Metrohm
Ion analysis

CH-9101 Herisau/Switzerland
E-Mail info@metrohm.com
Internet www.metrohm.com

794 Basic Titrino

Program version 5.794.0010

Instructions for Use

8.794.1003 02.2002 / pkl

Table of contents

1 Introduction 1
1.1 Instrument description 1
1.2 Controls and parts 2

2 Manual operation 6
2.1 Keypad 6
2.2 Principle of data input 7
2.3 Text input 8
2.4 Tutorial 9
2.4.1 Entering data, setting the dialog language 9
2.4.2 Development of a method, titration of an acid 11
2.4.3 Storage and loading of methods 16
2.4.4 pH calibration 17
2.4.5 Statistics, acid capacity of drinking water 18
2.5 Configuration, key <CONFIG> 22
2.6 Selection of the mode, key <MODE> 24
2.7 Parameters, key <PARAM> 26
2.7.1 Parameters for DET and MET 26
2.7.2 Parameters for SET 36
2.7.3 Parameters for MEAS 45
2.7.4 Parameters for CAL 47
2.7.5 Parameters for TIP 50
2.8 Result calculations 52
2.9 Statistics calculation 55
2.10 Common variables 57
2.11 Data output 58
2.12 TIP, Titration procedure 62
2.13 Method memory, keys <USER METH> 66
2.14 Calibration data, key <CAL.DATA> 68
2.15 Current sample data, key <SMPL DATA> 69
2.16 Silo memory for sample data 70
2.17 Storing determination results and silo calculations 73
2.17.1 Storing determination results 73
2.17.2 Silo calculations 74

3 Operation via RS232 Interface 77
3.1 General rules 77
3.1.1 Call up of objects 78
3.1.2 Triggers 79
3.1.3 Status messages 80
3.1.4 Error messages 82
3.2 Remote control commands 85
3.2.1 Overview 85
3.2.2 Description of the remote control commands 102
3.3 Properties of the RS 232 Interface 125
3.3.1 Handshake 125
3.3.2 Pin Assignment 129
3.3.3 What can you do if the data transfer does not work? 131

4 Error messages, Troubleshooting 133
4.1 Error and special messages 133
4.2 Diagnosis 137
4.2.1 General 137
4.2.2 Procedure 137
4.2.3 Equipment required: 138
4.2.4 Diagnosis steps 138
4.3 Initialise and test RAM 147
4.4 Releasing a locked spindle 148

5 Preparations 149
5.1 Setting up and connecting the instruments 149
5.1.1 Titrino with Stirrer or Titration Stand 149
5.1.2 Connection of a printer 150
5.1.3 Connection of a balance 151
5.1.4 Connection of a Sample Changer 152
5.1.5 Connection of a recorder 153
5.1.6 Connection of a computer 154
5.2 Connection of electrodes, preparing titration vessel 155

6 Appendix 158
6.1 Technical specifications 158
6.2 Pin assignment of the "Remote" socket 161
6.2.1 Lines of the "Remote" socket during the titration 163
6.2.2 Possible configurations of the activate pulse in SET and CAL 164
6.3 User methods 165
6.3.1 General 165
6.3.2 "Titer_pH" 166
6.3.3 "Blank" 167
6.3.4 "Chloride" 168
6.3.5 "TAN-TBN" 169
6.3.6 "Diazo" 170
6.3.7 "Br-Index" 171
6.3.8 "Sapon.No" 172
6.3.9 "Ca-Mg" 173
6.3.10 "EDTA-NTA" 174
6.3.11 "Metals" 175
6.3.12 "Perox.No" 176
6.3.13 "FormolNo"" 177
6.3.14 "P2O5Fert"" 180
6.4 Validation / GLP 183
6.5 Warranty and conformity 184
6.5.1 Warranty 184
6.5.2 EU Declaration of conformity 185
6.5.3 Certificate of Conformity and System Validation 186
6.6 Scope of delivery and ordering designations 187

Index 190

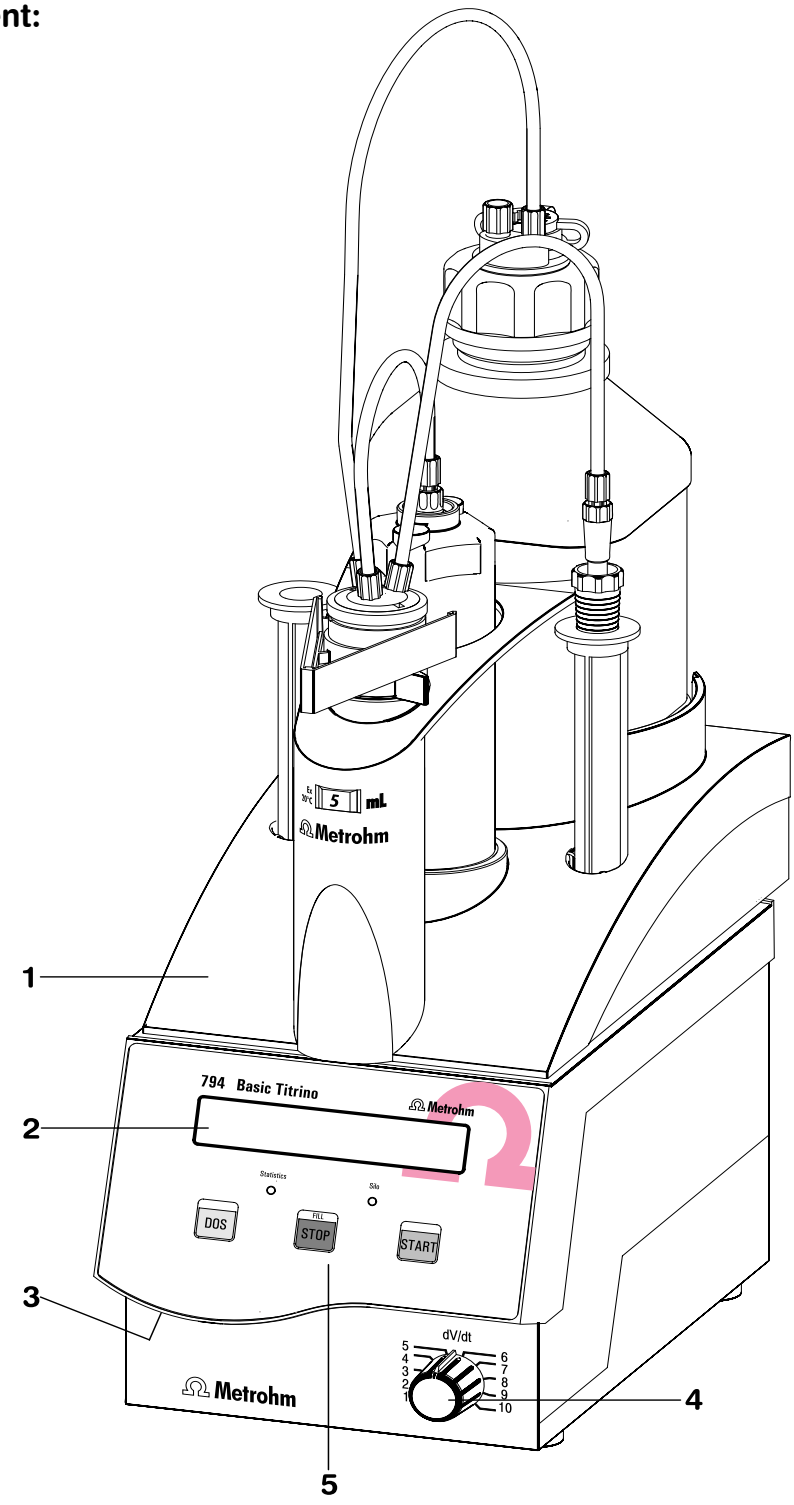
1 Introduction

1.1 Instrument description

The 794 Basic Titrino is an all-purpose titrator. Titration modes of the 794 Basic Titrino are constant or – depending on the titration curve – variable dosing of the titration reagent and Endpoint-Titration.
All operating modes of the Titrino can be combined to perform extensive analytical sequences. Ready-to-start methods for the most common applications are stored in the internal method memory. The operator is free to modify and overwrite this methods or to create and store his own titration sequences.
Data exchange with a PC is possible with the Metrodata VESUV Software and with Metrodata TiNet Software complete remote control, data acquisition and evaluation via PC is enabled.

1.2 Controls and parts

Front view of instrument:



1 Exchange Unit

2 Display

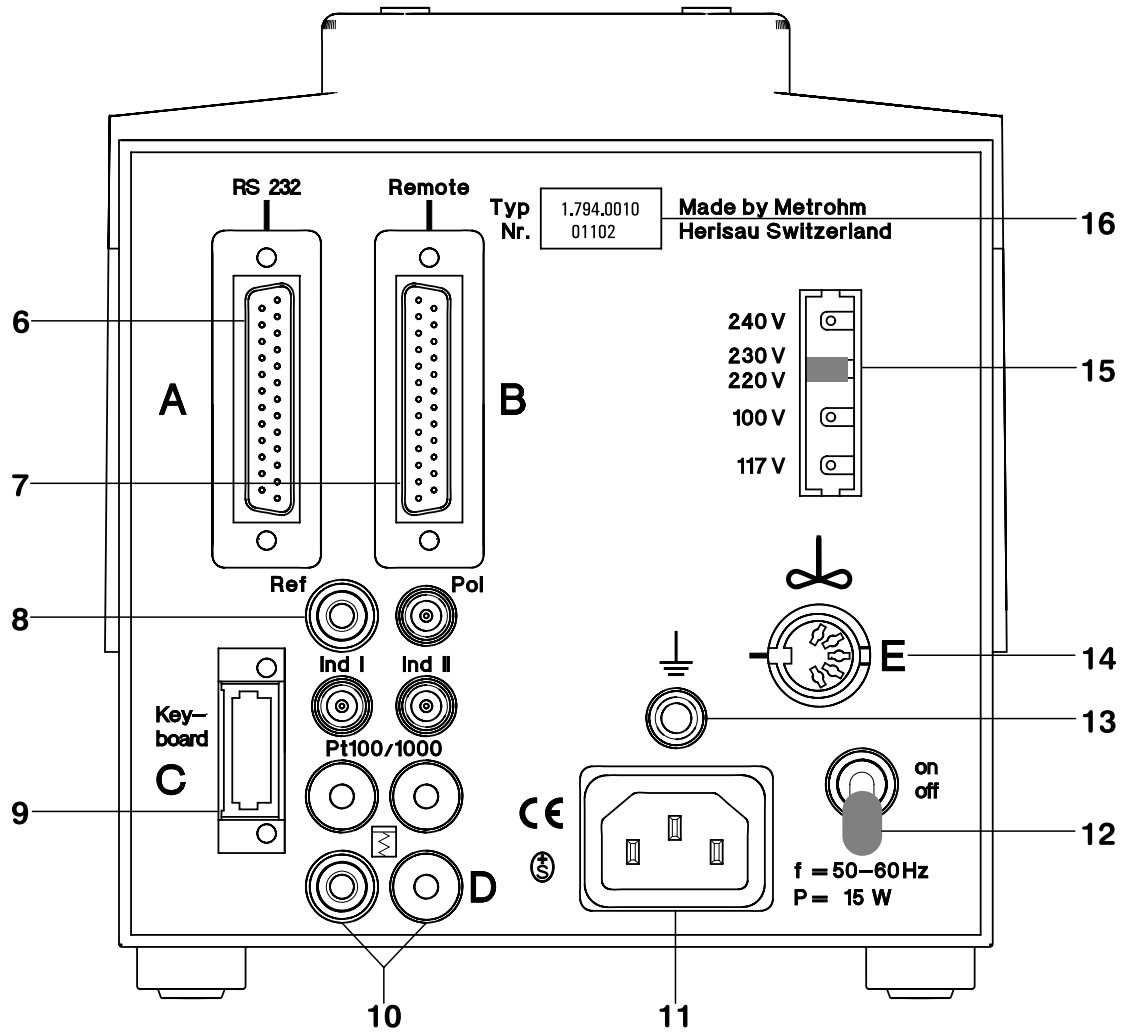
3 Setting of display contrast

4 Controls the dosing rate during manual dosing with <DOS> and subsequent filling

5 Control keys and indicator lamps on the Titrino

Key <DOS>	Dosing key. Dispensing is performed as long as <DOS> is being pressed. Used e.g. to prepare the Exchange Unit. The dispensing rate can be set with potentiometer (**4**).
Key <STOP/FILL>	- Stops procedures, e.g. titrations, conditioning. - Filling after manual dosing with <DOS>.
Key <START>	Starts procedures, e.g. titrations, conditioning. Identical with key <START> of the separate keypad.
Indicator lamps:	
"Statistics"	Lamp is on when the "statistics" function (calculation of mean and standard deviation) is on.
"Silo"	Lamp is on when silo memory (for sample data) is on.

Rear view of instrument:



6 **RS232 interface**
for the connection of printer, balance or a computer

7 **Remote lines**
(input/output)
for the connection of the Remote Box, Sample Changers, robots etc.

8 **Connection of electrodes and temperature sensor**

- 2 high-impedance measuring inputs for pH and U measurements (Ind I/ Ind II). They can either be used separately or for differential potentiometry, see page 155.
  Important: If you work with both measuring inputs in the same vessel, the same reference electrode must be used.
- 1 measuring input for polarized electrodes (Pol).
- 1 measuring input for PT100 or Pt1000 temperature sensor.

9 **Connection for separate keypad**

10 **Analog output for the connection of a recorder**

11 **Connection for power cable**
With power supplies where the voltage is subject to severe HF disturbances, the Titrino should be operated via an additional power filter, e.g. Metrohm 615 model.

12 **Mains switch**

13 **Earthing socket**

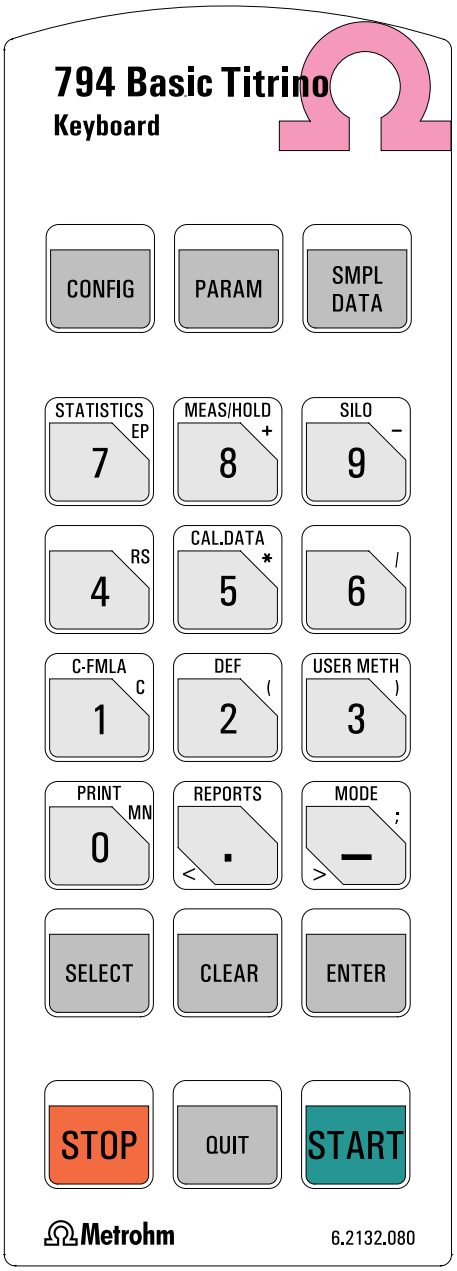
14 **Connection for stirrer**
728 Magnetic Stirrer, 802 Rod Stirrer, 703 or 727 Ti Stand
Supply voltage: 9 VDC ($I \leq 200$ mA)

15 **Display of the set mains voltage**
Before switching on for the first time, check that the set mains voltage matches the voltage of your power supply. If this is not the case, disconnect mains cable and change voltage.

16 **Rating plate**
with fabrication, series and instrument number

2 Manual operation

2.1 Keypad



CONFIG	Configuration.
PARAM	Parameters.
SMPL DATA	Sample data.
STATISTICS	ON/OFF switching of statistics calculations of consecutive determination, see page 55.
MEAS/HOLD	ON/OFF switching of measurements between titrations and hold during titrations.
SILO	ON/OFF switching of silo memory for sample data, see page 69.
CAL.DATA	Calibration data, see page 68.
C-FMLA	Calculation values, see page 54.
DEF	Formulas, data output, sequence for TIP, see page 52ff.
USER METH	Management of internal method memory, see page 66.
PRINT	Printing of reports, see page 60.
REPORTS	Result output.
MODE	Mode selection, see page 24.
<,>	Keys for text input.
SELECT	Selection of special values (dialog marked with ":")
CLEAR	Clears values, set special values.
ENTER	Stores values.
STOP	Stops methods.
QUIT	Quits inquiries, waiting times, printing.
START	Starts methods.

The third functions (inscriptions in the triangle) on the keys of the keypad are used for formula entry, see page 52.

2.2 Principle of data input

```
configuration
>peripheral units
```

- If you press a key you will find the corresponding menu in the display.
  Example key <CONFIG>:
  In the first line you see where you are: You pressed key <CONFIG> and you are now in the menu "configuration".

- In our example you are in the menu "configuration" on the title ">peripheral units". By pressing <CONFIG> you can move to the other titles of this menu.

```
>peripheral units
send to:              IBM
```

- If a dialog text is marked with ">", it contains a group of inquiries. You branch into this group by pressing <ENTER>.
  Example inquiries of "peripheral units":
  The first line indicates again where you are.
  If a dialog text of an inquiry is marked with ":", you can select a value with the key <SELECT>.

- A value is stored with <ENTER> and the cursor moves to the next inquiry.

- Repeated pressing of <ENTER> moves you through the inquiries of the group ">peripheral units“, after the last inquiry of this group you leave this group and return to the level above.
  The next group of the menu "configuration“ appears: ">auxiliaries“

```
configuration
>auxiliaries
```

- With key <QUIT> you leave an inquiry or a group of inquiries, it always moves you one level up.

```
DET pH              ********
```

- In this example you leave the menu "configuration" by pressing <QUIT> and return to the display of titration mode and the chosen method.

2.3 Text input

Example storing a method:

<USER METH>

```
user methods
>recall method
```

- Press key <USER METH>, the group ">recall method" appears.

<USER METH>
<ENTER>

```
>store method
method name:
```

- Choose ">store method" by pressing <USER METH> and press <ENTER>.
  The name of the method which is currently in the working memory is displayed.

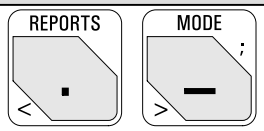
<CLEAR>

- Delete this name with <CLEAR>.

<<>

- Open the "text writing mode" with key <<>.

```
>store method
method name:      ABCDEFG
```



- Select the character marked by the blinking cursor with the Keys <<> and <>>, confirm it with <ENTER>. Select the next character...

  When you confirmed the last character, i.e. your name is complete, you quit the text writing mode with <QUIT>.
  Confirm now the name with <ENTER>.

  If your text fills the whole text field, just press <ENTER> to store the text.

<QUIT>
<ENTER>

```
>store method
method name:          text
```

- During text input you can correct typing errors with <CLEAR>:
  <CLEAR> deletes the characters one by one.

- If you wish to modify an existing name (e.g. if you have names like Text 1, Text 2, Text 3), do not delete the existing name before you start the text input mode. Proceed then as follows:
  1. Press <USER METH>, place the cursor to ">store method" and press <ENTER>.
  2. Open the text writing mode directly: Press key <<>.
  3. <CLEAR> now deletes the characters one by one or you can add additional characters.

2.4 Tutorial

This short operating course teaches you to work quick and efficient with the 794 Basic Titrino, by means of the most important applications.

Set up your Titrino and connect the peripheral devices needed, see chapter 5.

2.4.1 Entering data, setting the dialog language

We can thus make a start and first take a look at the fundamentals of the entry of data. We change the dialog language.

```
DET pH            ********
```

- Switch on the Titrino. It is now in the standby state, it shows you the active mode and method name.

<CONFIG>

- Press the key <CONFIG>, the display shows:

```
configuration
>peripheral units
```

This is the title of the group "peripheral units". This group contains various inquiries about peripheral units.

<CONFIG>

- Press again <CONFIG>. You see the title of a new group of inquiries.

```
configuration
>auxilliaries
```

This "auxiliaries" group contains the inquiry for the dialog language.

<ENTER>

- Pressing the <ENTER> key takes you to the inquiries of the group "auxiliaries". Note the ">" sign. All titles of inquiry groups are prefixed by this sign.

```
>auxilliaries
dialog:           english
```

This is the first inquiry of the "auxiliaries" group: the selection of the dialog language.

<SELECT>

- You select the various dialog languages with the <SELECT> key. Press <SELECT> repeatedly until "español" appears in the display.
  Note the sign ":". It appears if the values can be selected with the key <SELECT>.

```
>auxilliaries
dialog:           español
```

<ENTER>

- Accept the new "value" with <ENTER>.
  The next inquiry "fecha" (date) of the group "ajustes varios" (auxiliaries) is shown.

```
>ajustes varios
fecha          2002-01-02
```

You can open this inquiry by pressing <ENTER> too and go through all the inquiries of this group this way.

Because this inquiry follows no colon ":" the value can't be selected by <SELECT>, the date "fecha" has to be entered with the numeric keys.

<QUIT>

- Exit the inquiries with <QUIT>. You are one level higher in the "configuration" menu showing the title "ajustes varios" (auxiliaries).

```
configuration
>ajustes varios
```

<QUIT>

- Press <QUIT> once again to exit the "configuration" menu and return to the standby state.

```
DET pH              ********
```

All the dialog texts will now be displayed in Spanish. If you prefer English as the displayed dialog language, proceed as before and select "English".

2.4.2 Development of a method, titration of an acid

Selection of the mode

<MODE>

```
mode
mode                    DET
```

- Press <MODE> repeatedly until "DET" appears in the display. For a description of the DET mode see page 25.

<ENTER>

```
DET pH              ********
DET:                    pH
```

- Confirm "DET" with <ENTER>

4 × <SELECT>

- Now select the measured quantity: Press <SELECT> repeatedly until "pH" appears again in the display.
  Confirm the measured quantity "pH" with <ENTER>.

```
DET pH              ********
```

You are now ready to titrate.

For the titration put a Exchange Unit with *c*(NaOH) = 0.1 mol/L on the Titrino and rinse the tubing and the buret Tipp with <DOS>. Fill the buret again with <STOP/FILL>.
Plug a combined pH glass electrode into measuring input 1 (Ind I).
Pipette 2 mL *c*(HCl) = 0.1 mol/L into your titration vessel, dilute with ca. 20 mL dist. water.
Put a magnetic stirrer in the titration vessel and place buret tip and electrode in the probe, see page 157 for their arrangement.
Start the stirrer and press <START>

During the titration the first line of the display shows the current measured value and the volume already dispensed:

```
pH   3.02          0.351 ml
```

As soon as the instrument has found an equivalence point, this is shown on the second line:

```
pH   7.64          2.083 ml
                       EP1
```

Let the titration continue for a short while, e.g. until ca. pH 11.50. Now stop it with <STOP>.

```
DET pH              ********
EP1    2.083 ml pH   7.64
```

The first line now shows the mode "DET pH" and the name of the chosen method (here "********" because this method has not been saved under a own name until now). Of interest is the second line, which shows the equivalence point found.

If more than one equivalence point has been found, the others can be viewed with <ENTER>.

Calculation of the result: formula entry

With this equivalence point a result can be calculated.

<DEF>

- Press the <DEF> key.

```
def
>formula
```

<ENTER>

- Press <ENTER> to move on to the formula entry. The display now shows "RS?".

```
RS?
```

<1>

- Press "1", i.e. the first formula.

```
RS1=
```

You now can enter a formula. Note here the top inscription on the keys of the keypad and the numbers. The following symbols can be used:

EP# EP's with 1-digit number, e.g. EP1.

RS# Previously calculated results, e.g. RS1 in the second formula.

C## Calculation constant with 2-digit number, e.g. C01. C00 is reserved for the sample size. For the meaning of the calculation constants see page 53.

Calculate the content of your hydrochloric acid in g/L:

```
RS1=EP1*C01*C02/C00
```

RS1=EP1*C01*C02/C00

End point*conc.(titrant)*molecular weight/sample size

To correct a formula, delete it with <CLEAR>.

<ENTER>

- Confirm the formula with <ENTER>.

```
>formula
RS1 text                RS1
```

- You may enter a text for the result output, see page 8.

```
>formula
RS1 decimal places       2
```

- Enter the desired number of decimal places for the result.

```
>formula
RS1 unit                 %
```

- Select the desired unit g/L with <SELECT>, or type a text as unit, see page 8.

<SELECT>
<ENTER>

```
RS?
```

The Titrino prompts for the calculation of the next result.

2 x <QUIT>

Quit the formula entry by pressing <QUIT> twice.

In order to be able to calculate the result, enter the calculation constants used in the formula.

Entry of the calculation constants

<C-FMLA>

- Press <C-FMLA>.

The constants which have been used in the formula are requested: input with digit keys, confirm with <ENTER>.

C01: Concentration of your titrant= 0.1 mol/L. Enter 0.1.

C02: Molar mass of HCl = 36.47 g/mol

Entry of the sample size

4 x <SMPL DATA>

- Press <SMPL DATA> repeatedly until "sample size" appears in the display.

<2>
<ENTER>

- Enter 2.

<SELECT>

<ENTER>

- Use <SELECT> to select the unit "mL" and confirm the new value with <ENTER>.

The result is now calculated and can be displayed in place of the equivalence point. If your method already includes a formula at the end of the titration, the calculated result is displayed directly after the titration. As we have entered the formula later, we now have to select the result display:

Display of the result

<SELECT>

- Press <SELECT> repeatedly until ">display results" appears in the display.

<ENTER>

- Press <ENTER> to move to the result display.

If you have a printer connected, you probably wish to have the curve and a result report printed out automatically at the end of a titration.
To install a printer, see page 150.

Print reports

4 x <DEF>

- Press <DEF> repeatedly until the display shows:

```
def
>report
```

<ENTER>

- Press <ENTER> to move to the definition of reports.

```
report:
```

6 x <SELECT>
<;>
9 x <SELECT>

- With <SELECT> you select the individual repot blocks. Use a ";" as delimiter between the report blocks to print more than one block. If you wish to print out a curve and a full result report, enter "curve;full".

```
report:curve;full
```

<ENTER>
<QUIT>

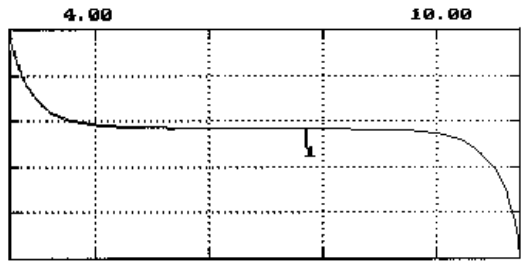
- Confirm the entry with <ENTER> and quit the inquiries with <QUIT>.

Now print your reports by pressing <PRINT><REPORTS><ENTER>. Your printout will look like the following:

```
 'cu
794 Titrino          01102         794.0010
date  2002-01-03      time 17:34          1
start V       0.000 ml   DET pH    ********
1.0 ml/div         dpH=2.0/div
```

Identification of the report type (cu=curve)

Start volume, mode and method name
Scaling of curve axis




```
 'fr
794 Titrino          01102         794.0010
date  2002-01-03      time 17:34          1
pH(init)          2.88   DET pH    ********
smpl size            2 ml
EP1              2.083 ml              7.64
RS1               3.80 g/l
manual stop
```

Identification of the report type (fr=full report)
Device type with identification and program version

Initial pH, mode and method name

Volume and pH value of EP1
Calculated result

So that you do not have to stop your titration manually each time, let us add a stop criterion for the titration.

Stop criterion

2 x <PARAM>

```
parameters
>stop conditions
```

- Press <PARAM> twice to display the title ">stop conditions".

<ENTER>

- Open this group of inquiries with <ENTER>.

```
>stop conditions
stop V:              abs.
```

Absolute stop volume. This can be used as a safety measure to prevent overflow of the titration vessel.

<ENTER>

```
>stop conditions
stop V:          99.99 ml
```

The magnitude of the absolute stop volume. Set a value that appears suitable for your titration vessel.

<ENTER>

```
>stop conditions
stop pH              OFF
```

Set the pH value, e.g. pH=11.5 as the expected stop criterion.

<ENTER>

If several stop criteria have been set, the one that is reached first applies.

2 x <QUIT>

Confirm your entries with <ENTER> and quit the inquiry with <QUIT>.

The development of your method is now complete. Before we store it in the method memory, you should check it again. Prepare a fresh sample and restart the titration with <START>.

If everything appears to be all right, you can now store the method in the method memory.

2.4.3 Storage and loading of methods

Now store the method you have just developed in the method memory.

Storage of a method

2 × <USER METH>

```
user methods
>store method
```

- Press <USER METH> repeatedly until the title ">store method" appears in the display.

<ENTER>

- Open the inquiry with <ENTER>.

```
>store method
method name:      ********
```

- Enter an identifier, e.g. 1 or Acid.
  For text input see page 8.

<ENTER>

```
DET pH                Acid
```

The method now runs under the name "Acid". It is ready to titrate.

If you have a printer connected, you can print out the contents of your method memory.
Key sequence: <PRINT><USER METH><ENTER>

Stored methods can be loaded at any time.

Loading a method from the method memory

<USER METH>

```
user methods
>recall method
```

- Press <USER METH>. The display shows the title ">recall method".

<ENTER>

- Open the inquiry <ENTER>

```
>recall method
method name:      ********
```

<SELECT>
or
direct entry

- You can select the desired method with <SELECT> (it shows all methods of the method memory one after the other) or by directly enter the method name.

<ENTER>

- Load the method with <ENTER>

```
DET pH                Acid
```

The method is ready to titrate.

2.4.4 pH calibration

pH calibrations are not a requirement for pH titrations, when the equivalence point is determined from a curve. For end-point titrations, however, where titration is performed to a fixed, specified pH value, a calibration should be performed.

Selection of the calibration mode, CAL

<MODE>

```
mode
mode                    CAL
```

- Press <MODE> repeatedly until "CAL" appears in the display and confirm the mode with <ENTER>.

<ENTER>

```
CAL                 ********
pH(as) 7.00 slope      1.000
```

The instrument is ready for a 2-point calibration. The second display line shows the current calibration data for measuring input 1.

Calibration procedure

<START>

- Immerse your electrode in the first buffer and start the calibration procedure.

```
CAL
cal.temp.             25.0°C
```

Inquiry of calibration temperature.

- Enter the current temperature. If you have a temperature sensor connected, this inquiry is skipped.

<ENTER>

```
                      25.0°C
buffer 1 pH            7.00
```

pH value of the first buffer.

- Enter the pH value of the buffer at your calibration temperature.

<ENTER>

```
                      25.0°C
buffer 2 pH            4.00
```

The voltage of the first buffer is measured. When the measured value has met the set drift criterion, the measurement is stopped and the pH value of the second buffer is requested.

- Now enter the pH value of the second buffer. If you require a 1-point calibration, you can also terminate the calibration with <STOP>.

<ENTER>
oder
<STOP>

```
CAL                 ********
pH(as) 6.89 slope      0.985
```

At the end of the calibration, the calibration data obtained are displayed: asymmetry pH and slope.

The calibration data can be viewed at any time under the <CAL.DATA> key. Our calibration data are stored under ">input 1".

The calibration report can be printed out at any time with the key sequence:
<PRINT><CAL.DATA><ENTER>

2.4.5 Statistics, acid capacity of drinking water

Let us now determine the acid capacity of drinking water. For this, the SET (**s**et **e**ndpoint **t**itration) mode is used to titrate to pH = 4.3.

First select the mode SET pH (keys <MODE> and <SELECT>).

Now set the end point.

Entry of the end point and the control parameters

<PARAM>

```
parameters
>SET1
```

- Press <PARAM>. The display shows:

Control parameters for EP1

<ENTER>

```
>SET1
EP at pH                OFF
```

```
>SET1
EP at pH                4.3
```

- Set the end point to pH = 4.3.

<ENTER>

```
>SET1
dynamics                OFF
```

```
>SET1
dynamics                 3
```

- Dynamics means the control range in which the adding of the titrant is controlled in dependence on the measured value (OFF: largest control range, i.e. slow titration).
  With buffered systems such as drinking water, this value can be set lower, e.g. to 3. I.e. 3 pH units before the set EP controlled dosing starts.

<ENTER>

```
>SET1
max.rate       10.0 ml/min
```

Maximum possible titration rate inside the control range.

<ENTER>

```
>SET1
min.rate       25.0µl/min
```

Minimum titration rate inside the control range.

2 × <QUIT>

- Quit the inquiry with <QUIT>.

Mount an Exchange Unit with *c*(HCl) = 0.1 mol/L as titrant. Add 25 mL drinking water as sample and start the titration with <START>. During the titration the first line of the display shows the measured value and dispensed volume. The "c" in pHc shows that the electrode assembly has been calibrated. The second line shows a "control bar", which indicates the control deviation of the current measured value from the set end point.

```
pHc 6.34          0.426 ml
#======
```

If the titration runs too slow or too fast, you can change the control parameters during the titration. If you wish to titrate faster, change the following parameters:

- dynamics: lower value, the control range becomes smaller (Attention: possibility of titrating over the set EP)
- max.rate: bigger value
- min.rate: bigger value

You will find further details of the control parameters on page 42.

After the titration, end point volume and pH value at the end point are displayed.

For the evaluation enter:

the formula to calculate the m value (key <DEF>)	RS1=EP1*C01*C02	
with an accuracy of	RS1 decimal places	2
the unit	RS1 unit:	mmol/L
and the calculation constants (key <C-FMLA>)	C01	1 (concentration of titrant ×10)
	C02	4 (factor for the sample size 100 mL/25 mL)

If you have a printer connected, select the automatic titration report (key <DEF>): "report:full". You can print out the results of the previous titration with keys <PRINT><REPORTS><ENTER>.

If the previous titration has run to your satisfaction, you can start thinking about performing statistics calculations. Have you already added a new sample to the titration vessel? If you are no longer certain, you can find out immediately with <MEAS/HOLD>.

Rapid measurement between titrations

Press <MEAS/HOLD>. The pH value of your sample is displayed. You can stop the measurement with a second <MEAS/HOLD>.

Statistics calculations

Now switch on the statistics calculations. Press <STATISTICS>. The "Statistics" LED is on. Duplicate determinations are now performed.

- Perform 2 titrations.

After the second titration you receive a printout with statistics calculations:

```
 'fr
794 Titrino          01102         794.0010
date  2002-01-03     time 17:34          3
pHc(init)         6.29   SET pH   ********
EP1              0.0628 ml             4.26
m value           5.02 mmol/l
               mean(2)   +/s            s/%
m value           5.04  0.028 mmol/l  0.56
           ==============
```

If you have no printer connected, you can view the mean value and standard deviation:

- Press <SELECT> until "display mean" appears in the display.
- With <ENTER> you obtain the mean value.
- A second <ENTER> displays the number of single values which have been used for the mean calculation.
- If you press <SELECT> again, the display "display std.deviation" appears. Once again, you can view this value, by pressing <ENTER>.

Perhaps you have noticed that the two values differ too greatly? In any case, we shall perform a third determination with the same sample. The result of this determination will be another value which is incorporated in the statistics calculations.

Addition of more determinations for the statistics calculations

5 × <PARAM>

- Press <PARAM> until the display shows:

```
parameters
>statistics
```

<ENTER>

```
>statistics
status:                  ON
```

- Statistics calculations can be switched on either with the <STATISTICS> key or in the inquiry "status:". We shall leave them switched on and proceed to the next inquiry.

<ENTER>

```
>statistics
mean:                n=  2
```

Mean value of 2 single determinations.

- Enter "3" to include an additional determination.

<3>
<ENTER>

2 × <QUIT>

- Quit the inquiry.

Perform another titration.

You can now decide which of the results is an "outlier". You can delete it from the statistics calculation.

Deleting a result from the statistics calculation

5 × <PARAM>

```
parameters
>statistics
```

- Press <PARAM> until the display shows:

3 × <ENTER>

```
>statistics
res.tab:          original
```

- Select with <ENTER> the inquiry of the result table "res.tab:"

2 × <SELECT>

```
>statistics
res.tab:          delete n
```

- To delete a single result with index n from the result table, press <SELECT> so that "delete n" appears.

<ENTER>

```
>statistics
delete            n=     1
```

- Enter index n of the result you wish to delete; in our example the second:

<2>
<ENTER>

2 × <QUIT>

- Quit the inquiry by pressing <QUIT>.

Mean value and standard deviation are recalculated and can be viewed in the display.

With <PRINT><REPORTS><ENTER> you can print a fresh report.

With <PRINT> <STATISTICS><ENTER> you can print a statistics overview, in this report the deleted result is marked with a "*" in the report.

2.5 Configuration, key <CONFIG>

Key <CONFIG> serves to enter device specific data. The set values apply to all modes.

```
configuration
>peripheral units
```

peripheral units:
Selection of printer, balance and the curve at the analog output.
auxiliaries:
e.g. setting of dialog language, date, time, etc.
RS232 settings:
RS parameters for the COM interface.
common variables:
Values of common variables.

The display texts of the Titrino are shown to the left. The values are the default values.

```
>peripheral units
```

Settings for peripheral units

```
   send to:              IBM
```

Selection of printer (Epson, Seiko, Citizen, HP, IBM) at the Titrino Rs232 interface.
"Epson", for Epson
"Seiko", e.g. for DPU-414
"Citizen", e.g. for iDP 562 RS, Custom DP40-S4N
"HP" e.g. for Desk Jet types. Place curves always at the beginning of a page as you cannot have them over 2 pages.
"IBM" for all printers with IBM character set Table 437 and IBM graphics, as well as for the data transmission to a computer with Metrodata software TiNET or VESUV.

```
   balance:         Sartorius
```

Selection of balance (Sartorius, Mettler, Mettler AT, AND, Precisa)

Sartorius:	Models MP8, MC1
Mettler:	Models AM, PM, AX, MX, UMX and balances with 011, 012, or 016 interface
Mettler AT:	Model AT
AND:	Models ER-60, 120, 180, 182, FR-200, 300 and FX-200, 300, 320
Precisa:	Models with RS232C interface

```
   record:                U
```

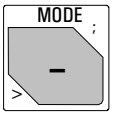
Selection of the curve for the output at the analog output (U, dU/dt, V, dV/dt, U(rel), T

U:.	Voltage
dU/dt:	Measured value drift
V:	Volume
dV/dt	Volume drift
U(rel):	Control deviation with SET
T:	Temperature with MEAS T

>auxiliaries	**General settings**
dialog: english	*Selection of dialog language (english, deutsch, francais, español, italiano, portugese, svenska)*
date 2001-01-03	*Current date (YYYY-MM-DD)* Format: Year-month-day, entry with leading zeros.
time 08:13	*Current time (HH-MM)* Format: Hours-minutes, entry with leading zeros.
run number 0	*Current run number for result output (0...9999)* The sample number is set to 0 when the instrument is switched on and incremented on every determination.
auto start OFF	*Automatic starts of titrations. (1...9999, OFF)* Number of automatic starts ("number of samples"). Used for instrument interconnections in which the external instrument does not initiate a start. Not advisable in connections with Sample Changers.
start delay 0 s	*Start delay (0...999999 s)* Delay time after start of methods. Abort start delay time with <QUIT>.
dev.label.	*Individual identification of devices (up to 8 ASCII characters)* Will be printed in the result report, see page 59.
program 794.0010	*Display of program version*
>RS232 settings	**Settings of RS232 interface** see also page 125ff.
baud rate: 9600	*Baud rate (300, 600, 1200, 2400, 4800, 9600)*
data bit: 8	*Data bit (7, 8)*
stop bit: 1	*Stop bit (1, 2)*
parity: none	*Parity (even, odd, none)*
handshake: HWs	*Handshake (HWs, HWf, SWline, SWchar, none)* see page 125ff.
RS control: ON	*Control via RS232 interface (ON, OFF)* "OFF" means that the receipt of commands via the RS232 interface is blocked. Data output is possible.

`>common variables`
 	
`C30 0.0`
`etc.`
	Values of the common variables
	
	Common variables C30...C39 (0.. ± 999 999)
	The values of all common variables are displayed. For creating of common variables see page 57.

2.6 Selection of the mode, key <MODE>

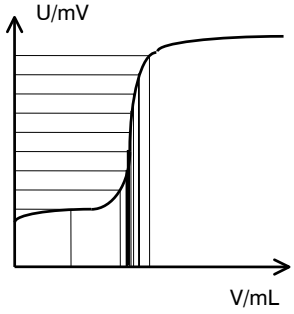
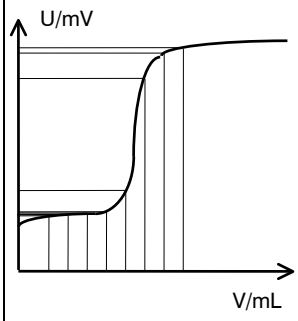
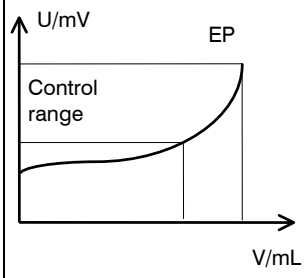


Press key <MODE> until the desired mode is displayed and confirm with <ENTER>.
Select the measured quantity pH, U, Ipol, Upol, (T) with <SELECT> and confirm it also with <ENTER>.

The following modes can be selected:
- DET: **D**ynamic **E**quivalence-point **T**itration
- MET: **M**onotonic **E**quivalence-point **T**itration
- SET: **S**et **E**ndpoint **T**itration.
- CAL: pH **Cal**ibration.
- MEAS: **Meas**uring.
- TIP: **Ti**tration **P**rocedure. Linking of various commands and methods to a titration procedure.

These standard modes are equipped with a set of standard parameters. They only need few settings in order to be ready to work.
TIP is an empty "shell". The TIP sequence has to be defined with <DEF>, see page 62.

