility that allows full control of the pH Meter via the RS232 interface, i.e. the pH Meter can receive data from an external controller or it can send data to such a controller. As terminators for the data transfer  $C_R$  and  $L_F$  are always used.

The commands are grouped logically and are simple to understand. Thus, for example, for the selection of the measurement mode 'pH' the command

**&Mode.pH \$G**  $C_R L_F$

must be sent with the input of the boldface characters sufficing, thus

**&M.P \$G**  $C_R L_F$ .

The slope is outputted by the pH Meter on the command

**&Mode.pH.Parameters.Slope \$Query**  $C_R L_F$

The value of the slope can not only be requested, it can also be modified:

**&Mode.pH.Parameters.Slope "0.953"**  $C_R L_F$

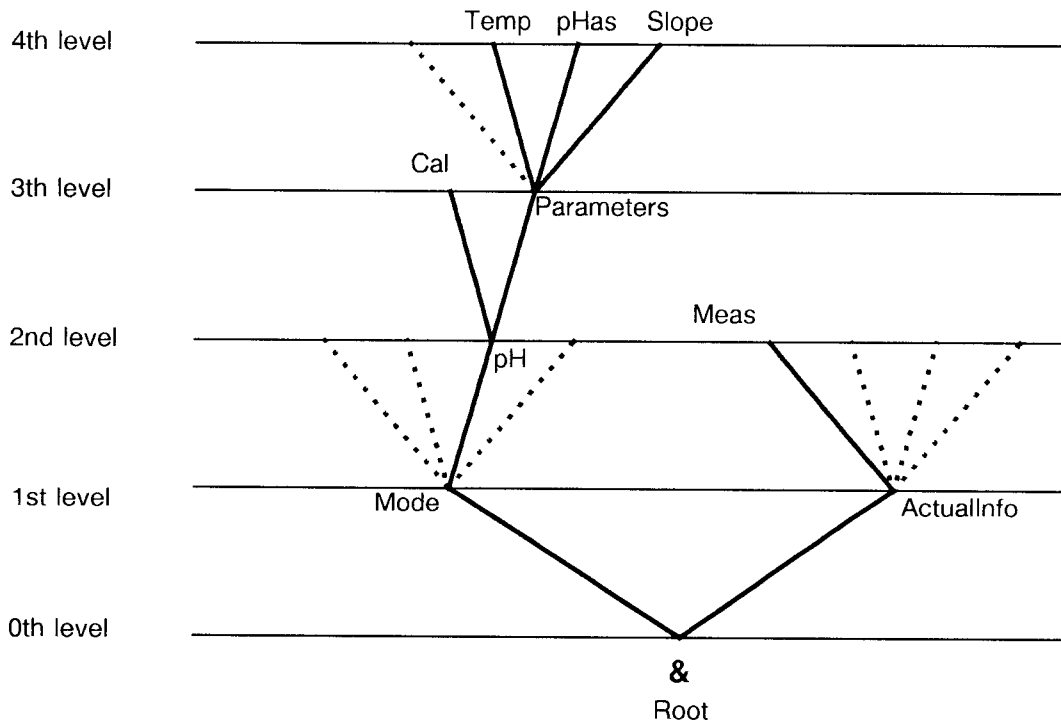
Values are entered within quotation marks ("").

The slope and all other callable quantities of the pH Meter are called **objects** in what follows.

The values of the slope can be requested with \$Query. \$Query triggers (initiates) the output of the value and is thus called a **trigger**.

#### 2.1.1 Call up of objects

All objects of the 691 pH Meter are grouped hierarchically (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 levels (nodes) of the tree are marked with a point (.).
- The initial letters suffice as input. Upper- or lowercase letters can be used.
- An object can be assigned a value. Values are marked at the beginning and end with quotation marks ("). They can contain up to 9 characters. Numerical values can include a negative sign, a decimal point and an exponent 'E'.
- If a new object is not called up, the old object remains current.
- New objects can also be addressed relative to old objects:  
**A preceding point** moves one level **forwards** in the tree.  
**Two preceding points** move one level **backwards** in the tree. n levels backwards require n + 1 preceding points.
- If a jump is to be made back to the root, a preceding & is entered.

