Metrohm METROHM AG CH-9101 Herisau (Switzerland)

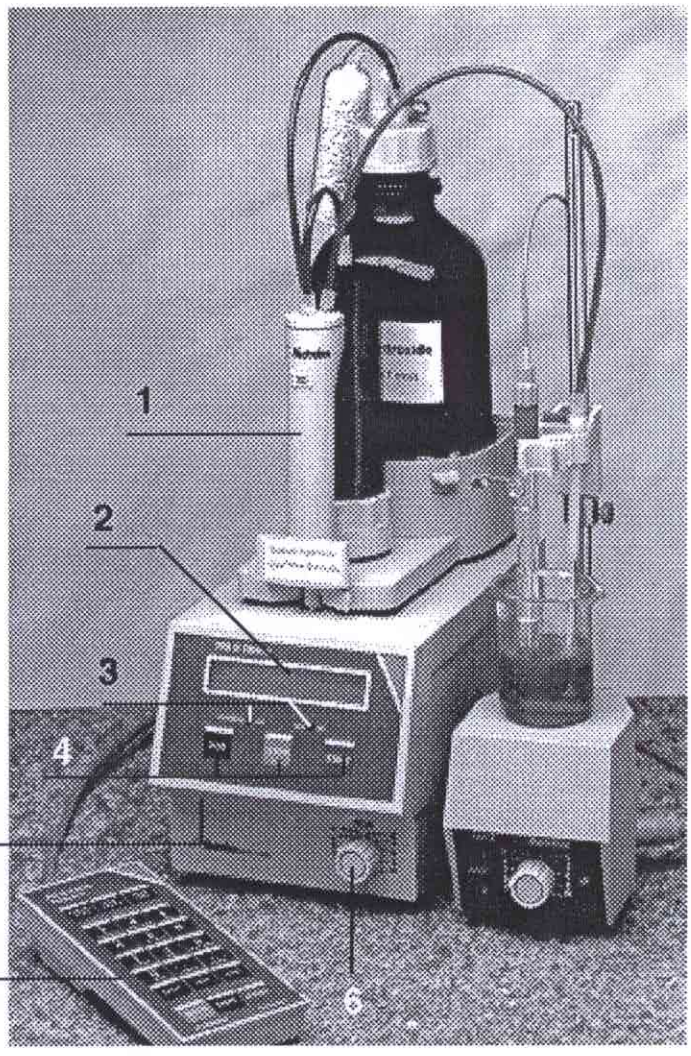
KFS Titrino 720

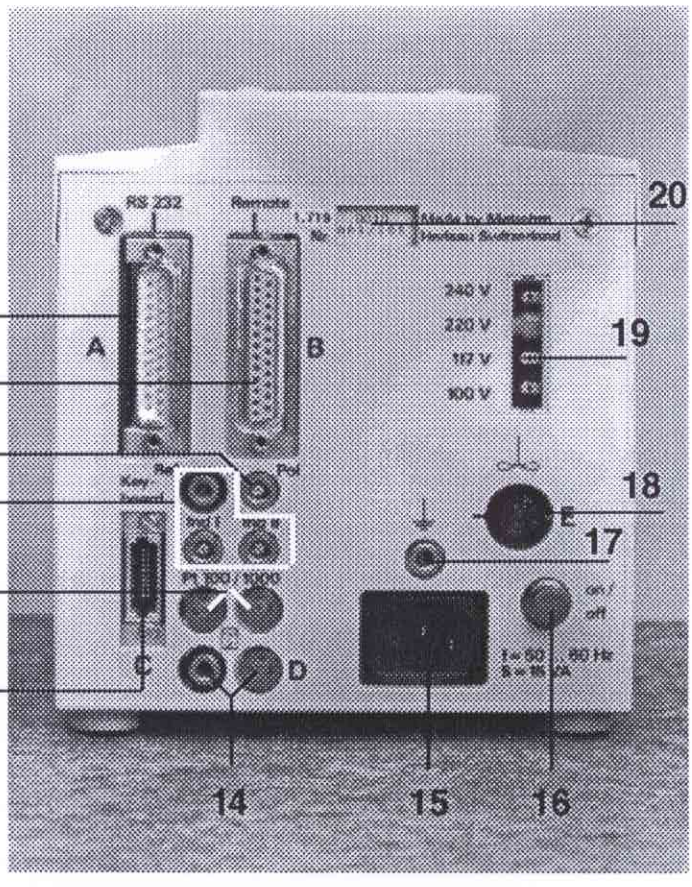
Series 01 ...

Instructions for Use 8.720.1003

94.07 dm

Table of contents


1
2
3
4
5
6
7


RS 232
Remote
240 V
220 V
117 V
100 V
A
B
C
D
E
8
9
10
11
12
13
14
15
16
17
18
19
20

1. Overview

Front view of instrument:

(1) **Exchange Unit**

(2) **Display**

(3) **Indicator lamps**

"statistics on": Lamp is on when the "statistics" function (calculation of mean value and standard deviation) is switched on.

"silo on": Lamp is on when silo memory (for sample data) is switched on.

"cond. on": Lamp is on when the titration cell is dry during conditioning. Lamp flashes when conditioning is being performed but the titration cell is wet.

(4) **Control keys of Titrino**

DOS: Dispensing is performed as long as <DOS> is pressed. Used to prepare the Exchange Unit. The dispensing rate can be set with potentiometer ⑥ .

STOP/FILL: – Stops procedures, e.g. titration, conditioning.
– Fill command after <DOS> to prepare the Exchange Unit.
Identical with the <STOP> key of the separate keypad.

START: Starts procedures, e.g. titration, conditioning.
Identical with the <START> key of the separate keypad.

(5) **Setting of the display contrast**

(6) **Control of the dispensing rate in dispensing with <DOS> and in subsequent filling**

(7) **Separate keypad**

Rear view of instrument:

(8) **RS232 Interface**
for the connection of a printer and balance or a computer

(9) **Remote lines** (input/output)
for the connection of a sample changer, robot, etc.

(10) **Connection for polarized electrodes**
for measured quantities Ipol and Upol

(11) **Connection for potentiometric electrodes**
for measured quantities pH and U (voltage). 2 measuring inputs which can be used either separately or as a single differential potentiometric input for non-aqueous titrations, see also page 134.
Important: If work is performed in the same measuring vessel with both measuring inputs, the same reference electrode must be used.

(12) **Connection for temperature sensor**
Pt100 or Pt1000

(13) **Connection for the separate keypad**

(14) **Analog output**
for the connection of a recorder

(15) **Mains connection**
With mains supplies where the mains voltage is subject to severe HF disturbances, the Titrino should be operated via an additional mains filter, e.g. Metrohm 615 model.

(16) **Mains switch**

(17) **Earthing socket**
The Titrino must be earthed properly and effectively, if need be via the earthing socket.

(18) **Connection for 728 Magnetic Stirrer, 722 Rod Stirrer, 727 or 703 Ti Stand**
Supply voltage: +9 VDC ($I \leq 200$ mA)

(19) **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.

(20) **Rating plate**
with fabrication, series and instrument number

2. Manual operation

2.1 Getting started; a short operating course with examples

Your instruments are already set up. If not, see pages 128 ff.

We can thus make a start and first take a look at the fundamentals for the entry of data. As an example we set the dialog language just for fun to Spanish. How do you like a Spanish dialog?

2.1.1 Entering data, setting the dialog language

<configuration>

Press <STOP> if the Titrino is busy. It is now in the inactive standby state of the instrument. Then press the <configuration> key. The display shows:

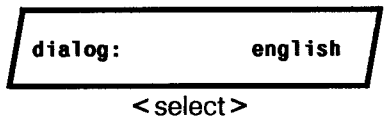
This is the title of the group "peripheral units". This group contains various inquiries about peripheral units.

<configuration>

Press the <configuration> key once more. You see the title of a new group of inquiries:

This is the title of the "auxiliaries" group. This group contains the inquiry for the dialog language. Note the ">" sign. All titles are prefixed by this sign.

<enter>



Pressing the <enter> key takes you to the inquiries of the group "auxiliaries". The display shows

This is the first inquiry of the "auxiliaries" group: the selection of the dialog language. You select the various dialog languages with the <select> key. Note the ":" sign. It appears if the values can be selected with key <select>. Press <select> repeatedly until "español" appears in the display. Accept the new "value" with <enter> and the next inquiry appears.

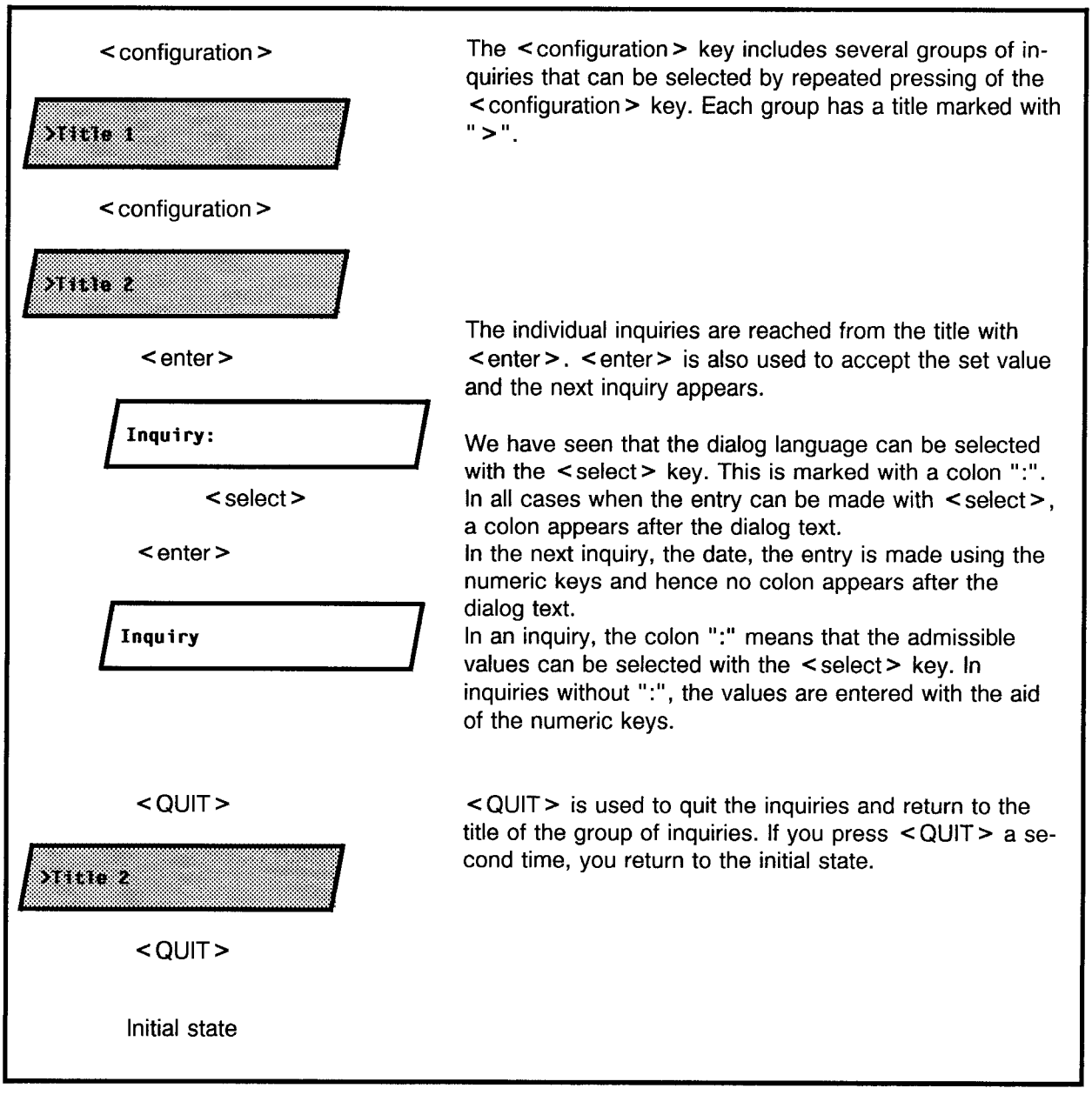
<select>

<enter>

The date in Spanish. Other inquiries of the <auxiliaries> group are not of interest at the moment. Exit the inquiries with <QUIT>. You are again shown the title of the group "ajustes varios" (auxiliaries in Spanish). Press <QUIT> once again to exit the inquiries of the <configuration> key and return to the standby state.
All the dialog texts will now be displayed in Spanish. Do you understand anything? You may want to change the dialog language back to English because this is still easier, isn't it? Proceed as before and select "english".

2 x <QUIT>

Summary

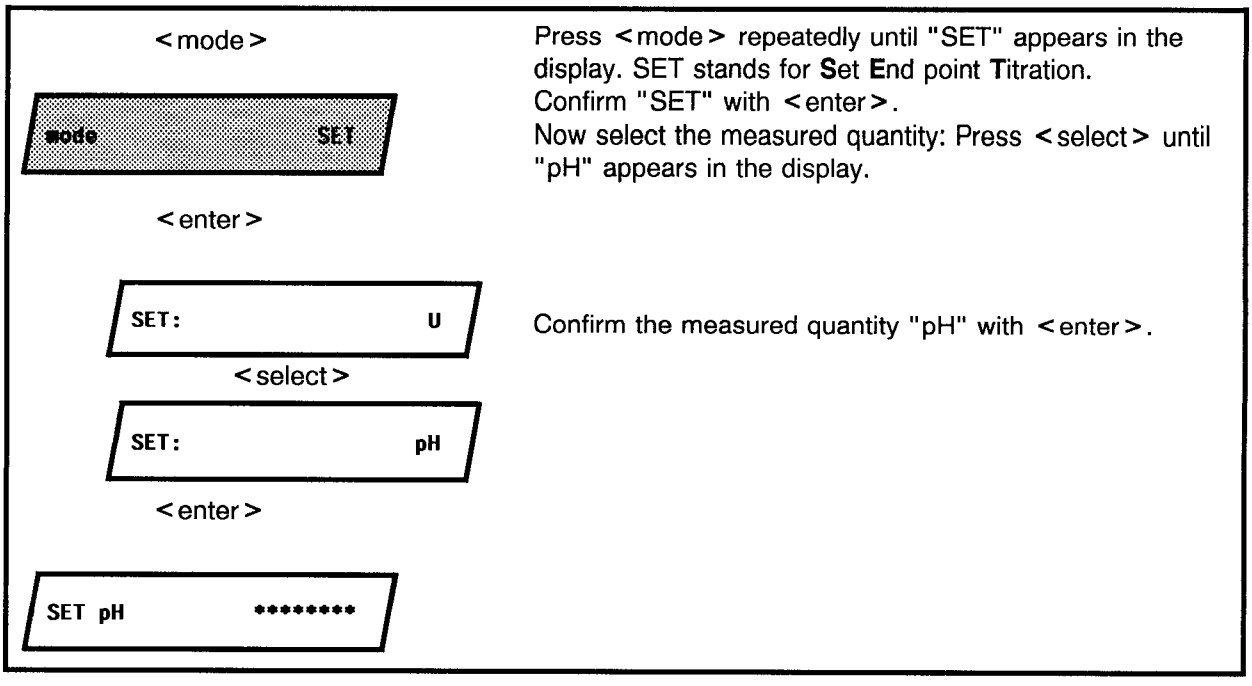


All data entries follow this principle.

Now develop a method and start your first titration.

2.1.2 Method development, titration of an acid

Mode selection

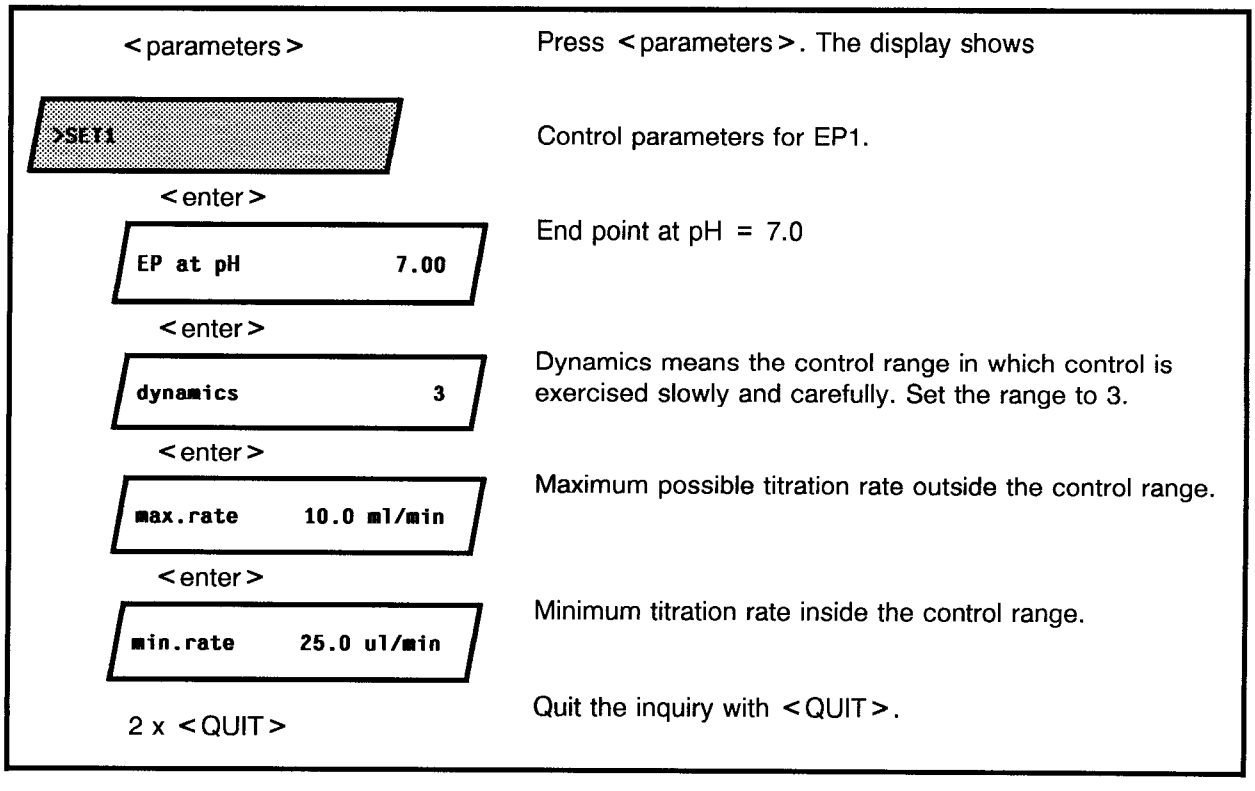


Press <mode> repeatedly until "SET" appears in the display. SET stands for **S**et **E**nd point **T**itration.
Confirm "SET" with <enter>.
Now select the measured quantity: Press <select> until "pH" appears in the display.

Confirm the measured quantity "pH" with <enter>.

Now you can set the endpoint

Setting the End point and control parameters



Press <parameters>. The display shows

Control parameters for EP1.

End point at pH = 7.0

Dynamics means the control range in which control is exercised slowly and carefully. Set the range to 3.

Maximum possible titration rate outside the control range.

Minimum titration rate inside the control range.

Quit the inquiry with <QUIT>.

For the titration you need an Exchange Unit with c(NaOH) = 0.1 mol/L. If you have not yet prepared an Exchange Unit, see page 138 ff.
Plug a combined pH glass electrode into measuring input 1 ("Ind I"). (Setting up the titration vessel, see page 134.)
Pipette 2 mL HCl, c ≈ 0.1 mol/L into your titration vessel, dilute it with ca. 20 mL dist. water, adjust the stirrer and press <START>.
During the titration the first line of the display shows the measured value and dispensed volume. The second line shows a "control bar", which indicates the control deviation of the current measured value from the set end point.

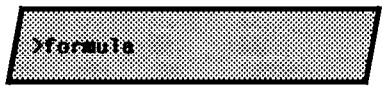
After the titration the end point volume and its pH value is displayed.

With this end point a result can be calculated:

Entry of a formula

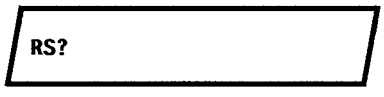
<def>

Press <def>. The display shows



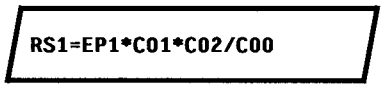
<enter>

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



<1>

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

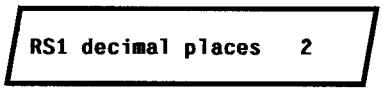


<enter>

You can now 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.
- Mathematical operations and parentheses.

Calculate the content of your hydrochloric acid in g/L:
RS1 = EP1*C01*C02/C00
Confirm the formula with <enter>.
You may enter a text for the result output, see page 20.

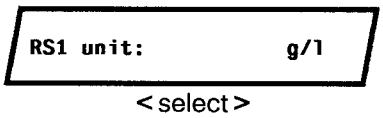
<enter>



Enter the desired number of decimal places for the result

and

<enter>



select the desired unit with <select>

<select>

<enter>

2 x <QUIT>

Quit the formula entry by pressing <QUIT> twice.

Now enter the calculation constants:

Entry of the calculation constants

<C-fmla>	Press <C-fmla>. The constants which have been used in the formula are requested:
C01	C01: Concentration of your titrant, 0.1 mol/L. Enter 0.1.
0.1 <enter>	
C02	C02: Molar mass of HCl: 36.47
36.47 <enter>	

You now need the sample size to perform the calculation:

Entry of the sample size

4 x <smpl data>	Press <smpl data> repeatedly until "smpl size" appears in the display.
smpl size 1 g	
2 <enter>	Enter 2.
smpl unit: ml	Use <select> to select the unit "ml" and confirm the new value with <enter>.
<select>	
<enter>	

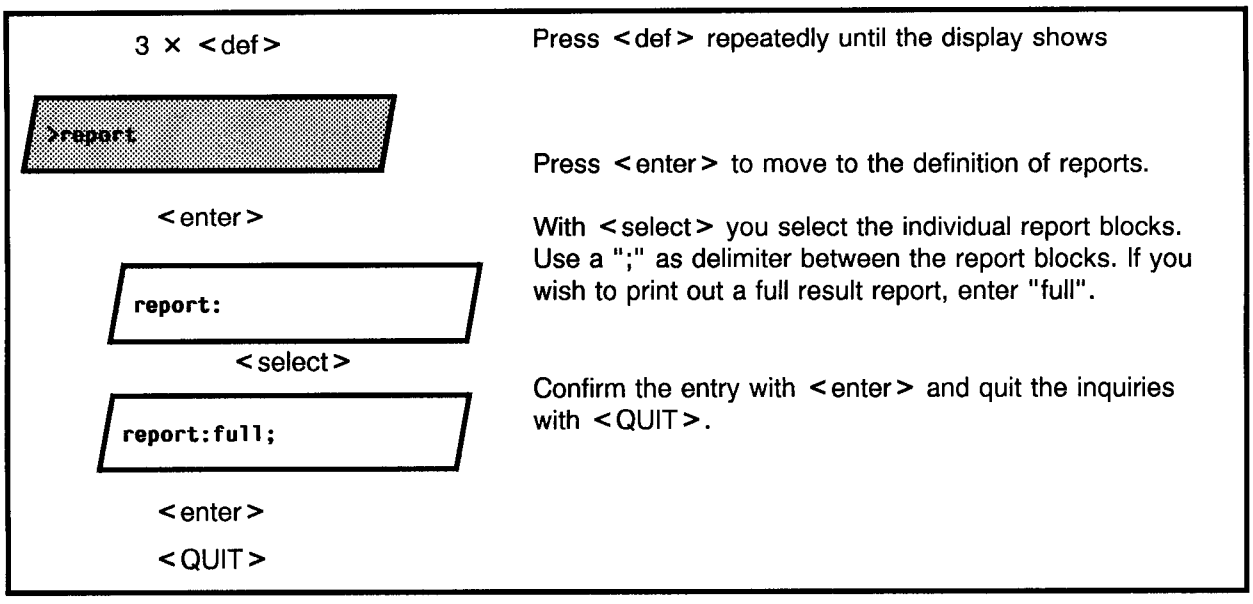
The result is now calculated and can be displayed instead of the end point. If your method already includes a formula, the calculated result is displayed directly after the titration. As we have entered the formula later, we now have to select the result display:

Result Display

<select>	Press <select> repeatedly until ">display results" appears in the display.
>display results	
<enter>	Press <enter> to move on to the result display.
RS1 3.47 g/l	

If you have a printer connected, you probably wish to have a result report printed out automatically at the end of a titration. If you are operating the printer for the first time, see page 129.

Selection of the automatic report



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. If you wish to print out a full result report, enter "full".

Confirm the entry with <enter> and quit the inquiries with <QUIT>.

Press <print> <reports> <enter>. Your printout will look like the following:

```
 'fr
720 KFS Titrino     OP1/103    720.0010
date  1998-04-05    time 09:07:54     1
pH(init)       2.40    SET pH  ********
sample size       2 ml
EP1            2.032 ml               8.14
RS1             3.71 g/l
          ============
```

- Label of report type (fr = full report)
- Instrument type, device number and program version
- Initial pH value, mode and method name
- Sample size
- Volume und pH value of EP1
- Calculated result (ev. with result text)

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

If everything seems to be ok, you can now store the method in the method memory.

2.1.3 Method memory, storage and loading

Store the method you have just developed in the method memory.

Storing a method

<user meth>	Press <user meth> repeatedly until the title ">store method" is displayed.
`>store method`	
<enter>	
`method name: ********`	Enter an identifier, e.g. 1 or Acid. For entering text see page 20.
<enter>	
`SET pH Acid`	The method now runs under the identifier "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>	Press <user meth>. The display shows the title ">recall method".
`>recall method`	
<enter>	
`method name: Acid`	You can select the method with <select>. <select> shows all the methods of your method memory. If you know the identifier of the method you want, you may prefer to enter it directly. You have a completely free hand!
<select> or direct entry	
<enter>	Load the method with <enter>.
`SET pH Acid`	The method is ready to titrate.

2.1.4 pH calibration

For end-point titrations, where titration is performed to a fixed, specified pH value, a calibration should be performed.

Selection of the CAL mode, calibration

<mode>	Press <mode> repeatedly until "CAL" appears in the display and confirm the mode with <enter>.
mode CAL	
<enter>	
CAL ********	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.temp. 25.0 °C	Inquiry of the calibration temperature. Enter the current temperature. If you have a temperature sensor connected, this inquiry is skipped.
<enter>	
buffer 1 pH 7.00	pH value of the first buffer. Enter the pH value of the buffer at your calibration temperature.
<enter>	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 requested.
buffer 2 pH 4.00	
<enter>	Now enter the pH value of the second buffer. If you require a 1-point calibration, you can also terminate the calibration with <STOP>.
or	
<STOP>	
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>

2.1.5 Statistics, acid capacity of drinking water

Let us now determine the acid capacity (m-value) of drinking water. For this, the SET (**S**et **E**nd-point **T**itration) is used to titrate to pH = 4.3.

Load the method "Acid", the one that you just have stored in the method memory. (keys <user meth>,
<select> and <enter>).

Set the end point pH = 4.3 and dynamics 3 as you did with your first example (key <parameters>). If you still feel unfamiliar with that, see page 6 again.

Now alter the calculation formula before the titration (keys <def>, <enter> and <1>).
Delete the existing formula with <clear> and enter the following formula:

RS1 = EP1*C01*C02

As RS1 unit select: mmol/l.

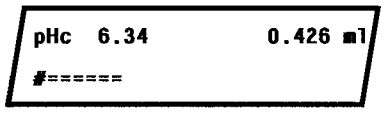
The calculation constants needed (key <C-fmla>:

C01	1	(titrant concentration * 10)
C02	4	(factor for sample size 25 ml)

If you have a printer connected to your Titrino, you can print out the titration parameters right now. Use the keys

<print>, <parameters> and <enter>.

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



If the titration runs too slow or too fast, you can change the control parameters during the titration. If you wish to titrate faster, you can make the following changes:
- dynamics: lower (Warning: titration can overshoot)
- max. rate: greater
- min.rate: greater

You will find further details of the control parameters on page 30.

