

794 Basic Titrino

Program version 5.794.0010

Instructions for Use

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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.

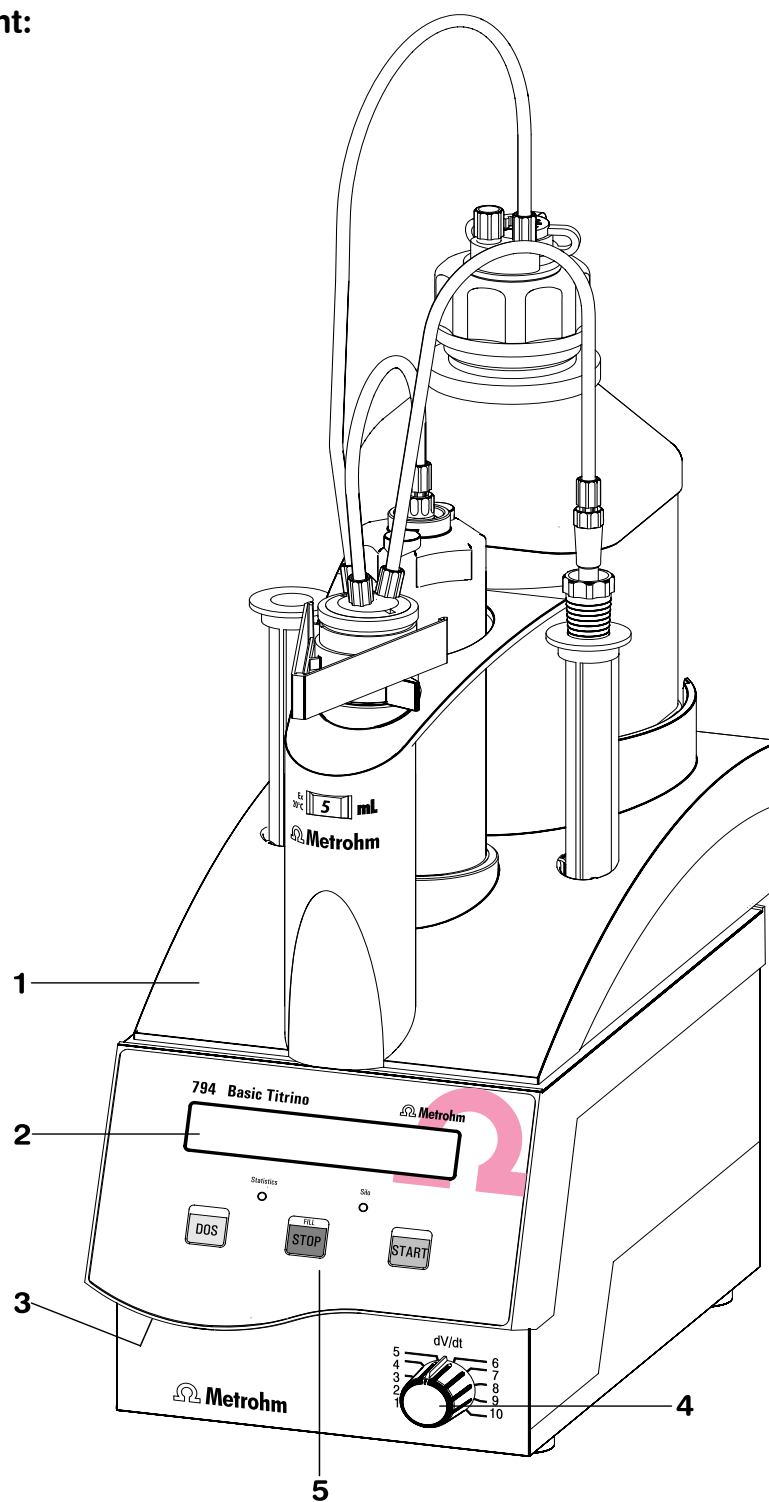
All operating modes of the Titrino can be combined to perform extensive analytical sequences. Ready-to-start methods for the most common applications are stored in the internal method memory. The operator is free to modify and overwrite this methods or to create and store his own titration sequences.

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.



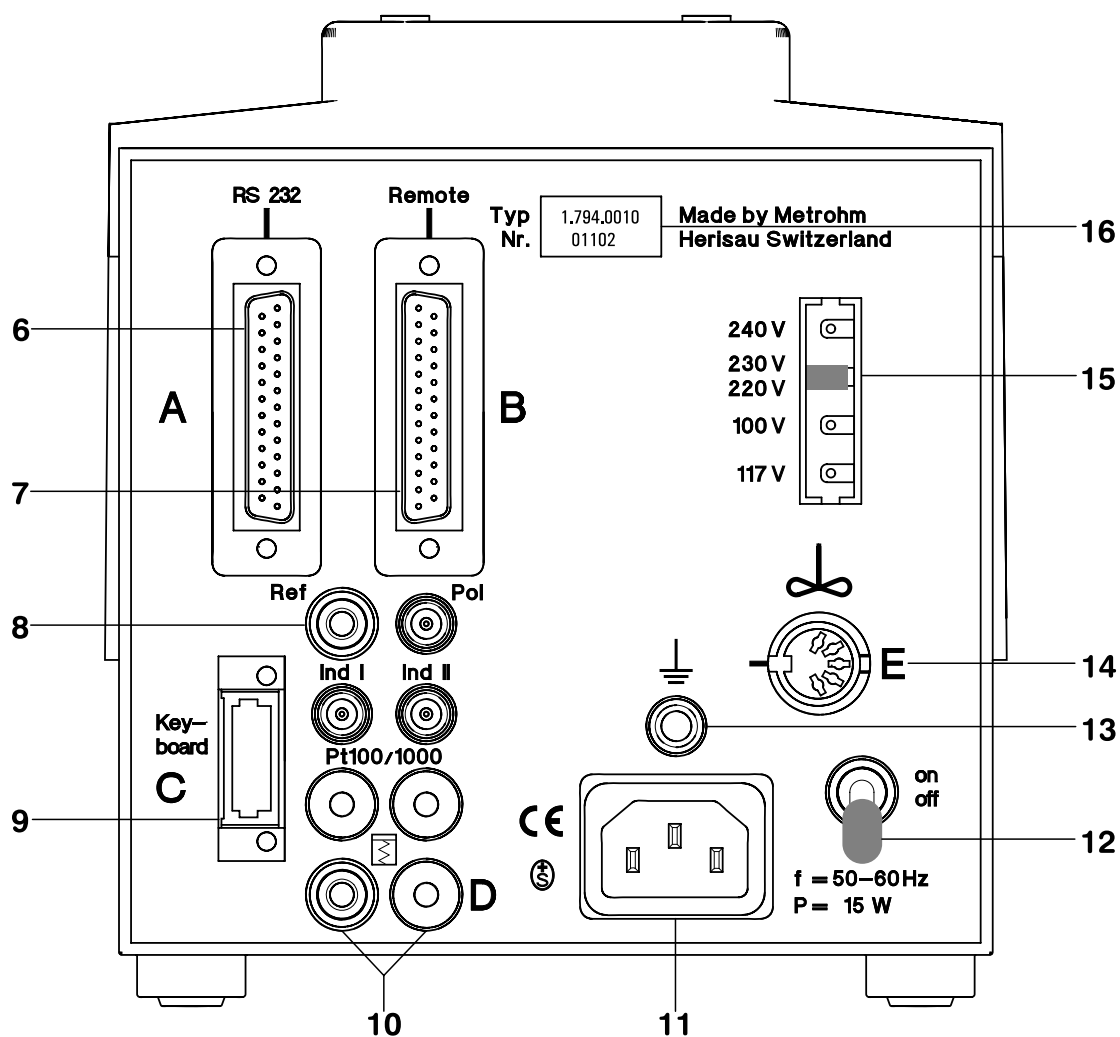
1.2 Controls and parts

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 Ti-trino 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

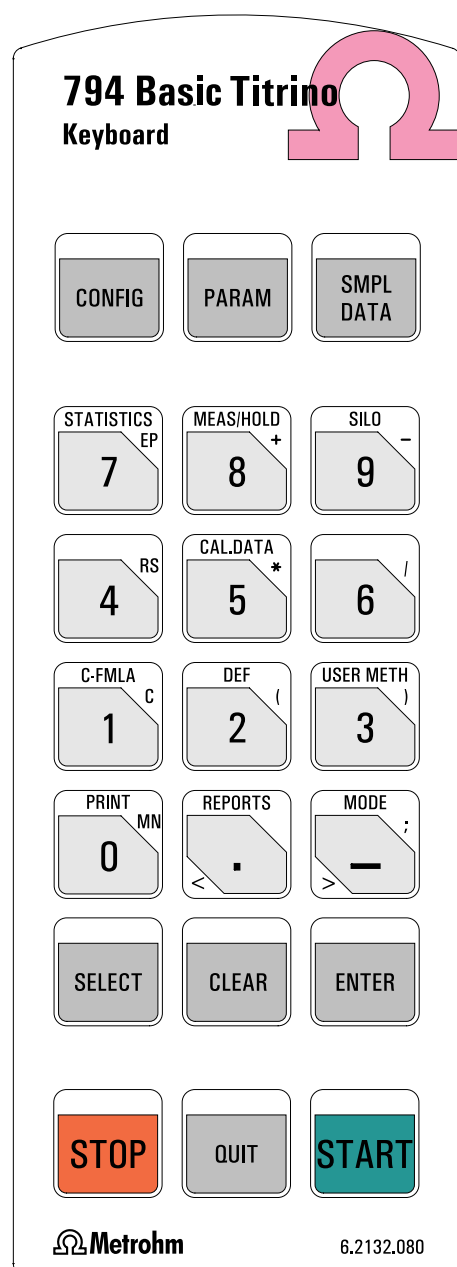
Before switching on for the first time, check that the set mains voltage matches the voltage of your power supply. If this is not the case, disconnect mains cable and change voltage.

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".

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

- 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.
- 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>.

```
configuration
>auxiliaries
```

- 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"

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

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

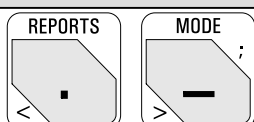
<CLEAR>

- 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>.

<QUIT>
<ENTER>

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

```
>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:
 - Press <USER METH>, place the cursor to ">store method" and press <ENTER>.
 - Open the text writing mode directly: Press key <<>.
 - <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 Titrimo, by means of the most important applications.

Set up your Titrimo 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 Titrimo. 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
>auxillaries

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

<ENTER>

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

>auxillaries
dialog: english

This is the first inquiry of the "auxillaries" 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>.

>auxillaries
dialog: español

<ENTER>

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

```
configuration
>ajustes varios
```

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

<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 | DET |
| mode | |
- 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 x <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 $c(\text{NaOH}) = 0.1 \text{ mol/L}$ 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 $c(\text{HCl}) = 0.1 \text{ mol/L}$ 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

<DEF>

def
>formula

With this equivalence point a result can be calculated.

- Press the <DEF> key.

<ENTER>

RS?

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

<1>

RS1=

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

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:

$RS1 = EP1 * C01 * C02 / C00$

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

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

RS1=EP1*C01*C02/C00

<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 Titrimo 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>

C-fmla	
>C01	0.0

- 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>

smpl data	
smpl size	1.0 g

<2>

<ENTER>

smpl data	
smpl unit:	g

<SELECT>

<ENTER>

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

- Enter 2.

- 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>

DET pH	*****
>display results	

<ENTER>

DET pH	*****
RS1	3.80 g/l

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

- 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>

```
def
>report
```

<ENTER>

```
report:
```

6 x <SELECT>

<;>

9 x <SELECT>

```
report:curve;full
```

<ENTER>

<QUIT>

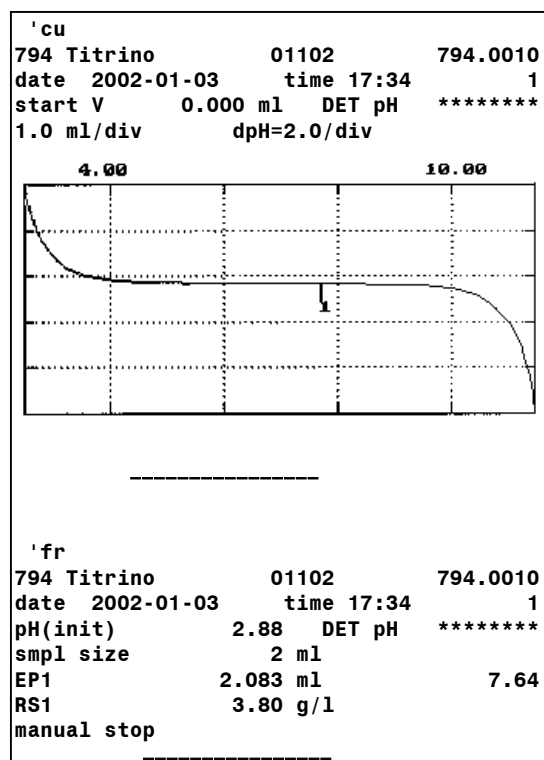
- Press <DEF> repeatedly until the display shows:

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

- With <SELECT> you select the individual report 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".

- 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:



Identification of the report type (cu=curve)

Start volume, mode and method name
Scaling of curve axis

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
```

<ENTER>

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

<ENTER>

```
DET pH           Acid
```

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

- Open the inquiry with <ENTER>.

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

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
```

<ENTER>

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

<SELECT>
or
direct entry

<ENTER>

```
DET pH           Acid
```

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

- Open the inquiry <ENTER>

- 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.

- Load the method with <ENTER>

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>

buffer 1 pH	25.0°C 7.00
-------------	----------------

pH value of the first buffer.

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

<ENTER>

buffer 2 pH	25.0°C 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.

<ENTER>
oder
<STOP>

- Now enter the pH value of the second buffer. If you require a 1-point calibration, you can also terminate the calibration with <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 (set endpoint titration) 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      25.0 µl/min
```

Minimum titration rate inside the control range.

2 x <QUIT>

- Quit the inquiry with <QUIT>.

Mount an Exchange Unit with $c(\text{HCl}) = 0.1 \text{ mol/L}$ 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
the unit

RS1 decimal places

2

RS1 unit:

mmol/L

and the calculation constants

(key <C-FMLA>)

C01 1 (concentration of titrant $\times 10$)

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 Titrimo      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 x <PARAM>

```
parameters
>statistics
```

<ENTER>

```
>statistics
status:
```

ON

<ENTER>

```
>statistics
mean:
```

n= 2

<3>

<ENTER>

2 x <QUIT>

- Press <PARAM> until the display shows:

- 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.

Mean value of 2 single determinations.

- Enter "3" to include an additional determination.

- 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 x <PARAM>

```
parameters
>statistics
```

- Press <PARAM> until the display shows:

3 x <ENTER>

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

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

2 x <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 x <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.

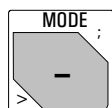
2.5 Configuration, key <CONFIG>

 configuration >peripheral units	Key <CONFIG> serves to enter device specific data. The set values apply to all modes. 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 send to: IBM balance: Sartorius record: U	Settings for peripheral units <i>Selection of printer (Epson, Seiko, Citizen, HP, IBM) at the Titrino Rs232 interface.</i> "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. <i>Selection of balance (Sartorius, Mettler, Mettler AT, AND, Precisa)</i> 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 <i>Selection of the curve for the output at the analog output (U, dU/dt, V, dV/dt, U(rel), T)</i> 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	<i>Selection of dialog language (english, deutsch, francais, español, italiano, portugese, svenska)</i>
date	2001-01-03	<i>Current date (YYYY-MM-DD) Format: Year-month-day, entry with leading zeros.</i>
time	08:13	<i>Current time (HH-MM) Format: Hours-minutes, entry with leading zeros.</i>
run number	0	<i>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.</i>
auto start	OFF	<i>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.</i>
start delay	0 s	<i>Start delay (0...999999 s) Delay time after start of methods. Abort start delay time with <QUIT>.</i>
dev.label.		<i>Individual identification of devices (up to 8 ASCII characters) Will be printed in the result report, see page 59.</i>
program	794.0010	<i>Display of program version</i>
>RS232 settings		Settings of RS232 interface see also page 125ff.
baud rate:	9600	<i>Baud rate (300, 600, 1200, 2400, 4800, 9600)</i>
data bit:	8	<i>Data bit (7, 8)</i>
stop bit:	1	<i>Stop bit (1, 2)</i>
parity:	none	<i>Parity (even, odd, none)</i>
handshake:	HWS	<i>Handshake (HWS, HWf, SWline, SWchar, none) see page 125ff.</i>
RS control:	ON	<i>Control via RS232 interface (ON, OFF) "OFF" means that the receipt of commands via the RS232 interface is blocked. Data <u>output</u> is possible.</i>

>common variables C30 etc.	Values of the common variables <i>Common variables C30...C39 (0.. ± 999 999)</i> 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>.