Overview of the titration modes

	DET Dynamic Equivalence point Titration	MET Monotonic Equivalence point Titration	SET, KFT Endpoint Titration
Titration	Reagent feeding: Variable volume increments, depending on the slope of the curve.  Acquisition of measured values: Drift controlled ("equilibrium titration") and/or after a fixed equilibration time.	Reagent feeding: Constant volume increments, independent of the slope of the curve.  Acquisition of measured values: Drift controlled ("equilibrium titration") and/or after a fixed equilibration time.	Titration to preset end-point.  Acquisition of measured values: Continuously
Evaluation	The evaluation of EP' s is based on the zero crossing of the second derivative with a Metrohm correction for the distortion of the curve from superimposed jumps. Can be combined with selectable recognition criteria. **Recognition criteria:** as for MET	The evaluation of EP's is based on the Fortuin interpolation. **Recognition criteria:** all EP's only the last EP only the greatest EP EP windows	Volume that has been dispensed up to the endpoint (EPX in mL).
Applications	Suitable titration mode for most problems. Specially recommended if jumps lie very close together and for very flat jumps. **Note**: The reagent feeding algorithm is based on measured data. The curve should therefore not deviate markedly from S-shape.	For • slow titration reactions (diazotations, coupling reactions) • sluggish electrode response.	• For rapid, quantitative determinations in analytical chemistry. Requirement: EP of the titration reaction is known and does not change during a determination series. • If an excess of titrant must be avoided.

2.7 Parameters, key <PARAM>

The key <PARAM> is used for the entry of values that determine the modes. Values marked with "cond." are accessible during the conditioning in the SET mode. "**titr." means that these values can be changed during the titration. They influence the ongoing determination. Other values can only be changed in the inactive state.
The display texts of the Titrino are shown to the left. The values are the default values.

2.7.1 Parameters for DET and MET

```
parameters
>titration parameters
```

titration parameters
determine the course of the titration and measured value acquisition.
stop conditions:
Parameters for the automatic termination of the titration.
statistics:
Calculation of mean values and standard deviation, see also page 55.
evaluation:
Parameters for the evaluation of EP's, fix EP's, and pK/HNP.
preselections:
ON/OFF of various auxiliary functions such as automatic requests after the start and activate pulse.

```
 >titration parameters

    meas.pt.density        4
DET

    min.incr.         10.0 µl
DET

    V step            0.10 ml
MET
```

General titration parameters

Measuring point density (0...9)
0 means highest density, 9 lowest. Selection of the meas.pt.density, see page 32.

Minimum increment (0...999.9 µL)
The increment is dispensed at the beginning of the titration and in the region of the equivalence point.

Size of volume increment (0...9.999 mL)
Dosing step. Small volume increments are needed to determine blank values or to assure accuracy with highly unsymmetrical curves. Selection of size of the increment, see page 33.

titr.rate max. ml/min
****titr.***

Dosing rate for volume increments (0.01...150 mL/min, max.)
<CLEAR> sets "max.".
The maximum rate depends on the Exchange Unit:

Exchange Unit	max.
5 mL	15 mL/min
10 mL	30 mL/min
20 mL	60 mL/min
50 mL	150 mL/min

signal drift 50 mV/min
****titr.***

Drift criterion for measured value acquisition. (input range depends on the measured quantity:
pH, U, Ipol: 0.5...999 mV/min, OFF
Upol: 0.05...99.9 µA/min, OFF)
<CLEAR> sets "OFF".
This type of measured value acquisition is often called an equilibrium titration.
"OFF" means that the measured value is acquired after an equilibration time. This may be useful for slow titration reactions or when the response of the electrode assembly is slow.

equilibr.time 26 s
****titr.***

Waiting time for measured value acquisition. (0...9999 s, OFF)
<CLEAR> sets "OFF".
If no new equilibration time has been entered, the Titrino calculates an equilibration time appropriate to the drift, see page 31. The measured value is acquired as soon as the first criterion (drift or time) has been met.

start V: OFF

Type of start volume (OFF, abs., rel.)
"OFF": start volume switched off
"abs": absolute start volume in mL
"rel.": relative start volume to sample size.

start V 0.0 ml

If "abs." is set:
Absolute start volume (0...999.99 mL)

factor 0

If "rel." is set:
Factor for relative start volume (0...±999 999).
Calculated as: start V (in mL) = factor ∗ sample size

dos.rate max. ml/min
****titr.***

Dosing rate for start volume (0.01...150 mL/min, max.)
<CLEAR> sets "max.".
Maximum rate depends on the Exchange Unit:

Exchange Unit	max.
5 mL	15 mL/min
10 mL	30 mL/min
20 mL	60 mL/min
50 mL	150 mL/min

pause **0 s** ***titr.**	*Waiting time (0...999999 s)* Waiting time, e.g. for equilibration of the electrode after the start or reaction time after dosing of start volume. The pause can be aborted with <QUIT>.
meas.input: 1	*Measuring input for pH and U (1, 2, diff.)* Request for measuring input for pH and U. Measuring input 1 or 2 or differential amplifier; connection of electrodes, see page 155. With polarized electrodes, instead of the measuring input the
I(pol) 1 µA	*polarization current (-127...127 µA)* or the
U(pol) 400 mV	*polarization voltage (-1270...1270 mV, in steps of 10 mV)* is inquired.
electrode test: OFF	*Electrode test (OFF, ON)* Test for polarized electrodes. Performed on changeover from the inactive standby state to a measurement. "OFF" means that the test is not performed.
temperature 25.0 °C	*Titration temperature (-170.0...500.0 °C)* The temperature is continuously measured if a T sensor is connected. This parameter is used for temperature compensation in pH titrations.
>stop conditions	**Stop conditions for the titration** If several stop conditions have been set, the criterion which is met first applies.
stop V: abs. ***titr.**	*Type of stop volume (abs., rel., OFF)* "abs.": absolute stop volume in mL. "rel.": relative stop volume to sample size. "OFF": stop volume switched off. Stop volume is not monitored.
stop V 99.99 ml ***titr.**	If "abs." is set: *Absolute stop volume (0...9999.99 mL)*
factor 999999 ***titr.**	If "rel." is set: *Factor for relative stop volume (0...±999999)* Calculated as: Stop V (in mL) = factor∗sample size
stop pH OFF ***titr.**	*Stop at measured value (input range dependent on measured variable:* *pH: 0... ± 20.00, OFF* *U, Ipol: 0... ± 2000 mV, OFF* *Upol: 0... ± 200.0 µA, OFF)* <CLEAR> sets "OFF". "OFF" means that the criterion is not monitored.

stop EP 9 ***titr.**	*Stop after a number of EP's have been found (1...9, OFF)* <CLEAR> sets "OFF". "OFF" means that the criterion is not monitored.
filling rate max. ml/min ***titr.**	*Filling rate (0.01...150 mL/min, max.)* <CLEAR> sets "max.". The maximum rate depends on the Exchange Unit: Exchange Unit max. 5 mL 15 mL/min 10 mL 30 mL/min 20 mL 60 mL/min 50 mL 150 mL/min
>statistics	**Statistics calculation**
status: OFF	*Status of statistics calculation (OFF, ON)* If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.
mean n= 2	*Mean value calculation from n single results (2...20)*
res.tab: original	*Result table (original, delete n, delete all)* "original": The original table is used. Deleted individual results are again incorporated in the evaluation. "delete n": Deletion of single results with the index n. "delete all": The entire table is deleted.
delete n= 1	*Delete data from sample number n (1...20)* The deleted result is removed from the statistics calculation.
>evaluation	**EP evaluation/recognition** See page 32ff.
EPC 5	*Equivalence point criterion (input range depends on mode.* *For DET:* *0...200* *For MET:* *pH: 0.10...9.99* *U, Ipol: 1...999 mV* *Upol: 0.1...99.9 µA)* Threshold for the size of the jump, see page 34.
EP recognition: all	*Recognition of EP's which fulfill the EP criterion. (all, greatest, last, window, OFF)* Selection of equivalence point recognition: "all": All equivalence points are recognized. "greatest": Only the greatest (steepest) equivalence point is recognized. "last": Only the last equivalence point is recognized.

		"window": Only EP's in specified windows are recognized. "OFF": Evaluation switched off. If "window" is selected, lower and upper limits of windows are inquired.
low lim.1 pH	**-20.00**	*Lower limit of window 1* and
up lim.1 pH	**20.00**	*upper limit of window 1* *(Input ranges for both inquiries depend on the measured quantity):* *pH: 0...±20.00, OFF* *U, Ipol: 0...±2000 mV, OFF* *Upol: 0...±200.0 µA, OFF)* <CLEAR> sets "OFF". Only equivalence points are recognized which lie within the set lower and upper limits. The equivalence point numbering is defined with the windows, see page 34. Window inquiries continue until the lower limit is set to "OFF". Up to 9 possible windows. Always set both limits to ≠ OFF for a valid window.
fix EP1 at pH	**OFF**	*Interpolation of volumes at fixed times (input range depends on the measured quantity:* *pH: 0...±20.00, OFF* *U, Ipol: 0...±2000 mV, OFF* *Upol: 0...±200.0 µA, OFF)* <CLEAR> sets "OFF". If a fix end point has been set, the volume value for the input measured value is interpolated from the curve, see also page 35. The volume values are available as C5X. Fix EP's are inquired until "OFF" is set. Up to 9 fix EP's.
pK/HNP:	**OFF**	*Evaluation of pK or HNP (ON, OFF)* pK evaluation in case of pH titrations and half neutralization potential for U, see page 35.
>preselections		**Preselections for the sequence**
req.ident:	**OFF**	*Request of identifications after start of titration. (id1, id1&2, all, OFF)* After start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries.
req.smpl size:	**OFF**	*Request of sample size after start of titration (value, unit, all, OFF)* "all" requests the value, then the unit.
activate pulse:	**OFF**	*Pulse output on I/O line "activate" (L6, pin 1) of the remote socket (ON, OFF)* see page 163.

Titration sequence of DET and MET

<START>	
(Activate pulse)	After the start, the activate pulse is outputted.
(Start delay)	The start delay time is waited off.
(Request ident.) (Request smpl size)	The sample identifications and the sample size are requested.
(Start conditions)	The start volume is dispensed (no meas.value acquisition) and the pause is waited off.
Titration: Dispense increments Acquire meas.values	During the titration the volume increments are dispensed and after each increment a measured value is acquired. Meas.values are either acquired drift controlled ("equilibrium titration") or a after a fixed waiting time. If you have not intentionally changed the equilibration time, it is calculated according to the formula: $\text{equilibr.time (in s)} = \frac{150}{\sqrt{\text{Drift} + 0.01}} + 5$ The criterion (drift or equilibration time) which is first met applies. This avoids "infinite" titrations. If the parameter "signal drift" is set "OFF", the measured values are acquired after a fixed equilibration time.
Stop conditions	The titration is terminated according to the first criterion which is met.
Calculations	Evaluations and calculations are carried out.
Data output	Data are outputted.

Reagent feeding and EP evaluation of DET

The reagent feeding of DET is similar to the controlling, a human being would apply in manually controlled titrations: Great volume increments are dosed far away from the EP, small increments in the region of the equivalence point.
The size of the volume increments dosed by the Titrino is determined by the following parameters:

meas.pt.density	The measuring point density is entered as a relative value from 0...9. Input of a low number means small volume increments, i.e. a large measuring point density on the curve. A curve results which reproduces all fine details. "Fine details", however, also include signal noise, which can easily lead to unwanted equivalence points. A high number, i.e. low measuring density, on the other hand, allows a more rapid titration. The standard value of 4 is suitable for most cases. If you work with small cylinder volumes (1 or 2 mL), a small measuring point density may be advisable. In these cases you should also lower the drift for meas.value acquisition and set a higher EPC.
min.incr.	Defines the minimum possible increment. This minimum increment is dosed at the beginning of the titration and in the region of the equivalence point (for steep curves). Use low minimum increments only, if small volumes of titrant consumption are expected, e.g. in micro titrations; otherwise unwanted equivalence points may arise. The standard value of 10.0 µL is suitable for most cases.
EPC	The EP's are evaluated according to a special METROHM procedure which is so sensitive that even weak equivalence points are determined correctly. Equivalence Point Criteria. The *preset* EPC is compared to the *found* ERC (Equivalence point Recognition Criteria) for each evaluated equivalence point. The ERC is given in the following reports: deriv (1st derivative), comp (combined titration and derivative curves) as well as in the mplist (measuring point list). The ERC is the first derivative of the titration curve overlaid with a mathematical function so that small maxima become higher and great maxima smaller. EP's whose ERC is below the preset EPC will not be recognized. For most cases the standard value of 5 is suitable. The evaluation can be repeated at any time after the titration in a "dry run" with changed evaluation criteria. The old titration data are not deleted until a new titration is started.

Reagent feeding and EP evaluation of MET

In monotonic titrations, the volume increment is constant over the whole titration curve.

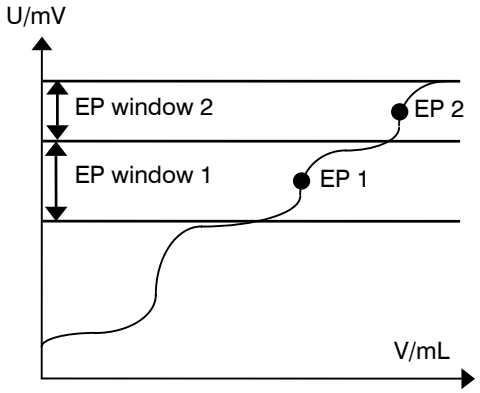
V step	Volume increment. A prerequisite for good accuracy is the correct size of the volume increments. A good value is given by V step = 1/20 V_{EP} (V_{EP} = volume of the EP). In any case, the increment size should always be between 1/10 V_{EP} and 1/100 V_{EP}; with steep jumps preferably in the region of 1/100 and with flat jumps preferably in the region of 1/10. The accuracy of the evaluation can not be increased by dispensing small increments as the changes in the measured value can then be of the same order of magnitude as the noise. This can produce "ghost EP's"!
EPC	The EP's are localized with an algorithm which is based on Fortuin and has been adapted by METROHM for numeric procedures. Here, the greatest change in the measured value is sought (Δ_n). The exact equivalence point is determined with an interpolation factor, which depends on the delta values before and after Δ_n: $V_{EP} = V_0 + \rho\ \Delta V$ V_{EP}: EP volume V_0: Total dispensed volume before Δ_n ΔV: Volume increment ρ : Interpolation factor (Fortuin) Equivalence Point Criteria. The *preset* EPC is compared to the *found* ERC (Equivalence point Recognition Criteria) for each evaluated equivalence point. The ERC is given in the following reports: deriv (1st derivative), comp (combined titration and derivative curves) as well as in the mplist (measuring point list). ERC is the sum of the measured value changes before and after the break: $\lvert\Delta_{n-2}\rvert + \lvert\Delta_{n-1}\rvert + \lvert\Delta_n\rvert + \lvert\Delta_{n+1}\rvert + \lvert\Delta_{n+2}\rvert$ (In certain cases there are only 3 or 1 summand). EP's whose ERC is below the preset EPC will not be recognized. For most titrations the standard value is suitable. The evaluation can be repeated at any time after the titration in a "dry run" with changed evaluation criteria. The old titration data are not deleted until a new titration is started.

EP recognition criteria for DET and MET

The parameter "EP recognition" offers you a range of possibilities to ensure selection of the EP you are interested in: If the desired jump is very large, you can select the "greatest" jump (with DET the steepest jump will be evaluated). Thus you always obtain just one EP per titration (EP1).
If you wish to determine the sum of different components (e.g. acid or base numbers), the "last" jump can be the correct one.
And finally you can set a "window" for each expected EP.

EP windows
EP windows are used
- to suppress disturbing influences and EP's which are not needed.
- to increase the liability for the calculation of the results. The EP windows make an unequivocal assignment of the EP's possible: per window one EP is recognized; the numbering of EP's is defined by the windows so that even if EP's are missing, the calculations are still performed with the correctly assigned EP volumes.

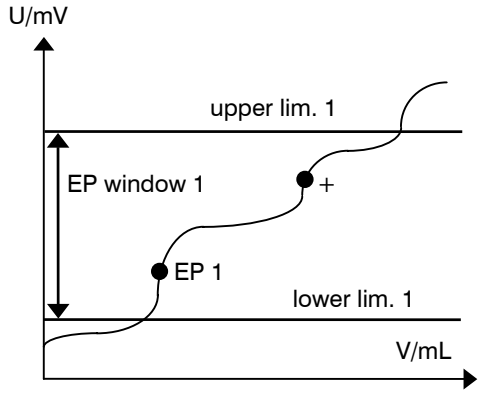
An EP window defines the range in which an EP is expected. EP's outside these ranges are not recognized. Windows are defined on the measured value axis.



2 EP's are recognized. Their numbering is defined by the windows:
Window 1 ⇒ EP1
Window 2 ⇒ EP2

If more than 1 EP is expected, a window must be set for each EP.

Windows must not overlap. They may only touch each another.



Rule: If there are more than 1 EP in a window, the first jump is recognized as EP1, the second is not recognized. EP1 is marked as EP1 + to indicate that more than one EP has been found in the window

Fix EP's

Fix EP's allow determination of the associated volume value for every inputted measured value on the titration curve. This function is useful for performing standard methods such as TAN/TBN determinations. For the evaluation of fix EP's, the pH calibration is advisable. The volume values of the fix EP's are available for the calculation as C5X:
Fix EP1 ⇒ C51
:
Fix EP9 ⇒ C59 Maximum 9 fix EP's are possible.

pK and HNP evaluation

The following relation (Henderson-Hasselbach), derived from the law of mass action, exists between the activities of a conjugate acid-base pair in aqueous solutions:

$$pH = pK + \log (a_B/a_A)$$

When the activities $a_B = a_A$, then pH = pK is valid. This value corresponds to the pH at the half neutralization point and can be taken from the titration curve. For pK determinations, a careful pH calibration is necessary.
The pK value determined is an approximate value owing to the fact that the ionic strength of the solution has not been taken into account. For more exact values, titrations must be performed with decreasing ionic strength and the results extrapolated to zero ionic strength.
The evaluation of pK's in aqueous solutions is limited to
pK>3.5 due to the leveling effect of strong acids in aqueous solutions
pK<10.5 because for weaker acids no inflection points can be found aqueous solutions.
pK evaluation for polybasic acids and for acid mixtures is also possible.

In non-aqueous solutions, the half neutralization potential (HNP) is often used instead of pK. The HNP is evaluated accordingly.

A start volume must be smaller than half of the equivalence point volume of the first EP.

The pK/HNP values are available for calculation as C6X.

2.7.2 Parameters for SET

parameters **>SET1**	**SET1, SET2:** Control parameters for EP1 and EP2. **titration parameters** are valid for the global titration sequence. **stop conditions:** Parameters for the termination of the titration. **statistics**: Calculation of mean values and standard deviation, see also page 55. **preselections**: ON/OFF of various auxiliary functions such as automatic requests after the start and activate pulse.
>SET1	**Control parameters for EP1 or EP2, resp.**
EP at pH **OFF** ***titr.**	*Preset EP1 (input range depends on the measured quantity:* *pH: 0...±20.00, OFF* *U, Ipol: 0...±2000 mV, OFF* *Upol: 0...±200.0 µA, OFF)* <CLEAR> sets "OFF". If EP1 is "OFF", no further inquiries under SET1 appear.
dynamics **OFF** ***titr.**	*Distance from EP where constant dosing should stop and controlling begins. (control range, input range depends on the measured quantity:* *pH: 0.01...20.00, OFF* *U, Ipol: 1...2000 mV, OFF* *Upol: 0.1...200.0 µA, OFF)* <CLEAR> sets "OFF". "OFF" means largest control range, i.e. low titration. Outside the control range, dispensing is performed continuously, see also page 42.
max.rate **10.0 ml/min** ***titr.**	*Maximum dosing rate (0.01...150 mL/min, max.)* <CLEAR> sets "max.". This parameter determines primarily the addition rate outside the control range, see also page 42. The maximum rate depends on the Exchange Unit: Exchange Unit max. 5 mL 15 mL/min 10 mL 30 mL/min 20 mL 60 mL/min 50 mL 150 mL/min

min.rate 25.0 µl/min ***titr.*	*Minimum dosing rate (0.01...999.9 µL/min)* This parameter determines the addition rate right at the start and the end of the titration, see also page 42. This parameter influences the titration speed and therefore its accuracy very strongly: A smaller min.rate results in a slower titration.
stop crit: drift ***titr.*	*Type of stop criteria (drift, time)*
stop drift 20 µl/min ***titr.*	*Titration stops if EP is and stop drift is reached. (1...999 µL/min)*
t(delay) 10 s ***titr.*	*Titration stops if there is no dosing during t(delay). (0...999 s, INF)* <CLEAR> sets "INF" Switch off when the end point is reached and the set time after the last dispensing has elapsed. If "INF" is set, an inquiry regarding the stop time appears. If t(delay) is "INF"
stop time OFF s ***titr.*	*Stop after a time (0...999999 s, OFF)* <CLEAR> sets "OFF". Stop after the set time after the start of the titration. "OFF" means no stop, i.e. titration for an "infinitely" long time.
>titration parameters	**General titration parameters**
titr.direction: auto	*Direction is set automatically (+, -, auto)* auto: The direction is set automatically by the Titrino (sign [U_{first} - EP]). +: Direction of higher pH, higher voltage (more "positive"), larger currents. - : Direction of lower pH, lower voltage, smaller currents. The titration direction is fixed if two EP's are set. In this case, an input for titration direction has no meaning.
start V: OFF ***cond.*	*Type of start volume (OFF, abs., rel.)* "OFF": start volume switched off "abs.": absolute start volume in mL "rel.": relative start volume to sample size.
start V 0.0 ml ***cond.*	If "abs." is set: *Absolute start volume (0...999.99 mL)*
factor 0 ***cond.*	If "rel." is set: *Factor for relative start volume (0...±999999).* Calculated as: start V (in mL) = factor∗sample size
dos.rate max. ml/min ***titr.*	*Dosing rate for start volume (0.01...150 mL/min, max.)* <CLEAR> sets "max.". The maximum rate depends on the Exchange Unit:

	Exchange Unit max. 5 mL 15 mL/min 10 mL 30 mL/min 20 mL 60 mL/min 50 mL 150 mL/min
pause 0 s ***titr.**	*Pause (0...999999 s)* Waiting time after start volume, e.g. reaction time after dosing of a start volume. The waiting time can be aborted with <QUIT>.
meas.input: 1	*Measuring input (1, 2, diff.)* Inquiry only with measured quantities pH and U. Measuring input 1 or 2 or differential amplifier; connection of electrodes, see page 155.
I(pol) 1 µA **U(pol) 400 mV**	With polarized electrodes, instead of the measuring input the *polarization current (-127...127 µA)* or the *polarization potential (-1270...1270 mV, in steps of 10 mV)* is inquired.
electrode test: OFF	*Electrode test (OFF, ON)* Test for polarized electrodes. Performed on changeover from the inactive state to a measurement. "OFF" means that the test is not performed.
temperature 25.0 °C ***cond.**	*Titration temperature (-170.0...500.0°C).* Temperature is measured at the start of the titration if a T sensor is connected. The value is used for temperature compensation in pH titrations.

>stop conditions	**Stop conditions for titration** If this is not "normal", i.e. after reaching the EP.
stop V: abs. ***titr.**	*Type of stop volume (abs., rel., OFF)* "abs.": absolute stop volume in mL. "rel.": relative stop volume to sample size. "OFF": stop volume switched off. Stop volume is not monitored.
stop V 99.99 ml ***titr.**	If "abs." is set: *Absolute stop volume (0...9999.99 mL)*
factor 999999 ***titr.**	If "rel." is set: *Factor for relative stop volume (0...±999999)* Calculated as: Stop V (in mL) = factor∗sample size
filling rate max. ml/min	*Filling rate after the titration (0.01...150 mL/min, max.)* <CLEAR> sets "max.". The maximum rate depends on the Exchange Unit: Exchange Unit max. 5 mL 15 mL/min 10 mL 30 mL/min 20 mL 60 mL/min 50 mL 150 mL/min
>statistics	**Statistics calculation**
status: OFF	*Status of statistics calculation (OFF, ON)* If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.
mean n= 2	*Mean value calculation from n single results (2...20)*
res.tab: original	*Result table (original, delete n, delete all)* "original": The original table is used. Deleted individual results are again incorporated in the evaluation. "delete n": Deletion of single results with the index n. "delete all": The entire table is deleted.
delete n= 1	*Delete data from sample number n (1...20)* The deleted result is removed from the statistics calculation.

>preselections	**Preselections for the sequence**
conditioning: OFF	*Automatic conditioning of titration vessel. (ON, OFF)* If conditioning is "on", between the titrations the titration solution is constantly maintained at the (1st) end point. When conditioning is performed, the volume drift can be displayed during the conditioning:
display drift: ON ***cond.***	*Display of drift during conditioning (ON, OFF).* Volume drift.
req.ident: OFF ***cond.***	*Request of identifications after start of titration (id1, id1&2, all, OFF)* After start, sample identifications can be requested automatically: Only id1, id1 & id2, all three id's or no inquiries.
req.smpl size: OFF ***cond.***	*Request of sample size after start of titration (value, unit, all, OFF)* "all" the value and the unit will be requested.
activate pulse: OFF ***cond.***	*Pulse output on I/O line 6 (L6, pin 1) of the remote socket (first, all, cond., OFF)* see page 163.

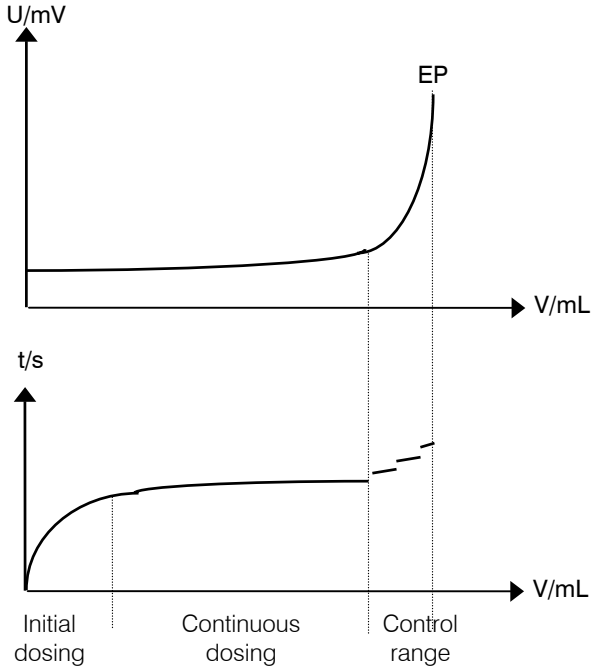
Titration sequence of SET

<START>	
(Activate pulse)	After the start, the activate pulse is outputted.
(Start delay)	The start delay time is waited off.
(Preconditioning) (<START> (Activate pulse) (Start delay)	If conditioning is on, the sample solution is titrated until the (first) EP is reached. The display shows then **drift OK 2.3 µl/min** or **SET pH conditioning** The vessel is now conditioned. The titration can be started with <START>.
(Request ident.) (Request smpl size)	The sample identifications and the sample size are requested.
	The temperature is measured if a T sensor is connected.
(Start conditions)	The start volume is dispensed and pause 2 waited off.
Titration: 1st end point 2nd end point	Then the titration is performed to the first, then to the second end point.
Calculations	Calculations are carried out.
Data output	Data are outputted.
(Reconditioning)	Conditioning is carried out.

Control parameters

The control parameters can be set separately for each end point. Optimize your control parameters for routine analyses for samples with a rather low content.

During the titration, reagent dosing occurs in 3 phases:



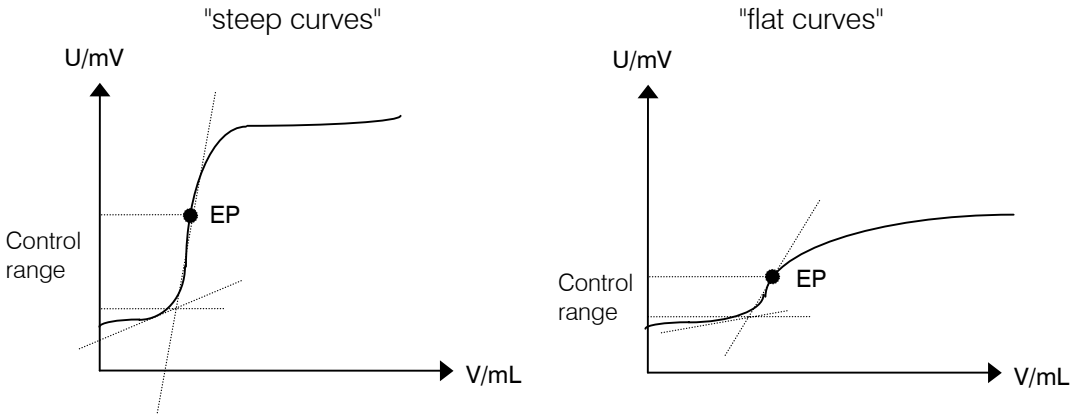
1. Initial dosing:
   Here the dosing rate increases constantly. The rate starts with "min.rate" and goes up to "max.rate".

2. Continuous dosing:
   Dosing is performed at the maximum rate "max.rate" until the control range (dynamics) is reached.

3. Control range (dynamics):
   In this range, dosing is performed in single steps. The last dosing steps are controlled by the parameter "min.rate".

Trial settings for the size of the control range

Set a large control range for steep curves. Relatively flat curves, on the other hand, need a smaller control range. You can get an initial, good approximation for the start of the control range from the intersection point of the tangents:



Relation between the stop criteria "time" and "drift"

The stop criterion "time", t(delay), means that the end point must be exceeded for a certain period of time. In other words, after the last dosed increment, time t is allowed to elapse before the titration is stopped. The size of this last increment depends on the volume of the Exchange Unit used. With a 20 mL Exchange Unit, the smallest possible increment is 2 µL. With a t(delay) = 5 s, the last 2 µL reagent must thus suffice for 5 s or longer. This results in a drift of ≤ 2 µL/5 s = 24 µL/min (the drift can be less than 24 µL/min as it is not known whether the last increment would also suffice for 10 s). If you have been working up to this point with a 20 mL Exchange Unit and a t(delay) = 5 s, you can set a value of ≤ 24 µL/min as stop drift. The following table shows several values for the maximum stop drift.

t(delay) / min.incr. (Exchange Unit)	5 s	10 s	20 s
0.5 µL (5 mL)	6 µL/min	3 µL/min	1.5 µL/min
1 µL (10 mL)	12 µL/min	6 µL/min	3 µL/min
2 µL (20 mL)	24 µL/min	12 µL/min	6 µL/min
5 µL (50 mL)	60 µL/min	30 µL/min	15 µL/min

Same t(delay) with a range of extremely small volume increments means different switch-off points. In case the stop criterion "drift" is used, the stopping point remains the same.

If you have entered the endpoint and the control range (dynamics), the default values for the other control parameters should suffice for the first titration. If you encounter difficulties in optimizing your titration, the following table will be of use.

How to proceed if ...

Problem	Possible causes and corrective measures
Dosing at the end too long and with too small increments. "Never ends!"	• Increase "min.rate". Perform an experiment with a much higher min.rate. • Change switch-off criterion. Attempt, e.g. to increase the stop drift or use a shorter t(delay) as stop criterion. • Possibly pass an inert gas through the titration vessel.
"Overshoots". Titration is not controlled, i.e. at the end single pulses are not dosed.	• Lower "max.rate". • Set larger control range. • Set "min.rate" much lower. • Optimize arrangement of electrode and buret tip and improve stirring, see page 157. This is particularly important with very fast titration reactions and with steep curves.
Titration time is too long.	• Set higher "min.rate". • Set higher "max.rate". • Lower "dynamics".
Scatter in titration results is too great.	• Set "min.rate" lower.

2.7.3 Parameters for MEAS

parameters **>measuring parameters**	**measuring parameters** determine the measurement. **statistics**: Calculation of mean values and standard deviation, see also page 55. **preselections**: ON/OFF of various auxiliary functions such as automatic requests after the start and activate pulse.
>measuring parameters	**Measuring parameters**
signal drift OFF mV/min	*Drift criterion for measured value acquisition (input range depends on the measured quantity:* *pH, U, Ipol: 0.5...999 mV/min, OFF* *Upol: 0.05...99.9 µA/min, OFF* *T: 0.5...999 °C/min, OFF)* <CLEAR> sets "OFF". "OFF" means that the measured value is acquired after a fixed equilibration time.
equilibr.time OFF s	*Waiting time for measured value acquisition (0...9999 s, OFF)* <CLEAR> sets "OFF". If no new equilibration time has been entered, the Titrino calculates an equilibration time appropriate to the drift with the formula $\text{equilibr.time (in s)} = \frac{150}{\sqrt{\text{Drift} + 0.01}} + 5$ The measured value is acquired when the first criterion (drift or time) is met. With drift and time "OFF", you will have an "infinite" measurement.
meas.input: 1	*Measuring input for pH and U. (1, 2, diff.)* Inquiry only with measured quantities pH and U. Measuring input 1 or 2 or differential amplifier; connection of electrodes, see page 155.
I(pol) 1 µA **U(pol) 400 mV**	With polarized electrodes, instead of the measuring input the *polarization current (-127...127 µA)* or the *polarization potential (-1270...1270 mV, in steps of 10 mV)* is inquired.
electrode test: OFF	*Electrode test (OFF, ON)* Test for polarized electrodes. Performed on changeover from the inactive standby mode to a measurement. "OFF" means that the test is not

	performed.
temperature 25.0 °C	*Temperature (-170.0...500.0 °C)* Temperature is measured at the start if a T sensor is connected. This parameter is used for temperature compensation in pH measurements.
>statistics	**Statistics calculation**
status: OFF	*Status of statistics calculation (OFF, ON)* If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.
mean n= 2	*Mean value calculation from n single results (2...20)*
res.tab: original	*Result table (original, delete n, delete all)* "original": The original table is used. Deleted individual results are again incorporated in the evaluation. "delete n": Deletion of single results with the index n. "delete all": The entire table is deleted.
delete n= 1	*Delete data from sample number n (1...20)* The deleted result is removed from the statistics calculation.
>preselections	**Preselections for the sequence**
req.ident: OFF	*Request of sample identifications after start of titration (id1, id1&2, all, OFF)* After start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries.
req.smpl size: OFF	*Request of sample size after start of titration (value, unit, all, OFF)*
activate pulse: OFF	*Pulse output on line "activate" (L6, pin 1) of the remote socket (ON, OFF)* see page 163.

2.7.4 Parameters for CAL

`parameters` `>calibration parameters`	**calibration parameters** determine the calibration procedure. **statistics**: Calculation of mean values and standard deviation, see also page 55.
`>calibration parameters`	**Calibration parameters**
`meas.input: 1`	*Measuring input (1, 2, diff.)* Measuring input 1 or 2 or differential amplifier; Connection of electrodes, see page 155.
`cal.temp. 25.0 °C`	*Calibration temperature (-20.0 ... 120.0 °C)* If a T sensor is connected, the temperature will be measured. The calibration temperature can also be input during the calibration sequence.
`buffer #1 pH 7.00`	*pH value of first buffer (0...±20.00)* The pH value of the buffers can be put in during the calibration sequence.
`buffer #2 pH 4.00`	*pH value of second and the following buffers (0...±20.00, OFF)* <CLEAR> sets "OFF". Buffers are requested until "OFF" is set. This gives an n-point calibration. Up to 9 buffers. A regression line will be calculated in calibrations with more than 2 buffers.
`buffer #3 pH OFF`	
`signal drift 2 mV/min`	*Drift for measured value acquisition (0.5...999 mV/min, OFF)* <CLEAR> sets "OFF". "OFF" means that the measured value is acquired after an equilibration time.
`equilibr.time 110 s`	*Equilibration time (0...9999 s, OFF)* <CLEAR> sets "OFF". If a new equilibration time has not been entered, the Titrino calculates an equilibration time appropriate to the drift, see page 43. The measured value is acquired as soon as the first criterion (drift or time) has been met. If drift and time are both set to "OFF", the measured value acquisition is immediate.
`electr.id`	*Electrode identification (up to 8 characters).*
`sample changer cal: OFF`	*Calibration with sample changer (ON, OFF)* In calibrations with a sample changer, there are no hold points in the calibration sequence for inputs. Calibration temperature and pH values of the buffers

	Calibration temperature and pH values of the buffers (which are temperature dependent) must therefore be entered in advance. The inputs in key <PARAM> are valid.
activate pulse: OFF	*Pulse output on the line "activate" (L6, pin 1) of the remote socket (all, first, OFF)* See page 163.
>statistics	**Statistics calculation**
status: OFF	*Status of statistics calculation (OFF, ON)* If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.
mean n= 2	*Mean value calculation from n single results (2...20)*
res.tab: original	*Result table (original, delete n, delete all)* "original": The original table is used. Deleted individual results are again incorporated in the evaluation. "delete n": Deletion of single results with the index n. "delete all": The entire table is deleted.
delete n= 1	*Delete data from sample number n (1...20)* The deleted result is removed from the statistics calculation.

Calibration sequence

<START>	
(Activate pulse)	After the start, the activate pulse is output.
(Start delay)	The start delay time is waited off.
Measuring cal.temp. or entry	Then, the calibration temperature is measured. It no T sensor is connected, you enter the temperature manually. Store the value with <ENTER> or continue with <START> (T is not stored).
Buffer 1 pH	Enter the nominal value of the first buffer. Store the value with <ENTER> or continue with <START> (the value is not stored).
Measuring buffer 1	The first buffer is measured.
Buffer 2 pH	Enter the nominal value of the second buffer. Store the value with <ENTER> or continue with <START> (the value is not stored). Leave the calibration with <STOP> ⇒ 1 point calibration.
Measuring buffer 2	The second buffer is measured.
etc.	As many buffers appear as have been specified in the <PARAM> key (up to 9). You may leave the calibration any time with <STOP>.
Data output	Data are output. The calibration data are available for calculation: C46: pHas C47: Electrode slope Calibration data can be viewed at any time with the <CAL.DATA> key and the calibration report printed out using the key sequence <PRINT><CAL.DATA><ENTER>.

2.7.5 Parameters for TIP

In TIP, several commands and methods can be linked to make a titration procedure. The TIP sequence can be defined with <DEF>, see page 62.

parameters **>sequence**	**sequence** Parameters for the TIP sequence see page 63. **statistics**: Calculation of mean values and standard deviation, see also page 55. **preselections**: ON/OFF of various auxiliary functions such as automatic requests after the start and activate pulse.
>statistics	**Statistics calculation**
status: OFF	*Status of statistics calculation (OFF, ON)* If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.
mean n= 2	*Mean value calculation from n single results (2...20)*
res.tab: original	*Result table (original, delete n, delete all)* "original": The original table is used. Deleted individual results are again incorporated in the evaluation. "delete n": Deletion of single results with the index n. "delete all": The entire table is deleted.
delete n= 1	*Delete data from sample number n (1...20)* The deleted result is removed from the statistics calculation.
>preselections	**Preselections for the sequence**
req.ident.: OFF	*Request of sample identifications after start (id1, id1&2, all, OFF)* After start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries.
req.smpl size: OFF	*Request of sample size after the start (value, unit, all, OFF)*
meas.mode: OFF	*Measured quantity (pH, U, Ipol, Upol, T, OFF)* Quantity for measurements with key <MEAS/HOLD>.
meas.input: 1	*Measuring input (1, 2, diff.)* Inquiry only with measured quantities pH and U. Measuring input 1 or 2 or differential amplifier; connection of electrodes, see page 155.

I(pol) 1 µA **U(pol) 400 mV**	With polarized electrodes, inquiry of *polarization current (-127...127 µA)* or *polarization potential (-1270...1270 mV, steps of 10 mV)*
electrode test: OFF	*Electrode test (OFF, ON)* Test for polarized electrodes. Performed on changeover from the inactive standby state to a measurement. "OFF" means that the test is not performed.
temperature 25.0 °C	*Temperature (-170.0...500.0 °C)* Temperature for pH compensation. Its value has to be entered manually even if a T sensor is connected.

2.8 Result calculations

Formula entry, key <DEF>

Key <DEF> contains various inquiries for result calculations and data output. The data of this key are method specific and they are stored in the method memory together with the method.

```
def
>formula
```

formula:
Formulas for result calculations.

The display texts of the Titrino are shown to the left. The values are the default values.

```
>formula
```

Input of formulas

```
   RS?
```

Enter formula number (1...9)
You can calculate up to 9 results per method.
Enter a number 1...9.

```
   RS1=
```

Input of formula
Example:

```
   RS1=EP1*C01/C00
```

RS1=EP1∗C01/C00
Enter formula by means of 3rd functions of keyboard. Here you will find operands, mathematical operations and parentheses. Operands require a number as an identification. You can use the following operands:
EPX: EP's. X = 1...9
RSX: Results which have already been calculated with previous formulas. X = 1...9.
CXX: Calculation constants. XX = 00...79.

Rules:
- Calculation operations are performed in the algebraic hierarchy: ∗ and / before + and -.
- Store formula with <ENTER>.
- Calculation quantities and operands can be deleted with <CLEAR> one by one.
- To delete a complete formula press <CLEAR> repeatedly until only RSX remains in the display. Confirm with <ENTER>.

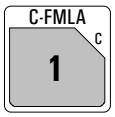
If a formula is stored with <ENTER>, result text, number of decimals and result unit will be requested:

RS1 text	**RS1**	*Text for result output (up to 8 characters)* Text input see page 8.
RS1 decimal places	**2**	*Number of decimal places for result (0...5)*
RS1 unit:	**%**	*Selection of result unit (%, ppm, g/L, mg/mL, mol/L, mmol/L, g, mg, mL, mg/pc, s, mL/min, no unit or up to 6 characters).* Enter next formula, e.g. for RS2.

Meaning of the calculation variables CXX:

C00	Sample size, see page 69.
C01...C19	Method specific operands, see page 54. They are stored with the method in the method memory.
C21...C23	Sample specific operands, see page 69ff.
C26, 27	Mean values from silo calculations.
C30...C39	Common variables.
C40	Initial measured value of the sample, last measured value in MEAS.
C41	End volume.
C42	Determination time.
C43	Volume drift for SET with conditioning.
C44	Temperature.
C45	Dispensed start volume.
C46	Asymmetry-pH (calibration).
C47	Electrode slope (calibration).
C51...C59	Fix EP for DET and MET.
C61...C69	pK/HNP values for DET and MET.
C70...C79	Temporary variables for calculations in TIP.

Input method specific operands C01...C19, key <C-FMLA>

	With <C-FMLA> the operands C01...C19 can be put in. For the calculation, the operands are used, which were introduced in the formula. The inputs method specific and are store in method memory.

The calculation report can be printed with the key sequence:

<PRINT><SELECT>(press key repeatedly until "calc" appears in the display)<ENTER>

2.9 Statistics calculation

Mean values, absolute and relative standard deviations are calculated.

The <DEF> key is used to allocate results for statistics calculation.
The entries are specific to the method and are stored in the method memory.

```
def
>mean
```

mean:
Assigns values for statistics calculations.

