Metrohm Ltd., CH-9101 Herisau, Switzerland

pH Meter

713

Series 01 ...

8.713.1003

11.92 ES

Principal keys and settings of 713 pH Meter

<Key>; display (LCD)	Remarks	Input range (initial values in **bold** face)
<mode>	1. Mode selection. 2. Brings instrument program back to its initial state.	**pH**, °C, mV, mV/Ipol
<select>	Selection of input options for dialog positions followed by a colon (:), e.g. «dialog:»,«meas. input:», etc.	
<clear>	Deletes parameter values and variables from the display.	
<quit>	Allows to exit from rolling inquiries, printing, stirring times and certain error messages; leads back to the next higher program level.	
<enter>	Confirms existing parameter settings or enters parameter values that have been keyed in and appear in the display.	
<config>	Instrument configuration; dialog positions are independent of mode.	
>auxiliaries		
last digit	Last digit of display can be switched off.	**ON**, OFF.
dialog:	Dialog language.	**english**, deutsch, français, español.
date	Date in YY-MM-DD format.	
time	Time in HH:MM:SS.	24 h format, e.g. 14:07:51
temperature unit:	Selection of temperature unit.	**C**, F (°C, °F).
run number	Run number.	**0**...999, OFF.
device label	Designation of 713 pH Meter for call-up via RS 232C.	8 ASCII characters. (<←>, <→> keys).
program	Designation of installed program version (read only).	

<Key>; display (LCD)	Remarks	Input range (initial values in **bold** face)
<param>	Parameter settings. The dialog positions depend on the mode selected; the following refers to the **pH mode**.	
>measuring parameters		
meas. input:	Measuring input.	**1**, 2, diff. 1: input «pH/ISE 1», 2: input «pH/ISE 2», diff.: differential potentiometry
electr. id:	<select> or enter (<←>, <→>) electrode name.	8 ASCII characters.
drift pH	Drift value for pH measurement.	0.005...**0.05**...9.999/pH
[temperature]	Measurement temperature. Appears only if no temperature sensor Pt 100 or Pt 1000 is connected.	–999.9...**25.0**...999.9
method id	Method name (read only).	
delta measurement:	Display and output of measured value referred to a reference value.	**OFF**, ON, meas.
stirrer:	Stirrer status.	**OFF**, ON, control.
<param>	713 pH Meter in **pH mode**.	
>calibration parameters		
[temperature]	Calibration temperature. Appears only if no temperature sensor Pt 100 or Pt 1000 is connected.	0.0...**25.0**...99.9
drift	Drift value for pH calibration.	0.1...**0.5**...9.9 mV/min
report:	Report type.	**OFF**, short, full.
no. of buffers	Number of buffers for calibration.	1...**2**...9
buffer type:	Buffer type for calibration.	**Metrohm**, NIST, DIN, Fisher, Ciba, Ingold, Merck, Beckman, Radiometer, special, own, mixed.
offset Uas state:	For electrodes whose Uas is outside ±30 mV.	**OFF**, ON, meas.
<cal>	Starts calibration.	
<cal. data>	Allows viewing of calibration data.	

713 pH Meter – Instructions for Use

Contents

1. Introduction

1.1 General

The 713 pH Meter puts at your disposal a large number of features and selection possibilities. However, the sophisticated user dialogue facilitates access to all these options and allows you to adapt the instrument optimally to your requirements.

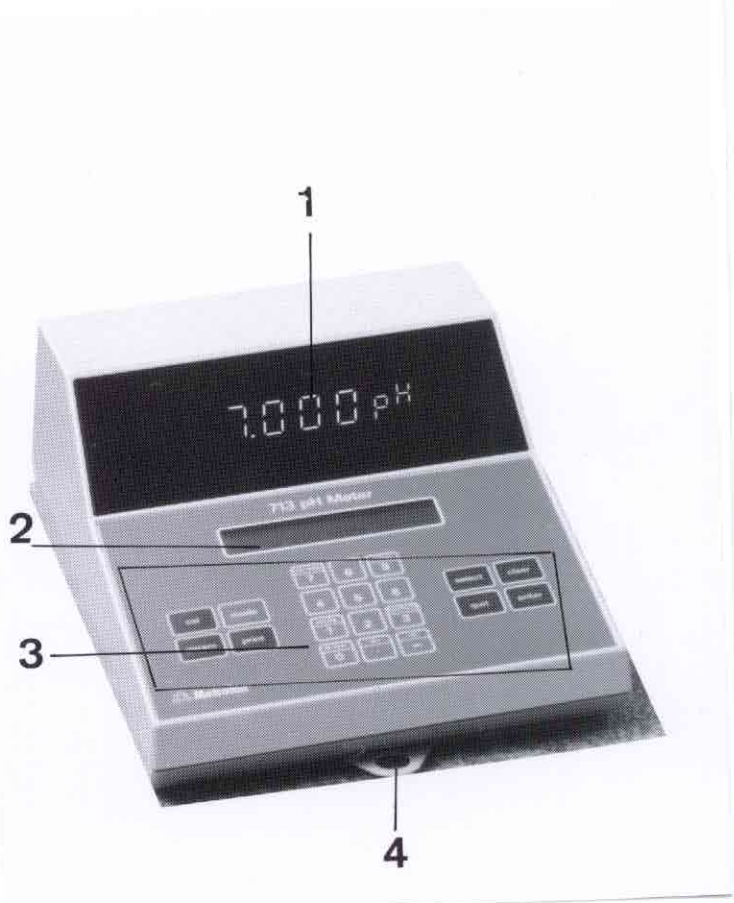
These Instructions for Use will first introduce the 713 pH Meter and subsequently show you how to prepare the instrument for pH measurement. At the same time, you will acquaint yourself with the dialogue structure, which is analogous for all the many uses this instrument can be put to.

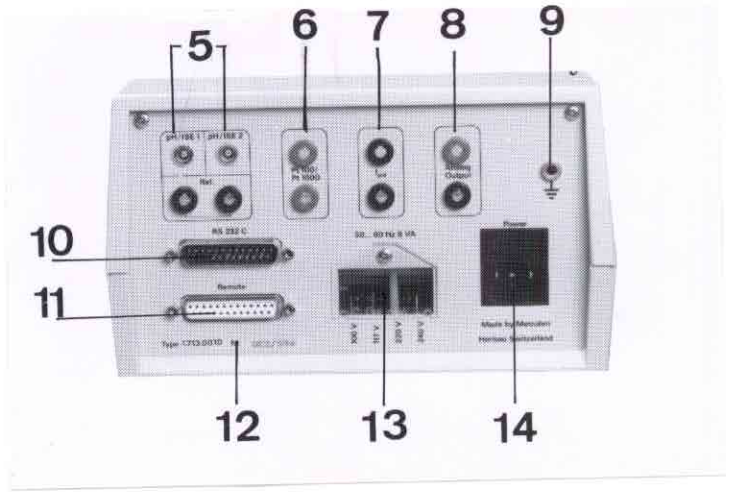
The list of contents preceding this page gives an idea of the organization of these Instructions for Use. When looking for a particular detail, the best approach is normally via the index, which is to be found at the end of the document.

The material printed on the green sheets is of interest if you wish to use the built-in RS 232 interface for the remote control of your 713 pH Meter.

Additional information on pH measurement and on electrodes can be taken from the following Metrohm documents:

- Application Bulletin No. 188 «pH measurement technique»,
- Leaflet accompanying the Metrosensor pH electrodes,
- Monograph «Electrodes in potentiometry»,
- Pamphlet «Metrosensor Electrodes»,
- Electrode catalog.


1
7.000 pH
2
3
4


5
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1.2 External features of the 713 pH Meter

(1) Main display (gas discharge display) with numerical value, unit and status indicators.

(2) Dialog display (LCD), consisting of two lines of 24 characters each.

(3) Keypad with number keys and operation keys.

(4) Short Instructions for Use.

(5) Two inputs for potentiometric sensors (pH, redox or silver electrodes or ISE's) with integrated or separate reference electrodes. The two «pH/ISE» inputs and one of the «Ref» inputs can be used for differential potentiometry. See also section 1.3.

(6) Input for Pt 100 or Pt 1000 temperature sensor.

(7) Input for polarized electrodes.

(8) Analog output for connecting a recorder or the pulse controller of a Combi Titrator consisting of pH meter, Impulsomat, Dosimat and, possibly, printer, recorder or PC.

(9) Earthing socket.

(10) RS 232C interface for connecting a printer or a computer.

(11) Remote control connection (I/O lines) for stirrer, sample changer or robot.

(12) Rating plate with series and manufacturing number.

(13) Voltage selector window.

(14) Power plug and power switch.

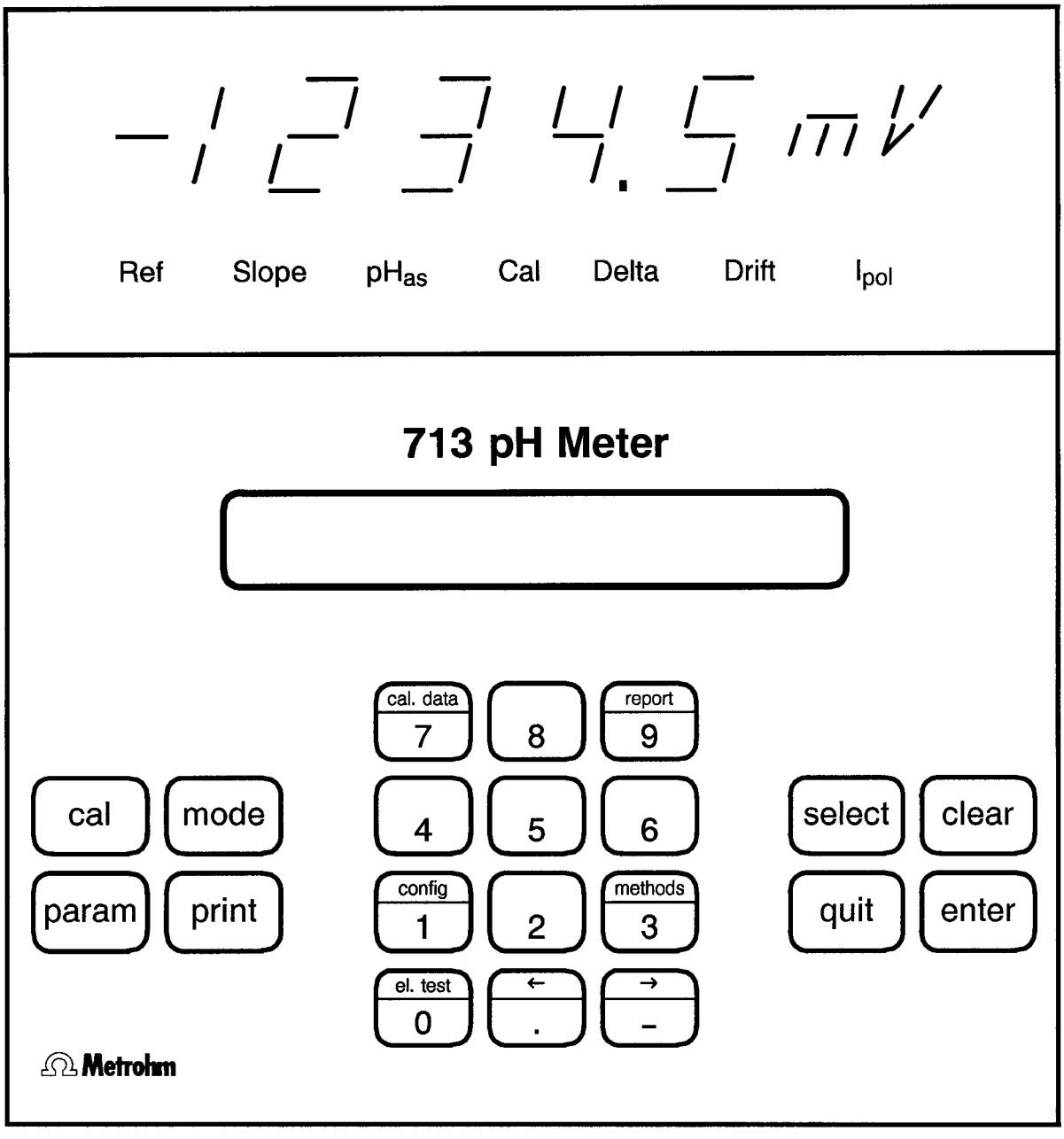
1.3 Input options for potentiometric electrodes, i.e. pH electrodes, redox electrodes, silver electrodes or ion selective electrodes

Key: CE Combined electrode (with integrated reference electrode)
SE Separate electrode (without reference electrode)
RE Reference electrode
AE Auxiliary electrode
Ve1 Vessel 1
Ve2 Vessel 2

Configuration	Input options offered by the 713 pH Meter (each line corresponds to one option)		
	pH/ISE 1	pH/ISE 2	Ref.
1 vessel, 1 indicator electrode	CE	–	–
	–	CE	–
	SE	–	RE
	–	SE	RE
1 vessel, 2 indicator electrodes	CE	SE	–
	SE	CE	–
	SE	SE	RE
2 vessels, 2 indicator electrodes **Important:** There must be *no electrical connection* between the two vessels (beware of earth loops)!	CE Ve1	CE Ve2	–
	SE Ve1	CE Ve2	RE Ve1
	CE Ve1	SE Ve2	RE Ve2
	SE Ve1	SE Ve2	RE Ve1 + RE Ve2
Differential potentiometry (see also section 5.2.3.)	SE (6.0133.100)	RE (6.0729.100, shielded)	AE (6.0301.100)

Note: The two reference electrode inputs (Ref.) are connected
- with each other and
- with the shields of the pH/ISE 1 and pH/ISE 2 inputs.

1.4 Sketch of main display and keypad



1.5 Some features of instrument operation

1.5.1 Non-volatile working memory

The 713 pH Meter, upon being switched on, is in exactly the same condition as when last switched off, i.e. mode, parameter settings, configuration and data memory are not affected when the power is switched off.

1.5.2 Basic methods

Ex works, the instrument memory is loaded with the basic methods «pH», «T», «U» and «I_{pol}». These contain the initial values of the parameters for the measurement of pH, temperature (°C), potential (mV) and potential with I_{pol}, respectively. To recall the basic method «pH», e.g., switch on the 713 pH Meter and press **<methods>**. The display will show:

```
methods
   >recall method
```

Press **<enter>** to get

```
   >recall method
      name:                XXXX
```

Press **<select>** repeatedly until the name «pH» appears in the display and conclude with <enter>. The working memory of the 713 pH Meter now contains the method named «pH».

The basic methods should be kept for reference purposes. Accordingly, any changes made to the basic methods should be stored under a method name that is different from the above mentioned ones.

1.5.3 Instrument dialog

Use the **<mode>** key to switch the 713 pH Meter to the desired mode. If you are in any dialog positon and wish to return to the initial state of the instrument program, press either <mode> or **<quit>**.

The instrument dialog is organized in the form of so-called rolling inquiries, which are arranged hierarchically. As an example, let us consider the inquiries accessible in the pH mode via the <param> key:

If **<param>** is pressed repeatedly, the following positions appear:

```
parameter
   >measuring parameters
   >calibration parameters
   >electrode test
   >analog output
   >limits pH
   >limits T
   >measuring parameters
```

To view or set the measuring parameters, depart from

```
parameter
   >measuring parameters
```

and press **<enter>**. This leads to

```
   >measuring parameters
      meas. input:          1
```

The colon appearing in the lower line of th LCD display means that there is a selection of settings that can be viewed by pressing **<select>** and confirmed by **<enter>**. This brings to the display the next inquiry position

```
      electr. id:
```

Here, the names of the pH electrodes (if any) stored with their calibration data can be viewed by pressing <select> or a new electrode name can be entered using the **<←>**, **<→>**, <clear> and <quit> keys. Upon pressing <enter>, the next inquiry position is displayed:

```
      drift pH      0.050 /min
```

This parameter setting can be left as it is or a different value can be keyed in using the number keys and confirmed with <enter>, which brings us to the next positions, namely

`temperature`	XX.X °C	This dialog position appears only if no temperature sensor Pt 100 or Pt 1000 is connected. Key in the measuring temperature and press <enter> to get ...
`method id`	`pH 04`	For example.

This «read only» information tells us that we are working with method «pH 04», e.g. We leave the inquiry by pressing **<quit>**, which brings us back to

```
parameter
   >measuring parameter
```

Pressing <quit> another time brings us to the initial state of the program, with, e.g., the following display:

```
temp. Pt1000          23.6 °C
YY-MM-DD HH:MM:SS
```

2. Setting up, two-point calibration and pH measurement

2.1 Power connection

The set operating voltage is visible at the rear of the instrument. If the set voltage does not agree with the available power voltage, proceed as follows:

- Disconnect power cable.
- Unscrew plastic cover of voltage selector window.
- Using a small pair of pliers, insert the voltage selection plug at the appropriate voltage.
- Screw on plastic cover.

The power cable supplied with the instrument is three-cored and equipped with a plug with an earthing pin. If a different plug has to be fitted, 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 its earthing socket. Each break in the earthing inside or outside the instrument can make it a hazard.

When the instrument is opened or if parts of it are removed, certain components may be live if the instrument is connected to the power line. The power cable must therefore always be unplugged when certain adjustments are made or parts replaced.

2.2 Buffer options

The buffer series listed below are stored in the 713 pH Meter as functions of temperature. The temperature dependence of each buffer is given in Appendix 3. The 713 pH Meter offers the possibility to use buffers belonging to various series for the same calibration («buffer type: mixed»). The additional buffers available for this are listed separately.

Buffer series	pH value of buffer										
	1	2	3	4	7	9	10	11	12	13	Additional buffers accessible under «buffer type: mixed»
Metrohm	●			●	●	●				●	
NIST[a)]	●			●	●	●				●	
DIN[b)]	●		●	●	●	●			●		
Fisher				●	●		●				
Ciba				●	●	●					
Ingold		●		●	●	●		●			
Merck		●		●	●	●			●		1 3 4.66 5 6 6.88 8 9.22 10 11 13
Beckman				●	●		●				
Radiometer				● 4.01	●	● 9.18					1.09 1.68 6.84 7.38 10.01

a) National Institute of Standards and Technology (formerly NBS)
b) Deutsches Institut für Normung (German Standards Association)

Additional possibilities:

«special» Enter up to 9 single buffer values of your own choice.

«own» Enter 5 buffer series of your own choice as follows: Key in the buffer values belonging to the temperature indicated in the display (e.g. «pH at 0 °C»); buffer values that are not explicitely known at a given temperature must be estimated by linear interpolation and entered; however, at the lower and upper ends of the table thus produced, pH = 0 may be set for those temperatures where no data is available. The instrument applies linear interpolation to calculate the buffer values as a function of temperature.

«mixed» Select 5 buffers from the following series: Metrohm, NIST, DIN, Fisher, Ciba, Ingold, Merck, Beckman, Radiometer or «own».

Please note: If the instrument is programmed to work with more than 2 buffers, buffers no. 3 to 9 may be the same as buffers no. 1 or 2. This procedure can be applied if one wishes to give added statistical weight to a given buffer. Of course, in two-point calibration, the same buffer cannot be used twice (error message: «same buffer»).

2.3 Preliminary settings

The 713 pH Meter is ready for measurement immediately after being switched on.

The following describes how the 713 pH Meter is prepared for pH measurement by setting the instrument configuration and the parameters and by carrying out a two-point calibration.

The information set in *italics* applies only if a Pt 100 or Pt 1000 temperature sensor is connected; on the other hand, the information put within square brackets [...] does not appear if one of the temperature sensors mentioned is connected.

Use the <select> key to view options, <clear> to delete entries, <quit> to switch to a higher program level and <enter> to confirm options as well as to enter parameters, time, date, etc.

Key	Display (LCD); recommended settings		Available options; remarks
Power on	***** 713 pH Meter ***** YY-MM-DD	HH:MM:SS	Power switch is above power cable connector.
<mode> →pH	temp. *Pt ...:* YY-MM-DD	XX.X °C HH:MM:SS	pH, °C, mV, mV/I_{pol}
<config>	config >auxiliaries		<config> key is combined with number key «1».
<enter>	last digit:	ON	ON, OFF (<select> key); OFF→last digit is not displayed.
<enter>	dialog:	english	english, deutsch, français, español
<enter>	date	YY-MM-DD	
<enter>	time	HH:MM:SS	24 h format, e.g. 15:07:51
<enter>	temp. unit:	C	C, F (°C, °F)
<enter>	run number	OFF	0, 1, 2, 3 ... 999, OFF
<enter>	device label	pH 713	ASCII string (← → keys); see chapter 3., <config>, <←> and <→> keys.
<enter>	program	XXXXXXXX	Installed program version.

Key	Display (LCD); recommended settings		Available options; remarks
<enter>	config >printer		Exit by pressing ...
<quit>	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	Switch to parameter settings by pressing...
<param>	parameter >measuring parameters		
<enter>	>measuring parameters meas. input:	1	1; 2; diff: electrode input 1, 2 or differential potentiometry. For details on differential potentiometry see sections 5.2.3 and 1.3.
<enter>	electr. id:	pH El 12	ASCII string (← → keys), 8 characters; electrode designation for the user memory; see chapter 3, <←> and <←> keys.
<enter>	drift pH	0.05/min	Refers to **measurement**, not calibration. 0.005 ... 9.999/min; OFF
[<enter>	temperature	XX.X °C]	-199.9 ... 399.9 °C; sample temperature
<enter>	method id.	XY ...	Name of current method; see chapter 3, <methods> key.
<enter>	delta measurement:	OFF	ON, meas, OFF. See chapter 3, «Delta» function.
<enter>	stirrer:	OFF	ON, control, OFF. If «control» is selected, there are some additional steps; see section 6.4.1.
<enter>	parameter >calibration parameters		
[<enter>	>calibration parameters temperature	XX.X °C]	0 ... 99.9 °C; buffer temperature.
<enter>	drift	0.5 mV/min	For **calibration**; 0.1 ... 9.9 mV/min. (Temperature drift for calibration is fixed to 1 °C/min.)
<enter>	report:	OFF	short, full, OFF
<enter>	no. of buffers	2	1; 2; ... 9
<enter>	buffer type:	Metrohm	Metrohm, NIST, DIN, Fisher, Ciba, Ingold, Merck, Beckman, Radiometer, special, own, mixed.
<enter>	offset Uas state	OFF	OFF, ON, meas. See section 2.6.
<enter>	>electrode test		Exit by pressing ...
<quit>	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	

2.4 Two-point calibration

Connect pH electrode to input «pH/ISE 1».