After the titration, end-point volume and pH value at the end point are displayed and a report is printed out.

If the previous titration has run satisfactory, you can start thinking about performing statistics calculations. Have you already prepared a new sample? If you are uncertain, you can find out easily.

Quick 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 get a printout with statistics calculations:

```
 'fr
720 KFS Titrino      OP1/103    720.0010
date  1998-04-05    time 11:11         9
pHc(init)      6.29      SET pH      Acid
EP1           0.628 ml                4.26
m value        5.02
              mean(2)     +/-s         s/%
m value        5.04     0.028         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 <parameters>	Press <parameters> until the display shows
>statistics	
<enter>	
status: on	Statistics calculations can be switched on either with the <statistics> key or in the inquiry "status:". We shall leave them switched on and proceed to the next inquiry.
<enter>	
mean n= 2	Mean value of 2 single determinations. We wish to append an additional determination and thus enter "3".
3 <enter>	
2 x <QUIT>	Quit the inquiry with <QUIT>.

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 <parameters>

```
>statistics
```

3 x <enter>

```
res.tab:          original
```

<select>

```
res.tab:          delete n
```

<enter>

```
delete              n =  1
```

2 <enter>

2 x <QUIT>

You would like to delete, e.g. the second result. Press <parameters> until the display shows

Press <enter> until the display shows

Press <select> so that "delete n" appears. This means that you wish to delete a single result with index n from the result table. Press <enter>.

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

Quit the inquiry by pressing <QUIT> twice. Mean value and standard deviation are recalculated and can be viewed in the display.

If you have a printer connected, you can print out a new report:
<print> <reports> <enter>.

2.1.6 Karl Fischer titration, common variables

Let's perform a water determination. First we determine the titer of a Karl Fischer solution, then we carry out a sample titration. You will learn to store the titer of a reagent for use in subsequent titrations by occupying common variables.

Set up a complete KF titration cell on a 703 Ti Stand or a 728 Stirrer and mount an exchange unit containing a KF reagent to your Titrino. Do not forget to plug a double platinum electrode in the **"Pol" socket** on the rear of the instrument. The measure input is set automatically when you use a KFT method. To set up all the required components correctly see pages 134ff.

Select the KFT Ipol method named "H2OTiter" with the keys <user meth> and <enter>, as you learned in the previous lesson.

You may check the settings of this method with the <parameters> key. Do not alter the parameters. The methods KFT Ipol and KFT Upol have default settings optimized for most cases of water determinations.

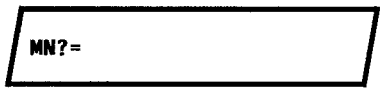
In the section "> statistics" you find the parameter "mean n = 5". For this short operating course you may modify this setting to n = 3. You should be familiar with the statistics function at this time.

4 x <def>

<enter>

Press the <def> key four times followed by <enter>.

Let's see what happens to the results of the three titer determinations.



If the display is now showing "mean MN? = " enter <1>.

<1>

Obviously the result RS1 is assigned to mean MN1.

Now we assign MN1 to a common variable.

<QUIT>

2 x <def>

<enter>

Press <QUIT>, two times <def> and finally <enter>.

In this section the assignments of the common variables are defined.

The ten possible common variables are reserved memory areas where values can be stored permanently for subsequent use. Their contents are kept in memory even when you switch off your Titrino. This is the ideal location to store the titer of your titrants (not only KF titers). You can use up to 10 common variables (C30 ... C39).

<enter>

<9>

Now enter <9>. You see, mean MN1 is assigned to the common variable C39. Mean values can be assigned to common variables, as well as results.

<clear>

<RS>

<1>

...

<enter>

For practicing alter the assignment by deleting the entry with the <clear> key and assign the result RS1 of the titer determination to this particular common variable C39: Enter "RS" (third function of key <4>) and <1>. But then again change the assignment back to **C39 = MN1**.

Do not forget to confirm with <enter>.

2 x <QUIT>

Quit the <def> section and start a titer determination

KF titer determination

Fill the titration cell with 20 ml methanol and press <START>. The solution is now being conditioned to the end point defined in the current method.

Concurrently fill a syringe (equipped with a needle) with distilled water and tare it on a balance.

When the solution is conditioned, the message "drift ok" is displayed and the Lamp "cond." is on. Press <START> again and you are prompted to enter the sample size. Add 4 drops of water by puncturing the septum.

Now weigh the syringe and enter the sample weight in g. Confirm with <enter> or <START>.

Now the Titrino titrates to the end point and displays the calculated titer. Right after the completion of the determination, the solution is reconditioned automatically.

Start the next titration after the conditioning is done.

After each titration the current mean value of the titer and the corresponding standard deviation can be displayed by multiple pressing of the <select> key.

When the third titration has finished press the <configuration> key four times to reach the >common variables section. Pressing the <enter> key repeatedly lets you browse all the common variables C30 ... C39. You will find that the current mean value of the KF titer is stored in C39.

Sample titration

Select the user method "KF" and check the predefined calculation formula (press <def>, <enter> and <1>). You will see that the common variable C39 is used in the calculation, i.e. the result of the latest titer determination is used to calculate the result of the current sample titration.

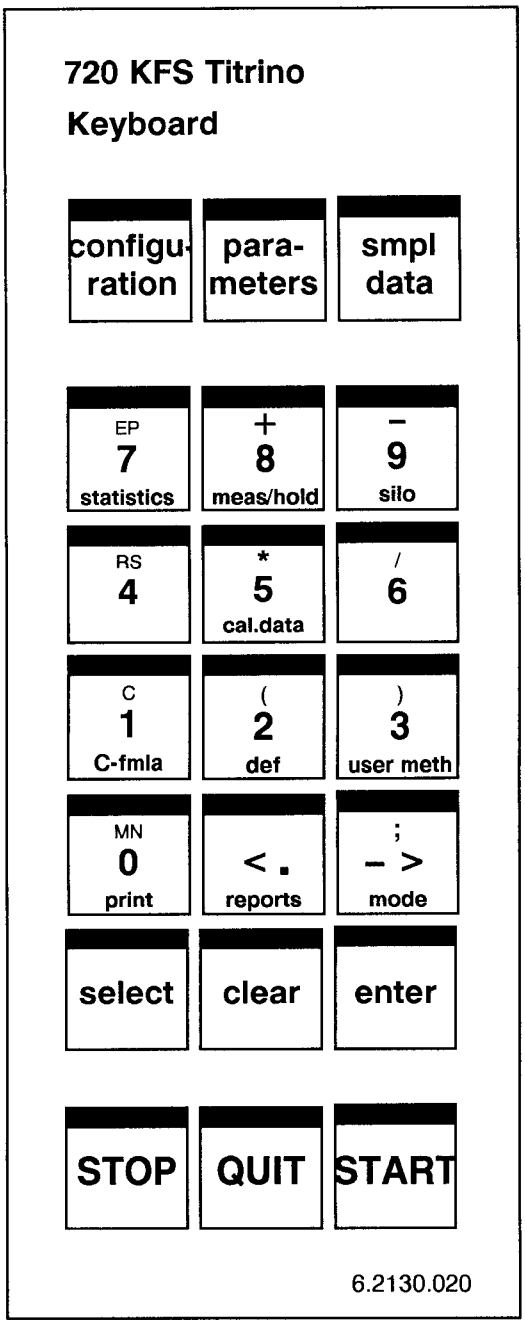
Exchange the used up methanol and perform a water determination of e.g. a wet solvent to prove this correlation. Proceed as you did previously to determine the KF titer.

In the same manner you can store the actual titer of any titrant in a separate common variable to use it automatically in subsequent sample titrations. But there are only 10 common variables available.

Take advantage of this useful function.

2.2 Detailed description

2.2.1 Keypad



The third functions (topmost inscriptions) on the keys of the keypad are used for formula entry.

<configuration>: Configuration

<parameters>: Parameters

<smpl data>: Sample data

<statistics>: On/off switching of statistics calculations (see page 49)

<meas/hold>: On/off switching of
- measurements between titrations
- the hold function during titrations

<silo>: On/off switching of the silo memory for sample data (see page 56 ff)

<cal.data>: Calibration data (see page 54)

<C-fmla>: Calculation constants (see page 48)

<def>: Formulas and information for result output (see page 47 ff)

<user meth>: Method memory (see page 53)

<print>: Printing of reports (see page 52)

<reports>: Result output: <print> + <reports> + <enter>

<mode>: Mode selection (see page 23)

<select>: selecting from a rolling inquiry, marked with a ":"

<clear>:
- clears entries
- sets special values, e.g. "OFF"

<enter>:
- accepts values and advances rolling inquiries
- branches to the individual inquiries of the inquiry groups ">"
- closing of command sequences

<STOP>: Stops methods

<QUIT>: Exit from
- rolling inquiries; leads to the next higher level
- waiting times
- printing

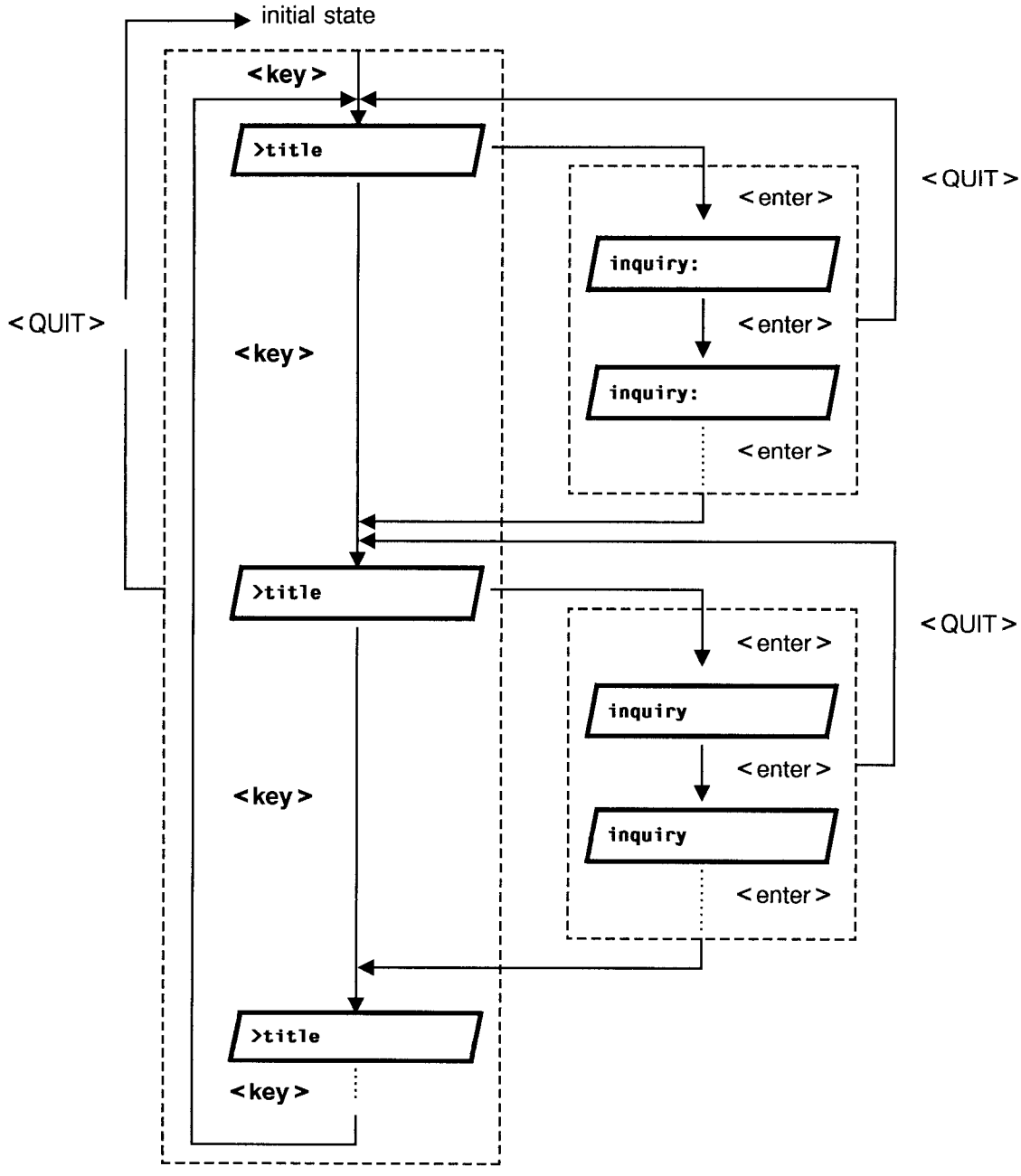
<START>: Starts methods

2.2.2. Keys with rolling inquiries

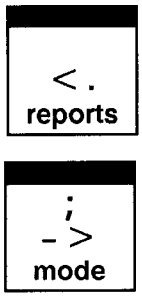
Inquiry keys are organised as rolling inquiries, i.e.

- The inquiries are collected into groups. Repeated pressing of these keys fetches the title of these groups into the display. All titles are marked with the symbol " >" before the dialog text. <enter> is used to branch to the individual inquiries.
- Displayed values of these inquiries are accepted with <enter> and the next inquiry appears.
- Entries can be performed either with the numeric keys or by selecting from preallocated values with the <select> key. All entries in which the <select> key can be used are marked with a colon ":" after the dialog text.
- <QUIT> can be used to exit the inquiries. The next higher level appears, i.e. return to the title of the inquiry group or the initial state.

The organisation of the rolling inquiries is shown schematically below:



2.2.3 Entering text, > and < keys



The > and < keys serve to select characters and write texts.

Writing of texts

1. Press the < key as first key for input of a new text.
2. The blinking postion can be selected. Move the characters with keys > and < until the desired character appears.
3. Confirm the character with <enter>.
4. Select the character for the next position and confirm it with <enter>... etc.
5. If your text is ok and shorter than the whole writing space in the display (8 or 5 characters), press <QUIT> to leave the text input mode, then <enter> to store the text.
   If your text fills up the possible writing space, press just <enter> to store the text.
6. If you made a spelling mistake, you can erase one position backwards pressing <clear>. If you press <clear> repeatedly, one position after the other is cleared.

Correction of stored texts

You can add characters to stored texts or correct them as follows:

1. Press the > key as first key for correction of an old text. The stored text appears, the last position is blinking and can be re-selected.
2. If you wish to correct another position, press <clear> until this position is blinking and can be corrected.

Text can be entered for the following items:

RSX text	In key <def>, >formula: *Result name for display and report (up to 8 characters)*
RSX unit:	*Result unit for display and report (up to 6 characters)* A choice of result units can also be selected with <select>.
method name:	In key <user meth> and in silo memory: *Method name (up to 8 characters)* The method name can be selected with <select>. All the user methods can be selected.
idX or C2X	In key <smpl data> and in silo memory: *Sample identifications (up to 8 characters)*
smpl unit:	*Sample size unit (up to 5 characters)* The unit can also be selected with <select>.
electr.id	In key <parameters>, >calibration parameters in mode CAL: *Electrode identification (up to 8 characters)*
device label	In key <configuration>, >auxiliaries: *Device label (up to 8 characters)*

2.2.4 Configuration, <configuration> key

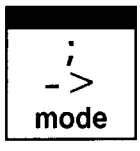
configu-ration	The <configuration> key serves to enter data specific to the instrument. The key is organised as a rolling inquiry. The set values apply to all modes. The values shown in the displays "/_____/" are the default values.

>peripheral units	**Settings for peripheral devices**
send to: IBM	*Selection of the printer type/character set (Epson, Seiko, Citizen, IBM, HP)* "Epson", for Epson mode "Seiko", e.g. for DPU-411 "Citizen", e.g. for iDP 560 RS "IBM" for all printers with IBM character set Table 437 and IBM graphics, as well as for the data transmission to a computer or a data system.
balance : Sartorius	*Selection of the balance type (Sartorius, Mettler, Mettler AT, AND, Precisa)* Sartorius: Models MP8, MC1 Mettler: Models AM, PM and balances with 011, 012, and 016 interfaces Mettler AT: Model AT AND: Models ER-60, 120, 180, 182, FR-200, 300 and FX-200, 300, 320 Precisa: Models with RS232C interface
record: U	*Selection of the curve for the output at the analog output (U, dU/dt, V, dV/dt, U(rel), T)* U: Voltage dU/dt: Measured value drift V: Volume dV/dt: Volume drift U(rel): Control deviation with SET
>auxiliaries	**Various settings**
dialog: english	*Selection of the dialog language (english, deutsch, francais, español, portuguese, italiano, svenska)*
date 1998-04-05	*Current date (YYYY-MM-DD)* Format: Year-month-day, entry with leading zeros.

time 08:13	*Current time (HH-MM)* Format: Hours-minutes, entry with leading zeros.
run number 1	*Current sample number (0...9999)* The sample number is set to 0 when the instrument is switched on. Each titration start increments the sample number by one digit.
auto start OFF	*Automatic, internal instrument start (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 the 664 Control Unit and Sample Changer.
start delay 0 s	*Start delay (0...999 999 s)* Delay time after the start before the method starts. The delay time can be aborted with <QUIT>.
device label	*Device label for the individual identification of devices in the instrument network (up to 8 characters)*
program 720.0010	*Display of program version*
>RS232 settings	**Settings for the RS232 interface** see also page 107 - Characteristics of the RS232 interface
baud rate: 9600	*Baud rate (300, 600, 1200, 2400, 4800, 9600)*
data bit: 8	*Data bit (7, 8)*
stop bit: 1	*Stop bit (1, 2)*
parity: none	*Parity (even, odd, none)*

handshake: HWs	*Handshake (HWs, HWf, SWline, SWchar, none)* see pages 107ff
RS control: ON	*Control via RS232 interface (OFF, ON)* "OFF" means that the receipt of commands via the RS232 interface is blocked. Data output is possible.
>common variables	**Values of the common variables**
C30	*Common variable C30...C39 (0... ±999 999)* The values of all common variables are displayed.
etc.	

2.2.5 Mode selection, <mode> key



The <mode> key is pressed repeatedly until the desired mode is displayed. It is accepted with <enter>.

The measured quantity pH, U, Ipol, Upol, (T) is selected with <select> and also confirmed with <enter>.

The following modes can be selected:
- SET, **S**et **E**nd point **T**itration
- CAL, pH **CAL**ibration
- MEAS, **MEAS**uring

All modes are loaded with a set of default parameters and are thus ready for immediate use. (With SET an end point has to be set.)

2.2.6 Parameters, <parameters> key

para- meters	The <parameters> key is used for the entry of values that determine the titration. The key is organised as a rolling inquiry. Values marked with "cond." are accessible during the conditioning in the SET mode, and "**titr." means that these values can be changed during the titration. They then influence the ongoing determination. The values shown in the display "▭" are the default values.

2.2.6.2 Parameters for SET

>SET1	**Control parameters for the first end point, EP1**
EP at pH OFF ** titr.	*First end point, EP1 (input range depends on the measured quantity:* *pH: 0... ± 20.00, OFF* *U, Ipol: 0... ± 2000 mV, OFF* *Upol: 0... ± 200.0 µA, OFF)* <clear> sets "OFF". If EP1 is "OFF", no further inquiries under SET1 appear.
dynamics OFF ** titr.	*Dynamics (control range, input range depends on the measured quantity:* *pH: 0.01...20.00, OFF* *U, Ipol: 1...2000 mV, OFF* *Upol: 0.1...200.0 µA, OFF)* <clear> sets "OFF". "OFF" means largest control range, i.e. low titration. Outside the control range, dispensing is performed continuously, see also page 30.
max.rate 10 ml/min ** titr.	*Maximum titration rate (0.01...150 mL/min, max.)* <clear> sets "max.". This parameter determines primarily the addition rate outside the control range, see also page 30. The maximum rate depends on the Exchange Unit: Exchange Unit — max. 5 mL — 15 mL/min 10 mL — 30 mL/min 20 mL — 60 mL/min 50 mL — 150 mL/min

min.rate 25.0 ul/min

** titr.

Minimum possible titration rate (0.01...999.9 µL/min)
This parameter determines the addition rate right at the start and the end of the titration, see also page 30.
This parameter influences the titration speed and therefore its accuracy very strongly: A smaller min.rate results in a slower titration.

---

stop crit: drift

** titr.

Type of stop criterion (drift, time)

stop drift 20 µl/min

** titr.

Switch off titration when end point and stop drift are reached (1...999 µL/min)

t(delay) 10 s

** titr.

Switch-off delay time (0...999 s, INF)
<clear> sets "INF"
Switch off when the end point is reached and the set time after the last dispensing has elapsed.
If "INF" is set, an inquiry regarding the stop time appears.

stop time OFF s

** titr.

Stop time (0...999 999 s, OFF)
<clear> sets "OFF".
Stop after expiry of the set time after the start of the titration. "OFF" means no stop, i.e. titration for an "infinitely" long time.

>SET2

Control parameters for the second end point, EP2
They are identical to those under SET1.

>titration parameters

Titration parameters
Apply globally for the entire titration.

---

titr.direction: auto

Titration direction (+ , –, auto)
auto: The direction is defined automatically by the Titrino (sign [U_{first} – EP]).
+: In the direction of higher pH, higher voltage (more "positive"), larger currents.
–: In the 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.

---

pause 1 0 s

** titr.

Pause 1 (0...999 999 s)
Waiting time, e.g. for equilibration of the electrode after the start. The equilibration time can be aborted with <QUIT>, see page 29.

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

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

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

**titr.

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

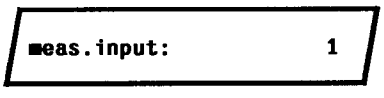
Exchange Unit	max.
5 mL	15 mL/min
10 mL	30 mL/min
20 mL	60 mL/min
50 mL	150 mL/min

** titr.

Pause 2 (0...999 999 s)
Waiting time, e.g. reaction time after the dispensing of a start volume. The waiting time can be aborted with <QUIT>, see page 29.

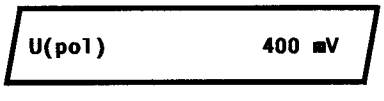
** titr.

Extraction time (0...999 999 s)
During extraction time no dispensing occurs but the titration does not stop.The extraction time can be aborted with <QUIT>, see page 29.



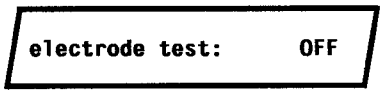
or

or



Measuring input (1, 2, diff.)
Inquiry only with measured quantities pH and U. Measuring input 1 or 2 or differential amplifier; connection of electrodes, see page 136.

With polarized electrodes, instead of the measuring input the
polarisation current (-127...127 µA)
or the
polarisation potential (-1270...1270 mV, in steps of 10 mV) is inquired.



Electrode test (OFF, ON)
Test for polarized electrodes. Performed on changeover from the inactive standby state to a measurement. "OFF" means that the test is not performed.

temperature 25.0 °C

Titration temperature (-170.0...500.0°C).
The temperaturte is measured at the the start of the titration if a T sensor is connected. This parameter is used for temperature compensation in pH titrations.

>stop conditions

Conditions for titration termination
If this is not "normal", i.e. after attainment of the end point.

stop V: abs.

**titr.

Type of stop volume volume (abs., rel., OFF)
"abs.": absolute stop volume in mL.
"rel.": stop volume relative to sample size.
"OFF": stop volume switched off. Stop volume is not monitored.
The stop volume is applied for one single titration. The conditioning volume is not monitored.
If "abs." is set:
Absolute stop volume (0...9999.99 mL)

stop V 99.99 ml

**titr.

If "rel." is set:
Factor for the calculation of the relative stop volume (0... ± 999 999)
Calculated as:
Stop V in mL = factor * sample size

factor 999 999

**titr.

filling rate max. ml/min

**titr.

Filling rate after the titration (0.01...150 mL/min, max.)
<clear> sets "max.".
The maximum rate depends on the Exchange Unit:

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

>statistics

Statistics calculations
Mean value, absolute and relative standard deviation, see also page 49.

status: OFF

*cond.

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

mean n= 2

*cond.

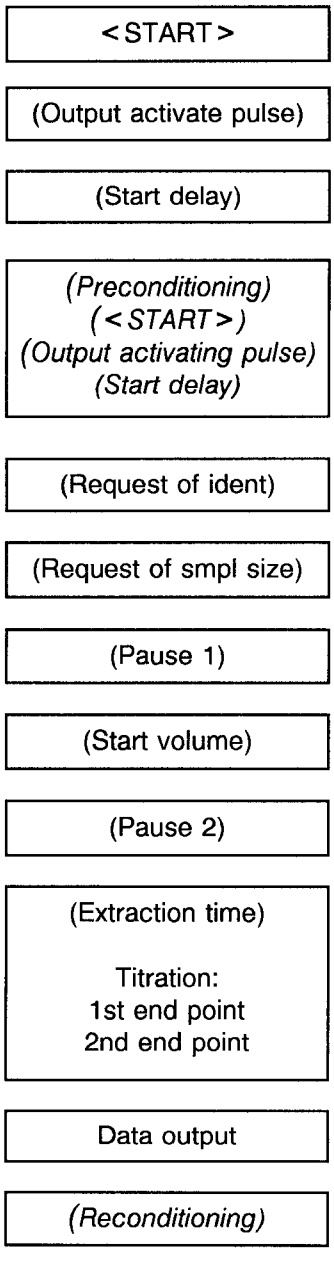
Mean value calculation from n single results (2...20)

`res.tab: original` *cond.	*Result table for the statistics (original, delete n, delete all)* "original": The original table is used. Deleted 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` *cond.	*Index n of the result to be deleted (1...20)* The deleted result is incorporated in the statistics calculation.
`>preselections`	**Preselections for the titration sequence**
`conditioning: OFF`	*Conditioning (ON, OFF)* If conditioning is "on", between the titrations the titration solution is constantly maintained at the (1st) end point. When conditioning is performed, the volume drift can be displayed during the conditioning:
`display drift: ON` *cond.	*Drift display (ON, OFF).* Volume drift.
`drift corr: OFF` *cond.	*Drift correction (auto, man., OFF)* Type of drift correction: (EP – drift * time) auto: drift value at start is valid man.: see below OFF : no correction
`drift value 0.0 µl/min` *cond.	If "man." is set: *Drift value (0.0...99.9 µl/min)*
`req. ident: OFF`	*Inquiry of sample identifications after the start of the titration (id1, id1 & id2, all, OFF)* After the start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries.
`req. smpl size: OFF`	*Inquiry of sample size after the start of the titration (value, unit, all, OFF)*
`activate pulse: OFF`	*Output pulse on the control line "activate" of the remote socket (first, all, cond., OFF)* see pages 153f.

Titration sequence of SET

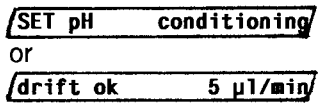
The titration sequence may be configured to match your particular application. The following parameters determine the titration sequence (see diagram below):

- Start delay
- Conditioning (on, off)
- Request of the sample identifications and the sample size after the start of titration
- Pause 1
- Start volume
- Pause 2
- Extraction time



Right after start, the activate pulse is transmitted eventually (possibilities to activate pulse, see page 154) and the start delay time is processed (see page 22).

If *conditioning* is switched on, then titrant is dispensed to the sample solution to reach the (1st) end point. When conditioning is completed, the display shows, e.g.



if the drift display is switched on. In the latter case, the current volume drift is also displayed continuously during conditioning.

The instrument is then ready for titration. It can be run by <START>.

After the start of the titration, the activate pulse is transmitted eventually and the start delay time is processed.

Then (if these options are switched on) the temperature is measured (if a T sensor is connected), identifications and "sample size" are requested.
If these requests are switched off, "add sample" is displayed and the titration sequence is halted for 6 seconds (the sequence can also be interrupted by <hold>). During this pause the sample may be added. Otherwise the sample addition can be done during sample ID or sample size request.

After the count down of pause 1, the start volume is dispensed and then pause 2 is processed. During dispensing of the start volume, no control is exerted. Then the titration is performed to the (1st) end point, then eventually to the second end point.
The titration will not be terminated before the extraction time has been waited out.

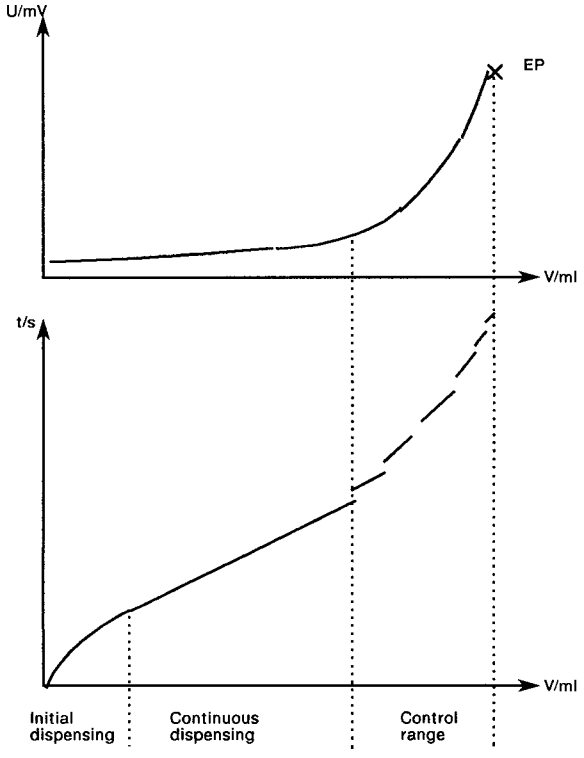
At the end of the titration, the data are displayed and, if you have a printer connected, a specified report ist printed out (see also page 51).

After the end of the titration, conditioning is again performed (if conditioning is switched on).

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 dispensing occurs in 3 phases:



1) Initial dispensing:
During this phase, the dispensing rate increases constantly. It starts at the set "min.rate" and continues up to the allowed "max.rate".

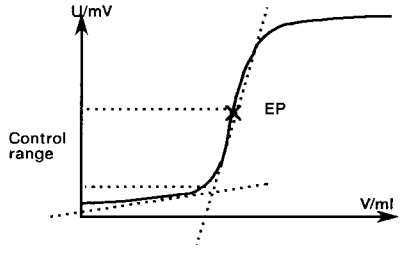
2) Continuous dispensing:
Dispensing is performed at the maximum rate "max.rate" until the control range (dynamics) is reached.

3) Dynamics (control range)
In this range, dispensing is performed in single steps. The last dispensing steps are controlled by the "min.rate" parameter.

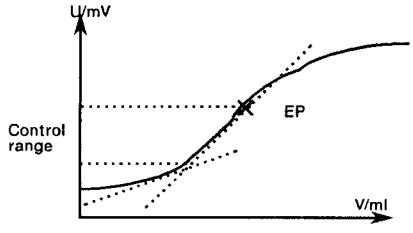
Trial settings for the size of the control range

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:

"steep" curves



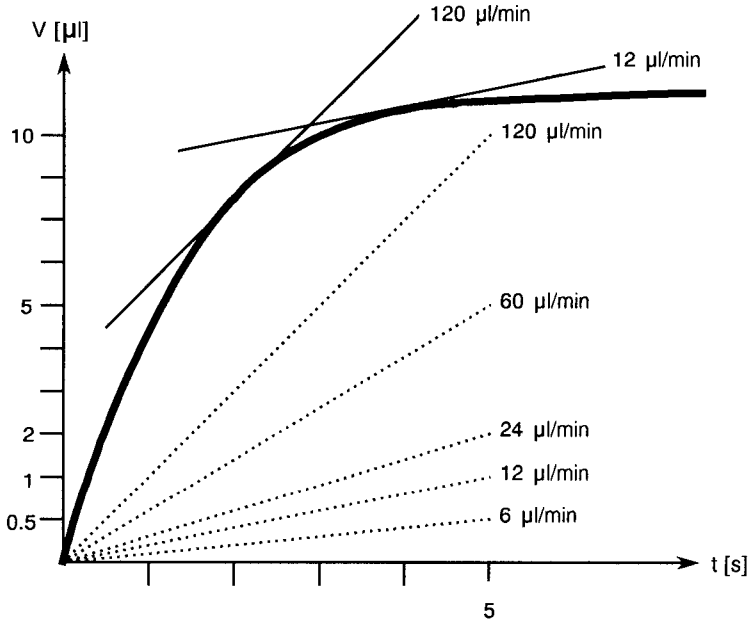
"flat" curves



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

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