Example:

Call up of the measurement temperature in the pH mode from the root:  
**&M.P.P.T** or **&Mode.pH.Parameters.Temp**

Entry of 25.3 °C for temperature in the pH mode: **&M.P.P.T"-25.3"**

**"-3.2E2"**

**"1.32E-3"**

incorrect entries:

**"1,5"**

**" + 3"**

Entry of a different temperature:

**"30.5"**

Forwards from the node 'Parameters' to 'Slope': **.S**

Jump from the object 'Slope' into the node 'Parameters' and selection of a new object 'pH<sub>as</sub>': **..P**

Jump from the object 'pH<sub>as</sub>' over the node 'Parameters' to the node 'pH' and to the new object 'Cal': **...C**

Change from the object 'Cal' via the root into the node 'ActualInfo': **&A**

### 2.1.2 Triggers

Triggers initiate an action at the pH Meter, e.g. loading of a new mode or sending of data. Triggers are marked with the introducer:

**S**

The following triggers are possible:

\$G	Go:	Starts operations. e.g. start of the calibration
\$S	Stop:	Stops operations. e.g. calibration, exit from error messages
\$Q	Query:	Used for inquiry of the values of the objects
\$I	Information:	Used for inquiry of the global status
\$D	Detailed Info:	Used for inquiry of the detailed status
\$F	Forward:	Provides the forward pulse for the sample changer

The triggers \$G, \$S and \$Q are linked to the objects, see overview table, page II-7.

The triggers \$I, \$D and \$F, on the other hand, can be used at any time and at all locations on the object tree.

Examples:

Inquiry of the value of the 'measurement temperature': **&Mode.pH.Parameters.Temperature\$Q**uery.

Start calibration: **&Mode.pH.Calibration\$G**o

Inquiry of the detailed status: **\$D**

### 2.1.3 Status inquiries

So that a meaningful control of an external instrument is possible, it must also be possible to query the status; it provides information on the status of the pH Meter. The triggers \$I and \$D initiate output of the status. The pH Meter can react with the following outputs:

- To \$I:
  - \$G           Go: The pH Meter measures and the drift condition has not yet been met or it is executing an operation, e.g. the calibration.
  - \$G;E       Go with Error
  - \$S           Stop: An operation is at an end, i.e. the drift condition in a measurement has been met or the pH Meter idles and waits for a start.
  - \$S;E       Stop with Error: The pH Meter waits for an error rectification.
- To \$D, e.g.:
  - \$G1;E3.7   The pH Meter is in the status G1 and has detected error E3 and error E7, see below.

### Possible status of the 691 pH Meter

#### Go status:

- \$G1   pH Meter in pH mode, calibrating, measuring temperature
- \$G2   pH Meter in pH mode, calibrating, measuring voltage of buffer 1
- \$G3   pH Meter in pH mode, calibrating, measuring voltage of buffer 2
- \$G4   pH Meter in measurement mode, drift condition not yet met.

#### Stop status:

- \$S1   pH Meter in pH mode, calibrating and requests buffer 2 (display bu 2)
- \$S2   pH Meter in measurement mode, drift condition has been met.

#### Error messages. Errors:

- E1    During the calibration, buffer 2 = buffer 1 recognized.  
Exit: \$S, leads to display bu 2.
- E2    After E1 a new start was made with \$G, buffer 2 is still identical to buffer 1.  
Exit: \$S, leads to display bu 2.
- E3    During the calibration with a buffer series an allocation of the buffer is not possible.  
Exit: \$S, leads to the measurement mode pH
- E4    During the calibration the measured temperature difference between the two buffers is  $>2^{\circ}\text{C}$ .  
Exit: \$S, leads to the measurement mode pH
- E5    Wrong command, i.e. wrong object call or wrong trigger has been sent.  
Exit: Send correct command, begin path for objects at the root (&).
- E6    Wrong value has been sent.  
Exit: Send correct value.
- E7    The command can not be executed in the current status of the pH Meter.  
Exit: Repeat command in status G4 or S2 or send different command.
- E8    Measurement range exceeded.  
Exit: Error is cleared when the measured value is again in the admissible measurement range.
- E9    "Measure" in the t °C mode without temperature sensor.  
Exit: Select new mode or attach temperature sensor.