Key	Display (LCD)		Remarks
<cal>	[enter cal.temp. temperature	XX.X °C]	Put electrode into buffer 1. [Enter buffer temperature and confirm with <cal> ...]
	measure temperature buffer 1		
[<cal>]	meas U buffer 1		
	change buffer buffer 2		Put electrode into buffer 2 or interrupt by pressing <quit> or <mode>. →One-point calibration.
<cal>	*measure temperature buffer 2*		
	meas U buffer 2		
	pHas	7.009	Electrode slope, e.g. 0.987, appears for some seconds in the main display.
	temp. *Pt ...:* YY-MM-DD	XX.X °C HH:MM:SS	Instrument switches to pH measurement automatically.

The 713 pH Meter is now ready for pH measurement.

2.5 Calibration data

The calibration data obtained by linear regression can be viewed as shown below. For additional information see chapter 3, <cal. data> key.

Key	Display (LCD)		Remarks
<cal. data>	cal. data electr. id	pH El 12	<cal. data> on key «7». Electrode designation. See section 2.3: <param> – >measuring parameters – «electr. id:».
<enter>	slope	0.987	Slope = 98.7% (e.g.). Range 0.001 ... 9.999.
<enter>	pH(as)	7.009	Asymmetry pH = 7,009 (e.g.). Range –99.999 ... 99.999.
<enter>	temperature [man]	XX.X °C	
<enter>	cal.date YY-MM-DD	HH:MM	Date and time of latest calibration.
			See following page*.
<enter>	measure input	1	Electrode input 1.
<enter>	offset Uas	XX.X mV	This information appears only if «offset Uas» has been set; see section 2.6.

Key	Display (LCD)		Remarks
<enter>	buffer type	Metrohm	
<enter>	no. of buffers	2	Number of buffers actually used for calibration.
<enter>	cal. table:	original	original, delete n, reset cal
<enter>	temp. *Pt ...:* YY-MM-DD	XX.X °C HH:MM:SS	

* If more than 2 buffers are used for calibration, the variance is shown here. It is calculated according to the following formula:

Variance = Sum of all $(U_{i\ calculated} - U_{i\ measured})^2$ / (N–F);

where	Ui (measured)	measured voltage of point i;
	U_i (calculated)	voltage resulting from regression analysis;
	N	number of points measured;
	F	degrees of freedom for pH calibration (linear correlation): F = 2 → variance can only be calculated for more than 2 buffers.

«variance manual» is displayed if calibration data have been entered manually.

2.6 Application of «offset U_{as}»

The automatic buffer recognition of the 713 pH Meter is based on an asymmetry potential U_{as} of ±30 mV. Normally, with Ag/AgCl reference systems, this condition is fulfilled. However, if this reference system is replaced by a calomel one, e.g., U_{as} may be outside the above limits. To ensure the functioning of the automatic buffer recognition also in those cases, the deviation has to be compensated as follows:

Key	Display (LCD)		Remarks
	parameter >calibration parameters		Press <enter> repeatedly ...
<enter> ...	>calibration parameters offset Uas state	meas	meas: measured potential is displayed in the next step. OFF: no offset U_{as}. ON: offset U_{as} can be set.
<enter>	offset Uas	XX.X mV	Immerse pH electrode into buffer pH = 7, wait for a stable reading and press <enter>. Offset Uas can also be keyed in manually, its range being –1999.9 ... 1999.9 mV. Offset U_{as} is taken into account by the instrument for the automatic buffer recognition and can be viewed under <cal. data> (see section 2.5).

2.7 Error messages

During calibration, the following error messages may appear:

Key	Display (LCD or main display)	Remarks; corrective action
	`buffer alloc. impossible`	Buffer cannot be recognized. →Replace buffer and press <cal>.
	`same buffer`	Same buffer used twice or asymmetry potential too large. →Change buffer and press <cal> or enter asymmetry potential U_{as} (see section 2.6).
	`buffer not defined`	pH value of «own» buffer not defined at given temperature. →Enter missing value in temperature table (<param> – >calibration parameters – buffer type: own – >own buffer X – pH at XX °C).
	1.381 (e.g.) Slope Cal	Main display.
	`pHas` `6.149` (e.g.) `yes: <enter>` `no: <mode>`	LCD. Cause: extreme values of calibration data.
<mode>		→Reject calibration data.
<enter>		→Accept calibration data.
	delta T>2 °C	Buffer temperatures differ by more than 2 °C. →Use buffers having the same temperature and press ...
<cal>	*meas temperature buffer X*	
	1999.9 °C (flashing)	Main display. Temperature sensor has been disconnected during calibration or is defective. →Reconnect or replace temperature sensor.
	meas temperature buffer X	

3. Functions of instrument keys

mode

The <mode> key serves to select the instrument functions. It automatically activates the instrument settings that were valid when the corresponding mode was left after its prior utilization.

- pH pH measurement,
- °C or °F temperature measurement,
- mV voltage (potential) measurement,
- mV I_{pol} voltage (potential) measurement with polarized electrodes.

Moreover, pressing the <mode> key brings the instrument program back to its initial state.

The following sequence illustrates the above.

Key	Display (LCD)	Main display
Power on	temp. *Pt* ...: XX.X °C YY-MM-DD HH:MM:SS	XX.XXX pH
<mode>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	XX.X °C
<param>	parameter >measuring parameters	XX.X °C
<param>	parameter >analog output T	XX.X °C
<enter>	>analog output T state: ON	XX.X °C
<enter>	>analog output T 0 mV at XX.X °C	XX.X °C
<mode>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	XX.X °C
<mode>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	XXX.X mV

cal

Starts pH calibration; is active in the pH mode only.

The calibration is electrode-specific. For further details, see description of <cal data> and <methods> keys below.

The following example describes a two-point calibration, whereby the information set in *italics* applies only if a Pt 100 or Pt 1000 temperature sensor is connected. On the other hand, the information put within square brackets [...] does not appear if one of the temperature sensors mentioned is connected.

Key	Display (LCD)		Remarks
<cal>	[enter cal.temp. temperature	XX.X °C]	Put electrode into buffer 1. [Enter buffer temperature and confirm with <cal> ...]
	measure temperature buffer 1		
[<cal>]	meas U buffer 1		
	change buffer buffer 2		Put electrode into buffer 2 or interrupt by pressing <quit> or <mode>. →One-point calibration.
<cal>	*measure temperature buffer 2*		
	meas U buffer 2		
	pHas	7.009	Electrode slope, e.g. 0.987, appears for some seconds in the main display.
	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	Instrument switches to pH measurement automatically.

param

This key gives access to the parameter settings available for the respective mode. In the sequence shown below, the rolling inquiry «parameter» is shown for the pH mode. In the other modes, the positions «calibration parameters» and «electrode test» do not appear and there is only one position «limits».

The first line of the two-line LCD is shown only where necessary.

Key	Display (LCD)		Main display
Power on	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	XX.XXX pH
<param>	parameter >measuring parameters		XX.XXX pH
<param>	>calibration parameters		XX.XXX pH
<param>	>electrode test		XX.XXX pH
<param>	>analog output		XX.XXX pH
<param>	>limits pH		XX.XXX pH
<param>	>limits T		XX.XXX pH
<mode>	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	XX.XXX pH
<mode>	***** 713 pH Meter ***** YY-MM-DD	HH:MM:SS	XX.X °C

Key	Display (LCD)	Main display
<param>	parameter >measuring parameters	XX.X °C
<param>	>analog output T	XX.X °C
<param>	>limits T	XX.X °C
<mode>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	XX.X °C
<mode>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	XXX.X mV
<param>	parameter >measuring parameters	XXX.X mV
<param>	>analog output U	XXX.X mV
<param>	>limits U	XXX.X mV
<mode>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	XXX.X mV
<mode>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	XXX.X mV I_{pol}
<param>	parameter >measuring parameters	XXX.X mV I_{pol}
<param>	>analog output Ipol	XXX.X mV I_{pol}
<param>	>limits Ipol	XXX.X mV I_{pol}
<mode>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	XXX.X mV I_{pol}
<mode>	temp. *Pt ...:* XX.X °C YY-MM-DD HH:MM:SS	XX.XXX pH

print

Manual triggering of stirrer sequence (if specified) and printer output. The printout specified on the following page looks as follows (with Pt 100 temperature sensor connected):

```
date     92-11-12      time   11:18:15

id1   713 pH Meter
id2   pH & temperature
#1    pH=2.006            23.7 °C
      92-11-12      11:18:15
            ==============
#2    pH=2.412            23.4 °C
      92-11-12      11:18:55
#3    pH=2.671            23.0 °C
      92-11-12      11:19:35
```

Print header with date and time plus

two **identifier** lines.

Run no. 1 with date and time.

Run no. 2 with date and time.

Run no. 3 with date and time.

Those parts of the instrument dialogue that are relevant to the printer output obtained in the pH mode are given below in abbreviated form.

Key	Display (LCD)		Remarks
<param>	>measuring parameters		
<enter ...>	drift pH	X.XXX/min	If «print crit: drift» (see below), the drift condition set here has to be met before printout occurs.
	stirrer:	control	The settings «ON» and «OFF» do not affect printout.
<enter> <enter> <enter>	prestir pause stir time poststir pause	XX s XX s XX s	0...99 999 s 0...99 999 s 0...99 999 s The set time intervals are shown in the form of «count downs» whenever <print> is actuated. See also sections 4.1 and 6.4.1.
<config>	config >printer		
<enter>	>printer character set:		Citizen, IBM, Epson or Seiko.
<enter>	print header:	once	once, always or OFF. The components of the printout are explained in the above sample.
<enter>	date & time	ON	ON or OFF; for print header.
<enter>	id1 713 pH Meter	(e.g.)	Enter ASCII string for first line of print header, 16 characters (← → keys)
<enter>	id2 pH & temperature	(e.g.)	Enter ASCII string for second line of print header, 16 characters (← → keys)
<enter>	config >print meas. value		
<enter>	print crit:	time	immediate, time, drift or OFF. immediate: printout occurs either immediately or after the stirrer sequence (if specified; see above) has been performed. time: printout occurs immediately after the stirrer sequence has been performed and subsequently in the specified time intervals until the stop time has elapsed. drift: printout occurs after the stirrer sequence has been performed **and** after the drift condition (see above) has been met. OFF: <print> key is not active.
<enter>	time interval	40 s	Time interval between printouts in multiples of 0.4 seconds.
<enter>	stop time	120 s	Total duration of recording in seconds.
<enter>	date & time:	ON	ON or OFF; for measured value.

clear

Is used to delete parameter values and variables from the display.

select

Whenever the <select> key can be used to view the available options, the corresponding parameter is followed by a colon (:). Selecting the dialog language is one of the many uses of the <select> key:

Key	Display (LCD)	
<config>	config >auxiliaries	
<enter>	last digit:	
<enter>	dialog:	english
<select>	dialog:	deutsch
<select>	dialog:	français
<select>	dialog:	español
<select>	dialog:	english
<enter>	date	YY-MM-DD

quit

<quit> is used to exit from rolling inquiries, printing, stirring times and certain error messages. <quit> brings you back to the next higher program level, as shown by the following example:

Key	Display (LCD)	
	temp. *Pt* ...:	XX.X °C
	YY-MM-DD	HH:MM:SS
<param>	parameter >measuring parameters	
<enter>	>measuring parameters meas. input	1
<quit>	parameter >measuring parameters	
<quit>	temp. *Pt* ...:	XX.X °C
	YY-MM-DD	HH:MM:SS

enter

<enter> is used to confirm existing parameter settings or to enter parameter values that have been keyed in and appear in the display.

cal. data
7

The <cal. data> key refers to the calibration of pH electrodes and consequently is active in the pH mode only.

The 713 pH Meter allows to calibrate a large number of different pH electrodes. The steps involved are:

- Define and enter electrode designation under <param> – >measuring parameters – «electrode id:».
- Carry out calibration.

The calibration data obtained by linear regression remain stored in the instrument (see also description of <methods> key in this chapter) and can be recalled by selecting the corresponding pH electrode under <param> – >measuring parameters – «electrode id:». The <cal. data> key serves to view the calibration data of the pH electrode thus specified.

Key	Display (LCD)		Remarks
<cal. data>	cal. data		
	electr. id	pH El 05	Electrode designation as specified under <param> – >measuring parameters – «electrode id:».
<enter>	slope	0.968	Slope = 96.8% (e.g.). Range 0.001 ... 9.999.
<enter>	pH(as)	7.075	Asymmetry pH = 6.988 (e.g.). Range –99.999 ... 99.999.
<enter>	temperature [man]	XX.X °C	
<enter>	cal.date YY-MM-DD	HH:MM	Date and time of latest calibration.
<enter>	variance	34.293	See section 2.5.
<enter>	measure input	1	Electrode input 1.
<enter>	offset Uas	XX.X mV	This information appears only if «offset Uas» has been set; see section 2.6.
<enter>	buffer type	Metrohm	
<enter>	no. of buffers	5	No. of buffers actually used for calibration.
<enter>	cal. table:	original	original, delete n, reset cal (see below)
<enter>	temp. *Pt* ...:	XX.X °C	
	YY-MM-DD	HH:MM:SS	

If more than 2 buffers have been used for calibration, one ore more of them can be deleted applying the following procedure:

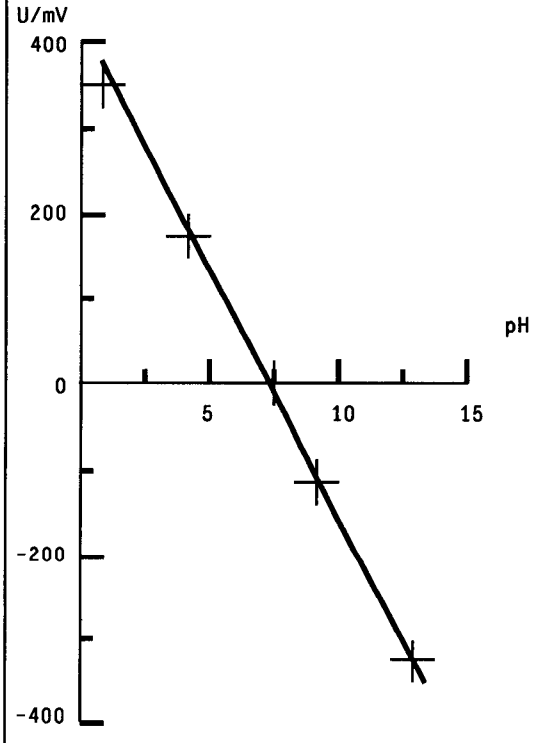
<enter>	cal. table:	original	original, delete n, reset cal; select «delete n»
<enter>	delete n	1	Key in «5» and press <enter>. The data obtained with buffer 5 (pH = 13) will be deleted; key in «2» to delete pH = 4 data, «3» to delete pH = 7 data, etc. To restore the original calibration data, select «original». If the «reset cal» option is selected, the electrode data are set to their default values, i.e. slope = 1.000 and pH_{as} = 7.000, and the corresponding electrode is deleted from the method memory. If a printer is connected, details concerning the buffers used can be taken from the printout.

The full report corresponding to the above calibration data is shown on the next page. The effect of deleting the data obtained with buffer 5 (pH = 13) is also shown.

pH calibration reports with original data (left) and after deleting one data set (right) (graphics not strictly representative)

Original printout:

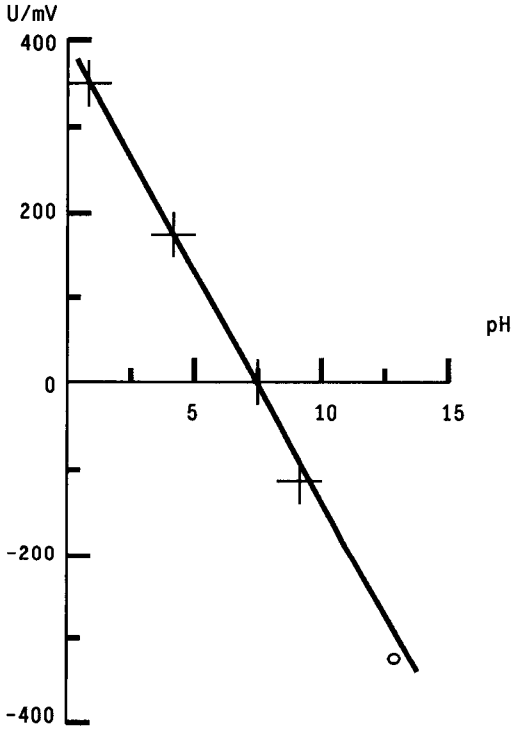
```
date  92-10-23      time 14:45:20        11
pH calibration
    meas. input                    1
    electr. id              pH El 05
    temperature                22.3  C
    cal. date       92-10-23  14:45
    buffer type              Metrohm

                      pH      U/mV      dpH*
    buffer 1       9.022    -116.4    -0.104
    buffer 2       3.995     174.3    -0.009
    buffer 3       7.011      -0.1    -0.066
    buffer 4       1.000     348.8     0.071
    buffer 5      12.914    -325.2     0.108
```




```
    variance          34.293
    slope              0.968
    pH(as)             7.075
    ============= **
```

Deleting the data measured with buffer 5, pH = 13, yields vastly improved calibration data, which indicates that the buffer in question was faulty.

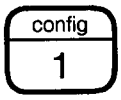
```
date  92-10-23      time 14:48:09        11
pH calibration
    meas. input                    1
    electr. id              pH El 05
    temperature                22.3  C
    cal. date       92-10-23  14:45
    buffer type              Metrohm

                      pH      U/mV      dpH*
    buffer 1       9.022    -116.4    -0.004
    buffer 2       3.995     174.3    -0.009
    buffer 3       7.011      -0.1    -0.001
    buffer 4       1.000     348.8     0.006
    buffer 5     deleted
```




```
    variance          0.240
    slope             0.989
    pH(as)            7.010
    ------------- **
```

* «dpH» is the difference between the pH value resulting from the regression analysis and the nominal pH value of the buffer at the potential measured.

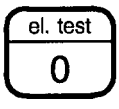
** The double dashed line appears at the end of original calibration reports, the single dashed line at the end of duplicates.



The <config> key gives access to all those settings that concern the configuration of the 713 pH Meter, which is independent of the mode selected. The following compilation shows all the dialogue positions concerned.

Key	Display (LCD)		Available options; remarks
Power on	***** 713 pH Meter YY-MM-DD	***** HH:MM:SS	Power switch is above power cable connector.
<mode> →pH	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	pH, °C, mV, mV/I_{pol}
<config>	config >auxiliaries		<config> key is combined with number key «1».
<enter>	last digit:	ON	ON, OFF (<select> key); OFF→last digit is not displayed and the measuring frequency increases from 2.5 to 12.5 per second.
<enter>	dialog:	english	english, deutsch, français, español
<enter>	date	YY-MM-DD	
<enter>	time	HH:MM:SS	24 h format, e.g. 15:07:51
<enter>	temp. unit:	C	C, F (°C, °F)
<enter>	run number	OFF	0, 1, 2, 3 ... 999, OFF
<enter>	device label	pH 713	ASCII string (← → keys); designation for addressing the 713 pH Meter via the RS 232C interface.
<enter>	program	XXXXXXXX	Installed program version.
<enter>	config >printer		
<enter>	character set:		Citizen, IBM, Epson, Seiko
<enter>	print header:		once, always, OFF
<enter>	date & time		ON, OFF
<enter>	id1		ASCII string for first line of print header, 16 characters (← → keys)
<enter>	id2		ASCII string for second line of print header, 16 characters (← → keys)
<enter>	config >print meas. value		
<enter>	print crit:		immediate, time, drift, OFF; see also function of <print> key in this chapter. If «time» is selected, two additional lines will appear here:

Key	Display (LCD)		Available options; remarks
<enter>	time interval	XX.X s	Time interval between printouts in multiples of 0.4 seconds.
<enter>	stop time	XXX s	Total duration of recording in seconds.
<enter>	date & time		ON, OFF
<enter>	config >RS 232 settings		See also section 6.1.3.
<enter>	baud rate:		9600, 4800, 2400, 1200, 600, 300
<enter>	data bit:		7, 8
<enter>	stop bit:		1, 2
<enter>	parity:		even, none, odd
<enter>	handshake:		HWs, HWf, SWchar, SWline, none
<enter>	RS control:		ON, OFF (refers to external control via RS 232 interface).
<enter>	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	



<el. test> starts the electrode test, which is described in detail in chapter 4.

With <report> you select the type of report to be printed out. The selection offered is independent of the mode. However, only the report types relevant to the current mode can be printed out.

Key	Display (LCD)		Remarks
	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS		
<report>	report select:	user memory	Lists contents of user memory with methods and calibration data sets together with storage capacity, both used up and still available.
<select>	select	calib	Calibration report of selected pH electrode.
<select>	select:	config	Configuration report of 713 pH Meter.
<select>	select:	param	Parameter report.
<select>	select:	el. test	Electrode test report of selected pH electrode.
<select>	select:	all	All relevant reports (depending on current mode).
<select>	select:	user memory	See above.

Examples of the following reports are shown below: user memory, configuration (config) and parameter report. For additional information on the user memory, see description of <methods> key given below.