The display texts of the Titrino are shown to the left.
The values are the default values.

```
>mean

   MN1=RS1
   MN2=
   :
   MN9=
```

Allocations for statistics calculations

Number n of single values for statistics calculation. (1...9)
You can perform statistics calculation using up to 9 results (RSX), endpoints (EPX) or variables (CXX). For MN1, the default value RS1 is entered.
Delete allocation with <CLEAR> + <ENTER>

Each mode has an inquiry group ">statistics" in key <PARAM>

```
>statistics

   status:              OFF

     mean               n=  2

     res.tab:       original

     delete             n=  1
```

Statistics calculation

Status of statistics calculation (OFF, ON)
If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.

Mean value calculation from n single results (2...20)

Result table (original, delete n, delete all)
"original": The original table is used. Deleted individual results are again incorporated in the evaluation.
"delete n": Deletion of single results with the index n.
"delete all": The entire table is deleted.

Delete data from sample number n (1...20)
The deleted result is removed from the statistics calculation. *)*

How do you obtain statistics calculations?

1) Enter the allocations for the statistics calculation, see page 55.
2) Switch on the statistics calculations: Either with <STATISTICS> or set the status under <PARAM>, "> statistics" to "ON". The "Statistics" LED is on. Storing a method in the method memory, the status of the statistics calculation is retained.
3) Change the number of the individual values n under "mean n", if necessary.
4) Perform at least 2 titrations. The statistics calculation are constantly updated and printed. The values are printed in the short and full result report.
5) The statistics report can be printed with <PRINT><STATISTICS><ENTER>.

Rules:

- Recalculated results are incorporated in the statistics calculation.
- If a result of a particular titration can not be calculated, no results for this determination are incorporated in the statistics calculation. However, the sample counter is still operative, i.e. the statistics calculation start afresh when the number of required individual determinations has been performed.
- If the statistics are switched off ("Statistics" LED no longer on), results are no longer entered in the statistics table. But the table remains unchanged. When the statistics are switched on again, you can immediately continue working.
- If you delete results, all results of the determination with index n are removed from the statistics evaluation.
- On method change, the old statistics table is cleared and the statistics instructions of the new method followed.
- Old results in the statistics table can be deleted with "delete all" (<PARAM>, ">statistics", "res.tab:").

2.10 Common variables

Common variables are used for:

- Determination of a titer with a method. This titer is stored permanently as C3X. The operand C3X can be used in various other methods like any other operand.
- Determination of a blank values with a method . Using this blank value in various other methods.
- Determination of a result with method. Reconciliation of this result in various other methods.

You may view the values of the common variables with <CONFIG>.

 def **>common variables**	With <DEF>, results (RSX), endpoints (EPX), variables (CXX) or mean values (MNX) can be allocated as common variables. The entries are specific to the method and are stored in the method memory. **common variables**: Assigns values as common variables. The display texts of the Titrino are shown to the left. The values are the default values.
>common variables **C30=** **C31** **:** **C39=**	**Allocation for common variables** *Common variable C30...C39 (RSX, EPX, CXX, MNX)* Results (RSX), endpoints (EPX), variables (CXX), and means (MNX) can be assigned. The values of the common variables remain in force for all methods until they are overwritten or deleted. They can be viewed under the <CONFIG> key. Delete allocation with <CLEAR>+<ENTER>.

2.11 Data output

Reports for the output at the end of a determination

	With <DEF>, the report sequence at the end of the determination is defined. The entries are specific to the method and are stored in the method memory.
def **>report**	**report**: Definition of report blocks to be printed automatically at the end of the determination. The display texts of the Titrino are shown to the left. The values are the default values.
>report **report:**	*Report sequence (input range depends on the mode:* *DET: full, short, mplist, curve, derive, comb, scalc full, scalc srt, param, calc, calib, ff* *MET: full, short, mplist, curve, scalc full, scalc srt, param, calc, calib, ff* *SET, MEAS, CAL:* *full, short, scalc full, scalc srt, param, calc, calib, ff* *TIP: full, short, scalc full, scalc srt, param, calc, ff*
report:full;curve	Select a block with <SELECT>. If you require more than one report block, set a ";" as a delimiter between the blocks.

Meaning of the report blocks:

full	Full result report with raw results, calculations and statistics.
short	Short result report with calculations and statistics.
mplist	Measuring point list.
curve	Titration curve (with DET and MET) or volume vs. time (with SET) or measured value vs. time (with MEAS)
derive	1st derivative of the titration curve (with DET)
comb	Combined titration curve and 1st derivative (with DET)
scalc full	Full report of silo calculations.
scalc srt	Short report of silo calculations.
param	Parameter report.
calc	Report with formulas and operands.
calib	Calibration data.
ff	Form feed on printer.

Original reports which are put out automatically at the end of the titration can be printed with recalculated values at any time. Key sequence:
<PRINT><REPORTS><ENTER>.

Original reports have double dashes ==== at the end, whereas recalculations are marked by single dashes ----.

Report outputs can be stopped with <QUIT>.

Example of reports:

Full result report

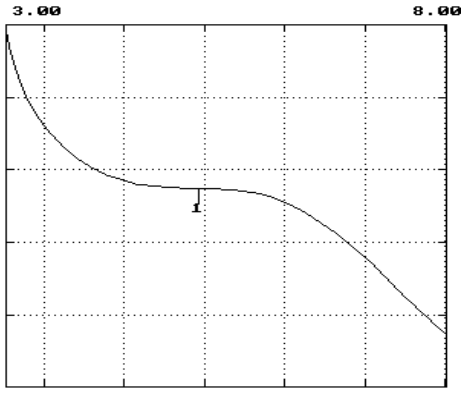
```
 'fr
794 Titrino          01102       794.0010
date  2002-01-03   time  08:54         14
pH(init)        2.88    DET pH  ********
smpl size      0.372 g
EP1            2.083 ml              7.64
RS1             3.80 g/L
device label   Titr 1         sign:
         ============
```

Device label (if there is a designation, see page 23) and manual signature

Titration curve

Scaling of volume and pH axis

```
 'cu
794 Titrino          01102       794.0010
date  2002-01-03   time  08:54         14
start V    0.000 ml    DET pH  ********
1.0 ml/div      dpH=1.0/div
   3.00                                8.00
```




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

Additional possibilities for report outputs

In addition to the reports which are printed at the end of the titration, various other reports can be put out. There are 2 possibilities to select the reports:

1) <PRINT><SELECT><ENTER> Cursor is pressed repeatedly until the desired report appears in the display.

2) <PRINT><keyX><ENTER> key X is the key under which the appropriate data are entered.

List of the "keys X":

Report	Display with <PRINT><SELECT>	<Key X>
Configuration report	configuration	CONFIG
Parameter report	parameters	PARAM
Current sample data	smpl data	SMPL DATA
Statistics report with the individual results	statistics	STATISTICS
All sample data from the silo memory	silo	SILO
Calibration data	cal.data	CAL.DATA
Operands C01...C19	C-fmla	C-FMLA
Contents of the <DEF> key	def	DEF
Contents of the method memory with details of the memory requirements of the individual methods and the remaining bytes	user methods	USER METH
Calculation report with formulas and operands	calc	
Full result report	full	
Short result report	short	
Measuring point list (DET and MET)	mplist	
Titration curve (DET and MET)	curve	
1st derivative of titration curve	deriv	
Combined 1st derivative and titration curve (DET)	comb	
Full report of silo calculations	scalc full	
Short report of silo calculations	scalc srt	
All reports	all	
Complete report sequence of the last determination, as defined under the <DEF> key in the method		REPORTS

Result display without printer

Results can also be viewed in the display. With <SELECT> key, the appropriate section (EP's, results, etc.) can be selected and <ENTER> can be used to view the individual EP's, results etc.

<SELECT>: display	<ENTER>: display	Remarks
`>display results`	`RS1...RS9`	calculated results
`>display EP's`	`EP1...EP9`	EP's
`>display fix EP's`	`C51...C59`	fix EP's (DET and MET)
`>dispaly mean`	`m(RS1)...m(RS9),n`	mean values and number of individual values
`>display std.deviation`	`s(RS1)...d(RS2)`	absolute standard deviation
`>display messages`		various (error) messages
`>display meas.val`	`C4O`	with MEAS
`>display calibration`	`pH(as) and slope`	with CAL
`>display temp. variables`	`C7O...C79`	with TIP

2.12 TIP, Titration procedure

TIP (**Ti**tration **P**rocedure) is used to link several commands in a sequence.
TIP is selected with <MODE> and <ENTER>. TIP is an "empty shell" in which the sequence of the determination must be defined.

Definition of the sequence

With key <DEF> the TIP can be defined.

```
def
>sequence
```

sequence:
Sequence of TIP.

The display texts of the Titrino are shown to the left.
The values are the default values.

```
>sequence

  1.step:            OFF
```

<ENTER>

```
  1.method:     Chloride
```

Sequence

Select a step with keys <SELECT>:

method:	Method from the user memory.
pause:	Waiting time
L4, L6 output:	Set an output.
info:	Hold sequence and write a message into the display.
stirrer	ON/OFF

<ENTER>

Confirm the step with <ENTER> and enter the parameter for the selected step, see below.

etc.

The request for the second step follows etc. Up to 30 steps can be selected.

2 x <QUIT>

On completion of the sequence definition, exit the inquiry with <QUIT>.

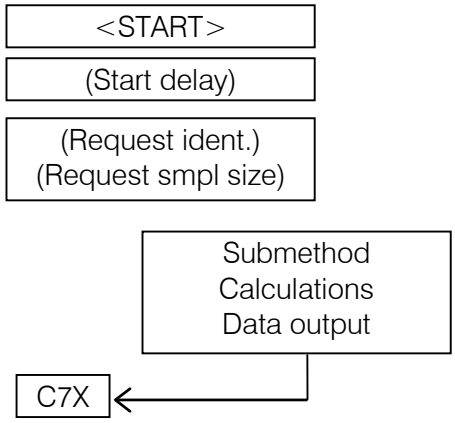
Information for the commands (steps):

Command	Meaning	Input range
method	Method from the user memory. This method runs as a submethod.	Name
pause	Waiting time. The waiting time can be aborted with <QUIT>. <CLEAR> sets "inf" (= infinitely long pause time).	0...999999 s, inf.
L4, L6 output	Set L4 output (pin 3) resp. L6 output (pin 1) of the remote socket. active = 0 V, inactive = 5 V, pulse > 100 ms, off = output is not used. Cable Titrino (L6) - Dosimat: 6.2139.000. Important: A pulse (e.g. a pulse from monitoring or an activate pulse in a submethod) can set an active output to inactive! At the end of the TIP method, the outputs are set to "inactive".	active, inactive, pulse, off
info	Message in the display . The TIP sequence is held and the message displayed. Continue the sequence with <START>, <QUIT> or <ENTER>.	up to 16 characters

The parameters of the sequence can be viewed and changed at any time under the <PARAM> key.

Sequence of TIP

As there is no preset sequence of TIP, in what follows the procedure is illustrated by a sequence that contains all available commands.



The start delay time is waited off.

The sample identifications and the sample size are requested.

Submethods are processed according to their parameters. They run to completion, including calculations and data output (e.g. curves). The determination data of submethods are overwritten in the next sequence step of TIP. Those values which are needed for higher-level calculations must therefore be assigned to temporary variables C7X.

The pause is waited off.

Outputs on the socket "Remote" can be set.

A message can be written in the display. The sequence is held until it is continued manually (with <START>, <QUIT> or <ENTER>).

TIP higher-level calculations are carried out.

Data output in TIP.
Attention: TIP contains no more determination data, i.e. curves must be put out within the submethods.

Preparation of submethods for use in TIP

All titration data, i.e. curves and lists of measured points must be put out in the submethod as they are overwritten on return to TIP.
Individual values from the submethod, e.g. endpoints or calculated results must be stored as temporary variables C7X. This allows them to be used in TIP for further calculations. Reevaluations of data of a submethod are not possible in TIP. The submethods should thus be thoroughly wet tested before they are used in TIP.

Assignment of temporary variables in the submethod:

 def **>temporary variables**	With key <DEF> temporary variables can be assigned. The entries are specific to the method and are stored in the method memory. **temporary variables** for higher-level calculations. The display texts of the Titrino are shown to the left. The values are the default values.
>temporary variables **C70=** **C71=** **:** **C79=**	**Temporary variables** *Assignment of result, endpoints or variables (RSX, EPX, CXX)* Values of the submethod to be used in TIP calculations.

Calculations in TIP

In TIP calculations variables C7X from different submethods can be used, formula entry see page 52.

Note:
We recommend to execute the calculations in TIP, as they can only be recalculated in TIP itself, e.g. with a different sample size.

2.13 Method memory, keys <USER METH>

```
user methods
>recall method
```

Management of the internal method memory with key <USER METH>.
Method identifications can be entered directly or selected with the <SELECT> key.

recall method:
Loads a method from the internal method memory into the working memory.
store method:
Stores the method which is in the working memory in the internal method memory.
delete method:
Deletes a method from the internal method memory.

The display texts of the Titrino are shown to the left.
The values are the default values.

```
>recall method

   method name:
```

Recall method

Recall method from the internal method memory to the working memory (input of method name, which is included in the memory).
If a method identification is entered which is not found in the method memory, the selected value blinks.

```
>store method

   method name:
```

Store method

Store method from the working memory to the internal method memory (up to 8 ASCII characters).
If a method with an identical name is already stored, you are requested if you wish to overwrite the old method. With <ENTER> it is overwritten, with <QUIT> you return to the entry.

```
>delete method

   method name:
```

Delete method

Delete method from the internal method memory (input of method name, which is included in the memory).
For safety, you are again asked if you really wish to delete the method. With <ENTER> it is deleted, with <QUIT> you return to the working memory.
If a method name is entered which is not found in the method memory, the selected value blinks.

The contents of the method memory can be printed with the key sequence

<PRINT><USER METH><ENTER>

Document your methods (e.g. parameter report, def. report and C-fmla report)!
With a PC and the 6.6008.XXX Vesuv program, you should carry out a complete method backup from time to time.

2.14 Calibration data, key <CAL.DATA>

```
cal. data
>input 1
```

With <CAL.DATA>, the current pH calibration data of all measuring inputs can be seen. Calibration data are entered here automatically on completion of a calibration.

input 1:
Calibration data for measuring input 1.
Identical for **input 2** and **diff**.

The display texts of the Titrino are shown to the left.
The values are the default values.

`>input 1`	**pH calibration data for measuring input 1**
`pH(as) 7.00`	*Asymmetry pH (0...±20.00)* Entered automatically after a calibration with measuring input 1.
`slope 1.000`	*Slope (0...±9.999)* Entered automatically after a calibration with measuring input 1.
`temp 25.0 °C`	*Calibration temperature (-20.0...120.0 °C)* Will be printed automatically after calibration with measuring input 1.
`cal.date`	*Date of last calibration (no entry possible)* If the calibration data "pH(as)" and/or "slope" are changed by a manual entry, the date entry is deleted.
`electr.id`	*Electrode identification of calibrated electrodes (no entry possible)* If an electrode identification has been entered in the CAL mode, it is automatically entered after the calibration.

The calibration report with the current measuring input data can be printed at any time with the key sequence

<PRINT><CAL.DATA><ENTER>.

2.15 Current sample data, key <SMPL DATA>

```
smpl data
>id#1 oer C21
```

The key <SMPL DATA> can be used to enter the current sample data. The contents of this key change when the silo memory is switched on, see page 71. Instead of entering the current sample data with <SMPL DATA>, you can request these data automatically after start of determinations. Configuration: <PARAM>, ">preselections". Current sample data can be entered live. For working with the silo memory see page 70.

id#1...3 or C21...C23, sample identifications:
The sample identifications can also be used as sample specific calculation variables C21...C23.

smpl size:
Sample size.
Entry using keypad or via balance, see page 151f.

smpl unit:
Unit of the sample size.

The display texts of the Titrino are shown to the left. The values are the default values.

Sample data

`smpl data`

`id#1 or C21`
`id#2 or C22`
`id#3 or C23`

Sample identification 1...3 or sample specific operand C21...C23 (up to 8 characters).
Sample identifications or sample specific operands can be entered using the keypad, via a balance with a special input device or via barcode reader.

`smpl size 1.0 g`

Sample size (6-digit number: ±X.XXXXX)
Entry using keypad, via balance or via barcode reader.

`smpl unit: g`

Unit of sample size (g, mg, mL, µL, pc, no unit or up to 5 characters)
Select unit with <SELECT>.

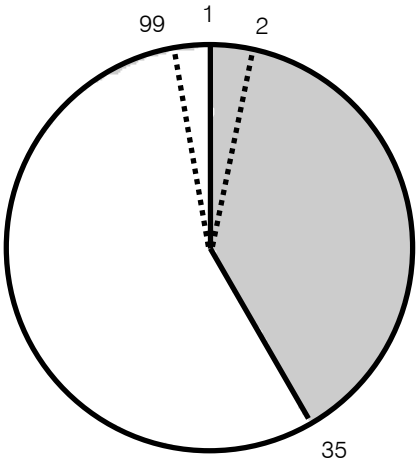
2.16 Silo memory for sample data

In the silo memory or pushup storage, sample data (method, identifications and smpl size) can be stored. This is useful, e.g. when you work with Sample Changers and other automatic sample addition systems or if you wish an overview of your determination results, see page 74.

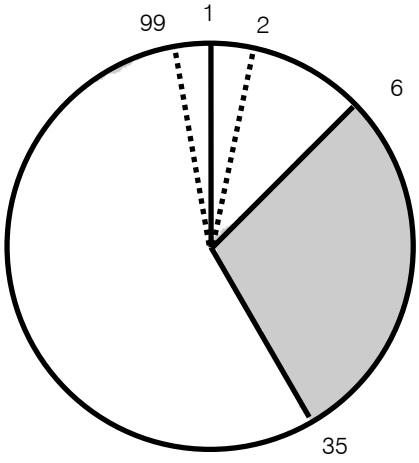
	Press the key <SILO> for working with the silo memory. The status LED "silo" is on when the silo memory is switched on. The silo memory works by the FIFO principle (First In, First Out).

If the silo memory is switched on, sample data are routed to the last free line of the silo memory. If no new value is put in, the value from the last line is automatically copied. In this manner, data can be simply taken over when they remain unchanged.
When the instrument is started, the sample data are fetched from the next silo line.

Organisation of the silo memory



Silo memory contains 35 lines.
Next free line is 36



6 of the 35 lines have been processed. Free lines from 36 to 99 and from 1 to 6.

1 silo line needs between 18 and 120 bytes memory capacity.

Filling the silo memory with a connected balance

If the silo memory is filled from the balance, you must ensure that there is sufficient space in the silo memory for the required number of silo lines! The number of free bytes is given in the user memory report.

When the sample data are entered from a balance, the transfer of the sample size is taken as the end of the silo line. You should not send data from the balance and edit the silo memory at the same time.
For mixed operation, manual input of identifications and sample sizes from a balance, the values from the balance are sent into the line in which editing just takes place. Confirmed the data with <ENTER> at the Titrino.

Key <SMPL DATA> with the silo memory switched on

Sample data can be entered into the silo memory with key <SMPL DATA>.

```
smpl data
>edit silo lines
```

edit silo lines:
Entering sample data into the silo memory.
delete silo lines:
Deletes single silo lines.
delete all silo lines:
Deletes the whole silo memory.

The display texts of the Titrino are shown to the left. The values are the default values.

```
>edit silo lines
```

Input for silo memory

```
   silo line              1
```

Silo line (1...99)
The next free line is displayed automatically. Lines already occupied can be corrected.

```
   method:
```

Method with which the sample is processed (method name from the method memory)
If no method name has been entered, the sample is processed with the method in the working memory. Selection of the method with <SELECT>.

```
   id#1 or C21
   id#2 or C22
   id#3 or C23
```

Sample identification 1..3 or sample specific calculation variables C21...C23 (up to 8 characters)

```
   smpl size          1.0 g
```

Sample size (6-digit number: ±X.XXXXX)
The method specific limits are tested on result calculation.

```
   smpl unit:             g
```

Unit of sample size (g, mg, mL, µL, pc, no unit or up to 5 characters)
Select unit with <SELECT>.

```
>delete silo lines
```

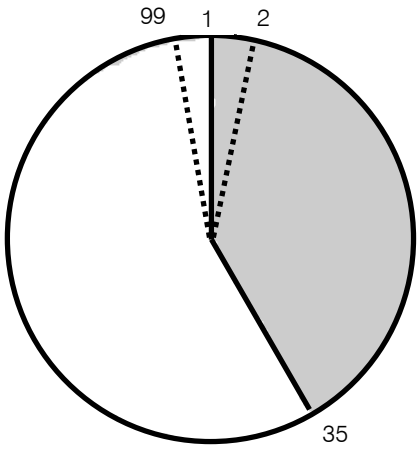
Delete individual silo lines

```
   delete line n        OFF
```

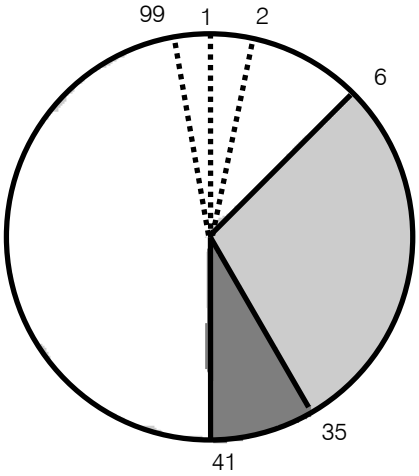
Line number of the line to be deleted(1...99, OFF)
<CLEAR> sets "OFF".
Deleted lines remain in the silo memory. Access is blocked during the processing. To show that a line has been deleted, they are marked with "∗". The symbol ∗ indicates that the line has been deleted.
Deleted lines can be reactivated if the appropriate line is re-edited.

>delete all silo lines **delete all: no**	**Delete all silo lines** *Confirmation (yes, no)* When all silo lines are deleted, the silo is completely empty: The line numbering starts again with 1.
cycle lines: OFF	*With "ON", worked off silo lines will be copied to the highest line of the silo memory (ON, OFF)* Data cycling "on" is useful if you constantly have to process the same sample data. In such a case, the processed silo line is not deleted, but copied to the next free line, see below. If you work in this mode, you should not enter any new silo lines during the determinations.
save lines: OFF	*Store results in the silo memory (ON, OFF)* Determination results will be stored as C24 or C25 in the silo memory according to the allocations in the methods, see page 73. "save lines" can only be set to "OFF" if the silo is completely empty.

Silo memory with data cycling "on"



Silo memory contains 35 lines.
Next free line is 36.



6 of 35 lines have been processed.
The processed lines have been copied to the end of the silo memory: your silo is filled up to line 41.

2.17 Storing determination results and silo calculations

2.17.1 Storing determination results

If the sample-specific data of the silo memory should be kept after the determination and supplemented by results, the following entries are necessary:

1. In the method under <DEF>
   Assignment of the determination results to C24 and/or C25:
2. In the silo memory, <SMPL DATA> (when the silo memory is switched on):
   "save lines: on"

Assignment of determination results

 def **>silo calculations**	The determination results are assigned in key <DEF>. The display texts of the Titrino are shown to the left. The values are the default values.
>silo calculations **C24=** **C25=**	**Silo calculations** *Assignment to C24 (RSX, EPX, CXX)* Calculated results (RSX), endpoints (EPX) or variables CXX can be stored as C24. Same procedure for C25.

Important:
Ensure that there is still sufficient space for storing the results C24 and C25. (In the report <PRINT><USER METH><ENTER> the number of free bytes is shown.) Result name, value and unit are stored. The memory requirements can be estimated as follows:
Result with text (8 characters) and unit (5 characters): 32 bytes
Measured value C40, value without unit: 22 bytes

After several samples have been processed, the silo memory report can have the following appearance (printout with <PRINT><SILO><ENTER>):

```
 'si
794 Titrino         01102      794.0010
date  2002-01-03   time  08:54       14
>silo
  cycle lines:            OFF
  save lines:              ON
 sl method   id 1/C21 id 2/C22 id 3/C23   C00        C24          C25
+ 1    11-2      A/12 94-09-12          0.233g    0.142ml/min  98.53%
+ 2    11-2      A/13 94-09-12          0.286g    0.138ml/min  95.75%
/ 3    11-2      A/14 94-09-12          0.197g    0.145ml/min 100.61%
  4    11-2      A/15 94-09-12          0.288g       NV           NV
  5    11-2      A/16 94-09-12          0.263g       NV           NV
```

← processed silo lines with saved results

The silo lines can be marked as follows (at very left of report):

\+ Silo line has been processed. It cannot be edited anymore.

* A silo line not yet processed has been deleted.

\- A processed silo line has been deleted and hence removed from the silo calculations.

/ The last processed silo line. Recalculation will be considered e.g., if the sample data of this line are changed.
No marking: The silo line is awaiting processing.

2.17.2 Silo calculations

Mean value and standard deviation of the results available in the silo memory can subsequently be calculated over the entire series.

The following details can be entered in the method under <DEF>:

>silo calculations	**Silo calculations**
C24= **C25=**	*Assignment to C24 and C25* Calculated results (RSX), endpoints (EPX) and variables (CXX) can be stored as C24. Identical for C25.
match id: OFF	*Which sample identifications must match in order to combine of the results (id1, id1&2, all, OFF)* "OFF" means no matching ids, all samples which have been processed with the same method are combined, see examples below.

Starting from the following silo report:

```
 'si
794 Titrino         01102      794.0010
date  2002-01-03   time  08:54       14
>silo
  cycle lines:            OFF
  save lines:              ON
 sl  method  id 1/C21 id 2/C22 id 3/C23   C00        C24          C25
+ 1    11-2      A/12 94-09-12          0.233g    0.142ml/min  98.53%  *
+ 2    0-15      A/13 94-09-12          0.286g    0.9976         NV    Assignment
+ 3    0-15      A/13 94-09-12          0.197g    0.9947         NV    for C24 only
+ 4    11-2      A/12 94-09-12          0.288g    0.138ml/min  95.75%  *
/ 5    11-2      A/15 94-09-12          0.263g    0.145ml/min 100.61%  *
```

with "match id: off" the following silo calculation report (scalc full) is obtained:

```
:
 method  id 1/C21 id 2/C22 id 3/C23         mean          +/-s    n
   11-2         *        *        *  Rate   0.142ml/min   0.0035  3
                                   Content    98.30%       2.438   3
   0-15         *        *        * Titer   0.9962        0.00105 2
```

All samples which have been processed with the same method are combined

With "match id: id1" the following silo calculation report (scalc full) is obtained:

```
:
 method  id 1/C21 id 2/C22 id 3/C23         mean          +/-s    n
   11-2      A/12        *        *  Rate   0.140ml/min   0.0028  2
                                   Content    97.14%       1.966   2
   0-15      A/13        *        * Titer   0.9962        0.00105 2
   11-2      A/15        *        *  Rate   0.145ml/min   0.000   1
                                   Content   100.61%       0.000   1
```

Sample processed with the same method and having the same id1 are combined

The short silo calculation report contains only calculations for the current sample.

```
:
 method  id 1/C21 id 2/C22 id 3/C23         mean          +/-s    n
   11-2      A/15        *        *  Rate   0.145ml/min   0.000   1
                                   Content   100.61%       0.000   1
```

The mean values of the silo calculations are available for further result calculations as C26 and C27 and can be used in the Titrino in formulas.
Mean value of C24 ⇒ C26
Mean value of C25 ⇒ C27

Important:

- If work is performed with silo calculations, the method name must be entered in the silo memory.
- Results will be overwritten in the silo recalculation, as long as the silo line is marked with "/". If you do not wish such an input, e.g. because you work off an urgent sample between a series, disconnect the silo.

- **Calculations and assignments are carried out in the following order:**
  1. Calculation of the results RSX
  2. Assignment of temporary variables C7X for TIP
  3. Calculation of means MNX
  4. Assignment of silo results C24 and C25
  5. Silo calculations
  6. Assignment of means C26 and C27 from silo calculations
  7. Assignment of common variables C3X

3 Operation via RS232 Interface

3.1 General rules

The Titrino has an extensive remote control facility that allows full control of the Titrino via the RS 232 interface, i.e. the Titrino can receive data from an external controller or send data to an external controller. C_R and L_F are used as terminators for the data transfer. The Titrino sends 2xC_R and L_F as termination of a data block, to differentiate between a data line which has C_R and L_F as terminators. The controller terminates its commands with C_R and L_F. If more than one command per line is sent by the controller, ";" is used as a separator between the individual commands.

The data are grouped logically and easy to understand. Thus e.g., for the selection of the dialog language, the following must be sent

&**C**onfig.**A**ux.**L**anguage **"english"**

whereby it is sufficient to only transmit the boldface characters, thus:

&**C**.**A**.**L "english"**

The quantities of the commands above are:

Config	configuration data
Aux	auxiliaries, various data
Language	setting the dialog language

The data are hierarchically structured (tree form). The quantities that occur in this tree are called **objects** in the following**.** The dialog language is an object which can be called up with the

&**C**onfig.**A**ux.**L**anguage

command.

If one is in the desired location in the tree, the value of the object can be queried.

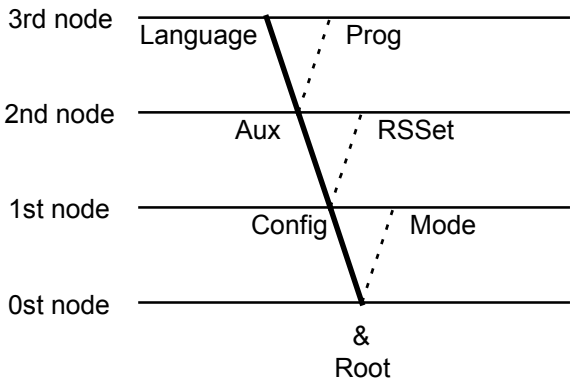
&**C**onfig.**A**ux.**L**anguage **$Q** Q means Query

The query command $Q initiates the issuing of the value on the instrument and the value emission is triggered. Entries which start with $, trigger something. They are thus called **triggers.**

Values of objects can not only be queried, they can also be modified. Values are always entered in quotes, for example:
&**C**onfig.**A**ux.**L**anguage **"english"**

3.1.1 Call up of objects

An excerpt from the object tree is represented below:



Rules	Example
The root of the tree is designated by &.	
The branches (levels) of a tree are marked with a dot (.) when calling up an object.	
When calling up an object, it is sufficient to give only as many letters as necessary to uniquely assign the object. If the call is not unequivocal, the first object in the series will be recognized.	Calling up the dialog language **&C**onfig.**A**ux.**L**anguage or **&C.A.L**
Upper- or lowercase letters may be used.	**&C.A.L** or **&c.a.l**
An object can be assigned a value. Values are signified at the beginning and end by quotes ("). They may contain up to 24 ASCII characters. Numerical values can contain up to 6 digits, a negative sign, and a decimal point. Numbers with more than 6 characters are not accepted; more than 4 decimal places are rounded off. For numbers <1, it is necessary to enter leading zeros.	Entering the dialog language: **&C.A.L"english"** correct entry of numbers: **"0.1"** incorrect entry of numbers "1,5" or "+3" or ".1"
The current object remains until a new object is called.	entry of another dialog language: **"deutsch"**
New objects can be addressed relative to the old object: **A preceding dot** leads **forwards** to the next level in the tree.	From the root to node 'Aux': **&C.A** Forward from node 'Aux' to 'Prog': **.P**
More than one preceding dot leads one level **backwards** in the tree. n node backwards require n+1 preceding dots.	Jump from node 'Prog' to node 'Aux' and select a new object 'Language' at this level: **..L**
If you must jump back to the root, enter a preceding &.	Change from node 'Language' via the root to node 'Mode': **&M**

3.1.2 Triggers

Triggers initiate an action on the Titrino, for example, starting a process or sending data. Triggers are marked by the introductory symbol $.

The following triggers are possible:

$G	**G**o	Starts processes, for ex. starting the mode run or setting the RS 232 interface parameters
$S	**S**top	Stops processes
$H	**H**old	Holds processes
$C	**C**ontinue	Continues processes after Hold
$Q	**Q**uery	Queries all information from the current node in the tree forward up to and including the values
$Q.P	**P**ath	Queries the path from the root of the tree up to the current node
$Q.H	**H**ighest Index	Queries the number of son nodes of the current node
$Q.N"i"	**N**ame	Queries the name of the son node with index i, i = 1 - n
$D	**D**etail-Info	Queries the detailed status information
$U	q**U**it	Aborts the data flow of the instrument, for example, after $Q

The triggers $G and $S are linked to particular objects, see the summary table page 85ff.

All other triggers can be used at any time and at all locations on the object tree.

Examples:

Querying the value of the baud rate: **&C**onfig**.R**SSet**.B**aud **$Q**
Querying all values of the node "RSSet": **&C**onfig**.R**SSet **$Q**
Querying the path of the node "RSSet": **&C**onfig**.R**SSet **$Q.P**
Start mode: **&M**ode **$G**
Querying the detailed status: **$D**

3.1.3 Status messages

In order to have an efficient control by an external control device, it must also be possible to query status conditions; they provide information on the status of the Titrino. The trigger $D initiates output of the status. Status messages consist of the global status, the detailed status and eventual error messages, e.g. $S.Mode.SET;E26. The global status informs on the activity of the process, while the detailed status conditions show the exact activity within the process.

The following **global status conditions** are possible:

$G	Go:	The Titrino is executing the last command.
$H	Hold:	The Titrino has been held ($H, key <meas/hold> or by an error which effects the hold status)
$C	Continue:	The Titrino has been restarted actively after hold
$R	Ready:	The Titrino has executed the last command and is ready
$S	Stop:	A process has been aborted in an "unnatural manner". e.g. stopped or aborted because there was an error.

Detailed status conditions

Status conditions of the global $G:

$G .Mode.DET	**.Inac**:	Instrument at the beginning or at the end of a titration.
	.Req .Id1:	Instrument in the DET mode, requesting Id1 after titration start.
	.Id2:	Instrument in the DET mode, requesting Id2 after titration start.
	.Id3:	Instrument in the DET mode, requesting Id3 after titration start.
	.Smpl:	Instrument in the DET mode, requesting sample size after titration start.
	.Unit:	Instrument in the DET mode, requesting unit of sample size after titration start.
	.Start:	Instrument in the DET mode, processing the start conditions.
	.Titr:	Instrument in the DET mode, titrating.
$G .Mode.MET...		As DET.
$G .Mode.SET	**.Inac**:	Instrument at the beginning or at the end of a titration.
	.Req .Id1:	Instrument in the SET mode, requesting Id1 after start.
	.Id2:	Instrument in the SET mode, requesting Id2 after start.
	.Id3:	Instrument in the SET mode, requesting Id3 after start.
	.Smpl:	Instrument in the SET mode, requesting sample size after start.
	.Unit:	Instrument in the SET mode, requesting unit of sample size after start.
	.Start:	Instrument in the SET mode, processing the start conditions.
	.SET1:	Instrument in the SET mode, titrating to the first endpoint.
	.SET2:	Instrument in the SET mode, titrating to the second endpoint.
	.Cond.Ok:	Instrument in the SET, conditioning, endpoint reached (after the first startup from the standby mode).
	.Cond.Prog:	Instrument in the SET mode, conditioning, endpoint not reached (Conditioning progressing).
$G .Mode.MEAS	**.Inac**:	Instrument at the beginning or at the end of a titration.
	.Req .Id1:	Instrument in the MEAS mode, requesting Id1 after start.
	.Id2:	Instrument in the MEAS mode, requesting Id2 after start.
	.Id3:	Instrument in the MEAS mode, requesting Id3 after start.
	.Smpl:	Instrument in the MEAS mode, requesting sample size after start.
	.Unit:	Instrument in the MEAS mode, requesting unit of sample size after start.
	.Meas:	Instrument in the MEAS mode, measuring.
$G .Mode.CAL	**.Inac**:	Instrument at the beginning or at the end of a calibration
	.Req.Temp:	Instrument in the CAL mode, requesting calibration temperature.
	.Meas.Temp:	Instrument in the CAL mode, measuring calibration temperature.
	.Req.Buf1:	Instrument in the CAL mode, requesting pH of buffer 1.
	.Meas.Buf1:	Instrument in the CAL mode, measures buffer 1.

	.Req.Buf2:	Instrument in the CAL mode, requesting pH of buffer 2.
	.Meas.Buf2:	Instrument in the CAL mode, measures buffer 2.
	etc.	
$G .Assembly.Bur	.Fill:	Buret in filling process
	.ModeDis:	Buret in DIS mode

In TIP, its global status as well as the step number (X) is available.

$G .TIP.X	.Inac:	Instrument at the beginning or at the end of a TIP.
	.Req .Id1:	Instrument in the TIP mode, requesting Id1 after start.
	.Id2:	Instrument in the TIP mode, requesting Id2 after start.
	.Id3:	Instrument in the TIP mode, requesting Id3 after start.
	.Smpl:	Instrument in the TIP mode, requesting sample size after start.
	.Unit:	Instrument in the TIP mode, requesting unit of sample size after start.
	.Pause:	Instrument in the TIP mode, in pause.
	.Info:	Instrument in the TIP mode, in info.
	.Mode...:	Instrument in the TIP mode, working off a submethod. The detailed status messages of the submethod appear, see above.

Status conditions of the global $H:

The status message of the action which has been held appears.
If the process is held because a monitored limit has been violated, its status message is $H.Mode.XXX.Titr.

Status conditions of the global $C:

The status conditions of the global $C are identical with the ones of the global status $G. They appear when the process has been restarted actively from the status "Hold" ($C, key <meas/hold> or automatically after elimination of an error).

Status conditions of the global $R:

$R .Mode.XXXX.QuickMeas:	Quick manual measurement from the initial status in mode XXXX.

$R .Mode.DET	.Inac:	Instrument in the DET mode, inactive.
$R .Mode.MET	.Inac:	Instrument in the MET mode, inactive.
$R .Mode.SET	.Inac:	Instrument in the SET mode, inactive.
	.Cond.Ok:	Instrument in the SET mode, conditioning, endpoint reached.
	.Cond.Prog:	Instrument in the SET mode, conditioning, endpoint not reached.
$R .Mode.MEAS	.Inac:	Instrument in the MEAS mode, inactive.
$R .Mode.CAL	.Inac:	Instrument in the CAL mode, inactive.
$R .Assembly.Bur.ModeDis:		Buret in the DIS mode, inactive.
$R .TIP.Inac:		Instrument in TIP, inactive.

Status conditions of the global $S:

$S .Mode.XXXX.QuickMeas:	Quick manual measurement from the initial status in mode XXXX.

The instrument gives the status from which it has been stopped. The detailed status information is therefore identical to for the global status $G.
Violation of monitored limits with action "end" give the status message $S.Mode.XXX.Inac;EYYY.

3.1.4 Error messages

Error messages are added to the status messages and separated from them by the sign ";".

E20 Check exchange unit.
Exit: Mount Exchange Unit (properly) or &m $S.

E21 Check electrode, short circuit.
Exit: Rectify fault or &m $S.

E22 Check electrode, break.
Exit: Rectify fault or &m $S.

E23 Division by zero.
Exit: The error message disappears on next startup or on recalculation.

E26 Manual stop.
Exit: The error message disappears on next startup.

E27 Stop V reached in SET.
Exit: The error message disappears on next startup.

E28 Wrong object call up
Exit: Send correct path for object. Start path at root.

E29 Wrong value or no value allowed.
Exit: Send correct value or call up new object.

E30 Wrong trigger, this trigger is not allowed or carrying-out of action not possible.
Exit: Send correct trigger (exception: $D) or call up new object.

E31 Command is not possible in active status. Repeat command in inactive status.
Exit: Send new command.

E32 Command is not possible during titration. Repeat command during the conditioning phase or in inactive status.
Exit: Send new command.

E33 Value has been corrected automatically.
Exit: Send new command.

E34 Instrument at the end of the titration and sample data is edited; the instrument at rest or editing during filling.
Exit: &m $S.

RS receive errors:

E36 Parity
Exit: <QUIT> and ensure settings of appropriate parameters at both devices are the same.

E37 Stop Bit
Exit: <QUIT> and ensure settings of appropriate parameters at both devices are the same.

E38 Overrun error. At least 1 character could not be read.
Exit: <QUIT>

E39 The internal working-off buffer of the Titrino is full (>82 characters).
Exit: <QUIT>

RS send errors:

E40	DSR=OFF No proper handshake for more than 1 s. Exit: <QUIT> Is the receiver switched on and ready to receive?
E41	DCD=ON No proper handshake for more than 1 s. Exit: <QUIT> Is the receiver switched on and ready to receive?
E42	CTS=OFF No proper handshake for more than 1 s. Exit: <QUIT> Is the receiver switched on and ready to receive?
E43	The transmission of the Titrino has been interrupted with XOFF for at least 6 s. Exit: Send XON or <QUIT>
E44	The RS interface parameters are no longer the same for both devices. Reset.
E45	The receive buffer of the Titrino contains an incomplete command (L_F missing). Sending from the Titrino is therefore blocked. Exit: Send L_F or <QUIT>.
E120	Overrange of the primary measured value (pH, U, Ipol, Upol or T with MEAS T). The secondary measured value (temperature) may be instable as well. Exit: Correct error or &m $S.
E121	Measuring point list overflow (more than 500 measuring points). Exit: The error message disappears on next startup.
E122	EP overflow. Exit: The error message disappears on next startup or on recalculation.
E123	Missing EP for calculation. Exit: The error message disappears on next startup or on recalculation.
E124	Number of EP does not correspond with the set windows. Exit: The error message disappears on next startup or on recalculation.
E125	Missing fix EP for calculation, has not been defined. Exit: The error message disappears on next startup or on recalculation.
E126	Fix-EP outside of measuring point list. Exit: The error message disappears on next startup or on recalculation.
E128	No new mean. Exit: The error message disappears on next startup or on recalculation.
E129	No new common variable, old value remains. Exit: The error message disappears on next startup or on recalculation.
E130	Wrong sample. For SET with preset titration direction the first measured value lies behind the endpoint. Exit: The error message disappears on next startup.
E131	No EP set for SET. Exit: The error message disappears on next startup.
E132	Silo empty and it has been started with open silo or empty silo has been opened. Exit: Send a silo entry.

E133 Silo full.
Exit: Send new command.

E134 No method. A method, which is required from the silo memory or in TIP, does not exist.
Exit: The error message disappears on next startup.

E135 Check temp.sensor in MEAS T.
Exit: Correct error or &m $S.

E136 Same buffer in CAL. Measured value of the second buffer differs less than 6 mV from the measured value of the first buffer.
Exit: Correct error or &m $S.

E137 XXX Bytes are missing so that the method, the silo line could not be stored or not enough RAM for running TIP.
Exit: Send new command.