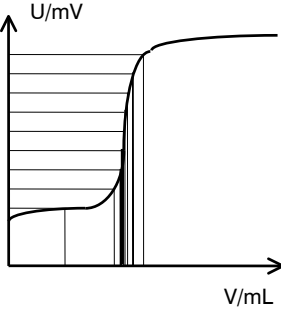
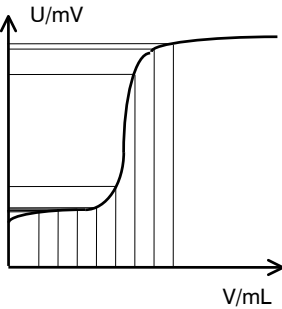
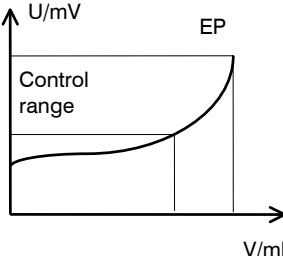
The following modes can be selected:

- 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 **C**alibration.
- MEAS: **M**easuring.
- TIP: **T**itration **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.  U/mV V/mL 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.  U/mV V/mL Acquisition of measured values: Drift controlled ("equilibrium titration") and/or after a fixed equilibration time.	Titration to preset end-point.  U/mV EP Control range V/mL 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 <i>DET</i> min.incr. 10.0 µl <i>DET</i> V step 0.10 ml <i>MET</i>	General titration parameters <i>Measuring point density (0...9)</i> 0 means highest density, 9 lowest. Selection of the meas.pt.density, see page 32. <i>Minimum increment (0...999.9 µL)</i> The increment is dispensed at the beginning of the titration and in the region of the equivalence point. <i>Size of volume increment (0...9.999 mL)</i> 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 **titr.	max. ml/min	<i>Dosing rate for volume increments (0.01...150 mL/min, max.)</i> <CLEAR> sets "max." The maximum rate depends on the Exchange Unit: <table><tr><td>Exchange Unit</td><td>max.</td></tr><tr><td>5 mL</td><td>15 mL/min</td></tr><tr><td>10 mL</td><td>30 mL/min</td></tr><tr><td>20 mL</td><td>60 mL/min</td></tr><tr><td>50 mL</td><td>150 mL/min</td></tr></table>	Exchange Unit	max.	5 mL	15 mL/min	10 mL	30 mL/min	20 mL	60 mL/min	50 mL	150 mL/min
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 **titr.	50 mV/min	<i>Drift criterion for measured value acquisition. (input range depends on the measured quantity:</i> <i>pH, U, Ipol: 0.5...999 mV/min, OFF</i> <i>Upol: 0.05...99.9 µA/min, OFF)</i> <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 **titr.	26 s	<i>Waiting time for measured value acquisition. (0...9999 s, OFF)</i> <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	<i>Type of start volume (OFF, abs., rel.)</i> "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: <i>Absolute start volume (0...999.99 mL)</i>										
factor	0	If "rel." is set: <i>Factor for relative start volume (0...±999 999).</i> Calculated as: start V (in mL) = factor* sample size										
dos.rate **titr.	max. ml/min	<i>Dosing rate for start volume (0.01...150 mL/min, max.)</i> <CLEAR> sets "max." Maximum rate depends on the Exchange Unit: <table><tr><td>Exchange Unit</td><td>max.</td></tr><tr><td>5 mL</td><td>15 mL/min</td></tr><tr><td>10 mL</td><td>30 mL/min</td></tr><tr><td>20 mL</td><td>60 mL/min</td></tr><tr><td>50 mL</td><td>150 mL/min</td></tr></table>	Exchange Unit	max.	5 mL	15 mL/min	10 mL	30 mL/min	20 mL	60 mL/min	50 mL	150 mL/min
Exchange Unit	max.											
5 mL	15 mL/min											
10 mL	30 mL/min											
20 mL	60 mL/min											
50 mL	150 mL/min											

pause **titr.	0 s	<i>Waiting time (0...999999 s)</i> 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	<i>Measuring input for pH and U (1, 2, diff.)</i> Request for measuring input for pH and U. Measuring input 1 or 2 or differential amplifier; connection of electrodes, see page 155.
I(pol)	1 μA	With polarized electrodes, instead of the measuring input the <i>polarization current (-127...127 μA)</i> or the <i>polarization voltage (-1270...1270 mV, in steps of 10 mV)</i> is inquired.
U(pol)	400 mV	
electrode test:	OFF	<i>Electrode test (OFF, ON)</i> 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 $^{\circ}$C	<i>Titration temperature (-170.0...500.0 $^{\circ}$C)</i> 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: **titr.	abs.	<i>Type of stop volume (abs., rel., OFF)</i> "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 **titr.	99.99 mL	If "abs." is set: <i>Absolute stop volume (0...9999.99 mL)</i>
factor **titr.	999999	If "rel." is set: <i>Factor for relative stop volume (0...$\pm$999999)</i> Calculated as: Stop V (in mL) = factor * sample size
stop pH **titr.	OFF	<i>Stop at measured value (input range dependent on measured variable:</i> pH: 0... $\pm$ 20.00, OFF U, Ipol: 0... $\pm$ 2000 mV, OFF Upol: 0... $\pm$ 200.0 μA, OFF) <CLEAR> sets "OFF". "OFF" means that the criterion is not monitored.

stop EP **titr.	9	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.

low lim.1 pH -20.00 up lim.1 pH 20.00	"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. <i>Lower limit of window 1</i> and <i>upper limit of window 1</i> <i>(Input ranges for both inquiries depend on the measured quantity):</i> <i>pH: 0...±20.00, OFF</i> <i>U, Ipol: 0...±2000 mV, OFF</i> <i>Upol: 0...±200.0 µA, OFF</i> <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	<i>Interpolation of volumes at fixed times (input range depends on the measured quantity):</i> <i>pH: 0...±20.00, OFF</i> <i>U, Ipol: 0...±2000 mV, OFF</i> <i>Upol: 0...±200.0 µA, OFF</i> <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	<i>Evaluation of pK or HNP (ON, OFF)</i> pK evaluation in case of pH titrations and half neutralization potential for U, see page 35.
>preselections	Preselections for the sequence
req.ident: OFF	<i>Request of identifications after start of titration. (id1, id1&2, all, OFF)</i> After start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries.
req.smp1 size: OFF	<i>Request of sample size after start of titration (value, unit, all, OFF)</i> "all" requests the value, then the unit.
activate pulse: OFF	<i>Pulse output on I/O line "activate" (L6, pin 1) of the remote socket (ON, OFF)</i> 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 <i>preset</i> EPC is compared to the <i>found</i> 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 $V_{\text{step}} = 1/20 V_{\text{EP}}$ (V_{EP} = volume of the EP). In any case, the increment size should always be between $1/10 V_{\text{EP}}$ and $1/100 V_{\text{EP}}$, 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: $V_{\text{EP}} = V_0 + \rho \Delta V$ V_{EP}: EP volume V_0: Total dispensed volume before Δ_n ΔV: Volume increment ρ: Interpolation factor (Fortuin) Equivalence Point Criteria. The <i>preset</i> EPC is compared to the <i>found</i> 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: $ \Delta_{n-2} + \Delta_{n-1} + \Delta_n + \Delta_{n+1} + \Delta_{n+2} $ (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.

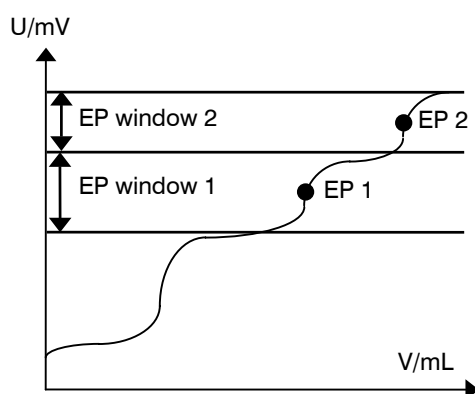
And finally you can set a "window" for each expected EP.

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.

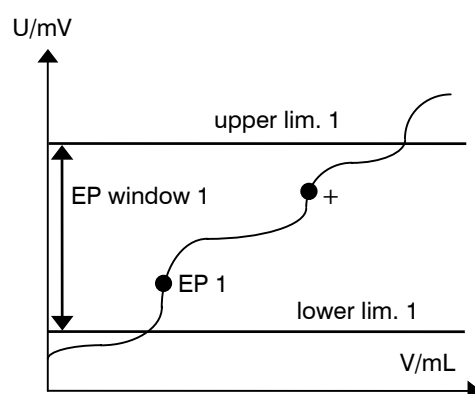
An EP window defines the range in which an EP is expected. EP's outside these ranges are not recognized. Windows are defined on the measured value axis.



2 EP's are recognized. Their numbering is defined by the windows:
Window 1 $\Rightarrow$ EP1
Window 2 $\Rightarrow$ 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 $\Rightarrow$ C51

:

Fix EP9 $\Rightarrow$ 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:

$$\text{pH} = \text{pK} + \log (a_{\text{B}}/a_{\text{A}})$$

When the activities $a_{\text{B}} = a_{\text{A}}$, then $\text{pH} = \text{pK}$ 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 EP at pH OFF **titr. dynamics OFF **titr. max.rate 10.0 mL/min **titr.	Control parameters for EP1 or EP2, resp. <i>Preset EP1 (input range depends on the measured quantity:</i> <i>pH: 0...±20.00, OFF</i> <i>U, Ipol: 0...±2000 mV, OFF</i> <i>Upol: 0...±200.0 µA, OFF)</i> <CLEAR> sets "OFF". If EP1 is "OFF", no further inquiries under SET1 appear. <i>Distance from EP where constant dosing should stop and controlling begins. (control range, input range depends on the measured quantity:</i> <i>pH: 0.01...20.00, OFF</i> <i>U, Ipol: 1...2000 mV, OFF</i> <i>Upol: 0.1...200.0 µA, OFF)</i> <CLEAR> sets "OFF". "OFF" means largest control range, i.e. low titration. Outside the control range, dispensing is performed continuously, see also page 42. <i>Maximum dosing rate (0.01...150 mL/min, max.)</i> <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: <table style="margin-left: 40px;"> <tr> <td>Exchange Unit</td><td>max.</td></tr> <tr> <td>5 mL</td><td>15 mL/min</td></tr> <tr> <td>10 mL</td><td>30 mL/min</td></tr> <tr> <td>20 mL</td><td>60 mL/min</td></tr> <tr> <td>50 mL</td><td>150 mL/min</td></tr> </table>	Exchange Unit	max.	5 mL	15 mL/min	10 mL	30 mL/min	20 mL	60 mL/min	50 mL	150 mL/min
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 **titr.	25.0 µl/min	<i>Minimum dosing rate (0.01...999.9 µL/min)</i> 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: **titr.	drift	<i>Type of stop criteria (drift, time)</i>
stop drift **titr.	20 µl/min	<i>Titration stops if EP is and stop drift is reached. (1...999 µL/min)</i>
t(delay) **titr.	10 s	<i>Titration stops if there is no dosing during t(delay). (0...999 s, INF)</i> <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 **titr.	OFF s	<i>Stop after a time (0...999999 s, OFF)</i> <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	<i>Direction is set automatically (+, -, auto)</i> 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: cond.	OFF	<i>Type of start volume (OFF, abs., rel.)</i> "OFF": start volume switched off "abs.": absolute start volume in mL "rel.": relative start volume to sample size.
start V cond.	0.0 mL	If "abs." is set: <i>Absolute start volume (0...999.99 mL)</i>
factor cond.	0	If "rel." is set: <i>Factor for relative start volume (0...±999999).</i> Calculated as: start V (in mL) = factor * sample size
dos.rate **titr.	max. mL/min	<i>Dosing rate for start volume (0.01...150 mL/min, max.)</i> <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 **titr.	0 s	<i>Pause (0...999999 s)</i> 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	<i>Measuring input (1, 2, diff.)</i> 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	With polarized electrodes, instead of the measuring input the <i>polarization current (-127...127 μA)</i> or the <i>polarization potential (-1270...1270 mV, in steps of 10 mV)</i> is inquired.	
U(pol)	400 mV		
electrode test:	OFF	<i>Electrode test (OFF, ON)</i> Test for polarized electrodes. Performed on changeover from the inactive state to a measurement. "OFF" means that the test is not performed.	
temperature cond.	25.0 $^{\circ}$C	<i>Titration temperature (-170.0...500.0°C).</i> 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: **titr.	abs.	<i>Type of stop volume (abs., rel., OFF)</i> "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 **titr.	99.99 mL	If "abs." is set: <i>Absolute stop volume (0...9999.99 mL)</i>
factor **titr.	999999	If "rel." is set: <i>Factor for relative stop volume (0...±999999)</i> Calculated as: Stop V (in mL) = factor*sample size
filling rate max. mL/min		<i>Filling rate after the titration (0.01...150 mL/min, max.)</i> <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	<i>Status of statistics calculation (OFF, ON)</i> If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.
mean	n= 2	<i>Mean value calculation from n single results (2...20)</i>
res.tab:	original	<i>Result table (original, delete n, delete all)</i> "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	<i>Delete data from sample number n (1...20)</i> The deleted result is removed from the statistics calculation.

>preselections		Preselections for the sequence
conditioning:	OFF	<i>Automatic conditioning of titration vessel. (ON, OFF)</i> 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: cond.	ON	<i>Display of drift during conditioning (ON, OFF).</i> Volume drift.
req.ident: cond.	OFF	<i>Request of identifications after start of titration (id1, id1&2, all, OFF)</i> After start, sample identifications can be requested automatically: Only id1, id1 & id2, all three id's or no inquiries.
req.smpl size: cond.	OFF	<i>Request of sample size after start of titration (value, unit, all, OFF)</i> "all" the value and the unit will be requested.
activate pulse: cond.	OFF	<i>Pulse output on I/O line 6 (L6, pin 1) of the remote socket (first, all, cond., OFF)</i> see page 163.

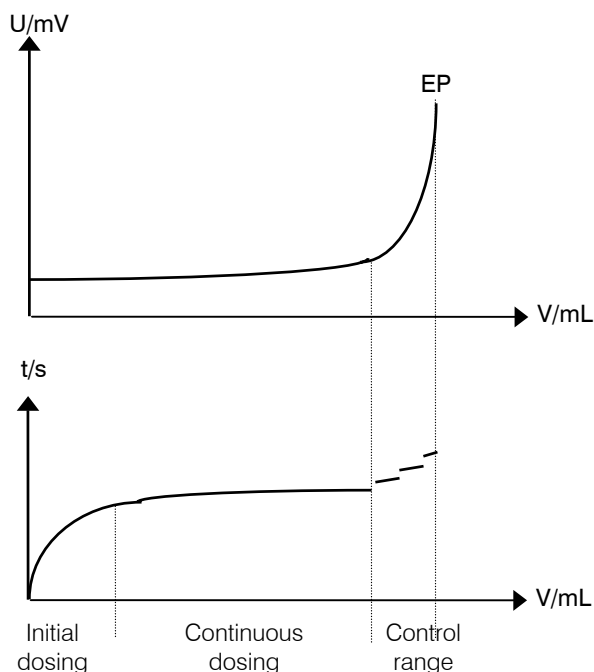
Titration sequence of SET

<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: 1 st end point 2 nd 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.

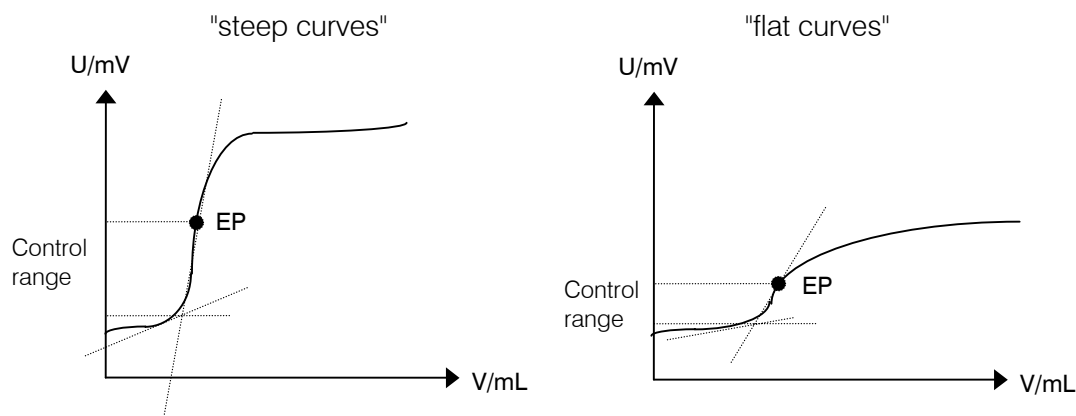
During the titration, reagent dosing occurs in 3 phases:



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", $t(\text{delay})$, 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 $2\text{ }\mu\text{L}$. With a $t(\text{delay}) = 5\text{ s}$, the last $2\text{ }\mu\text{L}$ reagent must thus suffice for 5 s or longer. This results in a drift of $\leq 2\text{ }\mu\text{L}/5\text{ s} = 24\text{ }\mu\text{L}/\text{min}$ (the drift can be less than $24\text{ }\mu\text{L}/\text{min}$ 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 $t(\text{delay}) = 5\text{ s}$, you can set a value of $\leq 24\text{ }\mu\text{L}/\text{min}$ as stop drift. The following table shows several values for the maximum stop drift.