Examples of reports: user memory, configuration and parameter report

```
date    92-09-22    time   16:59:11
user memory
>methods
   pH                   pH          44
   T                     T          26
   U                     U          24
   Ipol               Ipol          36
   pH                pH 05          64
>caldata
   pH             pH E1 05          62
               remaining bytes     4744
                  ---------
```

```
date    92-09-22    time   17:03:02
parameter
>measuring parameters
   meas.input                1
   electr.id:          pH/Pt 100
   drift pH              0.050 /min
   method id             22.9.
   delta measurement:      OFF
   stirrer:                OFF
>calibration parameters
   drift                   0.5 mV/min
   report:                full
   no. of buffers            5
   buffer type:         Metrohm
   offset Uas state:       OFF
>electrode test
   report:                full
>analog output
   select:                  pH
   state:                   ON
   0 mV at               7.000 pH
   1 V range            10.000 pH
>limits pH
   state:                  OFF
>limits T
   state:                  OFF
                  ---------
```

```
date    92-09-22    time   16:54:27
config
>auxiliaries
   last digit:              ON
   dialog:             english
   date                92-09-22
   time                16:54:27
   temp.unit:                C
   run number               35
   device label        713 pH M
   program             XXXXXXXX
>printer
   character set:         Seiko
   print header:           once
   date&time:                ON
   id1             713 pH Meter
   id2         pH & temperature
>print meas.value
   print crit:        immediate
   data&time:                ON
>RS232 settings
   baud rate:             9600
   data bit:                 8
   stop bit:                 1
   parity:                none
   handshake:              HWs
   RS control              OFF
                  ---------
```

The <methods> key allows the manipulation of methods. A method includes all parameter settings but not the instrument configuration (<config>).

Independent of the instrument mode, the rolling inquiry is made up of the following items:

Key	Display (LCD)	Remarks
	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	
<methods>	methods >recall method	
<enter>	>recall method name:	Select name of method to be recalled.
<enter>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	
<methods>	methods >recall method	
<methods>	>store method	Store method under its freely chosen name.
<methods>	>delete method	Delete a method.

The organization of the user memory is illustrated by the printouts shown on the following page together with details on the recall and deletion of methods and calibration data.

Reports illustrating the organization of the user memory

```
date    92-09-22    time   16:49:18
user memory
>methods
   pH                    pH          44
   T                      T          26
   U                      U          24
   Ipol                Ipol          36
>caldata
                remaining bytes     4870
                  ---------
```

1. Initial state of user memory, i.e. ex works or after RAM initialization. The «initial methods» pH, T, U and I_{pol} contain the default settings of each mode. They may be useful for reference purposes and should not be deleted.

```
date    92-09-22    time   16:54:47
user memory
>methods
   pH                    pH          44
   T                      T          26
   U                      U          24
   Ipol                Ipol          36
>caldata
   pH              pH El 05          62
                remaining bytes     4808
                  ---------
```

2. User memory after calibration of the pH electrode named «pH El 05»: Its calibration data are stored under «>caldata».

```
date    92-09-22    time   16:59:11
user memory
>methods
   pH                    pH          44
   T                      T          26
   U                      U          24
   Ipol                Ipol          36
   pH                 pH 05          64
>caldata
   pH              pH El 05          62
                remaining bytes     4744
                  ---------
```

3. The actual instrument settings (not including the configuration <config>) have been stored as method «pH 05». This method name has been chosen to indicate that the electrode «pH El 05» is meant to be used with method «pH 05». However, if required, methods and pH electrodes can be combined without any restrictions.

Recall of methods and calibration data

Whenever a method is recalled from the user memory, the actual instrument settings (except those falling under «configuration») are replaced by those of the recalled method.

To recall calibration data, select the pH electrode in question by the sequence <param> – >measuring parameters – «electr. id:».

Deleting methods and calibration data

After deleting the method «pH 05», the calibration data for the electrode «pH El 05» remain stored. By selecting «pH El 05» under «measuring parameters» (see above paragraph) and resetting its calibration data (<cal. data> – cal. table: reset cal), these are eliminated from the method memory. The user memory report now appears in its initial form shown at the top left.

<→> and <←> are used to key in alphanumeric electrode or method designations. The following example shows how a method designation is entered.

Key	Display (LCD)		Remarks
	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	
<methods>	methods >recall method		
<methods>	>store method		
<enter>	name	XXXXXXXX	
<clear>	name		<clear> serves to clear the display only; the corresponding method is not affected in any way. Press <→> or <←> until «p» appears flashing in the leftmost position. Press <enter> and continue by bringing «H» to the second position from left. Press <enter> and make a space (blank) appear in the third position from left. Press <enter> and key in «07». Press <quit> to clear the remaining positions. The display now shows ...
	name	pH 07	Press <enter> to store the current instrument settings (except configuration) as method «pH 07». To make corrections, i.e. to move one position to the left on the display, simply use <clear>.

The «Delta» function

The «Delta» function is available for all the modes of the 713 pH Meter. It allows to display the measured value relative to a reference value that is selectable within wide limits. The relative value appears not only in the display, but is also used for the analog output, the limits function and the RS 232C data interface.

Key	Display (LCD)		Remarks
<mode> → °C	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS		
<param>	parameter >measuring parameters		Press <enter> repeatedly ...
<enter> ...	>measuring parameters delta measurement:	meas	OFF, ON, meas. <select> meas; this causes the measured temperature to be offerd as the reference value. OFF: no delta measurement. ON: enter reference value.
<enter>	reference	23.6 °C	Measured temperature. Range –999.9 ... 999.9 °C.
<enter>	stirrer:	XXXX	Main display shows temperature relative to 23.6 °C and the «Delta» indicator is on. Exit by pressing <quit> twice.

If the reference temperature is set to –273.2 °C, the numerical value displayed (e.g. 298.9 at 25.7 °C) corresponds to the so-called absolute temperature (Kelvin).

By setting «delta measurement: OFF» you return to «normal» temperature measurement and the «Delta» indicator disappears from the main display.

4. pH electrode test

4.1 Equipment required

The pH electrode test offered by the 713 pH Meter allows you to determine whether your pH electrode is still working properly. The test can be carried out with any buffer set containing the buffers pH = 4, 7 and 9. While we recommend to use Metrohm buffers, NIST, DIN, Ciba, Ingold, Merck and Radiometer buffers can also be used. Buffer sets not containing the required buffers produce the error message «buffers unsuitable» as soon as <el. test> is actuated.

The test requires at least a Stirrer (622, 649 or 722) or a Titration Stand (727 or 703). Stirrer control is either automatic (connecting cable 6.2138.000 installed) or manual. If you wish to print out full or short test reports as well as the corresponding curves (potential-time transients) you require a printer and the corresponding connecting cable. Details on the connection of a printer can be found in section 6.1.

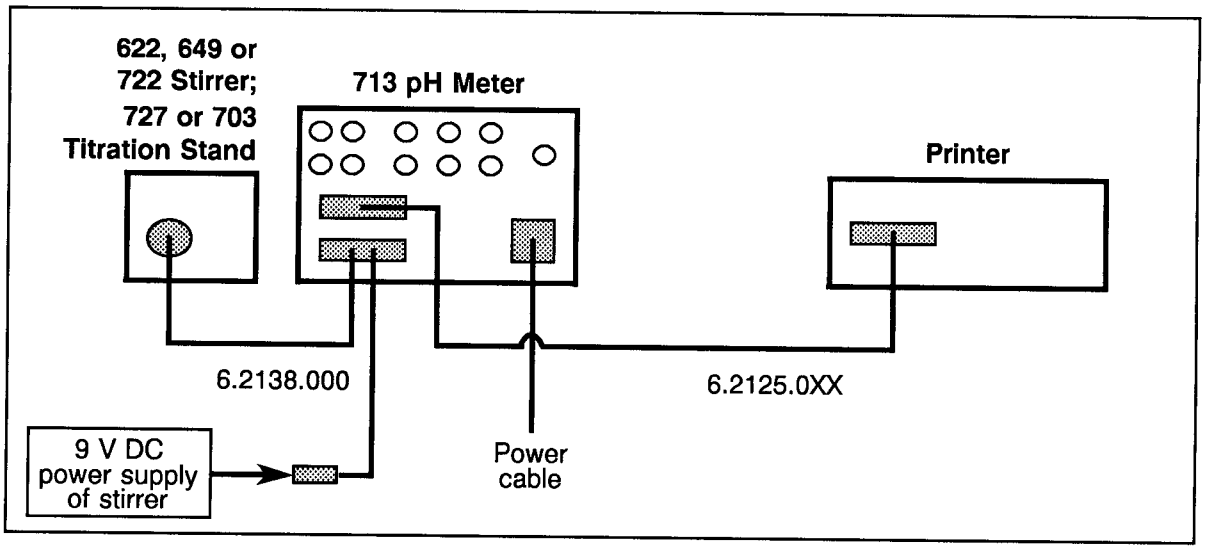


Fig. 4.1: Cable connections for the pH electrode test

4.2 Preliminary settings

Before the test can be started, a number of parameters have to be set. These are listed in the following.

Key	Display (LCD); required settings	Available options; remarks
Power on	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	Power switch is above power cable connector.
<mode>→pH	temp. *Pt* ...: XX.X °C YY-MM-DD HH:MM:SS	pH, °C, mV, mV/I_{pol}
<config>	config >auxiliaries	
<config>	>printer	
<enter>	character set:	Citizen, IBM, Epson, Seiko: see section 6.1.
<enter>	print header:	OFF, once, always

Key	Display (LCD); required settings		Available options; remarks
<enter>	date & time:		ON, OFF. Appears only of if «print header» is set to «once» or «always».
<enter>	id1	XXXXXX	ASCII string of 16 characters (← → keys).
<enter>	id2	XXXXXX	ASCII string of 16 characters (← → keys).
<enter>	>print meas. value		
<config>	>RS 232 settings		
<enter>	baud rate:		Baud rate to be set and additional RS 232 settings: see section 6.1. Press <quit> twice and continue with ...
<param>	parameter >measuring parameters		
	measuring input	1	1, 2, diff.
<enter>	electr. id:	XXXX	Press <enter> until «stirrer» is displayed:
<enter> ...	stirrer:	control	ON, control, OFF; <select> control.
<enter>	prestir pause	XX s	Waiting and stirring times are not effective for the electrode test. Switch to calibration parameters by pressing <quit> and ...
<param>	parameter >calibration parameters		Here the buffer set can be specified; see sections 4.1 and 2.3.
<param>	parameter >electrode test		
[<enter>	temperature	XX.X °C]	If no temperature sensor is connected.
<enter>	report:		short → short report, full → full report including response curves, OFF→ no report (if no printer is connected).
<enter>	parameter >analog output		Exit by pressing <quit>.

4.3 Procedure

Briefly, the test runs as follows: First, the electrode is immersed in buffer pH = 9 and its signal (potential) is monitored during 3 min under stirring and then 1 min in the absence of stirring. Subsequently, the same measurements are performed in buffers pH = 4 and pH = 7.

In order to get realistic response times, the electrode must not be immersed in the respective buffer before the start of the measurement. The stirring should be vigorous and the electrode tip located reasonably close to the stirrer.

The information set in *italics* applies only if a Pt 100 or Pt 1000 temperature sensor is connected; on the other hand, the information put within square brackets [...] does not appear if one of the temperature sensors mentioned is connected.

Key	Display (LCD)	Remarks
Power on	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	Power switch is above power cable connector.
<mode> →pH	temp. *Pt ...:* XX.X °C YY-MM-DD HH:MM:SS	pH, °C, mV, mV/I_{pol}
<el. test>	[enter temp. temperature XX.X °C]	
[<enter>]	buffer pH 9.00 press <enter> to start	Immerse electrode into Metrohm buffer pH = 9 and immediately press ...
<enter>	buffer pH 9.00 time to go XXX s	Count down 239→1 s. At 60 s, the stirrer is switched off automatically or – if it is not connected as shown in Fig. 4.1 – the prompts «switch stirrer on» and «switch stirrer off» appear before the start of the count down or at 60 s, repectively.
	meas temperature	
	buffer pH 4.00 press <enter> to start	Immerse electrode into Metrohm buffer pH = 4 and immediately press ...
<enter>	buffer pH 4.00 time to go XXX s	Count down 239→1 s. At 60 s, stirrer is switched off automatically or manually.
	meas temperature	
	buffer pH 7.00 press <enter> to start	Immerse electrode into Metrohm buffer pH = 7 and immediately press ...
<enter>	buffer pH 7.00 time to go XXX s	Count down 239→1 s. At 60 s, stirrer is switched off automatically or manually.
	meas temperature	
	Electrode test excellent electrode (e.g.)	Classification criteria and further possible messages see below.

If no printer is connected to the RS 232C interface, the following error message may appear:

```
***RS error 42
```

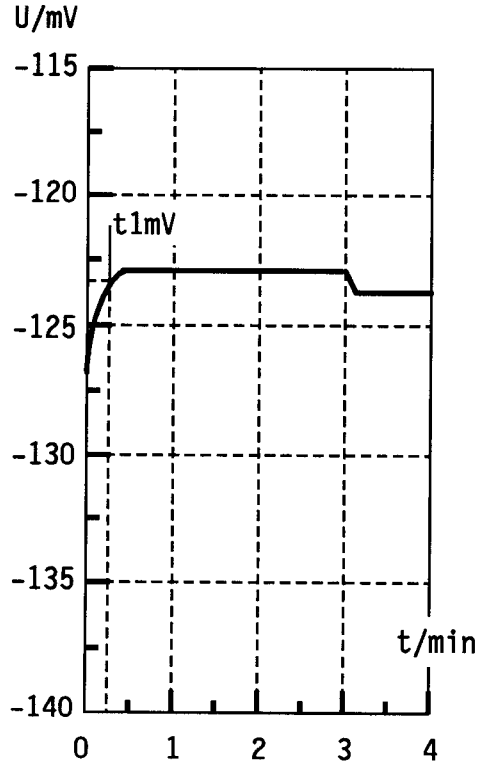
In this case, press <quit>, repeat the sequence shown at the end of paragraph 4.2 and set

```
>electrode test
report:                OFF
```

4.4 Results

4.4.1 Partial reproduction of a full electrode test report (transients not to scale)

```
date    92-09-22    time   08:29:18      3
Electrode test
   meas. input                  1
   temperature man.          25.0 C
   date          92-09-22  08:10

buffer pH 9.00 at 25.0 C

   time/min          U/mV       drift/mV/min
     1 (stirred)    -123.2      0.1
     2 (stirred)    -123.1      0.3
     3 (stirred)    -123.3      0.2
     4              -124.3      0.0

   response time     t(1mV)     5 s

   dU (unstirred-stirred)      -1.0 mV
```



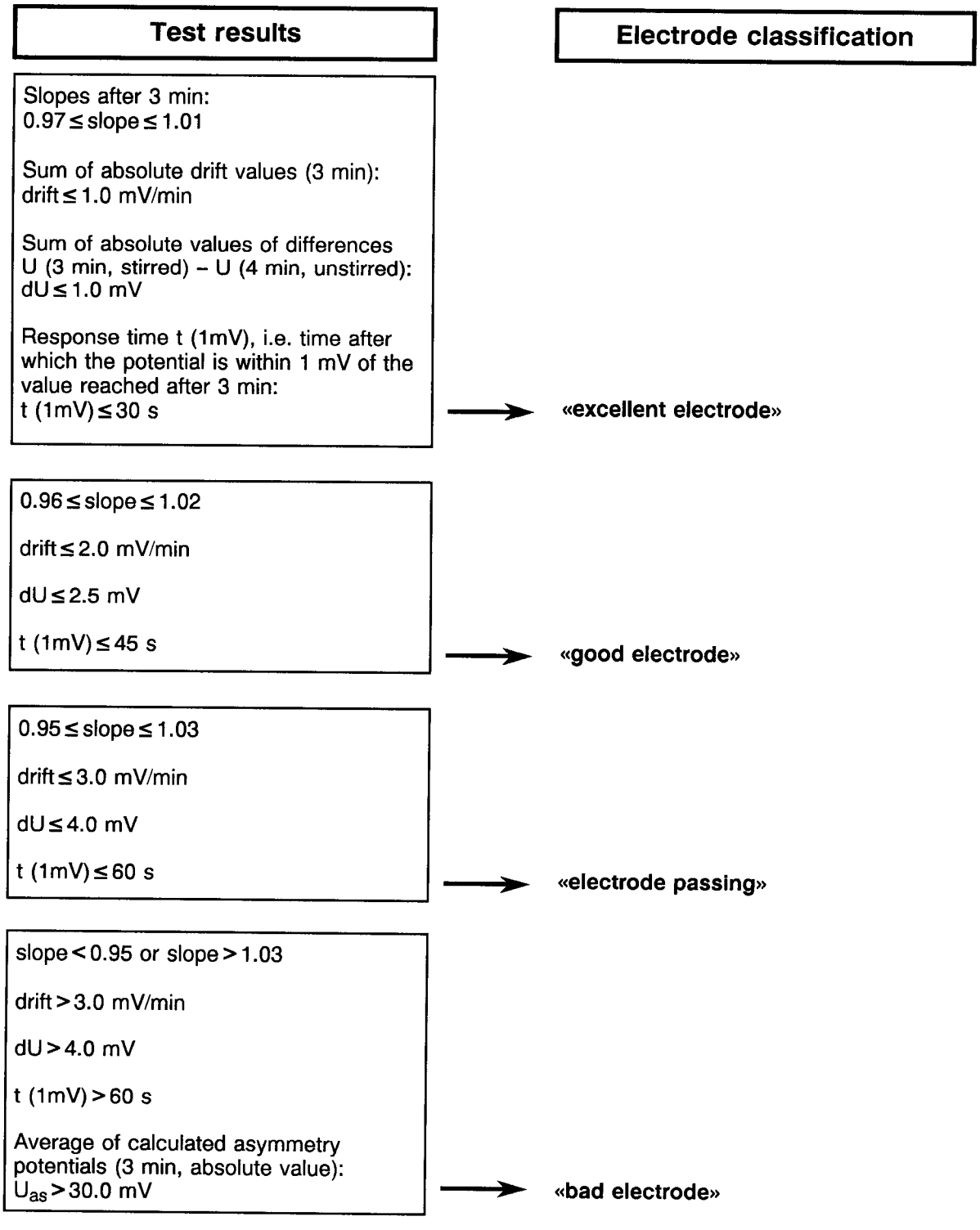

```
buffer pH 4.00 at 25.0 C

   time/min          U/mV       drift/mV/min
     1 (stirred)    166.7       0.0
     2 (stirred)    166.8       0.0
     3 (stirred)    166.8       0.2
     4              166.5       0.2

   response time     t(1mV)     12 s

   dU (unstirred-stirred)      -0.2 mV
```

```
buffer pH 7.00 at 25.0 C

   time/min          U/mV       drift/mV/min
     1 (stirred)    -7.4        0.1
     2 (stirred)    -7.3        0.2
     3 (stirred)    -7.4        0.2
     4              -7.7        0.2

   response time     t(1mV)     4 s

   dU (unstirred-stirred)      -0.3 mV
```

```
results buffers 4.00/7.00

   time/min      pHas       Uas/mV     slope
   1 (st)        6.872      -7.4       0.981
   2 (st)        6.874      -7.3       0.981
   3 (st)        6.872      -7.4       0.981
   4             6.867      -7.7       0.981

results buffers 7.00/9.00

   time/min      pHas       Uas/mV     slope
   1 (st)        6.872      -7.4       0.979
   2 (st)        6.874      -7.3       0.979
   3 (st)        6.872      -7.4       0.980
   4             6.868      -7.7       0.986

results buffers 9.00/4.00

   time/min      pHas       Uas/mV     slope
   1 (st)        6.874      -7.3       0.980
   2 (st)        6.876      -7.2       0.980
   3 (st)        6.874      -7.3       0.981
   4             6.862      -8.0       0.983

time/min      sum of drifts in 3 buffers
   1 (stirred)     0.2 mV/min
   2 (stirred)     0.5 mV/min
   3 (stirred)     0.6 mV/min
   4               0.4 mV/min

conclusion
              good electrode

              ========== *
```

* The double dashed line appears at the end of original reports, the single dashed line at the end of duplicates.

4.4.2 Classification of pH electrodes



4.4.3 Messages that may appear during and after the electrode test

Procedure and numerical tests		Message displayed if answer is «yes»
Measurement in buffer pH = 9.		
Absolute value of drift measured in pH = 9 after 3 min > 1 mV/min?	→	**«serious problem»**
U(4 min) < 10 mV AND sum of absolute drift values between 1 min ... 4 min < 12 mV/min?	→	**«short circuit»**
Measurement in buffer pH = 4.		
Measurement in buffer pH = 7.		
Calculation of slopes, drift values, absolute values of U(3 min, stirred) – U(4 min, unstirred) = dU.		
Sum of absolute drift values after 3 min in buffers 9, 4 and 7 > 3 mV/min?	→	**«bad electrode system»**
2 slopes do not fulfil 0.95 < slope < 1.03 AND 1 slope fulfils 0.95 < slope < 1.03?	→	**«wrong buffer»**
1 of the dU values > 4 mV?	→	**«bad diaphragm»**
0.95 < slope < 1.03 AND U_{as} > 30 mV?	→	**«reference not matching»**
All slopes do not fulfil 0.95 < slope < 1.03?	→	**«partial short circuit»**
1 response time t(1 mV) > 60 s?	→	**«glass membrane»**

4.5 Corrective action

4.5.1 Recommendations

The pH electrode test may result in electrode classifications or messages that require corrective action. The steps to be taken are explained in section 4.5.2 below. See also the leaflet that accompanies each Metrosensor pH electrode and the Metrohm Monograph «Electrodes in Potentiometry».

Message	Recommended measures
«electrode passing»	Clean diaphragm.
«bad electrode»	Clean diaphragm and/or regenerate glass membrane. Check reference system.
«serious problem»	Clean diaphragm and/or regenerate glass membrane.
«short circuit»	Replace electrode (electrical short or crack in glass membrane).
«bad electrode system»	Clean diaphragm and/or regenerate glass membrane.
«wrong buffer»	Repeat test with correct buffers.
«bad diaphragm»	Clean diaphragm.
«reference not matching»	Repeat with appropriate reference system (Ag/AgCl/ c(KCl) = 3 mol/L or calomel) or replace (contaminated) reference electrolyte.
«partial short circuit»	Check temperature sensor or set correct temperature; if this does not help, replace electrode.
«glass membrane»	Regenerate glass membrane.