E155 No new silo result (C24 or C25).
Exit: The error message disappears on next start or on recalculation.

E157 No sequence defined in TIP.
Exit. The error message disappears on next start.

E158 A second TIP has been called up in TIP.
Exit: The error message disappears on next start.

E160 No new temporary variable.
Exit: The error message disappears on next start.

E161 Measurement range of the secondary measured value (temperature) exceeded. The primary measured value (pH, U, Ipol, Upol) can also be unstable.
Exit: Rectify error or &m $S.

E166 Save lines is "OFF" although a submethod of TIP includes an assignment to C24 or C25.
Exit: The error message disappears on next start. Attention: The data of this sample will not be stored.

E172 In TIP, a QuickMeas was started, without defining a measuring quantity.
Exit: The error message disappears on next start or &Mode.QuickMeas $S.

3.2 Remote control commands

3.2.1 Overview

The internal object tree can be divided into the following branches:

&	**Root**
├ **M**ode	Method parameters
├ **U**serMeth	Administration of the internal user-memory for methods
├ **C**onfig	Instrument configuration
├ **S**mplData	Sample specific data
├ **I**nfo	Current Data
├ **A**ssembly	Component data
├ **Se**tup	Setting the operating mode
└ **D**iagnose	Diagnostics program

&Mode

Object	Description	Input range	Reference
& Root			
Mode	**Mode**	$G, $S, $H, $C	3.2.2.1.
.**Q**uickMeas	Rapid meas. in basic mode	$G, $S	3.2.2.2.
.**S**elect	Mode selection	**DET**,MET,SET, MEAS,CAL,TIP	3.2.2.3.
.**D**ETQuantity	Measured quantity for DET	**pH**, U, Ipol, Upol	ditto
.**M**ETQuantity	Measured quantity for MET	**pH**, U, Ipol, Upol	ditto
.**SET**Quantity	Measured quantity for SET	**pH**, U, Ipol, Upol	ditto
.**MEA**SQuantity	Measured quantity for MEAS	**pH**, U, Ipol, Upol, T	ditto
.**N**ame	Name of current method	read only/read+write	3.2.2.4.
.Parameter*	Parameter of current mode, page 87ff		
.Def	**Definitions for data output**		
.Formulas	**Calculation formulas**		
.1	for result 1		
.Formula	Calculation formula	special	3.2.2.5.
.TextRS	Text for result output	up to 8 ASCII char	ditto
.Decimal	Number of decimal places	0...**2**...5	ditto
.Unit	Unit for result output	up to 6 ASCII char	ditto
:	up to 9 results		
.SiloCalc	**Silo calculations**		
.Assign	Assignment		
.C24	Store as variable C24	RSX,EPX,CXX	3.2.2.6.
.C25	Store as variable C25	RSX,EPX,CXX	ditto
.MatchId	Matching of Id's	id1, id1&2, all, **OFF**	ditto
.ComVar	**Assignment of common variables**		
.C30	for C30	RSX,EPX,CXX,MNX	3.2.2.7.
up to C39			
.Report	**Reports at the end of determination**		
.Assign	Assignment	depends on mode	3.2.2.8.
.Mean	**Assignment for mean calculation**		
.1	MN1		
.Assign	Input of variable	RSX, EPX, CXX	3.2.2.9.
up to 9			
.TempVar	**Assignment of temporary variables**		
.C70	for C70	RSX,EPX,CXX	3.2.2.10.
up to C79			
.CFmla	**Calculation constants**		
.1	Calculation constant C01		
.Value	Input of value	**0**...±999 999	3.2.2.11.
up to C19			

***Parameter**	**Tree part "Parameters for DET"**		
├ .**T**itrPara	**Titration parameters**		
│ ├ .**M**ptDensity	Measuring point density	0...**4**...9	3.2.2.12.
│ ├ .**Mi**nIncr	Minimum increment	0...**10.0**...999.9	ditto
│ ├ .**D**osRate	Dispensing rate for increments	0.01...150.0, **max.**	3.2.2.13.
│ ├ .**S**ignalDrift	Drift for meas. value acquisition	depends on meas.quant.	3.2.2.14.
│ ├ .**U**nitSigDrift	Unit of measured value drift	read only	ditto
│ ├ .**E**quTime	Equilibrium time	0...**26**...9999, OFF	ditto
│ ├ .**St**artV	Start volume		
│ │ ├ .**T**ype	Type of start volume	abs., rel., **OFF**	3.2.2.15.
│ │ ├ .**V**	Volume for absolute start volume	**0**...999.99	ditto
│ │ ├ .**F**actor	Factor for relative start volume	**0**...±999 999	ditto
│ │ ├ .**R**ate	Dispensing rate for start volume	0.01...150.0, **max.**	ditto
│ ├ .**P**ause	Waiting time	**0**...999 999	3.2.2.16.
│ ├ .**Me**asInput	Measuring input	**1**, 2, diff.	3.2.2.17.
│ ├ .**I**pol	Polarization current	0...**1**...±127	ditto
│ ├ .**U**pol	Polarization voltage	0...**400**...±1270	ditto
│ ├ .**Po**lElectrTest	Test for polarized electrodes	ON, **OFF**	ditto
│ ├ .**T**emp	Titration temperature	-170.0...**25.0**...500.0	3.2.2.18.
├ .**S**topCond	**Stop conditions**		
│ ├ .**V**Stop	Stop volume		
│ │ ├ .**T**ype	Type of stop volume	**abs**., rel., OFF	3.2.2.19.
│ │ ├ .**V**	Volume for absolute stop volume	0...**99.99**...9999.99	ditto
│ │ ├ .**F**actor	Factor for relative stop volume	0...±**999 999**	ditto
│ ├ .**M**easStop	Stop measured value pH, U, I	depends on meas.quant.	3.2.2.20.
│ ├ .**U**nitMStop	Unit of stop measured value	read only	ditto
│ ├ .**E**PStop	Stop after a number of EP's	1...**9**, OFF	3.2.2.21.
│ ├ .**F**illRate	Filling rate	0.01...150.0, **max.**	3.2.2.22.
├ .**Sta**tistics	**Statistics**		
│ ├ .**S**tatus	Status of statistics calculation	ON, **OFF**	3.2.2.23.
│ ├ .**M**eanN	No. of individual determinations	**2**...20	ditto
│ ├ .**R**esTab	Result table		
│ │ ├ .**S**elect		**original**,delete n,delete all	ditto
│ │ ├ .**D**elN	Deletion of individual results	**1**...20	ditto
├ .**E**valuation	**Evaluation**		
│ ├ .**E**PC	EP criterion	0...**5**...200	3.2.2.24.
│ ├ .**R**ecognition	EP recognition		
│ │ ├ .**S**elect	Type of EP recognition	**all**,greatest,last,window,OFF	ditto
│ │ ├ .**W**indow	Window		
│ │ │ ├ .**1**	up to 9 windows		
│ │ │ │ ├.**L**owLim	Lower limit window 1	depends on meas.quant.	ditto
│ │ │ │ ├.**U**pLim	Upper limit window 1	depends on meas.quant.	ditto
│ ├ .FixEP	Fix endpoints		
│ │ ├ .**1**	up to 9 fix EP's		
│ │ │ ├.**V**alue	Measured value for fix EP1	depends on meas.quant.	ditto
│ ├ .**p**K pK or HNP evaluation		ON, **OFF**	ditto
├ .**P**resel	**Preselections**		
│ ├ .**I**Req	Request of Id's after start	id1, id1&2, all, **OFF**	3.2.2.25.
│ ├ .**S**req	Request of smpl size after start	value, unit, all, **OFF**	ditto
│ ├ .**A**ctPulse	Output of a pulse	ON, **OFF**	3.2.2.26.

***Parameter**	**Tree part "Parameters for MET"**		
├ **.T**itrPara	**Titration parameters**		
│ ├ .**V**Step	Volume increment	0...**0.10**...999.9	3.2.2.12.
│ ├ .**D**osRate	Dispensing rate for increments	0.01...150.0, **max.**	3.2.2.13.
│ ├ .**S**ignalDrift	Drift for meas. value acquisition	depends on meas.quant.	3.2.2.14.
│ ├ .**U**nitSigDrift	Unit of measured value drift	read only	ditto
│ ├ .**E**quTime	Equilibrium time	0...**26**...9999, OFF	ditto
│ ├ .**St**artV	Start volume		
│ │ ├ .**T**ype	Type of start volume	abs., rel., **OFF**	3.2.2.15.
│ │ ├ .**V**	Volume for absolute start volume	**0**...999.99	ditto
│ │ ├ .**F**actor	Factor for relative start volume	**0**...±999 999	ditto
│ │ ├ .**R**ate	Dispensing rate for start volume	0.01...150.0, **max.**	ditto
│ ├ .**P**ause	Waiting time	**0**...999 999	3.2.2.16.
│ ├ .**Me**asInput	Measuring input	**1**, 2, diff.	3.2.2.17.
│ ├ .**I**pol	Polarization current	0...**1**...±127	ditto
│ ├ .**U**pol	Polarization voltage	0...**400**...±1270	ditto
│ ├ .**Po**lElectrTest	Test for polarized electrodes	ON, **OFF**	ditto
│ ├ .**T**emp	Titration temperature	-170.0...**25.0**...500.0	3.2.2.18.
├ **.S**topCond	**Stop conditions**		
│ ├ .**V**Stop	Stop volume		
│ │ ├ .**T**ype	Type of stop volume	**abs**., rel., OFF	3.2.2.19.
│ │ ├ .**V**	Volume for absolute stop volume	0...**99.99**...9999.99	ditto
│ │ ├ .**F**actor	Factor for relative stop volume	0...±**999 999**	ditto
│ ├ .**M**easStop	Stop measured value pH, U, I	depends on meas.quant.	3.2.2.20.
│ ├ .**U**nitMStop	Unit of stop measured value	read only	ditto
│ ├ .**E**PStop	Stop after a number of EP's	1...**9**, OFF	3.2.2.21.
│ ├ .**F**illRate	Filling rate	0.01...150.0, **max.**	3.2.2.22.
├ **.Sta**tistics	**Statistics**		
│ ├ .**S**tatus	Status of statistics calculation	ON, **OFF**	3.2.2.23.
│ ├ .**M**eanN	No. of individual determinations	**2**...20	ditto
│ ├ .**R**esTab	Result table		
│ │ ├ .**S**elect		**original**,delete n,delete all	ditto
│ │ ├ .**D**elN	Deletion of individual results	**1**...20	ditto
├ **.E**valuation	**Evaluation**		
│ ├ .**E**PC	EP criterion	depends on meas.quant.	3.2.2.24.
│ ├ .**R**ecognition	EP recognition		
│ │ ├ .**S**elect	Type of EP recognition	**all**,greatest,last,window,OFF	ditto
│ │ ├ .**W**indow	Window		
│ │ │ ├ .**1**	up to 9 windows		
│ │ │ │ ├.**L**owLim	Lower limit window 1	depends on meas.quant.	ditto
│ │ │ │ ├.**U**pLim	Upper limit window 1	depends on meas.quant.	ditto
│ ├ .FixEP	Fix endpoints		
│ │ ├ .**1**	up to 9 fix EP's		
│ │ │ ├.**V**alue	Measured value for fix EP1	depends on meas.quant.	ditto
│ ├ .**p**K pK or HNP evaluation		ON, **OFF**	ditto
├ **.P**resel	**Preselections**		
│ ├ .**I**Req	Request of Id's after start	id1, id1&2, all, **OFF**	3.2.2.25.
│ ├ .**S**Req	Request of sample size after start	value, unit, all, **OFF**	ditto
│ ├ .**A**ctPulse	Output of a pulse	ON, **OFF**	3.2.2.26.

***Parameter**	**Tree part "Parameters for SET"**		
├ .**S**ET1	**Control parameters for EP1**		
│ ├ .**E**P Endpoint 1		depends on meas.quant.	3.2.2.27.
│ ├ .**U**nitEp	Unit of endpoint	read only	ditto
│ ├ .**D**yn	Dynamics	depends on meas.quant.	3.2.2.28.
│ ├ .**UnitD**yn	Unit of dynamics	read only	ditto
│ ├ .**M**axRate	Maximum dosing rate	0.01...**10**...150, max.	ditto
│ ├ .**Mi**nRate	Minimum dosing rate	0.01...**25.0**...9999	ditto
│ ├ .**S**top	Titration stop		
│ │ ├ .**T**ype	Type of stop criterion	**drift**, time	3.2.2.29.
│ │ ├ .**D**rift	Stop drift	1...**20**...999	ditto
│ │ ├ .**Ti**me	Switch-off delay time	0...**10**...999, inf	ditto
│ │ ├ .**S**topT	Stop time	0...999 999, **OFF**	ditto
├ .**SET2**	**Control parameters for EP2, as for EP1**		
├ .**T**itrPara	**Titration parameters**		
│ ├ .**D**irection	Titration direction	+, -, **auto**	3.2.2.30.
│ ├ .**S**tart V	Start volume		
│ │ ├ .**T**ype	Type of start volume	abs., rel., **OFF**	3.2.2.15.
│ │ ├ .**V**	Volume for absolute start volume	**0**...999.99	ditto
│ │ ├ .**F**actor	Factor for relative start volume	**0**...±999 999	ditto
│ │ ├ .**R**ate	Dispensing rate for start volume	0.01...150.0, **max.**	ditto
│ ├ .**P**ause	Waiting time after start volume	**0**...999 999	3.2.2.16.
│ ├ .**M**easInput	Measuring input	**1**, 2, diff.	3.2.2.17.
│ ├ .**I**pol	Polarization current	0...**1**...±127	ditto
│ ├ .**U**pol	Polarization voltage	0...**400**...±1270	ditto
│ ├ .**Po**lElectrTest	Test for polarized electrodes	ON, **OFF**	ditto
│ ├ .**T**emp	Titration temperature	-170.0...**25.0**...500.0	3.2.2.18.
├ .**St**opCond	**Stop conditions**		
│ ├ .**V**Stop	Stop volume		
│ │ ├ .**T**ype	Type of stop volume	**abs**., rel., OFF	3.2.2.19.
│ │ ├ .**V**	Volume for absolute stop volume	0...**99.99**...9999.99	ditto
│ │ ├ .**F**actor	Factor for relative stop volume	0...±**999 999**	ditto
│ ├ .**F**illRate	Filling rate	0.01...150.0, **max.**	3.2.2.22.
├ .**Sta**tistics	**Statistics**		
│ ├ .**S**tatus	Status of statistics calculation	ON, **OFF**	3.2.2.23.
│ ├ .**M**eanN	No. of individual determinations	**2**...20	ditto
│ ├ .**R**esTab	Result table		
│ │ ├ .**S**elect		**original**,delete n,delete all	ditto
│ │ ├ .**D**elN	Deletion of individual results	**1**...20	ditto
├ .**P**resel	**Preselections**		
│ ├ .**C**ond	Conditioning	ON, **OFF**	3.2.2.31.
│ ├ .**D**riftDisp	Display of drift during cond.	**ON**, OFF	ditto
│ ├ .**I**Req	Request of Id's after start	id1, id1&2, all, **OFF**	3.2.2.25.
│ ├ .**S**Req	Request of smpl size after start	value, unit, all, **OFF**	ditto
│ ├ .**A**ctPulse	Output of a pulse	first, all, cond., **OFF**	3.2.2.26.

*Parameter	Tree part "Parameters for MEAS"		
├ .Measuring	**Measuring parameters**		
│ ├ .SignalDrift	Drift for meas.value acquisition	depends on meas.quant.	3.2.2.32.
│ ├ .UnitSigDrift	Unit of measured value drift	read only	ditto
│ ├ .EquTime	Equilibrium time	0...9999, **OFF**	ditto
│ ├ .MeasInput	Measuring input	**1**, 2, diff.	3.2.2.33.
│ ├ .Ipol	Polarization current	0...**1**...±127	ditto
│ ├ .Upol	Polarization voltage	0...**400**...±1270	ditto
│ ├ .PolElectrTest	Test for polarized electrodes	ON, **OFF**	ditto
│ ├ .Temp	Titration temperature	-170.0...**25.0**...500.0	3.2.2.34.
├ .Statistics	**Statistics**		
│ ├ .Status	Status of statistics calculation	ON, **OFF**	3.2.2.23.
│ ├ .MeanN	No. of individual determinations	**2**...20	ditto
│ ├ .ResTab	Result table		
│ │ ├ .Select		**original**,delete n,delete all	ditto
│ │ ├ .DelN	Deletion of individual results	**1**...20	ditto
├ .Presel	**Preselections**		
│ ├ .IReq	Request of Id's after start	id1, id1&2, all, **OFF**	3.2.2.25.
│ ├ .SReq	Request of sample size after start	value, unit, all, **OFF**	ditto
│ ├ .ActPulse	Output of a pulse	ON, **OFF**	3.2.2.26.

*Parameter	Tree part "Parameters for CAL"		
├ .Calibration	**Calibration parameters**		
│ ├ .MeasInput	Measuring input	**1**, 2, diff.	3.2.2.35.
│ ├ .CalTemp	Calibration temperature	-20.0...**25.0**...120.0	3.2.2.36.
│ ├ .Buffer			
│ │ ├ .**1**			
│ │ │ ├ .Value	pH value of buffer 1	0...**7.00**...±20.00	3.2.2.37.
│ │ ├ .**2**			
│ │ │ ├ .Value	pH value of buffer 2	0...**4.00**...±20.00, OFF	ditto
│ │ ├ :	up to 9 buffers		
│ ├ .SignalDrift	Drift for meas.value acquisition	depends on meas.quant.	3.2.2.38.
│ ├ .EquTime	Equilibrium time	0...**110**...9999, OFF	ditto
│ ├ .ElectrodeId	Electrode identification	8 ASCII char.	3.2.2.39.
│ ├ .SmplChanger	Calibration on a Titrino	ON, **OFF**	3.2.2.40.
│ ├ .ActPulse	Output of a pulse	first, all, **OFF**	3.2.2.41.
├ .Statistics	**Statistics**		
│ ├ .Status	Status of statistics calculation	ON, **OFF**	3.2.2.23.
│ ├ .MeanN	No.of individual determinations	**2**...20	ditto
│ ├ .ResTab	Result table		
│ │ ├ .Select		**original**,delete n,delete all	ditto
│ │ ├ .DelN	Deletion of individual results	**1**...20	ditto

***Parameter**	**Tree part "Parameters for TIP"**		
├ .**S**equence	**Sequence**		
│ ├ .**1**	Step 1		
│ │ ├ .**S**elect	Step selection	method,pause,L4 output,L6 output, info, **OFF**	3.2.2.42.
│ │ ├ .**M**ethod	Method from memory	special	3.2.2.43.
│ │ ├ .**P**ause	Waiting time	**0.**..999 999, INF	ditto
│ │ ├ .**L**4Output	Line L4	active,inactive,pulse,**OFF**	ditto
│ │ ├ .**L6**Output	Line L6	active,inactive,pulse,**OFF**	ditto
│ │ ├ .**I**nfo	Display information	up to 16 ASCII char.	ditto
├ .**St**atistics	**Statistics**		
│ ├ .**S**tatus	Status of statistics calculation	ON, **OFF**	3.2.2.23.
│ ├ .**M**eanN	No. of individual determinations	**2**...20	ditto
│ ├ .**R**esTab	Result table		
│ │ ├ .**S**elect		**original**,delete n,delete all	ditto
│ │ ├ .**D**elN	Deletion of individual results	**1**...20	ditto
├ .**P**resel	**Preselections**		
│ ├ .**I**Req	Request of Id's after start	id1, id1&2, all, **OFF**	3.2.2.25.
│ ├ .**S**Req	Request of sample size after start	value, unit, all, **OFF**	ditto
│ ├ .**M**easMode	Measuring mode for man.meas.	pH,U,Ipol,Upol,T,**OFF**	3.2.2.44.
│ ├ .**Me**asInput	Measuring input	**1**, 2, diff.	ditto
│ ├ .**I**pol	Polarization current	0...**1**...±127	ditto
│ ├ .**U**pol	Polarization voltage	0...**400**...±1270	ditto
│ ├ .**P**olElectrTest	Test for polarized electrodes	ON, **OFF**	ditto
│ ├ .**T**emp	Titration temperature	-170.0...**25.0**...500.0	ditto

&UserMeth

Object	Description	Input range	Reference
& Root			
⋮			
├ **U**serMeth	**Method memory**		
⋮ ├ **.F**reeMemory	Memory available	read only	3.2.2.45.
├ **.R**ecall	Load method	$G	3.2.2.46.
│ ├ **.N**ame	Method name	8 ASCII characters	ditto
├ **.S**tore	Save method	$G	ditto
│ ├ **.N**ame	Method name	8 ASCII characters	ditto
├ **.D**elete	Delete method	$G	ditto
│ ├ **.N**ame	Method name	8 ASCII characters	ditto
├ **.DelA**ll	Delete all methods	$G	ditto
├ **.L**ist	List of methods		
│ ├ **.1**	Method 1		
│ │ ├ **.N**ame	Method name	read only	3.2.2.47.
│ │ ├ **.M**ode	Mode	read only	ditto
│ │ ├ **.Q**uantity	Measured quantity	read only	ditto
│ │ ├ **.B**ytes	Method size in bytes	read only	ditto
│ │ ├ **.C**hecksum	Checksum of method	read only	ditto
│ ├ **.2**	for each method		

&Config

Object	Description	Input range	Reference
& Root			
├ **C**onfig	**Instrument configuration**		
├ **.P**eriphUnit	**Selection of peripheral units**		
├ **.C**harSet1	External printer	Epson,Seiko,Citizen **IBM**,HP	3.2.2.48.
├ **.B**alance	Selection of balance	**Sartorius**,Mettler,Mettler AT AND,Precisa	3.2.2.49.
├ **.P**lot	Selection of plot at analog output	**U**, dU/dt, V, dV/dt U(rel), T	ditto
├ **.A**ux	**Miscellaneous**		
├ **.L**anguage	Dialog language	**english**, deutsch, francais, espanol, italiano, portugese, svenska	3.2.2.50.
├ **.S**et	Setting of date and time	$G	3.2.2.51.
├ **.D**ate	Date	XXXX-XX-XX	
├ **.T**ime	Time	XX:XX	
├ **.R**unNo	Run number	**0**...9999	3.2.2.52.
├ **.A**utoStart	Automatic start	1...9999, **OFF**	3.2.2.53.
├ **.St**artDelay	Start delay time	**0**...999 999	3.2.2.54.
├ **.D**evName	Device label	8 ASCII char.	3.2.2.55.
├ **.P**rog	Program version	read only	3.2.2.56.
├ **.R**SSet	**Settings RS232**	$G	3.2.2.57.
├ **.B**aud	Baud rate	300,600,1200,2400,4800, **9600**	
├ **.D**ataBit	Number of data bits	7, **8**	ditto
├ **.S**topBit	Number of stop bits	**1**, 2	ditto
├ **.P**arity	Parity	even, odd, **none**	ditto
├ **.H**andsh	Handshake	**HWs**, HWf, SWchar, SWline, none	ditto
├ **.C**omVar	**Values of common variables**		
├ **.C**30	C30	**0**... ±999 999	3.2.2.58.
├ up to C39	**0**... ±999 999		

&SmplData

Object	Description	Input range	Reference
& Root			
├ **S**mplData	**Sample data**		
├ **.S**tatus	Status of silo memory	ON, **OFF**	3.2.2.59.
├ **.O**FFSilo	Current sample data		
├ **.I**d1	Sample identification 1	up to 8 ASCII char	3.2.2.60.
├ **.Id2**	Sample identification 2	up to 8 ASCII char	ditto
├ **.Id3**	Sample identification 3	up to 8 ASCII char	ditto
├ **.V**alSmpl	Sample size	±X.XXXXX	ditto
├ **.U**nitSmpl	Unit of sample size	up to 5 ASCII char	ditto
├ **.ON**Silo	Current sample data		
├ **.C**ounter	Counter of silo memory		
├ **.M**axLines	Maximum lines	read only	3.2.2.61.
├ **.F**irstLine	First line	read only	ditto
├ **.L**astLine	Last line	read only	ditto
├ **.E**ditLine	Editing silo lines		
├ **.1**	1st silo line		
├ **.M**ethod	Method name	up to 8 ASCII char	3.2.2.62.
├ **.I**d1	Sample identification 1	up to 8 ASCII char	ditto
├ **.Id2**	Sample identification 2	up to 8 ASCII char	ditto
├ **.Id3**	Sample identification 3	up to 8 ASCII char	ditto
├ **.V**alSmpl	Sample size	±X.XXXXX	ditto
├ **.U**nitSmpl	Unit of sample size	up to 5 ASCII char	ditto
├ **.C24**	Value of variable C24	read only	ditto
├ **.C25**	Value of variable C25	read only	ditto
├ **.Ma**rk	Mark of silo line	read only	ditto
├ up to 99 lines			
├ **.D**elLine	Delete silo line	$G	3.2.2.63.
├ **.L**ineNum	Line number	1...99, **OFF**	ditto
├ **.DelA**ll	Delete silo line	$G	3.2.2.64.
├ **.Cy**cleLines	Cycle lines	ON, **OFF**	3.2.2.65.
├ **.S**aveLines	Save results	ON, **OFF**	3.2.2.66.

&Info

Object	Description	Input range	Reference
& Root			
⋮			
├ **I**nfo	**Current data**		
⋮ ├ **.R**eport	**Transmission of formatted reports**	$G	3.2.2.67.
│ ├ **.S**elect	Report type	configuration, parameters, smpl data, statistics, silo, calib C-fmla, def, user method, **full**, short, mplist, curve, derive, comb, scalc full, scalc srt, calc, all, ff	ditto
├ **.C**alibrationData	**pH calibration data**	$G	3.2.2.68.
│ ├ **.I**np1	For measuring input 1		
│ │ ├ **.p**Has	Asymmetry pH	0...**7.00**...±20.00	ditto
│ │ ├ **.S**lope	Slope of electrode	0...**1.000**...±9.999	ditto
│ │ ├ **.T**emp	Calibration temperature	-170.0...**25.0**...500.0	ditto
│ │ ├ **.D**ate	Date of calibration	read only	ditto
│ │ ├ **.E**lectrodeId	Id of the calibrated electrode	read only	ditto
│ ├ **.Inp2**	For measuring input 2, as for input 1		
│ ├ **.D**iff	For differential input, as for input 1		
├ **.C**hecksums	**Checksums**	$G	3.2.2.69.
│ ├ **.M**PList	Checksum of meas.point list	read only	ditto
│ ├ **.A**ctualMethod	Checksum of current method	read only	ditto
├ **.D**etermData	**Determination data**	$G	3.2.2.70.
│ ├ **.W**rite	Read/write for several nods	ON, **OFF**	
│ ├ **.E**xV	Volume of Exchange/Dosing unit	read only/read+write	ditto
│ ├ **.M**PList	Measuring point list		
│ │ ├ **.1**	Measuring point 1		
│ │ │ ├ **.A**ttribute	Attribute	read only/read+write	ditto
│ │ │ ├ **.X**	X coordinate	read only/read+write	ditto
│ │ │ ├ **.Y**	Y coordinate	read only/read+write	ditto
│ │	for each measuring point		
├ **.T**itrResults	**Titration results**		
│ ├ **.R**S	Calculated results		
│ │ ├ **.1**	1st result		
│ │ │ ├ **.V**alue	Value	read only	3.2.2.71.
│ │ ├ up to 9 results			
	"Info", continuation		
│ ├ **.E**P	Endpoint		
│ │ ├ **.1**	1st result		
│ │ │ ├ **.V**	Value	read only	ditto
│ │ │ ├ **.M**eas	Measured value	read only	
│ │ │ ├ **.Ma**rk	Mark if more than 1 EP per window	read only	
│ │ ├ up to 9 EP's			
│ ├ **.V**ar	Variables C4X		
│ │ ├ **.C**40	Start measured value	read only/read+write	ditto
│ │ ├ **.C41**	Titration end volume	read only/read+write	
│ │ ├ **.C42**	Titration time	read only/read+write	
│ │ ├ **.C43**	Volume drift in SET	read only/read+write	
│ │ ├ **.C44**	Titration temperature	read only/read+write	

.C45	Start volume	read only/read+write	
.C46	Asymmetry pH	read only	
.C47	Slope of electrode	read only	
.FixEP	Fix EP		
.51	C51		
.Value	Value	read only	3.2.2.72.
	up to 59		
.pK	pK/HNP		
.61	C61		
.Value	Value	read only	ditto
	up to 69		
.TempVar	Temporary variables C7X		
.C70	up to C79	read only/read+write	ditto
.StatisticsVal	**Statistics values**		
.ActN	Number of results in chart	read only	3.2.2.73.
.1	1st mean		
.Mean	Mean	read only	ditto
.Std	Absolute standard deviation	read only	ditto
.RelStd	Relative standard deviation	read only	ditto
up to 9 mean values			
.SiloCalc	**Values of silo calculations**		
.C24	Values of variable C24		
.Name	Name	read only	3.2.2.74.
.Value	Value	read only	ditto
.Unit	Unit	read only	ditto
.C25	as for C24		
.C26	Values of variable C26		
.ActN	Number of single values	read only	ditto
.Mean	Mean value	read only	ditto
.Std	Absolute standard deviation	read only	ditto
.RelStd	Relative standard deviation	read only	ditto
.C27	as for C26		
	"Info", continuation		
.ActualInfo	**Current data**		
.Inputs	I/O Inputs		
.Status	Line status	read only	3.2.2.75.
.Change	Change of line status	read only	ditto
.Clear	Clear change	$G	ditto
.Outputs	as for I/O Inputs		ditto
.Assembly	From Assembly		
.CyclNo	Cycle number	read only	3.2.2.76.
.Counter	Assembly counter	read only	3.2.2.77.
.V	Volume counter	read only	ditto
.Clear	Clears counter	$G	ditto
.Meas	Measured value	read only	3.2.2.78.
.Titrator	From Titrator		
.CyclNo	Cycle number	read only	3.2.2.79.
.V	Volume	read only	ditto
.Meas	Measured indicator voltage	read only	ditto
.dVdt	Volume drift dV/dt	read only	ditto
.dMeasdt	Measured value drift	read only	ditto
.dMeasdV	1st deviation of titration curve	read only	ditto
.ERC	ERC from DET	read only	ditto
.MeasPt	Entry in measuring point list		
.Index	Index of entry	read only	3.2.2.80.
.X	X coordinate	read only	ditto

├ **.Y**	Y coordinate	read only	ditto
├ **.E**P	EP entry		
├ **.I**ndex	Index of entry	read only	ditto
├ **.X**	X coordinate	read only	ditto
├ **.Y**	Y coordinate	read only	ditto
├ **.D**isplay	**Display**		
├ **.L**1	Text line 1	up to 24 ASCII char	3.2.2.81.
├ **.L**2	Text line 2	up to 24 ASCII char	ditto
├ **.As**sembly	**Assembly**		
├ **C**ycleTime	Cycle time	read only	3.2.2.82.
├ **E**xV	Volume of Exchange unit	read only	ditto

&Assembly

Object	Description	Input range	Reference
& Root			
├ **A**ssembly	**Assembly control**		
├ **. B**ur	**Buret**		
├ **.R**ates	Rates		
├ **.F**orward	Forward rate		
├ **.S**elect	Type of rate control	digital, **analog**	3.2.2.83.
├ **.D**igital	Digital rate	0...150, **max**.	ditto
├ **.R**everse	as for forward rate		
├ **.S**elect	Type of rate control	digital, **analog**	ditto
├ **.D**igital	Digital rate	0...150, **max**.	ditto
├ **.F**ill	Fill	$G,$H,$C	3.2.2.84.
├ **.M**odeDis	Dispensing	$G,$S,$H,$C	3.2.2.85.
├ **.S**elect	Type of dispensing control	**volume**, time	ditto
├ **.V**	Volume to be dispensed	0.0001...**0.1**...9999	ditto
├ **.T**ime	Time to dispense	0.25...**1**...86 400	ditto
├ **.VS**top	Limit volume	0.0001...9999, **OFF**	ditto
├ **.A**utoFill	Filling after each increment	ON, **OFF**	ditto
├ **.M**eas	**Measuring**		
├ **.S**tatus	Measuring ON/OFF	ON, **OFF**	3.2.2.86.
├ **.M**easInput	Selection of measuring input	**1**, 2, diff., Ipol, Upol, Temp	ditto
├ **.I**pol	Polarization current	0...**1**...±127	ditto
├ **.U**pol	Polarization voltage	0...**400**...±1270	ditto
├ **.O**utputs	**I/O outputs**		
├ **.A**utoEOD	Automatic output of EOD	**ON**, OFF	3.2.2.87.
├ **.S**etLines	Set I/O lines	$G	ditto
├ **.L**0	Signal on L0	active,inactive,pulse,**OFF**	ditto
├ up to L 3			
├ **.R**esetLines	Reset I/O lines	$G	ditto

&Setup

Object	Description	Input range	Reference
& Root			
⋮			
├ **Se**tup	**Settings for the operating mode**		
├ **.K**eycode	Send key code	ON, **OFF**	3.2.2.88.
├ **.T**ree	Sending format of path info		
├ **.S**hort	Short format of path	ON, **OFF**	3.2.2.89.
├ **.C**hangedOnly	Paths of modified nodes only	ON, **OFF**	ditto
├ **.Tra**ce	Message on changed values	ON, **OFF**	3.2.2.90.
├ **.L**ock	**Lock key functions**		
├ **.K**eyboard	Lock all keyboard keys	ON, **OFF**	3.2.2.91.
├ **.C**onfig	Lock <CONFIG> key	ON, **OFF**	ditto
├ **.P**arameter	Lock <PARAM> key	ON, **OFF**	ditto
├ **.S**mplData	Lock <SMPL DATA> key	ON, **OFF**	ditto
├ **.U**serMeth	Lock functions		
├ **.R**ecall	Lock “loading”	ON, **OFF**	ditto
├ **.S**tore	Lock “saving”	ON, **OFF**	ditto
├ **.D**elete	Lock “deletion”	ON, **OFF**	ditto
└ **.D**isplay	Lock display function	ON, **OFF**	ditto
├ **.M**ode	**Setting waiting intervals**		
├ **.S**tartWait	Waiting time after start	ON, **OFF**	3.2.2.92.
├ **.F**inWait	Waiting time after run	ON, **OFF**	ditto
├ **.S**endMeas	**Automatic sending of measured values**		
├ **.S**endStatus	Connect/disconnect sending	ON, **OFF**	3.2.2.93.
├ **.I**nterval	Time interval	0.08...**4**...16200, MPList	ditto
├ **.Sel**ect	Selection	Assembly, **Titrator**	3.2.2.94.
├ **.A**ssembly	From assembly		
├ **.C**yclNo	Cycle number	ON, **OFF**	3.2.2.95.
├ **.V**	Volume	ON, **OFF**	ditto
├ **.M**eas	Measured indicator voltage	ON, **OFF**	ditto
├ **.T**itrator	From Titrator		
├ **.C**yclNo	Cycle number	ON, **OFF**	3.2.2.96.
├ **.V**	Volume	ON, **OFF**	ditto
├ **.M**eas	Measured indicator voltage	ON, **OFF**	ditto
├ **.d**Vdt	Volume drift dV/dt	ON, **OFF**	ditto
├ **.dM**easdt	Measured value drift	ON, **OFF**	ditto
├ **.dMeasdV**	1st deviation of titration curve	ON, **OFF**	ditto
├ **.E**RC	ERC from DET	ON, **OFF**	ditto
├ **.A**utoInfo	**Automatic message for changes**		3.2.2.97.
├ **.S**tatus	Switch AutoInfo on/off	**ON**, OFF	ditto
├ **.P**	When mains is switched on	ON, **OFF**	ditto
├ **.T**	**Titrator infos**		
├ **.R**	When “ready”	ON, **OFF**	ditto
├ **.G**	When method started	ON, **OFF**	ditto
├ **.GC**	When start is initiated	ON, **OFF**	ditto
├ **.S**	When stopped	ON, **OFF**	ditto
├ **.B**	Begin of method	ON, **OFF**	ditto
├ **.F**	End of process	ON, **OFF**	ditto

	"Setup", continuation		
.E	Error	ON, **OFF**	ditto
.H	When “hold"	ON, **OFF**	ditto
.C	Continue after "hold"	ON, **OFF**	ditto
.O	Conditioning OK	ON, **OFF**	ditto
.N	Conditioning not OK	ON, **OFF**	ditto
.Re	Request after start	ON, **OFF**	ditto
.Si	Silo empty	ON, **OFF**	ditto
.M	Entry in measuring point list	ON, **OFF**	ditto
.EP	Entry in EP list	ON, **OFF**	ditto
.RC	Recalculation of results done	ON, **OFF**	ditto
.I	Changing an I/O input	ON, **OFF**	ditto
.O	Changing an I/O output	ON, **OFF**	ditto
.Graphics	Changing the curve output		
.Grid	Grid on curve	**ON**, OFF	3.2.2.98.
.Frame	Frame on curve	**ON**, OFF	ditto
.Scale	Type of depending axis	**Full**, Auto	ditto
.Recorder	Length of axes		
.Right	Length of meas value axis	0.2...**0.5**...1.00	ditto
.Feed	Length of paper drive axis	0.01...**0.05**...1.00	ditto
.PowerOn	RESET (power on)	$G	3.2.2.99.
.Initialise	Set default values	$G	3.2.2.100.
.Select	Selection of branch	**ActMeth**,Config,Silo,Calib Assembly,Setup,All	ditto
.RamInit	Initialization of working mem.	$G	3.2.2.101.
.InstrNo	Device Identification	$G	3.2.2.102.
.Value	Input of device identification	8 ASCII characters	ditto

&Diagnose

Object	Description	Input range	Reference
& Root			
⋮			
├ **D**iagnose	**Diagnose**		
├ **.R**eport	Output of adjustment parameters	$G	3.2.2.103.

3.2.2 Description of the remote control commands

3.2.2.1. **M**ode $G, $S, $H, $C

Start and stop ($G, $S) or hold of the current method (3.2.2.3) with $H and continue with $C.
$G also serves to continue after inquiries of identifications and sample size after the start (see 3.2.2.25) as well as after inquiries of calibration temperature and pH values of buffers (see 3.2.2.36 and 3.2.2.37).

3.2.2.2. **M**ode.**Q**uickMeas $G, $S

Start and stop of a measurement in the basic mode with the parameters (measured quantity, measuring input) of the current method. Corresponds to the <meas/hold> key. In TIP, the measured quantity is selected with &Mode.Parameter.Presel, see 3.2.2.44.
With an ongoing measurement, the current mode can be started. This stops the measurement automatically.

3.2.2.3. **M**ode.**S**elect **DET**, MET, SET, MEAS, CAL, TIP
Mode.**D**ETQuantity **pH**, U, Ipol, Upol
Mode.**M**ETQuantity **pH**, U, Ipol, Upol
Mode.**SET**Quantity **pH**, U, Ipol, Upol
Mode.**MEA**SQuantity **pH**, U, Ipol, Upol, T

Selection of the standard mode. Mode and the measured quantity belong to the complete selection.
If a method is selected from the method memory, the nodes &Mode.Select and &Mode.XXXQuantity are overwritten with mode and measured quantity of the corresponding user method.

3.2.2.4. **M**ode.**N**ame read only

Name of the current method in the working memory. $Q sends 8 ASCII characters. Standard methods carry the name ********. The node can be set read + write, see 3.2.2.70.

3.2.2.5. **M**ode.**Def.F**ormulas.**1.F**ormula EPX, CXX, RSX, +, -, *, /, (,)
Mode.**Def.F**ormulas.**1.T**extRS up to 8 ASCII characters
Mode.**Def.F**ormulas.**1.D**ecimal 0...**2**...5
Mode.**Def.F**ormulas.**1.U**nit up to 6 ASCII characters
Mode.**D**ef.**F**ormulas.**2.F**ormula
etc. up to **.9**

Entry of formulas. Rules for formula entry, see page 52ff.
Example: "(EP2-EP1)*C01/C00"
In addition to the formula, a text for result output, the number of decimal places and a unit for the result output can be selected. "No unit" is selected with the blank string.
In place of "RSX", a result name may be entered (.TextRS). This name is outputted in the report full, short, scalc full and scalc srt. It is used for the result and the corresponding mean value.

3.2.2.6. **M**ode.**Def.S**iloCalc.**A**ssign.**C**24 RSX, EPX, CXX
Mode.**Def.S**iloCalc.**A**ssign.**C25** RSX, EPX, CXX
Mode.**Def.S**iloCalc.**M**atchId id1, id1&2, all, **OFF**

.Assign.C2X: Assignment to store results in the silo as C2X.
.MatchId: Indication which sample identification(s) have to match so that the results can be combined.

3.2.2.7. **M**ode.**Def.C**omVar.**C**30 RSX, MNX, EPX, CXX
Mode.**Def.C**omVar.**C31**
etc., up to **.C39**

Assignment of common variables.
The values of the common variables are to be found in &Config.ComVar. They can be viewed and entered there, see 3.2.2.58.

3.2.2.8. **M**ode.**Def.R**eport.**A**ssign
DET: full, short, mplist, curve, derive comb, scalc full, scalc srt, calc, param, calib, ff
MET: full, short, mplist, curve, scalc full, scalc srt, calc, param, calib, ff
SET, MEAS, CAL:full, short, scalc full, scalc srt, calc, param, calib, ff
TIP: full, short, scalc full, scalc srt, calc, param, ff

Definition of the report sequence, which is outputted automatically at the end of the determination. Entries of more than one block have to be separated with ";".

3.2.2.9. **M**ode.**Def.M**ean.**1.A**ssign **RS1**, RSX, EPX, CXX
Mode.**Def.M**ean.**2.A**ssign
etc., up to **.9**

Assignment of the statistics calculations. Valid assignments are a requirement for statistics calculations. In addition, the statistics calculation must be switched on, see 3.2.2.23. Rules for statistics calculations see page 55.

3.2.2.10. **M**ode.**Def.T**empVar.**C70** RSX, EPX, CXX
etc. up to **.C79**

Assignment of temporary variables in a submethod for calculations in TIP.

3.2.2.11. **M**ode.**C**Fmla
Mode.**C**Fmla.**1.V**alue **0**...±999 999
Mode.**C**Fmla.**2.V**alue
etc., up to **.19**

Calculation constants specific to a method. Stored in the method memory of the Titrino. Operands specific to the sample (3.2.2.60 and 3.2.2.61) and values of common variables (3.2.2.58) on the other hand are not stored with the methods.

3.2.2.12. **M**ode.**P**arameter.**T**itrPara.**M**ptDensity 0...**4**...9
Mode.**P**arameter.**T**itrPara.**Mi**nIncr 0...**10.0**...999.9

Mode.**P**arameter.**T**itrPara.**V**Step 0...**0.10**...9.999

.MptDensity: Parameter for DET: Measuring point density.