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



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

If you have entered the end point 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
Dispensing 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 dispensed.	– Lower "max.rate". – Set larger control range. – Set "min.rate" much lower. – Optimize arrangement of electrode and burette tip and improve stirring, see page 134. This is particularly important with very fast titration reactions and with steep curves.
Titration time is too long.	– Set "min.rate" higher . – Set "max.rate" higher . – Lower "dynamics".
Scatter in titration results is too wide.	– Set "min.rate" lower.

2.2.6.2 Parameters for KFT

titration parameters

Titration parameters
Apply globally for the entire titration.

KFT IPol: titr.direction: −
or
KFT UPol: titr.direction: +

Titration direction (+ , −, auto)
auto: The direction is defined automatically by the Titrino.
+ : In the direction of higher voltage (more "positive"), larger currents.
− : In the direction of lower voltage, smaller currents.

---

pause 1 0 s
** titr.

Pause 1 (0...999 999 s)
Waiting time, e.g. for equilibration of the electrode after the start. The equilibration time can be aborted with <QUIT>, see page 38.

---

start V: OFF

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

start V 0.00 ml

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

factor 0

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

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

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

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

---

pause 2 0 s
** titr.

Pause 2 (0...999 999 s)
Waiting time, e.g. reaction time after the dispensing of a start volume. The waiting time can be aborted with <QUIT>, see page 38.

---

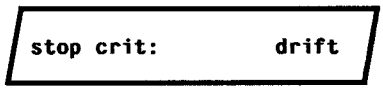
extr.time 0 s
** titr.

Extraction time (0...999 999 s)
During extraction time no dispensing occurs but the titration does not stop.The extraction time can be aborted with <QUIT>, see page 38.

I(pol) 1 µA or U(pol) 400 mV	*Polarisation current (-127...127 µA)* or the *polarisation potential (-1270...1270 mV, in steps of 10 mV)* is inquired.
electrode test: OFF	*Electrode test (OFF, ON)* Test for polarized electrodes. Performed on changeover from the inactive standby state to a measurement. "OFF" means that the test is not performed.
Temperatur 25.0 °C	*Titration temperature (-170.0...500.0°C).* The temperaturte is measured at the start of the titration if a T sensor is connected.
>control parameters	**Control parameters for the end point**
EP at U 250 mV ** titr. or EP at I 25.0 µA ** titr.	*Titration end point (input range depending on the measured quantity:* *U, Ipol: 0... ± 2000 mV* *I, Upol: 0... ± 200.0 µA)*
dynamics 100 mV ** titr. or dynamics 10 µA	*Dynamics (control range, input range depends on the measured quantity:* *U, Ipol: 1...2000 mV* *I, Upol: 0.1...200.0 µA)* Outside the control range, dispensing is performed continuously, see also page 39.
max.rate 10 ml/min ** titr.	*Maximum titration rate (0.01...150 mL/min, max.)* <clear> sets "max.". This parameter determines primarily the addition rate outside the control range, see also page 39. 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

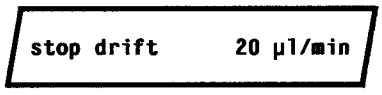
** titr.

Minimum volume increment (0.1...9.9 µl)
This parameter determines the addition rate right at the start and the end of the titration, see also page 39.
This parameter influences the titration speed and therefore its accuracy very strongly: A smaller "min.volume incr." results in a slower titration.



** titr.

Type of stop criterion (drift, time)

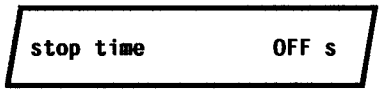


** titr.

Switch off titration when end point and stop drift are reached (1...999 µL/min)

** titr.

Switch-off delay time (0...999 s, INF)
<clear> sets "INF"
Switch off when the end point is reached and the set time after the last dispensing has elapsed.
If "INF" is set, an inquiry regarding the stop time appears.



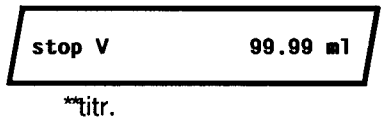
** titr.

Stop time (0...999 999 s, OFF)
<clear> sets "OFF".
Stop after expiry of the set time after the start of the titration. "OFF" means no stop, i.e. titration for an "infinitely" long time.

Conditions for titration termination
If this is not "normal", i.e. after attainment of the end point.

**titr.

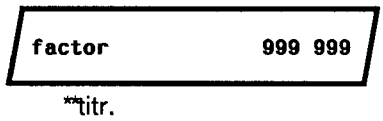
Type of stop volume volume (abs., rel., OFF)
"abs.": absolute stop volume in mL.
"rel.": stop volume relative to sample size.
"OFF": stop volume switched off. Stop volume is not monitored.
The stop volume is applied for one single titration. The conditioning volume is not monitored.
If "abs." is set:



**titr.

Absolute stop volume (0...9999.99 mL)

If "rel." is set:



**titr.

Factor for the calculation of the relative stop volume (0... ±999 999)
Calculated as:
Stop V in mL = factor * sample size

filling rate max. ml/min

**titr.

Filling rate after the titration (0.01...150 mL/min, max.)
<clear> sets "max.".
The maximum rate depends on the Exchange Unit:

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

>statistics

Statistics calculations
Mean value, absolute and relative standard deviation, see also page 49.

status: OFF

*cond.

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

mean n= 2

*cond.

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

res.tab: original

*cond.

Result table for the statistics (original, delete n, delete all)
"original": The original table is used. Deleted 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

*cond.

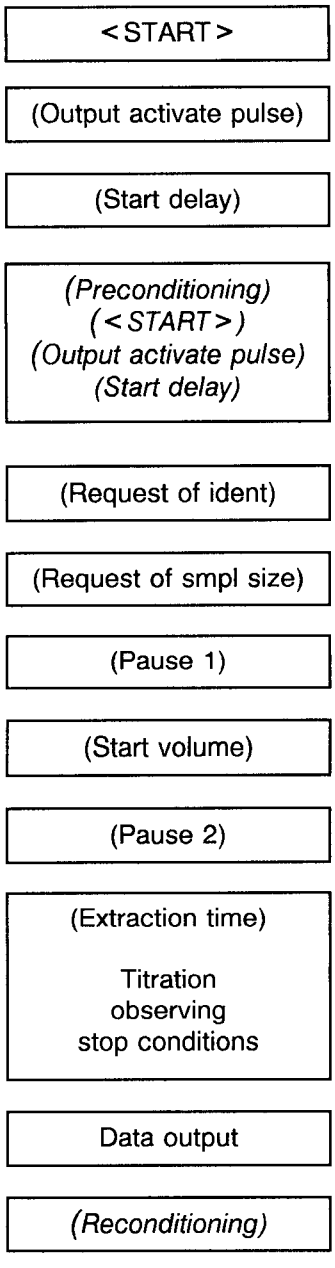
Index n of the result to be deleted (1...20)
The deleted result is incorporated in the statistics calculation.

>preselections	**Preselections for the titration sequence**
conditioning: ON	*Conditioning (ON, OFF)* If conditioning is "on", between the titrations the titration solution is constantly maintained at the end point. When conditioning is performed, the volume drift can be displayed during the conditioning:
display drift: ON *cond.	*Drift display (ON, OFF).* Volume drift.
drift corr: OFF *cond.	*Drift correction (auto, man., OFF)* Type of drift correction: (EP – drift * time) auto: drift value at start is valid man.: see below OFF : no correction
drift value 0.0 µl/min *cond.	If "man." is set: *Drift value (0.0...99.9 µl/min)*
req. ident: OFF	*Inquiry of sample identifications after the start of the titration (id1, id1 & id2, all, OFF)* After the start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries.
req. smpl size: OFF	*Inquiry of sample size after the start of the titration (value, unit, all, OFF)*
activate pulse: OFF	*Output pulse on the control line "activate" of the remote socket (first, all, cond., OFF)* see page 153f.

Titration sequence of KFT

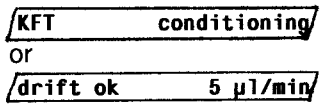
The titration sequence may be configured to match your particular application. The following parameters determine the titration sequence (see diagram below):

- Start delay
- Conditioning (ON, OFF)
- Request of the sample identifications and the sample size after the start of titration
- Pause 1
- Start volume
- Pause 2
- Extraction time



Right after start, the activate pulse is transmitted eventually (possibilities to activate pulse, see page 154) and the start delay time is processed (see page 22).

If *conditioning* is switched on, then titrant is dispensed to the sample solution to reach the end point. When conditioning is completed, the display shows, e.g.



if the drift display is switched on. In the latter case, the current volume drift is also displayed continuously during conditioning.

The instrument is then ready for titration. It can be run by <START>.

After the start of the titration, the activate pulse is transmitted eventually and the start delay time is processed.

Then (if these options are switched on) the temperature is measured (if a T sensor is connected), identifications and "sample size" are requested.
If these requests are switched off, "add sample" is displayed and the titration sequence is halted for 6 seconds (the sequence can also be interrupted by <hold>). During this pause the sample may be added. Otherwise the sample addition can be done during sample ID or sample size request.

After the count down of pause 1, the start volume is dispensed and then pause 2 is processed. During dispensing of the start volume, no control is exerted. Then the titration is performed to the end point.
The titration will not be terminated before the extraction time has been waited out.

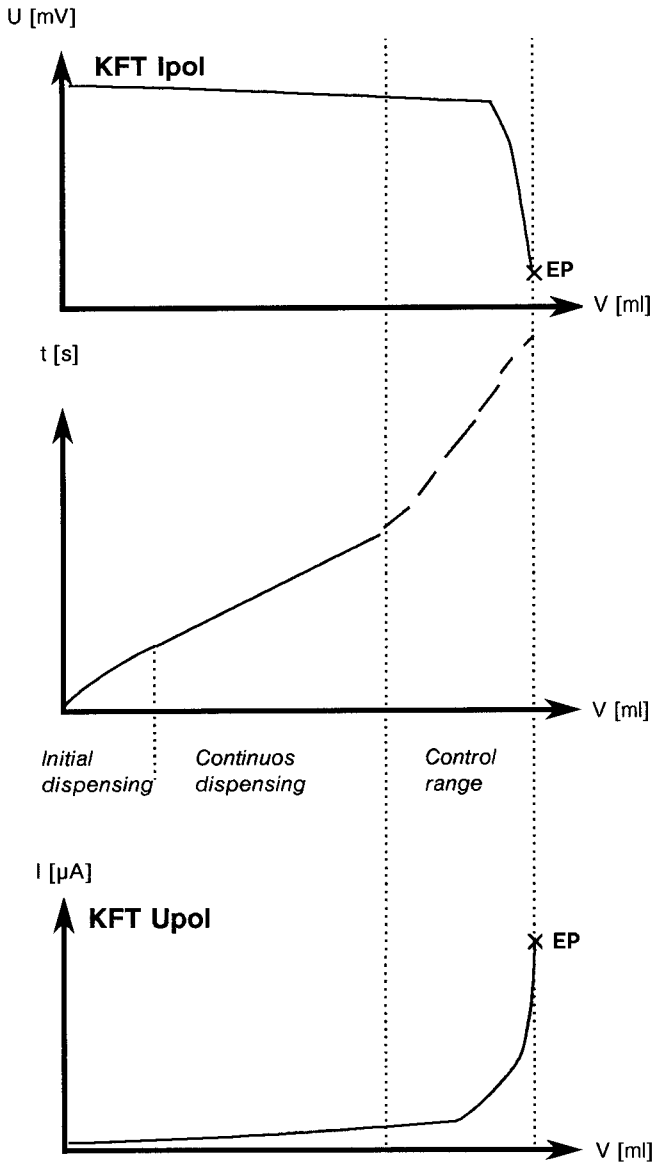
At the end of the titration, the data are displayed and, if you have a printer connected, a specified report ist printed out (see also page 51).

After the end of the titration, conditioning is again performed (if conditioning is switched on).

Control parameters

The control parameters can be set separately for each end point. The default parameters are already set to get satisfactory results. Optimize the control parameters for specific samples only.

During the titration, reagent dispensing is carried out in 3 phases:



1) Initial dispensing:
During this phase, the dispensing rate increases constantly. It starts at the set "min.volume incr." and continues up to the allowed "max.rate".

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

3) Dynamics (control range)
In this range, dispensing is performed in single steps. The last dispensing steps are controlled by the "min.volume incr." parameter.

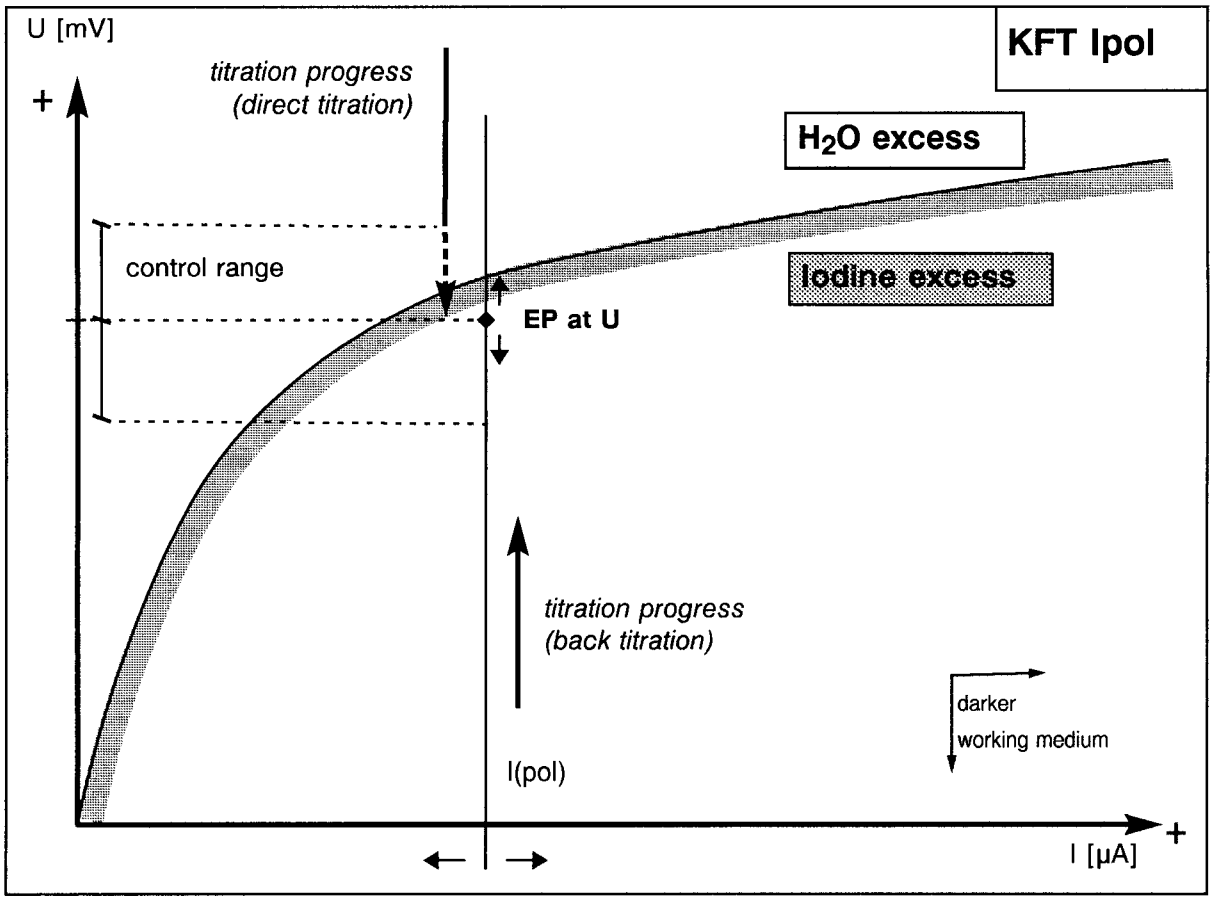
— Ipol results in steeper curves, Upol in rather flat curves.

— In standard-KF-titrations the Ipol-mode (featuring default parameters) is to be preferred.

Titer determinations should be performed using the same mode and parameters as the subsequent sample titrations.

The particular parameters work in the same manner as in SET.

Mechanisms of the KFT-parameters in Ipol mode



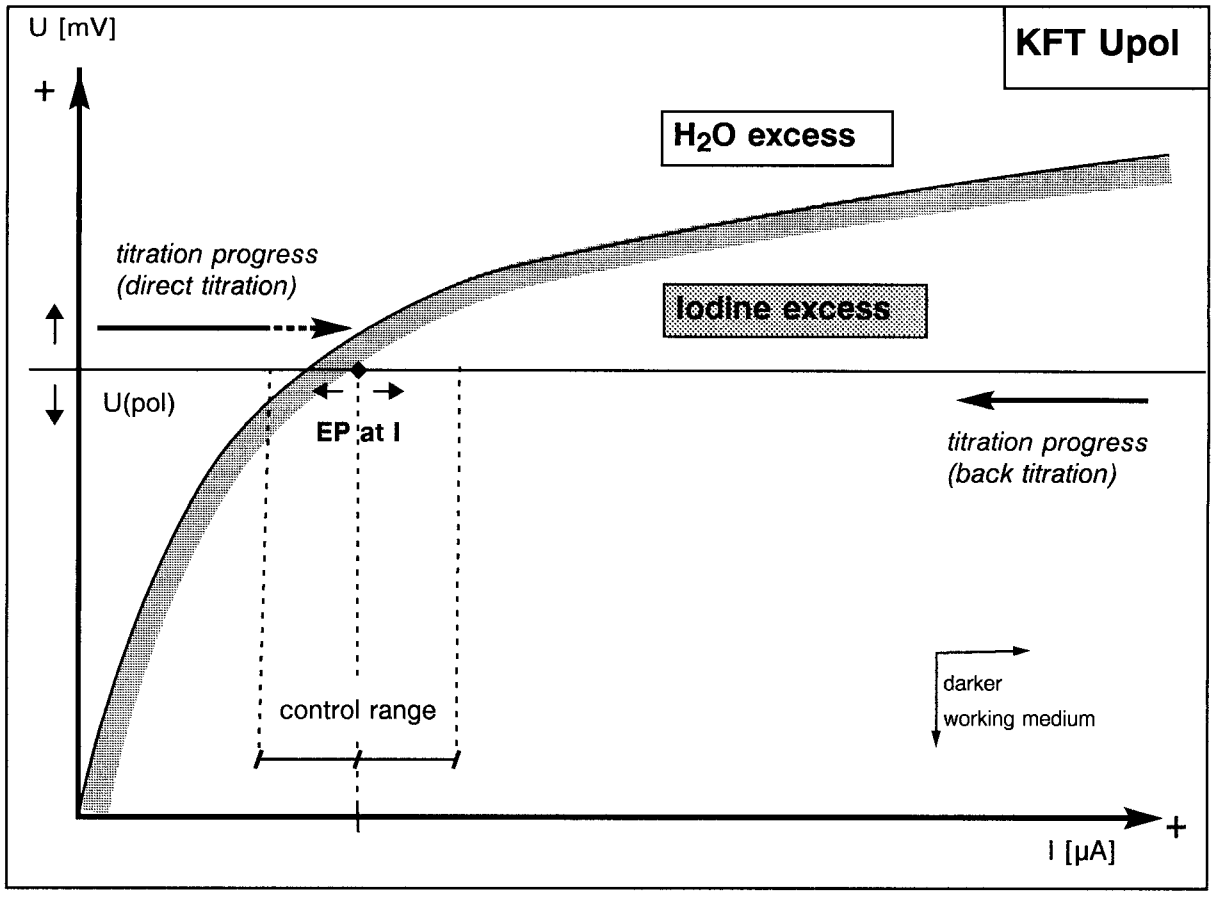
- The very position and curve characteristics of the line between the ranges of excess water or excess iodine depends on the type of sample and the ingredients of the working media.

- The end point has to be set close to the range margin, but always within the iodine excess range. If the end point is set too close to the limit, an overdose of KF reagent may be dispensed. The steeper the curve at the preset polarisation current I(pol), the more delicate it is to titrate to a steady and reproducible end point. For the titration of troublesome samples, the particular conditions must be optimized by trial and error. Always mind the colour of the working medium at the end point as your guideline.

  Remark: In most cases the preset default parameters of the methods KFT Ipol and KFT Upol provide precise and reproducible results.

- To prevent unreasonable combinations of parameters, do not set any single item to a negative value.

Mechanisms of the KFT-parameters in Upol mode



- In KFT Upol mode, all parameters work in a similar manner as in KFT Ipol mode.

The determination of the free water is easily done, as far as the specifications of the reagent manufacturer regarding the "water capacity" of the reagents are considered. Problems may occur with specific sample matrices. The relevant literature (see page 173) contains many precise analysis instructions. In the following table we attempt to show you solutions related more to the instrument's side:

What to do if ...

Problem	Possible causes and remedial action
Dispensing at end too long and increments too small. "Is never finished!"	– Increase "min.volume incr.".Try, e.g. 1 µl for 5 ml Exchange Unit 5 µl for 10 ml und 20 ml Exchange Units – Change stop criterion. Try, e.g. to increase stop drift or lower t(delay) – Change solvent. Try e. g. 2-methoxyethanol with keton or aldehyde samples or a mixture of methanol/glacial acetic acid with amine samples, see literature.
The increments at the end of the titration are too large. "Overshoots".	– Lower "max.rate". The following experiment gives you a reference point for the optimum max.rate: Display the drift during conditioning and add sample without starting the titration. Select a value below the maximum drift as "max.rate". – Optimize setup of electrode and burette tip and improve stirring, see page 72.
Solution becomes too brown at the end of the titration.	– The methanol fraction in the solvent is too low. Change the solvent. – Electrode could be coated; wipe off with acetone.
Solution becomes darker with every titration.	– Renew solvent. – Electrode could be coated; wipe off with acetone.
The drift increases with every titration.	– Does your sample evolve water extremely sluggishly? Work with the KF oven. – Are acids esterified in your sample? Change solution more frequently. Increase buffer capacity of the solvent. – Does your sample contain ketones or aldehydes? Use special reagents suitable for ketones and aldehydes.
The endpoint is reached "too rapidly".	– Reduce max.rate.
The titration times become longer and longer.	– With 2-component reagents the buffer capacity of the solvent can be exhausted. Change solution. – If the drift increases at the same time, see above.

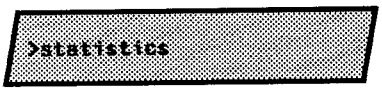
2.2.6.3 Parameters for MEAS

>measuring parameters	Measurement parameters
signal drift OFF mV/min	*Drift for the measured value acquisition (input range depends on the measured quantity:* *pH, U, Ipol, T: 0.5...999 mV/min, OFF* *Upol: 0.05...99.9 µA/min, OFF)* <clear> sets "OFF". "OFF" means that the measured value is acquired after a fixed equilibration time.
equilibr.time OFF s	*Equilibration time (0...9999 s, OFF)* <clear> sets "OFF". If no new equilibration time has been entered, the Titrino calculates an equilibration time appropriate to the drift. $\text{Equilibr.time (in s)} = \frac{150}{\sqrt{\text{Drift} + 0.01}} + 5$ The measured value is acquired as soon as the first criterion (drift or time) has been met. If drift and time are set to "OFF", measurement is continued indefinitely.
meas.input: 1 or I(pol) 1 µA or U(pol) 400 mV electrode test: OFF	*Measuring input (1, 2, diff.)* Inquiry only with measured quantities pH and U. Measuring input 1 or 2 or differential amplifier; connection of electrodes, see page 136. With polarized electrodes, instead of the measuring input the *polarisation current (-127...127 µA)* or the *polarisation potential (-1270...1270 mV, in steps of 10 mV)* is inquired. *Electrode test (OFF, ON)* Test for polarized electrodes. Performed on changeover from the inactive standby mode to a measurement. "OFF" means that the test is not performed.
temperature 25.0 °C	*Measurement temperature (-170.0...500.0C).* The temperaturte is measured at the the start if a T sensor is connected. This parameter is used for temperature compensation in pH measurements.

>statistics	**Statistics calculations** Mean value, absolute and relative standard deviation, see also page 49.
status: OFF	*ON/OFF switching of statistics calculations (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 for the statistics (original, delete n, delete all).* "original": The original table is used. Deleted 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	*Index n of the result to be deleted (1...20).* The deleted result is removed from the statistics calculation.
>presselections	**Preselections for the measurement sequence**
req. ident: OFF	*Inquiry of sample identifications after the start of the titration (id1, id1 & id2, all, OFF)* After the start, sample identifications can be inquired automatically: Only id1, id1 & id2, all three id's or no inquiries.
req.smpl size: OFF	*Inquiry of sample size after the start of the titration (value, unit, all, OFF)*
activate pulse: OFF	*Output pulse on the control line "activate" of the remote socket (ON, OFF)* see page 153.

2.2.6.4 Parameters for CAL

>Calibration parameters	Calibration parameters
meas.input: 1	*Measuring input (1, 2, diff.)* Measuring input 1 or 2 or differential amplifier; Connection of electrodes, see page 136.
cal.temp. 25.0 °C	*Calibration temperature (-20.0 ... 120.0 °C)* The calibration temperature can also be inputted during the calibration sequence.
buffer 1 pH 7.00 buffer 2 pH 4.00 buffer 3 pH non	*pH value of first buffer (0... ± 20.00)* The pH value of the buffers can also be inputted during the calibration sequence. *pH value of second and the following buffers (0... ± 20.00, OFF)* <clear> sets "OFF". Buffers are requested until "OFF" is set. This gives an n-point calibration. Up to 9 buffers.
signal drift 2 mV/min	*Drift for measured value acquisition (0.5...999 mV/min, OFF)* <clear> sets "OFF". "OFF" means that the measured value is acquired after an equilibration time.
equilibr.time 110 s	*Equilibration time (0...9999 s, OFF)* <clear> sets "OFF". If a new equilibration time has not been entered, the Titrino calculates an equilibration time appropriate to the drift, see page 28. The measured value is acquired as soon as the first criterion (drift or time) has been met. If drift and time are both set to "OFF", the measured value acquisition is immediate.
electr.id	*Electrode identification (up to 8 characters).*
sample changer cal: OFF	*Calibration with sample changer (ON, OFF)* In calibrations with a sample changer, there are no hold points in the calibration sequence for inputs. Calibration temperature and pH values of the buffers (which are temperature dependent) must therefore be entered in advance.
activate pulse: OFF	*Output pulse on the control line "activate" of the remote socket (all, first, OFF)* See page 153f.



statistics
see page 44

Calibration sequence

	Immerse electrode in first buffer solution.
<START>	Start calibration.
(Output activate pulse)	Before the calibration, possibly an activate pulse is outputted and a start delay is waited out.
(Start delay)	
Measure cal. temp. or input cal. temp.	Then the calibration temperature is measured or if no temperature sensor is connected, it must be entered. Confirm value with <enter> or advance with <START>.
Buffer 1 pH	Entry of the pH value of the 1st buffer. Accept value with <enter> or advance with <START>.
Measure buffer 1	The first buffer is measured.
Buffer 2 pH	Entry of the pH value of the 2nd buffer. Accept value with <enter> or advance with <START>. or quit the calibration with <STOP> → 1-point calibration.
(Measure buffer 2)	The second buffer is measured.
etc.	As many buffers appear as have been specified under the <parameters> key (up to 9). The calibration can be terminated at any time with <STOP>.
Data output	The calibration data appear in the display. If you have a printer connected, see page 51.

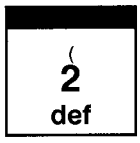
The calibration data are available for calculation:
C46: pHas
C47: Electrode slope

In calibrations with the sample changer, there are no hold points for entries in the calibration sequence. The values entered under the <parameters> key apply.

Calibration data can be viewed at any time with the <cal.data> key (see page 54) and the calibration report printed out using the key sequence <print> <cal.data> <enter>.

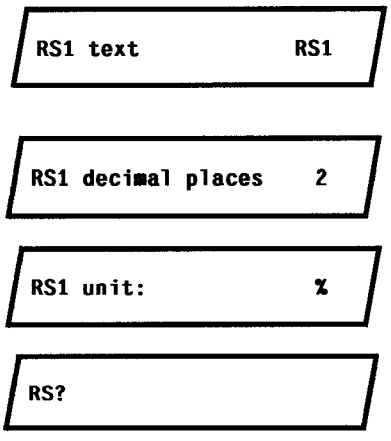
2.2.7 Calculations

Formula entry, <def> key



With the <def> key, you can enter formulas for the result calculation. The formulas are specific to a method and are stored in the method memory.

>formula	**Formula entry**
RS?	Result number ? (1...9) You can calculate up to 9 results per method. Enter a number 1...9.
RS1=	Formula entry Example: RS1 = EP1*C01/C00 When you enter a formula, note the third function on the keys of the keypad. 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...2 RSX: Results which have already been calculdated with previous formulas. X = 1...9. CXX: Calculation constants. XX = 00...47. The constants have the following meaning: C00 Sample size C01 : C19 Method-specific operands, see page 48. Are stored in the method memory. C21 : C23 Sample-specific operands, see page 55ff. C30 : C39 Common variables which have been determined by other methods, see page 50. C40 Initial measured value of the sample C41 Titration end volume (with SET) C42 Titration time C43 Volume drift at start of the titration (only in the case of SET with conditioning) C44 Titration temperature C45 Start volume (with SET) C46 Asymmetry pH, pH_{as} C47 Electrode slope
RS1=EP1*C01/C00	



Rules:
- Calculation operations are performed in the algebraic hierarchy: * and / before + and -.
- Store formula with <enter>.
- Overwrite formula with <clear> and new formula.
- Delete formula with <clear> + <enter>.

If a formula is stored with <enter>, the inquiries regarding the text, decimal places and the unit follow.

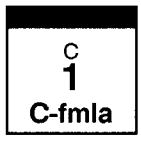
Text for result display and report (up to 8 characters)
Text input see page 20.

Number of decimal places for the result (0...5)

Unit for the result (%, ppm, g/l, mg/ml, mol/l, mmol/l, g, mg, ml, mg/pc, no unit or up to 6 characters).

The next formula can now be entered, e.g. for RS2.

Entry of method-specific operands, <C-fmla> key



With the <c-fmla> key, you can enter the values for operands C01...C19. Only those constants are inquired which you have used in the formulas.

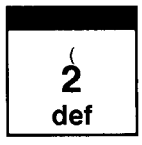
The entries are specific to a method and are stored in the method memory.

The calculation report can be printed out with the key sequence
<print> <select> (press key repeatedly until "calc" appears in the display) <enter>.

2.2.8 Statistics

Mean values, absolute and relative standard deviations are calculated.

Allocations for the statistics calculations, <def> key



The <def> key is used to allocate results for statistics calculations.

The entries are specific to the method and are stored in the method memory.

>mean	**Allocations for statistics calculations**
MN?=	*Mean value number ? (1...9)* You can perform statistics calculations using up to 9 results. For MN1, the default value RS1 is entered.
MN2=	Enter a number 1...9.
MN2=RS2	*Allocation of a result (RSX, EPX, CXX).* Delete allocation with <clear> + <enter>.

How do you obtain statistics calculations?

1) Enter the allocations for the statistics calculations, see above.
2) Switch on the statistics calculations: Either with the <statistics> key or set the status under the <parameters> key, "> statistics" to "on". The "statistics" LED is on. On storage of the method in the method memory, the status of the statistics calculations is retained.
3) If need be, change the number of the individual values n under "mean n".
4) Perform at least 2 titrations. The statistics calculations are constantly updated and outputted. The values are printed out in the short and full result report or you can view them in the display: Press <select> until the display shows "display mean". You can view the mean values with <enter>. Proceed in the same manner for the absolute standard deviations.

Rules:

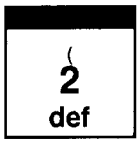
- Recalculated results are incorporated in the statistics calculation. Do not enter a new sample size before the start of a new titration, except when working with the silo.
- If a result of a particular titration can not be calculated, no results for this determination are incorporated in the statistics calculation. However, the sample counter is still operative, i.e. the statistics calculations 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 from where you last left off.
- If you delete results (see page 14), all results of the determination with index n are removed from the statistics evaluation. Removed results may be undeleted using the "original"option.

- On method change, the old statistics table is cleared and the statistics instructions of the new method followed.
- Old results in the statistics table no longer needed can be deleted with "delete all" (under <parameters> key, "> statistics", "res.tab:").
- The individual results of the statistics table can be printed out with <print> <statistics> <enter>.

2.2.9 Common variables

A common variable can be useful for, e.g. the following applications:
- Determination of a titer with a method A. This titer is stored permanently as C3X. The operand C3X can then be used in various other methods like any other operand.
- Determination of a blank value with a method A. Use of this blank value in various other methods.