## 2.2 Remote control commands

### 2.2.1 Overview

Object	Function	Input range	see...
<b>&amp;</b>	<b>Root</b>		
<b>Setup</b>	Setting up operational readiness		
.Remote	Remote control on/off	ON,OFF,\$Q	2.2.2.1
.PowerOn	Simulation power on	\$G	2.2.2.2
.Initialise	Initialise instrument	\$G	2.2.2.3
<b>Mode</b>	Modes	\$Q	2.2.2.4
.pH	pH mode	\$G	2.2.2.5
.Parameters	Parameters in pH mode		
.Reference	Reference value	-199.99...199.99,\$Q	2.2.2.6
.Temperature	Measurement temperature	-1999.9...1999.9,\$Q	2.2.2.7
.pHas	pHas	-199.99...199.99,\$Q	2.2.2.8
.Slope	Relative slope	-19.999...19.999,\$Q	2.2.2.8
.Calibration	pH calibration	\$G,\$S	2.2.2.9
.Temperature	Calibration temperature	0.0 ... 99.9,\$Q	2.2.2.10
.Send	Sending the calibration reports	\$G	2.2.2.11
.Buffer	Buffer selection		
.Type	Selection of buffer series	S1...S5, SP,\$Q	2.2.2.12
.1Value	pH value of special buffer 1	-199.99...199.99,\$Q	2.2.2.13
.2Value	pH value of special buffer 2	-199.99...199.99,\$Q	2.2.2.13
.U	U/mV mode	\$G	2.2.2.5
.Parameters	Parameters in U mode		
.Reference	Reference value	-19999...19999,\$Q	2.2.2.6
.T	Temperature mode	\$G	2.2.2.5
.Parameters	Parameters in t°C mode		
.Reference	Reference value	-1999.9...1999.9,\$Q	2.2.2.6
.Ipol	Ipol mode	\$G	2.2.2.5
.Parameters	Parameters in Ipol/mV mode		
.Reference	Reference value	-19999...19999,\$Q	2.2.2.6
<b>Configuration</b>	Configuration		
.Delta	Delta measurement on/off	ON,OFF,\$Q	2.2.2.14
.Send	Send on/off	ON,OFF,\$Q	2.2.2.15
.Output	Output of measured values		
.Drift	Drift-controlled data output	ON,OFF,\$Q	2.2.2.16
.Time	Time interval for data output	0.0...1999.9,\$Q	2.2.2.17
.InvertAnalog	Invert polarity at analog output	ON,OFF,\$Q	2.2.2.18
.RunNumber	Run number for data output	00...99,\$Q	2.2.2.19
.Limits	Limits		
.Type	Measured variable for limits	P,U,T,I,\$Q	2.2.2.20
.UpperLimit	Upper limit		
.Gate	Limit monitoring on/off	ON,OFF,\$Q	2.2.2.21
.Value	Set upper limit	as measured quantity,\$Q	2.2.2.22
.LowerLimit	Lower limit		
.Gate	Limit monitoring on/off	ON,OFF,\$Q	2.2.2.21
.Value	Set lower limit	as measured quantity,\$Q	2.2.2.22
.Program	Program version	\$Q	2.2.2.23
<b>ActualInfo</b>	Current information		
.MeasuredValue	Measured value	\$Q	2.2.2.24
.SampleReady	Sample ready at Sample Changer	\$Q	2.2.2.25
.UpperLimitStatus	Status of upper limit	\$Q	2.2.2.26
.LowerLimitStatus	Status of lower limit	\$Q	2.2.2.27



## 2.2.2 Description of the remote control commands

2.2.2.1 Setup.Remote ON, OFF | \$Q

**ON:** Switches remote control on. The keypad entry and the lines 11, 12 and 13 of the 'Remote' socket are disabled, see page I-12. The forward pulse for the sample changer is no longer outputted automatically when 'send' is 'on'. Only remote control commands are accepted.

**OFF:** Switches the remote control off. Keypad entry again enabled. Remote control commands are no longer accepted. Status inquiries (with \$I and \$D) are also possible when the remote control is switched off. On and off switching of the remote control clears error messages, see page II-6. Power off/on switches remote control off.

2.2.2.2 Setup.PowerOn \$G

Simulation of 'Power on': Switches remote control off, clears error messages (see page II-6), sets run number to 01. The pH Meter switches to the measurement program with the mode last selected being active.

2.2.2.3 Setup.Initialise \$G

Initialises instrument: Clears error messages (see page II-6) and sets all parameters to the initial values, see page I-25 (exceptions are the settings of the RS232 interface, which are retained).

2.2.2.4 Mode \$Q

Inquiry regarding the current mode. \$Q sends:

- P** for pH
- U** for U/mV
- T** for t/°C
- I** for Ipol

2.2.2.5	Mode.pH	\$G
	Mode.U	\$G
	Mode.T	\$G
	Mode.Ipol	\$G

\$G starts the mode. The display of the pH Meter is switched accordingly.

After a mode change the correct status display can be outputted at the earliest after 0.8 s. In the t/°C mode the pH Meter needs up to 3.6 s for reliable detection of the error message E9 (no temperature sensor attached).

2.2.2.6	Mode.pH.Parameters.Reference	-199.99 ... 199.99	\$Q
	Mode.U.Parameters.Reference	-19999 ... 19999	\$Q
	Mode.T.Parameters.Reference	-1999.9 ... 1999.9	\$Q
	Mode.Ipol.Parameters.Reference	-19999 ... 19999	\$Q

Reference value for U and U(Ipol) in mV, for t in °C. The reference value is used in the delta measurement:

$$\text{delta} = \text{current measured value} - \text{reference value}$$

2.2.2.7 Mode.pH.Parameters.Temperature -1999.9 ... 1999.9 | \$Q

Measurement temperature in °C. If a temperature sensor is attached, the measurement temperature is continuously updated (in the pH mode the temperature is measured every 3.6 s).