$t(\text{delay})$ min.incr. (Exchange Unit)	5 s	10 s	20 s
$0.5\text{ }\mu\text{L}$ (5 mL)	$6\text{ }\mu\text{L}/\text{min}$	$3\text{ }\mu\text{L}/\text{min}$	$1.5\text{ }\mu\text{L}/\text{min}$
$1\text{ }\mu\text{L}$ (10 mL)	$12\text{ }\mu\text{L}/\text{min}$	$6\text{ }\mu\text{L}/\text{min}$	$3\text{ }\mu\text{L}/\text{min}$
$2\text{ }\mu\text{L}$ (20 mL)	$24\text{ }\mu\text{L}/\text{min}$	$12\text{ }\mu\text{L}/\text{min}$	$6\text{ }\mu\text{L}/\text{min}$
$5\text{ }\mu\text{L}$ (50 mL)	$60\text{ }\mu\text{L}/\text{min}$	$30\text{ }\mu\text{L}/\text{min}$	$15\text{ }\mu\text{L}/\text{min}$

Same $t(\text{delay})$ 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 signal drift OFF mV/min equibr.time OFF s meas.input: 1 I(pol) 1 μA U(pol) 400 mV electrode test: OFF	Measuring parameters <i>Drift criterion for measured value acquisition (input range depends on the measured quantity:</i> <i>pH, U, Ipol: 0.5...999 mV/min, OFF</i> <i>Upol: 0.05...99.9 μA/min, OFF</i> <i>T: 0.5...999 °C/min, OFF)</i> <CLEAR> sets "OFF". "OFF" means that the measured value is acquired after a fixed equilibration time. <i>Waiting time for measured value acquisition (0...9999 s, OFF)</i> <CLEAR> sets "OFF". If no new equilibration time has been entered, the Titrino calculates an equilibration time appropriate to the drift with the formula $\text{equibr.time (in s)} = \frac{150}{\sqrt{\text{Drift} + 0.01}} + 5$ 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. <i>Measuring input for pH and U. (1, 2, diff.)</i> Inquiry only with measured quantities 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>polarization current (-127...127 μA)</i> or the <i>polarization potential (-1270...1270 mV, in steps of 10 mV)</i> is inquired. <i>Electrode test (OFF, ON)</i> Test for polarized electrodes. Performed on changeover from the inactive standby mode to a measurement. "OFF" means that the test is not

temperature	25.0 °C	performed. <i>Temperature (-170.0...500.0 °C)</i> 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	<i>Status of statistics calculation (OFF, ON)</i> If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.
mean	n= 2	<i>Mean value calculation from n single results (2...20)</i>
res.tab:	original	<i>Result table (original, delete n, delete all)</i> "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	<i>Delete data from sample number n (1...20)</i> The deleted result is removed from the statistics calculation.
>preselections		Preselections for the sequence
req.ident:	OFF	<i>Request of sample identifications after start of titration (id1, id1&2, all, OFF)</i> After start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries.
req.smpl size:	OFF	<i>Request of sample size after start of titration (value, unit, all, OFF)</i>
activate pulse:	OFF	<i>Pulse output on line "activate" (L6, pin 1) of the remote socket (ON, OFF)</i> 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 meas.input: 1 cal.temp. 25.0 °C buffer #1 pH 7.00 buffer #2 pH 4.00 buffer #3 pH OFF signal drift 2 mV/min equilibr.time 110 s electr.id sample changer cal: OFF	Calibration parameters <i>Measuring input (1, 2, diff.)</i> Measuring input 1 or 2 or differential amplifier; Connection of electrodes, see page 155. <i>Calibration temperature (-20.0 ... 120.0 °C)</i> If a T sensor is connected, the temperature will be measured. The calibration temperature can also be input during the calibration sequence. <i>pH value of first buffer (0...±20.00)</i> The pH value of the buffers can be put in during the calibration sequence. <i>pH value of second and the following buffers (0...±20.00, OFF)</i> <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. <i>Drift for measured value acquisition (0.5...999 mV/min, OFF)</i> <CLEAR> sets "OFF". "OFF" means that the measured value is acquired after an equilibration time. <i>Equilibration time (0...9999 s, OFF)</i> <CLEAR> sets "OFF". If a new equilibration time has not been entered, the Titrimo 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. <i>Electrode identification (up to 8 characters).</i> <i>Calibration with sample changer (ON, OFF)</i> 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

activate pulse:	OFF	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. <i>Pulse output on the line "activate" (L6, pin 1) of the remote socket (all, first, OFF)</i> See page 163.
>statistics		Statistics calculation
status:	OFF	<i>Status of statistics calculation (OFF, ON)</i> If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear.
mean	n= 2	<i>Mean value calculation from n single results (2...20)</i>
res.tab:	original	<i>Result table (original, delete n, delete all)</i> "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	<i>Delete data from sample number n (1...20)</i> 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. If 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: pH _s 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 status: OFF mean n= 2 res.tab: original delete n= 1	Statistics calculation <i>Status of statistics calculation (OFF, ON)</i> If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear. <i>Mean value calculation from n single results (2...20)</i> <i>Result table (original, delete n, delete all)</i> "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. <i>Delete data from sample number n (1...20)</i> The deleted result is removed from the statistics calculation.
>preselections req.ident.: OFF req.smp1 size: OFF meas.mode: OFF meas.input: 1	Preselections for the sequence <i>Request of sample identifications after start (id1, id1&2, all, OFF)</i> After start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries. <i>Request of sample size after the start (value, unit, all, OFF)</i> <i>Measured quantity (pH, U, Ipol, Upol, T, OFF)</i> Quantity for measurements with key <MEAS/HOLD>. <i>Measuring input (1, 2, diff.)</i> 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	With polarized electrodes, inquiry of <i>polarization current</i> (-127...127 μ A) or <i>polarization potential</i> (-1270...1270 mV, steps of 10 mV)
U(pol)	400 mV	
electrode test:	OFF	<i>Electrode test (OFF, ON)</i> 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	<i>Temperature (-170.0...500.0 °C)</i> Temperature for pH compensation. Its value has to be entered manually even if a T sensor is connected.

2.8 Result calculations

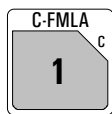
Formula entry, key <DEF>

 def >formula	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. formula: Formulas for result calculations. The display texts of the Titrino are shown to the left. The values are the default values.
>formula RS? RS1= RS1=EP1*C01/C00	Input of formulas <i>Enter formula number (1...9)</i> You can calculate up to 9 results per method. Enter a number 1...9. <i>Input of formula</i> Example: 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.

 <pre>def >mean</pre>	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. mean: Assigns values for statistics calculations. The display texts of the Titrimo are shown to the left. The values are the default values.
<pre>>mean MN1=RS1 MN2= : MN9=</pre>	Allocations for statistics calculations <i>Number n of single values for statistics calculation. (1...9)</i> 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>
<pre>>statistics status: OFF mean n= 2 res.tab: original delete n= 1</pre>	Statistics calculation <i>Status of statistics calculation (OFF, ON)</i> If the statistics calculation is switched off, the following inquiries regarding the statistics do not appear. <i>Mean value calculation from n single results (2...20)</i> <i>Result table (original, delete n, delete all)</i> "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. <i>Delete data from sample number n (1...20)</i> 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>.

 <pre>def >common variables</pre>	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 Titrimetric are shown to the left. The values are the default values.
<pre>>common variables C30= C31 : C39=</pre>	Allocation for common variables <i>Common variable C30...C39 (RSX, EPX, CXX, MNX)</i> 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

 def >report	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. 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:full;curve	<i>Report sequence (input range depends on the mode:</i> <i>DET: full, short, mplist, curve, derive, comb, scalc full, scalc srt, param, calc, calib, ff</i> <i>MET: full, short, mplist, curve, scalc full, scalc srt, param, calc, calib, ff</i> <i>SET, MEAS, CAL:</i> <i>full, short, scalc full, scalc srt, param, calc, calib, ff</i> <i>TIP: full, short, scalc full, scalc srt, param, calc, ff</i> 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.

<PRINT> <REPORTS> <ENTER>.

Report outputs can be stopped with <QUIT>.

Full result report

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

Titration curve

Scaling of volume and pH axis

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	scal full	
Short report of silo calculations	scal 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

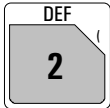
Results can also be viewed in the display. With <SELECT> key, the appropriate section (EP's, results, etc.) can be selected and <ENTER> can be used to view the individual EP's, results etc.

<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	C40	with MEAS
>display calibration	pH(as) and slope	with CAL
>display temp. variables	C70...C79	with TIP

2.12 TIP, Titration procedure

TIP (**T**itration **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

 def >sequence	With key <DEF> the TIP can be defined. 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 <ENTER> etc. 2 x <QUIT>	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 Confirm the step with <ENTER> and enter the parameter for the selected step, see below. The request for the second step follows etc. Up to 30 steps can be selected. On completion of the sequence definition, exit the inquiry with <QUIT>.

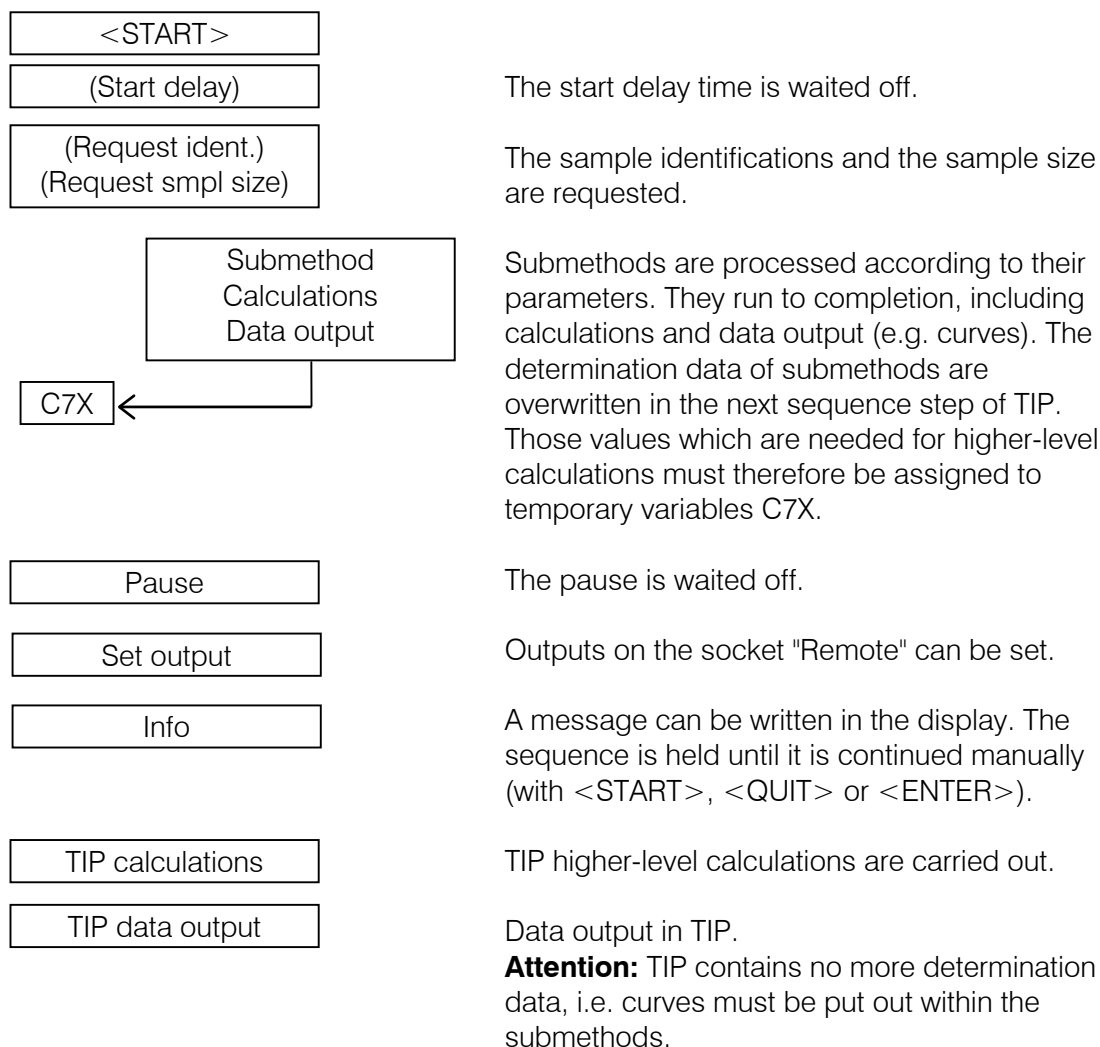
Information for the commands (steps):

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.



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:

 <pre>def >temporary variables</pre>	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.
<pre>>temporary variables C70= C71= : C79=</pre>	Temporary variables <i>Assignment of result, endpoints or variables (RSX, EPX, CXX)</i> 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 <i>Recall method from the internal method memory to the working memory (input of method name, which is included in the memory).</i> If a method identification is entered which is not found in the method memory, the selected value blinks.
>store method method name:	Store method <i>Store method from the working memory to the internal method memory (up to 8 ASCII characters).</i> 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 <i>Delete method from the internal method memory (input of method name, which is included in the memory).</i> 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 <table border="0"> <tr> <td data-bbox="225 815 475 846">pH(as)</td><td data-bbox="496 815 552 846">7.00</td></tr> <tr> <td data-bbox="225 943 475 974">slope</td><td data-bbox="485 943 552 974">1.000</td></tr> <tr> <td data-bbox="225 1070 475 1102">temp</td><td data-bbox="459 1070 552 1102">25.0 °C</td></tr> <tr> <td data-bbox="225 1198 475 1229">cal.date</td><td></td></tr> <tr> <td data-bbox="225 1326 475 1357">electr.id</td><td></td></tr> </table>	pH(as)	7.00	slope	1.000	temp	25.0 °C	cal.date		electr.id		pH calibration data for measuring input 1 <i>Asymmetry pH (0...±20.00)</i> Entered automatically after a calibration with measuring input 1. <i>Slope (0...±9.999)</i> Entered automatically after a calibration with measuring input 1. <i>Calibration temperature (-20.0...120.0 °C)</i> Will be printed automatically after calibration with measuring input 1. <i>Date of last calibration (no entry possible)</i> If the calibration data "pH(as)" and/or "slope" are changed by a manual entry, the date entry is deleted. <i>Electrode identification of calibrated electrodes (no entry possible)</i> If an electrode identification has been entered in the CAL mode, it is automatically entered after the calibration.
pH(as)	7.00										
slope	1.000										
temp	25.0 °C										
cal.date											
electr.id											

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.
smpl data id#1 or C21 id#2 or C22 id#3 or C23 smpl size 1.0 g smpl unit: g	Sample data <i>Sample identification 1...3 or sample specific operand C21...C23 (up to 8 characters).</i> Sample identifications or sample specific operands can be entered using the keypad, via a balance with a special input device or via barcode reader. <i>Sample size (6-digit number: ±X.XXXXX)</i> Entry using keypad, via balance or via barcode reader. <i>Unit of sample size (g, mg, mL, µL, pc, no unit or up to 5 characters)</i> Select unit with <SELECT>.

2.16 Silo memory for sample data

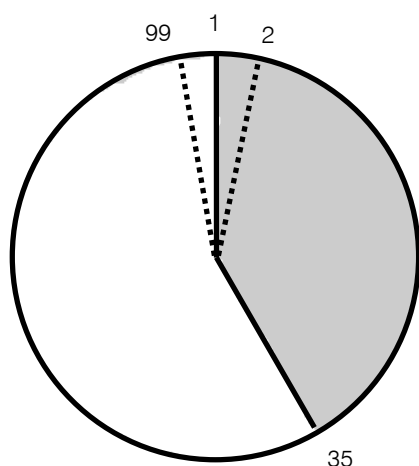
In the silo memory or pushup storage, sample data (method, identifications and smpl size) can be stored. This is useful, e.g. when you work with Sample Changers and other automatic sample addition systems or if you wish an overview of your determination results, see page 74.



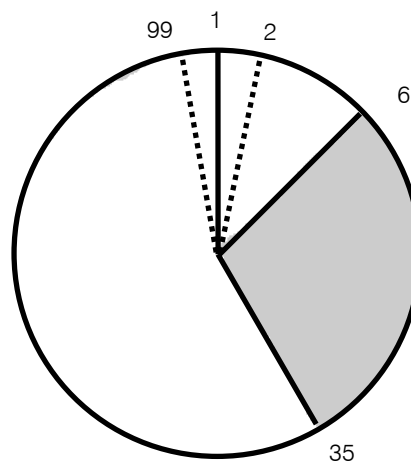
Press the key <SILO> for working with the silo memory. The status LED "silo" is on when the silo memory is switched on. The silo memory works by the FIFO principle (First In, First Out).

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.

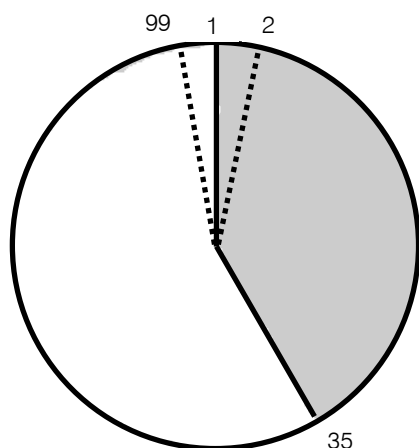
For mixed operation, manual input of identifications and sample sizes from a balance, the values from the balance are sent into the line in which editing just takes place. Confirmed the data with <ENTER> at the Titrimo.

Key <SMPL DATA> with the silo memory switched on

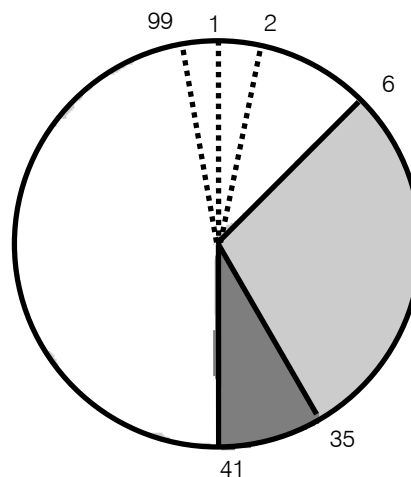
 smpl data >edit silo lines	Sample data can be entered into the silo memory with key <SMPL DATA>. edit silo lines: Entering sample data into the silo memory. delete silo lines: Deletes single silo lines. delete all silo lines: Deletes the whole silo memory. The display texts of the Titrino are shown to the left. The values are the default values.
>edit silo lines silo line 1 method: id#1 or C21 id#2 or C22 id#3 or C23 smpl size 1.0 g smpl unit: g	Input for silo memory <i>Silo line (1...99)</i> The next free line is displayed automatically. Lines already occupied can be corrected. <i>Method with which the sample is processed (method name from the method memory)</i> If no method name has been entered, the sample is processed with the method in the working memory. Selection of the method with <SELECT>. <i>Sample identification 1..3 or sample specific calculation variables C21...C23 (up to 8 characters)</i> <i>Sample size (6-digit number: ±X.XXXXX)</i> The method specific limits are tested on result calculation. <i>Unit of sample size (g, mg, mL, µL, pc, no unit or up to 5 characters)</i> Select unit with <SELECT>.
>delete silo lines delete line n OFF	Delete individual silo lines <i>Line number of the line to be deleted(1...99, OFF)</i> <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 <i>Confirmation (yes, no)</i> When all silo lines are deleted, the silo is completely empty: The line numbering starts again with 1.
cycle lines: OFF save lines: OFF	<i>With "ON", worked off silo lines will be copied to the highest line of the silo memory (ON, OFF)</i> 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 <u>new</u> silo lines during the determinations. <i>Store results in the silo memory (ON, OFF)</i> 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 <i>Assignment to C24 (RSX, EPX, CXX)</i> 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

← 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=		Assignment to C24 and C25 Calculated results (RSX), endpoints (EPX) and variables (CXX) can be stored as C24. Identical for C25.
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 Titrimo		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
+ 3	0-15	A/13	94-09-12		0.197g	0.9947	NV
+ 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%

*

Assignment for C24 only

*

*

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

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

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

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

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 Titrimo in formulas.