- Determination of a result with method A. Reconciliation of this result in various other methods.

Allocations for common variables, <def> key



With the <def> key, results or mean values are allocated for common variables.

The entries are specific to the method and are stored in the method memory.

>common variables	**Allocation for common variables**
C3?=	*Common variable C3? (0...9)* Common variables are stored as C3X (X = 0...9).
C30=	Enter a number.
C30=RS1	*Allocation of a result (RSX, MNX, EPX, CXX)* The values of the common variables remain in force for all methods until they are overwritten or deleted. They can be viewed under the <configuration> key, see page 23. Delete allocation with <clear> + <enter>.

2.2.10 Data output

Report sequence definition for a printer on completion of the determination, <def> key

With the <def> key, 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

Report sequence definition on completion of a determination

report:

Report sequence

Options:

param, calc, full, short, ff, calib

report:full

Select a block. If you require more than one report block, set a ";" as a delimiter between the blocks.
The individual blocks have the following meaning:

param	Parameter report.
calc	Report with formulas and operands
full	Full result report with EP list, results and statistics calculations.
short	Short result report with results and statistics calculations.
ff	From feed on printer.
calib	Calibration data.

Original reports which are printed automatically at the end of the titration can be reprinted with recalculated values at any time. Key sequence:

<print> <reports> <enter>

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

Report print outs may be stopped with <QUIT>.

Additional possibilities for report outputs

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

1) <print> <select> <enter> <select> is pressed repeatedly until the desired report appears in the display.
2) <print> <key X> <enter> key X is the key under which the appropriate data are entered.

The following list provides an overview of the report possibilities:

Report	Display with <print> <select>	<key X>
Configuration report	configuration	configuration
Parameter report	parameters	parameters
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: formulas, allocations for statistics calculations and common variables and definition of the report sequence	def	def
Contents of the method memory with details of the memory requirements of the individual methods and the remaining bytes	user methods	user methods
Calculation report with formulas and operands	calc	–
Full result report	full	–
Short result report	short	–
All reports	all	–
Complete report sequence as defined under the <def> key	–	reports

Remark: Parameter reports should only be printed before or after a titration (neither during conditioning). Otherwise the parameter list may be incomplete.

Result display without printer

Results can also be viewed in the display. With the <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 mean	m(RS1)...m(RS9), n	mean values and number of individual values
>display std.deviation	s(RS1)...s(RS9)	absolute standard deviation
>display messages		various (error) messages
>display meas.val	C40	with MEAS

2.2.11 Method memory, <user meth> key

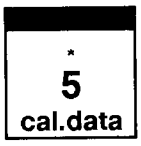
The <user meth> key is used to manage the method memory.
Method identifications can be entered directly or selected with the <select> key from the memory contents.

>recall method	**Recall method**
method name:	*Load method from the method memory into the working memory (entry of a method identification contained in the memory).* You may select a method with <select>. If a method identification is entered which is not found in the method memory, the inputted value flashes.
>store method	**Store method**
method name:	*Store method from the working memory in the method memory (entry of up to 8 characters).* Text input see page 20. If a method is already stored under the inputted identification, you are asked if you wish to overwrite the old method. With <enter> it is overwritten, with <QUIT> you return to the entry of the method identification.
>delete method	**Delete method**
method name:	*Delete method from the method memory (entry of a method identification contained in the memory).* For safety's sake, 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 identification is entered which is not found in the method memory, the inputted value flashes.

You can print out the contents of the method memory with the key sequence
<print> <user meth> <enter>.

Document your methods! With a personal computer and program 6.6019.000, backup all of your methods frequently.

2.2.12 Calibration data, <cal.data> key

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

>input 1	**pH calibration data of measuring input 1**
pH(as) 7.00	*Asymmetry pH (0... ± 20.00)* Entered automatically after a calibration with measuring input 1.
slope 1.000	*Slope (0... ± 9.999)* Entered automatically after a calibration with measuring input 1.
temp. 25.0 °C	*Calibration temperature (-170.0...500.0 °C)* Entered automatically after a calibration with measuring input 1.
cal.date	*Date of the last calibration (no entry possible)* If the calibration data "pH(as)" and/or "slope" are changed by a manual entry, the date entry is deleted.
electr.id	*Electrode identification of the electrode that has been calibrated (no entry possible)* If an electrode identification has been entered in the CAL mode, this entry is entered here automatically after the calibration.
>input 2	**pH calibration data of measuring input 2** Identical to that with measuring input 1.
>input diff.	**pH calibration data of the differential measuring input** Identical to that with measuring input 1.

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

<print> <cal.data> <enter>.

2.2.13 Current sample data, <smpl data> key

The <smpl data> key can be used to enter the current sample data. The contents of this key change when the silo memory is switched on, see page 56.

Instead of entering the current sample data with the <smpl data> key, you can request these automatically after the start of the determinations. For this, configure the determination sequence under the <parameters> key, "> preselections", see pages 37 and 44.

id#1 or C21 id#2 or C22 id#3 or C23	*Sample identification 1...3 or sample-specific operand C21...C23 (up to 8 characters).* Sample identifications or sample-specific operands can be entered using the keypad or via a balance with a special input device (see page 130).
smpl size 1 g	*Sample size (6-digit number: ± X.XXXXX)* Entry using keypad or via a balance (see page 130).
smpl unit: g	*Unit of the sample (g, mg, mL, µL, pc, no unit or up to 5 characters).* Selection with <select>.

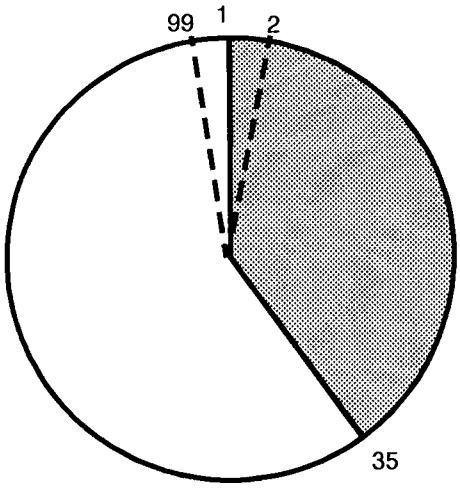
2.2.14 Silo memory for sample data

In the silo memory or stack, sample data (method, identifications and sampl size) can be stored. This is useful, e.g. when you work with sample changers.

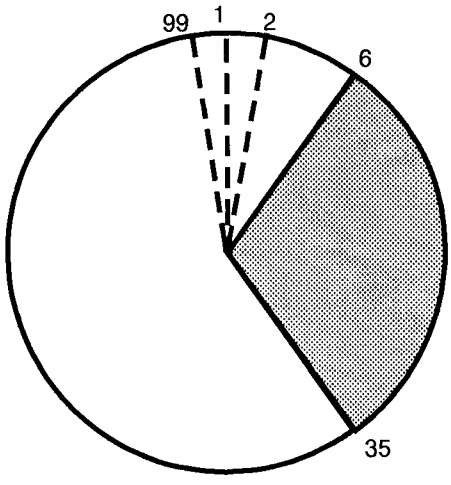
The <silo> key is used to switch the silo memory on and off. The status LED "silo" is on when the silo memory is switched on. The silo memory works by the FIFO principle (First In, First Out).

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 inputted, 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.

One silo line needs 90 bytes memory capacity.

If the silo memory is served by a balance, you must ensure that there is sufficient space in the silo memory for the required quantity of silo lines!

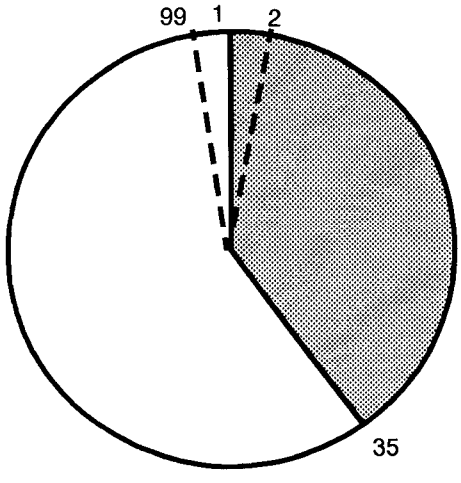
<smpl data> key with the silo memory switched on

>edit silo lines	**Entry of sample data in the silo memory**
silo line 1	*Silo line (1...99)* The next free line is displayed automatically. Lines already occupied can be corrected.
method:	*Method with which the sample is processed (method identification from the method memory)* If no method identification has been entered, the sample is processed with the method in the working memory. The method can be selected with <select> or entered directly.
id#1 or C21 id#2 or C22 id#3 or C23	*Sample identifications or sample-specific operands (up to 8 characters)*
smpl size 1 g	*Sample size (6-digit number: ± X.XXXXX)* When the sample data have been entered from a balance, the transfer of the sample size is taken as the end of the silo line.
smpl unit: g	*Unit of the sample (g, mg, ml, µl, pc, no unit or up to 5 characters)*
>delete silo lines	**Delete individual silo lines**
delete line n OFF	*Delete individual silo lines (1...99, OFF)* <clear> sets "OFF". Deleted lines remain in the silo memory. Access is blocked during the processing. To show that a line has been deleted, the inquiry "method*" appears. The symbol * indicates that the line has been deleted. Deleted lines can be reactivated when the appropriate line is reedited.

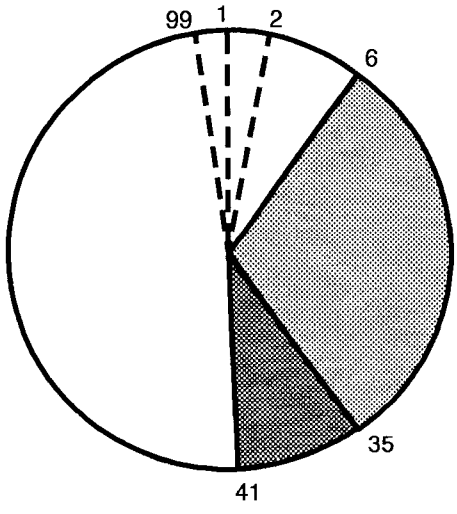
>delete all silo lines	**Deleting the entire silo memory**
delete all: no	*Delete all silo lines (yes, no)* When all silo lines are deleted, the silo is completely empty: The line numbering starts again with 1.
cycle lines: OFF	*Data cycling (ON, OFF)* Data cycling "on" is useful if you constantly have to process the same sample data. In such a case, the processed silo line is not deleted, but copied to the next free line, see below. When you work in this mode, you should not enter any new silo lines during the determinations.

If the silo memory is filled from the balance, a new silo line is established when transfering the weight. For mixed operation, manual entry and entry from a balance, the values from the balance are sent into the line in which editing just takes place. They must be confirmed with <enter> at the 720 KFS Titrino.

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.

2.3 Tips and techniques

2.3.1 Calculation formulas

Proved Standard calculation formulas for SET mode

$$RS1 = \frac{EP1 * C01 * C02 * C03}{C00 * C04}$$ *or* **RS1 = EP1*C01*C02*C03/C00/C04**

RS1 : assay
EP1 : volume at end point
C00 : sample size

C01 : titer of titrant
C02 : molar mass of sample
C03 : factor
C04 : divisor
(ev. common variable C3X, in preference to C01)

with blank value subtraction

$$RS1 = \frac{(EP1 - C05) * C01 * C02 * C03}{C00 * C04}$$ **RS1 = (EP1-C05)*C01*C02*C03/C00/C04**

C05 : blank value in ml
(ev. common variable C3X, instead of C05)

Factor and divisor provide the adaptation of the result to various units:

Unit RS1	sample size in ...	factor [1]	divisor
%	g	0.1 * c(titrant)	valence
%	mg	100 * c(titrant)	valence
%	ml	0.1 * c(titrant)	density of sample [g/ml] * valence
ppm	g	1000 * c(titrant)	valence
ppm	ml	1000 * c(titrant)	density of sample [g/ml] * valence
ppm	µl	1000 000 * c(titrant)	density of sample [g/ml] * valence
mg/ml	g	c(titrant) * density of sample [g/ml]	valence
mg/ml	ml	c(titrant)	valence
g/l	g	c(titrant) * density of sample [g/ml]	valence
g/l	ml	c(titrant)	valence
mg	1	c(titrant)	valence
ml	1	c(titrant)	1000 * density [g/ml] * valence
mg/pc	pc	c(titrant)	valence
mol/l [2]	ml	c(titrant)	valence
mmol/l [2]	ml	1000 * c(titrant)	valence

[1] When working with stock solutions, multiply the factor with the dilution factor.
[2] C02 must be 1 (no molar mass)

Formula for titer determinations

$$RS1 = \frac{C00 * C01}{C02 * EP1}$$ or **RS1 = C00*C01/C02/EP1**

RS1 : titer of titant

EP1 : volume at end point
C00 : sample size in g

C01 : theor. consumption for 1 mol standard substance in ml
C02 : molar mass of standard / valence

Proved standard calculation formulas for KFT mode

$$RS1 = \frac{EP1 * C01 * C02}{C00 * C03}$$

or

RS1 = EP1*C01*C02/C00/C03

RS1 : water content
EP1 : volume at end point
C00 : sample size

C01 : titer
C02 : factor
C03 : divisor

with blank value subtraction

$$RS1 = \frac{(EP1 - C04) * C01 * C02}{C00 * C03}$$

RS1 = (EP1–C04)*C01*C02/C00/C03

C04 : blank

ev. common variable C3X, in preference to C04

Factor and divisor provide the adaptation of the result to various units:

Unit RS1	sample size in...	factor	divisor
%	g	0.1	1
%	mg	100	1
%	ml	0.1	density of sample [g/ml]
ppm	g	1000	1
ppm	ml	1000	density of sample [g/ml]
ppm	µl	1000 000	density of sample [g/ml]
mg/ml	g	density of sample [g/ml]	1
mg/ml	ml	1	1
g/l	g	density of sample [g/ml]	1
g/l	ml	1	1
mg	1	1	1
ml	1	1	1000 * density H_2O [g/ml] ≈ 1000
mg/pc	pc	1	1

Formula for titer determinations

$$RS1 = \frac{C00 * C01}{EP1}$$

or

RS1 = C00*C01/EP1

RS1 : titer
EP1 : volume at end point
C00 : sample size

C01 : factor

The factor depends on type and water content of standard substance:

Standard	sample size in...	factor
water	g	1000
water	µl	density of H_2O [g/ml] ≈ 1
methanol	ml	water content of methanol in [mg/ml]
methanol	µl	0.001 * water content of methanol in [mg/ml]
$Na_2Tart * 2H_2O$	g	156.6
$Na_2Tart * 2H_2O$	mg	0.1566

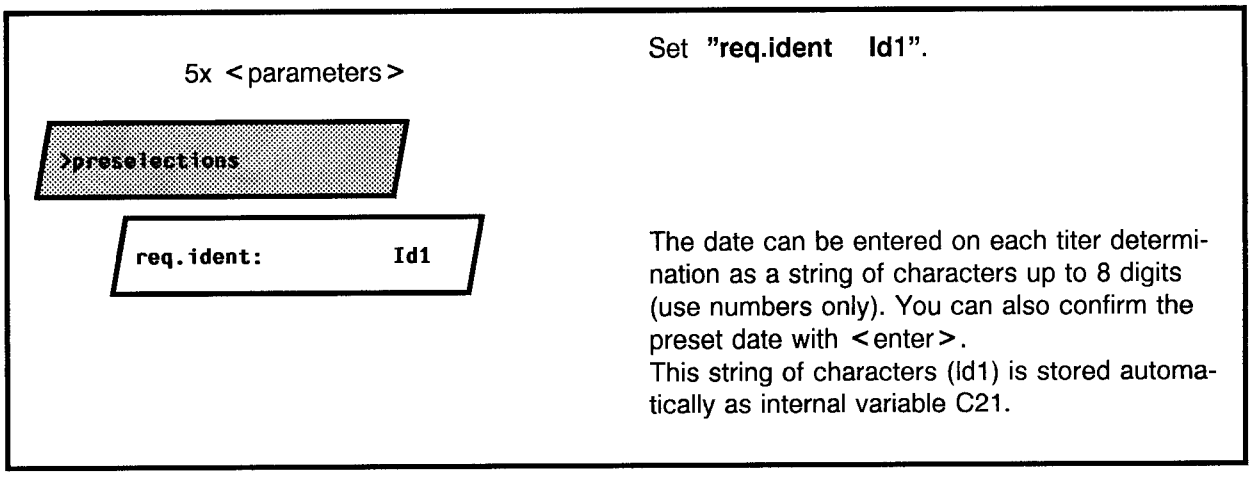
2.3.2 To store a titer and its determination date permanently

It makes sense to store the titer of a titrant and the date of its determination in the instrument for subsequent use. For this purpose, common variables are available. Common variables stay resident when the instrument is switched off.

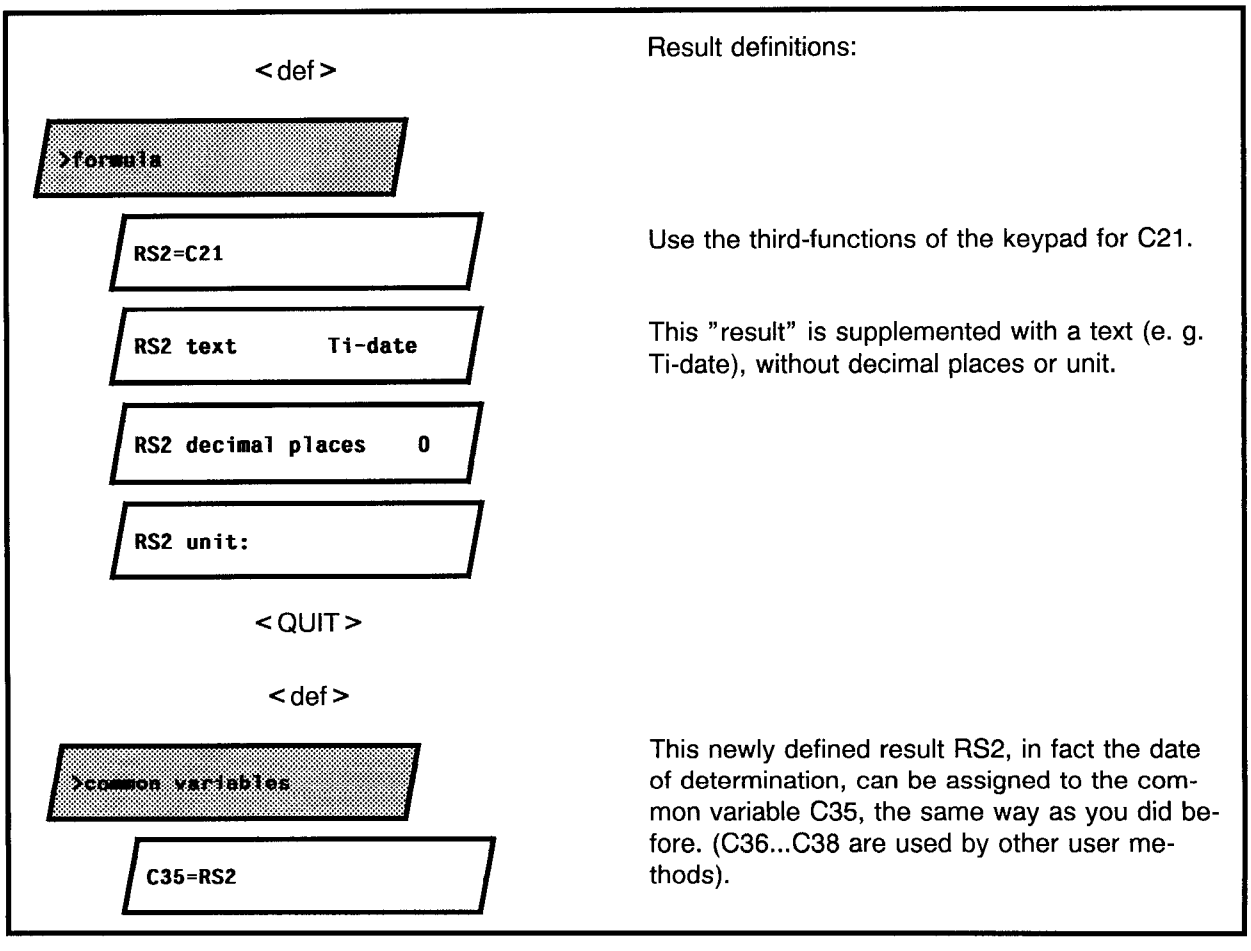
Proceed as follows:

Load e.g. user method H2OTiter (or TarTiter as you please).

The result RS1, the titer itself (in fact the mean value out of five determinations) is assigned to the common variable C39 as default in this method.
To store the actual date of each titer determination, modify this method in the sense to be requested for the actual date on each titration.



This variable can be defined as a result and be supplemented with a text. Then it may be assigned to a common variable.



Now the titer of the KF reagent and its determination date are stored permanently in the common variables C39 and C35.

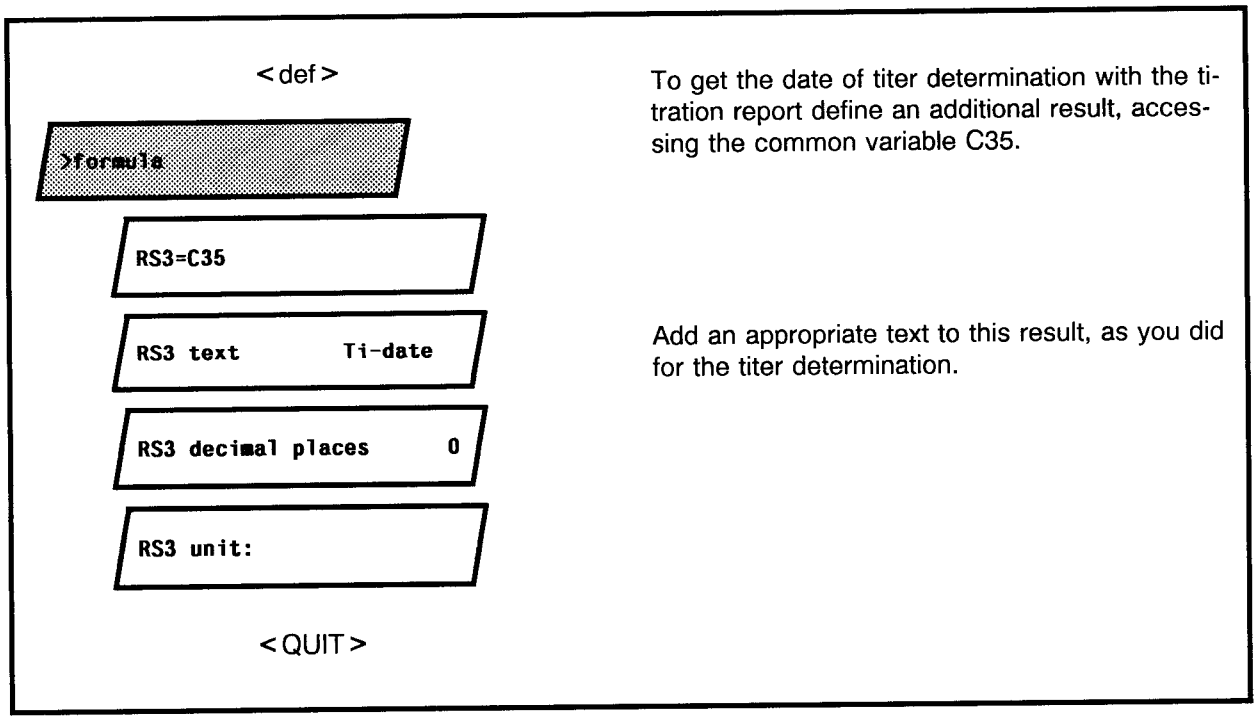
The modified method "H2OTiter" may be saved with a different name (e.g. KFTiter).

2x <user meth> >store method...

Always use this new method to determine the titer of your KF titrant.

Now how to proceed to have the titer and its date printed out on every Karl Fischer titration?
It is easily done.

Load the user method "KF". This method automatically accesses the value of the common variable C39 where the KF titer is stored.
In addition to the result RS1, it will also be printed on every KF titration as an additional result including the attached text.



You may store this modified method under a new name.

This is the elegant way to solve various problems in your laboratory practice. Use the helpful abilities of common variables.

2.3.3 Sample addition

For sample addition various accessories are available, e. g. injection syringes, weighing spoons etc.

It is a good idea to apply the back-weighing technique (except when disposing small amounts of liquids with the aid of syringes). Fill the syringe or the weighing spoon with your sample just before the titration (e. g. during conditioning) and tare it on a balance with an appropriate precision. It is best to connect the balance to your Titrino via serial cable. Sample size request should always be switched on.

<parameters> >preselections "req.smpl size: value"

Add the sample during the request for the sample size and weigh the empty syringe or weighing spoon again to evaluate the weight difference. Use the transfer of balance data to enter the correct sample size if possible (usually the weight in g is transmitted). Otherwise use the keypad to enter the size and eventually the corresponding unit. If you input the sample size by automatic data transfer, the sample size request is confirmed and the titration is started at once.

If the sample size request is switched off and preconditioning is set, you are explicit prompted to add your sample. For six seconds the message "add sample" is displayed after which the titration is started by the Titrino itself. This waiting time can also be extended longer by pressing <hold>.

Some recommendations for choosing the appropriate weighing accessories with KF titrations

Solid samples

Use a glass weighing spoon 6.2412.000 and dispose the sample through the opening for the septum stopper (see page 135).

Liquid samples

Use a disposable syringe (2...20 ml) or a micro-syringe with a long needle attached. Puncture the septum and dispose the sample carefully.

Recommendation:

When using disposable syringes add the liquid sample carefully without dipping into the solvent. Draw in the last drop of sample before you redraw the syringe. Back-weigh the added sample.

For disposing a (small) certain volume of liquid sample use a micro-syringe. Proceed as above, but dip the needle into the preconditioned solvent and dispose the sample carefully. It is not recommended to withdraw any drop of solvent or sample adhering to the needle.

Always keep in mind to exchange the septum, as soon as it shows any large punctures impairing the tightness of the titration cell.

Pasty, viscous samples

For samples which can not be disposed with a needle because of their high viscosity, you have the possibility to handle your sample with disposable syringes without a needle. Dispose your sample through the opening of the septum stopper. Back-weigh the added sample. Be sure to wipe off any adhering excess sample substance off the syringe before taring it.

Pay attention in any case to prevent the infiltration of atmospheric moisture into the KF cell when you are disposing the sample. If you still have to open the titration cell for any reason, determine a blank value and take it into consideration for the calculation of the titration result (EP1 – blank value in ml).

2.3.4 Electrode test

The electrode test is a useful function to check if the electrode is immersed correctly in the sample solution at titration start. This test is implemented for polarized electrodes only.

When working with a Sample Changer, it is best to perform the electrode test. It may be useful to prevent the start of a titration if the electrode and burette tip are not immersed correctly in the sample solution.

If you work with low polarization currents or voltages, the electrode test may alter the surface of the electrode. Therefore, use the electrode test only for work with a Sample Changer.

2.3.5 Colour of the solution in KF titration

At the end point of a Karl Fischer titration, the working medium should always show a yellow colour. Depending on the preset parameters, such as the EP and the polarization current (Ipol mode) or polarization voltage (Upol) respectively, this colour may vary.

When using the default parameters of the methods KFT Ipol (50 µA) and KFT Upol (400 mV) the colour of the solution at the end point may tend to brownish (negligible iodine excess). However, that is not an indication of overtitration.
If you want to avoid that brownish colour, the polarization current (in Ipol mode) may be set to lower values or the polarization voltage (in Upol mode) may be set to higher values. See also page 40 and 41.
Nevertheless you have to put up with, that a more passed away signal may be measured and this may cause a much slower titration rate. And this anew may support the well known disturbing influences on the KF titration to be more observable, such as there are atmospheric moisture or chemical side reactions.

General rules:

In Ipol mode:

The higher the polarization current at a certain end point,

- the darker the working medium.
- the higher the titration rate.

The lower the polarization current at a certain end point,

- the brighter the working medium.
- the lower the titration rate.

In Upol mode:

The higher the polarization voltage at a certain end point,

- the brighter the working medium.
- the higher the titration rate.

The lower the polarization voltage at a certain end point,

- the darker the working medium.
- the lower the titration rate.

It is a good advice to use the default parameters as far as possible and to apply the same parameters for titer determinations.

2.3.6 Back titrations

The technique of back titration is rarely applied nowadays, because the modern pyridine-free KF reagents are capable to solve far the most problems of water determinations in direct titration technique. However this is the description of an applicable method to perform reliable back titrations with the 720 KFS Titrino.

The principle of back titration:

The sample is added to an amount of solvent that is conditioned to complete dryness. A defined volume of KF reagent is added immediately. After a specific equilibration time the remaining excess is titrated with a methanol/water mixture. The water content is calculated on the basis of the consumption of the methanol standard.

Requirements:

The titer of the KF reagent is to be determined with distilled water (user method H2OTiter). With this very KF reagent the water content of the methanol standard solution (e. g. 5 mg/ml) is also to be determined exactly.

Place the exchange unit containing the methanol standard solution onto the 720 KFS Titrino and mount the KF reagent on an auxiliar 665 or 725 Dosimat. Connect the remote socket of the Titrino to the D-socket of the Dosimat (use 6.2139.000 cable). The KF reagent might be disposed manually as well, but this will result in a loss of reproducibility.

The method

Select the method KFT Upol. This mode is recommended for back titrations, as the titration control in the iodine excess range may be more cautious in Upol mode. The most important (recommended) control parameters are:

titr. direction:	–	(most important)
U(pol)	100 mV	
EP at I	50 µA	
dynamics	50 µA	
conditioning	ON	
req.smpl size:	value	
activate pulse	all	(for controlling the auxiliary Dosimat)

Particular samples may require different settings of the stop drift parameter.

Calculation formula:

$$\% H_2O = ((Titer_{KF} * \text{ml KF reagent}) - (Titer_{methanol\text{-}Std} * EP_{methanol\text{-}Std})) * 0.1 / \text{sample size in g}$$

or RS1 = ((C39*C01)–(C02*EP1))*C03/C00

C00 :sample size
C01 : ml KFR
C02 : titer methanol standard
C03 : factor 0.1
C39 : titer KFR

Proceeding

Select the KF reagent volume at the Dosimat (<mode> DIS R, <ΔVol> e. g. 5.00 ml). The amount of KF reagent should be set large enough to ensure an excess of KF reagent in the KF cell after the sample addition.

Place 20 ml methanol (or another adequate solvent) in the KF cell of the 720 KFS Titrino and start the conditioning to complete dryness. As a matter of fact, at the start of the method the activate pulse induces the Dosimat to dispose the preset amount of KF reagent, which is then titrated with the methanol standard solution.
As soon as the conditioning is done the titration can be launched with <START>. This again causes the Dosimat (in command of the activate pulse) to start the addition of the preset volume of KF reagent. The Titrino now requests the input of the sample size. The sample may now be added and the sample size be set with <enter>. Actually this starts the back titration of the KF reagent excess.

Remark

A large amount of iodine excess may result in a short time overrange of measure, which is inconsiderable to the titration.

3. Operation via RS232 interface

3.1 General rules

The 720 KFS Titrino has an extensive remote control facility that allows full control of the titrator via the RS232 interface, i.e. the titrator can receive data from an external controller or it can send data to an external controller. C_R and L_F are used as terminators for the data transfer. 720 S Tirino 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 terminator. The controller terminates its commands with C_R and L_F. If the controller sends more than one command per line, the character ';' is used as separator between the commands.

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

&Mode.**S**elect **"SET"**

must be sent, but only the boldface characters need to be transmitted, thus

&M.S"SET" .

All quantities of the 720 KFS Titrino are collected in groups. For example, the entries for the configuration are in the group

&Config

The "Config" group contains subgroups, e.g. for the setting of the RS interface parameters (RS Settings)

&Config.**R**SSet

This subgroup itself contains individual settings, e.g. parameter sets regarding the baud rate