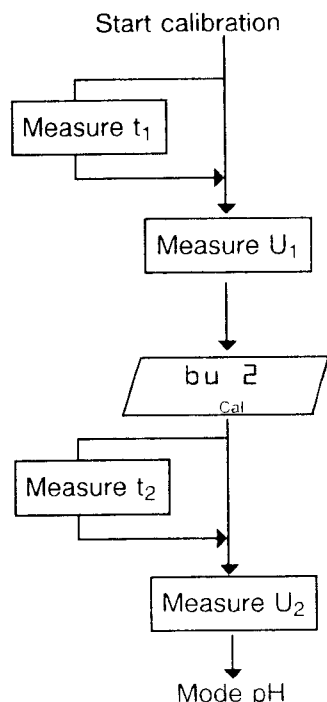
2.2.2.8 Mode.pH.Parameters.pHas -199.99 ... 199.99 | \$Q  
 Mode.pH.Parameters.Slope -19.999 ... 19.999 | \$Q

Calibration parameters 'pHas' and 'Slope'. Both parameters are updated after every calibration.

2.2.2.9 Mode.pH.Calibration \$G,\$S

\$G starts the calibration.

Sequence of the calibration:



Immerse electrode assembly in the first buffer and start calibration: send &M.P.C \$G

If a temperature sensor is attached, temperature  $t_1$  of the first buffer is measured (status G1) and the value accepted as soon as the drift condition is met.

The voltage of the first buffer  $U_1$  is measured (status G2) and accepted as soon as the drift condition is met (status S1).

For a 1-point calibration, abort with \$S.

For a 2-point calibration, immerse electrode assembly in the second buffer and continue calibration with \$G.

If a temperature sensor is attached, temperature  $t_2$  (status G1)

and the voltage  $U_2$  of the second buffer are measured (status G3).

The instrument is ready for measurement in the pH mode.

\$S can be used to abort the calibration at any time. The instrument switches to the pH mode.

2.2.2.10 Mode.pH.Calibration.Temperature 0.0 ... 99.9 | \$Q

Calibration temperature in °C. If a temperature sensor is attached, the measured calibration temperature is re-entered for every calibration. In the case of the 2-point calibration, where the temperature is measured in both buffers, the temperature of the second buffer is entered and used for the calculation of the slope.

2.2.2.11 Mode.pH.Calibration.Send \$G

Sending the calibration report. The output is started with \$G.

The measured temperature of the 2nd buffer is outputted on line 1 of the calibration report.

2.2.2.12 Mode.pH.Calibration.Buffer.Type S1.S2.S3.S4.S5.SP | \$Q

Selection of the buffer series:

- S1 Metrohm buffers
- S2 DIN/NBS buffers
- S3 Fisher buffers
- S4 Merck/Riedel deHaen buffers
- S5 Ciba-Geigy buffers
- SP Special buffers

2.2.2.13 Mode.pH.Calibration.Buffer.1Value -199.99 ... 199.99 | \$Q  
 Mode.pH.Calibration.Buffer.2Value -199.99 ... 199.99 | \$Q

pH values of the special buffers. Note that the pH values of buffers are temperature dependent.

2.2.2.14 Configuration.Delta ON,OFF | \$Q

**ON** switches the delta measurement on, **OFF** switches it off. The display of the pH Meter reacts with on/off switching of the status display 'Delta'.

2.2.2.15 Configuration.Send ON, OFF | \$Q

With "**ON**" the current sample number is incremented on output of the measurement data and the calibration report outputted in calibration.

It is advisable to set 'Configuration.Send' to 'OFF' and output measurement data with **&ActualInfo.Meas\$Query** and calibration reports with **&Mode.pH.Cal.Send\$Go** from the computer.

2.2.2.16 Configuration.Output.Drift ON,OFF | \$Q

Drift-controlled measurement data output. After a print command from 'Remote' (line 6, see page I-12) the measured value is outputted as soon as the drift criterion has been met.

It is advisable to set 'Configuration.Output.Drift' to 'OFF' and request the drift status with **\$D** and measurement data with **&ActualInfo.Meas\$Query** .

2.2.2.17 Configuration.Output.Time 0.0 ... 1999.9 | \$Q

Time interval for the output of measurement data in seconds. The inputted times must be multiples of 0.4 s. Intermediate values are rounded off, e.g.