Mean value of C24 $\Rightarrow$ C26

Mean value of C25 $\Rightarrow$ 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

&Config.Aux.Language "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

&Config.Aux.Language

command.

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

&Config.Aux.Language \$Q Q means Query

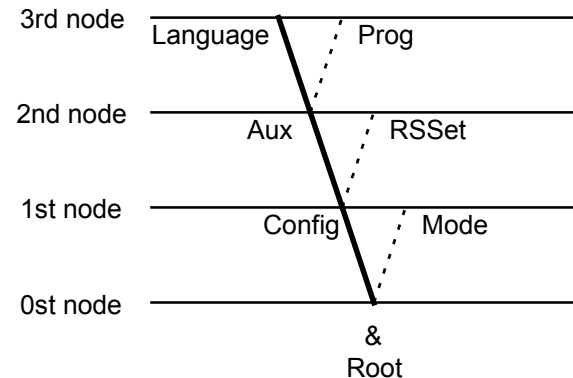
The query command \$Q initiates the issuing of the value on the instrument and the value emission is triggered. Entries which start with \$, trigger something. They are thus called **triggers**.

Values of objects can not only be queried, they can also be modified. Values are always entered in quotes, for example:

&Config.Aux.Language "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 &Config.Aux.Language 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	Go	Starts processes, for ex. starting the mode run or setting the RS 232 interface parameters
\$S	Stop	Stops processes
\$H	Hold	Holds processes
\$C	Continue	Continues processes after Hold
\$Q	Query	Queries all information from the current node in the tree forward up to and including the values
\$Q.P	Path	Queries the path from the root of the tree up to the current node
\$Q.H	Highest Index	Queries the number of son nodes of the current node
\$Q.N"i"	Name	Queries the name of the son node with index i, $i = 1 - n$
\$D	Detail-Info	Queries the detailed status information
\$U	qUit	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: **&Config.RSSet.Baud \$Q**

Querying all values of the node "RSSet": **&Config.RSSet \$Q**

Querying the path of the node "RSSet": **&Config.RSSet \$Q.P**

Start mode: **&Mode \$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.
		.Smp1:	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.
		.Smp1:	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.
		.Smp1:	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 .Fill1: 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.
.Smp1: 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 \$\$:

\$\$.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 \$\$.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 \$\$. |
| E21 | Check electrode, short circuit.
Exit: Rectify fault or &m \$\$. |
| E22 | Check electrode, break.
Exit: Rectify fault or &m \$\$. |
| 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 \$\$. |

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 Titrimo 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 Titrimo contains an incomplete command (L_F missing). Sending from the Titrimo is therefore blocked. Exit: Send L_F or <QUIT>.
E120	Overrange of the primary measured value (pH, U, I_{pol} , U_{pol} or T with MEAS T). The secondary measured value (temperature) may be instable as well. Exit: Correct error or &m \$\$.
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 \$\$.
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 \$\$.
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 \$\$.
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 \$\$.

3.2 Remote control commands

3.2.1 Overview

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

&	Root
├─ Mode	Method parameters
├─ UserMeth	Administration of the internal user-memory for methods
├─ Config	Instrument configuration
├─ SmplData	Sample specific data
├─ Info	Current Data
├─ Assembly	Component data
├─ Setup	Setting the operating mode
└─ Diagnose	Diagnostics program

&Mode

Object	Description	Input range	Reference
& Root			
Mode	Mode	\$G, \$S, \$H, \$C	3.2.2.1.
.QuickMeas	Rapid meas. in basic mode	\$G, \$S	3.2.2.2.
.Select	Mode selection	DET , MET, SET, MEAS, CAL, TIP	3.2.2.3.
.DETQuantity	Measured quantity for DET	pH, U, Ipol, Upol	ditto
.METQuantity	Measured quantity for MET	pH, U, Ipol, Upol	ditto
.SETQuantity	Measured quantity for SET	pH, U, Ipol, Upol	ditto
.MEASQuantity	Measured quantity for MEAS	pH, U, Ipol, Upol, T	ditto
.Name	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"		
.TitrPara	Titration parameters		
.MptDensity	Measuring point density	0... 4 ...9	3.2.2.12.
.MinIncr	Minimum increment	0... 10.0 ...999.9	ditto
.DosRate	Dispensing rate for increments	0.01...150.0, max.	3.2.2.13.
.SignalDrift	Drift for meas. value acquisition	depends on meas.quant.	3.2.2.14.
.UnitSigDrift	Unit of measured value drift	read only	ditto
.EquTime	Equilibrium time	0... 26 ...9999, OFF	ditto
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.15.
.V	Volume for absolute start volume	0...999.99	ditto
.Factor	Factor for relative start volume	0...±999 999	ditto
.Rate	Dispensing rate for start volume	0.01...150.0, max.	ditto
.Pause	Waiting time	0...999 999	3.2.2.16.
.MeasInput	Measuring input	1, 2, diff.	3.2.2.17.
.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	3.2.2.18.
.StopCond	Stop conditions		
.VStop	Stop volume		
.Type	Type of stop volume	abs. , rel., OFF	3.2.2.19.
.V	Volume for absolute stop volume	0... 99.99 ...9999.99	ditto
.Factor	Factor for relative stop volume	0...± 999 999	ditto
.MeasStop	Stop measured value pH, U, I	depends on meas.quant.	3.2.2.20.
.UnitMStop	Unit of stop measured value	read only	ditto
.EPStop	Stop after a number of EP's	1... 9 , OFF	3.2.2.21.
.FillRate	Filling rate	0.01...150.0, max.	3.2.2.22.
.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
.DeIN	Deletion of individual results	1 ...20	ditto
.Evaluation	Evaluation		
.EPC	EP criterion	0... 5 ...200	3.2.2.24.
.Recognition	EP recognition		
.Select	Type of EP recognition	all , greatest, last, window, OFF	ditto
.Window	Window		
.1	up to 9 windows		
.LowLim	Lower limit window 1	depends on meas.quant.	ditto
.UpLim	Upper limit window 1	depends on meas.quant.	ditto
.FixEP	Fix endpoints		
.1	up to 9 fix EP's		
.Value	Measured value for fix EP1	depends on meas.quant.	ditto
.pK	pK or HNP evaluation	ON, OFF	ditto
.Presel	Preselections		
.IReq	Request of Id's after start	id1, id1&2, all, OFF	3.2.2.25.
.Sreq	Request of smpl size after start	value, unit, all, OFF	ditto
.ActPulse	Output of a pulse	ON, OFF	3.2.2.26.

*Parameter	Tree part "Parameters for MET"		
.TitrPara	Titration parameters		
.VStep	Volume increment	0... 0.10 ...999.9	3.2.2.12.
.DosRate	Dispensing rate for increments	0.01...150.0, max.	3.2.2.13.
.SignalDrift	Drift for meas. value acquisition	depends on meas.quant.	3.2.2.14.
.UnitSigDrift	Unit of measured value drift	read only	ditto
.EquTime	Equilibrium time	0... 26 ...9999, OFF	ditto
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.15.
.V	Volume for absolute start volume	0...999.99	ditto
.Factor	Factor for relative start volume	0...±999 999	ditto
.Rate	Dispensing rate for start volume	0.01...150.0, max.	ditto
.Pause	Waiting time	0...999 999	3.2.2.16.
.MeasInput	Measuring input	1, 2, diff.	3.2.2.17.
.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	3.2.2.18.
.StopCond	Stop conditions		
.VStop	Stop volume		
.Type	Type of stop volume	abs. , rel., OFF	3.2.2.19.
.V	Volume for absolute stop volume	0... 99.99 ...9999.99	ditto
.Factor	Factor for relative stop volume	0...± 999 999	ditto
.MeasStop	Stop measured value pH, U, I	depends on meas.quant.	3.2.2.20.
.UnitMStop	Unit of stop measured value	read only	ditto
.EPStop	Stop after a number of EP's	1... 9 , OFF	3.2.2.21.
.FillRate	Filling rate	0.01...150.0, max.	3.2.2.22.
.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
.DeIN	Deletion of individual results	1 ...20	ditto
.Evaluation	Evaluation		
.EPC	EP criterion	depends on meas.quant.	3.2.2.24.
.Recognition	EP recognition		
.Select	Type of EP recognition	all , greatest, last, window, OFF	ditto
.Window	Window		
.1	up to 9 windows		
.LowLim	Lower limit window 1	depends on meas.quant.	ditto
.UpLim	Upper limit window 1	depends on meas.quant.	ditto
.FixEP	Fix endpoints		
.1	up to 9 fix EP's		
.Value	Measured value for fix EP1	depends on meas.quant.	ditto
.pK	pK or HNP evaluation	ON, OFF	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 SET"		
.SET1	Control parameters for EP1		
.EP Endpoint 1		depends on meas.quant.	3.2.2.27.
.UnitEp	Unit of endpoint	read only	ditto
.Dyn	Dynamics	depends on meas.quant.	3.2.2.28.
.UnitDyn	Unit of dynamics	read only	ditto
.MaxRate	Maximum dosing rate	0.01... 10 ...150, max.	ditto
.MinRate	Minimum dosing rate	0.01... 25.0 ...9999	ditto
.Stop	Titration stop		
.Type	Type of stop criterion	drift , time	3.2.2.29.
.Drift	Stop drift	1... 20 ...999	ditto
.Time	Switch-off delay time	0... 10 ...999, inf	ditto
.StopT	Stop time	0...999 999, OFF	ditto
.SET2	Control parameters for EP2, as for EP1		
.TitrPara	Titration parameters		
.Direction	Titration direction	+, -, auto	3.2.2.30.
.Start V	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.15.
.V	Volume for absolute start volume	0...999.99	ditto
.Factor	Factor for relative start volume	0...±999 999	ditto
.Rate	Dispensing rate for start volume	0.01...150.0, max.	ditto
.Pause	Waiting time after start volume	0...999 999	3.2.2.16.
.MeasInput	Measuring input	1, 2, diff.	3.2.2.17.
.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	3.2.2.18.
.StopCond	Stop conditions		
.VStop	Stop volume		
.Type	Type of stop volume	abs. , rel., OFF	3.2.2.19.
.V	Volume for absolute stop volume	0... 99.99 ...9999.99	ditto
.Factor	Factor for relative stop volume	0...± 999 999	ditto
.FillRate	Filling rate	0.01...150.0, max.	3.2.2.22.
.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		
.Cond	Conditioning	ON, OFF	3.2.2.31.
.DriftDisp	Display of drift during cond.	ON, OFF	ditto
.IReq	Request of Id's after start	id1, id1&2, all, OFF	3.2.2.25.
.SReq	Request of smpl size after start	value, unit, all, OFF	ditto
.ActPulse	Output of a pulse	first, all, cond., OFF	3.2.2.26.

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

*Parameter	Tree part "Parameters for CAL"		
Calibration parameters			
.Calibration			
.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 Titrimo	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
.DeIN	Deletion of individual results	1 ...20	ditto

*Parameter	Tree part "Parameters for TIP"		
Sequence			
.1	Step 1		
.Select	Step selection	method,pause,L4 output,L6 output, info, OFF	3.2.2.42.
.Method	Method from memory	special	3.2.2.43.
.Pause	Waiting time	0...999 999, INF	ditto
.L4Output	Line L4	active,inactive,pulse, OFF	ditto
.L6Output	Line L6	active,inactive,pulse, OFF	ditto
.Info	Display information	up to 16 ASCII char.	ditto
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
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
.MeasMode	Measuring mode for man.meas.	pH,U,Ipol,Upol,T, OFF	3.2.2.44.
.MeasInput	Measuring input	1, 2, diff.	ditto
.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	ditto

&UserMeth

Object	Description	Input range	Reference
& Root			
<pre> : : : - UserMeth : : </pre>			
Method memory			
<pre> : - .FreeMemory : </pre>	Memory available	read only	3.2.2.45.
<pre> : - .Recall : </pre>	Load method	\$G	3.2.2.46.
<pre> : - .Name : </pre>	Method name	8 ASCII characters	ditto
<pre> : - .Store : </pre>	Save method	\$G	ditto
<pre> : - .Name : </pre>	Method name	8 ASCII characters	ditto
<pre> : - .Delete : </pre>	Delete method	\$G	ditto
<pre> : - .Name : </pre>	Method name	8 ASCII characters	ditto
<pre> : - .DelAll : </pre>	Delete all methods	\$G	ditto
<pre> : - .List : </pre>	List of methods		
<pre> : - .1 : </pre>	Method 1		
<pre> : - .Name : </pre>	Method name	read only	3.2.2.47.
<pre> : - .Mode : </pre>	Mode	read only	ditto
<pre> : - .Quantity : </pre>	Measured quantity	read only	ditto
<pre> : - .Bytes : </pre>	Method size in bytes	read only	ditto
<pre> : - .Checksum : </pre>	Checksum of method	read only	ditto
<pre> : - .2 : </pre>	for each method		

&Config

Object	Description	Input range	Reference
& Root			
Config	Instrument configuration		
.PeriphUnit	Selection of peripheral units		
.CharSet1	External printer	Epson, Seiko, Citizen IBM , HP	3.2.2.48.
.Balance	Selection of balance	Sartorius , Mettler, Mettler AT AND, Precisa	3.2.2.49.
.Plot	Selection of plot at analog output	U , dU/dt, V, dV/dt U(rel), T	ditto
.Aux	Miscellaneous		
.Language	Dialog language	english , deutsch, francais, espanol, italiano, portugese, svenska	3.2.2.50.
.Set	Setting of date and time	\$G	3.2.2.51.
.Date	Date	XXXX-XX-XX	
.Time	Time	XX:XX	
.RunNo	Run number	0 ...9999	3.2.2.52.
.AutoStart	Automatic start	1...9999, OFF	3.2.2.53.
.StartDelay	Start delay time	0 ...999 999	3.2.2.54.
.DevName	Device label	8 ASCII char.	3.2.2.55.
.Prog	Program version	read only	3.2.2.56.
.RSSet	Settings RS232	\$G	3.2.2.57.
.Baud	Baud rate	300,600,1200,2400,4800, 9600	
.DataBit	Number of data bits	7, 8	ditto
.StopBit	Number of stop bits	1 , 2	ditto
.Parity	Parity	even, odd, none	ditto
.Handsh	Handshake	HWs , HWf, SWchar, SWline, none	ditto
.ComVar	Values of common variables		
.C30	C30	0 ... ±999 999	3.2.2.58.
up to C39	0 ... ±999 999		

&SmplData

Object	Description	Input range	Reference
& Root			
SmplData	Sample data		
.Status	Status of silo memory	ON, OFF	3.2.2.59.
.OFFSilo	Current sample data		
.Id1	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
.ValSmpl	Sample size	±X.XXXXX	ditto
.UnitSmpl	Unit of sample size	up to 5 ASCII char	ditto
.ONSilo	Current sample data		
.Counter	Counter of silo memory		
.MaxLines	Maximum lines	read only	3.2.2.61.
.FirstLine	First line	read only	ditto
.LastLine	Last line	read only	ditto
.EditLine	Editing silo lines		
.1	1 st silo line		
.Method	Method name	up to 8 ASCII char	3.2.2.62.
.Id1	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
.ValSmpl	Sample size	±X.XXXXX	ditto
.UnitSmpl	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
.Mark	Mark of silo line	read only	ditto
up to 99 lines			
.DelLine	Delete silo line	\$G	3.2.2.63.
.LineNum	Line number	1...99, OFF	ditto
.DelAll	Delete silo line	\$G	3.2.2.64.
.CycleLines	Cycle lines	ON, OFF	3.2.2.65.
.SaveLines	Save results	ON, OFF	3.2.2.66.