&Config.**R**SSet.**B**aud

or the parity

&Config.**R**SSet.**P**arity

The commands are organized in a hierarchical tree structure. The quantities that appear in this tree are called **objects** in the following. The baud rate is an object that is called by the command

&Config.**R**SSet.**B**aud

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

&Config.**R**SSet.**B**aud **$Q** Q for Query

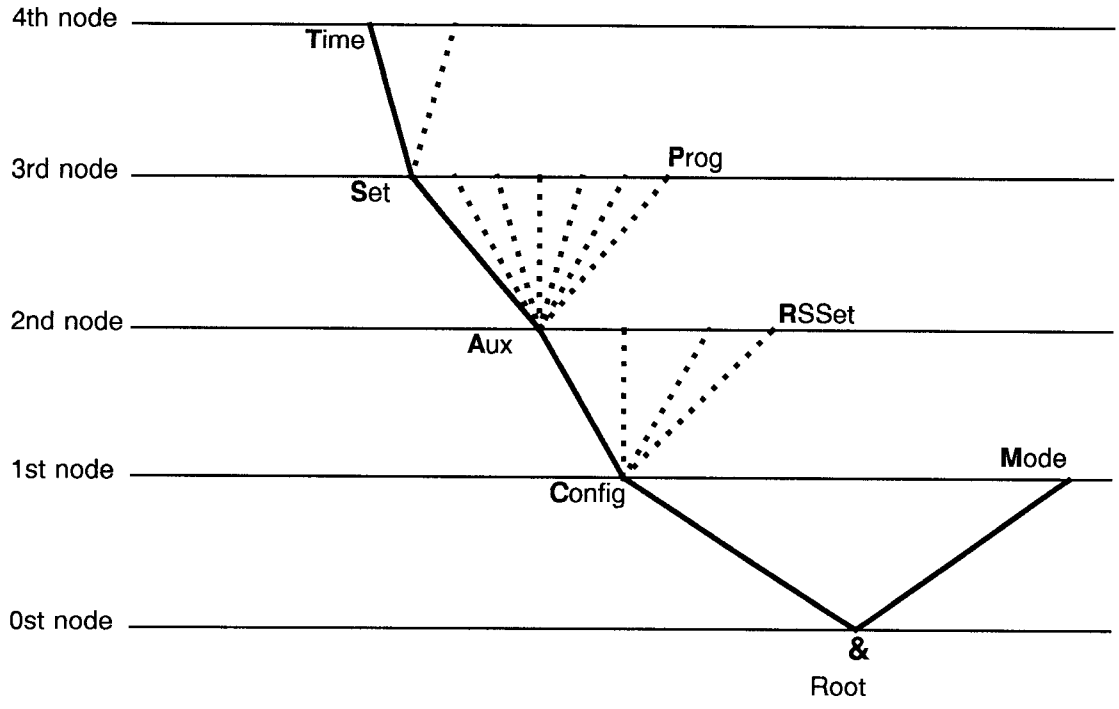
$Q triggers the output of the value from the 720 KFS Titrino. Entries that are introduced with the character dollar ($) trigger something. They are thus called **triggers.**

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

&Config.**R**SSet.**B**aud **"9600"**

3.1.1 Object calls

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



Rules:

- The root of the tree is designated with &.
- For the call up of an object the nodes (levels) of the tree are marked with a point (.).
- The call up of the objects requires as many letters as necessary to ensure unequivocal assignment of the object. If the call is not unequivocal, the first object in the series is recognised.
- Upper- or lowercase letters can be used
- An object can be assigned a value. Each value is marked at the beginning and end with quotation marks ("). A value can contain up to 24 characters. Numeric values can include up to 6 digits, a negative sign and a decimal point. Numbers with more than 6 digits will not be accepted; more than 4 decimal places are rounded off (5 decimal places for smpl size). With numbers <1, it is necessary to enter leading zeros.
- If a new object is not called up, the old object remains current.

Examples:

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

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

Entry of "08:10" for the time
&C.A.S.T "08:10"

Correct entries of numbers:
"-31.2273"
"0.1"
incorrect entries:
"1,5" or " +3" or ".1"

Entry of a different time:
"08:15"

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

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

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

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

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

Change from the node 'RSSet' via the root into the node 'Mode': **&M**

3.1.2 Triggers

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

The following triggers are possible:

$G	Go:	Starts operations, e.g. start of the titration or setting of the RS232 interface parameters
$S	Stop:	Stops operations, e.g. titration
$H	Hold:	Holds operations, e.g. titration
$C	Continue:	Continue after "Hold"
$Q	Query:	Used for inquiry of all information from the current node in the tree upwards up to and including the values
$Q.P	Path:	Used for inquiry of the path from the root of the tree up to the current node
$Q.H	Highest index:	Used for inquiry of the number of son nodes of the current node
$Q.N"i"	Name:	Used for inquiry of the name of the son node with index i, i = 1...n
$D	Detailed Info:	Used for inquiry of the detailed status
$U	qUit:	Used to abort the data flow of the Titrino, e.g. after $Q

The triggers $G, $S and $H, $C are linked to objects, see overview table, pages 74ff.

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

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

3.1.3 Status and error messages

In order to have an efficient control by an external control device, it must also be possible to query status conditions; they provide information on the status of the 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;E20. 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.
$H	Hold:	The Titrino has been holded ($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 stopped in an "unnatural manner".

Detailed status conditions

Status conditions of the global $G:

$G .Mode.SET	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in SET mode, requesting Id1 after titration start.
	.Id2:	Instrument in SET mode, requesting Id2 after titration start.
	.Id3:	Instrument in SET mode, requesting Id3 after titration start.
	.Smpl:	Instrument in SET mode, requesting sample size after titration start.
	.Unit:	Instrument in SET mode, requesting unit of sample size after titration start.
	.AddSmpl	Instrument in SET mode, processing the sample addition time.
	.Start:	Instrument in SET mode, processing the start conditions (pause 1, start volume, pause 2).
	.ExtrTime	Instrument in SET mode, processing the extraction time.
	.SET1:	Instrument in SET mode, titrating to the first end point.
	.SET2:	Instrument in SET mode, titrating to the second end point.
	.Cond.Ok:	Instrument in SET mode, conditioning, end point reached (after the first startup from the standby mode).
	.Cond.Prog:	Instrument in the SET mode, conditioning, end point not reached (Conditioning progressing).
$G .Mode.KFT	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in KFT mode, requesting Id1 after titration start.
	.Id2:	Instrument in KFT mode, requesting Id2 after titration start.
	.Id3:	Instrument in KFT mode, requesting Id3 after titration start.
	.Smpl:	Instrument in KFT mode, requesting sample size after titration start.
	.Unit:	Instrument in KFT mode, requesting unit of sample size after titration start.
	.AddSmpl	Instrument in KFT mode, processing the sample addition time.
	.Start:	Instrument in KFT mode, processing the start conditions (pause 1, start volume, pause 2).
	.ExtrTime	Instrument in KFT mode, processing the extraction time.
	.Titr.	Instrument in KFT mode, titrating to the end point.
	.Cond.Ok:	Instrument in KFT mode, conditioning, end point reached (after the first startup from the standby mode).
	.Cond.Prog:	Instrument in the KFT mode, conditioning, end point not reached (Conditioning progressing).

$G .Mode.MEAS	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in MEAS mode, requesting Id1 after start.
	.Id2:	Instrument in MEAS mode, requesting Id2 after start.
	.Id3:	Instrument in MEAS mode, requesting Id3 after start.
	.Smpl:	Instrument in MEAS mode, requesting sample size after start.
	.Unit:	Instrument in MEAS mode, requesting unit of sample size after start.
	.Meas:	Instrument in MEAS mode, measuring.

$G .Mode.CAL	.Inac:	Instrument at the beginning or the end of a calibration
	.Req.Temp:	Instrument in CAL mode, requesting calibration temperature.
	.Meas.Temp:	Instrument in CAL mode, measuring calibration temperature.
	.Req.Buf1:	Instrument in CAL mode, requesting pH of buffer 1.
	.Meas.Buf1:	Instrument in CAL mode, measuring buffer1.
	.Req.Buf2:	Instrument in CAL mode, requesting pH of buffer 2.
	.Meas.Buf2:	Instrument in CAL mode, measuring buffer2.
	etc.	
$G .Assembly.Bur	.Fill:	Burette in filling process.
	.ModeDis:	Burette in Dis mode.
	.ModeDOS:	burette dosing manually.

Status conditions of the global $H:

$H .Mode.SET	.Inac:	Instrument in SET mode, holded at the beginning.
	.AddSmpl:	Instrument in SET mode, holded during the sample addition time.
	.Start:	Instrument in SET mode, holded during the start conditions (pause 1, start volume, pause 2).
	.SET1:	Instrument in SET mode, holded during titration to the first endpoint.
	.SET2:	Instrument in SET mode, holded during titration to the second endpoint.
	.Cond:	Instrument in SET mode, holded during conditioning.

$H .Mode.KFT	.Inac:	Instrument in KFT mode, holded at the beginning.
	.AddSmpl:	Instrument in KFT mode, holded during the sample addition time.
	.Start:	Instrument in KFT mode, holded during the start conditions (pause 1, start volume, pause 2).
	.Titr:	Instrument in KFT mode, holded during titration to the endpoint.
	.Cond:	Instrument in KFT mode, holded during conditioning.

$H .Mode.MEAS	.Inac:	Instrument in MEAS mode, holded at the beginning.
	.Meas:	Instrument in MEAS mode, holded during measurement.

$H .Mode.CAL	.Inac:	Instrument in CAL mode, holded at the beginning.
	.Meas.Buf1:	Instrument in CAL mode, holded during measurement of buffer 1.
	.Meas.Buf2:	Instrument in the CAL mode, holded during measurement of buffer 2.
	etc.	

$H .Assembly.Bur.ModeDis: Burette has been holded in the Dis mode.

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.SET .Inac: Instrument in SET mode, inactive or during recalculation.
$R .Mode.KFT .Inac: Instrument in KFT mode, inactive or during recalculation.
$R .Mode.MEAS.Inac: Instrument in MEAS mode, inactive.
$R .Mode.CAL .Inac: Instrument in CAL mode, inactive.
$R .Assembly.Bur .ModeDis: Burette in Dis mode, inactive.

Status conditions of the global $S:

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

The instrument shows the status from which it has been stopped. The detailed status information is therefore identical as for the global status $G.

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).

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

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

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

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

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

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

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

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

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

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

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

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

RS receive errors:

E36 Parity
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 receive buffer of the Titrino is full (>82 characters).
Exit: <QUIT>

RS send errors:

E40 DSR = OFF
E41 DCD = ON
E42 CTS = OFF
} No proper handshake for more than 1 s.
Exit: <QUIT>
Is the receiver switched on and ready to receive?

E43 The transmission of the Titrino has been interrupted with XOFF for at least 3 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 720 KFS Titrino contains an incomplete command (L_F missing). Sending from the Titrino is therefore blocked.
Exit: Send L_F or <QUIT>.

E120 Overrange
Exit: Correct error or &m $S.

E123: Missing EP for calculation.
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, does not exist in the method memory.
Exit: The error message disappears on next startup.

E135: Check Temp.Sensor in MEAS T.
Exit: Correct error or &m $S.

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

E137: XXX Bytes are missing so that the method or the silo line could not be stored.
Exit: Send new command.

3.2 Remote control commands

3.2.1 Overview

Object	Function	Input range	see...
&	**Root**		
Mode	**Mode**	$G, $S, $H, $C	3.2.2.1
.**Q**uickMeas	Quick measurement in inactive state	$G, $S	3.2.2.2
.**S**elect	Selection of the mode	SET, MEAS, CAL	3.2.2.3
.**SET**Quantity	Measured quantity for SET	pH, U, Ipol, Upol	3.2.2.3
.**MEA**SQuantity	Measured quantity for MEAS	pH, U, Ipol, Upol, T	3.2.2.3
.**N**ame	Name of the current method	read only/read + write	3.2.2.4
.**P**arameter*	Parameters of the current method, depend on the mode, see pages 75 to 76		
.**Def**	**Definitions for the data output**		
.**F**ormulas	**Calculation formulas**		
.**1**	For result 1		
.**F**ormula	Calculation formula	special	3.2.2.5
.**T**extRS	Text for the result designation	up to 8 ASCII char	3.2.2.5
.**D**ecimal	Decimal places	0...5	3.2.2.5
.**U**nit	Unit for the result	up to 6 ASCII char	3.2.2.5
	up to 9 results		
.**C**omVar	**Assignment of common variables**		
.**C30**	Common variable C30	RSX, MNX, EPX, CXX	3.2.2.6
	up to C39		
.**R**eport	**Data output at the end of titration**		
.**A**ssign	Assignment	depends on mode	3.2.2.7
.**M**ean	**Assignments for statistics calculations**		
.**1**	Mean value 1, MN1		
.**A**ssign	Assignment for MN1	RSX, EPX, CXX	3.2.2.8
	up to 9 assignments		
.**C**Fmla	**Calculation constants**		
.**1**	Calculation constant C01		
.**V**alue	Value for C01	0... ±999 999	3.2.2.9
	up to C19		
UserMeth	**Management of the method memory**		
.**F**reeMem	Memory still available	read only	3.2.2.40
.**R**ecall	Recall method	$G	3.2.2.41
.**N**ame	Method identification	up to 8 ASCII char	3.2.2.41
.**S**tore	Store method	$G	3.2.2.41
.**N**ame	Method identification	up to 8 ASCII char	3.2.2.41
.**D**elete	Delete method	$G	3.2.2.41
.**N**ame	Method identification	up to 8 ASCII char	3.2.2.41
.**DelA**ll	Delete all methods	$G	3.2.2.41
.**L**ist	List of all methods in the method memory		
.**1**	Method 1		
.**N**ame	Name of the method	read only	3.2.2.42
.**M**ode	Mode	read only	3.2.2.42
.**Q**uantity	Measured quantity	read only	3.2.2.42
.**B**ytes	Bytes used from the mewthod memory	read only	3.2.2.42
.**C**hecksum	Checksum of the method	read only	3.2.2.42
	for all the methods		

Object	Function	Input range	see...
***Parameter**	**Subtree "Parameters for SET"**		
.SET1	**Control parameters for EP1**		
.EP	End point 1	depends on meas quant.	3.2.2.24
.UnitEp	Unit of the end point EP1	read only	3.2.2.24
.Dyn	Dynamics	depends on meas quant.	3.2.2.25
.UnitDyn	Unit of dynamics	read only	3.2.2.25
.MaxRate	Maximum dispensing rate	0.01...150, max.	3.2.2.25
.MinRate	Minimum dispensing rate	0.01...999.9	3.2.2.25
.Stop	Titration stop		
.Type	Type of stop criterion	drift, time	3.2.2.26
.Drift	Stop drift	1...999	3.2.2.26
.Time	Switch-off delay time	0...999, inf	3.2.2.26
.StopT	Stop time	0...999 999, OFF	3.2.2.26
.SET2	**Control parameters for EP2**, identical to SET1		
.TitrPara	**Titration parameters**		
.Direction	Titration direction	+, –, auto	3.2.2.10
.XPause	Pause 1	0...999 999	3.2.2.11
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.12
.V	Volume for the absolute start volume	0...999.99	3.2.2.12
.Factor	Factor for the relative start volume	0... ± 999 999	3.2.2.12
.Rate	Dispensing rate	0.01...150, max.	3.2.2.12
.Pause	Pause 2	0...999 999	3.2.2.13
.ExtrT	Extraction time	0...999 999	3.2.2.14
.MeasInput	Measuring input	1, 2, diff.	3.2.2.15
.Ipol	Polarisation current	0... ± 127	3.2.2.15
.Upol	Polarisation potential	0... ± 1270	3.2.2.15
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.15
.Temp	Titration temperature	–170.0...500.0	3.2.2.16
.StopCond	**Stop conditions**		
.VStop	Stop volume		
.Type	Type of stop volume	abs., rel., OFF	3.2.2.17
.V	Volume for the absolute stop volume	0...9999.99	3.2.2.17
.Factor	Factor for the relative stop volume	0... ± 999 999	3.2.2.17
.FillRate	Filling rate after the titration	0.01...150.0, max.	3.2.2.18
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.19
.MeanN	Number of individual determinations	2...20	3.2.2.19
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.19
.DelN	Deletion of individual results	1...20	3.2.2.19
.Presel	**Preselections**		
.Cond	Conditioning	ON, OFF	3.2.2.20
.DriftDisp	Display of the drift during conditioning	ON, OFF	3.2.2.20
.DCor	Drift correction		
.Type	Drift type	abs., rel., OFF	3.2.2.21
.Value	Value for manual drift correction	0.0...99.9	3.2.2.21
.IReq	Request of Id's after start	id1, id2, all, OFF	3.2.2.22
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.22
.ActPulse	Output of a pulse	first, all, cond., OFF	3.2.2.23

Object	Function	Input range	see...
*Parameter	**Subtree "Parameters for KFT"**		
.CrtlPara	**Control parameters for EP**		
.EP	End point	depends on meas quant.	3.2.2.27
.UnitEp	Unit of the end point EP	read only	3.2.2.27
.Dyn	Dynamics	depends on meas quant.	3.2.2.28
.UnitDyn	Unit of dynamics	read only	3.2.2.28
.MaxRate	Maximum dispensing rate	0.01...150, max	3.2.2.28
.MinIncr	Minimum volume increment	0.1...9.9, min	3.2.2.28
.Stop	Titration stop		
.Type	Type of stop criterion	drift, time	3.2.2.29
.Drift	Stop drift	1...999	3.2.2.29
.Time	Switch-off delay time	0...999, inf	3.2.2.29
.StopT	Stop time	0...999 999, OFF	3.2.2.29
.TitrPara	**Titration parameters**		
.Direction	Titration direction	+, –, auto	3.2.2.10
.XPause	Pause 1	0...999 999	3.2.2.11
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.12
.V	Volume for the absolute start volume	0...999.99	3.2.2.12
.Factor	Factor for the relative start volume	0... ± 999 999	3.2.2.12
.Rate	Dispensing rate	0.01...150, max.	3.2.2.12
.Pause	Pause 2	0...999 999	3.2.2.13
.ExtrT	Extraction time	0...999 999	3.2.2.14
.MeasInput	Measuring input	1, 2, diff.	3.2.2.15
.Ipol	Polarisation current	0... ± 127	3.2.2.15
.Upol	Polarisation potential	0... ± 1270	3.2.2.15
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.15
.Temp	Titration temperature	–170.0...500.0	3.2.2.16
.StopCond	**Stop conditions**		
.VStop	Stop volume		
.Type	Type of stop volume	abs., rel., OFF	3.2.2.17
.V	Volume for the absolute stop volume	0...9999.99	3.2.2.17
.Factor	Factor for the relative stop volume	0... ± 999 999	3.2.2.17
.FillRate	Filling rate after the titration	0.01...150.0, max.	3.2.2.18
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.19
.MeanN	Number of individual determinations	2...20	3.2.2.19
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.19
.DelN	Deletion of individual results	1...20	3.2.2.19
.Presel	**Preselections**		
.Cond	Conditioning	ON, OFF	3.2.2.20
.DriftDisp	Display of the drift during conditioning	ON, OFF	3.2.2.20
.DCor	Drift correction		
.Type	Drift type	abs., rel., OFF	3.2.2.21
.Value	Value for manual drift correction	0.0...99.9	3.2.2.21
.IReq	Request of Id's after start	id1, id2, all, OFF	3.2.2.22
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.22
.ActPulse	Output of a pulse	first, all, cond., OFF	3.2.2.23

Object	Function	Input range	see...
*Parameter	**Subtree "Parameters for MEAS"**		
.Measuring	**Measurement parameters**		
.SignalDrift	Drift for measured value acquisition	depends on meas quant.	3.2.2.30
.UnitSigDrift	Unit of measured value drift	read only	3.2.2.30
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.30
.MeasInput	Measuring input	1, 2, diff.	3.2.2.30
.Ipol	Polarisation current	0... ± 127	3.2.2.31
.Upol	Polarisation potential	0... ± 1270	3.2.2.31
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.31
.Temp	Measurement temperature	–170.0...500.0	3.2.2.32
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.19
.MeanN	Number of individual determinations	2...20	3.2.2.19
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.19
.DelN	Deletion of individual results	1...20	3.2.2.19
.Presel	**Preselections**		
.IReq	Request of Id's after start	id1, id2, all, OFF	3.2.2.20
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.20
.ActPulse	Output of a pulse	ON, OFF	3.2.2.21

Object	Function	Input range	see...
*Parameter	**Subtree "Parameters for CAL"**		
.Calibration	**Calibration parameters**		
.MeasInput	Measuring input	1, 2, diff.	3.2.2.33
.CalTemp	Calibration temperature	–20.0...120.0	3.2.2.34
.Buffer	pH value of the buffers		
.1	Buffer 1		
.Value	pH value of buffer 1	0... ± 20.00	3.2.2.35
.2	Buffer 2		
.Value	pH value of buffer 2	0... ± 20.00, OFF	3.2.2.35
	up to 9 buffers		
.SignalDrift	Drift for measured value acquisition	0.5...999, OFF	3.2.2.36
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.36
.ElectrodeId	Electrode identification	up to 8 ASCII char	3.2.2.37
.SmplChanger	Calibration at sample changer	ON, OFF	3.2.2.38
.ActPulse	Output of a pulse	first, all, OFF	3.2.2.39
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.19
.MeanN	Number of individual determinations	2...20	3.2.2.19
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.19
.DelN	Deletion of individual results	1...20	3.2.2.19

Object	Function	Input range	see...
&	**Root**		
Config	**Configuration**		
.PeriphUnit	**Selection of external devices**		
.CharSet	Selection of the character set	Epson,Seiko,Citizen,IBM, HP	3.2.2.43
.Balance	balance selection	Sartorius,Mettler,Mettler AT, AND,Precisa	3.2.2.44
.Plot	Sel. of the curve at the analog output	U, dU/dt, V, dV/dt, U(rel)	3.2.2.44
.Aux	**Setting of various auxiliary functions**		
.Language	Selection of the dialog language	english,deutsch, francais,espanol	3.2.2.45
.Set	Setting of date and time	$G	3.2.2.46
.Date	Date	XX-XX-XX	3.2.2.46
.Time	Time	XX:XX	3.2.2.46
.RunNo	Current sample number	0...9999	3.2.2.47
.AutoStart	Internal automatic start	1...9999, OFF	3.2.2.48
.StartDelay	Start delay	0...9999	3.2.2.49
.DevName	Device name	up to 8 ASCII char	3.2.2.50
.Prog	Program version	read only	3.2.2.51
.RSSet	**Settings for RS232**	$G	3.2.2.52
.Baud	Baud Rate	special (300...9600)	3.2.2.53
.DataBit	Data Bit	7,8	3.2.2.53
.StopBit	Stop Bit	1,2	3.2.2.53
.Parity	Parity	even,odd,none	3.2.2.53
.Handsh	Handshake	HWs,HWf,SWchar, SWline,none	3.2.2.53
.ComVar	**Values of the common variables**		
.C30	Value of C30 up to C39	0... ± 999 999	3.2.2.54
SmplData	**Sample data**		
.Status	Status of the silo memory	ON, OFF	3.2.2.55
.OFFSilo	Current sample data (Silo = OFF)		
.Id1	Sample identification 1	up to 8 ASCII char	3.2.2.56
.Id2	Sample identification 2	up to 8 ASCII char	3.2.2.56
.Id3	Sample identification 3	up to 8 ASCII char	3.2.2.56
.ValSmpl	Sample size	±X.XXXXX	3.2.2.56
.UnitSmpl	Unit of the sample size	up to 5 ASCII char	3.2.2.56
.ONSilo	Sample data in the silo memory (Silo = ON)		
.Counter	Counters for the silo memory		
.MaxLines	Maximum possible number of lines	read only	3.2.2.57
.FirstLine	First occupied line	read only	3.2.2.57
.LastLine	Last occupied line	read only	3.2.2.57
.EditLine	Edit silo lines		
.1	1st silo line		
.Method	Method used to process sample	up to 8 ASCII char	3.2.2.58
.Id1	Sample identification 1	up to 8 ASCII char	3.2.2.58
.Id2	Sample identification 2	up to 8 ASCII char	3.2.2.58
.Id3	Sample identification 3	up to 8 ASCII char	3.2.2.58
.ValSmpl	Sample size	±X.XXXXX	3.2.2.58
.UnitSmpl	Unit of sample up to max. 99 lines	up to 5 ASCII char	3.2.2.58
.DelLine	Delete silo line	$G	3.2.2.59
.LineNum	Line number	1...99, OFF	3.2.2.59
.DelAll	Delete entire silo memory	$G	3.2.2.60
.CycleLines	Data cycling	ON, OFF	3.2.2.61

Object	Function	Input range	see...
&	**Root**		
Info	**Information**		
.Report	**Send formatted reports**	$G	3.2.2.62
.Select	Selection of the reports	configuration, parameters, smpl data, statistics, silo, calib, C-fmla, def, user method, calc, full, short, ff, all	3.2.2.62
.CalibrationData	pH calibration data	$G	3.2.2.63
.Inp1	For measuring input 1		
.pHas	Asymmetry pH	0... ± 20.00	3.2.2.63
.Slope	Slope of the electrode	0... ± 9.999	3.2.2.63
.Temp	Calibration temperature	-170...500	3.2.2.63
.Date	Date of the calibration	read only	3.2.2.63
.ElectrodeId	Id of the calibrated electrode	read only	3.2.2.63
.Inp2	For measuring input 2, identical to 1		
.Diff	For differential input, identical to 1		
.Checksums	**Checksums**	$G	3.2.2.64
.ActualMethod	Checksum of the current method	read only/read + write	3.2.2.64
.DetermData	**Determination data**		
.Write	Read/write of &Mode.Name and C4X	ON, OFF	3.2.2.65
.ExV	Volume of exchange unit	read only/read + write	3.2.2.65
.TitrResults	**Results of the determination**		
.RS	Calculated results		
.1	Result 1		
.Value	Numeric value of result 1	read only	3.2.2.66
	up to 9 results		
.EP	End points		
.1	End point 1		
.V	Volume coordinate	read only	3.2.2.66
.Meas	Measured value coordinate	read only	3.2.2.66
	up to 2 endpoints		
.Var	Variables C4X		
.C40	Initial measured value	read only/read + write	3.2.2.66
.C41	Titration end volume	read only/read + write	3.2.2.66
.C42	Titration time	read only/read + write	3.2.2.66
.C43	Volume drift	read only/read + write	3.2.2.66
.C44	Titration temperature	read only/read + write	3.2.2.66
.C45	Start volume	read only/read + write	3.2.2.66
.C46	Asymmetry pH	read only	3.2.2.66
.C47	Slope of the electrode	read only	3.2.2.66
.DTime	Time for drift correction	read only/read + write	3.2.2.66
.StatisticsVal	**Statistics values**		
.ActN	Number of results in statistics table	read only	3.2.2.67
.1	Data of MN1		
.Mean	Mean value	read only	3.2.2.67
.Std	Absolute standard deviation	read only	3.2.2.67
.RelStd	Relative standard deviation	read only	3.2.2.67
	up to 9 mean values		

Object	Function	Input range	see...
&	**Root**		
	Information, continued		
.ActualInfo	**Current information**		
.Inputs	I/O inputs		
.Status	Status of the lines	read only	3.2.2.68
.Change	Change in the status of the lines	read only	3.2.2.68
.Clear	Clears the change byte	$G	3.2.2.68
.Outputs	I/O outputs		
.Status	Status of the lines	read only	3.2.2.68
.Change	Change in the status of the lines	read only	3.2.2.68
.Clear	Clears the change byte	$G	3.2.2.68
.Assembly	Regarding subtree &Assembly		
.CyclNo	Cycle number	read only	3.2.2.68
.Counter	Counter in assembly		
.V	Volume counter	read only	3.2.2.70
.Clear	Clears above counter	$G	3.2.2.70
.Meas	Measured value	read only	3.2.2.71
.Titrator	Regarding the titrator		
.CyclNo	Cycle number	read only	3.2.2.72