0.1 s → 0.4 s  
 1.0 s → 1.2 s  
 1.3 s → 1.6 s

If '0' is entered, the measured value is outputted once after a print command from 'Remote' (line 6, see page I-12).

It is advisable to set 'Configuration.Output.Time' to 'OFF' and request the measured values from the computer according to its own time framework.

2.2.2.18 Configuration.InvertAnalogOutput ON,OFF | \$Q

Polarity at the analog output, see page I-11.

"**ON**" corresponds to polarity -PA at the analog output.

"**OFF**" corresponds to polarity PA at the analog output.

2.2.2.19 Configuration.RunNumber 01...99 | \$Q

Current run number. It is set to 01 on power on, 'Setup.PowerOn' or 'Setup.Initialise'. After 99 the counter returns to 00, 01 ...

If 'Configuration.Send' is "**ON**", the run number is incremented on every data output.

2.2.2.20 Configuration.Limits.Type P,U,T,I | \$Q

Measured variable for the limits:

- P** für pH
- U** für U/mV
- T** für t/°C
- I** für U(lpol)/mV

The limit monitoring is active if the appropriate measurement mode is switched on.

2.2.2.21 Configuration.Limits.UpperLimit.Gate ON,OFF | \$Q  
 Configuration.Limits.LowerLimit.Gate ON,OFF | \$Q

Limit monitoring '**ON**' means the corresponding limit monitoring is active. With '**OFF**' it is switched off.

2.2.2.22 Configuration.Limits.UpperLimit.Value Entry dependent on measured variable | \$Q  
 Configuration.Limits.LowerLimit.Value Entry dependent on measured variable | \$Q

Entry of the upper or lower limit. The input range depends on the measured variable:

- pH -199.99 ... 199.99
- U -19999 ... 19999 (in mV)
- t -1999.9 ... 1999.9 (in °C)
- lpol -19999 ... 19999 (in mV)

2.2.2.23 Configuration.Program \$Q

Inquiry of the program version. The instrument sends

pH691 P\_10

in response to \$Q.

2.2.2.24 ActualInfo.MeasuredValue \$Q

\$Q sends the measured value as it is shown in the display, without unit and status display.

Examples:

- 2.54 (pH value)
- 25.4 (temperature)
- 254 (voltage)

The format of the transmitted value shows whether it is a pH value, a temperature or a voltage. From this value, however, it is not apparent whether the delta measurement is switched on (separate inquiry) or whether the voltage has been measured with polarised electrodes (mode inquiry).

The measured value is updated by the pH Meter every 400 ms. In the pH mode every 9th measurement is a temperature measurement; the pH value is then not updated.

2.2.2.25 ActualInfo.SampleReady \$Q

Inquiry of the glass beaker detector from the sample changer. On \$Q the 691 sends '**ON**' if the glass detector of the sample changer has been operated (line 6 of the 'Remote' socket, see page I-12), i.e. the sample is at the analysis station. \$F clears this signal.

'**OFF**' means: line 6 (Print) has not been reset since the last \$F.

## 2.2.2.26 ActualInfo.UpperLimitStatus \$Q

Inquiry of the status of the upper limit. On \$Q the 691 sends '**ON**' if the upper limit has been exceeded. "**OFF**" means that the measurement signal is in the admissible range or the control of the upper limit is switched off.

## 2.2.2.27 ActualInfo.LowerLimitStatus \$Q

Inquiry of the status of the lower limit. On \$Q the 691 sends '**ON**' if the measured value is below the lower limit.

"**OFF**" means that the measurement signal is in the admissible range or the control of the lower limit is switched off.

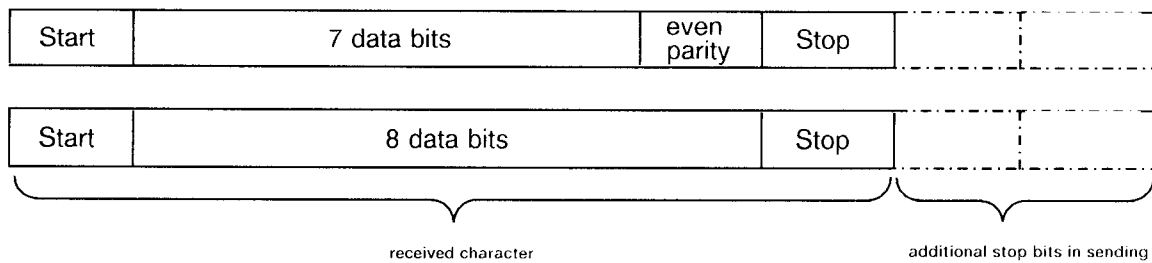
### 3. Features of the RS232 interface

#### 3.1 Data transmission protocol

The pH Meter is configured as DTE (Data Terminal Equipment).