.MinIncr: Parameter for DET: Minimum increment in µL. If the minimum increment is set to 0, measured values are stored vs. time.

.VStep: Parameter for MET: Volume increment in mL. With "0", there is no dispensing and measured values vs. time are entered in the measuring point list.

3.2.2.13. **M**ode.**P**arameter.**T**itrPara.**D**osRate 0.01...150, **max.**

Parameters for DET and MET: Dispensing rate for the volume increments in mL/min. Max. means maximum possible dispensing rate with the Exchange Unit in current use.

3.2.2.14. **M**ode.**P**arameter.**T**itrPara.**S**ignalDrift pH,U,Ipol:0.5...**50**...999, OFF
Upol: 0.05...**50**...99.9, OFF

Mode.**P**arameter.**T**itrPara.**U**nitSigDrift read only

Mode.**P**arameter.**T**itrPara.**E**quTime 0...**26**...9999, OFF

Parameters for DET and MET: Criteria for the measured value acquisition. Measured value drift in mV/min (with pH, U, Ipol) or µA/min (with Upol), equilibration time in s. OFF means that the corresponding criterion is switched off. If both criteria are OFF, the measured values are acquired immediately after dispensing.

If the equilibration time has never been edited, it is automatically calculated by the instrument to match the drift, see page 31. After it has been edited once, it remains in force with the set value.

3.2.2.15. **M**ode.**P**arameter.**T**itrPara.**St**artV.**T**ype abs., rel., **OFF**

Mode.**P**arameter.**T**itrPara.**St**artV.**V** **0**...999.99

Mode.**P**arameter.**T**itrPara.**St**artV.**F**actor **0**...±999 999

Mode.**P**arameter.**T**itrPara.**St**artV.**R**ate 0.01...150, **max.**

Parameters for DET, MET, SET: Start volume.

If an absolute start volume (abs.) has been selected, the volume in mL is valid.

A relative start volume (rel.) is dispensed as a function of the sample size:

Start volume in mL = smpl size * factor

The factor is valid.

The dispensing rate in mL/min applies to both cases. Max. means maximum possible dispensing rate with the Exchange Unit in current use.

3.2.2.16. **M**ode.**P**arameter.**T**itrPara.**P**ause **0**...999 999

Parameters for DET, MET, SET: Pause time in s. Is waited off after the dispensing of the start volume.

3.2.2.17. **M**ode.**P**arameter.**T**itrPara.**Me**asInput **1**, 2, diff.

Mode.**P**arameter.**T**itrPara.**I**pol -127...**1**...+127

Mode.**P**arameter.**T**itrPara.**Up**ol -1270...**400**...+1270

Mode.**P**arameter.**T**itrPara.**Po**lElectrTest ON, **OFF**

Parameters for DET, MET, SET:

Selection of the measuring input; valid with measured quantities pH and U. "diff." means differential amplifier, see page 155.
With Ipol, the inquiries for the polarization current in µA (Ipol) and .PolElectrTest are valid.
With Upol, the inquiry for the polarization voltage in mV (Upol) is valid. Entry in steps of 10 mV.
Besides .PolElectrTest is valid.
If the test for polarized electrodes is switched on, it is performed on change-over from the inactive state to an active state (titration or conditioning).

3.2.2.18. **M**ode.**P**arameter.**T**itrPara.**T**emp -170.0...**25.0**...500.0
Parameters for DET, MET, SET: Titration temperature in °C. If a Pt100 or Pt1000 is connected, the temperature is measured continuously and the parameter .Temp is updated.
The temperature is used for the temperature correction in pH measurements.

3.2.2.19. **M**ode.**P**arameter.**St**opCond.**V**Stop.**T**ype **abs.**, rel., OFF
Mode.**P**arameter.**St**opCond.**V**Stop.**V** 0...**99.99**...9999.99
Mode.**P**arameter.**St**opCond.**V**Stop.**F**actor 0...±**999 999**
Parameters for DET, MET, SET: Stop volume.
If an absolute stop volume (abs.) has been selected, the volume in mL is valid.
A relative stop volume (rel.) is dispensed as a function of the sample size:
Stop volume in mL = smpl size * factor
The factor is valid.
OFF means that the criterion is not monitored.

3.2.2.20. **M**ode.**P**arameter.**S**topCond.**M**easStop pH: 0...±20.00, **OFF**
U: 0... ±2000, **OFF**
I: 0...200.0, **OFF**
Mode.**P**arameter.**S**topCond.**U**nitMStop read only
Parameters for DET and MET: Stop when a measured value is reached. Entry as pH value, in mV (with U and Ipol) and in µA (with Upol). The appropriate unit can be viewed with .UnitMStop.
OFF means that the criterion is not monitored.

3.2.2.21. **M**ode.**P**arameter.**S**topCond.**E**PStop 1...**9**, OFF
Parameters for DET and MET: Stop when a certain number of EP's has been found.
OFF means that the criterion is not monitored.

3.2.2.22. **M**ode.**P**arameter.**S**topCond.**F**illRate 0.01...150, **max.**
Parameters for DET, MET, SET: Filling rate in the titration in mL/min. Max. means maximum possible filling rate with the Exchange Unit in current use.

3.2.2.23. **M**ode.**P**arameter.**Sta**tistics.**S**tatus ON, **OFF**
Mode.**P**arameter.**Sta**tistics.**M**eanN **2**...20

Mode.**P**arameter.**Sta**tistics.**R**esTab.**S**elected **original**, delete n, delete all

Mode.**P**arameter.**Sta**tistics.**R**esTab.**D**elN **1**...20

Entries for the statistics calculations.

.Status: On/off switching. Requirement for statistics calculations is a valid assignment, see 3.2.2.9.

.MeanN: Number of individual results for statistics calculations.

.ResTab.Select: Selection of the table for the statistics calculations.

original: Original table. The original table is (again) set up, i.e. any individual results which have been deleted are reincorporated in the statistics calculations.

delete n: Single result lines are removed from the statistics calculation. All results of the corresponding line in the statistics table are deleted. Specification of the line number in .ResTab.DelN.

delete all: Clear entire statistics table. The results can not be reactivated.

.ResTab.DelN: Specification of the line number to be deleted.

3.2.2.24. **M**ode.**P**arameter.**E**valuation.**E**PC DET: 0...**5**...200

MET pH: 0.1...**0.50**...9.99

U, Ipol: 1...**30**...999

Upol: 0.1...**2**...99.9

Mode.**P**arameter.**E**valuation.**R**ecognition.**S**elected **all**, greatest, last, window, OFF

Mode.**P**arameter.**E**valuation.**R**ecognition.**W**indow.**1.L**owLim

pH: 0...±20.00, **OFF**

U, Ipol: 0...±2000, **OFF**

Upol: 0...±200.0, **OFF**

Mode.**P**arameter.**E**valuation.**R**ecognition.**W**indow.**1.U**pLim Input range as LowLim

etc. up to 9 windows

Mode.**P**arameter.**E**valuation.**F**ixEP.**1.V**alue pH: 0...±20.00, **OFF**

U; Ipol: 0...±2000, **OFF**

etc. up to 9 fix EP's Upol: 0...±200.0, **OFF**

Mode.**P**arameter.**E**valuation.**p**K ON, **OFF**

Parameters for DET and MET: Evaluation of the EP's, see page 32.

.EPC: EP criterion in pH, in mV (with U and Ipol) or in µA (with Upol).

.Recognition.Selected: EP recognition.

all: All endpoints found are recognized.

great: Only the largest EP is recognized.

last: Only the last EP is recognized.

window: Only EP's that lie within set windows are recognized.

OFF: The EP evaluation is switched off.

.Recognition.Window.1.LowLim: Lower limit for window in pH, mV (with U and Ipol) or µA (with Upol).

.Recognition.Window.1.UpLim: Upper limit for window in pH, mV (with U and Ipol) or µA (with Upol).

Windows are opened until the lower limit is set to OFF. For every expected EP, an individual window must be set, see page 34.

.FixEP.1.Val: Fix-EP's in pH, mV (for U, Ipol) resp. µA (for Upol). Fix EP's are evaluated until the setting OFF is found.

.pK: pK or HNP evaluation. Possible only in pH and U titrations.

3.2.2.25. **M**ode.**P**arameter.**P**resel.**I**Req id1, id1&2, all, **OFF**
Mode.**P**arameter.**P**resel.**S**Req value, unit, all, **OFF**
Parameters for DET, MET, SET, MEAS: Automatic inquiry after the start of the determination. From such an inquiry, the determination continues if the requested entry/entries is/are made, e.g. &SmplData.OFFSilo.Id1 (see 3.2.2.84) or with &M $G, see 3.2.2.1.
$H is not possible in requests.

3.2.2.26. **M**ode.**P**arameter.**P**resel.**A**ctPuls ON, **OFF**
for SET: first, all, cond., **OFF**
Output of a pulse on the I/O line "Activate", see page 163.

3.2.2.27. **M**ode.**P**arameter.**S**ET1.**E**P pH: 0...±20.00, **OFF**
U, Ipol: 0...±2000, **OFF**
Upol: 0...±200.0, **OFF**
Mode.**P**arameter.**S**ET1.**U**nitEp read only
Parameters for SET: Setting the 1st endpoint as pH value, in mV (with U and Ipol) resp. µA (with Upol). The corresponding unit can be read with .UnitEP.
If the value is on "OFF", no further nodes will appear from SET1.

3.2.2.28. **M**ode.**P**arameter.**S**ET1.**D**yn pH: 0.01...20.00, **OFF**
U, Ipol: 1...2000, **OFF**
Upol: 0.1...200.0, **OFF**
Mode.**P**arameter.**S**ET1.**UnitD**yn read only
Mode.**P**arameter.**S**ET1.**M**axRate 0.01...**10**...150, max.
Mode.**P**arameter.**S**ET1.**Mi**nRate 0.01...**25.0**...9999.9
Parameters for SET: Control parameters, see page 42.
.Dyn: Dynamics, control range in pH, mV (with U and Ipol) or µA (with Upol). The corresponding unit can be read with .UnitDyn.
.MaxRate: Maximum allowed titration rate in mL/min. Max. means maximum possible rate with the Exchange Unit in current use.
.MinRate: Minimum titration rate in ul/min.

3.2.2.29. **M**ode.**P**arameter.**S**ET1.**S**top.**T**ype **drift**, time
Mode.**P**arameter.**S**ET1.**S**top.**D**rift 1...**20**...999
Mode.**P**arameter.**S**ET1.**S**top.**Ti**me 0...**10**...999, inf
Mode.**P**arameter.**S**ET1.**S**top.**S**topT 0...99 999, **OFF**
Parameters for SET: Type and size of the stop criterion of the titration.
.Type: Type of stop criterion after stop drift or switch-off delay time.
.Drift: Stop drift in ul/min. Applies when "drift" has been selected.
.Time: Switch-off delay time in s. Applies when "time" has been selected. "inf" means infinite.
.StopT: Stop time in s. Applies when "time" has been selected and the value of .Time is set to "inf.".

3.2.2.30. **M**ode.**P**arameter.**T**itrPara.**D**irection +, -, **auto**
Parameters for SET: Titration direction.
"auto" means the titration direction is determined automatically by the instrument. If 2 EP's have been set in a SET titration, the titration direction is given by the two EP's. The entry of the titration direction is then invalid.

3.2.2.31. **M**ode.**P**arameter.**P**resel.**C**ond ON, **OFF**
Mode.**P**arameter.**P**resel.**D**riftDisp **ON**, OFF
Parameters for SET:
.Cond: Conditioning ON/OFF
.DriftDisp: Drift display during conditioning ON/OFF.

3.2.2.32. **M**ode.**P**arameter.**M**easuring.**S**ignalDrift
pH, U, Ipol, T: 0.5...999, **OFF**
Upol: 0.05...99.9, **OFF**
Mode.**P**arameter.**M**easuring.**U**nitSigDrift read only
Mode.**P**arameter.**M**easuring.**E**quTime 0...9999, **OFF**
Parameters for MEAS: Criteria for the measured value acquisition. Measured value drift in mV/min (with pH, U, Ipol), μA/min (with Upol), resp. °C/min (with T). Equilibration time in s. OFF means that the corresponding criterion is switched off. If both criteria are OFF, the measurement continues indefinitely. If the equilibration time has never been edited, it is automatically calculated by the instrument to match the drift, see page 45. After it has been edited once, it remains in force with the set value.

3.2.2.33. **M**ode.**P**arameter.**M**easuring.**M**easInput **1**, 2, diff.
Mode.**P**arameter.**M**easuring.**I**pol ±127...**1**...+127
Mode.**P**arameter.**M**easuring.**Up**ol ±1270...**400**...+1270
Mode.**P**arameter.**M**easuring.**P**olElectrTest ON, **OFF**
Parameters for MEAS:
Selection of the measuring input; valid with measured quantities pH and U. "diff." means differential amplifier, see page 155.
With Ipol, the inquiries for the polarization current in μA (Ipol) and .PolElectrTest are valid.
With Upol the inquiry for the polarization voltage in mV (Upol) is valid. Entry in steps on 10 mV.
Besides .PolElectrTest is valid.
If the test for polarized electrodes is switched on, it is performed on change-over from the inactive state to the measurement.

3.2.2.34. **M**ode.**P**arameter.**M**easuring.**T**emp -170.0...**25.0**...500.0
Parameters for MEAS: Measurement temperature in °C. If a Pt100 or Pt1000 is connected, the temperature is measured.
The temperature is used for the temperature correction in pH measurements.

3.2.2.35. **M**ode.**P**arameter.**C**alibration.**M**easInput **1**, 2, diff.
Parameters for CAL: Selection of the measuring input. "diff." means differential amplifier, see page 155.

3.2.2.36. **M**ode.**P**arameter.**C**alibration.**C**alTemp -20.0...**25.0**...120.0
Parameters for CAL: Calibration temperature in °C. If a Pt 100 or Pt1000 is connected, the temperature is measured.

3.2.2.37. **M**ode.**P**arameter.**C**alibration.**B**uffer.**1.V**alue 0...**7.00**...±20.00
Mode.**P**arameter.**C**alibration.**B**uffer.**2.V**alue 0...**4.00**...±20.00, OFF
etc. up to 9 buffers
Parameters for CAL: pH of buffers. The first buffer which is set to "OFF" determines the number of buffers in the calibration.

3.2.2.38. **M**ode.**P**arameter.**C**alibration.**S**ignalDrift 0.5...**2**...999, OFF
Mode.**P**arameter.**C**alibration.**E**quTime 0...**110**...9999, OFF
Parameters for CAL: Criteria for measured value acquisition. Measured value drift in mV/min, equilibration time in s. OFF means that the corresponding criterion is switched off. If both criterions are on OFF, the measured value is acquired immediately.
If the equilibration time has never been edited, it is automatically calculated by the instrument to match the drift, see page 31. After it has been edited once, it remains in force with the set value.

3.2.2.39. **M**ode.**P**arameter.**C**alibration.**El**ectrodeId up to 8 ASCII char
Parameters for CAL: Electrode identification. It is classified under calibration data, see 3.2.2.68.

3.2.2.40. **M**ode.**P**arameter.**C**alibration.**Sm**plChanger ON, **OFF**
Parameters for CAL: Calibration at Titrino.
With "ON", there are no hold points in the calibration sequence for entries, the first buffer is measured directly.

3.2.2.41. **M**ode.**P**arameter.**C**alibration.**A**ctPulse first, all, **OFF**
Parameters for CAL: Output of a pulse on the I/O line "Activate", see page 163.

3.2.2.42. **M**ode.**P**arameter.**S**equence.**X.S**elect method, pause, L4 output, L6 output, info, **OFF**
Parameters for TIP: Selection of an element for step X (X = 1...30). For the parameters of the elements see 3.2.2.43.

3.2.2.43. **M**ode.**P**arameter.**S**equence.**X.M**ethod Method name
Mode.**P**arameter.**S**equence.**X.P**ause **0**...999 999, INF
Mode.**P**arameter.**S**equence.**X.L**4Output active, inactive, pulse, **OFF**
Mode.**P**arameter.**S**equence.**X.L6**Output as for L4
Mode.**P**arameter.**S**equence.**X.I**nfo up to 16 ASCII characters

Parameters for TIP: Parameters of the elements of TIP.
.Method: Method name of a method available in the user memory. Up to 8 ASCII characters.
.Pause: Pause time in s. INF means infinite. Continue the sequence with &m $G.
.L4 Output: Warning: A pulse triggered by the limit value monitoring at L4 (pin 3) in a submethod sets an output set to active in TIP to inactive.
.L6 Output: Warning: An activate pulse at L6 output (pin 1) in a submethod sets an output set to active in TIP to inactive.
.Info: Entry of a message which is written into the display. The sequence remains in the display with the corresponding message. Continue with &m $G.

3.2.2.44. **M**ode.**P**arameter.**P**resel.**M**easMode pH, U, Ipol, Upol, **OFF**
Mode.**P**arameter.**P**resel.**MeasI**nput **1**, 2, diff.
Mode.**P**arameter.**P**resel.**Ip**ol 0...**1**...±127
Mode.**P**arameter.**P**resel.**U**pol 0...**400**...±1270
Mode.**P**arameter.**P**resel.**Po**lElectrTest ON, **OFF**
Mode.**P**arameter.**P**resel.**T**emp -170....**25.0**...500.0

Parameters for TIP: Selection of the measured quantity for manual measurements in the inactive state, see 3.2.2.2. Selection of the measuring input (MeasInput) applies to measured quantities pH and U. "diff." means differential amplifier, see page 155. With Ipol the requests for the polarization current in μA (Ipol) and .PolElectrTest apply. With Upol the request for the polarization voltage in mV (Upol) applies. Entry in steps of 10 mV. .PolElectrTest also applies. If the test for polarized electrodes is switched on (ON), it will be performed on the change from the inactive state to an active state. The temperature applies to pH measurements.

3.2.2.45. **U**serMeth.**F**reeMem read only

Memory space, available for user methods or silo lines. $Q sends the number of free bytes, e.g. "4928".

3.2.2.46. **U**serMeth.**R**ecall $G
UserMeth.**R**ecall.**N**ame up to 8 ASCII characters
UserMeth.**S**tore $G
UserMeth.**S**tore.**N**ame up to 8 ASCII characters
UserMeth.**D**elete $G
UserMeth.**D**elete.**N**ame up to 8 ASCII characters
UserMeth.**DelA**ll $G

Management of the internal method memory: Load, store and delete methods. An action is performed if "$G" is sent to the corresponding node just after entering the name.
Do not use blank characters before and after method name!
.DelAll: Deletes all methods in the user memory.

3.2.2.47. **U**serMeth.**L**ist.**1.N**ame read only
UserMeth.**L**ist.**1.M**ode read only
UserMeth.**L**ist.**1.Q**uantity read only

UserMeth.**L**ist.**1.B**ytes read only
UserMeth.**L**ist.**1.C**hecksum read only
for each method

List of the methods in the user method memory with the following characteristics:
.Name: Name of the method
.Mode: Mode
.Quantity: Measured quantity
.Bytes: Number of bytes of the user memory used by the method
.Checksum: Checksum of the method, see 3.2.2.68.

3.2.2.48. **C**onfig.**P**eriphUnit.**C**harSet1 Epson, Seiko, Citizen, HP, **IBM**

Selection of the character set and the graphics control characters of the Titrino.
IBM means the IBM character set following character set table 437 and IBM graphics control characters. Select 'IBM' for work with the computer.

3.2.2.49. **C**onfig.**P**eriphUnit.**B**alance **Sartorius**,Mettler,Mettler AT, AND,Precisa
Config.**P**eriphUnit.**P**lot **U**, dU/dt, V, dV/dt, U(rel), T

Selection of the balance type and the signal at the analog output.

3.2.2.50. **C**onfig.**A**ux.**L**anguage **english**, deutsch, francais, espanol, italiano, portugese, svenska

Selection of the dialog language.

3.2.2.51. **C**onfig.**A**ux.**S**et $G
Config.**A**ux.**S**et.**D**ate YYYY-MM-DD
Config.**A**ux.**S**et.**T**ime HH:MM

Date and time.
Input format of the date: Year-month-day, two-digit, enter leading zeros.
Input format for the time: Hours:minutes, two-digit, enter leading zeros.
Date and time have to be set with &Config.Aux.Set $G just after entry of the value.

3.2.2.52. **C**onfig.**A**ux.**R**unNo **0**...9999

Current sample number.
Set to 0 on power on and initialization. After 9999, counting starts again at 0.

3.2.2.53. **C**onfig.**A**ux.**A**utoStart 1...9999, **OFF**

Number of automatic, internal starts.

3.2.2.54. **C**onfig.**A**ux.**St**artDelay **0**...999 999

Start delay time in s. During this time, the data of the preceding determination are retained.

3.2.2.55. **C**onfig.**A**ux.**D**evName up to 8 ASCII characters
Name of the instrument for connections with several units. It is advisable to use only the letters A...Z (ASCII No. 65...90), a...z (ASCII No. 97...122) and the numbers 0...9 (ASCII No. 48...57) when the function Setup.AutoInfo (3.2.2.97) is used at the same time.
If a name has been entered, it will be printed out in the result report (full, short).

3.2.2.56. **C**onfig.**A**ux.**P**rog read only
Output of the program version.
The Titrino sends "794.0010" on requests with $Q.

3.2.2.57. **C**onfig.**R**SSet $G
Config.**R**SSet.**B**aud 300, 600, 1200, 2400, 4800, **9600**
Config.**R**SSet.**D**ataBit 7, **8**
Config.**R**SSet.**S**topBit **1**, 2
Config.**R**SSet.**P**arity even, odd, **none**
Config.**R**SSet.**H**andsh **HWs**, HWf, SWchar, SWline, none
$G sets all RS settings. The changes are performed only if the instrument is inactive. After the setting of the interface parameters, wait at least 2 s to allow the components to equilibrate.
Settings of the values for the data transmission via the RS interface: baud rate, data bit, stop bit, parity and type of handshake, see also page 125ff.
The setting of the values must be initiated with $G immediately after entry of the values.

3.2.2.58. **C**onfig.**C**omVar.**C30**
with up to **.C39**, etc. 0... ±999 999
Values of the common variables from C30 up to C39. Insert the common variables directly or describe the determination results directly from the method, see 3.2.2.7

3.2.2.59. **S**mplData.**S**tatus ON, **OFF**
On/off switching of silo memory. When the silo memory is switched on, the sample data are fetched from the lowest valid silo line.

3.2.2.60. **S**mplData.**O**FFSilo.**I**d1 up to 8 ASCII characters
SmplData.**O**FFSilo.**Id2** up to 8 ASCII characters
SmplData.**O**FFSilo.**Id3** up to 8 ASCII characters
SmplData.**O**FFSilo.**V**alSmpl 6-digits, sign and decimal point
SmplData.**O**FFSilo.**U**nitSmpl up to 5 ASCII characters
Current sample data.
The identifications Id1...Id3 can be used in formulas as sample-specific calculation constants C21...C23.
If "no unit" is desired for the unit of the sample size, the blank string must be entered.

3.2.2.61. **S**mplData.**ON**Silo.**C**ounter.**M**axLines read only
SmplData.**ON**Silo.**C**ounter.**F**irstLine read only
SmplData.**ON**Silo.**C**ounter.**L**astLine read only

Information on silo memory.
.MaxLines: Maximum possible number of silo lines.
.FirstLine: Lowest valid silo line.
.LastLine: Last occupied silo line.

3.2.2.62. **S**mplData.**ON**Silo.**E**ditLine.**1.M**ethod up to 8 ASCII characters
SmplData.**ON**Silo.**E**ditLine.**1.I**d1 up to 8 ASCII characters
SmplData.**ON**Silo.**E**ditLine.**1.Id2** up to 8 ASCII characters
SmplData.**ON**Silo.**E**ditLine.**1.Id3** up to 8 ASCII characters
SmplData.**ON**Silo.**E**ditLine.**1.V**alSmpl 6-digits, sign and dec.point
SmplData.**ON**Silo.**E**ditLine.**1.U**nitSmpl up to 5 ASCII characters
SmplData.**ON**Silo.**E**ditLine.**1.C**24 read only
SmplData.**ON**Silo.**E**ditLine.**1.C25** read only
SmplData.**ON**Silo.**E**ditLine.**1.Ma**rk read only
etc., up to **.99**

Contents of a silo line.
.Method: Method used to process the sample, from the method memory or from the card.
.Id: The identifications Id1...Id3 can also be used as sample-specific calculation constants C21...C23 in formulas.
.UnitSmpl: If "no unit" is desired for the sample size, the blank string must be entered.
.C24, .C25: Results which have been assigned to C24 and C25.
.Mark: Mark of the silo line: "*"=deleted line, "+"=line which is worked off, "-"= line which is worked off and not valid for silo calculations (deleted), "/" last worked-off line, where recalculation can still be done. Silo lines which have been worked off are "read only".

3.2.2.63. **S**mplData.**ON**Silo.**D**elLine $G
SmplData.**ON**Silo.**D**elLine.**L**ineNum 1...99, **OFF**

Deletion of a silo line. The line # is deleted with &SmplData.ONSilo.DelLine $G. If a formerly deleted line is edited again, it becomes valid (function "undelete").

3.2.2.64. **S**mplData.**ON**Silo.**DelA**ll $G

Deletes the entire silo memory. Must be triggered with $G.

3.2.2.65. **S**mplData.**ON**Silo.**Cy**cleLines ON, **OFF**

Silo data cycling.
With "ON", executed lines are copied to the next free silo lines, see page 71.
Exercise caution if you edit the silo memory during the determinations!

3.2.2.66. **S**mplData.**ON**Silo.**S**aveLines ON, **OFF**

Silo lines are not deleted when they are worked off. Assigned results are stored as C24 and C25. "Save lines" can only be set to "ON" if the silo is completely empty. Delete the silo, see 3.2.2.64.

3.2.2.67. **I**nfo.**R**eport $G

Info.**R**eport.**S**elect configuration, parameters, smpl data, statistics, silo, calib, C-fmla, def, user method, **full**, short, mplist, curve, deriv, comb, scalc full, scalc srt, calc, all, ff

$G sends the selected report to the COM which is set in &Config.PeriphUnit.RepToComport:

configuration: Configuration report. Is not accessible during a running determination.

parameters: Parameter report of the current method. During a running determination only "live"-parameters are accessible.

smpl data: Current sample data.

statistics: Statistics table with the individual results.

silo: Contents of the silo memory.

calib: Calibration data of the measuring input in the current method.

C-fmla: Contents of the <C-fmla> key.

def: Contents of the <def> key.

user method: Contents of the method memory.

full: Full result report of the last completed determination.

short: Short result report of the last completed determination.

mplist: Measuring point list of the running determination.

curve: Titration curve of the last determination.

derive: 1st derive of titration curve of the last determination (with DET).

comb: 1st derive combined with the titration curve of the last determination (with DET).

scalc full: Full report of the silo calculations.

scalc srt: Short report of the silo calculations.

calc: Calculation report of the current method.

all: All reports.

ff: Form feed on printer.

Reports which are sent from the Titrino are marked with space (ASCII 32) and ' at the beginning. Then an individual identifier for each report follows. Reports which are triggered by RS232 ($G) have the same introducer but without preceding space, i.e. they start with '.

3.2.2.68. **I**nfo.**C**alibrationData $G

Info.**C**alibrationData.**I**np1.**p**Has -20.00...**7.00**...+20.00

Info.**C**alibrationData.**I**np1.**S**lope -9.999...**1.000**...+9.999

Info.**C**alibrationData.**I**np1.**T**emp -170.0...**25.0**...+500.0

Info.**C**alibrationData.**I**np1.**D**ate read only

Info.**C**alibrationData.**I**np1.**E**lectrodeId read only

identical for .Inp2 and .Diff

pH calibration data for measuring input 1. After the calibration, the data are entered automatically together with the date of the calibration and the electrode identification, see 3.2.2.39.

Calibration data can be entered. They are accepted with &Info.CalibrationData $G. If calibration data are entered, the calibration date is deleted.

3.2.2.69. **I**nfo.**Ch**ecksums $G
Info.**Ch**ecksums.**M**PList read only
Info.**Ch**ecksums.**A**ctualMethod read only

The checksums can be used to identify the content of a file unequivocally, e.g. files with identical content
have identical results of the checksums. An empty file has checksum "0". The calculation of the checksums is triggered with $G.

.MPList: Result of the checksum of the current measuring point list.

.ActualMethod: Result of the checksum of the current method in the working memory. Identical methods with different method names have the same results of the checksum.

3.2.2.70. **I**nfo.**D**etermData $G
Info.**D**etermData.**W**rite ON, **OFF**
Info.**D**etermData.**M**PList.**1.A**ttribute read only/read+write
Info.**D**etermData.**E**xV read only/read+write
Info.**D**etermData.**M**PList.**1.X** read only/read+write
Info.**D**etermData.**M**PList.**1.Y** read only/read+write
for every measuring point

Determination data in hexadecimal format. A measuring point list is available in mode DET, MET, SET, and MEAS.
Recalculation of the measuring data is triggered with $G.

.Write: With "ON", the following nodes can be overwritten: &Info.DetermData.MP.List, &Info.TitrResults.Var.C4X (X = 0...5), &Info.TitrResults.TempVar.C7X (X = 0...9), and &Mode.Name.

.ExV: Volume of the exchange unit, with which the determination was executed

.MPList.1.Attribute: Attribute

.MPList.X: X coordinate, time

.MPList.Y: Y coordinate, volume

3.2.2.71. **I**nfo.**T**itrResults.**R**S.**1.V**alue read only
etc., up to **.9**
Info.**T**itrResults.**E**P.**1.V** read only
Info.**T**itrResults.**E**P.**1.M**eas read only
etc., up to **.2**
Info.**T**itrResults.**V**ar.**C**40 read only/read+write
etc., up to **.C47**

.RS: Values of the calculated results.

.EP: Endpoints with DET, MET, SET:
Volume coordinate in mL, e.g. "1.2340"
Measured value coordinate in pH "5.12", mV (with U and Ipol) "-241" or µA (with Upol) "43.7".

.Var: Various variables. You may overwrite the variables C40...C45, see 3.2.2.95.

C40: Initial measured value in pH "5.12", mV (with U and Ipol) "41", µA (with Upol) "43.7" or °C (with T) "25.0". In MEAS final measured value.
C41: End volume with SET in ml, "12.5360".
C42: Time from start of titration to end in s, "62".
C43: Volume drift on start of a SET titration from the conditioning in ul/min, "3.5".
C44: (Last measured) temperature in °C. Used for the temperature compensation in pH measurements.
C45: Start volume with DET, MET, SET in ml, "2.800".
C46: Asymmetry pH of CAL, "6.89".
C47: Relative electrode slope of CAL, "0.9950".

3.2.2.72. **I**nfo.**T**itrResults.**F**ixEP.**51.V**alue read only
etc. up to **.59**
Info.**T**itrResults.**p**K.**61.V**alue read only
etc. up to **.69**
Info.**T**itrResults.**T**empVar.**C70** read only/read+write
etc. up to **.C79**

.FixEP: Fix EP with DET, MET. C5X corresponds to X = 1...9.
.pK: With DET, MET. C6X corresponds to X = 1...9.
.TempVar: Temporary variables in TIP corresponding to the assignments in the submethods.

3.2.2.73. **I**nfo.**S**tatisticsVal.**A**ctN read only
Info.**S**tatistics.**1.M**ean read only
Info.**S**tatistics.**1.S**td read only
Info.**S**tatistics.**1.R**elStd read only
etc. up to **.9**

The current values of the statistics calculation.
$Q sends, e.g.
ActN: Current value of the individual results "3"
Data for MN1:
Mean: Mean value (decimal places as in result) "3.421"
Std: Standard deviation (1 decimal place more than in result) "0.0231"
RelStd: Relative standard deviation (in %, 2 decimal places) "0.14"

3.2.2.74. **I**nfo.**S**iloCalc.**C**24.**N**ame read only
Info.**S**iloCalc.**C**24.**V**alue read only
Info.**S**iloCalc.**C**24.**U**nit read only
for **.C25** as for .C24
Info.**S**iloCalc.**C26.A**ctN read only
Info.**S**iloCalc.**C26.M**ean read only
Info.**S**iloCalc.**C26.S**td read only
Info.**S**iloCalc.**C26.R**elStd read only
for **.C27** as for .C26

The current values from the silo calculations. C26 is the mean value out of the C24 variables; C27 comes from C25.
$Q sends:
C24.Name: Name of the assigned value "RS1"

C24.Value: Value "2.222"
C24.Unit: Unit of the assigned value "%"
C26.ActN: Number of single results "3"
C26.Mean: Mean (decimal places as for the result itself) "3.421"
C26.Std: Standard deviation (decimal places as for the result + 1) "0.0231"
C26.RelStd: Relative standard deviation (in %, 2 decimal places) "0.14"

3.2.2.75. **I**nfo.**A**ctualInfo.**I**nputs.**S**tatus read only
Info.**A**ctualInfo.**I**nputs.**C**hange read only
Info.**A**ctualInfo.**I**nputs.**Cl**ear $G
Info.**A**ctualInfo.**O**utputs.**S**tatus read only
Info.**A**ctualInfo.**O**utputs.**C**hange read only
Info.**A**ctualInfo.**O**utputs.**Cl**ear $G

Status sends the current status of the I/O lines, Change sends the information regarding whether a change in status of a line has taken place since the last clearing, Clear clears the change information. For the output, there is a conversion from binary to decimal, e.g.

	0	0	0	0	1	0	1	0
Line No.	7	6	5	4	3	2	1	0

Output: $2^1 + 2^3 =$ "10"
1 means ON or change; 0 means OFF or no change.
The lines are assigned as follows (see also pages 161ff):

Inputs:

0	Start (pin 21)
1	Stop (pin 9)
2	Enter (pin 22)
3	Clear (pin 10)
4	Smpl Ready (pin 23)
5	pin 11
6	pin 24
7	pin 12

Outputs:

0	Ready (pin 5)
1	Cond. ok (pin 18)
2	Titration (pin 4)
3	EOD (pin 17)
4	L4 in TIP (pin 3)
5	Error (pin 16)
6	Activate, L6 in TIP (pin 1)
7	Pulse for recorder (pin 2)

3.2.2.76. **I**nfo.**A**ctualInfo.**A**ssembly.**C**yclNo read only

$Q sends the current cycle number of the voltage measurement cycle, e.g. "127". From the cycle number and the cycle time (see 3.2.2.82), a time frame can be set up.
The cycle number is set to 0 on switching on the instrument, on every start and for QuickMeas. It is incremented as long as the instrument remains switched on.

3.2.2.77. **I**nfo.**A**ctualInfo.**A**ssembly.**Co**unter.**V** read only
Info.**A**ctualInfo.**A**ssembly.**Co**unter.**C**lear $G

$Q sends the volume. With the function &Info.Assembly.Counter.Clear $G, the volume counter is set to zero.

3.2.2.78. **I**nfo.**A**ctualInfo.**A**ssembly.**M**eas read only

$Q sends the current measured value from the assembly.

3.2.2.79. **I**nfo.**A**ctualInfo.**T**itrator.**C**yclNo read only
Info.**A**ctualInfo.**T**itrator.**V** read only
Info.**A**ctualInfo.**T**itrator.**M**eas read only
Info.**A**ctualInfo.**T**itrator.**d**Vdt read only
Info.**A**ctualInfo.**T**itrator.**dM**easdt read only
Info.**A**ctualInfo.**T**itrator.**dMeasdV** read only
Info.**A**ctualInfo.**T**itrator.**E**RC read only

$Q sends the current values in the following formats:

	DET	MET	SET	MEAS	CAL
CyclNo	127	127	127	127	127
V(ml)	1.2345	1.2345	1.2345	-	-
Meas:					
pH	3.345	3.345	3.6(mV)	3.345	3.345
U, Ipol (mV)	-345.6	-345.6	-345.6	-345.6	-
Upol (uA)	-12.5	-12.5	-12.5	-12.5	-
T (°C)	-	-	-	25.0	-
dVdt (ul/s)	-	-	2.5142	-	-
dMeasdt					
pH,U,Ipol mV/s	0.7957	0.7957	0.7957	0.7957	0.7957
Upol (uA/s)	0.7957	0.7957	0.7957	0.7957	-
T (°C/s)	-	-	-	0.7957	-
dMeasdV (mV/ul)	-	-	10.6326	-	-
ERC	34	-	-	-	-

NV: Not Valid. If in the signal drift is OFF in modes MEAS and CAL, the signal drift is NV.
OV will be sent for "overrange".
A time frame can be set up from the cycle number and the cycle time (see 3.2.2.82). The cycle number is set to 0 at the start of a method and it is incremented until the end of the method.

3.2.2.80. **I**nfo.**A**ctualInfo.**M**easPt.**I**ndex read only
Info.**A**ctualInfo.**M**easPt.**X** read only
Info.**A**ctualInfo.**M**easPt.**Y** read only
Info.**A**ctualInfo.**E**P.**I**ndex read only
Info.**A**ctualInfo.**E**P.**X** read only
Info.**A**ctualInfo.**E**P.**Y** read only

$Q sends the last entry into the measuring point list (.MeasPt) or the last entry into the list of EP's with DET, MET.
.MeasPt.X"165" Volume (DET, MET)
.MeasPt.Y"3.654" Measured value (DET, MET)
.EP.X"1.234" Volume coordinate of the EP
.EP.Y"5.34" Measured value coordinate of the EP

3.2.2.81. **I**nfo.**A**ctualInfo.**D**isplay.**L**1 up to 24 ASCII characters
Info.**A**ctualInfo.**D**isplay.**L2** up to 24 ASCII characters

Lines of the display. The display can be written to from the computer. Proceed as follows:
Lock the display, see 3.2.2.91.
$Q sends the contents of the corresponding display line.

3.2.2.82. **I**nfo.**As**sembly.**C**ycleTime read only
Info.**As**sembly.**E**xV read only

Inquiries regarding basic variables of the assembly: Cycle time in s, volume of the active Exchange Unit in mL.

3.2.2.83. **A**ssembly.**B**ur.**R**ates.**F**orward.**S**elected digital, **analog**
Assembly.**B**ur.**R**ates.**F**orward.**D**igital 0...150, **max.**
Assembly.**B**ur.**R**ates.**R**everse.**S**elected digital, **analog**
Assembly.**B**ur.**R**ates.**R**everse.**D**igital 0...150, **max.**

Expel and aspirating rate.
Digital or analog control. With digital control, the inputted value applies (in mL/min). "max." means maximum possible rate with the Exchange Unit in current use.
Analog means rate control with the analog potentiometer on Titrino.

3.2.2.84. **A**ssembly.**B**ur.**F**ill $G, $H, $C

$G starts the 'FILL' mode of the buret function.

3.2.2.85. **A**ssembly.**B**ur.**M**odeDis $G, $S, $H, $C
Assembly.**B**ur.**M**odeDis.**S**elected **volume**, time
Assembly.**B**ur.**M**odeDis.**V** 0.0001...**0.1**...9999
Assembly.**B**ur.**M**odeDis.**T**ime 0.25...**1**...86400
Assembly.**B**ur.**M**odeDis.**VS**top 0.0001...9999, **OFF**
Assembly.**B**ur.**M**odeDis.**A**utoFill ON, **OFF**

Dispensing mode with parameters. The dispensing mode can only be started and stopped via the RS Control. During a running dosification, no method can be started at the Titrino.
.Selected: Dispensing of volume increments or during a preset time.
.Volume, .Time: Size of the volume increments or entry of time.
.VStop: Limit volume for the dispensing.
.AutoFill: ON means automatic filling after every dispensing.

3.2.2.86. **A**ssembly.**M**eas.**S**tatus ON, **OFF**
Assembly.**M**eas.**M**easInput **1**, 2, Diff., Ipol, Upol, Temp
Assembly.**M**eas.**I**pol ±127...**1**...+127
Assembly.**M**eas.**U**pol ±1270...**400**...+1270

Measurement in assembly. The measuring function can only be started via RS Control. When the measuring function is switched on, no method can be started at the Titrino.
.Input: Selection of the potentiometric measuring input 1, 2, diff., polarized electrodes or temperature.
.Ipol: Polarization current in µA.
.Upol: Polarization potential in mV, entry in steps of 10 mV.

3.2.2.87. **A**ssembly.**O**utputs.**A**utoEOD **ON**, OFF

Assembly.**O**utputs.**S**etLines $G
Assembly.**O**utputs.**S**etLines.**L**0 active, inactive, pulse, **OFF**
up to .L 3
Assembly.**O**utputs.**R**esetLines $G

Setting the I/O output lines.

.AutoEOD: The automatic output of the EOD (End of Determination) at the end of the determination can be switched off. Thus, for example, in conjunction with a Titrino several determinations can be performed in the same beaker. Before AutoEOD is switched on, line 3 must be set to "OFF".

.SetLines: With $G, all lines are set.

.SetLines.LX: Set the line LX. "active" means setting of a static signal, "inactive" means resetting of the signal, "pulse" means output of a pulse of app. 150 ms, "OFF" means the line is not operated, see also page 162.

Warnings:

- L2 is the EOD line. If you have "AutoEOD" set to "ON", an active line 2 is set to "inactive" by the EOD pulse.
- L3 is the line of the activate pulse. An active line 3 is set to "inactive" by the activate pulse.

.ResetLines: Lines are set to the inactive status (= high).

3.2.2.88. **Se**tup.**K**eycode ON, **OFF**

ON means the key code of a key pressed on the Titrino is outputted. The key code comprises 2 ASCII characters; table of the keys with their code, see page 139. A keystroke of key 11 is sent as follows:

#11

The beginning of the message is marked by a space (ASCII 32).

3.2.2.89. **Se**tup.**T**ree.**S**hort ON, **OFF**
Setup.**T**ree.**C**hangedOnly ON, **OFF**

Definition of the type of answer to $Q.

.Short: With "ON", each path is sent with only the necessary amount of characters in order to be unequivocal (printed in bold in this manual). A combination of .Short and .ChangedOnly is not possible.

.ChangedOnly: Sends only the changed values, i.e. values which have been edited. All paths are sent absolute, i.e. from the root.

3.2.2.90. **Se**tup.**Tra**ce ON, **OFF**

The Titrino automatically reports when a value has been confirmed with <enter> at the Titrino. Message, e.g.:

&SmplData.OFFSilo.Id1"Trace"

The beginning of the message is marked by a space (ASCII 32).