.V	Volume	read only	3.2.2.72
.Meas	Measured value	read only	3.2.2.72
.dVdt	Volume drift dV/dt	read only	3.2.2.72
.dMeasdt	Measured value drift	read only	3.2.2.72
.dMeasdV	1st derivative of the titration curve	read only	3.2.2.72
.EP	Entry of an EP		
.Index	Index of the input	read only	3.2.2.73
.X	X-coordinate (volume)	read only	3.2.2.73
.Y	Y-coordinate (measured value)	read only	3.2.2.73
.Display	Display		
.L1	1st line	up to 24 ASCII char	3.2.2.74
.L2	2nd line	up to 24 ASCII char	3.2.2.74
.Assembly	**Assembly**		
.CycleTime	Cycle time	read only	3.2.2.75
.ExV	Volume of the Exchange Unit	read only	3.2.2.75

Object	Function	Input range	see...
&	**Root**		
Assembly	**Basic elements of the assembly**		
.Bur	**Burette**		
.Rates	Rates		
.Forward	In direction "expel"		
.Select	Type of rate control	digital, analog	3.2.2.76
.Digital	Digital rate	0...150,max.	3.2.2.76
.Reverse	In direction "aspirate"		
.Select	Type of rate control	digital, analog	3.2.2.76
.Digital	Digital rate	0...150,max.	3.2.2.76
.Fill	Filling	$G, $H, $C	3.2.2.77
.ModeDis	Dispensing mode	$G, $S, $H, $C	3.2.2.78
.Select	Type of dispensing control	volume, time	3.2.2.78
.V	Volume to be dispensed	0.0001...9999	3.2.2.78
.Time	Time of dispensing	0.25...86400	3.2.2.78
.VStop	Limit volume	0.0001...9999,OFF	3.2.2.78
.AutoFill	Filling after every increment	ON, OFF	3.2.2.78
.Meas	**Measurement**		
.Status	On/off switching of measurement	ON, OFF	3.2.2.79
.MeasInput	Selection of the measuring input	1, 2, Diff., Ipol, Upol, Temp	3.2.2.79
.Ipol	Polarisation current	0... ± 127	3.2.2.79
.Upol	Polarisation potential	0... ± 1270	3.2.2.79
.Outputs	**I/O outputs**		
.AutoEOD	Output of pulse End Of Determination	ON, OFF	3.2.2.80
.SetLines	Set I/O lines	$G	3.2.2.80
.L1	Signal on line 1	active, inactive, pulse, OFF	3.2.2.80
.L2	Signal on line of the EOD	as L1	3.2.2.80
.L3	Signal on line activate	as L1	3.2.2.80
.ResetLines	Reset I/O outputs	$G	3.2.2.80
Setup	**Setting the operation mode**		
.Keycode	Send key code of pressed key	ON,OFF	3.2.2.81
.Tree			
.Short	Only necessary characters	ON,OFF	3.2.2.82
.ChangedOnly	Only changed values	ON,OFF	3.2.2.82
.Trace	Message when values change	ON,OFF	3.2.2.83
.Lock	**Disable key functions**		
.Keyboard	Disable all keys of the Titrino	ON,OFF	3.2.2.84
.Config	Disable the <configuration> key	ON,OFF	3.2.2.84
.Parameter	Disable the <parameters> key	ON,OFF	3.2.2.84
.SmplData	Disable the <smpl data> key	ON,OFF	3.2.2.84
.UserMeth			
.Recall	Disable "recall" in key <user meth>	ON,OFF	3.2.2.84
.Store	Disable "store" in key <user meth>	ON,OFF	3.2.2.84
.Delete	Disable "delete" in key <user meth>	ON,OFF	3.2.2.84
.Display	Disable display service of the Titrino	ON,OFF	3.2.2.84

Object	Function	Input range	see...
&	**Root**		
	Setting the operation mode, cont.		
.Mode	**Setting of waiting time**		
.StartWait	Start delay time	ON,OFF	3.2.2.85
.SendMeas	**Automatic transmission of meas. data**		
.SendStatus	On/off switching of transmission	ON,OFF	3.2.2.86
.Interval	Time interval for transmission	0.08...16200	3.2.2.86
.Select	Selection	Assembly, Titrator	3.2.2.87
.Assembly	Values from &Assembly		
.CyclNo	Cycle number	ON,OFF	3.2.2.88
.V	Volume	ON,OFF	3.2.2.88
.Meas	Associated measured value	ON,OFF	3.2.2.88
.Titrator	Values from titrator		
.CyclNo	Cycle number	ON,OFF	3.2.2.89
.V	Associated volume	ON,OFF	3.2.2.89
.Meas	Associated measured value	ON,OFF	3.2.2.89
.dVdt	Associated volume drift	ON,OFF	3.2.2.89
.dMeasdt	Associated measured value drift	ON,OFF	3.2.2.89
.dMeasdV	Associated 1st derivative titr. curve	ON,OFF	3.2.2.89
.AutoInfo	**Automatic message on status changes**		
.Status	Global switch for set AutoInfos	ON,OFF	3.2.2.90
.P	When power is switched on	ON,OFF	3.2.2.90
.T	From titrator		
.R	When instrument in "ready" status	ON,OFF	3.2.2.90
.G	When method is started.	ON,OFF	3.2.2.90
.GC	When start command is received	ON,OFF	3.2.2.90
.S	When instrument in "stop" status	ON,OFF	3.2.2.90
.B	Begin of titration	ON,OFF	3.2.2.90
.F	End of titration	ON,OFF	3.2.2.90
.E	On error message	ON,OFF	3.2.2.90
.H	When instrument in "hold" status	ON,OFF	3.2.2.90
.C	Continue after hold	ON,OFF	3.2.2.90
.O	Conditioning OK.	ON,OFF	3.2.2.90
.N	Conditioning Not OK.	ON,OFF	3.2.2.90
.Re	When in request after titration start	ON,OFF	3.2.2.90
.SI	When silo memory empty	ON,OFF	3.2.2.90
.EP	Entry in EP list	ON,OFF	3.2.2.90
.RC	Recalculation	ON,OFF	3.2.2.90
.I	On change of an I/O input	ON,OFF	3.2.2.90
.O	On change of an I/O output	ON,OFF	3.2.2.90
.PowerOn	Simulation "power on"	$G	3.2.2.91
.Initialise	Set values to default settings	$G	3.2.2.92
.Select	Selection	ActMeth,Silo,Calib,Setup Config, Assembly, All	3.2.2.92
.RamInit	Initialisation, see page 126	$G	3.2.2.93
.InstrNo	Device number		
.Value	Label	8 ASCII-characters	3.3.3.94

3.2.2 Description of remote control commands

&Mode ...

3.2.2.1 **M**ode — $G, $S, $H, $C

Start and stop ($G, $S) or hold of the current method (3.2.2.3) with $H and continue with $C.
$G also serves to continue after inquiries of identifications and sample size after the start of titration (see 3.2.2.22) as well as after inquiries of calibration temperature and pH values of buffers (see 3.2.2.34 and 3.2.2.35).

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

Start and stop of a measurement in the basic mode with the parameters (measured quantity, measuring input) of the current method. Corresponds to the <meas/hold> key.
With an ongoing measurement, the current mode can be started. This stops the measurement automatically.

3.2.2.3

Mode.**S**elect	**SET**, MEAS, CAL
Mode.**SET**Quantity	**pH**, U, Ipol, Upol
Mode.**KFT**Quantity	**Ipol**, Upol
Mode.**MEA**SQuantity	**pH**, U, Ipol, Upol, T

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

3.2.2.4 **M**ode.**N**ame — read only/read + write

Name of the current method in the working memory. $Q sends 8 ASCII characters. Standard methods carry the name ********. The current method name may be changed, see 3.2.2.65.

3.2.2.5

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

Entry of formulas. Rules for formula entry, see page 47.
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 full and short result report. It is used for the result and the corresponding mean value.

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

Assignment of common variables. Results RS1...RS9 or Mean values MN1...MN9 can be assigned. The values of the common variables are to be found in &Config.ComVar. They can be viewed and entered there, see 3.2.2.54.

3.2.2.7 **M**ode.**Def.R**eport.**A**ssign full, short, ff, calc, param, calib

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

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

Assignment of the statistics calculations. Valid assignments are a requirement for statistics calculations. In addition, the statistics calculation must be switched on, see 3.2.2.19. Rules for statistics calculations see page 49.

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

Calculation constants specific to a method. Stored in the method memory of the Titrino. Operands specific to the sample (3.2.2.56 and 3.2.2.66) and values of common variables (3.2.2.54) on the other hand are not stored with the methods.

3.2.2.10 **M**ode.**P**arameter.**T**itrPara.**D**irection +, –, auto

Parameter for SET and KFT: Titration direction.

Default value in SET mode : **auto**
Default value in KFT Ipol mode: **–**
Default value in KFT Upol mode: **+**
"auto" means the titration direction is determined automatically by the instrument. If 2 EP's have been set (in SET mode), the titration direction is given by the two EP's. The entry of the titration direction is then invalid.

3.2.2.11 **M**ode.**P**arameter.**T**itrPara.**X**Pause **0**...999 999

Parameter for SET and KFT: Pause time 1 in s. Elapses **before** dispensing of start volume.

3.2.2.12 **M**ode.**P**arameter.**T**itrPara.**St**artV.**T**ype abs., rel., **OFF**
Mode.**P**arameter.**T**itrPara.**St**artV.**V** **0**...999.99
Mode.**P**arameter.**T**itrPara.**St**artV.**F**actor **0**... ±999 999
Mode.**P**arameter.**T**itrPara.**St**artV.**R**ate 0.01...150, **max.**

Parameter for SET and KFT: Start volume.
If an absolute start volume (abs.) has been selected, the volume in mL is valid.
A relative start volume (rel.) is dispensed as a function of the sample size:

Start volume in mL = smpl size* factor

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

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

Parameter for SET and KFT: Pause time 2 in s. Elapses after dispensing of start volume.

3.2.2.14 **M**ode.**P**arameter.**T**itrPara.**E**xtrT **0**...999 999

Parameter for SET and KFT: Extraction time in s.

3.2.2.15 **M**ode.**P**arameter.**T**itrPara.**Me**asInput **1**, 2, diff.
Mode.**P**arameter.**T**itrPara.**I**pol -127... + 127
Mode.**P**arameter.**T**itrPara.**U**pol -1270...**400**... + 1270
Mode.**P**arameter.**T**itrPara.**Po**lElectrTest ON, **OFF**

Parameter for SET and KFT:
Default values for Ipol: in mode SET **1**, KFT Ipol **50**, KFT Upol **20**
Selection of the measuring input; valid with measured quantities pH and U. "diff." means differential amplifier, see page 137.
With Ipol, the inquiries for the polarisation current in µA (Ipol) and .PolElectrTest are valid.
With Upol, the inquiry for the polarisation 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 changeover from the inactive state to an active state (titration or conditioning).

3.2.2.16 **M**ode.**P**arameter.**T**itrPara.**T**emp –170.0...**25.0**...500.0

Parameter for SET and KFT: Titration temperature in °C. If a Pt100 or Pt1000 is connected, the temperature is measured after the start of a method and the parameter .Temp updated.
The temperature is used for the temperature correction in pH measurements.

3.2.2.17 **M**ode.**P**arameter.**St**opCond.**V**Stop.**T**ype **abs.**, rel., OFF
Mode.**P**arameter.**St**opCond.**V**Stop.**V** 0...**99.99**...9999.99
Mode.**P**arameter.**St**opCond.**V**Stop.**F**actor 0... ± **999 999**

Parameter for SET and KFT: 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.

3.2.2.18 **M**ode.**P**arameter.**St**opCond.**F**illRate 0.01...150, **max.**

Parameter for SET and KFT: Filling rate after the titration in mL/min. Max. means maximum possible filling rate with the exchange unit in current use.

3.2.2.19 **M**ode.**P**arameter.**Sta**tistics.**S**tatus ON, **OFF**
Mode.**P**arameter.**Sta**tistics.**M**eanN **2**...20
Mode.**P**arameter.**Sta**tistics.**R**esTab.**S**elected **original**, delete n, delete all
Mode.**P**arameter.**Sta**tistics.**R**esTab.**D**elN 1...20

Entries for the statistics calculations.

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

.MeanN: Number of individual results for statistics calculations.

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

- original: Original table. The original table is (again) set up, i.e. any individual results which have been deleted are reincorporated in the statistics calculations.
- delete n: Single result lines are removed from the statistics calculation. All results of the corresponding line in the statistics table are deleted. Specification of the line number in .ResTab.DelN.
- delete all: Clear entire statistics table. The results can not be reactivated.

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

3.2.2.20 **M**ode.**P**arameter.**P**resel.**C**ond ON, **OFF**
Mode.**P**arameter.**P**resel.**D**riftDisp **ON**, OFF

Parameter for SET and KFT:
.Cond: On/off switching of conditioning.
.DriftDisp: On/off switching of drift display during conditioning.

3.2.2.21 **M**ode.**P**arameter.**P**resel.**DC**or.**T**ype auto,man,**OFF**
Mode.**P**arameter.**P**resel.**DC**or.**V**alue **0.0**...99.9

Parameter for SET and KFT:
.Type: Mode of drift correction
.Value: drift value in ul/min
If "auto" is set, the actual drift value at the start of titration is used for drift.correction.
Formula for drift correction : EP – (drift value * titration time)

3.2.2.22 **M**ode.**P**arameter.**P**resel.**I**Req id1, id1&2, all, **OFF**
Mode.**P**arameter.**P**resel.**S**Req value, unit, all, **OFF**

Parameter for SET, KFT and MEAS: Automatic inquiry after the start of the determination. From such an inquiry, the determination continues if the requested entry/entries is/are made, e.g. &SmplData.OFFSilo.Id1 (see 3.2.2.56) or with &M $G, siehe 3.2.2.1.

3.2.2.23 **M**ode.**P**arameter.**P**resel.**A**ctPulse SET, KFT: first, all, cond.,**OFF**
MEAS: ON, **OFF**

Parameters for SET, KFT and MEAS:
Output of a pulse on the I/O line "activate", see page 153f.

3.2.2.24 **M**ode.**P**arameter.**S**ET1.**E**P — pH: 0... ±20.00, **OFF**; U, Ipol: 0... ±2000, **OFF**; Upol: 0... ±200.0, **OFF**

Mode.**P**arameter.**S**ET1.**U**nitEp — read only

Parameter for SET: Setting of the 1st end point as a pH value, in mV (with U and Ipol) or µA (with Upol). The corresponding unit can be read with .UnitEP.
If the value is on "OFF", there are no further nodes of SET1 appearing.

3.2.2.25 **M**ode.**P**arameter.**S**ET1.**D**yn — pH: 0.01... ±20.00, **OFF**; U, Ipol: 1... ±2000, **OFF**; Upol:0.1... ±200.0, **OFF**

Mode.**P**arameter.**S**ET1.**UnitD**yn — read only
Mode.**P**arameter.**S**ET1.**M**axRate — 0.01...**10**...150, max.
Mode.**P**arameter.**S**ET1.**M**inRate — 0.01...**25.0**...999.9

Parameters for SET: Control parameters, see page 24ff.
.Dyn: Dynamics, control range in pH, mV (with U and Ipol) or µA (with Upol). The corresponding unit can be read with .UnitDyn.
.MaxRate: Maximum allowed titration rate in mL/min. Max. means maximum possible rate with the Exchange Unit in current use.
.MinRate: Minimum titration rate in µL/min.

3.2.2.26 **M**ode.**P**arameter.**S**ET1.**S**top.**T**ype — **drift**, time
Mode.**P**arameter.**S**ET1.**S**top.**D**rift — 1...**20**...999
Mode.**P**arameter.**S**ET1.**S**top.**T**ime — 0...**10**...999, inf.
Mode.**P**arameter.**S**ET1.**S**top.**S**topT — 0...999 999, **OFF**

Parameter für 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 µl/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.".

3.2.2.27 **M**ode.**P**arameter.**C**trlPara.**E**P — U, Ipol: **250**... ±2000; I, Upol: **25**... ±200.0

Mode.**P**arameter.**C**trlPara.**U**nitEp — read only

Parameter for KFT: Setting of the end point as in mV (with Ipol) or µA (with Upol). The corresponding unit can be read with .UnitEP.

3.2.2.28 **M**ode.**P**arameter.**C**trlPara.**D**yn — pH: 0.01... ±20.00, **OFF**; U, Ipol: 1... ±2000, **OFF**; Upol:0.1... ±200.0, **OFF**

Mode.**P**arameter.**C**trlPara.**UnitD**yn — read only

Mode.**P**arameter.**C**trlPara.**M**axRate — 0.01...150, **max**

Mode.**P**arameter.**C**trlPara.**M**inIncr — 0.1...9.9, **min**

Parameters for KFT: Control parameters, see page 33ff.

.Dyn: Dynamics, control range in mV (with Ipol) or µA (with Upol). The corresponding unit can be read with .UnitDyn.

.MaxRate: Maximum allowed titration rate in mL/min. Max. means maximum possible rate with the Exchange Unit in current use.

.MinIncr: Minimum volume increment in µL.

3.2.2.29 **M**ode.**P**arameter.**C**trlPara.**S**top.**T**ype — **drift**, time

Mode.**P**arameter.**C**trlPara.**S**top.**D**rift — 1...**20**...999

Mode.**P**arameter.**C**trlPara.**S**top.**T**ime — 0...**10**...999, inf

Mode.**P**arameter.**C**trlPara.**S**top.StopT — 0...999 999, **OFF**

Parameter for KFT: 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 µl/min. Applies when "drift" has been selected.

.Time: Switch-off delay time in s. Applies when "time" has been selected. "inf" means infinite.

.StopT: Stop time in s. Applies when "time" has been selected and the value of .Time is set to "inf.".

3.2.2.30 **M**ode.**P**arameter.**M**easuring.**S**ignalDrift — pH, U, Ipol, T: 0.5...999, **OFF**; Upol: 0.05...99.9, **OFF**

Mode.**P**arameter.**M**easuring.**U**nitSigDrift — read only

Mode.**P**arameter.**M**easuring.**E**quTime — 0...9999, **OFF**

Parameters for MEAS: Criteria for the measured value acquisition. Measured value drift in mV/min (with pH, U, Ipol, T) or µA/min (with Upol), 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. After it has been edited once, it remains in force with the set value.

3.2.2.31 **M**ode.**P**arameter.**M**easuring.**M**easInput — **1**, 2, diff.

Mode.**P**arameter.**M**easuring.**I**pol — -127...**1**... + 127

Mode.**P**arameter.**M**easuring.**U**pol — -1270...**400**... + 1270

Mode.**P**arameter.**M**easuring.**Pol**ElectrTest — ON, **OFF**

Parameter for MEAS:
Selection of the measuring input; valid with measured quantities pH and U. "diff." means differential amplifier, see page 137.
With Ipol, the inquiries for the polarisation current in µA (Ipol) and .PolElectrTest are valid.
With Upol the inquiry for the polarisation 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 changeover from the inactive state to the measurement.

3.2.2.32 **M**ode.**P**arameter.**M**easuring.**T**emp — –170.0...**25.0**...500.0

Parameter for MEAS: Measurement temperature in °C. If a Pt100 or Pt1000 is connected, the temperature is measured after the start and the parameter .Temp updated.
The temperature is used for the temperature correction in pH measurements.

3.2.2.33 **M**ode.**P**arameter.**C**alibration.**M**easInput **1**, 2, diff.

Parameter for CAL: Selection of the measuring input. "diff." means differential amplifier, see page 137.

3.2.2.34 **M**ode.**P**arameter.**C**alibration.**C**alTemp –20.0...**25.0**...120.0

Parameter for CAL: Calibration temperature in °C. If a Pt 100 or Pt1000 is connected, the temperature is measured.

3.2.2.35 **M**ode.**P**arameter.**C**alibration.**B**uffer.**1.V**alue -20.00...**7.00**... + 20.00
Mode.**P**arameter.**C**alibration.**B**uffer.**2.V**alue -20.00...**4.00**... + 20.00, OFF
etc. up to 9 buffers

Parameter for CAL: pH of buffers. The first buffer which is set to "OFF" determines the number of buffers in the calibration.

3.2.2.36 **M**ode.**P**arameter.**C**alibration.**S**ignalDrift 0.5...**2**...999, OFF
Mode.**P**arameter.**C**alibration.**E**quTime 0...**110**...9999, OFF

Parameter for CAL: Criteria for measured value acquisition. Measured value drift in mV/min, equilibration time in s. OFF means that the corresponding criterion is switched off. If both criterions are on OFF, the measured value is acquired immediately.
If the equilibration time has never been edited, it is automatically calculated by the instrument to match the drift, see page 28. After it has been edited once, it remains in force with the set value.

3.2.2.37 **M**ode.**P**arameter.**C**alibration.**E**lectrodeId up to 8 ASCII characters

Parameter for CAL: Electrode identification. It is classified under calibration data, see 3.2.2.63.

3.2.2.38 **M**ode.**P**arameter.**C**alibration.**Sm**plChanger ON, **OFF**

Parameter for CAL: Calibration at sample changer.
With "ON", there are no hold points in the calibration sequence for entries, the first buffer is measured directly.

3.2.2.39 **M**ode.**P**arameter.**C**alibration.**A**ctPulse first, all, **OFF**

Parameter for CAL: Output of a pulse on the I/O line "activate", see page 153f.

&UserMeth ...

3.2.2.40 **U**serMeth.**F**reeMem — read only

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

3.2.2.41

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

Management of the method memory from the Titrino: Loading, storage and deletion of methods. An action is performed if "$G" is sent to the corresponding node just after entering the name.
Do not use preceding or succeeding blanks in method names!
.DelAll: Deletes all methods in the user memory.

3.2.2.42

UserMeth.**L**ist.**1**.**N**ame	read only
UserMeth.**L**ist.**1**.**M**ode	read only
UserMeth.**L**ist.**1**.**Q**uantity	read only
UserMeth.**L**ist.**1**.**B**ytes	read only
UserMeth.**L**ist.**1**.**C**hecksum	read only
for every 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 3.2.2.64.

&Config ...

3.2.2.43 **C**onfig.**P**eriphUnit.**C**harSet — Epson, Seiko, Citizen, **IBM**, HP

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

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

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

3.2.2.45 **C**onfig.**A**ux.**L**anguage — **english**, deutsch, francais, espanol, portuguese, italiano, svenska

Selection of the dialog language.

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

Date and time.
Input format of the date: Year-month-day, 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.

3.2.2.47 **C**onfig.**A**ux.**R**unNo — **0**...9999

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

3.2.2.48 **C**onfig.**A**ux.**A**utoStart — 1...9999, **OFF**

Number of automatic, internal starts.

3.2.2.49 **C**onfig.**A**ux.**S**tartDelay — **0**...999 999

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

3.2.2.50 **C**onfig.**A**ux.**Dev**Name — 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 Nos 65...90), a...z (ASCII Nos 97...122) and the numbers 0...9 (ASCII Nos 48...57) when the function Setup.AutoInfo (3.2.2.90) is used at the same time.

3.2.2.51 **C**onfig.**A**ux.**P**rog — read only

Output of the program version.
The Titrino sends "720.0010" on requests with $Q.

3.2.2.52 **C**onfig.**R**SSet — $G

$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.

3.2.2.53	**C**onfig.**R**SSet.**B**aud	300, 600, 1200, 2400, 4800, **9600**
	Config.**R**SSet.**D**ataBit	7, **8**
	Config.**R**SSet.**S**topBit	**1**, 2
	Config.**R**SSet.**P**arity	even, odd, **none**
	Config.**R**SSet.**H**andsh	**HWs**, HWf, SWchar, SWline, none

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 107 ff.
The setting of the values must be initiated with $G immediately after entry of the values, see 3.2.2.52.

3.2.2.54 **C**onfig.**C**omVar.**C30** — **0**... ± 999 999
etc. up to **.C39**

Values of the common variables C30 to C39. The common variables can either be entered or written directly from the experimental results of the methods, see 3.2.2.6.

&SmplData ...

3.2.2.55 **S**mplData.**S**tatus — ON, **OFF**

On/off switching of silo memory. When the silo memory is switched on, the sample data are fetched from the lowest valid silo line.

3.2.2.56	**S**mplData.**O**FFSilo.**I**d1	up to 8 ASCII characters
	SmplData.**O**FFSilo.**Id2**	up to 8 ASCII characters
	SmplData.**O**FFSilo.**Id3**	up to 8 ASCII characters
	SmplData.**O**FFSilo.**V**alSmpl	6-digit number with sign and decimal point
	SmplData.**O**FFSilo.**U**nitSmpl	up to 5 ASCII characters

Current sample data.
The identifications Id1...Id3 can be used in formulas as sample-specific calculation constants C21...C23.
If "no unit" is desired for the unit of the sample size, the blank string must be entered.

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

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

3.2.2.58	**S**mplData.**ON**Silo.**E**ditLine.**1.M**ethod	up to 8 ASCII characters
	SmplData.**ON**Silo.**E**ditLine.**1.I**d1	up to 8 ASCII characters
	SmplData.**ON**Silo.**E**ditLine.**1.Id2**	up to 8 ASCII characters
	SmplData.**ON**Silo.**E**ditLine.**1.Id3**	up to 8 ASCII characters
	SmplData.**ON**Silo.**E**ditLine.**1.V**alSmpl	6-digit number with sign and decimal point
	SmplData.**ON**Silo.**E**ditLine.**1.U**nitSmpl	up to 5 ASCII characters
	etc. up to **.99**	

Contents of a silo line.
.Method: Method used to process the sample, from the method memory.
.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.

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

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

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

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

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

Silo data cycling.
With "ON", executed lines are copied to the next free silo lines, see page 58. Exercise caution if you edit the silo memory during the determinations!

&Info ...

3.2.2.62 **I**nfo.**R**eport $G
Info.**R**eport.**S**elect configuration, parameters, smpl data, statistics, silo, calib, C-fmla, def, user method, calc, full, short, ff, all

$G sends the selected report:

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.
cal.data:	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.
calc:	Calculation report of the current method.
full:	Full result report of the last completed determination.
short:	Short result report of the last completed determination.
ff:	Form feed on printer.