The interface has the following technical data:

Data interface in accordance with the RS 232C standard	
Baud rates:	300, 600, 1200, 2400, 4800, 9600 (adjustable, see page II-1)
Handshake:	software or hardware handshake (see page II-1 and section 3.2)
Word length/parity:	7 bit, even parity or 8 bit, no parity
Stop bit:	
pH Meter as receiver	1
pH Meter as sender	3
max. line length:	39 characters + C <sub>R</sub> L <sub>F</sub>
Control characters:	C <sub>R</sub> (ASCII DEC 13) L <sub>F</sub> (ASCII DEC 10) XON (ASCII DEC 17) XOFF (ASCII DEC 19)
Cable length:	max. ca. 15 m



For interconnection of the 691 pH Meter with non-Metrohm units only a shielded data cable (e.g. METROHM D.104.0201) 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).

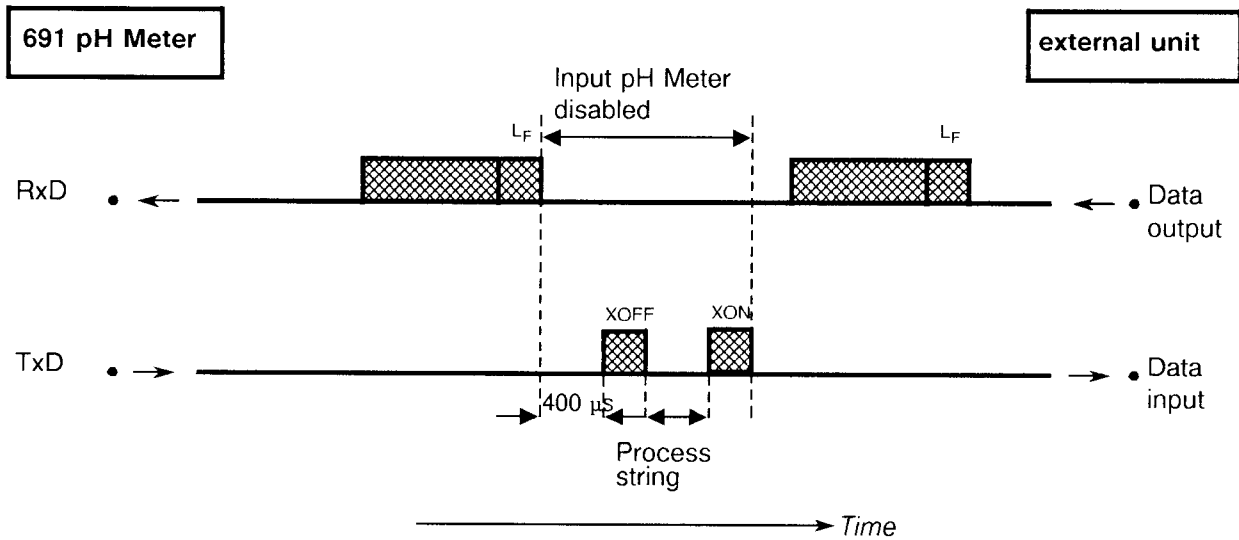
### 3.2 Handshake

#### 3.2.1. Software handshake ( $\overline{HS} \square$ )

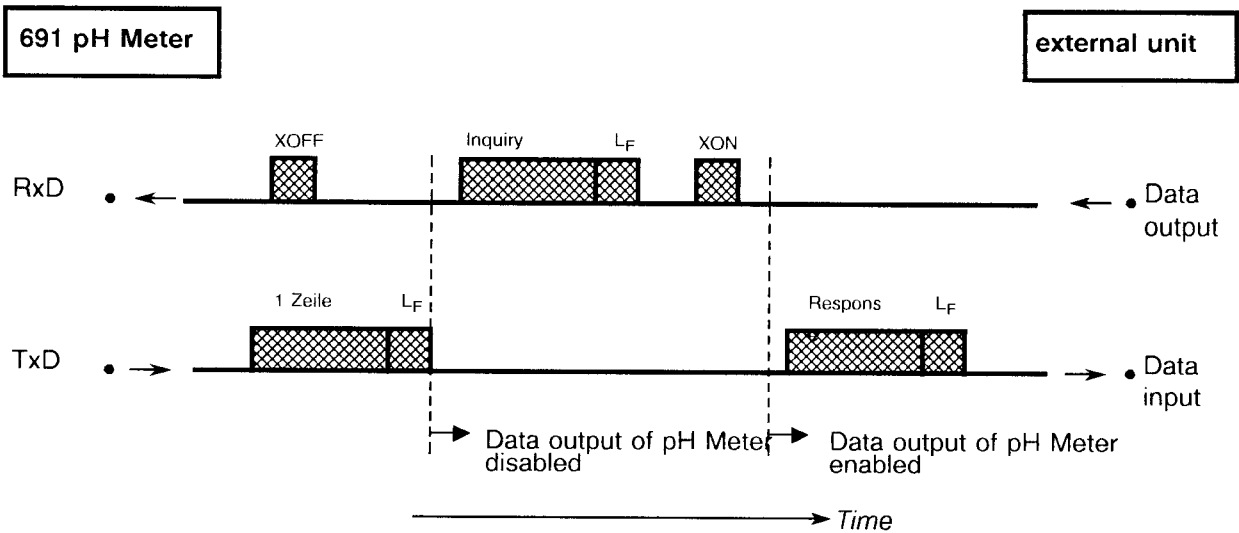
Handshake inputs at the pH Meter (CTS, DSR, DCD) are not checked. Handshake outputs (DTR, RTS) are set by the pH Meter.