3.2.2.91. **S**etup.**L**ock.**K**eyboard ON, **OFF**
Setup.**L**ock.**C**onfig ON, **OFF**
Setup.**L**ock.**P**arameter ON, **OFF**
Setup.**L**ock.**S**mplData ON, **OFF**

Setup.**L**ock.**U**serMeth.**R**ecall ON, **OFF**
Setup.**L**ock.**U**serMeth.**S**tore ON, **OFF**
Setup.**L**ock.**U**serMeth.**D**elete ON, **OFF**
Setup.**L**ock.**D**isplay ON, **OFF**

ON means disable the corresponding function:
.Keyboard: Disable all keys of the Titrino
.Config: Disable the <configuration> key
.Parameter: Disable the <parameter> key
.SmplData: Disable the <smpl data> key
.UserMeth.Recall: Disable "recall" in <user meth> key
.UserMeth.Store: Disable "store" in <user meth> key
.UserMeth.Delete: Disable "delete" in <user meth> key
.Display: Disable the display, i.e. it will not be written to by the device program of the Titrino and can be operated from the computer.

3.2.2.92. **Se**tup.**M**ode.**S**tartWait ON, **OFF**
Setup.**M**ode.**F**inWait ON, **OFF**

Holding points in the method sequence. If they are "ON", the sequence stops until "OFF" is sent. Switching the instrument on sets both nodes to OFF:
.StartWait: Holding point right after starting a method or submethod in TIP (holding point after AutoInfo !".T.GC").
.FinWait: Holding point at the end a method or submethod in TIP (holding point after AutoInfo !".T.F").

3.2.2.93. **Se**tup.**S**endMeas.**S**endStatus ON, **OFF**
Setup.**S**endMeas.**I**nterval 0.08...**4**...16200, MPList

.SendStatus: ON means the automatic transmission of measured values (see 3.2.2.95 and 3.2.2.96) in the inputted interval is active.
.Interval: Time interval (in s) for the automatic transmission of associated measured values defined under points 3.2.2.95 and 3.2.2.96. The inputted value is rounded off to a multiple of 0.08. The smallest possible time interval depends on the number of measured values which have to be sent, on the baud rate, on the load on the interface and on the type of device connection. With "MPList" the measured values are sent at the time of their entry into the measured point list.

The automatic transmission is switched on/off with 'SendStatus'.

3.2.2.94. **Se**tup.**S**endMeas.**Sel**ect Assembly, **Titrator**

Selection of the unit of which the measured values should be sent (3.2.2.95 or 3.2.2.96).

3.2.2.95. **Se**tup.**S**endMeas.**A**ssembly.**C**yclNo ON, **OFF**
Setup.**S**endMeas.**A**ssembly.**V** ON, **OFF**
Setup.**S**endMeas.**A**ssembly.**M**eas ON, **OFF**

Selection of the values from Assembly for the output in the set time interval (see 3.2.2.93):
.CyclNo: Cycle number of the potential measurement. Together with the cycle time (3.2.2.82), a time frame can be set up.

The cycle number is set to 0 on switching on the instrument and it is always incremented as long as the instrument remains switched on.

.V: Volume

.Meas: Measured value associated to the cycle number.

The unit "assembly" must be preset (see 3.2.2.94).

3.2.2.96.

Setup.**S**endMeas.**T**itrator.**C**yclNo	ON, **OFF**
Setup.**S**endMeas.**T**itrator.**V**	ON, **OFF**
Setup.**S**endMeas.**T**itrator.**M**eas	ON, **OFF**
Setup.**S**endMeas.**T**itrator.**d**Vdt	ON, **OFF**
Setup.**S**endMeas.**T**itrator.**dM**easdt	ON, **OFF**
Setup.**S**endMeas.**T**itrator.**dMeasdV**	ON, **OFF**
Setup.**S**endMeas.**T**itrator.**E**RC	ON, **OFF**

Selection of the values from the titrator which are sent in the set time interval (see 3.2.2.93, formats see 3.2.2.79):

.CyclNo: Cycle number. Together with the cycle time (3.2.2.82), a time frame can be set up. The other data belong to the corresponding cycle number. The cycle number is set to 0 at the start of a method and it is incremented until the end of the method.

.V: Volume.

.Meas: Measuring value

.dVdt: associated volume drift.

.dMeasdt: associated measured value drift.

.dMeasdV: associated 1st derivative of the titration curve.

.ERC: ERC in DET.

The unit "titrator" must be preset (see 3.2.2.94).

3.2.2.97.

Setup.**A**utoInfo.**S**tatus	**ON**, OFF
Setup.**A**utoInfo.**P**	ON, **OFF**
Setup.**A**utoInfo.**T.R**	ON, **OFF**
Setup.**A**utoInfo.**T.G**	ON, **OFF**
Setup.**A**utoInfo.**T.GC**	ON, **OFF**
Setup.**A**utoInfo.**T.S**	ON, **OFF**
Setup.**A**utoInfo.**T.B**	ON, **OFF**
Setup.**A**utoInfo.**T.F**	ON, **OFF**
Setup.**A**utoInfo.**T.E**	ON, **OFF**
Setup.**A**utoInfo.**T.H**	ON, **OFF**
Setup.**A**utoInfo.**T.C**	ON, **OFF**
Setup.**A**utoInfo.**T.O**	ON, **OFF**
Setup.**A**utoInfo.**T.N**	ON, **OFF**
Setup.**A**utoInfo.**T.Re**	ON, **OFF**
Setup.**A**utoInfo.**T.Si**	ON, **OFF**
Setup.**A**utoInfo.**T.M**	ON, **OFF**
Setup.**A**utoInfo.**T.EP**	ON, **OFF**
Setup.**A**utoInfo.**T.RC**	ON, **OFF**
Setup.**A**utoInfo.**I**	ON, **OFF**
Setup.**A**utoInfo.**O**	ON, **OFF**

ON means that the Titrino reports automatically the moment the corresponding change occurs.

.Status: Global switch for all set AutoInfo.

.P PowerOn: Simulation of power on (3.2.2.99). Not from mains.

Messages from node .T, Titrator:

.T.R Ready: Status 'Ready' has been reached.

.T.G Go: Instrument has been started.

.T.GC GoCommand: Instrument (or submethod in TIP) has received a go command.

.T.S Stop: Status 'Stop' has been reached.

.T.B Begin of sequence (or submethod).

.T.F Final: End of determination (or submethod), the final steps will be carried out.

.T.E Error. Message together with error number, see page 82ff.

.T.H Hold: Status 'Hold' has been reached.

.T.C Continue: Continue after hold.

.T.O Conditioning OK: EP reached (in SET with conditioning).

.T.N Conditioning Not OK: EP not reached (in SET with conditioning).

.T.Re Request: In the inquiry of an identification or the sample size after start of titration.

.T.Si SiloEmpty: Silo empty, i.e. the last line has been removed from the silo memory.

.T.M MeasList: Entry in the measuring point list (with DET, MET).

.T.EP EPList: Entry into EP list (with DET, MET, SET)

.T.RC Results have been recalculated.

Messages for changings in the I/O lines. If the changings are made simultaneously, there is 1 message. Pulses receive 2 messages: one message each for line active and inactive.

.I Input: Change of an input line.

.O Output: Change of an output line (except 7, pin 2, for recorder pulses).

If a change occurs that requires a message, the Titrino sends space (ASCII 32) and ! as an introducer. This is followed by the name of the device (see 3.2.2.55). Special ASCII characters in the device name are ignored. If no device name has been entered, only ! is sent. Finally the Titrino sends the information which node has triggered the message.

Example: !John".T.Si": The message was triggered from instrument "John", node .T.Si

3.2.2.98. **Se**tup.**G**raphics.**G**rid **ON**, OFF

Setup.**G**raphics.**F**rame **ON**, OFF

Setup.**G**raphics.**S**cale **Full**, Auto

Setup.**G**raphics.**R**ecorder.**R**ight 0.2...**0.5**...1.00

Setup.**G**raphics.**R**ecorder.**F**eed 0.01...**0.05**...1.00

Change in the appearance and the format of the curve for the output. The settings are valid for both Titrino COM ports.

.Grid: On/off switching of grid over curve.

.Frame: On/off switching of frame surrounding the curve. If grid and frame are switched off, the curve is printed faster as the print head does not have to move to the end of the paper.

.Scale: Type of scaling of the measured value axis: Full means that the scale runs from the smallest up to the greatest measured point. With auto, the smallest measured value is taken and the next smaller tick defines the beginning of the scale; the next greater tick to the greatest measured value is the end of the scale.

.Right: Relative specification of the width of the output medium (e.g. paper width) for the length of the measured value axis. 1 means the measured value axis is plotted over the entire width of the paper (largest possible width). In extreme cases, the writing of the right tick may lie outside.

.Feed: Length of the volume axis referred to the burette cylinder volume, V(B) per cm (0.1 means, e.g. 1 mL/cm with a 10 mL Exchange Unit). Depending on the printer, the measure in cm may not always be correct.

3.2.2.99. **Se**tup.**P**owerOn $G

Simulation of 'power on'. The device has the same status as after power on: The cylinder is filled, error messages deleted and the current sample number set to 0. The method last used is ready for operation.

3.2.2.100. **Se**tup.**I**nitialise $G

Setup.**I**nitialise.**S**elect **ActMeth**, Silo, Calib, Config, Assembly, Setup, All

Setting of default values for the following areas:

ActMeth: Current method. Parameters, calculations, and assignments for the data output, operands C01...C19.

Silo: The silo memory is deleted. Same function as delete entire silo.

Calib: pH calibration data for all measuring inputs.

Config: All values under &Config.

Assembly: All values under &Assembly.

Setup: All values under &Setup.

All: Values of the entire tree (except silo and method memory).

The action must be triggered with &Setup.Initalise $G.

3.2.2.101. **Se**tup.**R**amInit $G

Initializes instrument, see page 147. All parameters are set to their default value and error messages are cleared. The user and silo memories will be deleted. The user memory contains the default user methods from Metrohm.

3.2.2.102. **Se**tup.**Ins**trNo $G

Setup.**Ins**trNo.**V**alue **serial number**, 8 ASCII characters

Instrument identification for report output.

Set the value with &Setup.InstrNo $G .

3.2.2.103. **D**iagnose.**R**eport $G

Output of the report containing the adjustment parameters. The Titrino has to be in its inactive basic state.

3.3 Properties of the RS 232 Interface

Data Transfer Protocol

The Titrino is configured as DTE (Data Terminal Equipment).

The RS 232 interface has the following technical specifications:

- Data interface according to the RS 232C standard, adjustable transfer parameters, see page 10.
- Max. line length: 512 characters
- Control characters: C_R (ASCII DEC 13)
  L_F (ASCII DEC 10)
  XON (ASCII DEC 17)
  XOFF (ASCII DEC 19)
- Cable length: max. approx. 15 m

Start	7 or 8 Data Bit	Parity Bit	1 or 2 Stop Bit

Only a shielded data cable (for example, METROHM D.104.0201) may be used to couple the Titrino with foreign devices. The cable shield must be properly grounded on both instruments (pay attention to current loops; always ground in a star-head formation). Only plugs with sufficient shielding may be used (for example, METROHM K.210.0381 with K.210.9045).

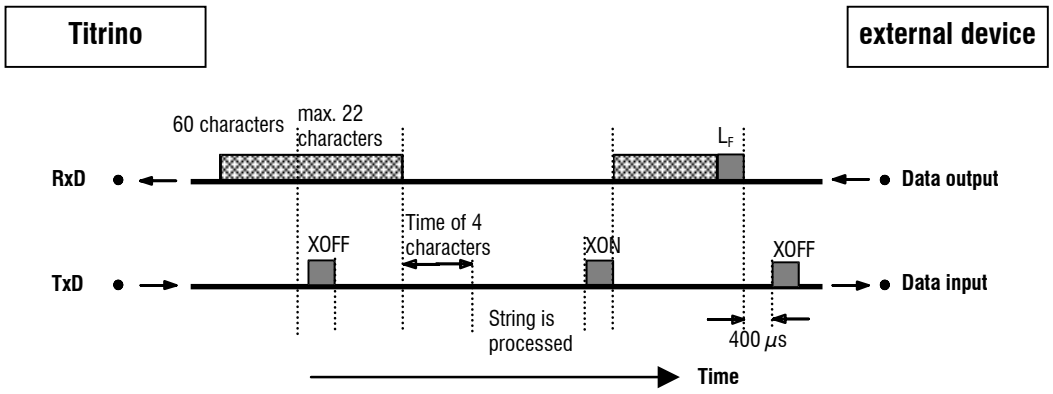
3.3.1 Handshake

Software-Handshake, SWchar

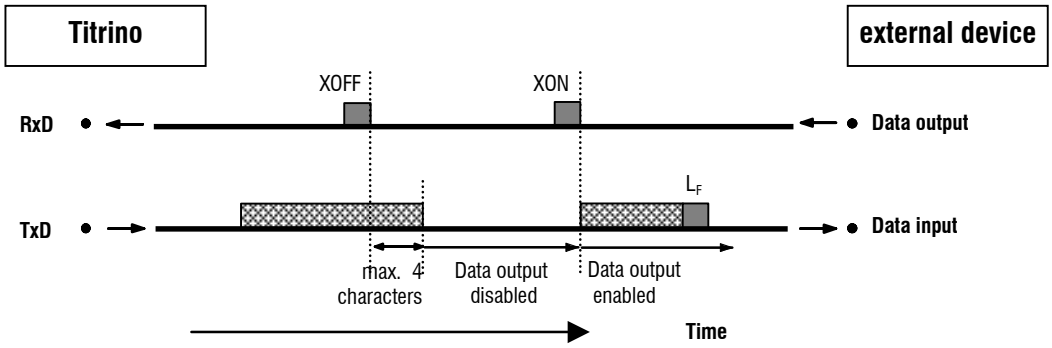
Handshake inputs on the Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the Titrino.

As soon as a L_F is recognized, the Titrino sends XOFF. It can then receive 6 extra characters and store them.
However, the Titrino also sends XOFF if its input buffer contains 60 characters. After this, it can receive maximum 22 extra characters (incl. L_F).
If the transmission is interrupted for the time of 4 characters after the Titrino has sent XOFF, the string received earlier is processed even if no L_F has been sent.

Titrino as Receiver :



Titrino as Sender :

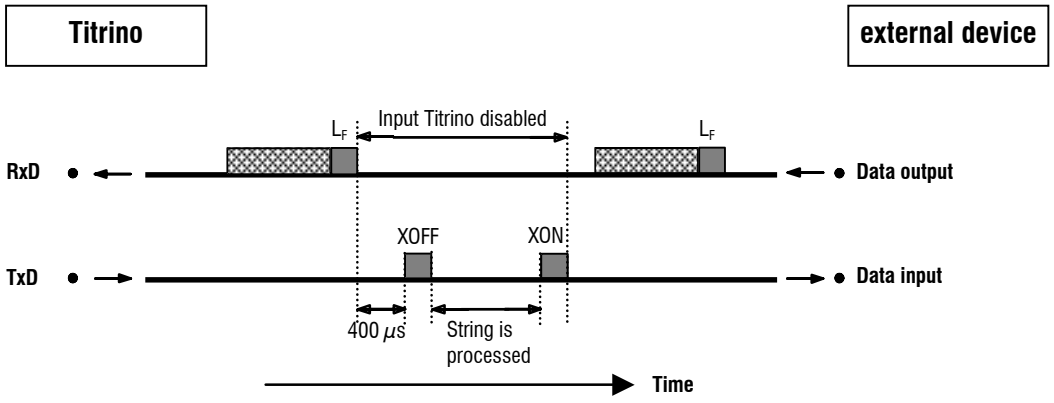


Software-Handshake, SWline

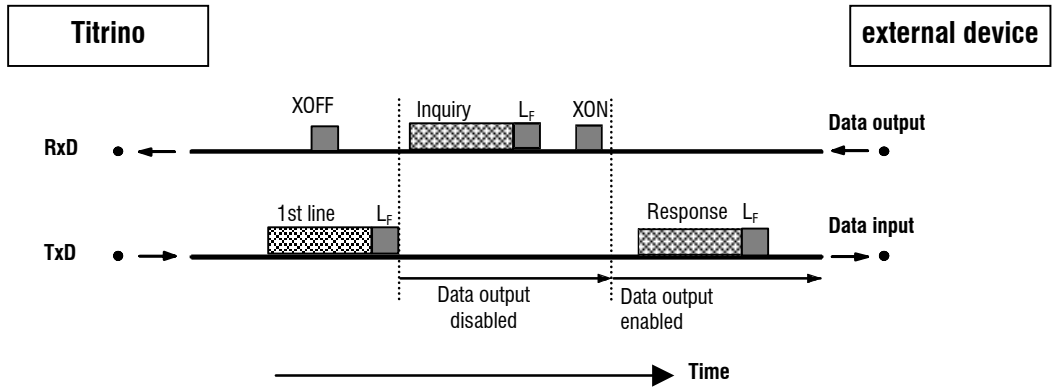
Handshake input ports on the Titrino (CTS, DSR, DCD) are not checked. Handshake output ports (DTR, RTS) are set by the Titrino.

The Titrino is equipped with an input buffer that can accommodate a string of up to 80 characters + C_RL_F. As soon as an L_F is recognized, the Titrino sends XOFF. After this, it can receive maximum 6 extra characters and store them. The string sent previously is now processed by the Titrino. Afterwards, the Titrino sends XON and is again ready to receive.

Titrino as Receiver :



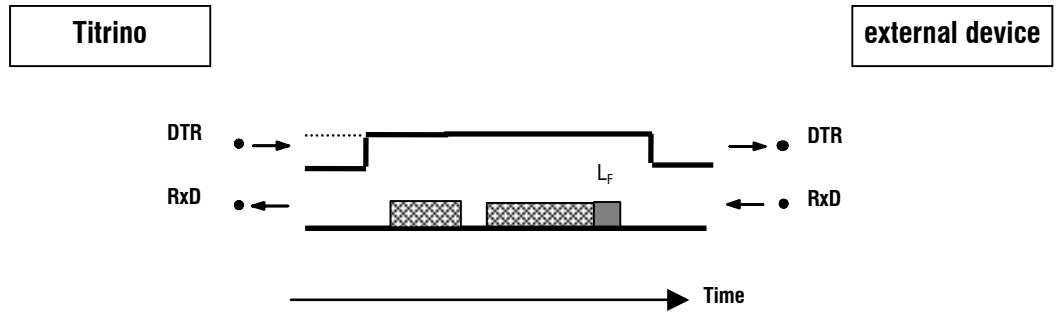
Titrino as Sender:



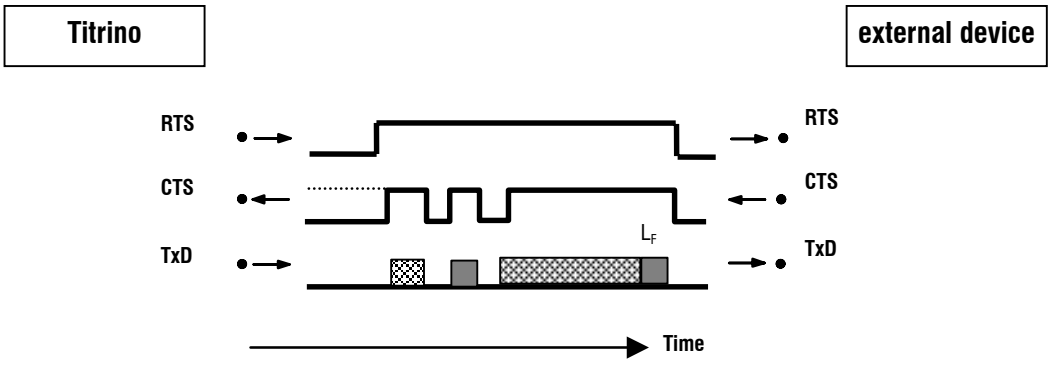
Titrino transmission can be stopped by external instruments with XOFF. After XOFF is received the Titrino completes sending the line already started. If data output is disabled for more than 3 s by XOFF, E43 appears in the display.

Hardware-Handshake, HWs

Titrino as Receiver :



Titrino as Sender:

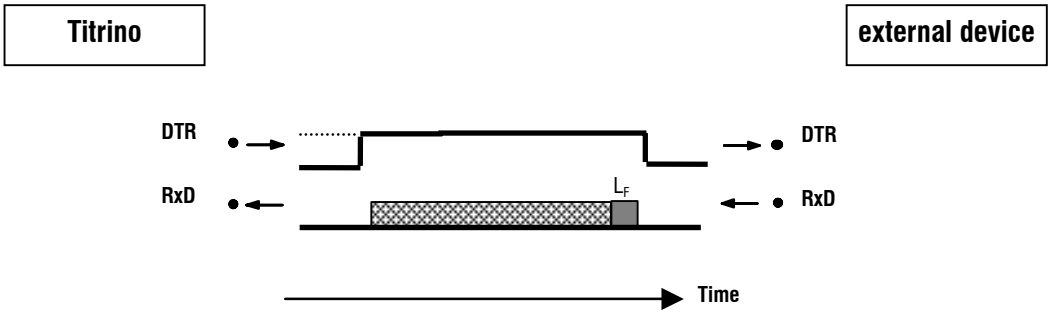


The data flow can be interrupted by deactivating the CTS line.

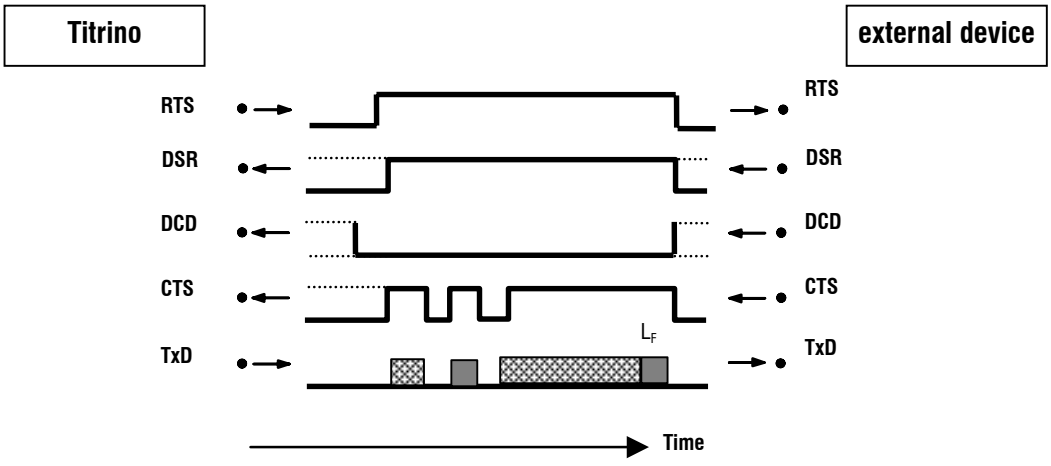
Hardware-Handshake, HWf

All handshake inputs are checked at the Titrino, handshake outputs are set.

Titrino as Receiver :



Titrino as Sender:



The data flow can be interrupted by deactivating the CTS line.

3.3.2 Pin Assignment

RS232C Interface

Transmitted Data (TxD).
If no data are transmitted, the line is held in the “ON” condition. Data will only be sent when CTS and DSR are in the ”ON” condition and DCD is in the "OFF" condition.

Received Data (RxD)
Data are received only when DCD is "ON".

Request to Send (RTS)
ON condition: Titrino is ready to send data.

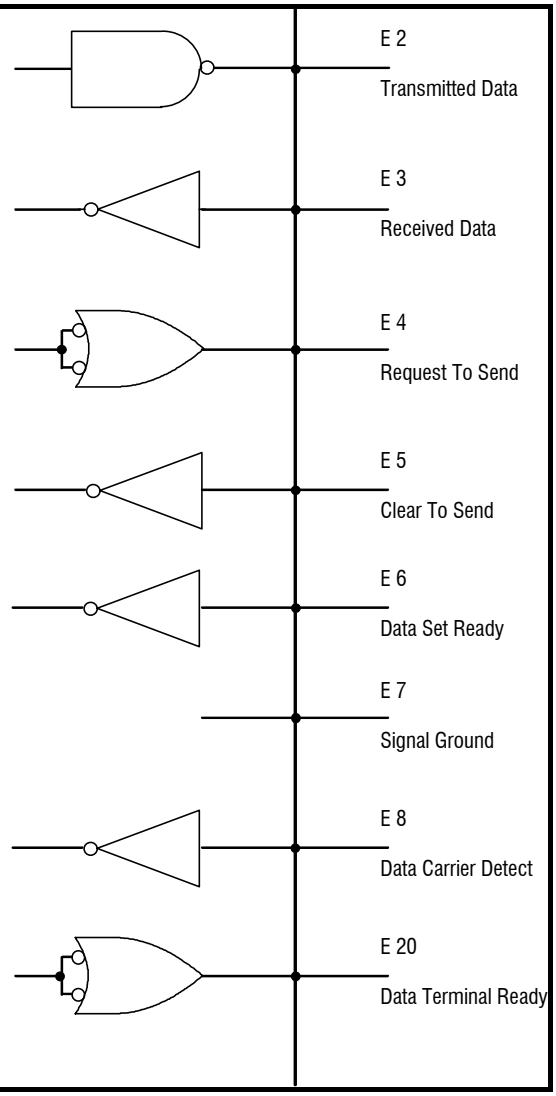
Clear to Send (CTS)
ON condition: Remote station is ready to receive data.

Data Set Ready (DSR)
ON: Condition: The transmission line is connected.

Signal ground (GND)

Data Carrier Detect (DCD)
ON condition: The level of the received signal is within the tolerance range (remote station is ready to send data).

Data Terminal Ready (DTR)
ON condition: Instrument is ready to receive data.



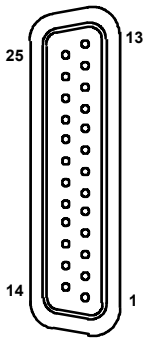
Protective earthing
Direct connection from cable plug to the protective ground of the instrument.

Polarity allocation of the signals
- Data lines (TxD, RxD)
  voltage negative (<-3 V): signal state ”ON”
  voltage positive (>+3 V): signal state ”ZERO”
- control or message lines (CTS, DSR, DCD, RTS, DTR)
  voltage negative (<-3 V): OFF state
  voltage positive (>+3 V): ON state

In the transitional range from +3 V to -3 V the signal state is undefined.

Driver 14C88 according to EIA RS 232C specification
Receiver 14C89 " "

Contact arrangement at plug (female) for RS 232C socket (male)



View of soldered side of plug

Ordering numbers:
K.210.9004 and K.210.0001

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

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

Problem	Questions for remedial action
No characters can be received on a connected printer.	- Are the instruments switched on and cables plugged in correctly? - Is the printer set to ”on-line”? - Are baud rate, data bit and parity the same on both instruments? - Is the handshake set properly? If everything seems to be ok, try to print a report with the key sequence <PRINT><SMPL DATA><ENTER>. If this report is printed out correctly, check if reports are defined in key <DEF>.
No data transmission and the display of the Titrino shows an error message.	- **error 42**: Transmission error. Is the printer set to "on-line"? Is the connection cable properly wired? - **error 43**: Data output of the Titrino disabled for longer than 6 s by XOFF. - **error 36-39**: Receive error. Are the RS settings the same on both devices?
The received characters are garbled.	- Are the RS settings the same on 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.
Wrong line spacing.	The printer does not emulate completely the preset mode. Usually these problems arise with the IBM mode. Set the printer to a different mode (e.g. Epson).
Printout of titration curve is not ok. Other reports are printed ok.	Handshake is necessary for the printout of curves. - Is your cable correctly wired? (The DTR of the printer has to be connected to the CTS of the Titrino.) - Set "HWs" for the handshake of the Titrino. Configure the printer such that its DTR is set (possibly with DIP switches).

4 Error messages, Troubleshooting

Data transfer inoperative See measures on page 131.

4.1 Error and special messages

XXX bytes missing
XXX bytes missing. For the storage of a method or a silo line XXX bytes are missing or there is insufficient RAM for a TIP sequence.
Remedy: <QUIT>. Delete methods no longer needed or use fewer silo lines.

check electrode
With polarized electrodes. There is a break or short circuit.
Possible causes and rectification of the fault:
- the electrode is not plugged in ⇒ plug it in
- the electrode is not immersed in the solution ⇒ immerse it
- the electrode is defective ⇒ use new electrode.
- the electrode cable is defective ⇒ use new cable.
The electrode test can be switched off under the <PARAM> key.
Exit: Rectify fault or <STOP>.

check exchange unit
The Exchange Unit is not mounted (properly).
Exit: Mount Exchange Unit (properly) so that the coupling engages or <STOP>.

check T-sensor
No temperature sensor is attached (with MEAS T or if the temperature monitoring is active).
Exit: Connect Pt100 or Pt1000 or <STOP>.

data set reevaluation
Message if Titrino is reevaluating downloaded measuring point lists.

division by zero
The result could not be calculated as a divisor in the formula was equal to zero.
Exit: Enter appropriate value.

EP overflow
In a DET or MET titration 9 EP's or more were found. The first 9 EP's will be listed.
Remedy: Recalculation of data with higher EP criterion.

manual stop
The determination has been manually stopped.

meas.pt list overflow
Maximum 500 measured points can be stored.
Exit: Use start criteria or select larger time interval.

missing EP
An EP needed for calculation in a formula is missing.

missing fix EP
A fix EP needed for calculation in a formula is missing.

no.EP not corresponding
In DET or MET titrations, the number of EP's actually found does not match the set windows: Exactly 1 EP per window has not been found.

no EP set
In SET, no EP has been set.
Exit: <STOP> and set EP.

no meas.quantity
In TIP a manual measurement (<MEAS/HOLD>) has been performed without defining a measuring quantity.
Exit: <MEAS/HOLD> and define measured quantity.

no method	The method required by the sample data from the silo memory or in a TIP sequence is not available in the method memory. Exit: <CLEAR>.
no new com.var.	The common variable could not be assigned as the result or the mean value could not be calculated. The old value remains in force.
no new mean	No new mean value has been calculated as at least one quantity stipulated for mean value calculations could not be calculated.
no new silo result	No new silo result C24 or C25 could be stored as the assigned quantity could not be calculated.
no new temp.var.	No new temporary variable C7X could be stored as the assigned quantity could not be calculated.
no sequence	No sequence is defined in TIP. Exit: <CLEAR> and define sequence.
no titration data	No curve can be printed as no data are available.
not valid	A value is not available.
outside	The set fix EP is outside the measuring range.
overrange	The measuring range of ±2 V has been exceeded. Overrange replaces the corresponding measured value (pH, U, I or temperature). Exit: Rectify error, <STOP> or >MEAS/HOLD>.
same buffer	In the calibration sequence the voltage difference between the first and second buffer is < 6 mV. Exit: <QUIT> and change buffer or <STOP> (abort calibration).
save lines OFF	The function "save lines" is not active although a submethod of TIP contains assignments to C24 or C25. Exit: <CLEAR> and switch on "save lines" under <SMPL DATA> key. **Warning:** The results of this line will not be saved.
second TIP call	In TIP no further TIP can be called up as a submethod. Exit: <CLEAR> and define new sequence.
silo empty	The silo memory is switched in but empty and a titration has been started. Corrective action: At least the first 1 silo line before starting the first titration. Exit: <CLEAR>.
silo full	The silo memory is full up. Corrective action: If you have filled less than 99 silo lines, you can create more space by deleting old methods no longer needed. 1 silo line needs 18...120 bytes. Exit: <CLEAR>.
stop EP reached	A DET or MET titration was stopped as the stop criterion "stop EP" was reached.
stop meas.val.reached	A DET or MET titration was stopped as the stop measuring value pH, U or I was reached.
stop time reached	SET has been stopped as the stop time has been reached.

stop V reached	The determination has been stopped as the stop volume has been reached.
system error 3	The instrument adjustment data have been overwritten. Exit: <CLEAR>. Default adjustment data are set. The error message appears each time the instrument is switched on until it has been readjusted (Metrohm service).
TIP terminated	TIP has been terminated.
wrong sample	With SET, with preset titration direction the first measured value is outside the end point.

Error messages in connection with the data transfer

If neither a computer nor a printer is attached, the report output at the end of the titration must be switched off:

Receive errors:

E36	Parity Exit: <QUIT> and set corresponding quantity the same on both instruments
E37	Stop bit Exit: <QUIT> and set corresponding quantity the same on both instruments
E38	Overrun error. At least 1 character could not be read. Exit: <QUIT>
E39	Overflow of the receive buffer of the Titrino (> 82 characters). Exit: <QUIT>

Send errors:

E40	DSR=OFF
E41	DCD=OFF
E42	CTS=OFF Handshake unsatisfactory for more than 1 s. Exit: <QUIT> Is the receiver switched on and ready to receive?
E43	The transmission of the Titrino has been interrupted with XOFF for at least 3 s. Exit: <QUIT>.

E44 The RS interface parameters are no longer the same for both instruments.

E45 The receive buffer of the Titrino contains an incomplete string (missing L_F). Transmission of the Titrino is thus blocked.
Exit: Send L_F or <QUIT>.

4.2 Diagnosis

4.2.1 General

The 794 Basic Titrino is a very precise and reliable instrument. Thanks to its rugged construction it is virtually impossible for external mechanical or electrical influences to have an adverse effect on its functions.

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

It is 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.

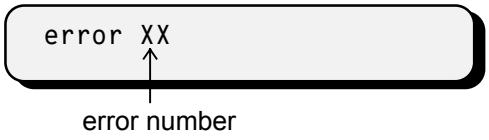
In inquiries always quote the manufacturing (page 4) and program number (see configuration, page 23) and specify possible error displays..

4.2.2 Procedure

- The diagnostic steps must be performed in sequence and compared with the reactions of the 794 Basic Titrino (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 allow re-entry into the test routine for repetition if the following display appears:

If the instrument is in a subprogram of the diagnostic routine: Press <Clear>.
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 <Clear> has been pressed during the display of **'diagnose press key 0...9'**, the instrument returns to the user program.
- Error display: An error is shown in the display as follows:



- If a fault causes the burette drive to stick at the top or bottom end of the cylinder, see page 148, point 4.4.

4.2.3 Equipment required:

- *voltage calibrator, e.g. 1.773.0010 Metrohm pH Simulator*
  or 1.767.0010 Calibrated Reference for mV, pH, Ω µS, °C
- *highly insulated interconnection cable 6.2108.060*
- *cable 3.496.5070*
- *exchange units, if possible with different cylinder volumes (or 3.496.0070 dummy exchange unit)*
- *stop watch or watch with second hand*
- *digital or analogue voltmeter (if need be, connect a calibrated recorder)*
- *2 connecting cables with 4 mm banana plugs*
- *test plug 3.496.8510 (necessary only if plug 'Remote' should be checked)*
- *test plug 3.496.8480 (necessary only if plug 'RS 232' should be checked)*

4.2.4 Diagnosis steps

1 Prepare instruments for diagnostic test

- Power off.
- Disconnect all external connections (cables at rear, except mains cable and keyboard).
- Remove exchange unit.
- Power on and immediately press and hold the **<9>** key until the power up test pattern disappears.

```
diagnose press key 0...9
```

2 Perform display test

- Press **<2>**.

```
display test
```

- Press **<Enter>**.

Characters for a visual check of the display are generated on the eight lines.

Test sequence:

a) The display is cleared and overwritten from the left to the right with a dot pattern (▮▮▮ ▮▮▮▮▮).

b) The display is cleared and both lines are written into with the letters A, B, C,…Z.

c) The complete character set is shown as a moving display. At the same time with moving display the LED's „COND.", „STATISTICS" and „SILO" are swtiches on and off.

- The test sequence can be held and then continued at any time by pressing **<5>**.
- Block 2 is quit by pressing **<Clear>**.

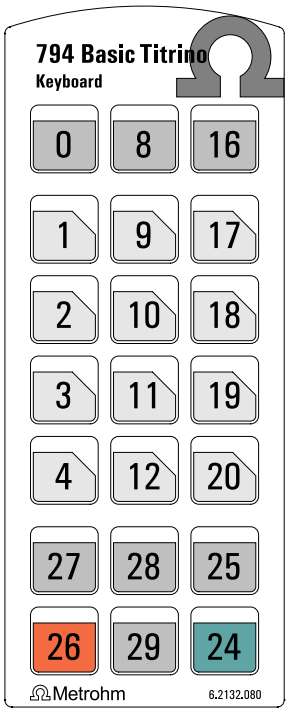
```
diagnose press key 0...9
```

```
keys test
```

- Press **<Enter>**.

```
keys test
matrix code
```

- If any key is now pressed (on the 6.2132.080 keypad or on the fron panel of the 794), the appropriate matrix code appears in the display.



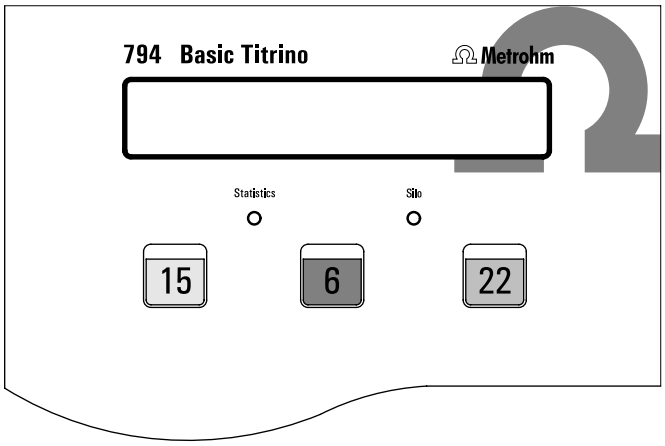


Fig. 2 Front panel 794

Fig. 1 Keypad 794

- Block 1 is quit by pressing the **<Clear>** key twice.

```
diagnose press key 0...9
```

4 Cylinder code, date, time

- Put exchange unit or dummy on the Titrino and put the burette tip into a collecting receptacle.
- Press **<0>**.

```
date/time
cylinder code
```

- Press **<Enter>**.

```
date XX-XX-XX  XX:XX:XX
code:D0   XX ml
```

activated dosing unit — *mL-code*

- Check date and time.
- Check whether the mL-code does correspond with the exchange unit placed or not.
  For the sake of completeness, different exchange units can be inserted to check their mL code. If desired, the exchange unit can be removed again. If no exchange unit is inserted display does not show the mL-code but „check exchange unit !“.
- Press **<Clear>**.

```
diagnose press key 0...9
```

5 Analogue output test

A voltage can be set at the analog output (sockets at D) using the kexpad. But this should not exceed ± 2000 mV. This voltage can also be used for the calibration of a connected recorder.

- Connect a voltage measuring instrument (voltmeter, DVM, recorder) to the analogue output ***(10)***.
- Press **<3>**.

```
analog output-1 test
```

- Press **<Enter>**.

```
analog output-1 test
V-out =              XXmV
```

Enter a voltage value in the range ± 2000 mV using the keypad. After the <ENTER> key has been pressed, this value appears as a voltage at the analog output..

Read off value an the connected voltmeter and compare with the mV value on the display. (Tolerance ± 2 mV)

- Press **<Quit>**.
- Disconnect voltmeter.

6 Motor timer test

- Press **<6>**.

```
motor-timer test
```

- Press **<Enter>**.

```
pot.meter dV/dt ➜ 10?
```

- Turn knob '**dV/dt**' to the right stop and press **<Enter>**.

Test sequence:

a) In a first step, the frequency of the RC oscillator (analogue rate) is tested over a period of 1 second.

b) In a second step, the frequency of the quartz oscillator (digital rate) is tested over a period of 1 second.

c) If no error is found, after about 3 s it appears

```
motor-timer test     o.k.
```

- Press **<Clear>**.

```
diagnose press key 0...9
```

7 Analogue input test

- Press **<7>**.

```
analog input test 1...5
```

7.1 Examination of highly insulated measuring inputs

- Connect 'Ind I' measuring input to a voltage calibrator (e.g. Metrohm 773 pH simulator) by means of a highly insulated cable (e.g. 6.2108.060). Set calibrator to 0 V.
- Press **<1>**.

```
Input 1          0.0 mV
```

Tolerance: ± 0.5 mV

- Set the calibrator voltage, on setting 'low ohmic' (with 773 = ~ 0.002 MΩ) to different values (e.g. +1500 mV) and compare with the displayed value.

Tolerance (with ± 1500 ÷ 2000 mV) ± 1 mV. Be aware of the calibrator's tolerance.

- Set simulator to high ohmic condition (with 773 = 1000 MΩ).

The displayed reading may vary slightly only (with 1500 mV ≤ 1 mV)

- Press **<Clear>**.

```
analog input test 1...5
```

- Disconnect simulator from 'Ind I' input and connect to 'Ind II' input.
- Press **<2>**.

```
Input 2            XX mV
```

- Carry out the same measurements as with Input 1.
- Press **<Clear>**.

```
analog input test 1...5
```

- Short-circuit input 'Ind I' (e.g. with cable 3.496.5070).
- Press **<3>**.

```
Input 1-2          XX mV
```

The differencial voltage between inputs 'Ind I' and 'Ind II' is displayed.

Example: 0 - (+)1500 mV = -1500 mV

- Remove cables from the inputs 'Ind I' and 'Ind II'.
- Press **<Clear>**.

```
analog input test 1...5
```

7.2 To check Pt 100 / 1000 connection

- Connect a Pt 100 or Pt 1000 sensor, a resistor switch-box or a single resistor of 100 Ω or 1 kΩ, respectively, to sockets 'Pt 100/1000' by means of short cables.
- Press **<4>**.

```
Pt 100*            XX °C
```

(* or Pt 1000)

Tolerance: ± 0.5 °C (Note also tolerance of resistor switch-box).

The sensor allows automatic displaying of the room temperature. (The resistor values correspond to 0°C.)

- Press **<Clear>**.

```
analog input test 1...5
```

- Remove cables and resistor switch-box.

7.3 Polarizer test

- Press **<5>**.

```
polarizer test
```

- Press **<Enter>**.

```
dummy resistor 14.3kΩ ?
```

- Connect resistor switch-box (or suitable resistor 14.3 kΩ 0.1%) using 3.496.5070 cable to 'Pol' socket. Switch-box to 14.3 kΩ.
- Press **<Enter>**.

Test sequence:

1. *An asterisk flashes during the test.*
2. *In case of an error an error message appears. (If for example the switch-box is not connected,* ***error 100*** *appears).*
3. *If no error is found, after about 15 s display shows*

```
polarizer test    o.k.
```

- Press **<Clear>**.

```
analog input test 1...5
```

- Press **<Clear>.**

```
diagnose press key 0...9
```

- Remove cable and resistor switch-box.

8 External inputs and outputs

This test is meaningful only if the 794 Basic Titrino is used interconnected with other instruments via the 'Remote' connection. In addition, a 3.496.8510 test plug normally used in the repair service is required for this test. However, this plug can also be purchased by customers under the above number.

For the sake of completeness, the procedure is described here. If a diagnostic test of the external inputs and outputs is not required, continue with point 9.