all:	All reports.

Reports which are sent from the Titrino are marked with space (ASCII32) 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 preceeding space, i.e. they start with '.

3.2.2.63 **I**nfo.**C**alibrationData $G
Info.**C**alibrationData.**I**np1.**p**Has -20.00...**7.00**... + 20.00
Info.**C**alibrationData.**I**np1.**S**lope -9.999...**1.000**... + 9.999
Info.**C**alibrationData.**I**np1.**T**emp -170.0...**25.0**... + 500.0
Info.**C**alibrationData.**I**np1.**D**ate read only
Info.**C**alibrationData.**I**np1.**E**lectrodeId read only
identical for .Inp2 and .Diff

pH calibration data for measuring input 1. After the calibration, the data are entered automatically together with the date of the calibration and the electrode identification, see 3.2.2.37.
Calibration data can be entered. They are accepted with &Info.CalibrationData $G. If calibration data are entered, the calibration date is deleted.

3.2.2.64 **I**nfo.**Ch**ecksums $G
Info.**Ch**ecksums.**A**ctualMethod read only

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

.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.

3.2.2.65 **I**nfo.**D**etermData $G
Info.**D**etermData.**W**rite ON, **OFF**
Info.**D**etermData.**E**xV read only/read + write

Recalculation of the measuring data is triggered with $G.
.Write: With "ON" &Mode.Name as well as the variables C4X , X = 0...5, in node &Info.TitrResults.Var can be entered.

3.2.2.66 **I**nfo.**T**itrResults.**RS.1.V**alue read only
etc. up to **.9**
Info.**T**itrResults.**EP.1.V** read only
Info.**T**itrResults.**EP.1.M**eas read only
same for **.EP.2**
Info.**T**itrResults.**V**ar.**C**40 read only/read + write
etc. up to **.C47**
Info.**T**itrResults.**V**ar.**D**Time read + write

.RS: Values of the calculated results.
.EP: Endpoint(s) with SET and KFT:
- Volume coordinate in mL, e.g. "1.234"
- Measured value coordinate in pH "5.12", mV (with U and Ipol) "-241" or µA (with Upol) "43.7".

.Var: Various variables. The variables C40...C45 may be modified, see 3.2.2.62.
C40: Initial measured value in pH "5.12", mV (with U and Ipol) "–241", µA (with Upol) "43.7" or °C (withT) "25.0".
C41: Titration end volume with SET and KFT in mL, "12.536".
C42: Titration time from start to end in s, "62".
C43: Volume drift on start of a SET or KFT titration from the conditioning in µL/min, "3.5".
C44: Titration temperature in °C, "23.2". Measured after the start and used for the temperature correction in pH measurements.
C45: Start volume with SET and KFT in mL, "2.800".
C46: Asymmetry pH of CAL, "6.89".
C47: Relative electrode slope of CAL, "0.995".
DTime: Time for calculation of drift correction.

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

The current values of the statistics calculation.

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

3.2.2.68 **I**nfo.**A**ctualInfo.**I**nputs.**S**tatus read only
Info.**A**ctualInfo.**I**nputs.**C**hange read only
Info.**A**ctualInfo.**I**nputs.**C**lear $G
Info.**A**ctualInfo.**O**utputs.**S**tatus read only
Info.**A**ctualInfo.**O**utputs.**C**hange read only
Info.**A**ctualInfo.**O**utputs.**C**lear $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 byte. For the output, the byte is converted 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 151ff):

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	Freely selectable (pin 3)
5	pin 11	5	Error (pin 16)
6	pin 24	6	Activate (pin 1)
7	pin 12	7	Pulse for recorder (pin 2)

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

$Q sends the current cycle number of the voltage measurement cycle, e.g. "127". From the cycle number and the cycle time (see 3.2.2.75), 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.

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

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

3.2.2.71 **I**nfo.**A**ctualInfo.**A**ssembly.**P**istonPos read only
Info.**A**ctualInfo.**A**ssembly.**M**eas read only

Piston position and measured value in mV from assembly.
Piston position:
0 = initial position (filled)
10 000 = end position (empty)

3.2.2.72 **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:

		SET	MEAS	CAL
Cycle number		127	127	127
Volume (ml)		1.2345	–	–
Meas.value:	pH	-345.6 (mV)	3.456	3.456
	U, Ipol (mV)	-345.6	-345.6	–
	Upol (uA)	-12.5	-12.5	–
	T (°C)	–	25.0	–
Volume drift (ul/s)		2.5	–	–
Meas.value-	pH, U, Ipol (mV/s)	0.7	0.7	0.7
drift:	Upol (uA/s)	0.7	0.7	–
	T (°C/s)	–	0.7	–

NV: Not valid. If 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 3.2.2.75). The cycle number is set to 0 at the start of a method and it is incremented until the end of the method.

3.2.2.73 **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 list of EP's with SET.
&Info.Actualinfo.EP $Q sends e.g.

.Index"1"	EP1
..X"1.234"	Volume coordinate of the EP
..Y"5.34"	Measured value coordinate of the EP

3.2.2.74 **Info.Actualinfo.Display.L1** up to 24 ASCII characters
Info.Actualinfo.Display.L2 up to 24 ASCII characters

1st or 2nd line of the display. The display can be written to from the computer.
The display is not operated by the Titrino if 'Setup.Lock.Display' is set to ON, see 3.2.2.84.
$Q sends the contents of the corresponding display line.

3.2.2.75 **Info.Assembly.CycleTime** read only
Info.Assembly.ExV read only

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

&Assembly ...

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

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

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

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

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

Dispensing mode with parameters. The dispensing mode can only be started and stopped via the RS Control. During a running dosification, no method can be started at the Titrino.

.Selected:	Dispensing of volume increments or during a preset time.
.Volume, .Time:	Size of the volume increments or entry of time.
.VStop:	Limit volume for the dispensing.
.AutoFill:	ON means automatic filling after every dispensing.

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

Measurement in assembly. The measuring function can only be started via RS Control. When the measuring function is switched on, no method can be started at the Titrino.

.Input:	Selection of the potentiometric measuring input 1, 2, diff., polarized electrodes or temperature.
.Ipol:	Polarisation current in µA.
.Upol:	Polarisation potential in mV, entry in steps of 10 mV.

3.2.2.80	**A**ssembly.**O**utputs.**A**utoEOD	**ON**, OFF
	Assembly.**O**utputs.**S**etLines	$G
	Assembly.**O**utputs.**S**etLines.**L**1	active, inactive, pulse, **OFF**
	Assembly.**O**utputs.**S**etLines.**L2**	active, inactive, pulse, **OFF**
	Assembly.**O**utputs.**S**etLines.**L3**	active, inactive, pulse, **OFF**
	Assembly.**O**utputs.**R**esetLines	$G

Setting the I/O output lines.

.AutoEOD: The automatic output of the EOD (End of Determination) at the end of the determination can be switched off. Thus, for example, in conjunction with a sample changer several determinations can be performed in the same beaker. Before AutoEOD is switched on, line 2 must be set to "OFF".

.SetLines: With $G, lines 1 and 2 are set.

.SetLines.1: Set the freely forcible line 1. "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 152.

.SetLines.2: Line of EOD. Exercise caution in combinations with AutoEOD "ON": A statically active line 2 is set by the EOD pulse to "inactive".

.SetLines.3: Line "activate". Exercise caution in combinations with activate pulse: A statically active line 3 is set by the activate pulse to "inactive".

.ResetLines: Lines 1, 2 and 3 are set to the inactive status (=high).

&Setup ...

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

ON means the key code of a key pressed on the Titrino is outputted. The key code comprises 2 ASCII characters; table of the keys with their code, see page 119. A keystroke of key 11 is sent as follows:

#11

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

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

Definition of the type of answer to $Q. Enables rapid data transfer.

.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 ave been edited. All paths are sent absolute, i.e. from the root &. ChangedOnly works properly in the following subtrees:
&Mode
&User
&Config
&SmplData
A combination of .Short and .ChangedOnly is not possible.

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

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

&SmplData.OFFSilo.ld1"Trace"

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

3.2.2.84 **S**etup.**L**ock.**K**eyboard ON, **OFF**
Setup.**L**ock.**C**onfig ON, **OFF**
Setup.**L**ock.**P**arameter ON, **OFF**
Setup.**L**ock.**S**mplData ON, **OFF**
Setup.**L**ock.**U**serMeth.**R**ecall ON, **OFF**
Setup.**L**ock.**U**serMeth.**S**tore ON, **OFF**
Setup.**L**ock.**U**serMeth.**D**elete ON, **OFF**
Setup.**L**ock.**D**isplay ON, **OFF**

ON means disable the corresponding function:

.Keyboard: Disable all keys of the Titrinos
.Config: Disable the <configuration> key
.Parameter: Disable the <cparameter> 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.

3.2.2.85 **Se**tup.**M**ode.**S**tartWait ON, **OFF**

Indefinite start delay (only for remote control). The last determination's data remain available. On power ON/OFF StartWait is set to OFF.

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

.SendStatus: ON means the automatic transmission of measured values (see 3.2.2.88 and 3.2.2.89) in the inputted interval is active.
.Interval: Time interval (in s) for the automatic transmission of associated measured values defined under points 3.2.2.88 and 3.2.2.89. 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.
The automatic transmission is switched on/off with 'SendStatus'.

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

Selection of the unit of which the measured values should be sent (3.2.2.88 or 3.2.2.89).

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

Selection of the values from Assembly for the output in the set time interval (see 3.2.2.86):
.CyclNo: Cycle number of the potential measurement. Together with the cycle time (3.2.2.75), 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 3.2.2.87).

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

Selection of the values from the titrator which are sent in the set time interval (see 3.2.2.86, formats see 3.2.2.72):
.CyclNo: Cycle number. Together with the cycle time (3.2.2.75), 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: associated volume.
.Meas: associated measured value.
.dVdt: associated volume drift.
.dMeasdt: associated measured value drift.
.dMeasdV: associated1st derivative of the titration curve..
The unit "titrator" must be preset (see 3.2.2.87).

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

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

.Status:	Global switch for all set AutoInfo.
.P	PowerOn: Simulation of power on (3.2.2.91). Not from mains.

Messages from node .T, Titrator:

.T.R	Ready: Status 'Ready' has been reached.
.T.G	Go: Method has been started.
.T.GC	Go Command: Start command has been received.
.T.S	Stop: Status 'Stop' has been reached.
.T.B	Begin of titration.
.T.F	Final: End of determination, the final steps will be carried out.
.T.E	Error. Message together with error number, see page 70ff.
.T.H	Hold: Status 'Hold' has been reached.
.T.C	Continue: Continue after hold.
.T.O	Conditioning OK in SET and KFT with conditioning.
.T.N	Conditioning Not OK in SET and KFT with conditioning.
.T.Re	Request: In the inquiry of an identification or the sample size after start of titration or in temperature or buffer request in CAL mode.
.T.Si	SiloEmpty: Silo empty, i.e. the last line has been removed from the silo memory.
.T.EP	EPList: Entry into EP list (with SET and KFT)
.T.RC	Recalculation of results.

Messages for changements in the I/O lines. If the changements 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 3.2.2.50). 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

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

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

3.2.2.92 **Se**tup.**I**nitialise $G
Setup.**I**nitialise.**S**elect **ActMeth**, Silo, Calib, Config, Assembly, Setup, All

Setting of default values for the following areas:

ActMeth:	Current method. Parameters, calculations, and assignments for the data output, operands C01...C19.
Silo:	The silo memory is deleted. Same function as delete entire silo.
Calib:	pH calibration data for all measuring inputs.
Config:	All values under &Config.
Assembly:	All values under &Assembly.
Setup:	All values under &Setup.
All:	Values of the entire tree (except silo and method memory).

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

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

Initialises instrument as in the diagnosis, see page 126. All parameters are set to their default value and error messages are cleared.

3.2.2.94 **Se**tup.**Ins**trNo.**V**alue 8 ASCII characters

Device number.

3.3. RS232 interface characteristics

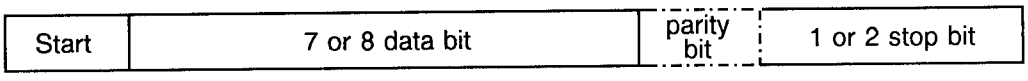
3.3.1 Data transfer protocol

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

The RS232 interface has the following technical specifications:

Data interface in accordance with the RS 232C standard. RS parameters can be selected, see page 22.

Max. line length:	80 characters + C_R L_F
Control characters:	C_R (ASCII DEC 13)
	L_F (ASCII DEC 10)
	XON (ASCII DEC 17)
	XOFF (ASCII DEC 19)
Cable length:	max. ca. 15 m



For interconnections of the Titrino with non-Metrohm units, only a shielded data cable (e.g. METROHM D.104.0201) may be used. The cable shielding must be faultlessly earthed at both units (pay attention to current loops; always use star-head earthing). Only connectors with adequate shielding may be used (e.g. METROHM K.210.0001 with K.210.9004).

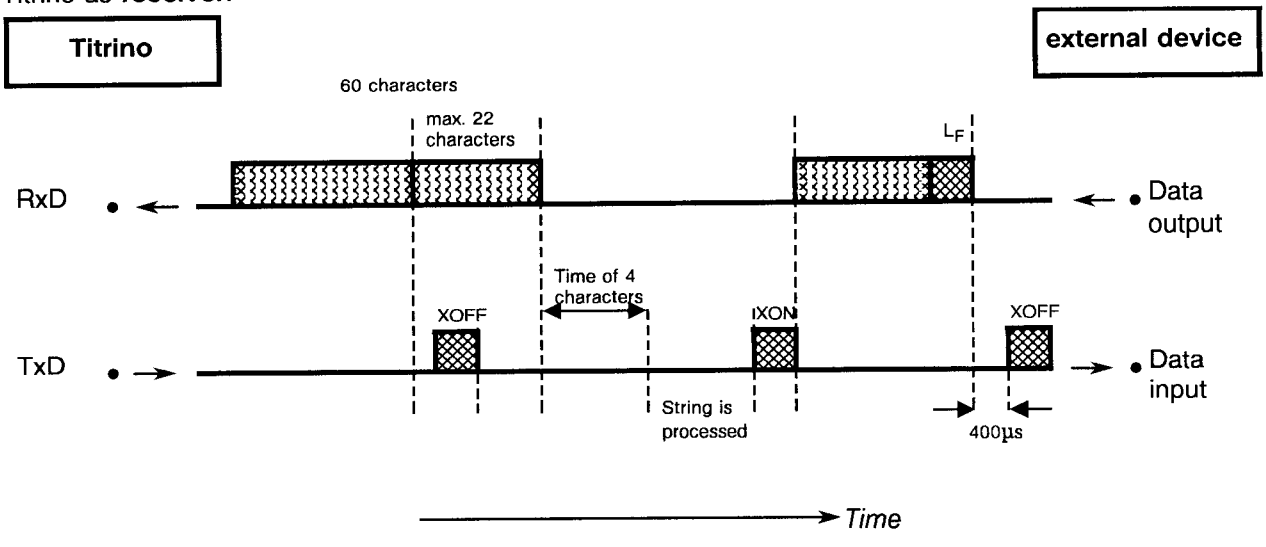
3.3.2 Handshake

3.3.2.1 Software handshake , SWChar

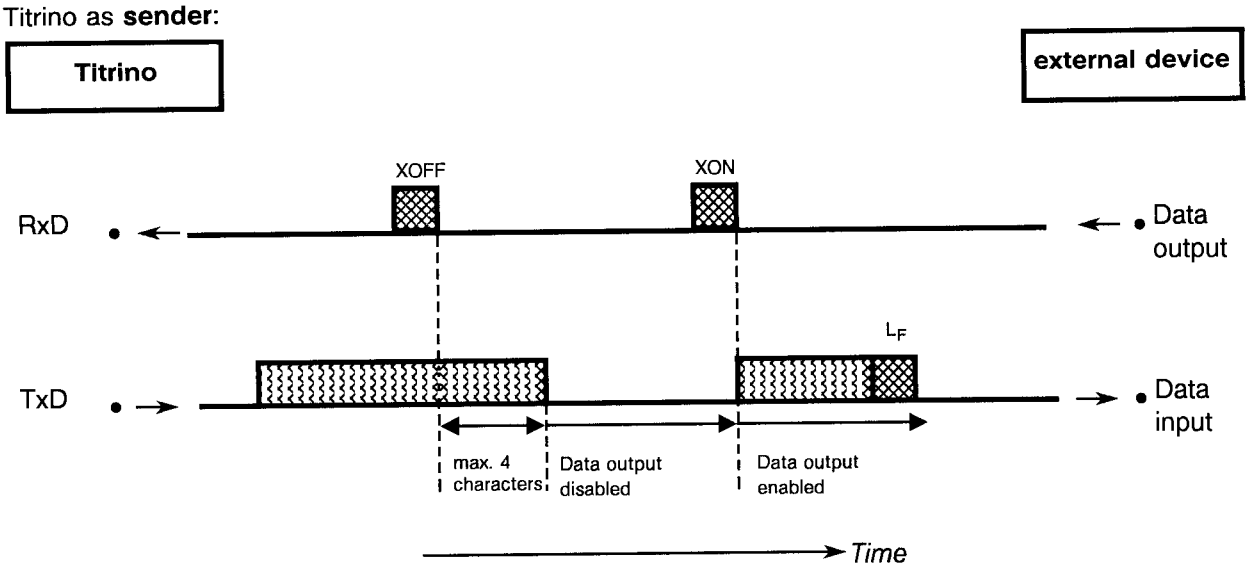
Handshake inputs at the Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the Titrino.

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

Titrino as **receiver**:



Titrino as **sender**:

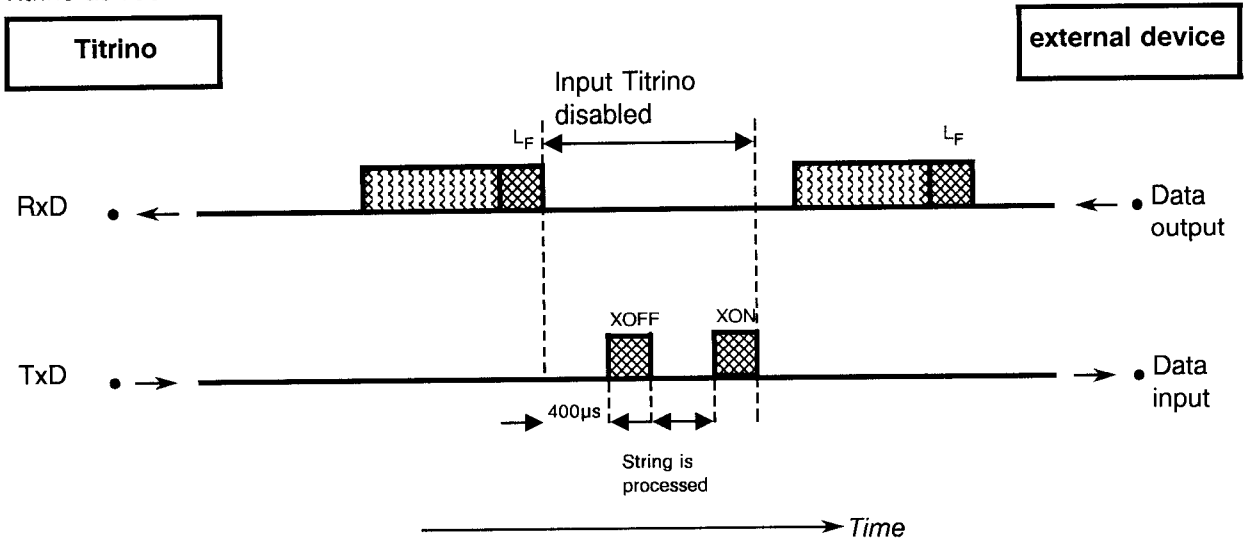


3.3.2.2 Software-Handshake , SWline

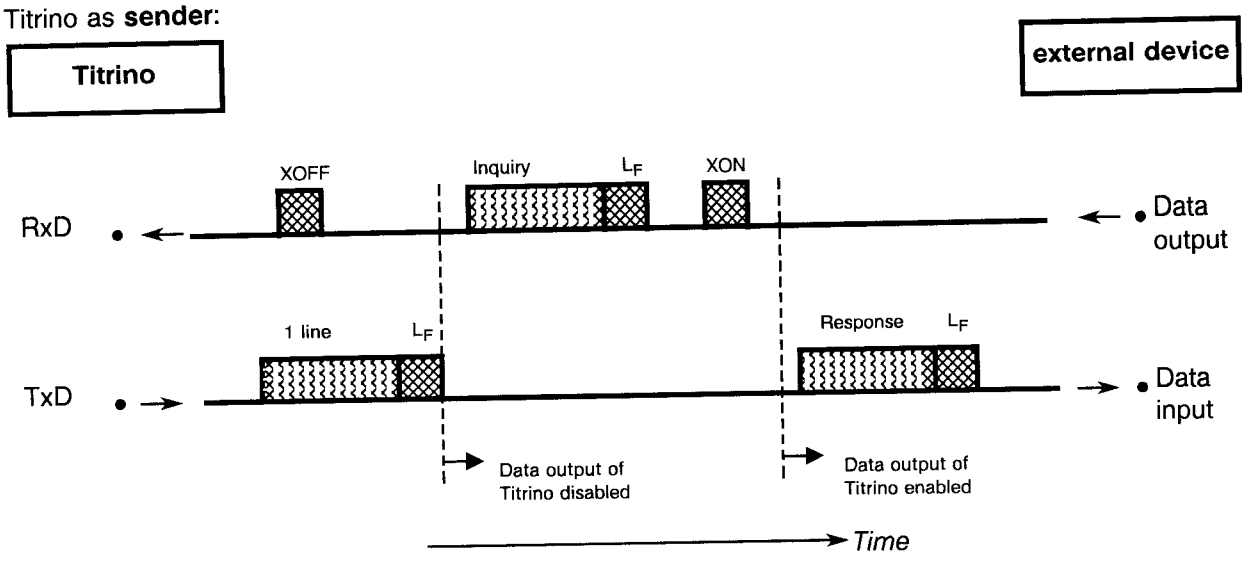
Handshake inputs at the Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the Titrino.

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

Titrino as **receiver**:



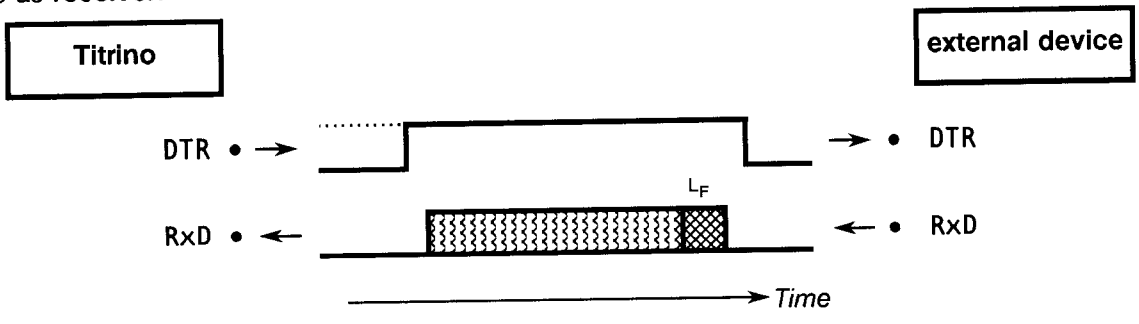
Titrino as **sender**:



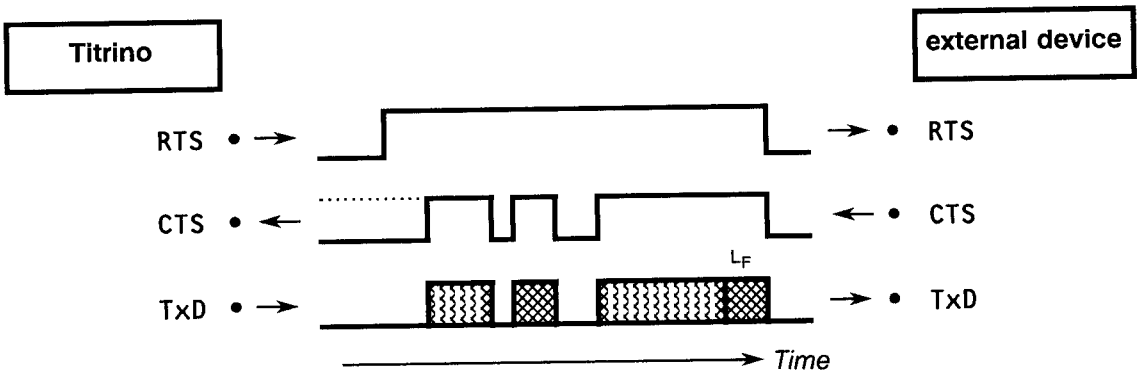
The transmission of the Titrino can be stopped by the external device with XOFF. After receipt of XOFF, the Titrino completes transmission of the line already started. If the data output is disabled for more than 3 s by XOFF, E43 appears in the display.

3.3.2.3 Hardware handshake, HWs

Titrino as **receiver**:



Titrino as **sender**:

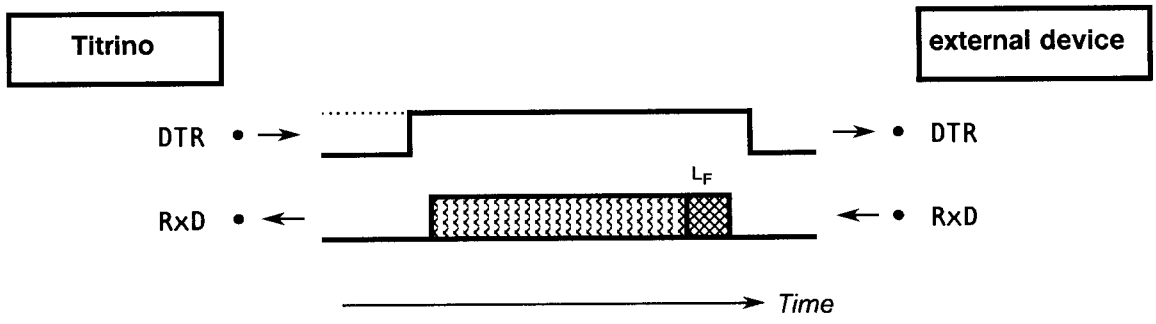


The data flow can be interrupted by deactivation of the CTS line.

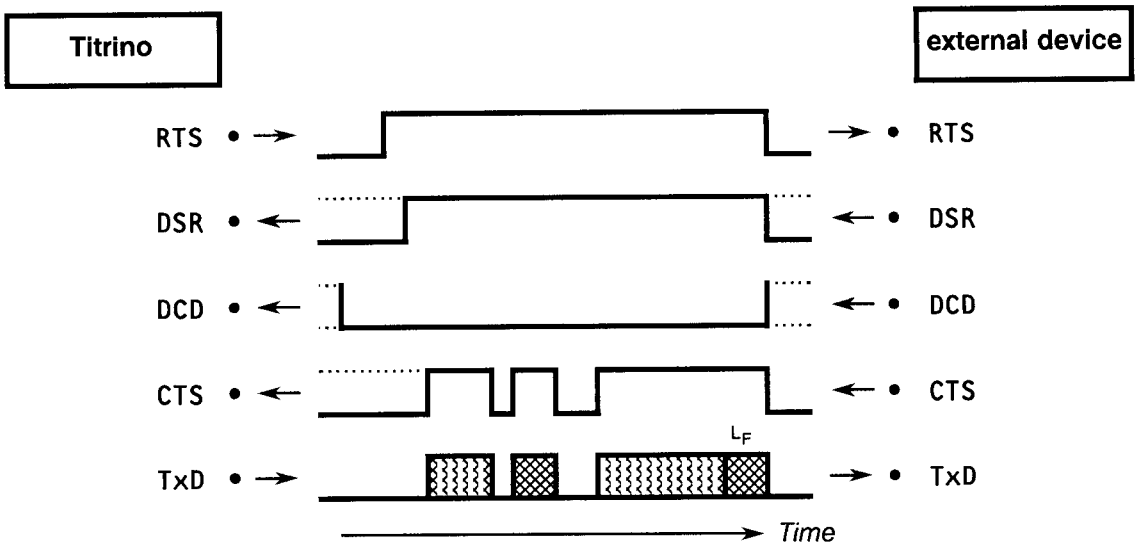
Hardware handshake, HWf

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

Titrino as **receiver:**

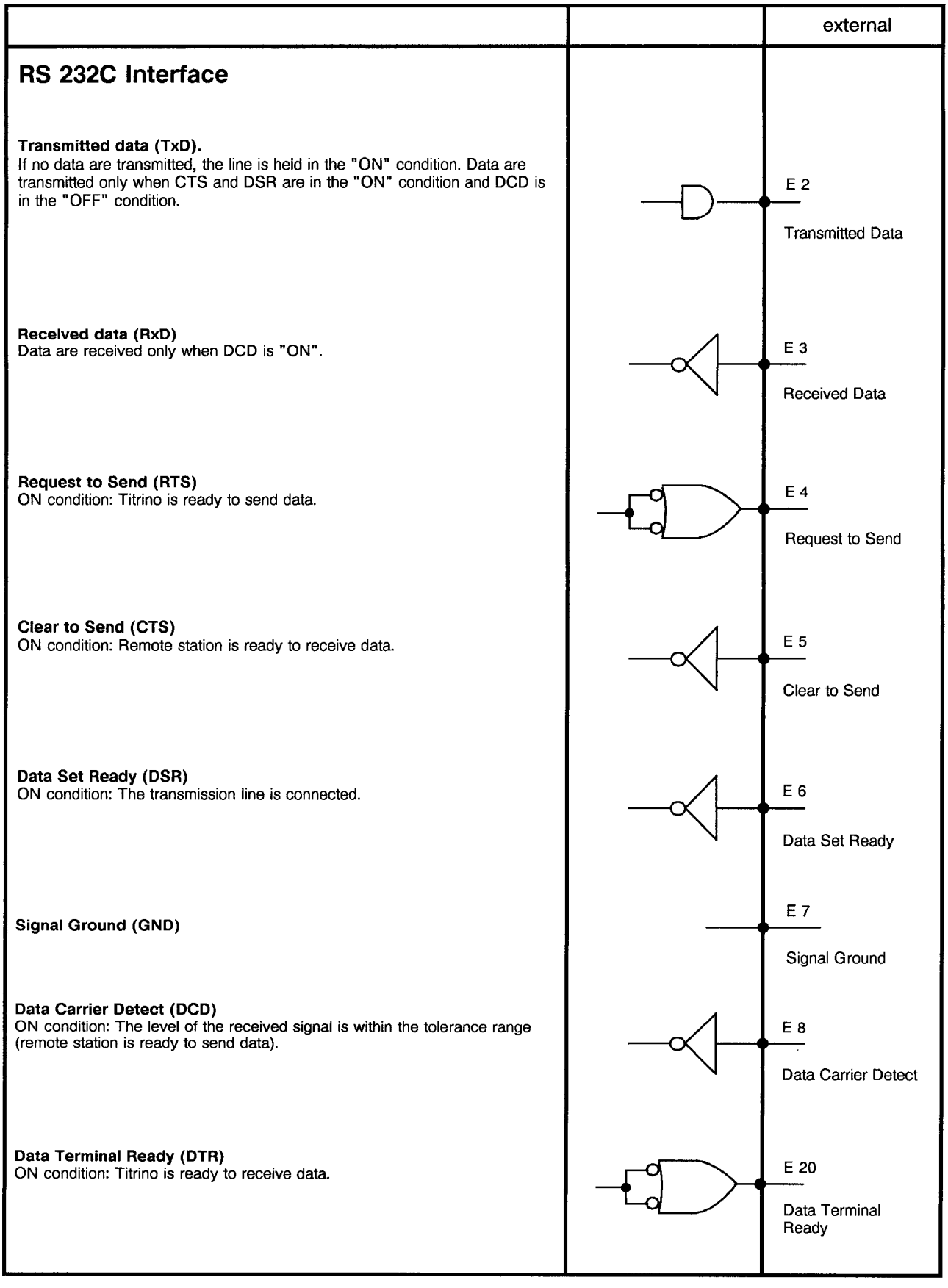


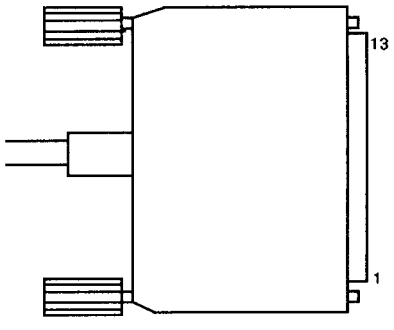
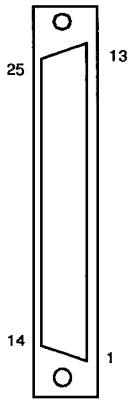
Titrino as **sender:**



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

3.3.3 Pin assignment



		external
RS 232C (continued) **Protective earth** Direct connection from cable connector to protective earth of instrument. **Polarity allocation of the signals** - Data lines (TxD, RxD) Voltage negative (< -3 V): signal status "ONE" Voltage positive (> +3 V): signal status "ZERO" - Control or message lines (CTS, DSR, DCD, RTS, DTR) Voltage negative (< -3 V): OFF status Voltage positive (> +3 V): ON status In the transition region from +3 V to - 3 V the signal status is undefined. Driver 14C88 Receiver 14C89 } in compliance with EIA RS 232C specification **Contact arrangement at connector (female) for RS 232 C socket (male)**  Ordering numbers: K.210.9004 und K.210.0001  View from solder side of connector		

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

3.4 What to do if data transfer fails?

Problem	Questions for remedial action
No characters can be received on a connected printer	– Are the instruments and the connection cables plugged in properly? – Is the printer set to "on-line"? – Are baud rate, data bit and parity settings the same for both devices? – Is the handshake set properly? If everything appears to be in order, try to print out a report with the key sequence <print><smpl data><enter>. If this report is printed out correctly, check whether under the key <def>, >report a report is preselected.
No data transmission occurs and the display of the Titrino shows an error message	– **E40-42**: Transmission error. Is the cable used properly wired and connected? Is the printer switched on and set to "on-line"? – **E43**: Data output of the Titrino disabled for longer than 3 s by XOFF. – **E36-39**: Receive error. Are the settings of the RS232 data transmission parameters the same for both devices?
The received characters are garbled	– Are the data bit and the parity settings the same for both devices? – Is the baud rate setting the same for both devices? – Has the correct printer been selected? – Data transfer has been interrupted on the hardware side during the printout of a curve. Re-establish connections and switch printer off/on.

4. Error messages, Troubleshooting

"Clicking" of the Exchange Unit	Cause: Stopcock switch mechanism bouncing. Press the stopcock switch lever manually into the end position. Do not rotate the stopcock when the Titrino is switched on!
Data transfer inoperative	See measures on page 113.

4.1 Error and special messages

XXX bytes missing	XXX more bytes are needed to store a method or a silo line. Exit: <QUIT>. Delete methods no longer needed or use fewer silo lines.
check electrode	With polarized electrodes. There is a break or short circuit. Possible causes and rectification of the fault: – the electrode is not plugged in → plug it in – the electrode is not immersed in the solution → immerse it – the electrode is defective → use new electrode. The electrode test can be switched off under the <parameters> key, "> titration parameters" or "> measuring parameters", see pages 26, 34 and 43. 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.
check T-sensor	In MEAS T, no temperature sensor has been connected. Exit: Connect Pt100 or Pt1000 or <STOP>.
division by zero	The result could not be calculated as a divisor in the formula was equal to zero. Exit: Enter appropriate value.
manual stop	The determination has been terminated manually.
missing EP	An EP needed in a formula for calculation purposes is missing.
no EP set	In a SET titration, no EP has been set. Exit: <STOP> and set EP.
no method	The method required by the sample data from the silo memory 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 is retained.
no new mean	No new mean value has been calculated as at least one result of this determination designated for mean value calculations could not be calculated.
not valid	Value not existing.
overrange	The measurement range of ±2 V has been exceeded. Exit: Rectify error, <STOP> or <meas/hold>.

same buffer
In the calibration routine, the potential difference between the first and the second buffer is < 6 mV.
Exit: <QUIT> and change buffer or <STOP> (stop calibration).

silo empty
The silo memory is switched on and empty and a titration has been started.
Corrective measure: Fill at least 1 silo line before you start the first titration.
Exit: <clear>.

silo full
The silo memory is full.
Corrective measure: If you have assigned less than 99 silo lines, you can create more space by deleting old methods you no longer need. 1 silo line requires 90 bytes.
Exit: <clear>.

stop time reached
A SET titration, (pH) stat, has been terminated as the stop time has been reached.

stop V reached
The titration has been terminated as the stop volume has been reached.

system error 3
Instrument adjustment data have been overwritten.
Exit: <clear>. Standard adjustment data are set. The error message appears after every switching on of the instrument until it is re-adjusted (Metrohm service).

wrong sample
In a SET titration with preset titration direction (or with 2 set EP's), the first measured value is already past the end point.

Error messages in connection with the data transfer

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

Receive errors:

E36 Parity
E37 Stop bit
} Exit: <QUIT> and ensure settings of appropriate parameter are the same at both devices.

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

E39
The receive buffer of the Titrino is full (>82 characters).
Exit: <QUIT>

Send errors:

E40 DSR = OFF
E41 DCD = ON
E42 CTS = OFF
} No proper handshake for 1 s or longer.
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 devices. Reset.

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

4.2 Diagnosis (for 5.720.001X Program)

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

In inquiries always quote the manufacturing (page 3) and program number (see configuration, page 22) and specify possible error displays.

Procedure

- The diagnostic steps must be performed in sequence and compared with the reactions of the 720 KFS 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 marked with a triangle (≫) allow re-entry into the test routine for repetition if the following display appears:

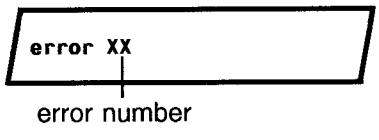
  

  If the instrument is in a subprogram of the diagnostic routine: Press the <clear> key.

  If need be, switch the power off then on again after a few seconds. At the same time press key "9" until the above display appears.

- If the <clear> key is pressed during the display of 'diagnose press key 0...9', the instrument returns to the user program.

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

- If a fault causes the burette drive to stick at the top or bottom end of the cylinder, see point 13, page 127.

Equipment required:
- voltage calibrator, e.g. Metrohm pH Simulator 642[1]
- Highly insulated interconnection cable 6.2108.060
- Resistor switch-box, class 0.1% (or resistor 14.3 k 0.1%)
- 3.496.5070 Cable[2]
- Exchange Units, if possible with different cylinder volumes (or 3.496.0070 Dummy Exchange Unit)
- Stop watch or watch with second hand
- 6.2130.020 Keypad
- Digital or analog voltmeter (if need be, connect a calibrated recorder) (connecting cables with 4 mm banana plugs)

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

⩾ 1. Prepare instruments for diagnostic test

Power off

Disconnect all external connections (cables at rear) except mains cable and keypad.

Remove Exchange Unit

Power on and immediately press and hold the <9> key until the powerup test pattern disappears.

⩾ 2. Perform display test

Press <2>

Press <enter>.

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

Test sequence:

- Display is cleared and overwritten from the left with a dot pattern.
- Display is cleared and both lines are written into with the letters A, B, C...Z.
- The complete character set (see Fig. 4-1) is shown as a moving display. At the same time with the moving display, the LED lamps 'statistics', 'silo' and 'cond.' are switched on and off.

The test sequence can be held at any time with the <5> key and then continued.

Block 2 is quit with the <clear> key.

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

2 If no suitable cable is available: Remove indicator electrode from cell. Connect switch-box or resistor combination with laboratory cable and test clips carefully to the platinum wires of the indicator electrode.
(Warning: Do not bend platinum wire!)

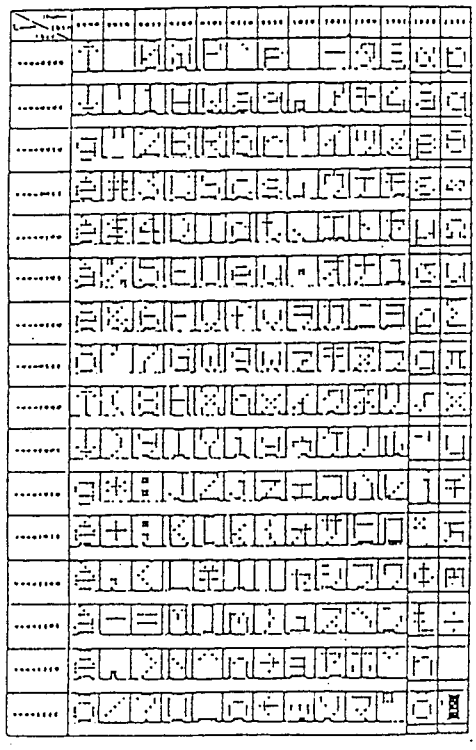
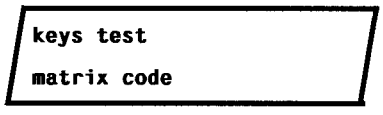


Fig. 4-1: Character set

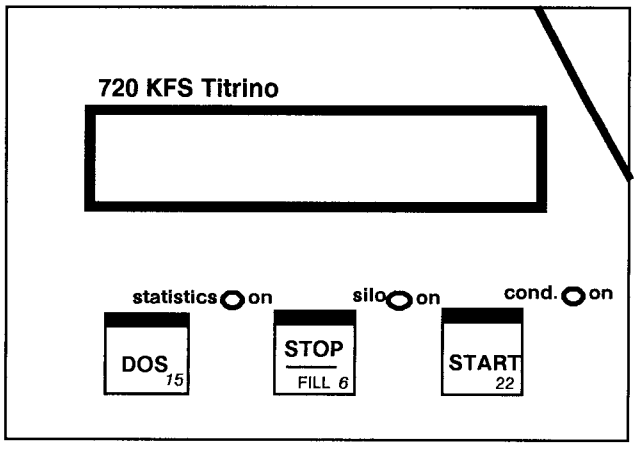
≫ 3. **Keypad test**

Press <1>

Press <enter>



If any key is now pressed (on the 6.2130.020 Keypad or on the front panel of the 720), the appropriate matrix code appears in the display (0...31).



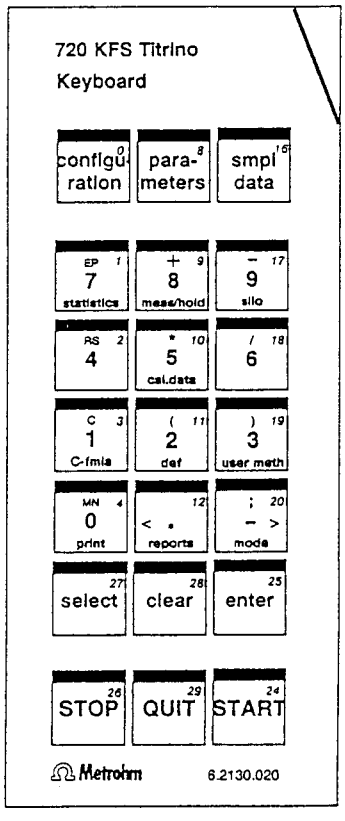


Fig. 4-2 Tabelle Matrixcode

Block 1 is quit by pressing the <clear> key twice.

≫ 4. Cylinder code, date, time

Press <0>