4.5.2 Care and maintenance of pH glass electrodes

General

Always make sure that

- the combined electrode is filled with the correct reference electrolyte, i.e. c(KCl) = 3 mol/L,
- the reference electrolyte compartment is filled to the top with clean electrolyte,
- the filling hole is open during measurement (and closed during storage),
- there are no air bubbles in the internal or in the reference electrolyte,
- the cable connections are dry and clean.

Caution: Ultrasonic cleaning may damage the electrodes.

Storage

- Combined glass electrodes should be stored in the reference electrolyte, c(KCl) = 3 mol/L. If a combined electrode is stored in water, AgCl will precipitate within the diaphragm!
- Separate glass electrodes should be stored in distilled water.

Cleaning of the diaphragm

- After measurements in media of low chloride concentration (precipitated AgCl in the diaphragm, which has a darkish brown colour): Place electrode overnight in concentrated ammonia solution, rinse with water and renew the reference electrolyte.
- After measurements in protein containing media: Immerse electrode for several hours in a solution of 5% pepsin in c(HCl) = 0.1 mol/L, the best effect being obtained at 38 °C. Then soak thoroughly.
- After measurements in sulphide-containing media (Ag_2S in the diaphragm, which assumes a dark colour): Place electrode for several hours in freshly prepared, slightly acidic 7% thiourea solution. Then rinse with water and renew the reference electrolyte.
- If the electrode is contaminated with organic compounds: Place electrode for approximately 5 min in chromosulphuric acid at 80 °C, then rinse thoroughly with water and renew reference electrolyte.
- If the above measures do not help: Carefully file down diaphragm with a diamond nail file. The outflowing electrolyte should be visible as a dark ring.

Care of the glass membrane

- When performing measurements in non-aqueous media, soak electrode in water between the measurements.
- Regeneration of the glass membrane: Immerse the glass membrane either for 1 min in a 10% solution of ammonium hydrogenfluoride (NH_4HF_2) or for a few seconds in 40% HF. *Attention: HF is poisonous and affects the skin! Do not use glass vessels!* After the etching, rinse for approximately 10 seconds in a solution H_2O : HCl = 1 : 1. Rinse electrode in water and allow to stand for 24 h in the storage solution.

5. Measuring temperature and potential

5.1 Measuring temperature

Whenever a Pt 100 or Pt 1000 temperature sensor is connected to the inputs marked «Pt 100/Pt 1000» of the 713 pH Meter, the temperature can be measured either simultaneously with the pH value (pH mode) or alone (°C mode). In the pH mode, the temperature appears on the LCD display and serves to correct the pH value for the effect of temperature.

The procedure given below prepares the 713 pH Meter for straightforward temperature measurement; see chapter 3 on delta measurement, section 6.4.1 on stirrer control, section 6.3.1 on the analogue output and section 6.4.3 on limits.

Key	Display (LCD); recommended settings		Available options; remarks
Power on	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS		Power switch is above power cable connector.
<mode> → °C	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS		pH, °C, mV, mV/I_{pol}. Main display shows temperature.
<config>	config >auxiliaries		<config> key is combined with number key «1».
<enter>	last digit:	ON	ON, OFF (<select> key); OFF→last digit is not displayed.
<enter>	dialog:	english	english, deutsch, français, español
<enter>	date	YY-MM-DD	
<enter>	time	HH:MM:SS	24 h format, e.g. 15:07:51
<enter>	temp. unit:	C	C, F (°C, °F)
<enter>	run number	OFF	0, 1, 2, 3 ... 999, OFF
<enter>	device label	pH 713	ASCII string (← → keys)
<enter>	program	XXXXXXXX	Installed program version.
<enter>	config >printer		Exit by pressing ...
<quit>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS		Switch to parameter settings by pressing...
<param>	parameter >measuring parameters		
<enter>	electr. id	Pt 1000	ASCII string (← → keys), 8 characters; electrode designation.
<enter>	drift	1 °C/min	0.5 ... 999.9 °C/min; OFF
<enter>	method id	T 03	Name of current method; see chapter 3, <methods> key.

Key	Display (LCD); recommended settings		Available options; remarks
<enter>	delta measurement:	OFF	OFF, ON, meas. See chapter 3.
<enter>	stirrer:	OFF	OFF, ON, control. See section 6.4.1.
<enter>	parameter >analog output T		See section 6.3.1. Exit by pressing ...
<quit>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS		

5.2 Measuring potential

5.2.1 Measuring redox potential

Redox potential (voltage) measurements can be carried out with a combined noble metal electrode or with a separate metal electrode plus a reference electrode. The inputs «pH/ISE 1» or «pH/ISE 2» are used, see also section 1.3.

The 6.2306.020 redox standard serves to check the proper functioning of redox electrodes. The procedure is explained in the leaflet accompanying the Metrohm metal electrodes.

Of course, the signal of pH, ion selective or silver electrodes can also be monitored in the «mV» mode.

The procedure given below prepares the 713 pH Meter for straightforward potential measurement; see chapter 3 on delta measurement, section 6.4.1 on stirrer control, section 6.3.1 on the analogue output and section 6.4.3 on limits. The configuration settings, accessible via the <config> key, are not mentioned below; see, e.g., the preceding section 5.1.

Key	Display (LCD); recommended settings		Available options; remarks
Power on	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS		Power switch is above power cable connector.
<mode> →mV	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS		pH, °C, mV, mV/I_{pol}. Main display shows potential in mV.
<param>	parameter >measuring parameters		
<enter>	meas. input:	1	1, 2, diff: electrode input 1, 2 or differential potentiometry. For details on differential potentiometry see sections 5.2.3 and 1.3.
<enter>	electr. id	Pt 415	ASCII string (← → keys), 8 characters; electrode designation.
<enter>	drift	1.0 mV/min	0.5 ... 999.9 mV/min, OFF.
<enter>	method id	U 05	Name of current method; see chapter 3, <methods> key.
<enter>	delta measurement:	OFF	OFF, ON, meas. See chapter 3.

Key	Display (LCD); recommended settings	Available options; remarks
<enter>	stirrer: OFF	OFF, ON, control. See section 6.4.1.
<enter>	parameter >analog output U	See section 6.3.1. Exit by pressing ...
<quit>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	

5.2.2 Measuring potential with polarized electrodes

Double metal electrodes are used for these measurements; the input to be used is marked «I_{pol}».

The procedure given below prepares the 713 pH Meter for straightforward potential measurement with polarized electrodes; see chapter 3 on delta measurement, section 6.4.1 on stirrer control, section 6.3.1 on the analogue output and section 6.4.3 on limits. The configuration settings, accessible via the <config> key, are not mentioned below; see, e.g., the preceding section 5.1.

Key	Display (LCD); recommended settings	Available options; remarks
Power on	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	Power switch is above power cable connector.
<mode> →mV/I_{pol}	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	pH, °C, mV, mV/I_{pol}. Main display shows the potential in mV and the indicator «I_{pol}» is on.
<param>	parameter >measuring parameters	
<enter>	electr. id Pt 308	ASCII string (← → keys), 8 characters; electrode designation.
<enter>	drift 1.0 mV/min	0.5 ... 999.9 mV/min, OFF.
<enter>	I(pol) 10 µA	–127 ... 127 µA. The initial value is 1 µA; for many applications the recommended setting is I_{pol} = 10 µA.
<enter>	method id Ipol 4	Name of current method; see chapter 3, <methods> key.
<enter>	delta measurement: OFF	OFF, ON, meas. See chapter 3.
<enter>	stirrer: OFF	OFF, ON, control. See section 6.4.1.
<enter>	parameter >analog output Ipol	See section 6.3.1. Exit by pressing ...
<quit>	***** 713 pH Meter ***** YY-MM-DD HH:MM:SS	

5.2.3 Differential potentiometry

In potentiometric measurements in media of low conductivity, e.g. in organic solvents, high-impedance electrode assemblies such as pH electrodes record noise voltages which arise from stray electrostatic and electromagnetic fields. Particularly high field strengths occur through friction at insulators such as plastic floors, synthetic clothing, etc.; i.e. conditions which can appear in every normal laboratory environment. These disturbing voltages are superimposed on the measurement signal and when titration curves are recorded can lead to «ghost end points», which make an automatic evaluation virtually impossible.

Problems of this type can be solved by measurement using a differential amplifier. Here, the indicator and reference electrode are each connected to a high-impedance measuring input. It is important to ensure that both electrodes have identical shielding and are thus symmetrical with regard to the recording of noise signals. An auxiliary electrode provides the electrical connection between the reference point of the amplifier circuit and the measurement solution.

The 713 pH Meter is prepared for differential potentiometric measurements in the «pH» or «mV» modes as follows: <param> – >measuring parameters – <enter> – meas. input: (1, 2, diff.) – <select> diff. – enter.

Electrodes recommended for differential potentiometry

Measuring input	Manual determinations		Determinations with sample changer	
pH/ISE 1	6.0133.100	pH glass electrode	6.0104.100	pH glass electrode
pH/ISE 2	6.0729.100	shielded Ag/AgCl reference electrode	6.0729.110	shielded Ag/AgCl reference electrode
Ref. (use only one reference input)	6.0301.100	auxiliary electrode	6.0302.110	auxiliary electrode

Practical tip: Glass electrodes should be preconditioned in the solvent used for ca. 1 hour.

6. Connection possibilities

6.1 Connecting a printer to the RS 232 interface

Data transfer is possible only if the printers are set to «on line».

6.1.1 Connecting cables

RS 232C – Seiko DPU 411-11B(E/U), DPU 411-20B(E/U) 6.2125.020

RS 232C – Epson P-40, EX-800, LQ-850/1050 . . . . . 6.2125.040
(EX, LQ: without serial interface #8148)

RS 232C – Citizen iDP-560RS, Epson FX, LX, LQ,
Kodak Diconix 180 Si 6.2125.050
(FX, LX, LQ with serial interface #8148)

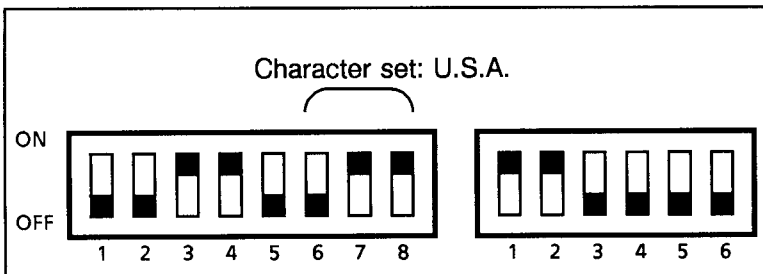
6.1.2 Graphics settings

The initial values of the parameters «width» and «length» – 0.8 and 1.0, respectively – will normally produce graphics outputs that fit onto the printer strip. To change these parameters, proceed as follows:

Key	Display (LCD)		Remarks
Power on & **<config>**	***** 713 pH Meter ***** >input assign		Press <config> during power up until «>input assign» appears.
<config>	>temp. measurement		
<config>	>graphics		
<enter>	grid:	ON	ON, OFF
<enter>	frame:	ON	ON, OFF
<enter>	width	0.8	0.4 ... 1.0 (1.0 ≙ maximum width).
<enter>	length	1.0	0.4 ... 1.0 (1.0 ≙ maximum length).
<enter>	temp. *Pt* ...: YY-MM-DD	XX.X °C HH:MM:SS	

6.1.3 Printer configurations

Seiko DPU 411-11B(E/U), DPU 411-20B(E/U): DIP switch positions

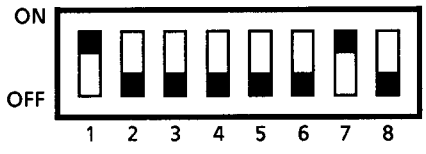


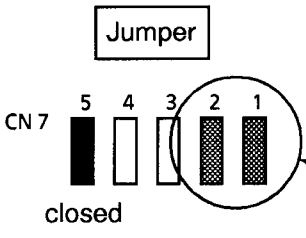
Configuration 713
<config>
>printer
character set: Seiko

>RS 232 settings
baud rate: 9600
data bit: 8
stop bit: 1
parity: none
handshake: HWs

Citizen iDP-560-RS: DIP switch and jumper positions

Set printer to on line with <SEL>





Jumper 1 & 2: Character code

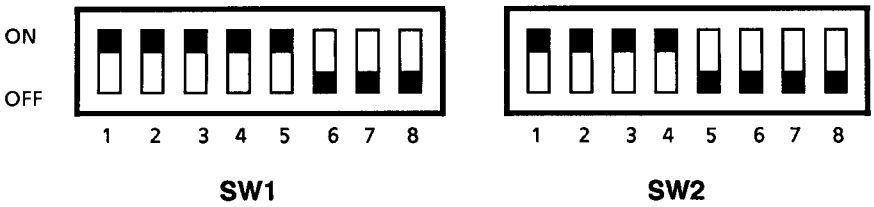
USA	**J1: open J2: open**
England	J1: closed J2: closed
France	J1: closed J2: open
Germany	J1: open J2: closed

Configuration 713
<config>
>printer
character set: Citizen

>RS 232 settings
baud rate: 9600
data bit: 8
stop bit: 1
parity: none
handshake: HWs

Epson LQ-850/1050: DIP switch positions on the printer (without #8148 interface board)

With this printer, the parameters «width» and «length» have both to be set to 0.7. The procedure is explained in section 6.1.2.

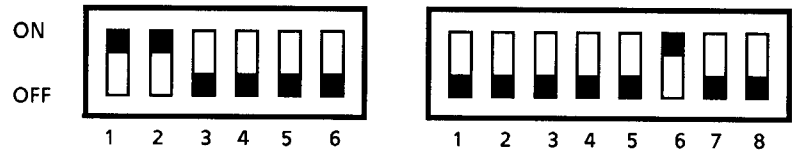


Configuration 713
<config>
>printer
character set: Epson

>RS 232 settings
baud rate: 9600
data bit: 8
stop bit: 1
parity: none
handshake: HWs

Epson FX-/LX-/LQ-: DIP switch positions on the #8148 interface board of the printer

With this printer, the parameters «width» and «length» have both to be set to 0.7. The procedure is explained in section 6.1.2.



SW2 SW1

Configuration 713
<config>
>printer
character set: Epson

>RS 232 settings
baud rate: 9600
data bit: 8
stop bit: 1
parity: none
handshake: HWs

Kodak Diconix 180 si

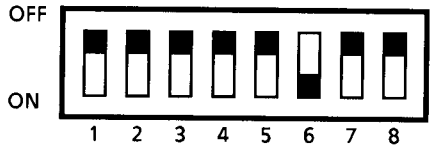
The settings on the Kodak Diconix 180 si are performed by means of a dialogue-guided set up procedure.

Configuration 713
<config>
>printer
character set: Epson

>RS 232 settings
baud rate: 9600
data bit: 8
stop bit: 1
parity: none
handshake: HWs

Epson P-40

The Epson P-40 printer is markedly slower than the other printers mentioned here. To get graphics that fit onto the printer strip, the parameters «width» and «length» must both be set to 0.4 with «character set: Epson». For English-language printouts, «character set: Seiko» may be used; in this case, «width» and «length» must both be set to 0.7 using the procedure shown in section 6.1.2.



Configuration 713
<config>
>printer
charact. set: s. above

>RS 232 settings
baud rate: 9600
data bit: 8
stop bit: 1
parity: none
handshake: HWs

6.2 Connecting a computer to the RS 232 interface

The computer is connected to the 713 pH meter as follows:

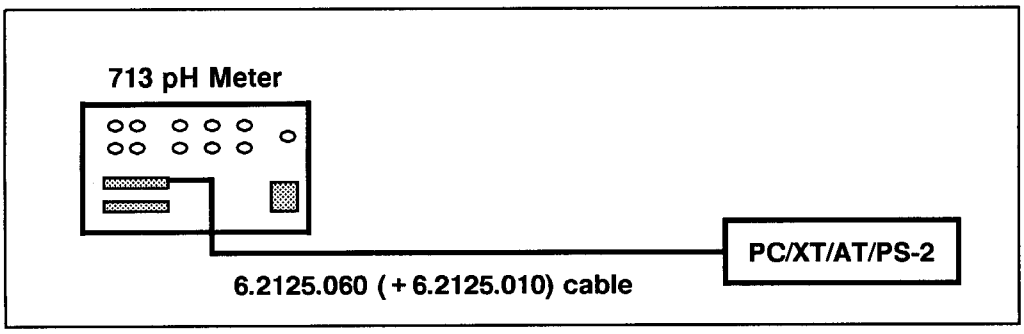


Fig. 6.2: Connection between 713 pH Meter and computer

For the connection of IBM® AT computers and compatibles that are fitted with a 9-pin connector, the 6.2125.010 adapter cable is required.

The RS 232 settings to be performed on the 713 pH Meter depend on the control program of the computer.

6.6008.010 PC program VESUV for the acquisition of measuring data on a PC. User dialogue configurable in English or German. Data from up to 8 Metrohm instruments can be received, stored as ASCII text files and printed out.

6.3. Applications of the analog output

6.3.1 Connecting a recorder

The Metrohm 586 Labograph can be connected to the 713 pH meter as follows:

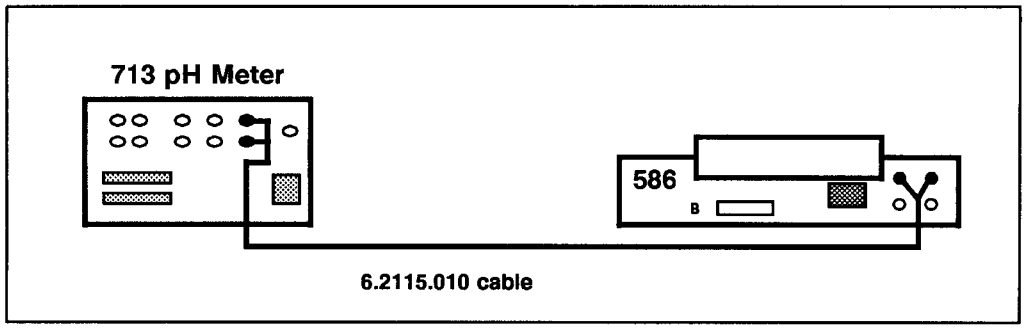


Fig. 6.3.1.1: Connection between 713 pH Meter and 586 Labograph

Other makes of laboratory recorders can be connected in place of the 586 Labograph.

In the pH mode, either the pH or the temperature can be brought to the analog output of the 713 pH Meter. Assuming that we want to record pH values in the range pH = 3 ... 7, the recorder can be «calibrated» from the 713 pH Meter as follows:

Key	Display (LCD)		Remarks
			Press <param> repeatedly ...
<param> ...	parameter >analog output		
<enter>	select:	pH	pH, T
<enter>	state:	PRESET	OFF, ON, PRESET. <select> PRESET to «calibrate» the recorder. OFF: O mV across analog output. ON: voltage across analog output according to settings.
<enter>	0 mV at	5.000 pH	–19.999 ... 19.999. Key in 5, i.e. the centre of the pH range to be recorded.
<enter>	1 V range	4 pH	–19.999 ... 19.999. Key in 4.
<enter>	preset	XX.XXX pH	Key in 5 and press <enter>. Set recorder to 0 V and adjust recorder pen to the exact centre of the full scale range. Set recorder to 1 V (1000 mV) full scale. Key in 3 and press <enter>. The recorder pen will shift to the lower limit of the full scale range. Key in 7 and press <enter>. The recorder pen will shift to to the upper limit of the full scale range. Enter values between 3 and 7 and observe the reaction of the recorder pen. Conclude the «calibration» by pressing ...

Key	Display (LCD)		Remarks
<quit>	>analog output		
<enter>	select:	pH	
<enter>	state:	PRESET	<Select> ON to switch to normal analog output operation and press ...
<enter>	0 mV at	5.000 pH	Exit by pressing <quit> twice and start recording.

Further examples, still using the recorder at 1 V (1000 mV) full scale:

Prepare the recording of pH values between 2 and 12 by setting ...

0 mV at	7.000 pH	and
1 V range	10.000 pH	

Prepare the recording of pH values between 8.500 and 9.500 by setting ...

0 mV at	9.000 pH	and
1 V range	1.000 pH	

Verify the settings as shown above by entering the appropriate preset values.

The following example is less straightforward:

Configure the 713 pH Meter such that pH = 3 corresponds to +0.250 V and pH = 2 to –0.150 V at the analog output.

In Fig. 6.3.1.2, the resulting function is sketched and the relevant formulae are applied. The resulting settings are as follows:

0 mV at	2.375 pH	and
1 V range	2.5 pH	

Fig. 6.3.1.3 shows the analog output circuit of the 713 pH Meter.