&Info

Object	Description	Input range	Reference
& Root			
- Info - Report .Select Current data Transmission of formatted reports Report type \$G 3.2.2.67. 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 - CalibrationData pH calibration data \$G 3.2.2.68. .Inp1 For measuring input 1 .pHas Asymmetry pH 0...7.00...±20.00 ditto .Slope Slope of electrode 0...1.000...±9.999 ditto .Temp Calibration temperature -170.0...25.0...500.0 ditto .Date Date of calibration read only ditto .ElectrodeId Id of the calibrated electrode read only ditto .Inp2 For measuring input 2, as for input 1 .Diff For differential input, as for input 1 - Checksums Checksums \$G 3.2.2.69. .MPList Checksum of meas.point list read only ditto .ActualMethod Checksum of current method read only ditto - DetermData Determination data \$G 3.2.2.70. .Write Read/write for several nodes ON, OFF .ExV Volume of Exchange/Dosing unit read only/read + write ditto .MPList Measuring point list .1 Measuring point 1 .Attribute Attribute read only/read + write ditto .X X coordinate read only/read + write ditto .Y Y coordinate read only/read + write ditto - Titration results Titration results .RS Calculated results .1 1st result .Value Value read only 3.2.2.71. "Info", continuation .EP Endpoint .1 1st result .V Value read only ditto .Meas Measured value read only .Mark Mark if more than 1 EP per window read only .Var Variables C4X .C40 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	1 st 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		
-.ActualInfo	"Info", continuation		
.Inputs	Current data		
.Status	I/O Inputs		
.Change	Line status	read only	3.2.2.75.
.Clear	Change of line status	read only	ditto
.Outputs	Clear change	\$G	ditto
.Assembly	as for I/O Inputs		ditto
.CyclNo	From Assembly		
.Counter	Cycle number	read only	3.2.2.76.
.V	Assembly counter	read only	3.2.2.77.
.Clear	Volume counter	read only	ditto
.Meas	Clears counter	\$G	ditto
.Titrator	Measured value	read only	3.2.2.78.
.CyclNo	From Titrator		
.V	Cycle number	read only	3.2.2.79.
.Meas	Volume	read only	ditto
.dVdt	Measured indicator voltage	read only	ditto
.dMeasdt	Volume drift dV/dt	read only	ditto
.dMeasdV	Measured value drift	read only	ditto
.ERC	1st deviation of titration curve	read only	ditto
.MeasPt	ERC from DET	read only	ditto
.Index	Entry in measuring point list		
.X	Index of entry	read only	3.2.2.80.
	X coordinate	read only	ditto

-	-	.Y	Y coordinate	read only	ditto
-	-	.EP	EP entry		
-	-	.Index	Index of entry	read only	ditto
-	-	.X	X coordinate	read only	ditto
-	-	.Y	Y coordinate	read only	ditto
-	-	.Display	Display		
-	-	.L1	Text line 1	up to 24 ASCII char	3.2.2.81.
-	-	.L2	Text line 2	up to 24 ASCII char	ditto
-	-	.Assembly	Assembly		
-	-	.CycleTime	Cycle time	read only	3.2.2.82.
-	-	.ExV	Volume of Exchange unit	read only	ditto

&Assembly

Object	Description	Input range	Reference
& Root			
.Assembly	Assembly control		
.Bur	Buret		
.Rates	Rates		
.Forward	Forward rate		
.Select	Type of rate control	digital, analog	3.2.2.83.
.Digital	Digital rate	0...150, max.	ditto
.Reverse	as for forward rate		
.Select	Type of rate control	digital, analog	ditto
.Digital	Digital rate	0...150, max.	ditto
.Fill	Fill	\$G,\$H,\$C	3.2.2.84.
.ModeDis	Dispensing	\$G,\$S,\$H,\$C	3.2.2.85.
.Select	Type of dispensing control	volume , time	ditto
.V	Volume to be dispensed	0.0001... 0.1 ...9999	ditto
.Time	Time to dispense	0.25... 1 ...86 400	ditto
.VStop	Limit volume	0.0001...9999, OFF	ditto
.AutoFill	Filling after each increment	ON, OFF	ditto
.Meas	Measuring		
.Status	Measuring ON/OFF	ON, OFF	3.2.2.86.
.MeasInput	Selection of measuring input	1 , 2, diff., lpol, Upol, Temp	ditto
.Ipol	Polarization current	0... 1 ...±127	ditto
.Upol	Polarization voltage	0... 400 ...±1270	ditto
.Outputs	I/O outputs		
.AutoEOD	Automatic output of EOD	ON , OFF	3.2.2.87.
.SetLines	Set I/O lines	\$G	ditto
.L0	Signal on L0	active,inactive,pulse, OFF	ditto
up to L 3			
.ResetLines	Reset I/O lines	\$G	ditto

&Setup

Object	Description	Input range	Reference
& Root			
Setup	Settings for the operating mode		
.Keycode	Send key code	ON, OFF	3.2.2.88.
.Tree	Sending format of path info		
.Short	Short format of path	ON, OFF	3.2.2.89.
.ChangedOnly	Paths of modified nodes only	ON, OFF	ditto
.Trace	Message on changed values	ON, OFF	3.2.2.90.
.Lock	Lock key functions		
.Keyboard	Lock all keyboard keys	ON, OFF	3.2.2.91.
.Config	Lock <CONFIG> key	ON, OFF	ditto
.Parameter	Lock <PARAM> key	ON, OFF	ditto
.SmplData	Lock <SMPL DATA> key	ON, OFF	ditto
.UserMeth	Lock functions		
.Recall	Lock "loading"	ON, OFF	ditto
.Store	Lock "saving"	ON, OFF	ditto
.Delete	Lock "deletion"	ON, OFF	ditto
.Display	Lock display function	ON, OFF	ditto
.Mode	Setting waiting intervals		
.StartWait	Waiting time after start	ON, OFF	3.2.2.92.
.FinWait	Waiting time after run	ON, OFF	ditto
.SendMeas	Automatic sending of measured values		
.SendStatus	Connect/disconnect sending	ON, OFF	3.2.2.93.
.Interval	Time interval	0.08...4...16200, MPList	ditto
.Select	Selection	Assembly, Titration	3.2.2.94.
.Assembly	From assembly		
.CyclNo	Cycle number	ON, OFF	3.2.2.95.
.V	Volume	ON, OFF	ditto
.Meas	Measured indicator voltage	ON, OFF	ditto
.Titration	From Titration		
.CyclNo	Cycle number	ON, OFF	3.2.2.96.
.V	Volume	ON, OFF	ditto
.Meas	Measured indicator voltage	ON, OFF	ditto
.dVdt	Volume drift dV/dt	ON, OFF	ditto
.dMeasdt	Measured value drift	ON, OFF	ditto
.dMeasdV	1st deviation of titration curve	ON, OFF	ditto
.ERC	ERC from DET	ON, OFF	ditto
.AutoInfo	Automatic message for changes		3.2.2.97.
.Status	Switch AutoInfo on/off	ON, OFF	ditto
.P	When mains is switched on	ON, OFF	ditto
.T	Titration 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			
.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			
. - Diagnose - .Report	Diagnose		
	Output of adjustment parameters	\$G	3.2.2.103.

3.2.2 Description of the remote control commands

3.2.2.1. Mode \$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. Mode.QuickMeas \$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. Mode.Select DET, MET, SET, MEAS, CAL, TIP

Mode.DETQuantity	pH, U, Ipol, Upol
Mode.METQuantity	pH, U, Ipol, Upol
Mode.SETQuantity	pH, U, Ipol, Upol
Mode.MEASQuantity	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. Mode.Name 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. Mode.Def.Formulas.1.Formula EPX, CXX, RSX, +, -, *, /, (,)

Mode.Def.Formulas.1.TextRS	up to 8 ASCII characters
Mode.Def.Formulas.1.Decimal	0...2...5
Mode.Def.Formulas.1.Unit	up to 6 ASCII characters
Mode.Def.Formulas.2.Formula	
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. Mode.Def.SiloCalc.Assign.C24 RSX, EPX, CXX
Mode.Def.SiloCalc.Assign.C25 RSX, EPX, CXX
Mode.Def.SiloCalc.MatchId 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. Mode.Def.ComVar.C30 RSX, MNX, EPX, CXX
Mode.Def.ComVar.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. Mode.Def.Report.Assign
 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. Mode.Def.Mean.1.Assign RS1, RSX, EPX, CXX
Mode.Def.Mean.2.Assign
 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. Mode.Def.TempVar.C70 RSX, EPX, CXX
 etc. up to **.C79**
 Assignment of temporary variables in a submethod for calculations in TIP.

3.2.2.11. Mode.CFmla
Mode.CFmla.1.Value 0...±999 999
Mode.CFmla.2.Value
 etc., up to **.19**
 Calculation constants specific to a method. Stored in the method memory of the Titrimo. 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. Mode.Parameter.TitrPara.MptDensity 0...4...9
Mode.Parameter.TitrPara.MinIncr 0...10.0...999.9

Mode.Parameter.TitrPara.VStep 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. Mode.Parameter.TitrPara.DosRate 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. Mode.Parameter.TitrPara.SignalDrift pH,U,Ipol:0.5...**50**...999, OFF
 Upol: 0.05...**50**...99.9, OFF

Mode.Parameter.TitrPara.UnitSigDrift read only

Mode.Parameter.TitrPara.EquTime 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 $\mu\text{A}/\text{min}$ (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. Mode.Parameter.TitrPara.StartV.Type abs., rel., **OFF**
Mode.Parameter.TitrPara.StartV.V 0...999.99
Mode.Parameter.TitrPara.StartV.Factor 0... $\pm$ 999 999
Mode.Parameter.TitrPara.StartV.Rate 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 = $\text{smpl size} \cdot \text{factor}$

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. Mode.Parameter.TitrPara.Pause 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. Mode.Parameter.TitrPara.MeasInput 1, 2, diff.
Mode.Parameter.TitrPara.Ipol -127...**1**...+127
Mode.Parameter.TitrPara.Upol -1270...**400**...+1270
Mode.Parameter.TitrPara.PolElectrTest 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. Mode.Parameter.TitrPara.Temp -170.0...25.0...500.0

Parameters for DET, MET, SET: Titration temperature in $^{\circ}\text{C}$. 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. Mode.Parameter.StopCond.VStop.Type abs., rel., OFF Mode.Parameter.StopCond.VStop.V 0...99.99...9999.99 Mode.Parameter.StopCond.VStop.Factor 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. Mode.Parameter.StopCond.MeasStop pH: 0...±20.00, OFF U: 0... ±2000, OFF I: 0...200.0, OFF Mode.Parameter.StopCond.UnitMStop 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. Mode.Parameter.StopCond.EPStop 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. Mode.Parameter.StopCond.FillRate 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. Mode.Parameter.Statistics.Status ON, OFF Mode.Parameter.Statistics.MeanN 2...20

Mode.Parameter.Statistics.ResTab.Selected	original , delete n, delete all
Mode.Parameter.Statistics.ResTab.DeIN	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.DeIN`.

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. Mode.Parameter.Evaluation.EPC DET: 0...**5**...200
MET pH: 0.1...**0.50**...9.99
U, Ipol: 1...**30**...999
Upol: 0.1...**2**...99.9

Mode.Parameter.Evaluation.Recognition.Selected **all**, greatest,
last, window, OFF

Mode.Parameter.Evaluation.Recognition.Window.1.LowLim
 pH: 0...±20.00, **OFF**
 U, Ipol: 0...±2000, **OFF**
 Upol: 0...±200.0, **OFF**

Mode.Parameter.Evaluation.Recognition.Window.1.UpLim
Input range as LowLim

etc. up to 9 windows

Mode.Parameter.Evaluation.FixEP.1.Value pH: 0...±20.00, **OFF**
 U; Ipol: 0...±2000, **OFF**
 etc. up to 9 fix EP's Upol: 0...±200.0, **OFF**

Mode:Parameter:Evaluation.pK 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 I_{pol}) or in μ A (with U_{pol}).

.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. Mode.Parameter.Presel.IReq id1, id1&2, all, **OFF**
Mode.Parameter.Presel.SReq 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. &SmpIData.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. Mode.Parameter.Presel.ActPuls 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. Mode.Parameter.SET1.EP pH: 0...±20.00, **OFF**
 U, Ipol: 0...±2000, **OFF**
 Upol: 0...±200.0, **OFF**
Mode.Parameter.SET1.UnitEp read only

Parameters for SET: Setting the 1st endpoint as pH value, in mV (with U and Ipol) resp. μ A (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. Mode.Parameter.SET1.Dyn pH: 0.01...20.00, **OFF**
 U, Ipol: 1...2000, **OFF**
 Upol: 0.1...200.0, **OFF**
Mode.Parameter.SET1.UnitDyn read only
Mode.Parameter.SET1.MaxRate 0.01...**10**...150, max.
Mode.Parameter.SET1.MinRate 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 μ A (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 μ L/min.

3.2.2.29. Mode.Parameter.SET1.Stop.Type drift, time
Mode.Parameter.SET1.Stop.Drift 1...**20**...999
Mode.Parameter.SET1.Stop.Time 0...**10**...999, inf
Mode.Parameter.SET1.Stop.StopT 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 μ L/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. Mode.Parameter.TitrPara.Direction +, -, 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. Mode.Parameter.Presel.Cond ON, OFF
Mode.Parameter.Presel.DriftDisp ON, OFF

Parameters for SET:

.Cond: Conditioning ON/OFF

.DriftDisp: Drift display during conditioning ON/OFF.

3.2.2.32. Mode.Parameter.Measuring.SignalDrift
pH, U, Ipol, T: 0.5...999, OFF
Upol: 0.05...99.9, OFF
Mode.Parameter.Measuring.UnitSigDrift read only
Mode.Parameter.Measuring.EquTime 0...9999, OFF

Parameters for MEAS: Criteria for the measured value acquisition. Measured value drift in mV/min (with pH, U, Ipol), μ A/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. Mode.Parameter.Measuring.MeasInput 1, 2, diff.
Mode.Parameter.Measuring.Ipol $\pm 127 \dots 1 \dots +127$
Mode.Parameter.Measuring.Upol $\pm 1270 \dots 400 \dots +1270$
Mode.Parameter.Measuring.PolElectrTest 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 μ A (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. Mode.Parameter.Measuring.Temp -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. Mode.Parameter.Calibration.MeasInput 1, 2, diff.
Parameters for CAL: Selection of the measuring input. "diff." means differential amplifier, see page 155.

3.2.2.36. Mode.Parameter.Calibration.CalTemp -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. Mode.Parameter.Calibration.Buffer.1.Value 0...**7.00**...±20.00
Mode.Parameter.Calibration.Buffer.2.Value 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. Mode.Parameter.Calibration.SignalDrift 0.5...**2**...999, OFF
Mode.Parameter.Calibration.EquTime 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 criteria 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. Mode.Parameter.Calibration.ElectrodeId 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. Mode.Parameter.Calibration.SmplChanger ON, **OFF**
Parameters for CAL: Calibration at Titrimo.
With "ON", there are no hold points in the calibration sequence for entries, the first buffer is measured directly.

3.2.2.41. Mode.Parameter.Calibration.ActPulse first, all, **OFF**
Parameters for CAL: Output of a pulse on the I/O line "Activate", see page 163.

3.2.2.42. Mode.Parameter.Sequence.X.Select 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. Mode.Parameter.Sequence.X.Method Method name
Mode.Parameter.Sequence.X.Pause 0...999 999, INF
Mode.Parameter.Sequence.X.L4Output active, inactive, pulse, **OFF**
Mode.Parameter.Sequence.X.L6Output as for L4
Mode.Parameter.Sequence.X.Info 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.	Mode.Parameter.Presel.MeasMode	pH, U, Ipol, Upol, OFF
	Mode.Parameter.Presel.MeasInput	1, 2, diff.
	Mode.Parameter.Presel.Ipol	0...1...±127
	Mode.Parameter.Presel.Upol	0...400...±1270
	Mode.Parameter.Presel.PolElectrTest	ON, OFF
	Mode.Parameter.Presel.Temp	-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. **UserMeth.FreeMem** 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.	UserMeth.Recall	\$G
	UserMeth.Recall.Name	up to 8 ASCII characters
	UserMeth.Store	\$G
	UserMeth.Store.Name	up to 8 ASCII characters
	UserMeth.Delete	\$G
	UserMeth.Delete.Name	up to 8 ASCII characters
	UserMeth.DeIAI	\$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!

.DeIAI: Deletes all methods in the user memory.

3.2.2.47.	UserMeth.List.1.Name	read only
	UserMeth.List.1.Mode	read only
	UserMeth.List.1.Quantity	read only

UserMeth.List.1.Bytes read only
UserMeth.List.1.Checksum 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. Config.PeriphUnit.CharSet1 Epson, Seiko, Citizen, HP, **IBM**
Selection of the character set and the graphics control characters of the Ti-trino.
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. Config.PeriphUnit.Balance **Sartorius**,Mettler,Mettler AT,
AND,Precisa
Config.PeriphUnit.Plot **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. Config.Aux.Language **english**, deutsch, francais, espanol,
italiano, portugese, svenska
Selection of the dialog language.

3.2.2.51. Config.Aux.Set \$G
Config.Aux.Set.Date YYYY-MM-DD
Config.Aux.Set.Time 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. Config.Aux.RunNo **0...9999**
Current sample number.
Set to 0 on power on and initialization. After 9999, counting starts again at 0.

3.2.2.53. Config.Aux.AutoStart **1...9999, OFF**
Number of automatic, internal starts.

3.2.2.54. Config.Aux.StartDelay **0...999 999**
Start delay time in s. During this time, the data of the preceding determination are retained.

3.2.2.55. Config.Aux.DevName 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. Config.Aux.Prog read only
Output of the program version.
The Titrimo sends "794.0010" on requests with \$Q.

3.2.2.57. Config.RSSet \$G
Config.RSSet.Baud 300, 600, 1200, 2400, 4800, **9600**
Config.RSSet.DataBit 7, **8**
Config.RSSet.StopBit 1, 2
Config.RSSet.Parity even, odd, **none**
Config.RSSet.Handsh **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. Config.ComVar.C30
with up to **.C39**, etc. 0... $\pm 999\ 999$
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. SmpIData.Status 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. SmpIData.OFFSilo.Id1 up to 8 ASCII characters
SmpIData.OFFSilo.Id2 up to 8 ASCII characters
SmpIData.OFFSilo.Id3 up to 8 ASCII characters
SmpIData.OFFSilo.ValSmpl 6-digits, sign and decimal point
SmpIData.OFFSilo.UnitSmpl 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.	SmplData.ONSil.Counter.MaxLines	read only
	SmplData.ONSil.Counter.FirstLine	read only
	SmplData.ONSil.Counter.LastLine	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.	SmplData.ONSil.EditLine.1.Method	up to 8 ASCII characters
	SmplData.ONSil.EditLine.1.Id1	up to 8 ASCII characters
	SmplData.ONSil.EditLine.1.Id2	up to 8 ASCII characters
	SmplData.ONSil.EditLine.1.Id3	up to 8 ASCII characters
	SmplData.ONSil.EditLine.1.ValSmpl	6-digits, sign and dec.point
	SmplData.ONSil.EditLine.1.UnitSmpl	up to 5 ASCII characters
	SmplData.ONSil.EditLine.1.C24	read only
	SmplData.ONSil.EditLine.1.C25	read only
	SmplData.ONSil.EditLine.1.Mark	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.	SmplData.ONSil.DelLine	\$G
	SmplData.ONSil.DelLine.LineNum	1...99, OFF

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

3.2.2.64.	SmplData.ONSil.DeIAI	\$G
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Deletes the entire silo memory. Must be triggered with \$G.