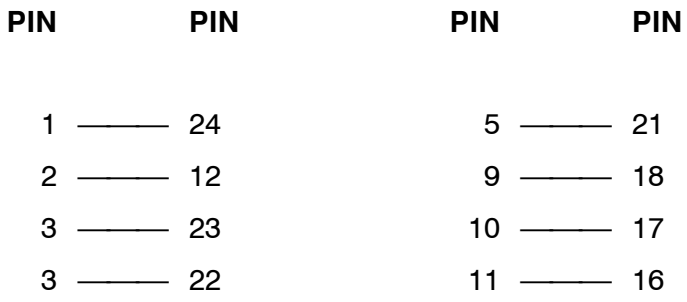


Fig. 3 Connections in the 3.496.8510 test plug

- Press **<4>**

```
extern input/output test
```

- Press **<ENTER>**.

```
I/O-test-connector?
```

- Insert the 3.496.8510 test plug in port B 'Remote'. (Do not switch off instrument!)
- Press **<ENTER>**.

Test sequence:

1. *In case of an error an error message is displayed. If for example no test plug is connected, error message* **error 50 01HEX** *appears).*
2. *If no error is found, after about 1 s display shows*

```
extern input/output o.k.
```

- Remove test plug.
- Press **<CLEAR>**.

```
diagnose press key 0...9
```

9 RS 232 test

A 3.496.8480 test plug normally used in the repair service is required for this test. However, this plug can also be purchased by customers under the above number.

For the sake of completeness, the procedure is described here. If a diagnostic test of the RS 232 interface is not required, continue with point 10.

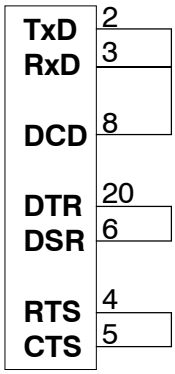


Fig. 4 Connections in the 3.496.8480 plug

- Press **<5>**.

```
RS232 test
```

- Press **<ENTER>**.

```
RS232 test-connector?
```

- Insert the 3.496.8480 test plug in 'RS 232' port.
- Press **<Enter>**.

Test sequence:

1. *In case of an error an error message is displayed. If for example no test plug is connected, error message **error 68** appears).*
2. *If no error is found, after about 5 s display shows*

```
RS232 test    o.k.
```

- Remove test plug.
- Press **<Clear>**.

```
diagnose press key 0...9
```

10 Spindle drive and stopcock changeover

- Press **<Clear>**.

The Titrino fills (only if an exchange unit is inserted)

The Titrino gets out of the diagnosis menu and returns to the user program.

- Remove exchange unit.
- Check spindle zero position, see Fig. 5.

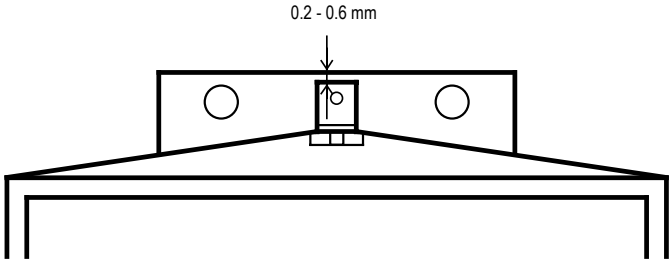


Fig. 5

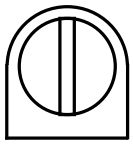


Fig. 6

The spindle must be 0.2 - 0.6 mm below the edge of the sliding plate.

The bar of the stopcock coupling must be exactly parallel to the lateral edges of the MPT Titrino, see Fig.6.

- Reinsert Exchange Unit.

Titrino fills.

The display of before reappears.

- Knob '**dV/dt**' to right stop.
- Press the **<DOS>** key (on instrument) until the piston rod reaches the top and at the same time measure the time from start to end.

```
XXX X          ********
cylinder empty !
```

mind selected language!

Spindle remains at maximum position. The transit time of the spindle is 20 s.

- Measure spindle lifting (can be performed only if the 3.496.0070 Dummy Exchange Unit is inserted or the locking switch (in right hole) is carefully operated with a screwdriver after removal of the Exchange Unit).

  From the start point, the spindle travels 80 mm. Instead of the spindle height, the expelled volume can be measured (corresponds to max. vol. of Exchange Unit used).

- Press **<FILL>** (on instrument) and simultaneously measure the time until the Titrino is again in the 'ready' position.

  Times for filling: per stop cock cycle 1 s
  for filling 20 s (Tolerance: 10 %)

  The following generally holds: Spindle and stopcock must move at a constant speed (noise!). In the filling setting, the stopcock coupling must position the lever of the Exchange Unit correctly at the left stop (with virtually no play and without sticking).

- Set potentiometer '**dV/dt**' to left stop.
- Press **<DOS>** (on instrument) at same time and use a stopwatch to measure the time for 1/10 of the cylinder volume to be expelled. The time should be ca. 90 ... 110 s.
- Set potentiometer '**dV/dt**' to right stop.
- Press **<FILL>.**

11 Setting up original arrangement

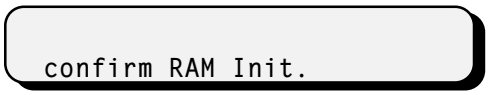
Reconnect all peripherals disconnected at the start of the diagnostic routine and perform a short function test with these.

4.3 Initialise and test RAM

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

- Power OFF
- Power ON and simultaneously press keys **<DOS>** and **<STOP/FILL>**.

- Press **<START>**.



- Press **<START>**.

RAM is tested and initialised. Subsequently a warm start is executed.

The lost data of the user memory must now be reentered.

If '**system error 3**' appears in the display, **<Clear>**can be used to return to the instrument program. The initialisation values are loaded automatically. The instrument thus remains capable of measurement. However, possibly a small loss in accuracy must be anticipated. A new optimum adjustment can be performed by Metrohm service. The error message 'system error 3' always appears after the instrument is switched on until this adjustment has been performed.

4.4 Releasing a locked spindle with inserted Exchange Unit

- The burette drive may very occasionally jam at the top or bottom end of the cylinder. If jamming occurs at the top or when the drive is out of function, the Exchange Unit can no longer removed. In this case, it is necessary to proceed as follows:

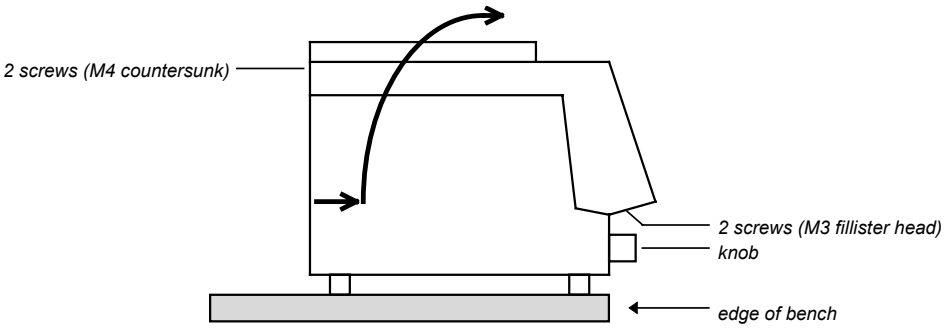


Fig. 7

- Disconnect instrument from power supply!
- Remove control knob
- Place instrument over edge of bench to allow the M3 screws to be removed (Fig. 7)
- Remove M4 screws
- Lift off top part of instrument together with Exchange Unit in the manner shown by the arrow

The electronic circuits are now accessible!
On no account touch these!

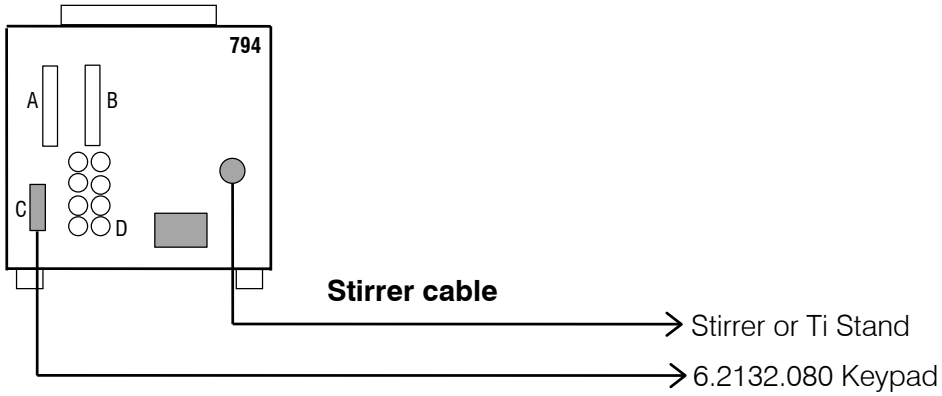
- Remove spindle from mechanical stop by turning the large gear wheel. (In case that the motor is inoperative, position spindle by hand to zero position.)

5 Preparations

The mains cables supplied with the instrument are three-core 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. 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 mains. The mains cable must therefore always be unplugged when certain adjustments are made or parts replaced.

5.1 Setting up and connecting the instruments

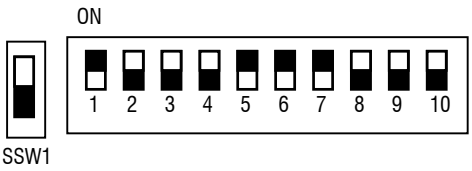
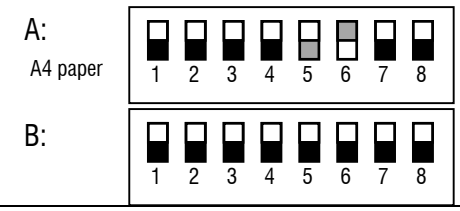
5.1.1 Titrino with Stirrer or Titration Stand



The 802 Rod Stirrer, the 727, or the 703 Ti Stand with 6.2108.100 cable can also be connected instead of the 728 Magnetic Stirrer.

5.1.2 Connection of a printer

A variety of printers can be connected to the RS232 interface of the Titrino. If you connect a printer other than one of those mentioned below, ensure that the Epson mode is emulated or that it uses the international character set following the IBM Standard Table 437 and IBM-compatible graphics control characters.
If a **balance** is connected at the same COM of the Titrino as a printer, you need the 6.2125.030 Adapter. The printer must be pluged into the "data out" receptable of the adapter. It can be operated only with the simple hardware handshake (HWs) or without handshake.

Printer	Cable	Settings on Titrino	Settings on Printer
Seiko DPU-414	6.2125.130	baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs send to: Seiko	none
Custom DP40-S4N	6.2125.130	baud rate: 9600 data bit: 8 stop bit: 1 parity: none handshake: HWs send to: Citizen	none, pre-set on Metrohm version IDP-560 EMULATION FONT MAP =GERMANY PRINT=REVERSE LITTLE CR CODE=VOID CR AFTER B :FULL=VOID CR ON b. EMPTY=VALID BUFFER 1K BYTE BAUD RATE=9600 PROTOCOL=8,N,1 FLOW CONTROL CTS-RTS
Citizen iDP562 RS	6.2125.050	baud rate: 9600 data bit: 8 stop bit: 1 parity none handshake: HWs send to: Citizen	
Epson LX-300	6.2125.050	as above, but send to: Epson	see printer manual
HP Desk Jet with serial interface	6.2125.050	baud rate: 9600 data bit: 8 stop bit: 1 parity none handshake: HWs send to: HP	
HP Desk Jet with parallel interface	2.145.0330 RS232/ Parallel Converter	baud rate: 9600 data bit: 8 stop bit: 1 parity none handshake: HWs send to: HP	see printer manual

5.1.3 Connection of a balance

The following balances can be connected to the RS232 output of the Titrino:

Balance	Cable
Sartorius MP8, MC1	6.2125.070
Shimadzu BX, BW	6.2125.080 Settings on Titrino: balance SARTORIUS Balance: delimiter CR+LF
Ohaus Voyager, Explorer, Analytical Plus	from Ohaus: AS017-09 (Ohaus parts number)+ 6.2125.170 Settings on Titrino: balance SARTORIUS Balance: SET BALANCE INTERFACE BAUD RATE 9600 DATA BITS 8 PARITY none STOP BITS 1
Mettler AB, AG (LC-RS25)	in the scope of delivery of the balance
Mettler AM, PM	6.2146.020 additionally from Mettler: ME 47473 Adapter and ME 42500 hand switch or ME 46278 foot switch
Mettler interface 016	Cable in scope of delivery of interface 016: red lead to pin 3, white lead to pin 7 of the 25-pin connector 25-pole/9-pole adapter
Mettler interface 011 or 012	6.2125.020
Mettler AT	6.2146.020
Mettler PG, AB-S	6.2134.120 + 6.2125.170
Mettler AX, MX ,UMX	6.2134.120 + 6.2125.170
AND Models ER-60, 120, 180, 182 Models FR-200, 300 Models FX-200, 300, 320 with RS232 interface (OP-03)	6.2125.020
Precisa, balances with RS232C-interface	6.2125.080

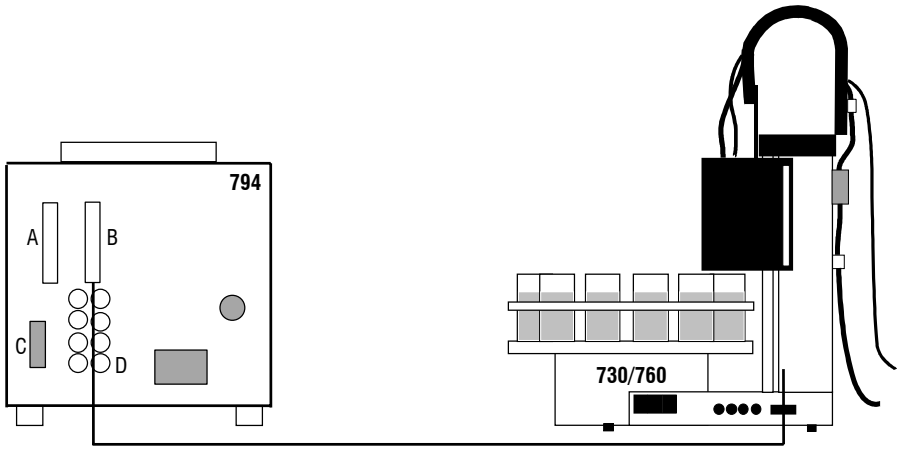
The balance type must be preselected at the Titrino with the <CONFIG> key.
Balance **and** printer can be connected at the same time with the aid of the 6.2125.030 adapter. The balance must then be plugged into the "data in" receptable of the adapter.

The weight is transferred as a number with up to 6 digits, sign and decimal point. Units and control characters sent by the balance are not transmitted.
With the aid of a special input unit supplied by the balance manufacturer, in addition to the weight identifications and methods can be inputted from the balance. For this, the address of the identifications and method, resp. must be preselected on the input unit.

Balance	Method	Id1	Id2	Id3
Sartorius	METH or 27	ID.1 or 26	ID.2 or 24	C-20 or 23
Mettler (AT)	D (Mthd)	C (ID#1)	B (ID#2)	A (c20)

If the balance works only with 7 bit and the printer with 8 bit and if they are at the same Titrino, the balance has to bet to "space parity" and Titrino/printer to 8 bit, "no parity".

5.1.4 Connection of a Sample Changer



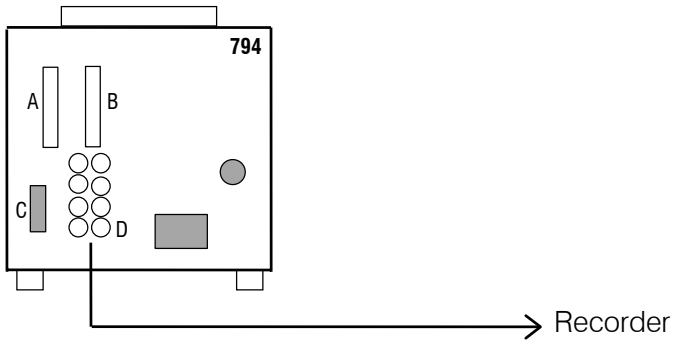
6.2141.020 Cable

With 6.2141.030 cable (instead of 6.2141.020), two Titrinos can be connected to the 730 or 760 Sample Changer at the same time.

- The "Remote" socket allows not only connection of a sample changer but also additional control functions. Pin assignment of the "Remote" socket and control possibilities, see page 161f.
- If a calibration has to be performed with the sample changer, the calibration parameter "sample changer:" must be set to "ON".
- In connections with the sample changer, "auto start" should be set to "OFF" in the <CONFIG> key. The start command is given by the Sample Changer.

5.1.5 Connection of a recorder

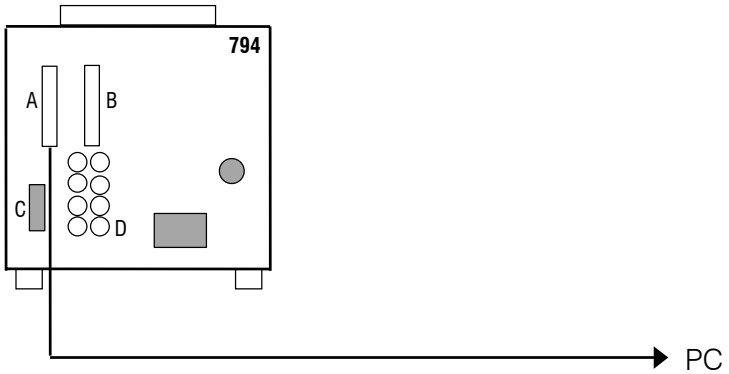
The recorder is connected to the analog output of the Titrino.



The signal at the analogue output can be preselected on the Titrino (key <CONFIG>, ">peripheral units", "curve:"):

Preselection at Titrino	Meaning	Resolution, Signal at analogue output	
U	Voltage	pH = 0.00:	– 700mV
		pH = 7.00:	0 mV
		pH = 14.00:	+700 mV
		U = + 1 mV:	+ 1 mV
		U = – 1 mV:	– 1 mV
		I = + 1 µA:	+ 10 mV
		I = – 1 µA:	– 10 mV
		T = 0 °C:	0 mV
		T = + 1 °C:	+ 10 mV
		T = – 1 °C:	– 10 mV
dU/dt	Measured value drift	1 mV/min:	1 mV
		1 °C/min:	1 mV
		1 µA/min:	10 mV
V	Volume	1 Zylindervolumen:	2000 mV
dV/dt	Volume drift	100 µL/min:	1000 mV
U(rel)	Control deviation	ΔpH = 1:	100 mV
		ΔU = 1 mV:	1 mV
		ΔI = 1 µA:	10 mV
T	Temperature	ΔT = ±1 °C:	10 mV
		T = 0 °C:	0 mV

5.1.6 Connection of a computer



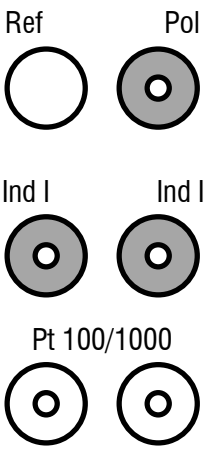
Cable 6.2125.060 (+6.2125.010)

Preselections on the Titrino:

RS232 settings: ..... depend on the control program of the computer
Send to: ..... IBM
Vesuv 3.0, PC program for data acquisition and method backup
for up to 64 devices 6.6008.200

5.2 Connection of electrodes, preparing titration vessel

Rear panel:



Ref	Connection for separate reference electrode. Input is free when a combined electrode is used.
Pol	Connection of polarized electrodes. If measured quantities Ipol or Upol are selected, this measuring input is automatically active.
Ind I Ind II	Connection of pH, redox, ISE electrodes. Combined or separate electrodes. Select measuring input 1 or 2 in the Titrino. Important: The measuring inputs 1 and 2 have a common reference. They may therefore be used as a differential measuring input see below. However, only one reference electrode can be used in the same vessel!
Pt100/ 1000	Connection of a temperature sensor Pt100 or Pt1000..

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.; conditions which can appear in every normal laboratory environment.

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. Recommended electrodes:

Meas.input	Manual determinations	Sample Changers
Ind I	6.0133.100 pH Glass electrode	6.0130.100 pH Glass electrode
Ind II	6.0729.100 double-shielded Ag/AgCl reference electrode	6.0729.110 double-shielded Ag/AgCl reference electrode
Ref	6.0301.100 auxiliary electrode	6.0302.110 auxiliary electrode

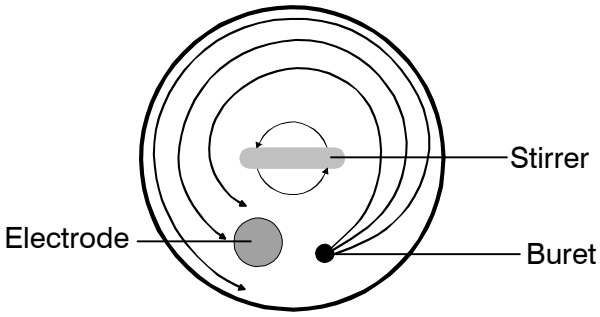
Practical tips

- Glass electrodes should be preconditioned in the solvent used for ca. 1 hour.
- If the potential jump after the first dispensing step is too large, a small start volume may help.
- As an "auxiliary electrode", the 6.1808.030 burette tip with earthing may be used in some cases. Use burette tips without anti-diffusion valve!

Setting up the titration vessel

The titration vessel is set up as shown below. During a titration, it is important to ensure that the solution in contact with the electrode is thoroughly mixed. This is achieved by

- efficient stirring. But it should not be too fast, otherwise the stirrer vortex will suck in air bubbles and CO_2 or O_2 can disturb the titration.
- placing the buret tip according to the drawing below for maximum distance between the adding of the titrant and the electrode.



Pay attention on the direction of rotation of the stirrer!

6 Appendix

6.1 Technical specifications

Modes

DET: **D**ynamic **E**quivalence Point **T**itration
MET: **M**onotonic **E**quivalence Point **T**itration
SET: **S**et **E**nd point **T**itration
MEAS: **Meas**urement
CAL: pH **cal**ibration
TIP: Links commands to **ti**tration **p**rocedure

Measuring inputs

2 high-impedance measuring inputs for pH, redox and ISE electrodes.
1 reference input for a separate reference electrode. May also be used as a differential amplifier.
1 measuring input for polarized electrodes.
1 measuring input for temperature sensor Pt100 or Pt1000.

Measuring range

pH value (pX)	0...±20.00, resolution 0.01
Voltage	0...±2000 mV, resolution 1 mV, error limit 0.1 % fullscale
Current	0...±200 µA, resolution 1 µA
Temperature	–150.0...+450.0 °C, resolution 1 °C

Polarizer

Ipol	0...±127 µA, resolution 1 µA
Upol	0...±1270 mV, in steps of 10 mV

Measuring amplifier (at 25 °C and Titrino warmed-up)

Input resistance	$>10^{13}\,\Omega$
Offset current	$<3*10^{-13}$ A
Deviation of offset voltage	15 µV/K

Dosification

Volume of buret cylinder	1, (2), 5, 10, 20 or 50 mL
Resolution	10 000 steps per buret cylinder
Titrating burets	1 internal buret
Auxiliary burets	2 additional burets: 776 or 765 Dosimat

Materials

Housing	Polybutyleneterephthalate (PBTP)
Keypad cover	Polycarbonate (PC)

Display	LCD, 2 lines of 24 characters each Height of characters 5 mm LED back-lit
Internal memory	Method memory for up to 100 methods. Data bank with 17 Metrohm methods. Silo memory for sample data and results
RS232 interface	for printer, balance or computer connection: completely controllable from external control unit
Remote input/output lines	for Sample Changer, robot connection, etc.
Analog output	
Output signal	-2000 ... 2000 mV
Signal at analog-output	depending on preselection: U (measuring value) dU/dt (measured value drift) V (volume) dV/dt (volume drift) U(rel) (control deviation at SET) T (temperature) 1 mV (12 Bit), see also page 153
Ambient temperature	
Nom. operation range	5 ... 40 °C
Storage	– 20 ... 60 °C
Transport	– 40 ... 60 °C
Safety specifications	Designed and tested in accordance to IEC publication 61010-1, safety class I. This manual contains information and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.

Mains connection

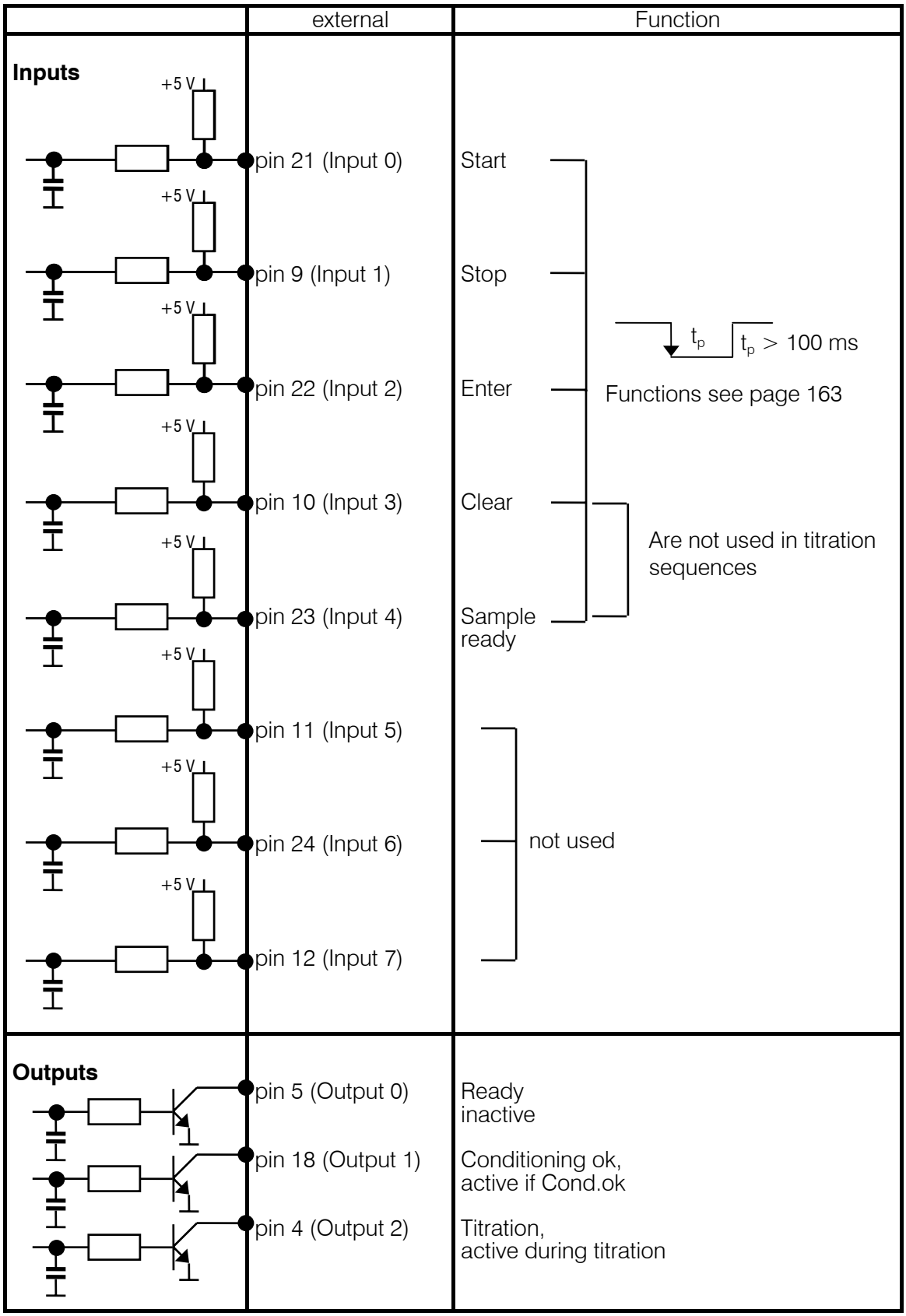
Voltage	100, 117, 220/230, 240 V (switchable)
Frequency	50 ... 60 Hz
Power consumption	15 W
Fuse	Thermal fuse

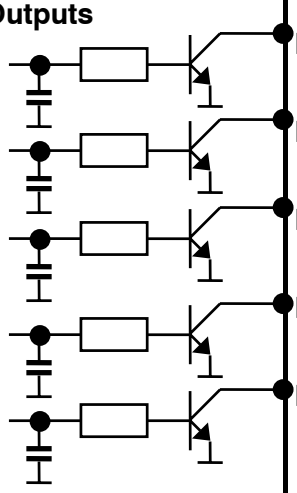
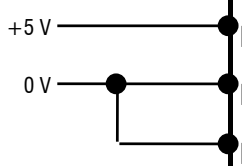
Dimensions with Exchange Unit

Width	150 mm
Height	450 mm
Depth	275 mm

Weight, incl. keypad app. 3.6 kg

6.2 Pin assignment of the "Remote" socket

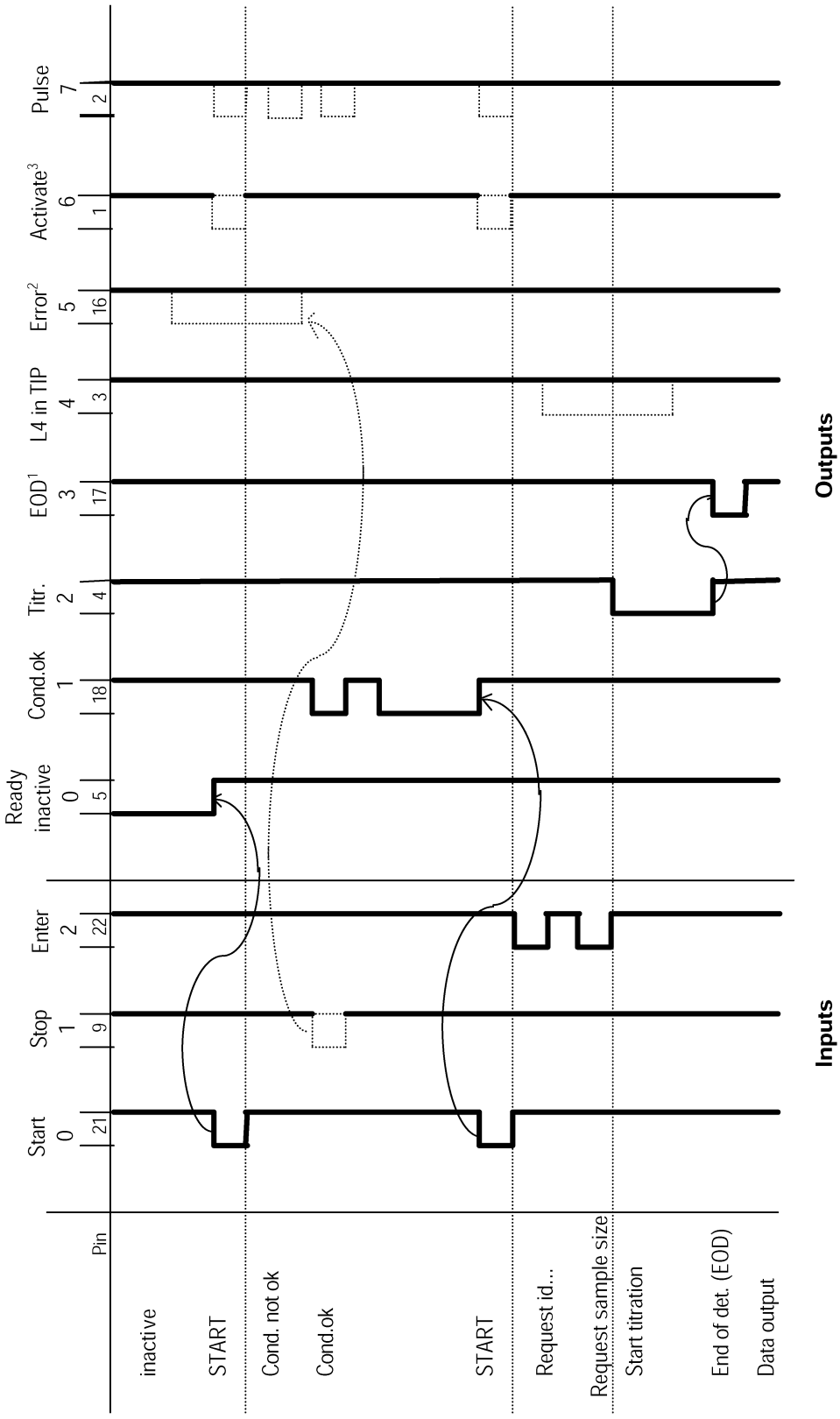


Outputs 	pin 17 (Output 3)	End of determination EOD
	pin 3 (Output 4)	L4 in TIP
	pin 16 (Output 5)	Error, active with errors
	pin 1 (Output 6)	Activate pulse, see page 163. L6 in TIP
	pin 2 (Output 7)	Pulses for recorder (t_p=150 µs) 10 000 per buret cylinder
		For all outputs: V_{CE0} = 40 V I_C = 20 mA t_{Pulse} > 100 ms Functions see page 163.
Voltage 	pin 15	I ≤ 75 mA
	pin 14	0 V: active 5 V: inactive
	pin 25	

Ordering numbers for plug:
K.210.9004 (shell) and K.210.002

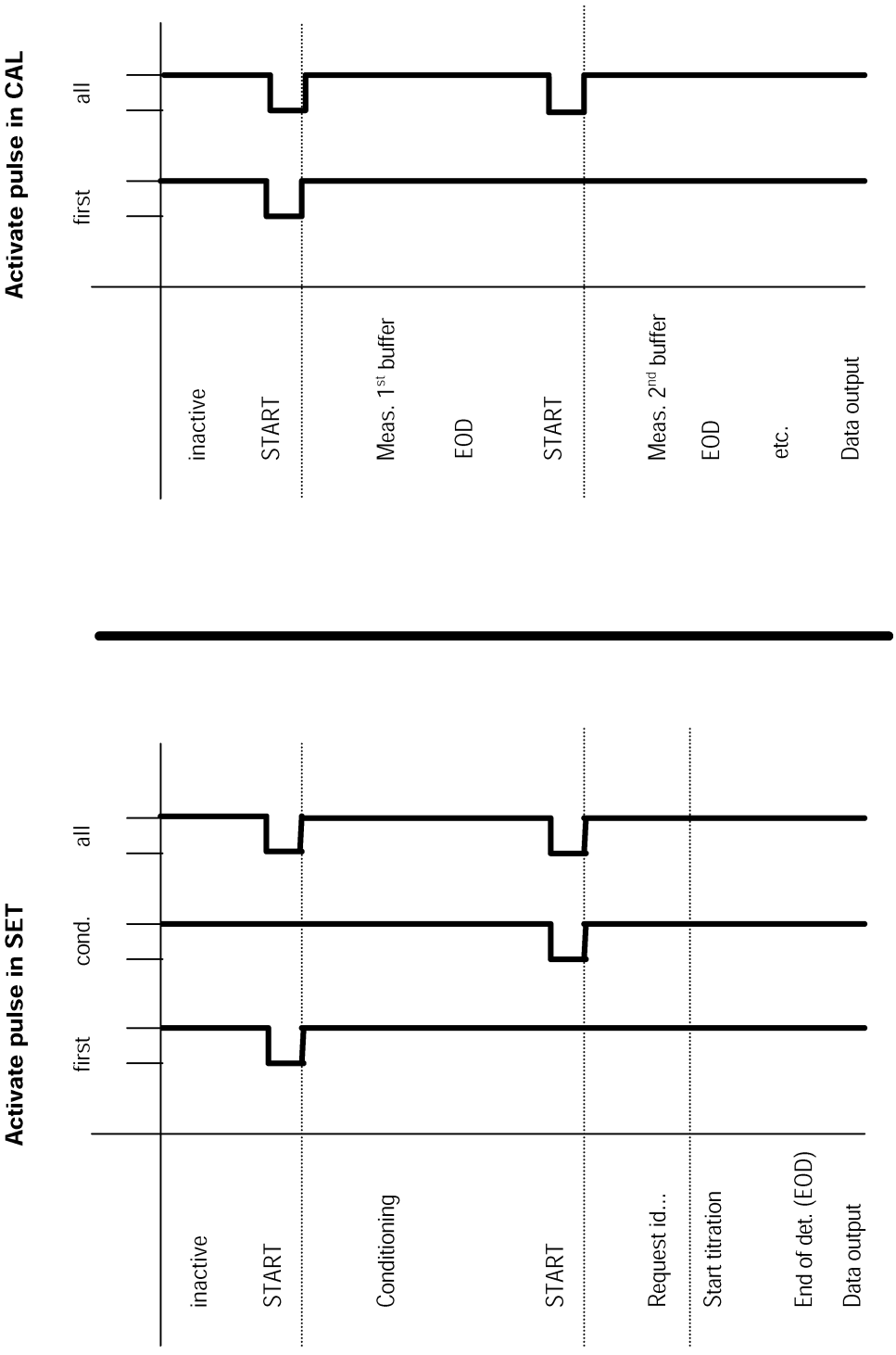
No liability whatsoever will be accepted for damage caused by improper interconnection of instruments.

6.2.1 Lines of the "Remote" socket during the titration



1: In CAL, EOD is sent after every buffer. Automatic output of EOD can be switched off via RS232, see page 120.
2: The error line is reset when the error is rectified.
3: Line used in TIP as L6.

6.2.2 Possible configurations of the activate pulse in SET and CAL



6.3 User methods

6.3.1 General

The methods are stored in the user memory ready for use. They can be loaded, modified and overwritten.

If the result should have another unit, you need to adjust the calculation constants using the key <C-FMLA>.

Stop volumes or other stop conditions should be entered depending on sample.

If a printer is connected, the methods should be completed with report instructions (key <DEF>).

The following methods are available:

```
 'um
794 Titrino             01102   794.0010
Datum 2002-01-03    Zeit  15:16
user method                     bytes
DET  pH       Titer_pH            192
DET  U           Blank            178
DET  U        Chloride            234
MET  U         TAN-TBN            220
MET  U           Diazo            208
MET  Ipol     Br-Index            226
DET  U        Sapon.No            170
DET  U           Ca-Mg            278
DET  U        EDTA-NTA            216
DET  U          Metals            190
DET  U        Perox.No            172
SET  pH       Form.Pre             88
SET  pH       Form.Det            100
TIP           FormolNo            186
DET  pH         P2O5-1            158
DET  pH         P2O5-2            138
TIP           P2O5Fert            164
          Freie Bytes           6856
         ------------
```

6.3.2 "Titer_pH"

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:34        0
DET  pH            Titer_pH
parameters
>titration parameters
  meas.pt.density           4
  min.incr.              10.0 µl
  titr.rate              max. ml/min
  signal drift             50 mV/min
  equilibr.time            26 s
  start V:                 OFF
  pause                     0 s
  meas.input:               1
  temperature            25.0 °C
>stop conditions
  stop V:                abs.
  stop V                   20 ml
  stop pH                  OFF
  stop EP                   9
  filling rate           max. ml/min
>statistics
  status:                   ON
  mean                n=     5
  res.tab:            original
>evaluation
  EPC                       5
  EP recognition:         all
  fix EP1 at pH            OFF
  pK/HNP:                  OFF
>preselections
  req.ident:               OFF
  req.smpl size:         value
  activate pulse:          OFF
          ------------

 'fm
794 Titrino             01102   794.0010
date  2002-01-03    time  09:34        0
DET  pH            Titer_pH
>calculations
Titer=C00*C01/C02/EP1;4;
C00=                   1.0
C01=                 10000
C02=                204.23
          ------------
```

The titer is calculated as a factor without dimension out of 5 determinations and stored as common variable C31. It can therefore be used directly by subsequent methods.

Electrode:
6.0232.100 combined glass pH electrode, at measuring input 1.

Titrant:
c(NaOH) = 0.1 mol/L (free of carbonate)

Sample:
Weigh in app. 300 mg potassium hydrogen phtalate (PHP). Dried 2 h at 105 °C, diluted in 40 mL dist. Water (free of carbonate).

Reference:
METROHM Application Bulletin Nr. 206:

– Result (Titer) as a digit without dimension
– Sample size PHP in g
– Theoretical consumption for 1 mol PHP
– Molar mass PHP

6.3.3 "Blank"

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:38        0
DET  U                Blank
parameters
>titration parameters
  meas.pt.density           4
  min.incr.              10.0 µl
  titr.rate              max. ml/min
  signal drift             50 mV/min
  equilibr.time            26 s
  start V:                 OFF
  pause                     0 s
  meas.input:               1
  temperature            25.0 °C
>stop conditions
  stop V:                abs.
  stop V                   30 ml
  stop U                   OFF mV
  stop EP                   9
  filling rate           max. ml/min
>statistics
  status:                   ON
  mean                n=     3
  res.tab:            original
>evaluation
  EPC                       5
  EP recognition:          all
  fix EP1 at U             OFF mV
  pK/HNP:                  OFF
>preselections
  req.ident:               OFF
  req.smpl size:           OFF
  activate pulse:          OFF
          ------------

 'fm
794 Titrino             01102   794.0010
date  2002-01-03    time  09:38        0
DET  U                Blank
>calculations
Blank=EP1/CO1;3;ml
CO1=                    1
          ------------
```

Treat the "blank sample" in the same way as you treat your real samples. Can be used e.g. for the methods Sapon.No. and Perox.No, see pages 172 and 176.

The blank value is stored as common variable C30 and can therefore be used directly by subsequent methods.

Reference:
METROHM Application Bulletin Nr. 210:

– Result as reagent consumption in mL
– Division factor if multiple quantities of solvent are used for the blank determination.

6.3.4 "Chloride"

```
 'pa
794 Titrino              01102   794.0010
date  2002-01-03    time  09:40        0
DET  U             Chloride
parameters
>titration parameters
  meas.pt.density           4
  min.incr.              10.0 µl
  titr.rate              max. ml/min
  signal drift             50 mV/min
  equilibr.time            26 s
  start V:                 OFF
  pause                     0 s
  meas.input:               1
  temperature            25.0 °C
>stop conditions
  stop V:                  abs.
  stop V                 99.99 ml
  stop U                   OFF mV
  stop EP                   1
  filling rate           max. ml/min
>statistics
  status:                  OFF
>evaluation
  EPC                       5
  EP recognition:          all
  fix EP1 at U             OFF mV
  pK/HNP:                  OFF
>preselections
  req.ident:               OFF
  req.smpl size:           all
  activate pulse:          OFF
          ------------

 'fm
794 Titrino              01102   794.0010
date  2002-01-03    time  09:40        0
DET  U             Chloride
>calculations
Chloride=EP1*C01*C02*C03/C00;2;ppm
NaCl=EP1*C04*C05*C06/C00;2;%
C00=                   1.0
C01=                  0.01
C02=                 35.45
C03=                  1000
C04=                 58.44
C05=                   0.1
C06=                   0.1
          ------------
```

Electrode:
6.0430.100 Ag-Titrode at measuring input 1.