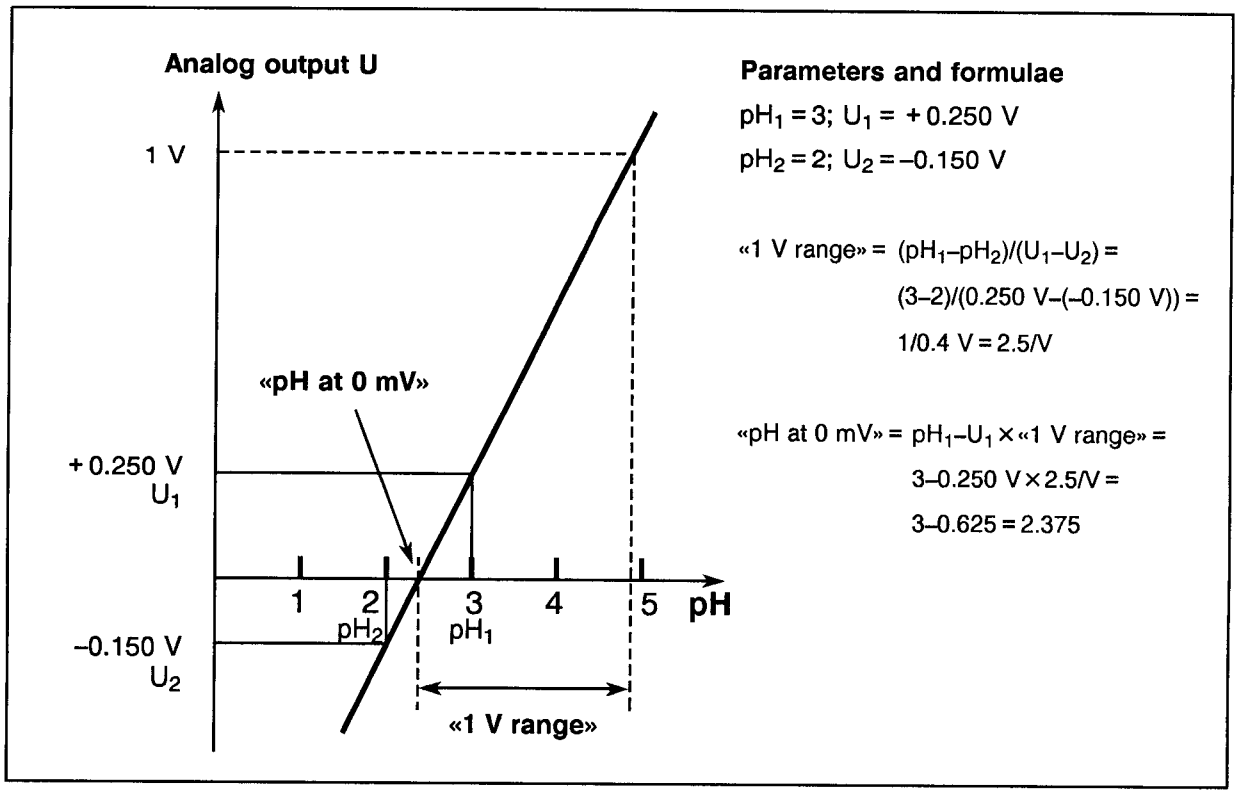
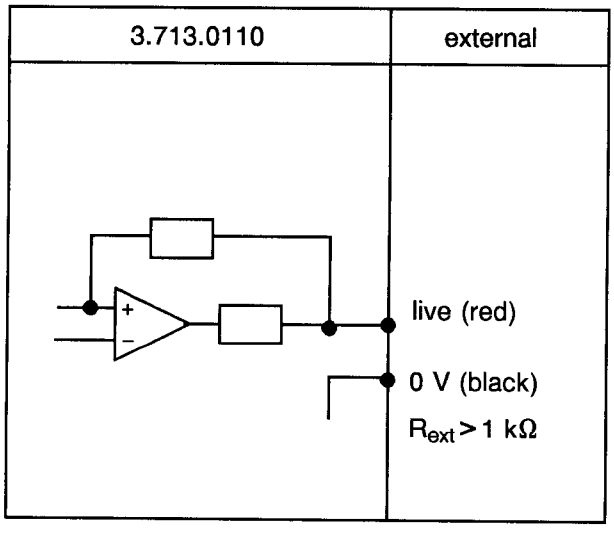


Fig. 6.3.1.2: Example of analog output voltage as a function of pH



Voltage range of analog output: –2000...2000 mV.

Resolution: 1 mV (12 bit).

Fig. 6.3.1.3: Analog output circuit of 713 pH Meter

6.3.2 Expansion of the 713 pH Meter to a titrator

Fig. 6.3.2.1 shows one possible set of cable connections between 713 pH Meter, 665 Dosimat and 614 Impulsomat. Depending on the application, cables different from those shown in Fig. 6.3.2.1 will be needed. This becomes clear from Fig. 6.3.2.2, which illustrates the Combi Titrator concept and shows the equipment needed for the different options. The printer shown in Fig. 6.3.2.2 is the Seiko DPU-411. To connect alternative printers to the RS 232 interface of the 665 Dosimat, the following cables are needed:

6.2124.070 cable for the connection 665 – Citizen iDP 560 RS, Epson LX ..., LQ ..., FX ... and Kodak Diconix;

6.2124.040 cable for the connection 665 – Epson P-40 or P-80.

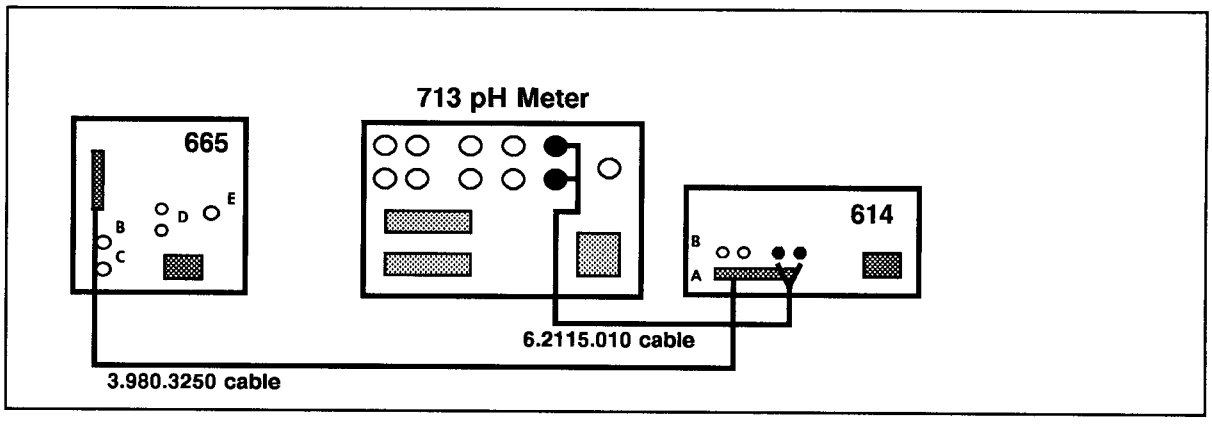


Fig. 6.3.2.1: Cable connections between 713 pH Meter, 665 Dosimat and 614 Impulsomat.

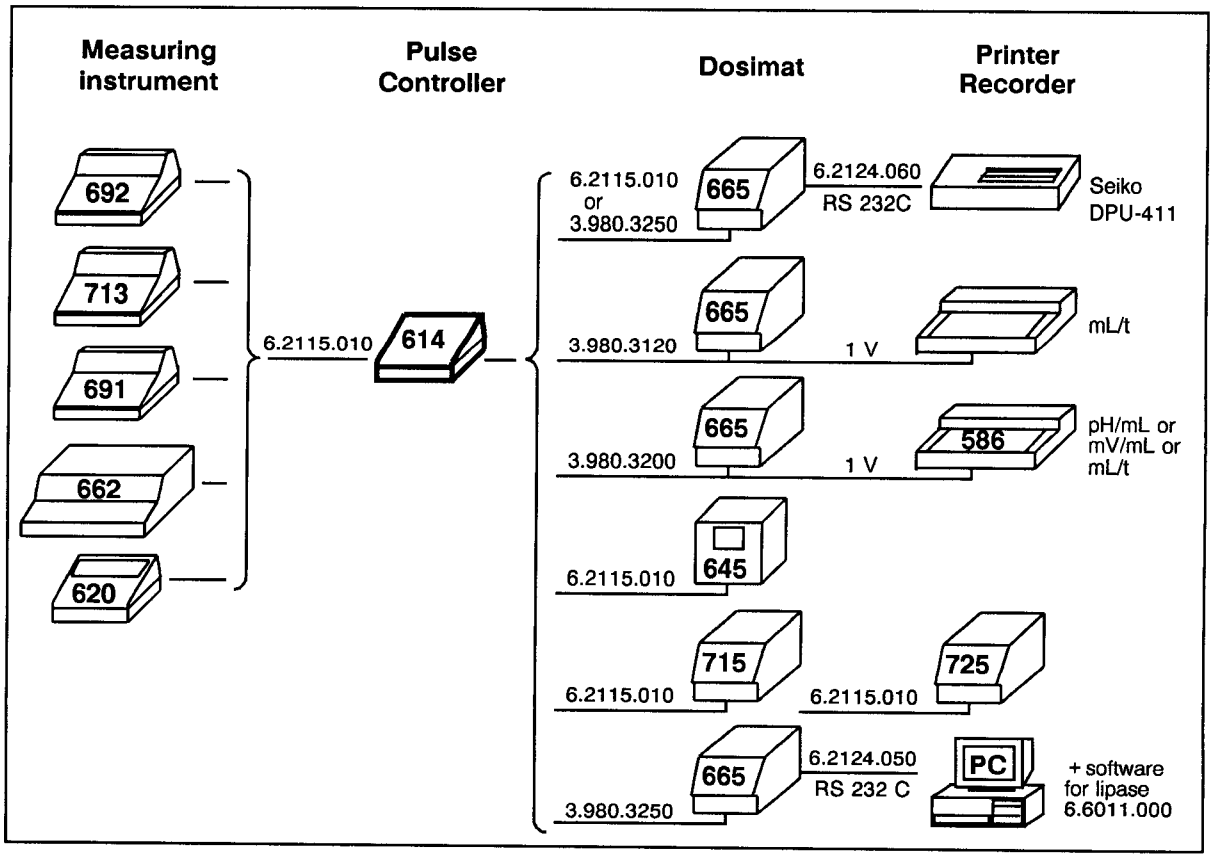


Fig. 6.3.2.2: The Combi Titrator Concept

6.4 Applications of the «Remote» I/O lines

6.4.1 Stirrer control via the «Remote» I/O lines

The operation of the 622, 649 and 722 Stirrers and of the 727 Titration Stand can be controlled by the 713 pH Meter via the optional 6.2138.000 cable. The set-up is shown in section 4.1, Fig 4.1.

The following steps serve to set the stirring procedure on the 713 pH Meter:

Key	Display (LCD)		Available options, remarks
<param>	parameter >measuring parameters		
	measuring input	1	1, 2, diff.
<enter>	electr. id:	XXXX	Press <enter> until «stirrer» is displayed:
<enter> ...	stirrer:	control	ON, control, OFF
<enter>	prestir pause	XXX s	Waiting time before stirring starts, in seconds.
<enter>	stir time	XXX s	Stirring time in seconds.
<enter>	poststir pause	XXX s	Waiting time after stirring, in seconds.

During calibrations or when the <print> key is actuated, the stirrer sequence thus specified will be executed before the measured value is taken over, considering the criteria specified as follows:

	config >print meas. value		
<enter>	print crit:	drift (e.g.)	immediate, time, drift, OFF (see chapter 3, <print> key): <select> and confirm with <enter>.

6.4.2 Connecting a sample changer to the «Remote» I/O lines

The «Remote» socket allows not only connection of a sample changer but also additional control functions. Pin assignment of the «Remote» socket see Appendix 5.

The sample changer is connected as follows:

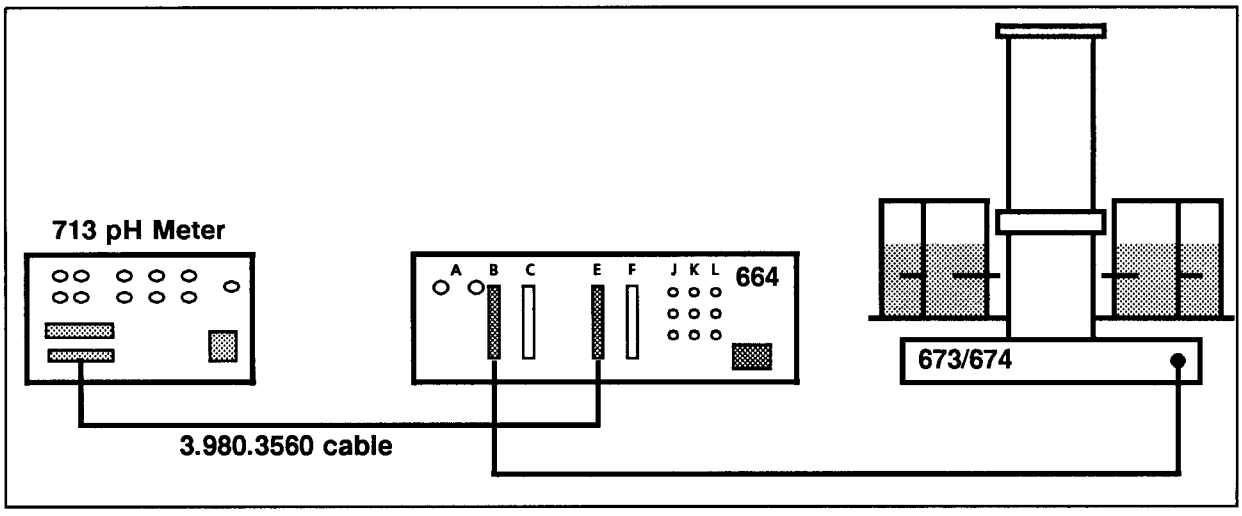


Fig. 6.4.2: Connection of a sample changer

6.4.3 The «Limits» function

The «Limits» function opens up a large number of applications of the «Remote» outputs. The pin assignment of the «Remote» socket is shown in Appendix 5.

Assuming that we wish to keep the the pH value within the range 7 to 9 by control via the «Remote» socket, the settings are performed as follows:

Key	Display (LCD)		Available options, remarks
<param>	parameter >measuring parameters		Press <param> repeatedly ...
<param> ...	parameter >limits pH		
<enter>	state:	ON	ON, OFF; <select> ON.
<enter>	u.limit	9 pH	–19.999 ... 19.999; key in 9 for the upper limit (pH = 9.000).
<enter>	u. hyst.	0.020 pH	–19.999 ... 19.999; 0.020 = default value of upper hysteresis.
<enter>	l. limit	7 pH	–19.999 ... 19.999; key in 7 (pH = 7.000).
<enter>	l. hyst.	0.020 pH	–19.999 ... 19.999; 0.020 = default value.
<enter>	parameter >limits T		Exit by pressing <quit>.

Figs 6.4.3.1 and 6.4.3.2 schematically show the functioning of «Limits».

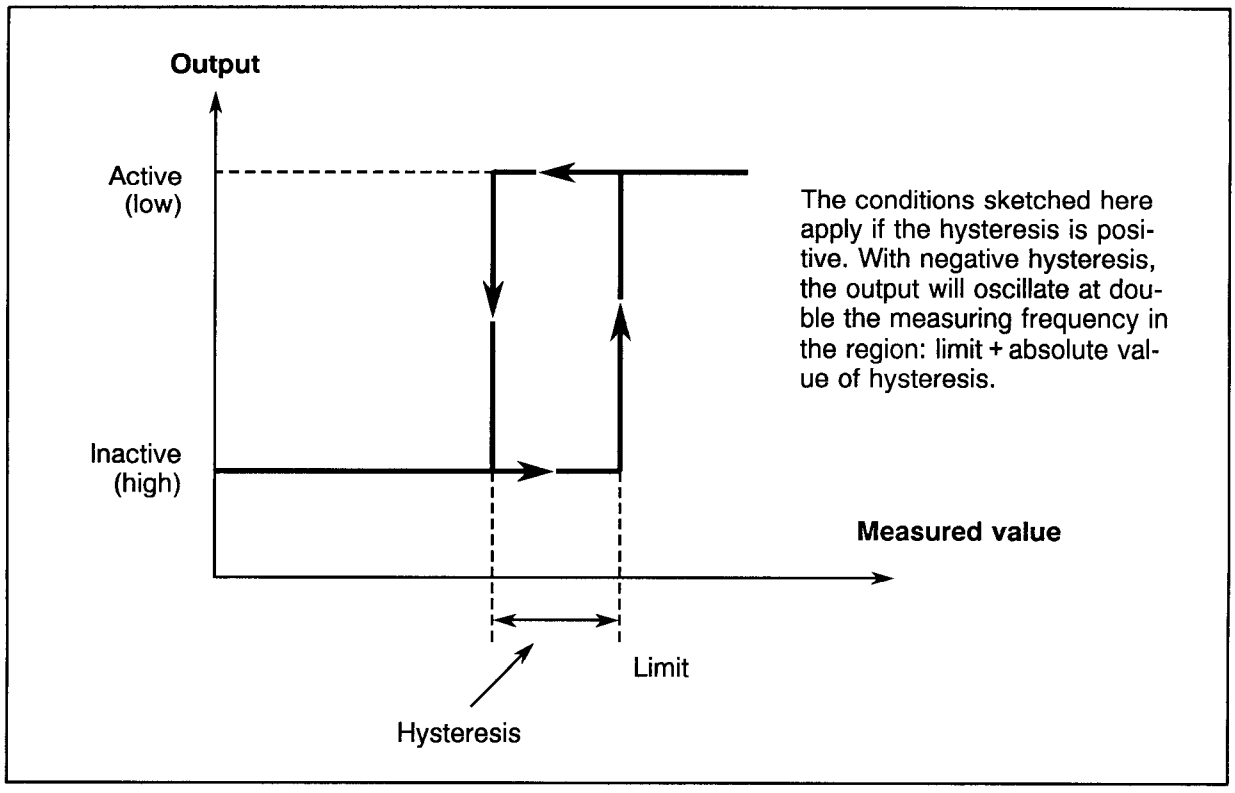


Fig. 6.4.3.1: Schematic of «Limits» function.

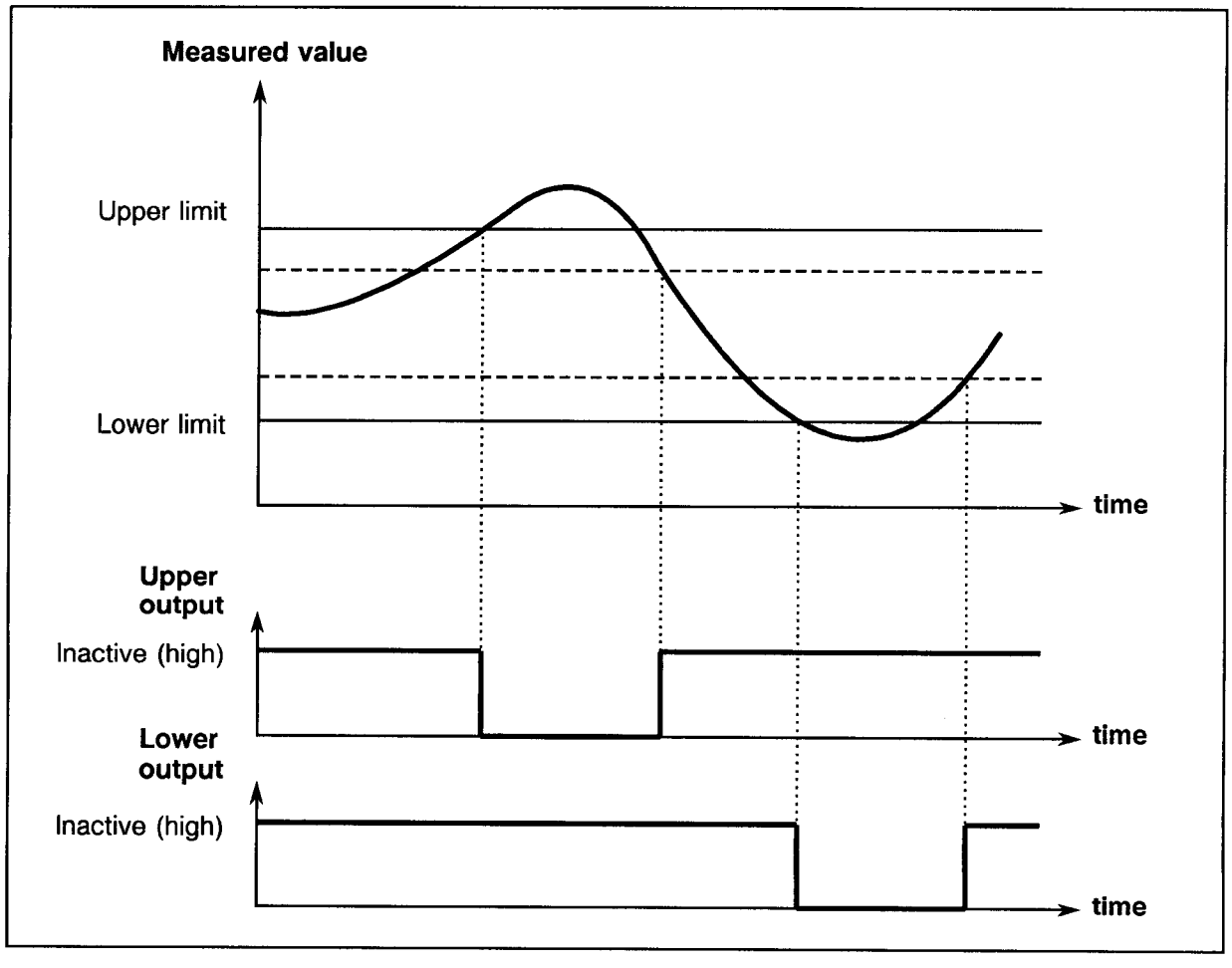


Fig. 6.4.3.2: «Remote» outputs obtained as a function of the measured value when applying the «Limits» function.

7. Operation via RS 232C interface

7.1 General rules

The 713 pH Meter has an extensive remote control facility that allows full control of the titrator via the RS232 interface, i.e. the titrator 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. 713 pH Meter 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. (After $Q the last data line is terminated by C_R L_F and the data block is marked in addition by C_R C_R L_F, i.e., an empty line is sent.)

The controller terminates its commands with C_R and L_F. If the controller sends more than one command per line, a semicolon (;) is used as separator between the commands.