3.2.2.65.	SmplData.ONSil.CycleLines	ON, OFF
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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.	SmplData.ONSil.SaveLines	ON, OFF
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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. Info.Report \$G Info.Report.Select

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. Info.CalibrationData \$G

Info.CalibrationData.Inp1.pHas -20.00...**7.00**...+20.00

Info.CalibrationData.Inp1.Slope -9.999...**1.000**...+9.999

Info.CalibrationData.Inp1.Temp -170.0...**25.0**...+500.0

Info.CalibrationData.Inp1.Date read only

Info.CalibrationData.Inp1.ElectrodeId 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. **Info.Checksums** \$G
 Info.Checksums.MPList read only
 Info.Checksums.ActualMethod 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. **Info.DetermData** \$G
 Info.DetermData.Write ON, OFF
 Info.DetermData.MPList.1.Attribute read only/read + write
 Info.DetermData.ExV read only/read + write
 Info.DetermData.MPList.1.X read only/read + write
 Info.DetermData.MPList.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. **Info.TitrResults.RS.1.Value** read only
 etc., up to **.9**
 Info.TitrResults.EP.1.V read only
 Info.TitrResults.EP.1.Meas read only
 etc., up to **.2**
 Info.TitrResults.Var.C40 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 μ A (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 I_{pol}) "41", μ A (with U_{pol}) "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 μ l/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. **Info.TitrResults.FixEP.51.Value** read only
 etc. up to **.59**
Info.TitrResults.pK.61.Value read only
 etc. up to **.69**
Info.TitrResults.TempVar.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. **Info.StatisticsVal.ActN** read only
Info.Statistics.1.Mean read only
Info.Statistics.1.Std read only
Info.Statistics.1.RelStd 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. **Info.SiloCalc.C24.Name** read only
Info.SiloCalc.C24.Value read only
Info.SiloCalc.C24.Unit read only
 for **.C25** as for **.C24**
Info.SiloCalc.C26.ActN read only
Info.SiloCalc.C26.Mean read only
Info.SiloCalc.C26.Std read only
Info.SiloCalc.C26.RelStd 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. Info.ActualInfo.Inputs.Status	read only
Info.ActualInfo.Inputs.Change	read only
Info.ActualInfo.Inputs.Clear	\$G
Info.ActualInfo.Outputs.Status	read only
Info.ActualInfo.Outputs.Change	read only
Info.ActualInfo.Outputs.Clear	\$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:	Outputs:
0 Start (pin 21)	0 Ready (pin 5)
1 Stop (pin 9)	1 Cond. ok (pin 18)
2 Enter (pin 22)	2 Titration (pin 4)
3 Clear (pin 10)	3 EOD (pin 17)
4 Smpl Ready (pin 23)	4 L4 in TIP (pin 3)
5 pin 11	5 Error (pin 16)
6 pin 24	6 Activate, L6 in TIP (pin 1)
7 pin 12	7 Pulse for recorder (pin 2)

3.2.2.76. Info.ActualInfo.Assembly.CyclNo	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. Info.ActualInfo.Assembly.Counter.V	read only
Info.ActualInfo.Assembly.Counter.Clear	\$G

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

3.2.2.78. Info.ActualInfo.Assembly.Meas	read only
--	-----------

\$Q sends the current measured value from the assembly.

3.2.2.79.	Info.ActualInfo.Titrator.CyclNo	read only
	Info.ActualInfo.Titrator.V	read only
	Info.ActualInfo.Titrator.Meas	read only
	Info.ActualInfo.Titrator.dVdt	read only
	Info.ActualInfo.Titrator.dMeasdt	read only
	Info.ActualInfo.Titrator.dMeasdV	read only
	Info.ActualInfo.Titrator.ERC	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, I _{pol} (mV)	-345.6	-345.6	-345.6	-345.6	-
U _{pol} (uA)	-12.5	-12.5	-12.5	-12.5	-
T (°C)	-	-	-	25.0	-
dVdt (ul/s)	-	-	2.5142	-	-
dMeasdt					
pH,U,I _{pol} mV/s	0.7957	0.7957	0.7957	0.7957	0.7957
U _{pol} (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.	Info.ActualInfo.MeasPt.Index	read only
	Info.ActualInfo.MeasPt.X	read only
	Info.ActualInfo.MeasPt.Y	read only
	Info.ActualInfo.EP.Index	read only
	Info.ActualInfo.EP.X	read only
	Info.ActualInfo.EP.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.	Info.ActualInfo.Display.L1	up to 24 ASCII characters
	Info.ActualInfo.Display.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. **Info.Assembly.CycleTime** read only
Info.Assembly.ExV 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. **Assembly.Bur.Rates.Forward.Selected** digital, **analog**
Assembly.Bur.Rates.Forward.Digital 0...150, **max.**
Assembly.Bur.Rates.Reverse.Selected digital, **analog**
Assembly.Bur.Rates.Reverse.Digital 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. **Assembly.Bur.Fill** \$G, \$H, \$C
\$G starts the 'FILL' mode of the buret function.

3.2.2.85. **Assembly.Bur.ModeDis** \$G, \$S, \$H, \$C
Assembly.Bur.ModeDis.Selected **volume**, time
Assembly.Bur.ModeDis.V 0.0001...0.1...9999
Assembly.Bur.ModeDis.Time 0.25...1...86400
Assembly.Bur.ModeDis.VStop 0.0001...9999, **OFF**
Assembly.Bur.ModeDis.AutoFill **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. **Assembly.Meas.Status** **ON**, **OFF**
Assembly.Meas.MeasInput 1, 2, Diff., Ipol, Upol, Temp
Assembly.Meas.Ipol $\pm 127...1...+127$
Assembly.Meas.Upol $\pm 1270...400...+1270$

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. **Assembly.Outputs.AutoEOD** **ON**, **OFF**

Assembly.Outputs.SetLines \$G
Assembly.Outputs.SetLines.L0 active, inactive, pulse, **OFF**
 up to .L 3
Assembly.Outputs.ResetLines \$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. Setup.Keycode 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. Setup.Tree.Short ON, **OFF**

Setup.Tree.ChangedOnly 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. Setup.Trace ON, **OFF**

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

&SmpIData.OFFSilo.Id1"Trace"

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

3.2.2.91. Setup.Lock.Keyboard ON, **OFF**

Setup.Lock.Config ON, **OFF**

Setup.Lock.Parameter ON, **OFF**

Setup.Lock.SmplData ON, **OFF**

Setup.Lock.UserMeth.Recall	ON, OFF
Setup.Lock.UserMeth.Store	ON, OFF
Setup.Lock.UserMeth.Delete	ON, OFF
Setup.Lock.Display	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. Setup.Mode.StartWait	ON, OFF
Setup.Mode.FinWait	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. Setup.SendMeas.SendStatus	ON, OFF
Setup.SendMeas.Interval	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. Setup.SendMeas.Select	Assembly, Titration
--	----------------------------

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. Setup.SendMeas.Assembly.CyclNo	ON, OFF
Setup.SendMeas.Assembly.V	ON, OFF
Setup.SendMeas.Assembly.Meas	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.SendMeas.Titrator.CyclNo	ON, OFF
	Setup.SendMeas.Titrator.V	ON, OFF
	Setup.SendMeas.Titrator.Meas	ON, OFF
	Setup.SendMeas.Titrator.dVdt	ON, OFF
	Setup.SendMeas.Titrator.dMeasdt	ON, OFF
	Setup.SendMeas.Titrator.dMeasdV	ON, OFF
	Setup.SendMeas.Titrator.ERC	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.AutoInfo.Status	ON, OFF
	Setup.AutoInfo.P	ON, OFF
	Setup.AutoInfo.T.R	ON, OFF
	Setup.AutoInfo.T.G	ON, OFF
	Setup.AutoInfo.T.GC	ON, OFF
	Setup.AutoInfo.T.S	ON, OFF
	Setup.AutoInfo.T.B	ON, OFF
	Setup.AutoInfo.T.F	ON, OFF
	Setup.AutoInfo.T.E	ON, OFF
	Setup.AutoInfo.T.H	ON, OFF
	Setup.AutoInfo.T.C	ON, OFF
	Setup.AutoInfo.T.O	ON, OFF
	Setup.AutoInfo.T.N	ON, OFF
	Setup.AutoInfo.T.Re	ON, OFF
	Setup.AutoInfo.T.Si	ON, OFF
	Setup.AutoInfo.T.M	ON, OFF
	Setup.AutoInfo.T.EP	ON, OFF
	Setup.AutoInfo.T.RC	ON, OFF
	Setup.AutoInfo.I	ON, OFF
	Setup.AutoInfo.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. Setup.Graphics.Grid **ON, OFF**
Setup.Graphics.Frame **ON, OFF**
Setup.Graphics.Scale **Full, Auto**
Setup.Graphics.Recorder.Right 0.2...**0.5**...1.00
Setup.Graphics.Recorder.Feed 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. Setup.PowerOn \$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. Setup.Initialise \$G Setup.Initialise.Select 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.Initalize \$G.

3.2.2.101. Setup.RamInit \$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. Setup.InstrNo \$G Setup.InstrNo.Value serial number, 8 ASCII characters

Instrument identification for report output.
 Set the value with &Setup.InstrNo \$G .

3.2.2.103. Diagnose.Report \$G

Output of the report containing the adjustment parameters. The Titrimo 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).

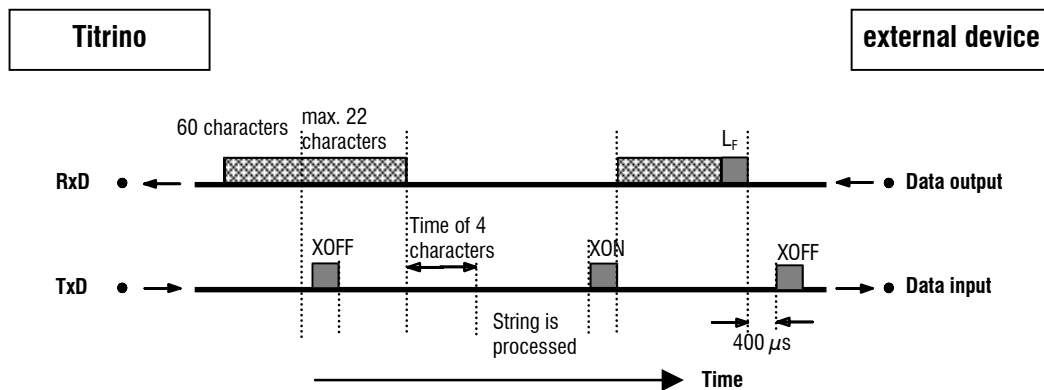
3.3.1 Handshake

Software-Handshake, SWchar

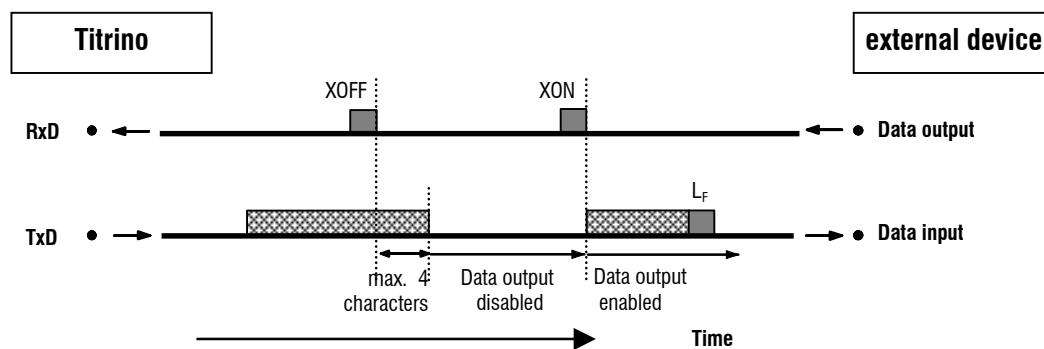
Handshake inputs on the Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the Titrino.

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.

Titrimo as Receiver :



Titrimo as Sender :

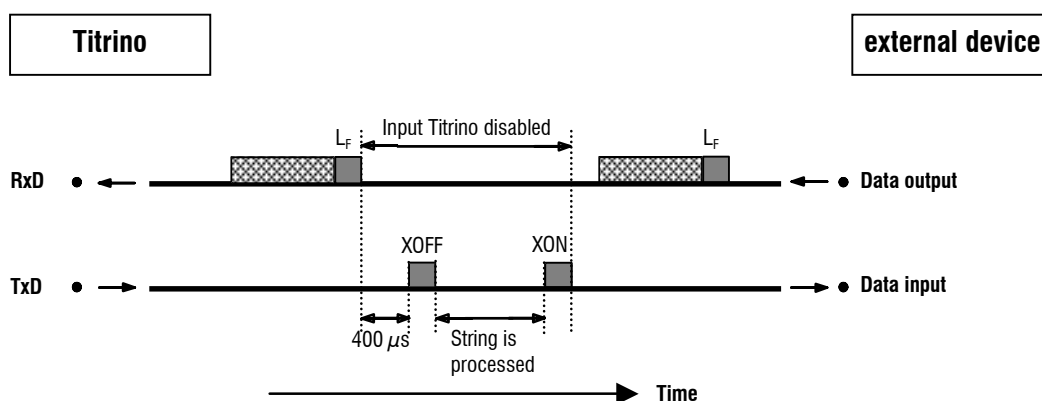


Software-Handshake, SWline

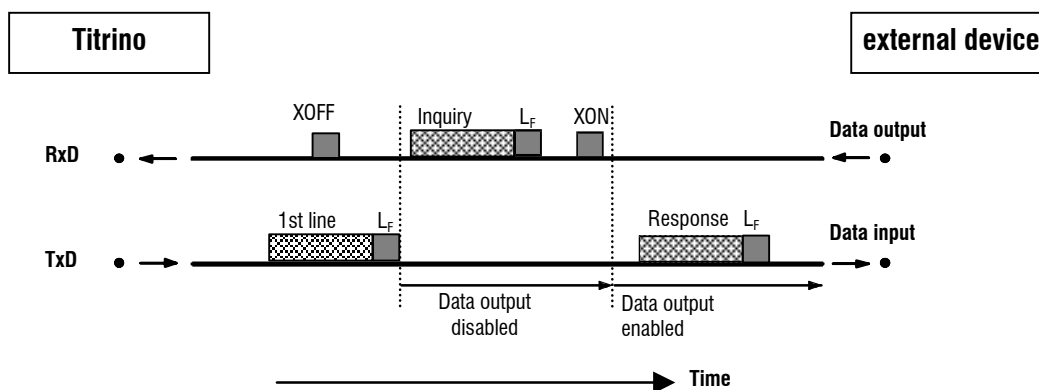
Handshake input ports on the Titrimo (CTS, DSR, DCD) are not checked.
Handshake output ports (DTR, RTS) are set by the Titrimo.

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

Titrimo as Receiver :



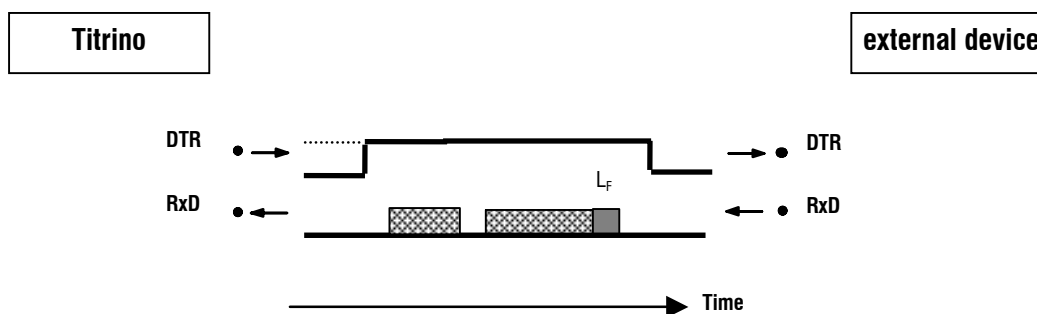
Titrimo as Sender:



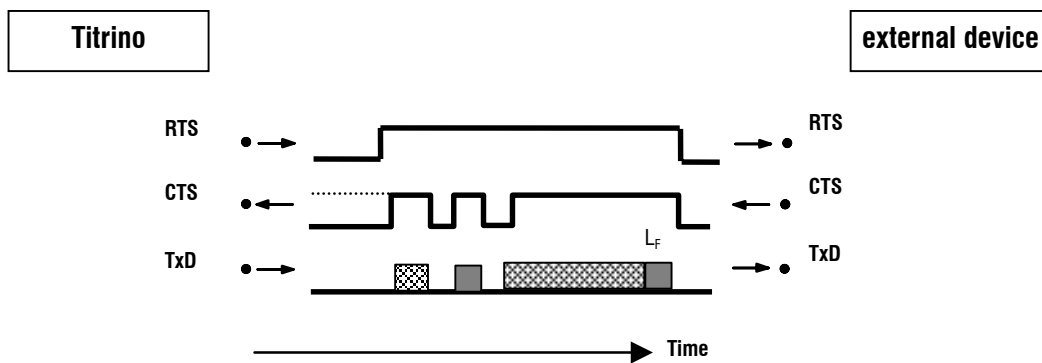
Titrimo transmission can be stopped by external instruments with XOFF. After XOFF is received the Titrimo completes sending the line already started. If data output is disabled for more than 3 s by XOFF, E43 appears in the display.

Hardware-Handshake, HWs

Titrimo as Receiver :



Titrimo as Sender:

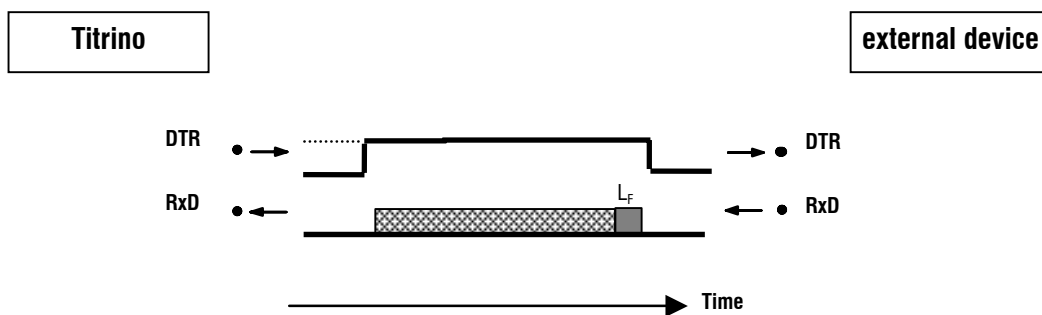


The data flow can be interrupted by deactivating the CTS line.