Titrant:
$c(AgNO_3)$ = 0.01 mol/L for low Cl^- contents, e.g. in tap water
$c(AgNO_3)$ = 0.1 mol/L for higher Cl^- contents, e.g. in food

Sample:
Dissolve sample and add HNO_3.

Remarks:
Select the appropriate formula. The other may be deleted.

Reference:
METROHM Application Bulletin Nr. 130

Content of Cl^- in ppm
Content of table salt in %
Sample size in g
Concentration of titrant
Molar mass of Cl
Factor for ppm
Molar mass of NaCl
Concentration of titrant
Factor for %

6.3.5 "TAN-TBN"

Determination of the acid number according to ASTM D 5664-95 resp. of the base number according to ASTM D 2896-88.

Electrodes: 6.0102.102 pH glass electrode at measuring input 1 ("Ind I")
6.0729.100 Ag/AgCl reference electrode (outer elektrolyte solution LiCl in sat. ethanol) at measuring input 2 (Ind II")
6.0301.100 Pt-Electrode at measuring input "Ref"
Differential input

Optional a Solvotrode can be used, in this case select **meas.input: 1** in the method.
TAN 6.0229.100 Solvotrode at measuring input 1 ("Ind I")
6.2320.000 elektrolyte c(TEA-Br) = 0.4 mol/L in ethylene glycol
TBN 6.0229.100 Solvotrode at measuring input 1 ("Ind I")
6.2312.000 elektrolyte diluted 1:1 with ethanol (ca. 2 mol/L LiCl in ethanol)

TAN titrant: c(KOH) = 0.1 mol/L in isopropanol/methanol (e.g. Merck No. 105544).
TBN titrant: $c(HClO_4)$ = 0.1 mol/L in acetic acid.

TAN solvent: toluene/isopropanol/H_2O 500:495:5
TBN solvent: acetic acid/toluene 1:1

Sample: 0.1 – 10 g sample in 50 – 125 mL solvent.

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:42        0
MET  U              TAN-TBN
parameters
>titration parameters
  V step                 0.10 ml
  titr.rate              max. ml/min
  signal drift            OFF mV/min
  equilibr.time            50 s
  start V:                OFF
  pause                   100 s
  meas.input:           diff.
  temperature            25.0 °C
>stop conditions
  stop V:                abs.
  stop V                   10 ml
  stop U                  OFF mV
  stop EP                   9
  filling rate           max. ml/min
>statistics
  status:                 OFF
>evaluation
  EPC                      20 mV
  EP recognition:        last
  fix EP1 at U            OFF mV
  pK/HNP:                 OFF
>preselections
  req.ident:              OFF
  req.smpl size:        value
  activate pulse:         OFF
         ------------

 'fm
794 Titrino             01102   794.0010
date  2002-01-03    time  09:42        0
MET  U              TAN-TBN
>calculations
TAN-TBN=(EP1-CO1)*CO2*CO3/CO0;2;mg/g
CO0=                  1.0
CO1=                    0
CO2=                  0.1
CO3=               56.106
         ------------
```

Remarks:
- Store glass electrode in dist. water over night. Before titrating, brecondition it in solvent during 10…30 min.
- ASTM requires an equilibration time of 100 s between volume increments. In most cases it is possible to titrata with shorter equilibration times.
- If fix end points are evaluated, the voltage value to be set has to be determined with buffers.

Reference:
METROHM Application Bulletin Nr. 80:

Differential potentiometry, see page 155.

Makes sure that the sum value is evaluated.

– Result in mg KOH per g sample
– Sample size in g
– Consumption of blank sample in mL
– Normality of the titrant (0.1*titer)
– Molar mass of KOH

6.3.6 "Diazo"

```
 'pa
794 Titrino              01102   794.0010
date  2002-01-03    time  09:43        0
MET  U                 Diazo
parameters
>titration parameters
  V step                 0.10 ml
  titr.rate              max. ml/min
  signal drift            OFF mV/min
  equilibr.time            20 s
  start V:               abs.
  start V                 0.5 ml
  dos.rate               max. ml/min
  pause                    80 s
  meas.input:               1
  temperature            25.0 °C
>stop conditions
  stop V:                abs.
  stop V                 6.00 ml
  stop U                  OFF mV
  stop EP                   9
  filling rate           max. ml/min
>statistics
  status:                 OFF
>evaluation
  EPC                      30 mV
  EP recognition:    greatest
  fix EP1 at U            OFF mV
  pK/HNP:                 OFF
>preselections
  req.ident:              OFF
  req.smpl size:        value
  activate pulse:         OFF
          ------------

 'fm
794 Titrino              01102   794.0010
date  2002-01-03    time  09:43        0
MET  U                 Diazo
>calculations
Content=EP1*C01*C02*C03/C00;2;%
C00=                   1.0
C01=                     1
C02=                     1
C03=                   0.1
          ------------
```

Diazotation of sulfonamides and primary amines.

Electrode:
6.0341.100 Pt-Titrode, at measuring input 1

Titrant:
$c(NaNO_2)$ = 0.1 mol/L.

Solvent:
w(HBr) = 0.3 (30%)

Sample:
Dilute 0.2 – 0.5 mmol of the substance to be determined in 30 mL solvent and add 20 mL dist. water. Titrate immediately.

– Sample size in g
– Molar mass of the substance to be determined
– Normality of the titrant (0.1*titer)
– Factor for %

6.3.7 "Br-Index"

```
 'pa
794 Titrino              01102   794.0010
date  2002-01-03    time  09:44        0
MET  Ipol          Br-Index
parameters
>titration parameters
  V step                 0.05 ml
  titr.rate              max. ml/min
  signal drift            OFF mV/min
  equilibr.time            20 s
  start V:                OFF
  pause                     0 s
  I(pol)                    1 µA
  electrode test:         OFF
  temperature            25.0 °C
>stop conditions
  stop V:                abs.
  stop V                   10 ml
  stop U                    5 mV
  stop EP                   9
  filling rate           max. ml/min
>statistics
  status:                 OFF
>evaluation
  EPC                      30 mV
  EP recognition:    greatest
  fix EP1 at U            OFF mV
>preselections
  req.ident:              OFF
  req.smpl size:        value
  activate pulse:         OFF
         ------------

 'fm
794 Titrino              01102   794.0010
date  2002-01-03    time  09:44        0
MET  Ipol          Br-Index
>calculations
Br-Index=(EP1-CO1)*CO2*CO3/CO0;1;mg
CO0=                   1.0
CO1=                     0
CO2=                  0.05
CO3=                  7990
         ------------
```

Determination of the bromine index in petroleum hydrocarbons according to ASTM D 2710-72.

The bromine index is defined as the quantity of mg bromine which reacts with 100g sample.

Electrode:
6.0308.100 double Pt-electrode, at measuring input "Pol".

Titrant:
Solution of bromide/bromate,
$c(BrO_3^-/Br^-) = 0.05$ mol/L
Dilute 5.1 g KBr and 1.4 g $KBrO_3$ separately and make up to 1 L.

Solvent:
714 mL glacial acetic acid,
134 mL 1,1,1-trochloroethane,
134 mL Methanol,
18 mL $w(H_2SO_4) = 0.2$ (20%)

Sample:
app. 3 g sample in 20 – 100 mL solvent. Titrate blank sample the same way.

Remarks:
The bromine index can be determined easily by endpoint titration (SET).

Reference:
Metrohm Application Bulletin Nr. 177

– Result in mg bromine/100 g sample
– Sample size in g
– Consumption of blank sample in mL
– Normality of the titrant (0.05*titer)
– Calculation factor (includes molar mass of the bromine)

6.3.8 "Sapon.No"

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:50        0
DET  U             Sapon.No
parameters
>titration parameters
  meas.pt.density          4
  min.incr.             10.0 µl
  titr.rate             max. ml/min
  signal drift            50 mV/min
  equilibr.time           26 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:                abs.
  stop V                99.99 ml
  stop U                  OFF mV
  stop EP                  1
  filling rate          max. ml/min
>statistics
  status:                OFF
>evaluation
  EPC                      5
  EP recognition:        all
  fix EP1 at U           OFF mV
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:       value
  activate pulse:        OFF
          ------------

 'fm
794 Titrino             01102   794.0010
date  2002-01-03    time  09:50        0
DET  U             Sapon.No
>calculations
Sapon.No=(C30-EP1)*C01/C00;2;mg/g
C00=                  1.0
C01=                 28.05
C30=                  0.0
          ------------
```

Determination of the saponification number of edible oils and fats.

Electrode:
6.0229.100 Solvotrode, at measuring input 1.
6.2320.000 Elektrolyte *c*(TEA-Br) = 0.4 mol/L in ethylene glycol.

Titrant:
c(HCl) = 0.5 mol/L

Sample:
Weigh in app. 2 g of sample. Add 25 mL *c*(KOH) = 0.5 mol/L in ethanol and allow to boil lightly for at least 30 miutes. Rinse the content into a beaker and titrate the excess KOH with HCl.
Determine a blank sample the same way.

Remarks:
Change the result unit e.g. to mg KOH.

Reference:
Metrohm Application Bulletin Nr. 141

– Saponification number in mg KOH per g sample
– Sample size in g
– Molar mass of KOH * normality of titrant (56.10*0.5)
– Consumption of "blank sample" in mL

6.3.9 "Ca-Mg"

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:52        0
DET  U                Ca-Mg
parameters
>titration parameters
  meas.pt.density           1
  min.incr.              10.0 µl
  titr.rate              max. ml/min
  signal drift             20 mV/min
  equilibr.time            38 s
  start V:                OFF
  pause                    0 s
  meas.input:              1
  temperature            25.0 °C
>stop conditions
  stop V:                abs.
  stop V                   5 ml
  stop U                 OFF mV
  stop EP                  9
  filling rate           max. ml/min
>statistics
  status:                OFF
>evaluation
  EPC                      5
  EP recognition:        all
  fix EP1 at U           OFF mV
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:         all
  activate pulse:        OFF
          ------------

 'fm
794 Titrino             01102   794.0010
date  2002-01-03    time  09:52        0
DET  U                Ca-Mg
>calculations
Ca++=EP1*CO1*CO2/COO;2;mmol/l
Mg++=(EP2-EP1)*CO1*CO2/COO;2;mmol/l
Total=EP2*CO1*CO2/COO;2;mmol/l
COO=                  1.0
CO1=                 0.05
CO2=                 1000
          ------------
```

Determination of the hardness of drinking water

Electrode:
6.0504.100 Ca electrode and 6.0726.100 Ag/AgCl reference electrode (outer electrolyte KNO_3 sat.), at measuring input 1.

Titrant:
$c(Na_2EDTA)$ = 0.1 mol/L in c(KOH) = 0.1 mol/L

Aux. reagent:
c(acetyl acetone) = 0.1 mol/L + c(TRIS) = 0.2 mol/L (TRIS = trishydroxymethyl aminomethane)

Sample:
100 mL drinking water,
add 15 mL auxiliary reagent.

Remarks:
The volume of the auxiliary reagent can be optimized: As a rule of thumb, the ratio Mg/acetyl acetone should be app. 0.05.

Reference:
Metrohm Application Bulletin Nr. 125

– Calcium hardness in mmol/L
– Magnesium hardness in mmol/L
– Total hardness in mmol/L
– Sample size in mL
– Concentration of the titrant
– Factor for mmol

6.3.10 "EDTA-NTA"

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:53        0
DET  U             EDTA-NTA
parameters
>titration parameters
  meas.pt.density           4
  min.incr.              10.0 µl
  titr.rate              max. ml/min
  signal drift             50 mV/min
  equilibr.time            26 s
  start V:                 OFF
  pause                     0 s
  meas.input:               1
  temperature            25.0 °C
>stop conditions
  stop V:                abs.
  stop V                    4 ml
  stop U                   OFF mV
  stop EP                   9
  filling rate           max. ml/min
>statistics
  status:                  OFF
>evaluation
  EPC                       5
  EP recognition:          all
  fix EP1 at U             OFF mV
  pK/HNP:                  OFF
>preselections
  req.ident:               OFF
  req.smpl size:           all
  activate pulse:          OFF
         ------------

 'fm
794 Titrino             01102   794.0010
date  2002-01-03    time  09:53        0
DET  U             EDTA-NTA
>calculations
EDTA=(EP1-C01)*C02*C03/C00;2;%
NTA=(EP1-C01)*C02*C04/C00;2;%
C00=                  1.0
C01=                    2
C02=                  100
C03=               2.9225
C04=               1.9114
         ------------
```

EDTA und NTA in detergents.

Electrode:
6.0502.140 Cu electrode and 6.0726.100 Ag/AgCl reference electrode (outer elcetrolyte KNO_3 sat.), at measuring input 1.

Titrant:
$c(CuNO_3)$ = 0.01 mol/L

Sample:
Weigh 0.5 – 1 g sample into a 100 mL measuring flask and add app. 50 mL dist. water. Heat to app. 40 °C. Allow to cool and fill up to mark. Pipette 10 mL into a beaker, add 2 mL EDTA or NTA standard solution (c = 0.01 mol/L) and 10 mL buffer solution ($c(NH_3/NH_4NO_3)$ = 1 mol/L; pH = 9.6) and titrate.

Remarks:
Select the appropriate formula. The other may be deleted.

Reference:
Metrohm Application Bulletin Nr. 143

– EDTA content in %
– NTA content in %
– Sample size in g
– Volume of standard solution added
– Factor for %
– Molar mass of EDTA*concentration of titrant
– Molar mass of NTA*concentration of titrant

6.3.11 "Metals"

The following metals can be detected according to this method:

		buffer solution	molar mass
Barium	Ba	pH = 10	137.36
Cadmium	Cd	pH = 10	112.41
Cobalt	Co	pH = 10	58.94
Lead	Pb	pH = 4.7	207.21
Nickel	Ni	pH = 10	58.71
Water, total hardness	(Ca+Mg)	pH = 10	64.40
Zinc	Zn	pH = 10	65.38

```
 'pa
794 Titrino              01102   794.0010
date  2002-01-03    time  09:54        0
DET  U                Metals
parameters
>titration parameters
  meas.pt.density            2
  min.incr.               10.0 µl
  titr.rate               max. ml/min
  signal drift              20 mV/min
  equilibr.time             38 s
  start V:                 OFF
  pause                      0 s
  meas.input:                1
  temperature             25.0 °C
>stop conditions
  stop V:                 abs.
  stop V                    10 ml
  stop U                   OFF mV
  stop EP                    9
  filling rate            max. ml/min
>statistics
  status:                  OFF
>evaluation
  EPC                        5
  EP recognition:          all
  fix EP1 at U             OFF mV
  pK/HNP:                  OFF
>preselections
  req.ident:               OFF
  req.smpl size:           all
  activate pulse:          OFF
          ------------

 'fm
794 Titrino              01102   794.0010
date  2002-01-03    time  09:55        0
DET  U                Metals
>calculations
Content=EP1*CO1*CO2/CO0;2;g/l
CO0=                    1.0
CO1=                    0.1
CO2=                      1
          ------------
```

Electrode:
6.0502.140 Cu electrode and 6.0726.100 Ag/AgCl reference electrode (outer electrolyte KNO_3 sat.), at measuring input 1.

Titrant:
EDTA, c = 0.1 mol/L

Buffer pH = 10:
54 g NH_4Cl and 350 mL $w(NH_3)$ = 0.25 are dissolved in 1 L dist. water.

Buffer pH = 4.7:
123 g Naac and 86 mL glacial acetic acid are dissolved in 1 L dist. water.

Sample:
Add 5 mL of buffer solution and 1 mL c(CuEDTA) = 0.05 mol/L to sample. Wait for 20 – 30 s and titrate.

Remarks:
Refer to the table above for the molar mass of a metal and the appropriate buffer.

Reference:
Metrohm Application Bulletin Nr. 101

– Content of metal in g/L
– Sample size in mL
– Concentration of titrant
– Molar mass of metal

6.3.12 "Perox.No"

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:56        0
DET  U             Perox.No
parameters
>titration parameters
  meas.pt.density           4
  min.incr.              10.0 µl
  titr.rate              max. ml/min
  signal drift             50 mV/min
  equilibr.time            26 s
  start V:                 OFF
  pause                     0 s
  meas.input:               1
  temperature            25.0 °C
>stop conditions
  stop V:                abs.
  stop V                 99.99 ml
  stop U                   OFF mV
  stop EP                   1
  filling rate           max. ml/min
>statistics
  status:                  OFF
>evaluation
  EPC                       5
  EP recognition:          all
  fix EP1 at U             OFF mV
  pK/HNP:                  OFF
>preselections
  req.ident:               OFF
  req.smpl size:         value
  activate pulse:          OFF
         -----------

 'fm
794 Titrino             01102   794.0010
date  2002-01-03    time  09:56        0
DET  U             Perox.No
>calculations
Perox.No=C01*(EP1-C30)/C00;2;mE/kg
C00=                  1.0
C01=                   10
C30=                  0.0
         -----------
```

Determinationof the peroxid number of edible oil sand fats.

Electrode:
6.0431.100 Pt-Titrode, at measuring input 1.

Titrant:
$c(Na_2S_2O_3)$ = 0.01 mol/L, to be prepared daily from 0.1 mol/L.

Sample:
Weigh app. 5 g sample into an Erlenmeyer flask and dissolve in 10 mL glacial acetic acid/1-decanol 3:2. Add 0.2 mL saturated KI solution, shake for 5 s and store in the dark for 1 min. Rinse solution into the titration vessel with dist. water and titrate immediately. Same treatment for blank sample.

Remarks:
The sample must be stirred very well during the titration, in order to obtain a good emulsion.

Reference:
Metrohm Application Bulletin Nr. 141

– Result in milli-equivalent O_2/kg
– Sample size in g
– Calculation factor
– Consumption of the blank sample in mL

6.3.13 "FormolNo""

Determination of the formaldehyde number in fruit juices.

TIP method with the submethods "Form.Pre" and "Form.Det"

Electrode: 6.0232.100 combined pH glass electrode, at measuring input 1.

Additonal instrument: 765 Dosimat, connect to 794 Basic Titrino via Remote line.

Titrant: *c*(NaOH) = 0.1 mol/L.

Aux. reagent: *w*(formaldehyde) = 0.35 adjusted to pH 8.5 with NaOH.

Sample: Pipette exactly 25 mL sample into the titration vessel.
Fill the dosimat with the formaldehyde solution and adjust the dosing volume to 15 mL.

Sequence: **FormolNo** is started and the submethod **Form.Pre** titrates the sample to pH=8.5. An activating pulse starts the Dosimat dispensing the formaldehyde solution. After the reaction time of 60 s **Form.Det** titrates again to pH = 8.5. The calculation is performed in **FormolNo**.

Reference: Metrohm Application Bulletin Nr. 180

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:57        0
SET  pH            Form.Pre
parameters
>SET1
  EP at pH               8.50
  dynamics               1.5
  max.rate              10.0 ml/min
  min.rate              25.0 µl/min
  stop crit:           drift
  stop drift              20 µl/min
>SET2
  EP at pH               OFF
>titration parameters
  titr.direction:          +
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:                abs.
  stop V                99.99 ml
  filling rate           max. ml/min
>statistics
  status:                OFF
>preselections
  conditioning:          OFF
  req.ident:             OFF
  req.smpl size:         OFF
  activate pulse:        OFF
         ------------
```

Form.Pre Preparation of the sample.

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  09:58        0
SET  pH            Form.Det
parameters
>SET1
  EP at pH               8.50
  dynamics               1.5
  max.rate              10.0 ml/min
  min.rate              25.0 µl/min
  stop crit:           drift
  stop drift               20 µl/min
>SET2
  EP at pH               OFF
>titration parameters
  titr.direction:          +
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:                abs.
  stop V                99.99 ml
  filling rate           max. ml/min
>statistics
  status:                OFF
>preselections
  conditioning:          OFF
  req.ident:             OFF
  req.smpl size:         OFF
  activate pulse:        OFF
          ------------

 'de
794 Titrino             01102   794.0010
date  2002-01-03    time  09:59
SET  pH            Form.Det
def
>formula
>silo calculations
  match id:              OFF
>common variables
>report
>mean
  MN1=RS1
>temporary variables
  C70=EP1
          ------------
```

Form.Det Determination of the sample.

- Transfer of the end point as temporary variable to **FormolNo**.

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  10:00        0
TIP                FormolNo
parameters
>sequence
  1.method:          Form.Pre
  2.L6 output:          pulse
  3.pause                  60 s
  4.method:          Form.Det
>statistics
  status:                  ON
  mean               n=     3
  res.tab:           original
>preselections
  req.ident:               OFF
  req.smpl size:           OFF
  meas.mode:               OFF
  temperature             25.0 °C
          ------------

 'fm
794 Titrino             01102   794.0010
date  2002-01-03    time  10:00        0
TIP                FormolNo
>calculations
FormolNo=C70*C01;1;
C01=                     4
C70=                 5.522
          ------------
```

FormolNo TIP sequence

- Start **Form.Pre**
- Activation of Dosimat
- Reaction time
- Start **Form.Det**

- Formaldehyde number in mL c(NaOH) = 0.1 mol/L per 100 mL sample
- Calculation factor for 100 mL sample
- EP1 from **Form.Det**

6.3.14 "P2O5Fert""

Determination of P_2O_5 in fertilizer.

TIP method with submethods "P2O5-1" and "P2O5-2"

Electrode: 6.0232.100 combined pH glass electrode, at measuring input 1.

additional instrument: 765 Dosimat, connect to 794 Basic Titrino via Remote line.

Titrant: c(NaOH) = 1.0 mol/L.

Reagents: c(HCl) = 1.0 mol/L
Sodium oxalate sat.

Sample: Pipette exactly 10 mL liquid fertilizer into the titration vessel. Add 5 mL c(HCl) = 1.0 mol/L and dilute with 40 mL dist. water.
Fill the Dosimat with sodium oxalate solution and adjust the dosing volume to 15 mL.

Sequence: **P2O5Fert** is startet and the submethod **P2O5-1** titrates the sample to the dihydrogenphosphate and determines the excess of dispensed titrant. An activating pulse starts the Dosimat dispensing the sodium oxalate solution. After the waiting time of 30 s **P2O5-2** titrates the dihydrogenphosphate. **P2O5Fert** calculates the content of P_2O_5.

Reference: Metrohm Application Bulletin Nr. 240.

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  10:01        0
DET  pH              P2O5-1
parameters
>titration parameters
  meas.pt.density          4
  min.incr.             10.0 µl
  titr.rate             max. ml/min
  signal drift            50 mV/min
  equilibr.time           26 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:                abs.
  stop V                99.99 ml
  stop pH                 OFF
  stop EP                  1
  filling rate          max. ml/min
>statistics
  status:                OFF
>evaluation
  EPC                      5
  EP recognition:       all
  fix EP1 at pH          OFF
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:         OFF
  activate pulse:        OFF
         ------------
```

P2O5-1 Titration of the first equivalence point of H_3PO_4.

```
 'de
794 Titrino             01102   794.0010
date  2002-01-03    time  10:03
DET  pH              P2O5-1
def
>formula
  excess=C41-EP1
  RS1 text             excess
  RS1 decimal places        3
  RS1 unit:                ml
>silo calculations
  match id:               OFF
>common variables
>report
>mean
  MN1=RS1
>temporary variables
  C7O=RS1
         ------------
```

- Excess of dispensed titrant is determined..

- Transfer of the determined excess of titrant to **P2O5Fert**.

```
 'pa
794 Titrino             01102   794.0010
date  2002-01-03    time  10:04        0
DET  pH              P2O5-2
parameters
>titration parameters
  meas.pt.density           4
  min.incr.              10.0 µl
  titr.rate              max. ml/min
  signal drift             50 mV/min
  equilibr.time            26 s
  start V:                OFF
  pause                     0 s
  meas.input:               1
  temperature            25.0 °C
>stop conditions
  stop V:                 abs.
  stop V                 99.99 ml
  stop pH                  OFF
  stop EP                    1
  filling rate           max. ml/min
>statistics
  status:                  OFF
>evaluation
  EPC                        5
  EP recognition:       window
  low lim.1 pH               7
  up lim.1 pH                9
  low lim.2 pH             OFF
  fix EP1 at pH            OFF
  pK/HNP:                  OFF
>preselections
  req.ident:               OFF
  req.smpl size:           OFF
  activate pulse:          OFF
         ------------

 'de
794 Titrino             01102   794.0010
date  2002-01-03    time  10:04
DET  pH              P2O5-2
def
>formula
>silo calculations
  match id:               OFF
>common variables
>report
>mean
  MN1=RS1
>temporary variables
  C71=EP1
         ------------
```

P2O5-2 Titration of dihydrogenphosphate.

- Transfer of the determined end point as temporary variable to **P2O5Fert**.

```
 'pa
794 Titrino              01102   794.0010
date  2002-01-03    time  10:06        0
TIP                 P205Fert
parameters
>sequence
  1.method:            P205-1
  2.L6 output:          pulse
  3.pause                 30 s
  4.method:            P205-2
>statistics
  status:                  ON
  mean                n=     3
  res.tab:            original
>preselections
  req.ident:              OFF
  req.smpl size:          OFF
  meas.mode:              OFF
  temperature            25.0 °C
         ------------

 'fm
794 Titrino              01102   794.0010
date  2002-01-03    time  10:06        0
TIP                 P205Fert
>calculations
P205=(C70+C71)*C01*C02/C00;2;%
C00=                   1.0
C01=                     1
C02=                   7.1
C70=                 1.031
C71=                10.614
         ------------
```

P2O5Fert TIP sequence

- Start **P2O5-1**
- Activaton of Dosimaten
- Waiting time
- Start **P2O5-2**

- Content of P_2O_5 in %
- Sample size
- Concentration of titrant
- Equivalence weight of P_2O_5 in g/mol
- Excess of titrant in 1st titration in mL
- Volume of titrant in 2nd titration in mL

6.4 Validation / GLP

GLP (Good Laboratory Practice) requires the periodic validation of the analytical instruments. The reproducibility and accuracy of the instruments are checked according to standard operating procedures.

Guidelines for the testing regulations (SOP, Standard Operating Procedure) are given in the following Metrohm Application Bulletin:
No. 252: Validation of Metrohm Titrators (potentiometric) according to GLP/ISO 9001.

Contact your Metrohm agency for support with the validation of your Titrino. There you get a validation documentation, which helps you to perform the installation qualification (IQ) and the operational qualification (OQ).

6.5 Warranty and conformity

6.5.1 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, buret 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.

6.5.2 EU Declaration of conformity

CE

EU Declaration of Conformity

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

794 Basic Titrino

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

Source of the specifications:

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

Description of apparatus:

All-purpose titrator, titration sequences can be programmed and methods stored in the internal memory.

Herisau, October 30, 2001

Dr. J. Frank	Ch. Buchmann
Leiter Entwicklung	Leiter Produktion und Beauftragter Qualitätssicherung

6.5.3 Certificate of Conformity and System Validation

Certificate of Conformity and System Validation

This is to certify the conformity to the standard specifications for electrical appliances and accessories, as well as to the standard specifications for security and to system validation issued by the manufacturing company.

Name of commodity:	794 Basic Titrino
System software:	Stored in ROMs
Name of manufacturer:	Metrohm Ltd., Herisau, Switzerland

This Metrohm instrument has been built and has undergone final type testing according to the standards:

Electromagnetic compatibility: Emission
EN50081-1, EN50081-2, EN55022 (class B)

Electromagnetic compatibility: Immunity
EN50082-1, IEC61000-6-2, Namur, IEC61000-4-2, IEC61000-4-3, IEC61000-4-5, IEC61000-4-6, IEC61000-4-11

Safety specifications
IEC61010-1, EN61010-1

It has also been certified by the Swiss Electrotechnical Association (SEV), which is member of the International Certification Body (CB/IEC).

The technical specifications are documented in the instruction manual.

The system software, stored in Read Only Memories (ROMs) has been validated in connection with standard operating procedures in respect to functionality and performance. The features of the system software are documented in the instruction manual.

Metrohm Ltd. is holder of the SQS-certificate of the quality system ISO 9001 for quality assurance in design/development, production, installation and servicing.

Herisau, October 30, 2001

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

6.6 Scope of delivery and ordering designations

794 Basic Titrino 2.794.0010
inclusive the following accessories:

1 Titrino 1.794.0010
1 Keypad for 794 Basic Titrino 6.2132.080
1 Key for Exchange Units 6.2739.010
1 Mains cable with cable socket, type CEE(22), V
Cable plug to customer's specifications
type SEV 12 (Switzerland...) 6.2122.020
type CEE(7), VII (Germany...) 6.2122.040
type NEMA/ASA (USA...) 6.2122.070
1 Vesuv 3.0 light, PC program for data acquisition and method backup
for 2 devices 6.6008.500
1 Instructions for Use for 794 Basic Titrino 8.794.1003
1 Quick Reference for 794 Basic Titrino 8.794.1013

Options

Accessories to separate order and on payment of extra charge:

Burets

Auxiliary burets
765 Dosimat 2.765.0010
776 Dosimat 2.776.0010
Cable Titrino (activate pulse, line L6) — 765 or 776 Dosimat 6.2139.000
Exchange Units
V = 1 mL, ... 6.3026.110
V = 5 mL, ... 6.3026.150
V = 10 mL, ... 6.3026.210
V = 20 mL, ... 6.3026.220
V = 50 mL, ... 6.3026.250

Stirrers and Titrating Stands

728 Magnetic stirrer 2.728.0040
727 Ti Stand for rinsing and addition of fresh solvent 2.727.0010
802 Rod Stirrer 2.802.0010
727 Ti Stand with built-in magnetic stirrer 2.727.0100

Titration equipment

Titration vessel, volumes
- 1... 50 mL 6.1415.110
- 5... 70 mL 6.1415.150
- 10... 90 mL 6.1415.210
- 20... 90 mL 6.1415.220
- 50... 150 mL 6.1415.250
- 70... 200 mL 6.1415.310

Titration vessel with thermostatic jacket, volumes
- 1... 50 mL 6.1418.110
- 5... 70 mL 6.1418.150
- 10... 90 mL, order 6.2036.000 holding ring separately 6.9914.023
- 20... 90 mL 6.1418.220
- 50... 150 mL 6.1418.250

Titration vessel lid (5 openings) 6.1414.010

Magnetic stirring bars, length
- 12 mm 6.1903.010
- 16 mm 6.1903.020
- 25 mm 6.1903.030

Electrode holder 6.2021.020

Electrodes and accessories

comb. pH Glass electrode with SGJ, without cable 6.0233.100
comb. pH glass electrode, without cable 6.0232.100
comb. pH micro glass electrode, without cable 6.0234.100
comb. pH glass electrode with built-in T sensor, with SGJ 6.0238.000
T adapter for the connection of one electrode to 2 Titrinos 6.2103.100
T sensor (Pt1000) with SGJ, without cable 6.1110.100
Electrode cable, 1m 6.2104.020
Cable for T sensor 6.2104.080
SGJ sleeve for electrodes without SGJ 6.1236.040

Printers

Custom-Drucker DP40-S4N 2.140.0200
Cable Titrino – Custom DP40-S4N (25/9 pins) 6.2125.130
Cable Titrino – Seiko DPU-414 ..... 6.2125.130
Cable Titrino – EPSON LX300+ (25/25 pins) 6.2125.050
Cable Titrino – HP Desk Jet (serial interface) (25/25 pins) 6.2125.050
Cable Titrino – HP Desk/Laser Jet (parallel IF) 2.145.0330
Adapter for connection of printer/balance at the same COM 6.2125.030

Balances

Cable Sartorius – balances MP8, MC1 (9/25 pins) 6.2125.070
Cable Shimadzu – balances BX, BW 6.2125.080
Ohaus Voyager, Explorer, Analytical Plus ..... cable from Ohaus
Mettler AB, AG balances (interface LC-RS25) ..... cable with balance
Mettler AT balance 6.2146.020
Mettler AM, PM balance ..... 6.2146.020+accessories from Mettler
Mettler balances with interface 016 ..... cable from Mettler
Mettler balances with interface 011 or 012 ..... 6.2125.020
Mettler PG, AB-S, AX, MX, UMX balances ..... 6.2134.120+6.2125.170
AND balances (with RS232 interface OP-03) 6.2125.020
Precisa balances 6.2125.080
Adapter for connection of printer/balance at the same COM 6.2125.030

PC connection

Cable Titrino – PC (25/25 pins) 6.2125.060
Cable Titrino – PC (25/9 pins) ..... 6.2125.060+6.2125.010
RS232 C extension cable (25/25 pins) 6.2125.020
Vesuv 3.0, PC program for data acquisition and method backup
for up to 64 devices 6.6008.200

Sample Changer

730 Sample Changer, 1 working station, 1 pump and 1 valve 2.730.0010
730 Sample Changer, 1 working station, 2 pumps and 2 valves 2.730.0020
730 Sample Changer, 2 working stations, 2 pumps and 2 valves 2.730.0110
730 Sample Changer, 2 working stations, 4 pumps and 4 valves 2.730.0120
760 Sample Changer, 1 working station 2.760.0010
Cable Titrino — 730, 760 Sample Changer 6.2141.020
Cable 2x Titrino — 730, 760 Sample Changer 6.2141.030
Cable Titrino — 730, 760 Sample Changer+665, 725, 765, 776 Dosimat 6.2141.040
Cable Titrino — 730, 760 Sample Changer+ 2x 665, 725, 765, 776 Dosimat 6.2141.050
Cable Titrino — Control Unit 664 for Sample Changer 673/674 ..... 3.980.3560

Index

Keys are marked with < >, **display texts** are in bold characters and pages concerning the green part are *printed in Italic*.

A

Accessories ... 187ff
activate pulse: ... 30, 40, 46, 47
Analogue output
  connection of a recorder ... 153
  resolution ... 153
  test ... 140
auto start ... 23
auxiliaries ... 23

B

Balance
  connection ... 151
  selection ... 22
balance: ... 22
baud rate: ... 23
Blank ... 167
Br-Index ... 171
buffer 1 pH ... 47

C

Cable ... 188ff
CAL ... 47
cal.date ... 68
cal.temp. ... 47
Calculation ... 52
  formula ... 52
  variables CXX ... 53
Calibration
  sequence ... 49
calibration parameters ... 47
Ca-Mg ... 173
CE ... 185
Certificates ... 185ff
check electrode ... 133
check exchange unit ... 133
check T-sensor ... 133
Chloride ... 168
Common variable ... 57
common variables ... 24, 57
Computer
  connection ... 154
conditioning: ... 40
Configuration ... 22
Conformity ... 184
Connection
  balance ... 151
  cable ... 188ff
  computer ... 154
  electrodes ... 155
  printer ... 150
  recorder ... 153
  sample changer ... 152
  stirrer ... 149
  Ti stand ... 149
Contrast of display ... 3
Control
  lines ... 161ff
  parameters ... 42ff
  via RS232 ... *77ff*
Curve
  printing ... 60
cycle lines: ... 72

D

Data
  input ... 7, 8
  output ... 60
data bit: ... 23
data set reevaluation ... 133
Data transmission (RS232) ... *77ff*
date ... 23
Decimal places ... 52
Delete
  common variables ... 57
  formula ... 52
  method ... 66
  silo lines ... 71
  statistics values ... 55
  text ... 8
delete all silo lines ... 72
delete all: ... 72
delete method ... 66
delete n= ... 29, 39, 46, 48, 50, 55
delete silo lines ... 71
DET ... 26ff
dev.label. ... 23
dialog language ... 22
dialog: ... 23
Diazo ... 170
Differential potentiometry ... 155
Display
  contrast ... 3
  lock ... *121*
display drift: ... 40
division by zero ... 133
dos.rate ... 26, 37
Dosing ... 3
Drift ... 31, 45
dynamics ... 36

E

Earthing 5
edit silo lines 71
EDTA-NTA 174
electr.id 47, 68
electrode test: 26, 37, 45, 50
Electrodes
  connection 155
End volume 53
EP
  criterion 32
  evaluation 32ff
  titration 36ff
  window 34
EP at pH 36
EP overflow 133
EP recognition: 29
EPC 29, 32, 33
equilibr.time 26, 45, 47
Equilibration time 31
Error messages *82*, 133ff
evaluation 29
Evaluation 32ff
Examples 11ff, 165ff
Exchange unit 3, 187
EXX 135

F

Fabrication number 5
factor 26, 28, 37, 39
filling rate 28, 39
Fix end point 35
fix EP1 at pH 29
Form.Det 177
Form.Pre 177
FormolNo 177
formula 52

G

GLP 183
Graphics
  printing 60

H

Handshake *125ff*
  hardware *127*
  software *125*
handshake: 23
Hardware-Handshake *127*
HNP 35

I

I(pol) 26, 37, 45, 50
I/O-lines 161f
id#1 or C21 ..... 69, 71
Identification
  inquiry 30
  request 40
  sample 69
info 63
Initialise RAM 147
input 1 68
Inputs 161
Instrument number 5
ISO 186

K

Key
  <CAL.DATA> 6, 68
  <C-FMLA> 6, 54
  <CLEAR> 6
  <CONFIG> 6, 22
  <DEF> 6, 52
  <DOS> 3
  <ENTER> 6
  <MEAS/HOLD> 6
  <MODE> 6, 24
  <PARAM> 6, 26
  <PRINT> 6, 60
  <QUIT> 6
  <REPORTS> 6, 59
  <SELECT> 6
  <SILO> 6, 70
  <SMPL DATA> 6, 69
  <START> 3, 6
  <STATISTICS> 6, 56
  <STOP/FILL> 3
  <STOP> 6
  <USER METH> 6, 66
Keypad 6
  lock *120*

L

Language 22
LED
  Silo 3
  Statistics 3
Lock
  display *121*
  keypad *120*
low lim.1 pH 29
LX output 63

M

Mains 5
Manual operation 6ff
manual stop 133
match id: 74
max.rate 36
mean 29, 39, 46, 48, 50, 55
Mean
  calculation 55
  delete result 55
  silo 74
MEAS 45
meas.input: 26, 37, 45, 47, 50

meas.mode: ... 50
meas.pt list overflow ... 133
meas.pt.density ... 26, 32
measuring parameters ... 45
Measuring point list
print ... 60
Menu ... 7
MET ... 26ff
Metals ... 175
method ... 63
Method
memory ... 66
name ... 66
method name: ... 66
method: ... 71
min.incr. ... 26, 32
min.rate ... 36
missing EP ... 133
missing fix EP ... 133
Mode
CAL ... 47
DET ... 26
MEAS ... 45
MET ... 26
selection ... 24
SET ... 36
TIP ... 62

N

no... ... 133f
no.EP not corresponding ... 133
Non aqueous titration ... 155
not valid ... 134

O

Object tree ... *85ff*
Operating course ... 9ff
Ordering designations ... 187ff
Outputs ... 161
outside ... 134
overrange ... 134

P

P2O5-1 ... 180
P2O5-2 ... 180
P2O5Fert ... 180
Parameters
CAL ... 47
DET ... 26
MEAS ... 45
MET ... 26
SET ... 36
TIP ... 62
parity: ... 23
pause ... 26, 37, 63
peripheral units ... 22
Perox.No ... 176
Perturbation ... 133ff
pH(as) ... 68
Pin assignment
RS232 ... *129*
Socket "Remote" ... 161f
pK ... 35
pK/HNP: ... 29
preselections ... 30, 40, 46, 50
Printer
connection ... 150
problems ... 131
selection ... 22
Printing ... 60ff
Problems
non aqueous titration ... 155
printer ... 131
SET titratons ... 44
program ... 23

R

RAM initialisation ... 147
recall method ... 66
record: ... 22
Recorder connection ... 153
Remote control
commands
details ... *102ff*
overview ... *85*
via "Remote" lines ... 161ff
via RS232 ... *77ff*
Remote lines ... 163
report ... 58
Report
output ... 58
printing ... 59, 60
reproduction ... 60
selection ... 58, 60
req.ident: ... 30, 40, 46, 50
req.smpl size: ... 30, 40, 46, 50
res.tab: ... 29, 39, 46, 48, 50, 55
Result
calculation ... 52
delete ... 55
report ... 58
store ... 73
RS? ... 52
RS1 decimal places ... 52
RS1 unit: ... 52
RS1= ... 52
RS232 settings ... 23
RS232-interface
configuration ... 23
pin assignment ... *129*
properties ... *125ff*
Rules for operation via RS232 ... *77ff*
run number ... 23

S

same buffer 134
Sample
  data 69
  identification 30, 69
  size 70
sample changer cal: 47
Sapon.No 172
save lines OFF 134
save lines: 72
Save method 66
Scope of delivery 187
second TIP call 134
Selection
  balance 22
  mode 24
  printer 22
send to: 22
Sensor
  connection 155
sequence 62
Sequence
  CAL 49
  DET 31
  MET 31
  SET 41
  TIP 64
Series number 5
SET 36ff
SET1 36
Setup 149ff
signal drift 26, 45, 47
Silo
  memory 70ff
    report 74
  report 60
silo calculations 73, 74
silo empty 134
silo full 134
silo line 71
slope 68
smpl data 69
smpl size 69, 71
smpl unit: 69, 71
Software-Handshake *125*
start delay 23
start V 26, 37
Start volume 26, 37
statistics 29, 39, 46, 48, 50, 55
Statistics
  calculations 55
  report 60
  values
    delete results 55
    silo 74
status: 29, 39, 46, 48, 50, 55
Stirrer connnection 149
stop bit: 23
stop conditions 28, 39
stop crit: 36
Stop criteria 28, 43
stop drift 36
stop EP 28
stop pH 28
stop time 36
stop V 39
stop V: 28
stop… 134
store method 66
Submethods in TIP 65
system error 3 135

T

t(delay) 36
TAN-TBN 169
Technical specifications 158
temp 68
temperature 26, 37, 45, 50
Temporary variable 65
temporary variables 65
Text input 8
time 23
time interval 45
TIP 62
TIP terminated 135
Titer_pH 166
titr.direction: 37
titr.rate 26
Titration
  modes 25
  non aqueous 155
  parameters
    DET 26
    MET 26
    SET 37
  printing curve 60
  sequence
    DET 31
    MET 31
    SET 41
    TIP 64
  vessel setup 157
titration parameters 26, 37
Tree *85ff*
Troubleshooting 133ff
Tutorial 9ff

U

U(pol) 26, 37, 45, 50
Unit
  result 52
  sample size 69
up lim.1 pH 29

User methods 66, 165ff

V

V step 26, 33
Validation 183
Values entry 7

W

Warranty 184
wrong sample 135

X

XXX bytes missing 133