The commands are grouped logically and are easy to understand. Thus, e.g., for the selection of the pH mode the command

&Mode.Select "pH"

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

&M.S "pH"

All quantities of the 713 pH Meter 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 RS interface parameters (RS Settings)

&Config.**RS**Set

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

&Config.**RS**Set.**B**aud

or regarding the setting of the parity

&Config.**RS**Set.**P**arity

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.**RS**Set.**B**aud

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.**RS**Set.**B**aud **$Q** (Q for Query)

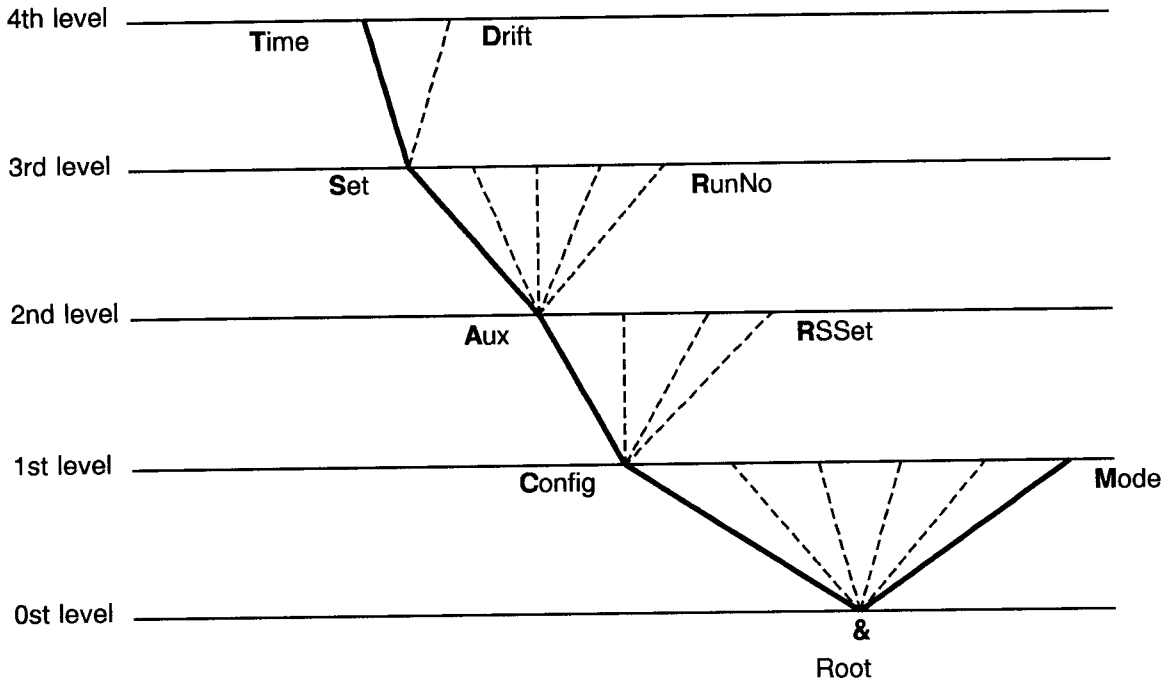
$Q triggers the output of the value from the 713 pH Meter. Entries that are introduced with the character dollar ($) trigger something. They are thus called **triggers** in what follows.

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

&Config.**RS**Set.**B**aud **"9600"**

7.2 Call up of objects

All objects of the 713 pH Meter are grouped hierarchically. They have a tree structure. A section of this tree is shown below:



Rules	Examples
– The root of the tree is marked by &.	
– 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.	Call up of time: **&C**onfig.**A**ux.**S**et.**T**ime or **&C.A.S.T**
– Upper- or lowercase letters can be used	**&C.A.S.T** or **&c.a.s.t**
– An object can be assigned a value. Each value is marked at the beginning and end with quotation marks ("). A value can contain up to 24 characters. Numeric values can include up to 6 digits, a negative sign and a decimal point. Numbers with more than 6 digits will not be accepted; more than 4 decimal places are rounded off. With numbers < 1, it is necessary to enter leading zeros.	Entry of "14:37" for the time **&C.A.S.T "14:37"** Correct entries of numbers: "**–31.2273**" "**0.1**" incorrect entries: "1,5" or " + 3" or ".1"
– If a new object is not called up, the old object remains current.	Entry of a different time: **"14:42"**
– New objects can also be addressed relative to old objects: **A preceding point** moves one node **forwards** in the tree.	From the root to the 'Aux' node: **&C.A** Forwards from the 'Aux' node to 'Set': **.S**
More than one preceding point moves one node **backwards** in the tree. n nodes backwards require n + 1 preceding points.	Jump from 'Set' onto the 'Aux' node and selection of a new object at this node, 'RunNo': **..R** Jump from the object 'RunNo' via the 'Aux' node to the 'Config' node and to the new node 'RSSet': **...R**
– If a jump is to be made back to the root, a preceding & is entered.	Change from the 'RSSet' node via the root into the 'Mode' node: **&M**

7.3 Triggers

Triggers initiate an action at the 713 pH Meter, e.g. starting of a procedure or sending of data. Triggers are marked with the introducer: **$**

The following triggers are possible:

$G	Start:	Starts operations, e.g. start of the calibration or setting of the RS232 interface parameters
$S	Stop:	Stops operations, e.g. calibration
$D	Detailed Info:	Used for inquiry of the detailed status
$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
$U	qUit:	Used to abort the data flow of the 713 pH Meter, e.g. after $Q

The triggers $G and $S and are linked to objects, see section 7.2.

The other triggers, however, can be used at any time and at any location on the object tree.

Examples:

Inquiry of the value of the baud rate: **&C**onfig.**R**SSet.**B**aud **$Q**

Inquiry of all values of the node 'RSSet': **&C**onfig.**R**SSet **$Q**

Inquiry of the path of the node 'RSSet': **&C**onfig.**R**SSet **$Q.P**

Start of calibration: **&M**ode.**p**H.**C**al **$G**

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

7.4 Status conditions and error messages

There is only one status message per inquiry ($D).

The main process is the foreground measurement. The measurement of the main process does not need to be started. The instrument is ready. The global condition is then $R. The stirrer macro is started in the measure mode as well. Its global conditioin is $G.

Besides the above main processes, there are others: pH calibration, electrode test. Their status messages only appear if these processes run in the foreground. As soon as they are concluded, the status condition of the main process is active again.

7.4.1 Status conditions

Status conditions of the global $G
The status $G appears if a process has been started actively.

$G.Mode.pH	.Stirrer:	Waiting for the stirring times to elapse during measurement.
	.Cal.Inac:	At beginning of calibration.
	.Stirrer:	Calibrating, waiting for stirring times to elapse.
	.Req.Temp1:	Requesting temperature.
	.Meas.TempX:	Temperature measurement in buffer X.
	.Meas.BufX:	Calibrating, measuring buffer X.
	.Req.BufX:	Requesting pH of buffer X.
	.Data:	Display of data, data output.
	.ElTest .Inac:	At beginning of electrode test.
	.Req.TempX:	Requesting X^{th} temperature.
	.Meas.BufX:	Performing X^{th} measurement.
	.Req.BufX:	Waiting for X^{th} buffer.
	.Meas.IncX:	Measuring X^{th} increment.
	.Data:	Data output.
$G.Mode.U.Stirrer:		Waiting for the stirring times to elapse during measurement.
$G.Mode.T.Stirrer:		Waiting for the stirring times to elapse during measurement.
$G.Mode.Ipol.Stirrer:		Waiting for the stirring times to elapse during measurement.

Status conditions of the global $R
The process has been concluded in the normal way or has not yet been actively started.

$R.Mode.pH	.Drift:	Measuring in pH mode, drift criterium not met.
	.DriftOK:	Drift criterium met.
$R.Mode.U	.Drift:	Measuring in U mode, drift criterium not met.
	.DriftOK:	Drift criterium met.
$R.Mode.T	.Drift:	Measuring in T mode, drift criterium not met.
	.DriftOK:	Drift criterium met.
$R.Mode.Ipol	.Drift:	Measuring in I_{pol} mode, drift criterium not met.
	.DriftOK:	Drift criterium met.

Status conditions of the global $S
The process has been stopped arbitrarily because of an error that produces $S... The condition from which the process has been stopped is indicated. Example:

$S.Mode.XX.Drift(OK)	Measurement stopped via RS 232.

7.4.2 Error messages

Error messages are sent upon status inquiry at the end of the status message, after the separating semicolon «;». Example: $R.Mode.Ipol;E22.

Some errors interrupt the running process; the corresponding messages are marked by an asterisk «*».

The error numbers are valid for all Metrohm instruments whose software is arranged in a tree structure. Accordingly, the error numbers for a given instrument have gaps between them. If you connect several Metrohm instruments to your computer, you are able to set up a table containing the error numbers and their meaning.

Error		How to exit
E21	Check electrode, short circuit.	Rectify fault or change mode.
E22	Check electrode, break (for polarized electrodes).	Rectify fault or change mode.
E26	Manual stop.	$G, $S or mode change.
E28	Wrong object call up.	Correct path.
E29	Wrong value.	Correct value or new path.
E30	Wrong trigger.	Correct trigger or new path.
E31	Command not possible in active status.	Repeat command in inactive status.
RS receive errors		
E36	Parity.	<quit> and ensure settings are the same on both devices.
E37	Stop Bit.	<quit> and ensure settings are the same on both devices.
E38	Overrun error. At least 1 character could not be read.	<quit>.
E39	The internal receive buffer of the 713 pH Meter is full.	<quit>.
RS send errors		
E40	DSR = OFF. No proper handshake for more than 1 second.	<quit>. Is receiver switched on and ready?
E41	DCD = ON. No proper handshake for more than 1 second.	<quit>. Is receiver switched on and ready?
E42	CTS = OFF. No proper handshake for more than 1 second.	<quit>. Is receiver switched on and ready?
E43	Transmission from the 713 pH Meter has been interrupted by XOFF for at least 3 seconds.	Send XON or <quit>.
E44	The RS 232 interface parameters are no longer the same for both devices.	Reset.
E45	The receive buffer of the 713 pH Meter contains an incomplete command (L_F missing). Sending from the 713 is therefore blocked.	Send L_F or <quit>.
E120*	Overrange.	Rectify fault or change mode. In running process: $G.
E135*	Check temperature sensor.	Rectify fault or change mode.
E136*	Same buffer.	$S or $G.
E137	XXX bytes missing (during method storage).	New command.
E138*	Buffer not defined.	$S or $G.
E139*	Buffer alloc. impossible.	$S or $G.
E140*	Delta T > 2 °C.	$S or $G.
E141*	Cal. data out of limits.	$S or $G.
E142*	El. test failed.	$S or mode change.
E148*	Buffer not valid for el. test.	$S or mode change.

7.5 Remote control commands

7.5.1 Definition of «macros»

These «macros» will no longer be listed in detail later on.

Delta measurement

«.Delta» means

.Delta	$G	Acquire actual measured value
.Status	ON/meas/OFF	Switch on/off or offer measured value
.Reference	Depends on meas. value	Either measured or fixed value

Limits

«.Limit macro» means

.Status	ON/OFF	Switch on/off. If «OFF», the lines are available.
.UpperLim	Depends on meas. value	Upper limit
.UHysteresis	Depends on meas. value	Hysteresis for upper limit
.LowerLim	Depends on meas. value	Lower limit
.LHysteresis	Depends on meas. value	Hysteresis for lower limit

Analog output

«.Analog output macro» means

.Status	ON, OFF, preset	
.Zero	Depends on meas. value	Measured value for 0 mV analog signal
.Range	Depends on meas. value	Range for 2 V analog signal
.PresetValue	Depends on meas. value	Setting of a fixed value

Stirrer

«.Stirrer» means		This macro is started by «print» or &Config.PrintMeasVal $G.
.Status	ON, control, OFF	ON: continuous stirring; OFF: no stirring; control: intervals
.PreStirTime	0 ... 99999	Waiting time before stirring starts, in seconds
.StirTime	0 ... 99999	Stirring time in seconds
.PostStirTime	0 ... 99999	Waiting time after stirring, in seconds

7.5.2 Instrument tree structure

«Macros» as defined in the preceding section.

Command	Input options Default values are marked by **bold** type.	Meaning
&Mode		
.Select	**pH**, T, U, Ipol	Loading of mode
.pH		
.Cal	$G, $S	Start or stop mode Cal
.ElTest	$G, $S	Start or stop Electrode Test
.MeasPara		
.MeasInput	**1**, 2, diff	
.ElectrodeId	8 ASCII	Electrode identification
.Drift	0.005...**0.05**...9.999	pH drift in 1/min
.Temperature	–999.9...**25.0**...999.9	Measuring temperature
.MethodId	Read only	Method name
«.Delta»		Macro
«.Stirrer»		Macro
.CalPara		
.CalTemp	0.0...**25.0**...99.9	Calibration temperature
.Drift	0.1...**0.5**...9.9	Drift in mV/min
.Report	full, short, OFF	Calibration report
.Buffer		
.Number	1...**2**...9	Number of buffers for calibration
.Type	**Metrohm**, NIST, DIN, Fisher, Merck, Ciba, Ingold, Beckman, Radiometer, special, own, mixed	Selection of buffer set
.Special		Special buffers
.1		1st special buffer
.Val	0... ± 19.999	pH value
:		
.n		
.Own		Definition of own buffers
.1		1st buffer
.1		Temperature no. 1; 0 °C
.Val	0... ± 19.999	pH value at 0 °C
.2		Temperature no. 2; 5 °C
:		
.20		Temperature no. 20; 95 °C
.2		2nd buffer
:		
.5		Maximum 5 buffers
.Mixed		Mix of buffers
.1		1st buffer
.Select	Met X, NIST X, DIN X, Fis X, Mer X, Cib X, Ing X, Bec X, Rad X, own X	Selection of buffer, X = buffer designation; e.g. Met 9 = Metrohm buffer pH = 9.
:		
.5		Maximum 5 buffers
.UOffset	$G	Acquisition of measured value
.Status	ON, meas, **OFF**	Status of UOffset. meas = preparation for measured value
.Value	0... ± 1999.9	Measuring or fixed value.
.ElTestPara		Parameters for electrode test
.Temperature	0...**25.0**...99.9	Temperature
.Report	full, short OFF	Report
.AnalogOutput		

.Select	**pH**, T	Assignation
.pH		
«.Analog output macro»		
.T		
«.Analog output macro»		
.LimitspH		
«.Limit macro»		
.LimitsT		
«.Limit macro»		
.U		
.MeasPara		
.MeasInput	1, 2, diff	
.ElectrodeId	8 ASCII	
.Drift	0.5...**1**...999.9, OFF	Drift value in mV/min
.MethodId	Read only	Method name
«.Delta»		Macro
«.Stirrer»		Macro
.AnalogOutput		
«.Analog output macro»		
.Limits		
«.Limit macro»		
.T		
.MeasPara		
.ElectrodeId	8 ASCII	
.Drift	0.5...**1**...999.9, OFF	Drift value in °C/min or °F/min
.MethodId	Read only	Method name
«.Delta»		Macro
«.Stirrer»		Macro
.AnalogOutput		
«.Analog output macro»		
.Limits		
«.Limit macro»		
.Ipol		
.MeasPara		
.ElectrodeId	8 ASCII	
.Drift	0.5...**1**...999.9, OFF	Drift value in mV/min
.Current	−127...**1**...127	Polarization current
.MethodId	Read only	Method name
«.Delta»		Macro
«.Stirrer»		Macro
.AnalogOutput		
«.Analog output macro»		
.Limits		
«.Limit macro»		

&UserMeth		User methods
.FreeMemory	Read only	Memory still available
.Recall	$G	Move method to foreground
.Name	n ASCII	Method name
.Store	$G	Store method
.Name	n ASCII	Method name
.Delete	$G	Delete method
.Name	n ASCII	Method name
.DeleteAll	$G	Delete all methods

&Config		User methods
.Aux		
.LastDigit	**ON**, OFF	Last digit of display
.Language	**english**, deutsch, francais, español	Language selection for manual operation; remote control language: english only
.Set	$G	Sets date and time
.Date	XX-XX-XX	Format: YY-MM-DD
.Time	XX:XX:XX	HH-MM-SS; 24 h format
.TempUnit	C, F	Temperature unit °C or °F
.RunNo	**0**...999, OFF	Current run number
.DevName	8 ASCII	Instrument name
.Prog	Read only	Program version
.Printer		
.CharSet	Epson, Seiko, **IBM**, Citizen	Selection of character set
.PrintHead	**once**, always, OFF	Print header once, always, never
.DateTime	**ON**, OFF	Date and time for print header
.Id1	16 ASCII	Additional identifier for print header
.Id2	16 ASCII	Additional identifier for print header
.PrintMeasVal	$G, $S	Send/print (same as <print> key)
.PrintCrit	drift, OFF, **Immediate**, time	Print criterion for measured value
.Time		
.Interval	0.08...**4**...99999	Time interval for sending, in seconds
.StopTime	1...999999, **OFF**	When elapsed, an EOD is sent
.DateTime	**ON**, OFF	Date and time for measured value
.RSSet	$G	$G sets RS 232 parameters
.Baud	Value	Baud rate, default value 9600
.Data bit	7, **8**	Data length
.Stop bit	1, 2	Stop bits
.Parity	even, odd, **none**	Parity
.Handsh	HWf, HWs, SWchar, SWline, none	Handshake
(.RSControl		This node is not visible during RS 232 operation)
&Info		
.Report	$G, $S	$G sends formatted reports
.Select	user memory, calib, config, param, el. test, all	Selection of report type
.pHCalData		pH calibration data
.ElectrodeId	Read only	Electrode identification
.Slope	0.001...**1**...9.999	Slope
.pHas	0...**7**...99.999	Asymmetry pH
.CalTemp	Read only	Calibration temperature
.DateTime	Read only	Date and time of calibration
.Variance	Read only	Statistics parameter
.MeasInput	Read only	Measuring input
.BufferType	Read only	Buffer set
.NoBuffer	Read only	Number of buffers used for calibration
.CalTab		Buffer table
.Select	original, delete n, reset cal	
.DeleteN	**1**...9	Delete measurement with buffer N
.MeasData		Query for measured values
.1		Buffer 1
.pH	Read only	Nominal pH value
.U	Read only	Measured potential

.dpH	Read only	Deviation resulting from regression analysis
.2		Buffer 2
.ElTestData		Electrode Test Data
.ElectrodeId	Read only	Electrode identification
.Temp	Read only	Temperature
.DateTime	Read only	Date and time of test
.MeasInput	Read only	Measuring input
.Message	Read only	Result of electrode test
.ActualInfo		
.Inputs		
.Status	Read only	Status query in byte form
.Change	Read only	Change of line since Clear, in byte form. Example: |1|0|0|0|1|0|0|0| 7 6 5 4 3 2 1 0 Decimal output: "136"
.Clear	$G	Clears Change byte
.Outputs		
.Status	Read only	Status query in byte form
.Change	Read only	Change of line since Clear
.Clear	$G	Clears Change byte
.MeasValue		Measured value
.Primary	Read only	Primary measured value
.Secondary	Read only	Secondary measured value
.Display		SQ sends whole display
.Value	Numerical value	Main display; measured value
.Unit	Unit	Main display; unit
.Ind		Indicators in byte form | 7 | 6 | 5 | 4 | 3 | 2 | 1 | Ref Slpe pH_{as} Cal Dlta Drft Ipl Output: decimal
.L1	24 ASCII	LCD Line 1
.L2	24 ASCII	LCD Line 2
.Assembly		
.CycleTime	Read only	Measuring cycle in seconds

&Assembly		
.Meas		Measurement
.Status	**ON**, OFF	Switch measurement on or off
.Outputs		Assignment of Output lines of Remote socket
.SmplX	**ON**, OFF	Sample Changer assignment; with OFF, I/O inputs are inactive
.AutoEOD	ON, OFF	Automatic output of EOD signal at the end of a determination → forward pulse for Sample Changer
.SetLines	$G	Set lines
.L1	active, inactive, pulse, **OFF**	
:		
.L8	24 ASCII	
.ResetLines	$G	Switch off all lines

&Setup		
.IdReport	ON, OFF	Report identification on/off With printer: No report id's
.Keycode	ON, OFF	Sends the code of actuated keys | #XX|
.Trace	ON, OFF	Instrument sends path and value upon changes | &XXX"XXX"|
.Lock		
.Keyboard	ON, OFF	Lock all keys
.Config	ON, OFF	Lock <config> key
.Parameter	ON, OFF	Lock <param> key
.Cal	ON, OFF	Lock <Cal> key
.UserMeth		
.Recall	ON, OFF	Lock recall function of <methods>
.Store	ON, OFF	Lock store function of <methods>
.Delete	ON, OFF	Lock delete function of <methods>
.CalData	ON, OFF	Lock <cal. data> key
.Mode	ON, OFF	Lock <mode> key
.ElTest	ON, OFF	Lock <el. test> key
.Display	ON, OFF	Display is no longer served by 713's program
.AutoInfo		Automatic message upon status change
.Message		Definition of message Full message: Space!DevName"nodes involved"Date Time; e.g., !713pHM".G;.E;.I" 92-09-24 16:33:09
.DateTime	ON, OFF	Date and time of occurrence
.P	ON, OFF	PowerOn if line power is on
.G	ON, OFF	Procedure has been started
.R	ON, OFF	Ready
.S	ON, OFF	Instrument has been stopped
.E	ON, OFF	Error
.Re	ON, OFF	Instrument in "request" mode
.D	ON, OFF	DriftOk if drift condition ok
.I	ON, OFF	Input: change upon inputs
.O	ON, OFF	Output: change upon outputs
.InputAssign		Assignment of I/O line inputs
.pH	0...**1**...15	Mode pH
.T	0...**2**...15	Mode T
.U	0...**3**...15	Mode U
.Ipol	0...**4**...15	Mode Ipol
.pHcal	0...**5**...15	Start pH calibration
.ElTest	0...**6**...15	Start electrode test
.Enter	0...**15**	<enter> key
.TMeas		
.Cycles	3...9...9999, OFF	Temperature measurement in pH mode: every n^{th} cycle
.Graphics		
.Grid	ON, OFF	Grid across graph
.Frame	ON, OFF	Frame around graph
.Recorder		
.Right	0.4...**0.8**...1	Recording width
.Feed	0.4...**1.0**	Recording length

&Diagnose		Entry into diagnostic program stops measurement
.Init	$G	Set default values
.Select	Value	Value: ActMode, Modes, Setup, Config, Assembly, All
.RamTest	$G	Starts RAM test
.PolarizerTest	$G	Starts polarizer test
.PlasmaTest	$G, $S	Plasma test
.LcdTest	$G, $S	LCD test
.IoTest	$G, $S	Input/output test
.RSTest	$G, $S	RS 232 interface test
.KeyTest	$G, $S	Key test
.SimulateKey	0...23	Simulates pressing of key
.Adjust	$G, $S	Sets adjustment data
.Report	ON, OFF	Adjustment report
.PowerOn	$G	Simulation of power on

7.6 Troubleshooting

Problem	Questions for corrective 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 using the <report> key. If this report is printed out correctly, check whether a report is specified at all for the corresponding procedure (calibration, electrode test).
No data transmission occurs and the display of the 713 pH Meter shows an error message.	– **RS error 40–42:** Transmission error. Is the cable used properly wired and connected? Is the printer switched on and set to «on-line»? – **RS error 43:** Data output of the 713 pH Meter disabled for longer than 3 s by XOFF. – **RS error 36–39:** Receive error. Are the settings of the RS 232 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 713 pH Meter.) – Set «HWs» for the handshake at the 713 pH Meter. Configure the printer such that its DTR is set (normally with DIP switches).