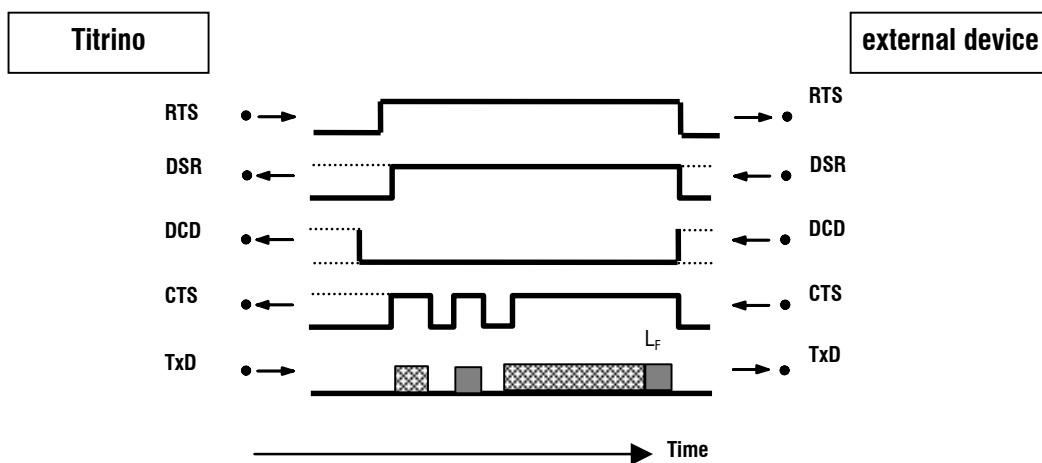
Hardware-Handshake, HWf

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

Titrimo as Receiver :



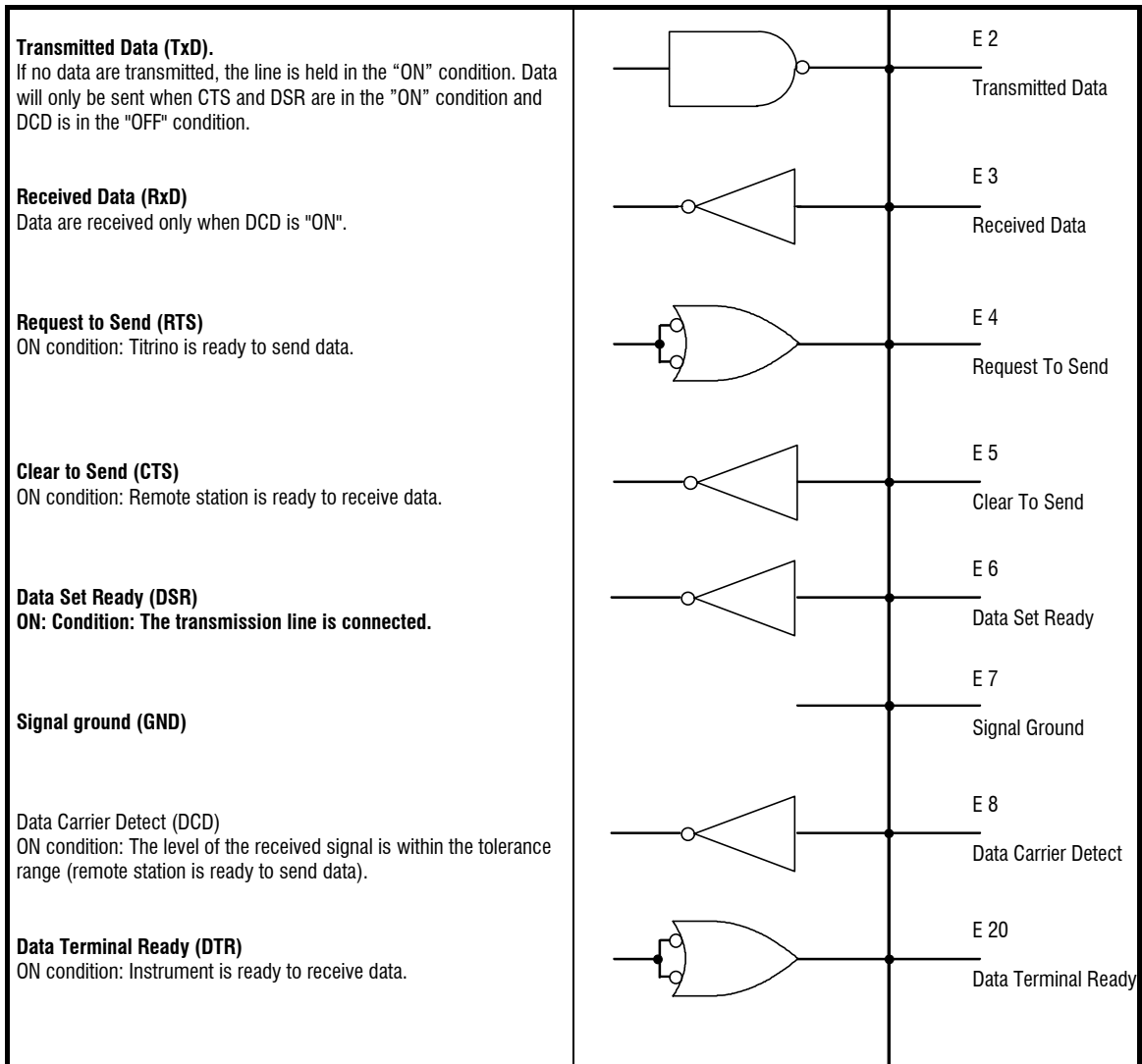
Titrimo as Sender:



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

3.3.2 Pin Assignment

RS232C Interface



Protective earthing

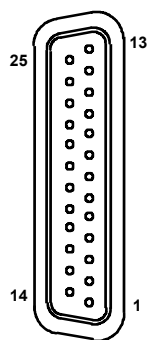
Direct connection from cable plug to the protective ground of the instrument.

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 $\Rightarrow$ plug it in - the electrode is not immersed in the solution $\Rightarrow$ immerse it - the electrode is defective $\Rightarrow$ use new electrode. - the electrode cable is defective $\Rightarrow$ 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:

diagnose press key 0...9

*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:

error XX

↑
error number

- 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 μ S, °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 switches 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 front panel of the 794), the appropriate matrix code appears in the display.

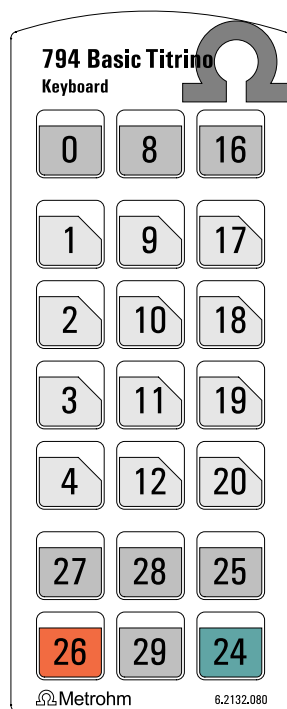


Fig. 1 Keypad 794

- Block 1 is quit by pressing the **<Clear>** key twice.

diagnose press key 0...9

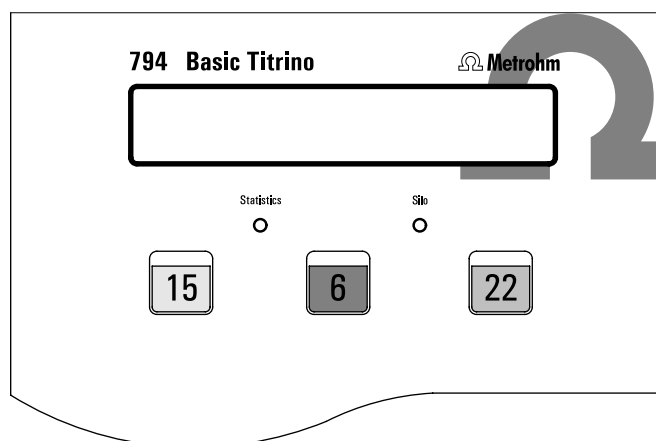


Fig. 2 Front panel 794

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>**.

activated dosing unit

date XX-XX-XX XX:XX:XX
code:D0 XX ml

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 keypad. 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 on 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:

- In a first step, the frequency of the RC oscillator (analogue rate) is tested over a period of 1 second.*
- In a second step, the frequency of the quartz oscillator (digital rate) is tested over a period of 1 second.*
- 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 M Ω) to different values (e.g. +1500 mV) and compare with the displayed value.

Tolerance (with $\pm 1500 \div 2000$ mV) ± 1 mV. Be aware of the calibrator's tolerance.

- Set simulator to high ohmic condition (with 773 = 1000 M Ω).

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 differential voltage between inputs 'Ind I' and 'Ind II' is displayed.

Example: $0 - (+)1500 \text{ mV} = -1500 \text{ mV}$

- 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 k Ω , respectively, to sockets 'Pt 100/1000' by means of short cables.
- Press **<4>**.

Pt 100* XX °C

(* or Pt 1000)

Tolerance: $\pm 0.5 \text{ °C}$ (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 14.3k Ω ?

- Connect resistor switch-box (or suitable resistor 14.3 k Ω 0.1%) using 3.496.5070 cable to 'Pol' socket. Switch-box to 14.3 k Ω .
- 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 Titrimo 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.

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

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.

TxD	2
RxD	3
DCD	8
DTR	20
DSR	6
RTS	4
CTS	5

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.

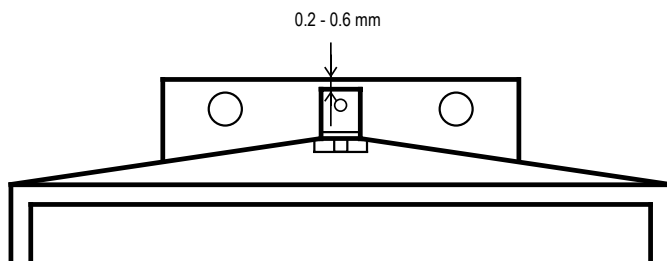


Fig. 5

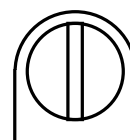


Fig. 6

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

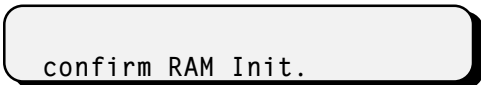
On the odd occasion large disturbing signals (e.g. mains spikes, lightning, etc.) can have an adverse effect on the processor functions and hence lead to a system crash. After such a crash the RAM area must be initialised. Although the basic instrument data remain stored, the RAM initialisation should 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>**.



RAM Init.

- Press **<START>**.



confirm RAM Init.

- Press **<START>**.



RAM Init. activ

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 be removed. In this case, it is necessary to proceed as follows:

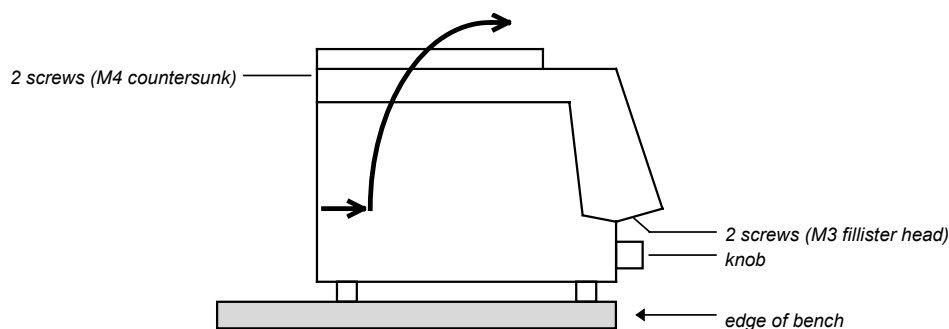


Fig. 7

- 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.)

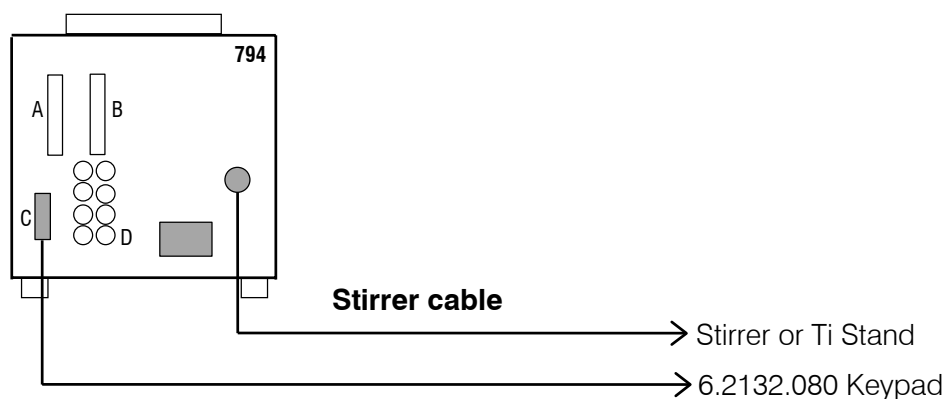
5 Preparations

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

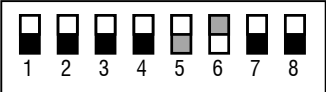


The 802 Rod Stirrer, the 727, or the 703 Ti Stand with 6.2108.100 cable can also be connected instead of the 728 Magnetic Stirrer.

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 plugged 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	ON  SSW1
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	A: A4 paper  B: 
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" receptacle of the adapter.

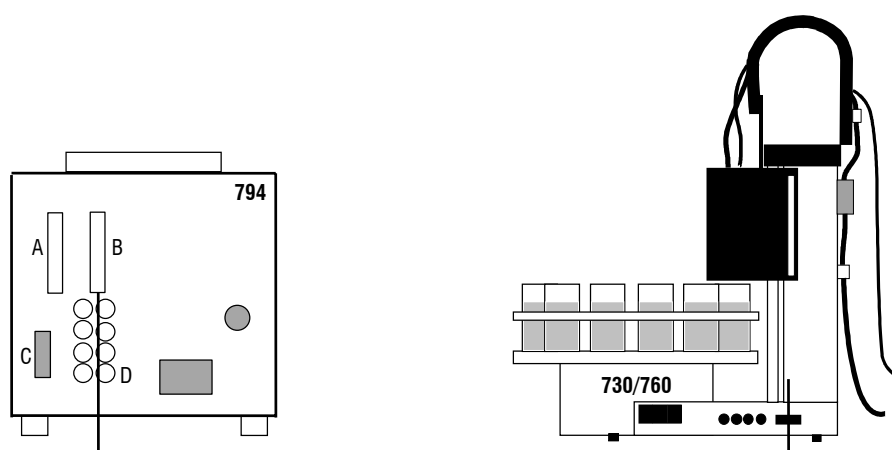
The weight is transferred as a number with up to 6 digits, sign and decimal point. Units and control characters sent by the balance are not transmitted.

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 Titrimo, the balance has to bet to "space parity" and Titrimo/printer to 8 bit, "no parity".

5.1.4 Connection of a Sample Changer



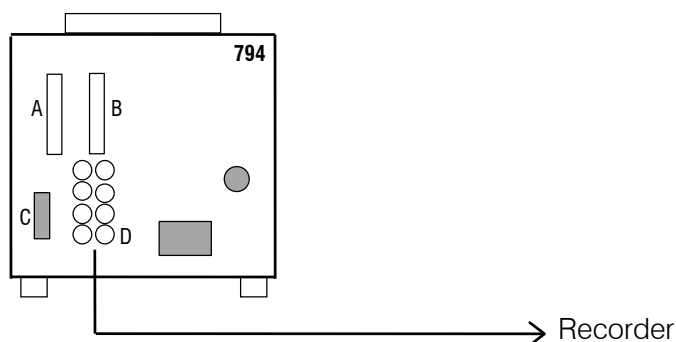
6.2141.020 Cable

With 6.2141.030 cable (instead of 6.2141.020), two Titrimos 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: pH = 7.00: pH = 14.00: U = + 1 mV: U = - 1 mV: I = + 1 μ A: I = - 1 μ A: T = 0 °C: T = + 1 °C: T = - 1 °C:	- 700mV 0 mV + 700 mV + 1 mV - 1 mV + 10 mV - 10 mV 0 mV + 10 mV - 10 mV
dU/dt	Measured value drift	1 mV/min: 1 °C/min: 1 μ A/min:	1 mV 1 mV 10 mV
V	Volume	1 Zylindervolumen:	2000 mV
dV/dt	Volume drift	100 μ L/min:	1000 mV
U(rel)	Control deviation	Δ pH = 1: Δ U = 1 mV: Δ I = 1 μ A:	100 mV 1 mV 10 mV
T	Temperature	Δ T = $\pm$ 1 °C: T = 0 °C:	10 mV 0 mV

5.1.6 Connection of a computer



Preselections on the Titrino:

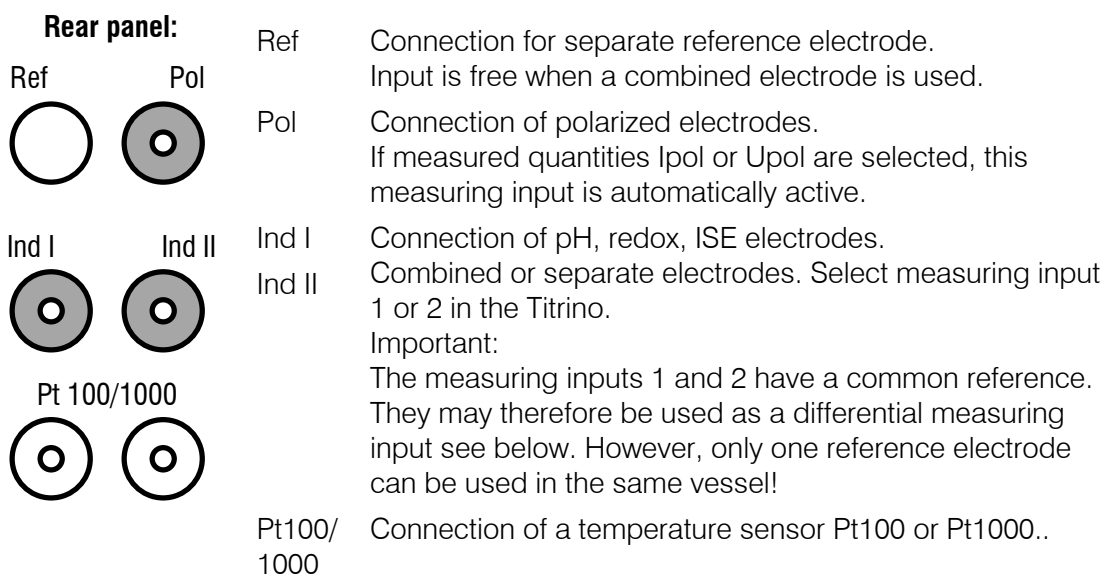
RS232 settings: depend on the control program of the computer