The 691 pH Meter is fitted with an input buffer that can accommodate a string of up to 80 characters +  $C_{RLF}$ . As soon as an  $L_F$  is recognised, the pH Meter sends XOFF. After this it can receive maximum 6 extra characters and store them. The string sent previously is now processed by the pH Meter. Depending on the time of the entry and length of the string, this process can take up to 115 ms. Afterwards the pH Meter sends XON and is again ready to receive:

pH Meter as receiver:



pH Meter as sender:

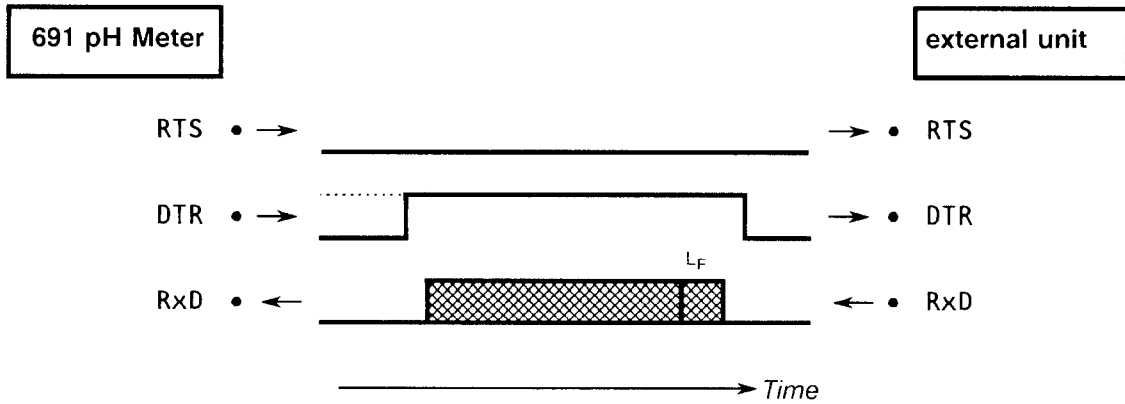


The transmission of the pH Meter can be stopped by the external unit with XOFF. After the receipt of XOFF the pH Meter completes transmission of the line already started. If the data output is blocked for more than 3 s through XOFF, E23 appears in the display.

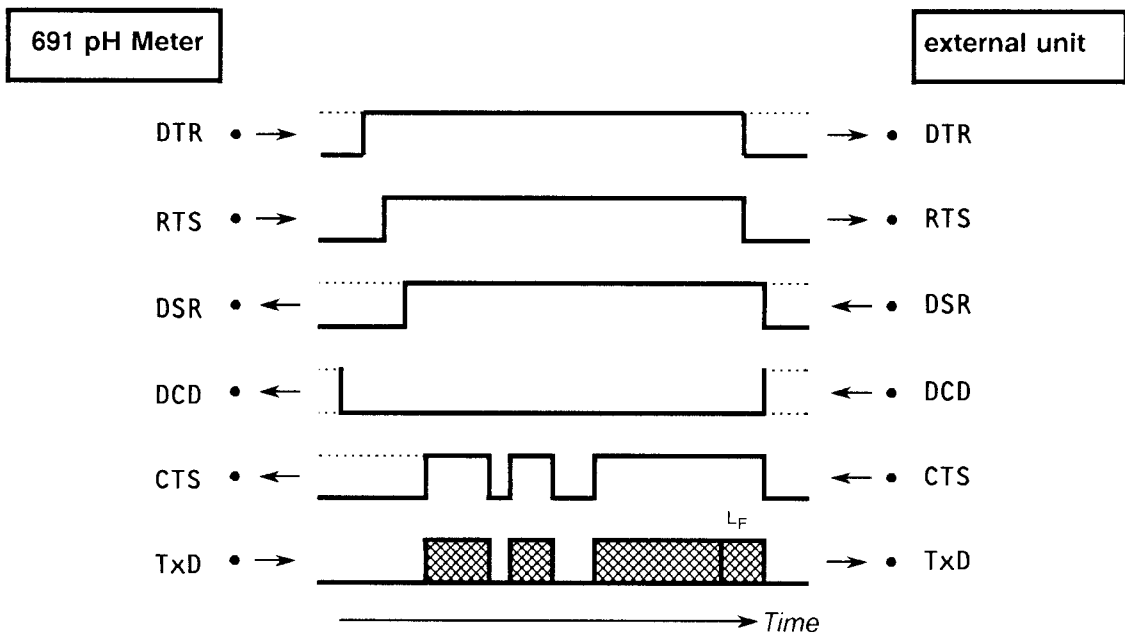
### 3.2.2 Hardware handshake (HS 1)