Appendix

A 1. Technical specifications

Sensor-related effects not considered.

Modes available

pH	pH value
°C, °F	Temperature
mV	Voltage
mV_{Ipol}	Voltage of polarized electrodes

Sensor inputs

2 high-impedance inputs for pH, ion selective or redox electrodes.

1 input for reference electrode, consisting of 2 banana sockets that are connected with each other and with the shields of the 2 high-impedance inputs (if the 2 sensors are in the same solution, use 1 reference electrode only). These inputs can be used for differential potentiometric measurements.

1 input for polarized electrodes.

1 input for temperature sensors Pt 100 or Pt 1000.

Measuring ranges

pH	–19.999 ... 19.999
Temperature	–170.0 ... 500 °C (–274.0 ... 932.0 °F)
Voltage	–1999.9 ... 1999.9 mV
Voltage with I_{pol}	–1999.9 ... 1999.9 mV

Resolution

pH	0.001
Temperature	0.1 °C (0.1 °F)
Voltage	0.1 mV
Voltage with I_{pol}	0.1 mV

Measuring frequency

With last digit on	2.5 Hz (cycles/s)
With last digit off	12.5 Hz (cycles/s)
Temperature in the pH mode	
Every n^{th} cycle is a temperature measurement	n = 3 ... 9 ... 9999, OFF (9 = default value)
Setting of n	Power on & <config> – >temp. measurement – temp. meas n.

Measuring error

Absolute (at adjustment temperature)	
pH	± 0.003 ± 1 digit
Temperature	± 0.1 °C ± 1 digit in the –130 ... 500 °C range
Voltage	± 0.2 mV ± 1 digit
Voltage with I_{pol}	± 0.2 mV ± 1 digit
As a function of the operating temperature	
pH	± 0.004% of (reading–7)/K ± offset deviation
Temperature	± 0.03 °C/K
Voltage	± 0.004% of reading/K ± offset deviation
Voltage with I_{pol}	± 0.004% of reading/K
Common mode error (differential potentiometry)	
Common mode rejection DC	>55 dB

Measuring amplifier (inputs pH/ISE 1 and pH/ISE 2)

Input resistance	$>10^{13}\ \Omega$
Offset current	$<3\times10^{-13}$ A
Deviation of offset voltage as a function of the operating temperature	<15 µV/K

Polarizer current

I_{pol}	–127 ... 127 µA
Resolution	1 µA
Error	± 1.5% of selected value ± 0.7 µA

pH measurement

Compensation of temperature effect within the 0 ... 100 °C range.

continued ...

pH calibration

Number of buffers	1, 2 ... 9
Buffer recognition	Automatic.
Buffer series stored as functions of temperature	Metrohm, NIST, DIN, Fisher, Ciba, Ingold, Merck, Beckman, Radiometer.
«Mixed» buffer sets	5 buffer series can be selected from those mentioned above.
«Own» buffer sets	5 buffer series can be entered as a function of temperature.
«Special» buffers (no automatic recognition)	9 single buffer values can be entered.

RS 232 interface

Purpose	Connection of a printer. Connection of a computer; the 713 pH Meter can be controlled entirely via the computer keyboard.

«Remote» I/O lines

Purpose	Connection of sample changer or laboratory robot.
Input lines	Start, Enter, Sample Ready.
Output lines	Basic state, End of measurement, Error, Activate, lines to be set via RS 232 control.

Analog output

Output signal	–2000 ... 2000 mV (see section 6.3.1)
Signal type	According to current mode; in the pH mode, pH or T can be selected.
Resolution	1 mV (12 bit)
Output signal error	
Absolute (at adjustment temp.)	± 1.5 mV
As a function of the operating temperature	± 0.005% of selected output/K ± 50 µV/K

The above specifications apply under the following conditions:

Adjustment interval	1 year
Adjustment temperature	23 ± 2 °C
Operating temperature	5 ... 50 °C
Relative humidity	5 ... 85%
Temperature during transport and storage	–20 ... 70 °C
Measuring frequency	2.5 Hz (cycles/s)

Displays

Main display	
Type	Gas discharge display.
Character height	15 mm
Dialog display	
Type	LCD, 2 lines of 24 characters each.
Character height	5 mm

Materials

Housing	Light metal alloy, stove-enamelled.
Keypad	Chemically resistant plastic film (polyester).

Safety specifications

Designed and tested in accordance with IEC publication 348, safety class I. This manual contains information and warnings that have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.

Power connection

Voltage	100, 117, 220 (230), 240 V ± 10% (switchable)
Frequency	50 ... 60 Hz (cycles/s)
Power consumption	8 VA
Fuse	Thermal fuse

Dimensions

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

Weight, including standard accessories	3.3 kg

A 2. Scope of delivery; options

Scope of delivery

	2.713.0010	713 pH Meter,
		including the following accessories:
1 ×	6.2001.030	Base plate for stand rod
1 ×	6.2013.010	Clamping ring
1 ×	6.2016.050	Stand rod
1 ×	6.2021.020	Electrode holder
1 ×		Power cable with cable plug to customer's specifications:
	6.2122.020	Plug type SEV 12 (Switzerland ...), socket type IEC 320/C13
	6.2122.040	Plug type CEE(7), VII (Germany ...), socket type IEC 320/C13
	6.2122.070	Plug type NEMA/ASA (USA ...), socket type CEE(22) V
1 ×	6.2723.270	Dust cover
1 ×	8.713.1003	Instructions for Use for 713 pH Meter

Options

For more detailed information, see the Electrode Catalogue and the Monograph «Electrodes in Potentiometry», which you can obtain free of charge from your Metrohm agency.

6.2021.020	Electrode holder for stand rod of 10 mm diameter; for up to 4 electrodes and 2 burette tips
6.1236.040	SGJ sleeve made of silicone rubber for electrodes without SGJ 14/15
6.2104.020	Cable for pH electrodes, ion-selective electrodes, combined silver and noble-metal electrodes fitted with a plug-in head; length 1 m, with plug F (Ø ≈ 5 mm)
6.2104.000	Adapter for the attachment of electrodes with E plug (DIN 19 262) to the 713 pH Meter
6.2103.090	Adapter for the attachment of electrodes with BNC plug to the 713 pH Meter
6.0233.100	Combined pH electrode with plug-in head and SGJ; with low-resistance membrane glass, with fewer diaphragm problems and short response time on temperature change
6.0238.000	Combined pH electrode with built-in Pt 1000 temperature sensor, SGJ and fixed cable (1 m) with plug F and 2 × plug B
6.0218.010	Combined pH electrode with built-in Pt 100 temperature sensor, SGJ and fixed cable (1 m) with plug F and 2 × plug B
6.0415.100	Combined platinum cap electrode with plug-in head and SGJ
6.0308.100	Double platinum wire electrode (each 0.8 × 6 mm) with plug-in head and SGJ
6.1103.000	Pt 100 resistance thermometer with SGJ and fixed cable (length 1 m, 2 × plug B)
6.2305.010	3 × 50 mL concentrate pH = 4; to be diluted to 250 mL
6.2305.020	3 × 50 mL concentrate pH = 7; to be diluted to 250 mL
6.2305.030	3 × 50 mL concentrate pH = 9; to be diluted to 250 mL
6.2307.000	1000 mL ready-to-use buffer solution pH = 4
6.2307.010	1000 mL ready-to-use buffer solution pH = 7
6.2307.020	1000 mL ready-to-use buffer solution pH = 9

continued ...

6.2306.020	250 mL ready-to-use redox standard solution; can also be used as buffer pH = 7
6.2313.000	1000 mL electrolyte solution c(KCl) = 3 mol/L; for Ag/AgCl reference systems
6.2125.020	Connecting cable 713 – Seiko printer DPU-411-11BX (X = U (USA), E (Europe) or J (Japan))
6.2125.050	Connecting cable 713 – printers with 25-pin connector (DB 25), e.g. Citizen iDP 560 RS, Epson FX, LX, LQ or Kodak Diconix 180 si
6.2125.040	Connecting cable 713 – Epson printer with 6-pin circular connector (DIN 45 322; 60 °)
6.2125.060	Connecting cable 713 – IBM® PC/XT/PS-2 and compatibles
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 713 – 614 Impulsomat
3.980.3560	Connecting cable 713 – 664 Control Unit for Sample Changer
6.2138.000	Connecting cable 713 – 622, 649 or 722 Stirrer or 727 Titration Stand
6.6008.010	PC program VESUV for the acquisition of measuring data on a PC. User dialogue configurable in English or German. Data from up to 8 Metrohm instruments can be received, stored as ASCII text files and printed out.

A 3. Buffer sets stored in the 713 pH Meter

Of the buffer sets cited below, only those with **bold** headings are directly accessible. However, those with light-faced heading can be used for composing mixed buffer sets.

The buffer designations appearing below are identical to those in the dialog of the 713 pH Meter; they may, in some cases, differ from the actual buffer designations.

The calibration at temperatures where the respective buffer value is not listed («–» in the tables) should be avoided (error message: «buffer alloc. impossible»).

Temp. °C	**Metrohm buffers «Met»**					**NIST[a] buffers «NIST»**				
	pH 1.00 ±0.02	**pH 4.00** ±0.02	**pH 7.00** ±0.02	**pH 9.00** ±0.02	**pH 13.00** ±0.03	**pH 1**	**pH 4**	**pH 7**	**pH 9**	**pH 13**
0	–	3.99	7.11	9.27	–	–	4.010	6.984	9.464	13.423
5	–	3.99	7.08	9.18	–	1.668	4.004	6.951	9.395	13.207
10	0.99	3.99	7.06	9.13	13.38	1.670	4.000	6.923	9.332	13.003
15	0.99	3.99	7.04	9.08	13.18	1.672	3.999	6.900	9.276	12.810
20	1.00	3.99	7.02	9.04	**13.00**	1.675	4.001	6.881	9.225	12.627
25	**1.00**	**4.00**	**7.00**	**9.00**	12.81	1.679	4.006	6.865	9.180	12.454
30	1.00	4.00	6.99	8.96	12.62	1.683	4.012	6.853	9.139	12.289
35	1.00	4.01	6.98	8.93	12.46	1.688	4.021	6.844	9.102	12.133
40	1.00	4.02	6.98	8.90	12.30	1.694	4.031	6.838	9.068	11.984
45	1.01	4.03	6.97	8.87	12.14	1.700	4.043	6.834	9.038	11.841
50	1.01	4.04	6.97	8.84	11.98	1.707	4.057	6.833	9.011	11.705
55	1.01	4.06	6.97	8.81	11.84	1.715	4.071	6.834	8.985	11.574
60	1.01	4.07	6.97	8.79	11.70	1.723	4.087	6.836	8.962	11.449
65	1.01	4.09	6.98	8.76	11.57	1.732	4.108	6.840	8.941	–
70	1.01	4.11	6.98	8.74	11.45	1.743	4.126	6.845	8.921	–
75	1.02	4.13	6.99	8.73	11.32	1.754	4.145	6.852	8.902	–
80	1.02	4.15	7.00	8.71	11.20	1.766	4.164	6.859	8.885	–
85	1.02	4.18	7.00	8.70	11.09	1.778	4.185	6.867	8.867	–
90	1.02	4.20	7.01	8.68	10.98	1.792	4.205	6.877	8.850	–
95	–	4.23	7.02	8.67	–	1.806	4.227	6.886	8.833	–

a) NIST = National Institute of Standards and Technology (formerly NBS)

Temp. °C	**DIN[b] buffers «DIN»**						**Fisher buffers «Fis»**		
	pH 1	**pH 3**	**pH 4**	**pH 7**	**pH 9**	**pH 12**	**pH 4**	**pH 7**	**pH 10**
0	1.08	–	4.67	6.89	9.48	–	4.01	7.13	10.34
5	1.08	–	4.66	6.86	9.43	–	3.99	7.10	10.26
10	1.09	3.10	4.66	6.84	9.37	13.37	4.00	7.07	10.19
15	1.09	3.08	4.65	6.82	9.32	13.15	3.99	7.05	10.12
20	1.09	3.07	4.65	6.80	9.27	12.96	4.00	7.02	10.06
25	1.09	3.06	4.65	6.79	9.23	12.75	4.00	7.00	10.00
30	1.10	3.05	4.65	6.78	9.18	12.61	4.01	6.99	9.94
35	1.10	3.05	4.66	6.77	9.13	12.44	4.02	6.98	9.90
40	1.10	3.04	4.66	6.76	9.09	12.29	4.03	6.97	9.85
45	1.10	3.04	4.67	6.76	9.04	12.13	4.04	6.97	9.81
50	1.11	3.04	4.68	6.76	9.00	11.98	4.06	6.97	9.78
55	1.11	3.04	4.69	6.76	8.97	11.84	4.07	6.97	9.74
60	1.11	3.04	4.70	6.76	8.92	11.69	4.09	6.98	9.70
65	1.11	3.04	4.71	6.76	8.90	11.56	4.11	6.99	9.68
70	1.11	3.04	4.72	6.76	8.88	11.43	4.13	7.00	9.65
75	1.12	3.04	4.74	6.77	8.86	11.30	4.14	7.02	9.63
80	1.12	3.05	4.75	6.78	8.85	11.19	4.16	7.03	9.62
85	1.12	3.06	4.77	6.79	8.83	11.08	4.18	7.06	9.61
90	1.13	3.07	4.79	6.80	8.82	10.99	4.21	7.08	9.60
95	–	–	–	–	–	–	4.23	7.11	9.60

b) DIN = Deutsches Institut für Normung (German Standards Association)

Temp. °C	Ciba buffers «Cib»			Ingold buffers «Ing»				
	pH 4	pH 7	pH 9	pH 2	pH 4	pH 7	pH 9	pH 11
0	4.01	7.11	9.20	2.03	4.01	7.12	9.52	11.90
5	4.00	7.08	9.15	2.02	4.01	7.09	9.45	11.72
10	4.00	7.05	9.10	2.01	4.00	7.06	9.38	11.54
15	4.00	7.02	9.05	2.00	4.00	7.04	9.32	11.36
20	4.00	7.00	9.00	2.00	4.00	7.02	9.26	11.18
25	4.01	6.98	8.96	2.00	4.01	7.00	9.21	11.00
30	4.01	6.97	8.91	1.99	4.01	6.99	9.16	10.82
35	4.02	6.96	8.88	1.99	4.02	6.98	9.11	10.64
40	4.03	6.95	8.84	1.98	4.03	6.97	9.06	10.46
45	4.04	6.94	8.80	1.98	4.04	6.97	9.03	10.28
50	4.06	6.94	8.77	1.98	4.06	6.97	8.99	10.10
55	4.07	6.93	8.74	1.98	4.08	6.98	8.96	–
60	4.09	6.93	8.71	1.98	4.10	6.98	8.93	–
65	4.11	6.93	8.69	1.98	4.13	6.99	8.90	–
70	4.13	6.94	8.67	1.99	4.16	7.00	8.88	–
75	4.14	6.94	8.65	1.99	4.19	7.02	8.85	–
80	4.16	6.95	8.63	2.00	4.22	7.04	8.83	–
85	4.18	6.96	8.61	2.00	4.26	7.06	8.81	–
90	4.21	6.97	8.60	2.00	4.30	7.09	8.79	–
95	4.23	6.98	8.59	–	4.35	7.12	8.77	–

Temp. °C	Merck buffers (1) «Mer»									
	pH 1	pH 2	pH 3	pH 4	pH 4.66	pH 5	pH 6	pH 6.88	pH 7	pH 8
0	0.96	2.01	3.05	4.05	4.68	5.06	6.04	6.98	7.13	8.15
5	0.99	2.01	3.05	4.04	4.68	5.05	6.02	6.95	7.07	8.10
10	0.99	2.01	3.03	4.02	4.67	5.02	6.01	6.92	7.05	8.07
15	0.99	2.00	3.01	4.01	4.67	5.01	6.00	6.90	7.02	8.04
20	1.00	2.00	3.00	4.00	4.66	5.00	6.00	6.88	7.00	8.00
25	1.01	2.00	3.00	4.01	4.66	5.00	6.02	6.86	6.98	7.96
30	1.01	2.00	3.00	4.01	4.66	5.00	6.03	6.86	6.98	7.94
35	1.01	2.00	3.00	4.01	4.66	5.00	6.03	6.85	6.96	7.92
40	1.01	2.00	2.98	4.01	4.67	5.00	6.04	6.84	6.95	7.90
45	1.01	2.00	2.975	4.00	4.675	5.005	6.05	6.84	6.95	7.875
50	1.01	2.00	2.97	4.00	4.68	5.01	6.06	6.84	6.95	7.85
55	1.015	2.00	2.97	4.00	–	5.025	6.08	6.84	6.95	7.84
60	1.02	2.00	2.97	4.00	–	5.04	6.10	6.84	6.96	7.83
65	1.02	2.00	2.97	4.00	–	5.045	6.11	6.84	6.96	7.815
70	1.02	2.01	2.97	4.00	–	5.05	6.12	6.84	6.96	7.80
75	1.02	2.01	2.97	4.00	–	5.075	6.145	6.85	6.96	7.79
80	1.02	2.01	2.97	4.00	–	5.10	6.17	6.86	6.97	7.78
85	1.02	2.01	2.965	4.00	–	5.12	6.205	6.87	6.98	7.765
90	1.02	2.01	2.96	4.00	–	5.14	6.24	6.88	7.00	7.75
95	–	–	–	4.00	–	–	–	–	7.02	–

continued...

Temp. °C	Merck buffers (2) «Mer»						Beckman buffers «Bec»		
	pH 9	pH 9.22	pH 10	pH 11	**pH 12**	pH 13	**pH 4 (red)**	**pH 7 (green)**	**pH 10 (blue)**
0	9.24	9.46	10.26	11.45	12.58	13.80	4.00	7.12	10.32
5	9.16	9.40	10.17	11.32	12.41	13.59	4.00	7.09	10.25
10	9.11	9.33	10.11	11.20	12.26	13.37	4.00	7.06	10.18
15	9.05	9.28	10.05	11.10	12.10	13.18	4.00	7.04	10.12
20	9.00	9.22	10.00	11.00	12.00	13.00	4.00	7.02	10.06
25	8.95	9.18	9.94	10.90	11.88	12.83	4.00	7.00	10.01
30	8.91	9.14	9.89	10.81	11.72	12.67	4.01	6.99	9.97
35	8.88	9.10	9.84	10.72	11.67	12.59	4.02	6.985	9.93
40	8.85	9.07	9.82	10.64	11.54	12.41	4.03	6.98	9.89
45	8.82	9.04	9.78	10.56	11.435	12.28	4.045	6.975	9.86
50	8.79	9.01	9.74	10.48	11.33	12.15	4.06	6.97	9.83
55	8.76	8.985	9.705	10.465	11.185	11.95	4.075	6.975	–
60	8.73	8.96	9.67	10.45	11.04	11.75	4.09	6.98	–
65	8.715	8.945	9.645	10.32	10.97	11.68	4.105	6.985	–
70	8.70	8.93	9.62	10.19	10.90	11.61	4.12	6.99	–
75	8.68	8.91	9.585	10.125	10.80	11.50	4.14	6.995	–
80	8.66	8.89	9.55	10.06	10.70	11.39	4.16	7.00	–
85	8.65	8.87	9.52	9.995	10.59	11.27	4.175	7.01	–
90	8.64	8.85	9.49	9.93	10.48	11.15	4.19	7.02	–
95	–	–	–	–	–	–	4.21	7.03	–

Temp. °C	Radiometer buffers «Rad»							
	pH 1.09	pH 1.68	**pH 4.01**	pH 6.84	**pH 7.00**	pH 7.38	**pH 9.18**	pH 10.01
0	1.082	1.666	4.000	6.984	7.118	7.534	9.464	10.317
5	1.085	1.668	3.998	6.951	7.087	7.500	9.395	10.245
10	1.087	1.670	3.997	6.923	7.059	7.472	9.332	10.179
15	1.089	1.672	3.998	6.900	7.036	7.448	9.276	10.118
20	1.091	1.675	4.001	6.881	7.016	7.429	9.225	10.062
25	1.094	1.679	4.005	6.865	7.000	7.413	9.180	10.012
30	1.096	1.683	4.011	6.853	6.987	7.400	9.139	9.966
35	1.098	1.688	4.018	6.844	6.977	7.389	9.102	9.925
40	1.101	1.694	4.027	6.838	6.970	7.380	9.068	9.889
45	1.103	1.700	4.038	6.834	6.965	7.373	9.038	9.856
50	1.106	1.707	4.050	6.833	6.964	7.367	9.011	9.828
55	1.108	1.715	4.064	6.834	6.965	7.361	8.985	9.813
60	1.111	1.723	4.080	6.836	6.968	–	8.962	9.782
65	1.113	1.732	4.097	6.840	6.974	–	8.941	9.765
70	1.116	1.743	4.116	6.845	6.982	–	8.921	9.751
75	1.119	1.754	4.137	6.852	6.992	–	8.900	9.739
80	1.121	1.765	4.159	6.859	7.004	–	8.885	9.731
85	1.124	1.778	4.183	6.867	7.018	–	8.867	9.726
90	1.127	1.792	4.210	6.877	7.034	–	8.850	9.724
95	–	–	4.240	6.886	–	–	–	–

A 4. Diagnosis

The 713 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 cannot be excluded completely, it is certainly much more likely that malfunctions are caused by wrong operation or handling or through improper connections and 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.

In inquiries always quote the manufacturing (section 1.2) and program number (see <config>, section 2.3) and specify possible error displays.