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



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

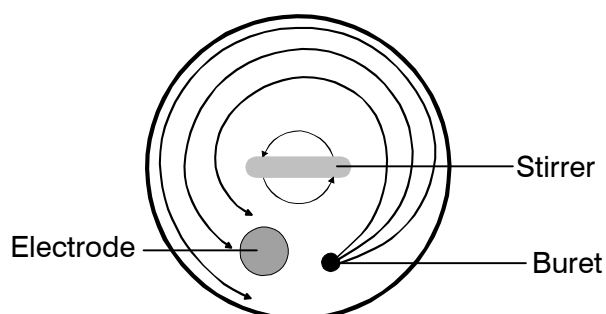
Practical tips

- 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: **M**easurement
 CAL: pH **c**alibration
 TIP: Links commands to **t**itration **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

I_{pol} 0...±127 µA, resolution 1 µA
 U_{pol} 0...±1270 mV, in steps of 10 mV

Measuring amplifier (at 25 °C and Titrino warmed-up)

Input resistance $> 10^{13} \Omega$
 Offset current $< 3 \cdot 10^{-13} \text{ A}$
 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

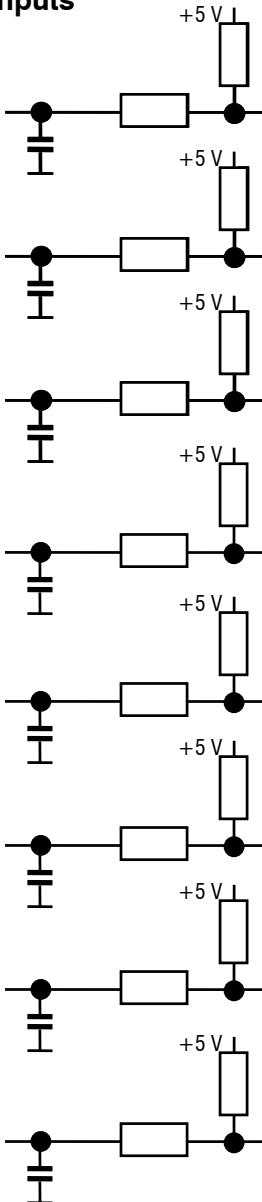
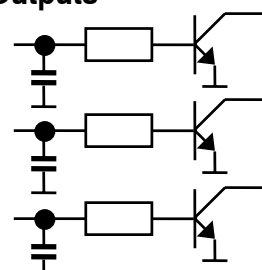
Voltage	100, 117, 220/230, 240 V (switchable)
Frequency	50 ... 60 Hz
Power consumption	15 W
Fuse	Thermal fuse

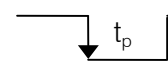
Dimensions with Exchange Unit

Width	150 mm
Height	450 mm
Depth	275 mm

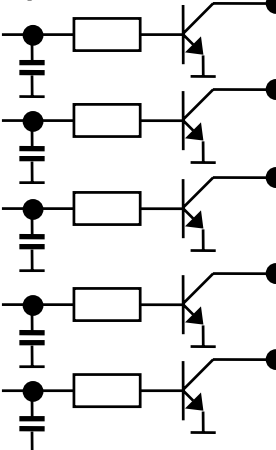
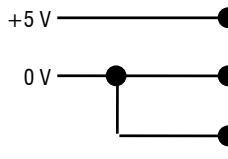
Weight, incl. keypad app. 3.6 kg

6.2 Pin assignment of the "Remote" socket

	external	Function
Inputs 	pin 21 (Input 0)	Start
	pin 9 (Input 1)	Stop
	pin 22 (Input 2)	Enter
	pin 10 (Input 3)	Clear
	pin 23 (Input 4)	Sample ready
	pin 11 (Input 5)	not used
	pin 24 (Input 6)	
	pin 12 (Input 7)	
Outputs 	pin 5 (Output 0)	Ready inactive
	pin 18 (Output 1)	Conditioning ok, active if Cond.ok
	pin 4 (Output 2)	Titration, active during titration


 $t_p > 100 \text{ ms}$
 Functions see page 163

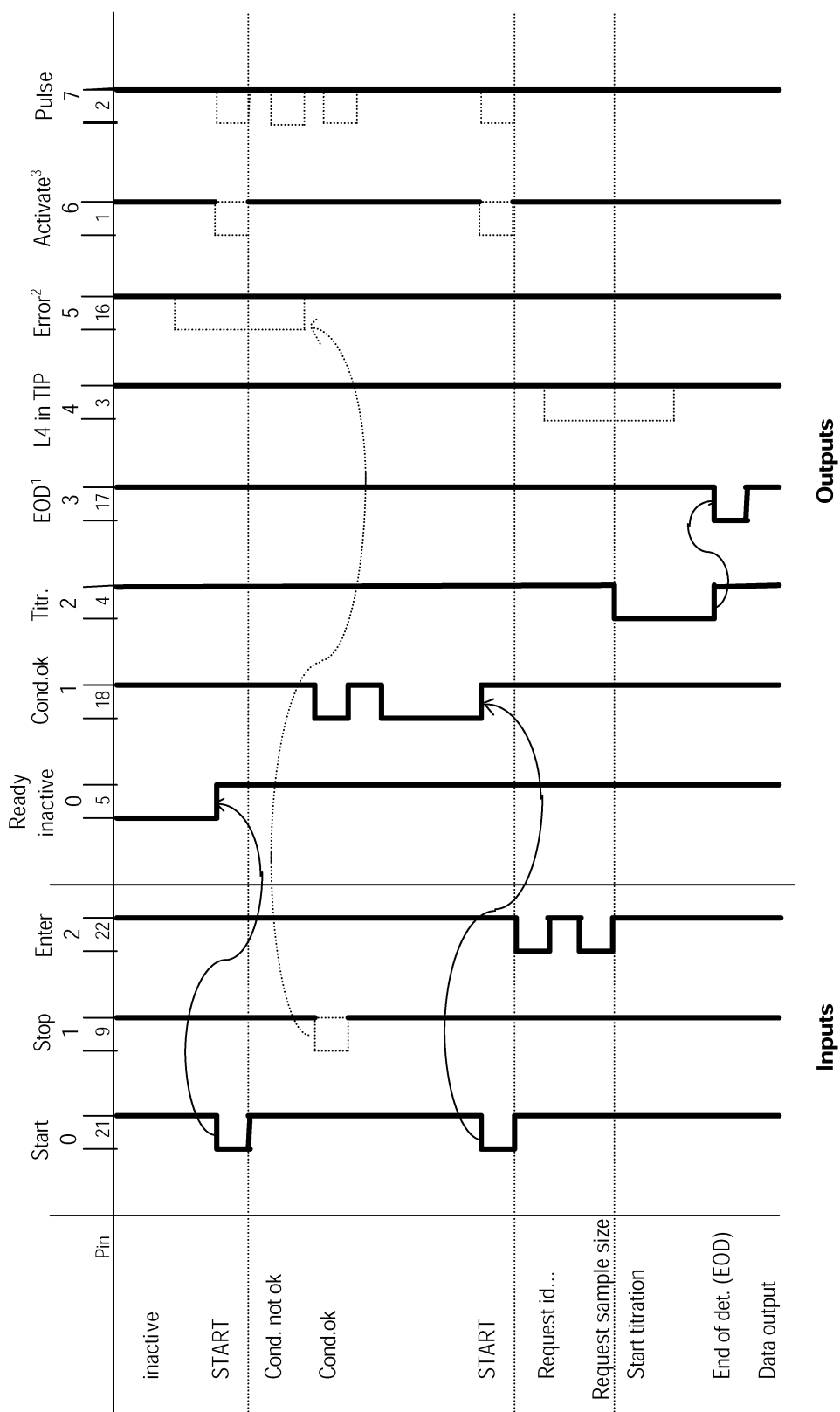
Are not used in titration sequences

Outputs 	pin 17 (Output 3) pin 3 (Output 4) pin 16 (Output 5) pin 1 (Output 6) pin 2 (Output 7)	End of determination EOD L4 in TIP Error, active with errors Activate pulse, see page 163. L6 in TIP Pulses for recorder ($t_p = 150 \mu s$) 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 pin 14 pin 25	$I \leq 75 mA$ 0 V: active 5 V: inactive

Ordering numbers for plug:
K.210.9004 (shell) and K.210.002

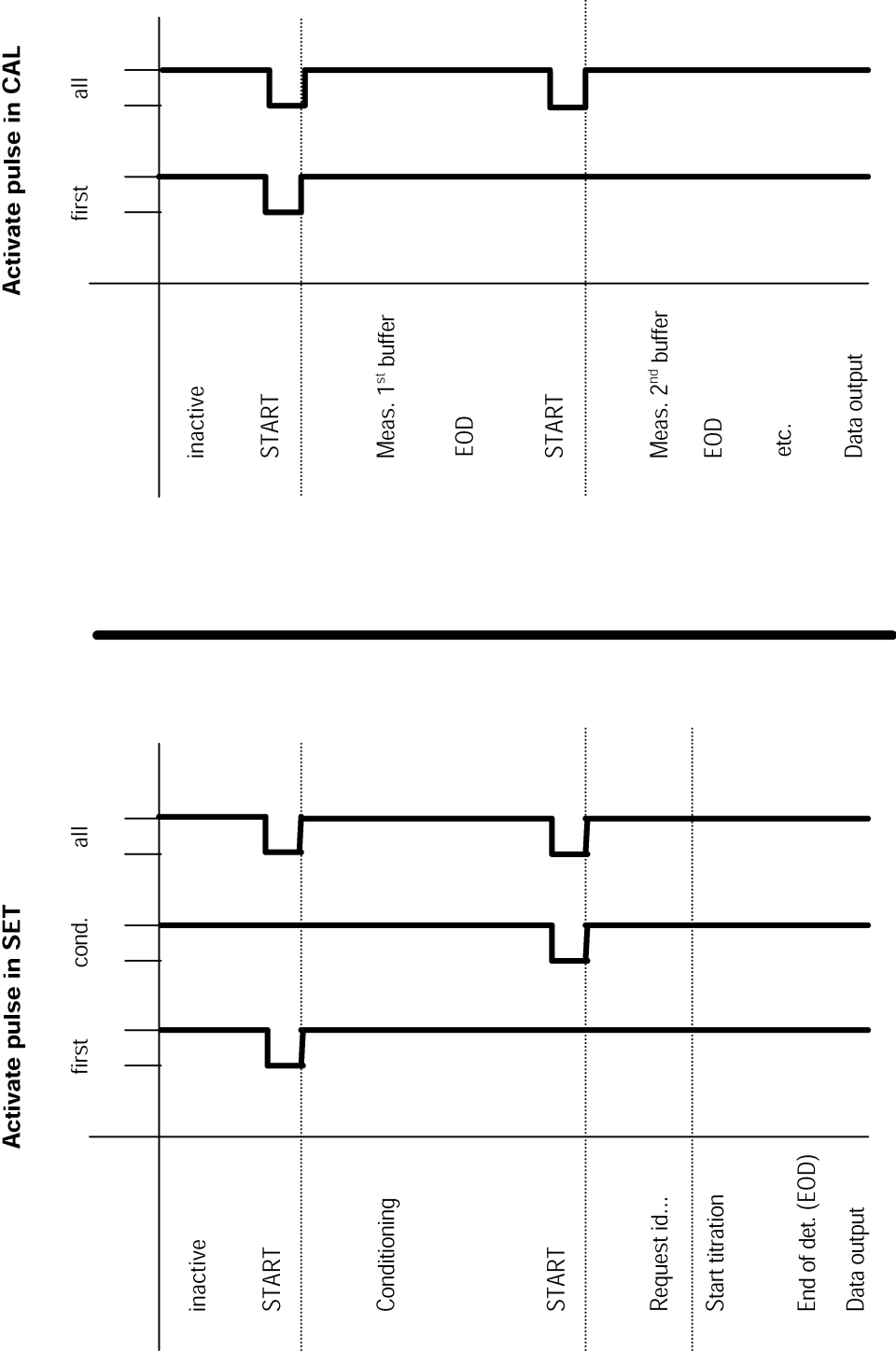
No liability whatsoever will be accepted for damage caused by improper interconnection of instruments.

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	Titrimo	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	Ipo1	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	P205-1	158
DET	pH	P205-2	138
TIP		P205Fert	164
		Freie Bytes	6856

6.3.2 "Titer_pH"

```
'pa
794 Titrimo          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 Titrimo          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 phthalate (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/C01;3;ml
C01=                  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:

$c(\text{AgNO}_3) = 0.01 \text{ mol/L}$ for low Cl^- contents,
e.g. in tap water

$c(\text{AgNO}_3) = 0.1 \text{ mol/L}$ 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 electrolyte 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 electrolyte c(TEA-Br) = 0.4 mol/L in ethylene glycol
TBN 6.0229.100 Solvotrode at measuring input 1 ("Ind I")
6.2312.000 electrolyte 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(HClO₄) = 0.1 mol/L in acetic acid.

TAN solvent: toluene/isopropanol/H₂O 500:495:5

TBN solvent: acetic acid/toluene 1:1

Sample: 0.1 – 10 g sample in 50 – 125 mL solvent.

```
'pa
794 Titrimo          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 Titrimo          01102  794.0010
date 2002-01-03      time 09:42      0
MET U                TAN-TBN
>calculations
TAN-TBN=(EP1-C01)*C02*C03/C00;2;mg/g
C00=                  1.0
C01=                  0
C02=                  0.1
C03=                  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 titrate 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 Titrimo          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 Titrimo          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:

$c(\text{NaNO}_2) = 0.1 \text{ mol/L}$.

Solvent:

$w(\text{HBr}) = 0.3 \text{ (30\%)}$

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 Titrimo           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 Titrimo           01102  794.0010
date 2002-01-03      time 09:44      0
MET Ipol             Br-Index
>calculations
Br-Index=(EP1-C01)*C02*C03/C00;1;mg
C00=                  1.0
C01=                  0
C02=                  0.05
C03=                  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,
 $c(\text{BrO}_3^-/\text{Br}^-) = 0.05 \text{ mol/L}$
 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-trichloroethane,
 134 mL Methanol,
 18 mL $w(\text{H}_2\text{SO}_4) = 0.2$ (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 ($0.05 \cdot \text{titer}$)
- 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 minutes. 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 Titrimo          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 Titrimo          01102  794.0010
date 2002-01-03      time 09:52      0
DET U                Ca-Mg
>calculations
Ca++=EP1*C01*C02/C00;2;mmol/l
Mg++=(EP2-EP1)*C01*C02/C00;2;mmol/l
Total=EP2*C01*C02/C00;2;mmol/l
C00=                  1.0
C01=                  0.05
C02=                  1000
  -----
```

Determination of the hardness of drinking water

Electrode:

6.0504.100 Ca electrode and 6.0726.100 Ag/AgCl reference electrode (outer electrolyte KNO₃ sat.), at measuring input 1.

Titrant:

c(Na₂EDTA) = 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 amino-methane)

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 Titrimo          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 Titrimo          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 electrolyte KNO₃ sat.), at measuring input 1.

Titrant:

c(CuNO₃) = 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(NH₃/NH₄NO₃) = 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

Electrode:

6.0502.140 Cu electrode and 6.0726.100 Ag/AgCl reference electrode (outer electrolyte KNO₃ sat.), at measuring input 1.

Titrant:

EDTA, c = 0.1 mol/L

Buffer pH = 10:

54 g NH₄Cl and 350 mL w(NH₃) = 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

```
'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*C01*C02/C00;2;g/l
C00=                  1.0
C01=                   0.1
C02=                   1
  -----
```

- 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
  -----
```

Determination of the peroxid number of edible oil and fats.

Electrode:

6.0431.100 Pt-Titrode, at measuring input 1.

Titrant:

$c(\text{Na}_2\text{S}_2\text{O}_3) = 0.01 \text{ mol/L}$, to be prepared daily from 0.1 mol/L.

Sample:

Weigh approx. 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.

Additional 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: $c(\text{NaOH}) = 1.0 \text{ mol/L}$.

Reagents: $c(\text{HCl}) = 1.0 \text{ mol/L}$
Sodium oxalate sat.

Sample: Pipette exactly 10 mL liquid fertilizer into the titration vessel. Add 5 mL $c(\text{HCl}) = 1.0 \text{ mol/L}$ 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 started 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 Titrimo           01102  794.0010
date 2002-01-03      time 10:03
DET pH               P205-1
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
  C70=RS1
-----
```

- Excess of dispensed titrant is determined..

- Transfer of the determined excess of titrant to **P205Fert**.

```
'pa
794 Titrimo           01102  794.0010
date 2002-01-03      time 10:04      0
DET pH               P205-2
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
-----
```

P205-2 Titration of dihydrogenphosphate.

```
'de
794 Titrimo           01102  794.0010
date 2002-01-03      time 10:04
DET pH               P205-2
def
>formula
>silo calculations
  match id:           OFF
>common variables
>report
>mean
  MN1=RS1
>temporary variables
  C71=EP1
-----
```

- Transfer of the determined end point as temporary variable to **P205Fert**.

```
'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
  -----
```

P205Fert TIP sequence

- Start **P205-1**
 - Activation of Dosimaten
 - Waiting time
 - Start **P205-2**
-
- 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



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 Titrino2.794.0010

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
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Electrode holder 6.2021.020

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comb. pH micro glass electrode, without cable	6.0234.100
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Cable Titrimo – Seiko DPU-414.....	6.2125.130
Cable Titrimo – EPSON LX300+ (25/25 pins).....	6.2125.050
Cable Titrimo – HP Desk Jet (serial interface) (25/25 pins)	6.2125.050
Cable Titrimo – 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

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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
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