Handshake inputs are checked at the pH Meter, handshake outputs set.

pH Meter as **Receiver**:


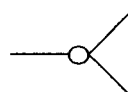
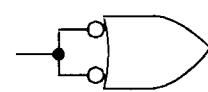
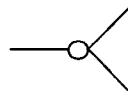
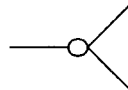
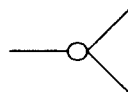
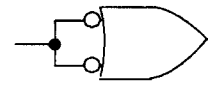


pH Meter as **Sender**:



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

### 3.3 Pin assignment

	3.691.0110	extern
<b>RS 232C Interface</b>		
<b>Transmitted data (TxD)</b> If no data are transmitted, the line is held in the "ON" condition. Data are transmitted only when CTS and DSR are "ON" and DCD is "OFF".		E 2 Transmitted Data
<b>Received data (RxD)</b> Data are received only when DCD is "ON".		E 3 Received Data
<b>Request to Send (RTS)</b> ON: pH Meter is ready to send data.		E 4 Request to Send
<b>Clear to Send (CTS)</b> ON: remote station is ready to receive data.		E 5 Clear to Send
<b>Data Set Ready (DSR)</b> On: The transmission line is connected		E 6 Data Set Ready
<b>Signal Ground (GND)</b>		E 7 Signal Ground
<b>Data Communication Detector (DCD)</b> ON: The received line signal detect is within the tolerance range (remote station is ready to send data).		E 8 Data Communication Detector
<b>Data Terminal Ready (DTR)</b> ON: 691 pH Meter is ready to receive data.		E 20 Data Terminal Ready



## 4. What you can do if data transmission doesn't work

Problem	Questions for remedial action
No characters can be received on an attached printer	<ul style="list-style-type: none"> <li>- Are the instruments and the connection cables plugged in properly?</li> <li>- Is the printer set to "on-line"?</li> <li>- Is the baud rate setting for both instruments the same?</li> <li>- Is the handshake set properly?</li> </ul> <p>If everything is in order, configure the pH Meter as follows:            Power on + press &lt;ref→M&gt; key            SE: 1            d: 0            Time interval: 0 s            With &lt;mode&gt; into the measurement program and trigger data output at the pH Meter with &lt; → &gt; .</p>
No data transmission occurs and the display of the pH meter shows an error message	<ul style="list-style-type: none"> <li>- <b>E22:</b> CTS error. Is the printer set to "on-line"?</li> <li>- <b>E20-23:</b> Transmission error. Is the cable properly wired and connected?</li> <li>- <b>E23:</b> Data output of the pH Meter blocked for longer than 3 s by XOFF.</li> <li>- <b>E25-28:</b> Receive error. Is the cable properly wired and connected?</li> </ul>
The received characters are garbled	<ul style="list-style-type: none"> <li>- Are the bit length and the parity settings for both instruments the same? For the pH Meter, the following holds: 7 bit and even parity or 8 bit and no parity</li> <li>- Is the baud rate setting the same for both instruments?</li> <li>- Has the correct character set been selected on the printer?</li> </ul>

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Pages II–XX refer to instruments with an RS232

interface (green pages)

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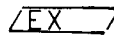
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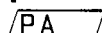
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## W

Warranty

**691 pH Meter**



Metrohm Ltd.  
CH-9101 Herisau  
Switzerland  
Phone +41 71 53 85 85  
Fax +41 71 53 89 01

## EC Declaration of Conformity

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

### 691 pH Meter

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:

pH Meter for measurement of pH, voltage, and temperature.

---

Herisau, December 6, 1995

Dr. J. Frank

Development Manager

Ch. Buchmann

Production and  
Quality Assurance Manager