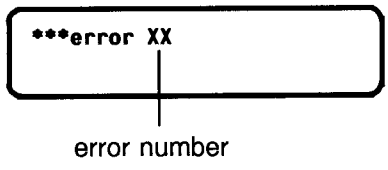
Procedure

- The diagnostic steps must be performed in sequence and compared with the reactions of the 713 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 steps marked with a triangle (≫) allow re-entry into the test routine for repetition if the following display appears:

- Selection of the diagnosis program with key <9>.

  If the instrument is in a subprogram of the diagnostic routine: Press the <quit> key.

  If need be, switch the power off then on again after a few seconds. At the same time press key "9" until the above display appears.
- If the <quit> key is pressed during the display of 'diagnose >XXXXXXXX', the instrument jumps back into the user program.
- Error display: An error is shown in the display as follows:



Equipment required:
- voltage calibrator, e.g. Metrohm pH Simulator 642[1]
- Resistor switch-box, class 0.1% (or resistor 14.3 k 0.1 %)

Necessary only if external functions should also be checked:
- 3.496.8510 Test Plug (at 'Remote' connector)
- 3.496.8480 Test Plug (at 'RS 232' connector)
- 3.496.5070 cable

1 If no suitable voltage calibrator is available: Use any stable voltage source and connect a precise DVM in parallel.

≫ 1. **Prepare instrument for diagnosis**

Power off

Remove all external connections (cables at rear, except power cable)

Switch on and immediately press key <9>, holding it down until power-up test pattern disappears. The LCD display then shows:

```
diagnose
>RAM Initialization
```

≫ 2. **Plasma display test**

Press <9> repeatedly until

```
diagnose
>Plasma Display Test
```

Press <enter>

On pressing the <enter> key, characters will be generated for visually checking the display, see Fig. A 4.1.

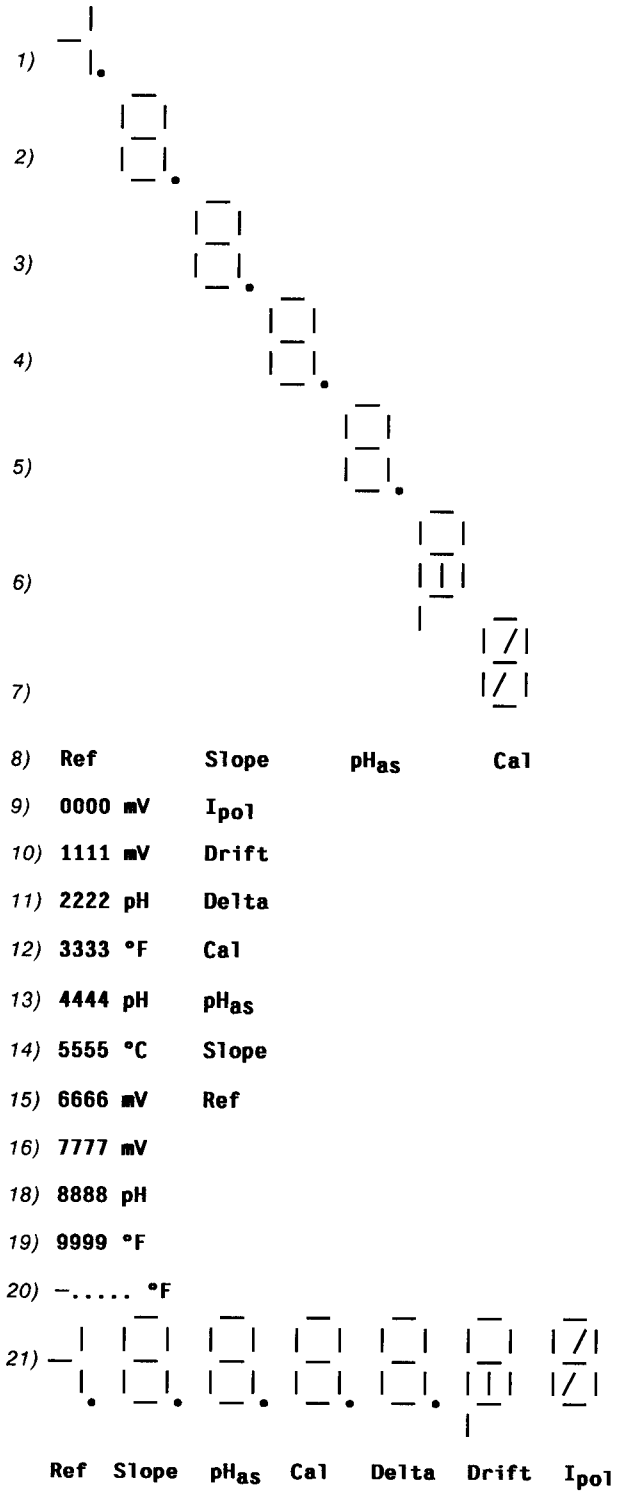


Fig. A 4.1 Sequence of display test

The test sequence can be stopped and started again by pressing key <5>.

```
diagnose
>LCD Display Test
```

≫ 3. **LCD display test**

If necessary, press <9> repeatedly until

```
diagnose
>LCD Display Test
```

Press <enter>

On pressing the <enter> key, characters will be generated on both lines for visually checking the display.

Test sequence:

- Each pixel on the display is activated.
- Display is cleared, first marked with '#', then with 'H' and finally with 'I'.
- The full character set is shown in a continuous string (0, 1, ..., 9, A, B, ..., Y, Z).
- The test sequence can be stopped and started again by pressing key <5>.
- To quit the test, press the <mode> key.

```
diagnose
>Input/Output Test
```

≫ 4. **Keyboard test**

Press <9> repeatedly until

```
diagnose
>Key Test
```

Press <enter>

```
>Key Test
```

Pressing any key will cause the matrix code according to Fig. A 4.2 to appear on the display (0 - 22). Check the code displayed.

```
>Key Test
code: XX
```

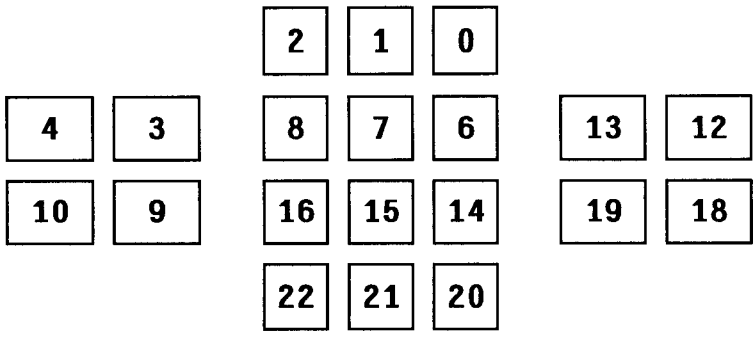


Fig. A 4.2 Keyboard with key numbers

To quit the test, press the <mode> key twice.

```
diagnose
>Instrument Adjustment
```

≫ 5. **Polarizer test**

Press <9> repeatedly until

```
diagnose
>Polarizer Test
```

Press <enter>

```
>Polarizer Test
dummy resistor 14.3k ?
```

Use 2 short lab cables to connect resistance decade (or suitable resistor 14.3 k/0.1 %) to socket 'Ipol'.
Set decade to 14.3 k.

Press <enter>

```
>Polarizer Test
 polarizer testing     *
```
— blinks

The plasma display shows mV values measured while testing.

The test runs automatically. If everything is OK, after about 16 s there appears:

```
>Polarizer Test
 polarizer ok
```

If not, an error message appears. (If no decade is connected, 'Error 100' appears.)

Remove cables and resistance decade.

Press <enter>

```
diagnose
>Plasma Display Test
```

⩾ 6. External inputs and outputs

This test is useful only when the 713 pH Meter is used together with other equipment connected to the 'Remote' socket. Also, this test requires a test connector 3.496.8510 normally used for repairs/servicing. However, the customer can obtain this connector under the above number.
For the sake of completeness, the procedure is described here.
(If diagnosis of the external inputs and outputs is not required, continue from 7.)

Connector 3.496.8510

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

Fig. A 4.3 Pin allocation in connector 3.496.8510

Press <9> repeatedly until

```
diagnose
>Input/Output Test
```

Press <enter>

```
>Input/Output Test
 io connector ?
```

Insert connector 3.496.8510 in 'Remote' socket. (Do not switch off instrument, check connector is the right way round.)

Press <enter>

The test runs automatically. If everything is OK, there appears:

```
>Input/Output Test
 io test ok
```

If not, an error message appears. (If no test connector is in place, 'Error 50' appears.)

Remove test connector.

Press <enter>

```
diagnose
>RS-232 Test
```

⩾ 7. RS 232 test

This test is useful only when the 713 pH Meter is used together with other equipment connected to the 'RS 232' socket. Also, this test requires a test connector 3.496.8480 normally used for repairs/servicing. However, the customer can obtain this connector under the above number.

For the sake of completeness, the procedure is described here.

(If diagnosis of the RS 232 interface is not required, continue from 8.)

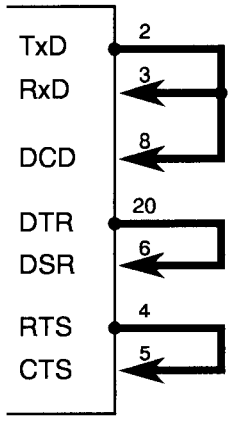


Fig. A 4.4 Connections in connector 3.496.8480

Press <9> repeatedly until

```
diagnose
>RS-232 Test
```

Press <enter>

```
>RS-232 Test
 rs connector ?
```

Insert connector 3.496.8480 in socket 'RS 232 C'.
(Do not switch off instrument, check connector is the right way round.)

Press <enter>

```
>RS-232 Test
 rs testing
```

The test runs automatically. If everything is OK, there appears

```
>RS-232 Test
 rs test ok
```

If not, an error message appears. (If no test connector is in place, 'Error 68' appears.)

Remove test connector.

Press <enter>

```
diagnose
>Key Test
```

≫ 8. **RAM test** *(not to be confused with RAM initialisation)*

Non-destructive RAM test of the whole range.

Press <9> repeatedly until

```
diagnose
>RAM Test
```

Press <enter>

```
>RAM Test
 ram test ok
```

<quit> twice

The previously selected mode in the instrument program appears.

≫ 9. **Check instrument calibration**

Connect DVM to analog output.

In case that another language is selected, but English is disired, see section 2.3.

9.1 **Potential measurement, check Input 1**

Press <mode> (as often as needed) until the display shows the mV range (mV without Ipol).

Press <param>, <enter>, <select> (<select> as often as needed) until

```
>measuring parameters
meas. input:          1
```

Press <enter>

```
>measuring parameters
electr.id
```

- Using a screened, highly insulated cable, connect a voltage calibrator (mV source, pH simulator *(set to 'low impedance')* etc.] of class 0.1 mV, or an inexact source with parallel precision voltmeter (0.1 mV), to measuring input pH/ISE on the 713. Set a voltage <2000 mV (e.g. 1900 mV) and compare readings. Wait till 'drift' disappears! (Tolerance ±1 mV)
- Compare DVM reading (Tolerance ±2 mV)
- Check resistance:
  (if source device allows) set source to 'high impedance' (Ri = 1000 MΩ) and compare indicated value with previous reading. Wait till 'drift' disappears! The value must not differ by more than 10 digit.

9.2 **Potential measurement, check Input 2**

Detach voltage source from measuring input 1 and connect to measuring input 2.

Press <quit>, <enter>

```
>measuring parameters
meas. input:          1
```

Press <select>

```
>measuring parameters
meas. input:          2
```

Press <enter>

```
>measuring parameters
electr.id
```

Compare the readings from the same measurements (high and low impedance) as in section 9.1.

9.3 Potential measurement, check derivative response

Short-circuit measuring input 1 with cable 3.496.5070.

Press <quit>, <enter>

```
>measuring parameters
meas. input:          2
```

Press <select>

```
>measuring parameters
meas. input:       diff.
```

Press <enter>

```
>measuring parameters
electr.id
```

Same readings as in 9.2, but opposite sign.

Detach calibrator, DVM and cable 3.496.5070.

9.4 Check temperature measurement

Press <mode> (as often as needed) until '°C' appears.

(Selection of temperature unit see section 2.3.)

Connect Pt 100 or Pt 1000 simulator (or appropriate resistors of 100 Ω or 1 kΩ/0.1 %) to socket 'Pt 100/Pt 1000', and read off the temperature (100 Ω and 1000 Ω are each equivalent to 0°C, Tolerance ±1°C).

Detach temperature simulator (or resistor).

End of diagnosis

⩾ 10. Put things back as they were

Re-connect the peripherals which were detached when diagnosis began, then do a quick function test that includes them.

⩾ 11. Initialise RAM

It can happen on rare occasions that severe noise signals (e.g. power spikes, lightning, etc.) can upset the processor functions and so result in a system crash. After a system crash, the RAM has to be initialised. Although the instrument's default data are preserved, RAM initialisation should be done only when necessary, as the stored user data (electrode calibration data, chosen buffers, configurations, etc.) are then erased.

Execute step 1 of diagnosis procedure.

```
diagnose
>RAM Initialization
```

Press <enter>

```
>RAM Initialization
Select:          ACTMODE
```

Press <select> repeatedly until

```
>RAM Initialization
Select:              ALL
```

Press <enter>

```
diagnose
>RAM Test
```

Press <enter>

```
>RAM Test
ram test ok
```

Press <quit> twice

The unit returns to the previously selected mode.

The data lost from the user memory must then be inputed again.

Execute step 10.

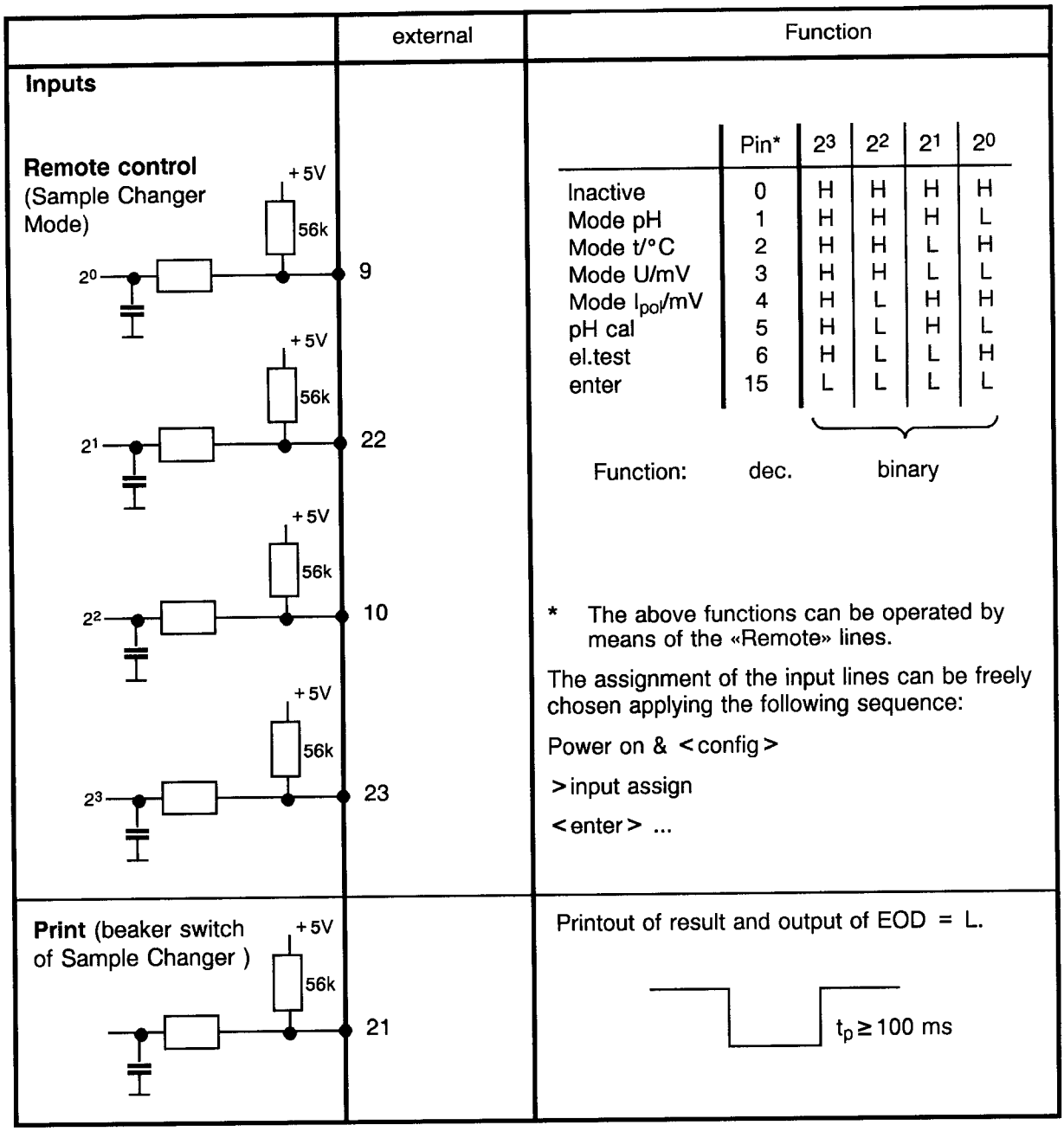
If the display shows 'system error 3', you can leave the instrument program with <quit>. The adjustment default values are then loaded automatically. This means that the instrument can still measure, but there may be a slight loss of accuracy. Metrohm Service can restore the optimum set-up. The error message 'system error 3' appears every time the instrument is switched on, until these adjustments have been made.

Problems and their possible causes

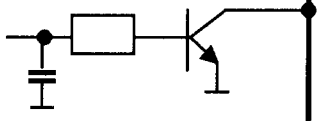
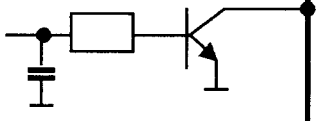
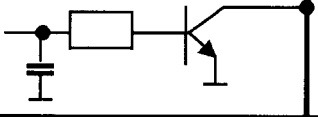
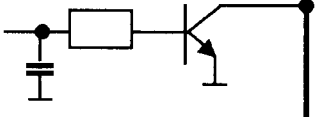
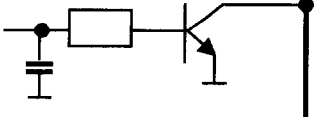
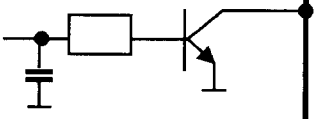
If your diagnosing keeps going wrong at the same point, the table below may help. If it doesn't, you will have get in touch with a Metrohm service centre.

Problem	Remedy
– No response from keyboard. Keying in commands has no effect. Instrument does nothing when key is pressed. – Plasma display does not function. – LCD display does not function.	Do step 1 of diagnosis routine, go into initialisation program with <enter>, select 'SETUP' procedure with <select> and start it with <enter>. If this is completed succesfully, the display shows '>RAM Test'. Then work through the diagnosis routine again.
RS 232 interface does not work.	Do step 1 of diagnosis routine, go into initialisation program with <enter>, select 'CONFIG' procedure with <select> and start it with <enter>. If this is completed successfully, the display shows '>RAM Test'. Then work through the diagnosis routine again.

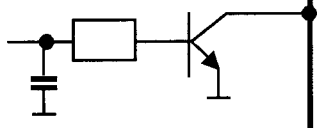
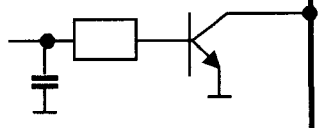
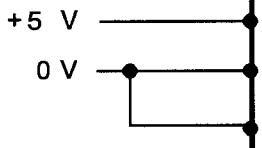
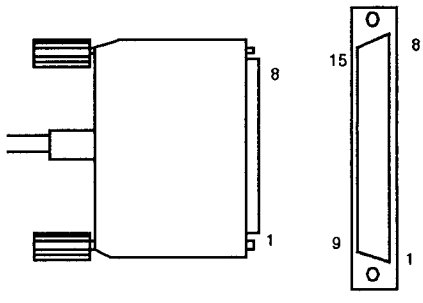
A 5. Pin assignment of the «Remote» socket



continued...

	external	Function
Outputs		
EOD: Sample Changer forward pulse (FP) 	17	 t_p = 20 ms V_{CE0} = 40 V I_C = 20 mA
Ready (End of procedure) 	5	Measured value ok = L Calibration procedure = H
Error 	16	In case of error = L
Upper limit, primary measured value 	18	Above upper limit = L V_{CE0} = 40 V I_C = 20 mA
Lower limit, primary measured value 	4	Below lower limit = L V_{CE0} = 40 V I_C = 20 mA
Upper limit, secondary measured value 	1	Above upper limit = L V_{CE0} = 40 V I_C = 20 mA

continued...

	external	Function
Lower limit, secondary measured value 	2	Below lower limit = L V_{CE0} = 40 V I_C = 20 mA
Stirrer 	3	If stirrer «ON» or «control» V_{CE0} = 40 V I_C = 20 mA
Voltage 	15 14 25	I ≤ 40 mA R_i = ca. 12 Ω
		Contact arrangement at plug (male) for «Remote» socket (female).  View from connector solder side Order numbers: K.210.0002 plug with K.210.9004 shell
No liability whatsoever is accepted for damage due to improper interconnection of instruments.		

Overview: Assignment of inputs and outputs

Mode	Inputs							
	0	1	2	3	4	5	6	7
Pin assignment DB-25	21	9	22	10	23	11	24	12
Sample Changer mode	Print	Remote 2^0	Remote 2^1	Remote 2^2	Remote 2^3			

Mode	Outputs							
	0	1	2	3	4	5	6	7
Pin assignment DB 25	5	18	4	17	3	16	1	2
Sample Changer, limits, stirrer	Ready	Primary, upper limit	Primary, lower limit	EOD	Stirrer	Error	Sec., upper limit	Sec., lower limit

A 6. 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.

Index

Page nos. A-... refer to the Appendix, RS-... to chapter 7, «Operation via RS 232C interface».

Ionenanalytik • Analyse des ions • Ion analysis • Análisis iónico

713 pH Meter

CE

Metrohm

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EC Declaration of Conformity

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

713 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 50082-2	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	Ch. Buchmann
Development Manager	Production and Quality Assurance Manager