```
date/time
cylinder code
```

Press <enter>

```
date XX-XX-XX[1] XX:XX:27[2]
check exchange unit
```

Check date and time. If deviations are found, enter new date and/or time, see page 21 and 22.

Insert Exchange Unit (or dummy)

```
date XX-XX-XX[1] XX:XX:XX[2]
code:            XX ml[3]
```

For the sake of completeness, different Exchange Units can be inserted to verify their ml code.

If desired, the Exchange Unit can be removed again.

Press <clear>

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

≫ 5. Check analog output

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(***14***)

Press key <3>

```
analog output-1 test
```

<enter>

```
analog output-1 test
V-out =      XX[4] mV
```

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)

Exit: <QUIT>

Disconnect voltmeter.

1 acurrent date
2 current time
3 Check that mL code of Exchange unit used is displayed
4 This value is incidental, but can be accepted with <enter>.

⩾ 6. Motortimertest

<6>

```
motor-timer test
```

<enter>

```
pot.meter dV/dt → 10 ?
```

Turn knob 'dV/dt' to the right stop

<enter>

```
motor-timer test
```

Test sequence

- In a first step, the frequency of the RC oscillator (analog 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.

After ca. 3 s, the text 'o.k' appears in the display.

<clear>

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

⩾ 7. Analog input test

Press <7>

```
analog input test 1...5
```

7.1 Examination of highly insulated measuring inputs

Connect 'Ind I' measuring input (***11***) to a voltage calibrator (e.g. Metrohm 642 pH simulator) by means of a highly insulated cable (e.g. 6.2108.060). Set calibrator to 0 V.

<1>

```
Input 1          0.0 mV
```

Tolerance: ±0.5 mV

Set the calibrator voltage, on setting 'low ohmic' (with 642 = ~0.002 MΩ), to different values (e.g. +1500 mV) and compare with the displayed value.

Tolerance (with ±1500÷2000 mV) ±1 mV

(Be aware of the calibrator's tolerance.)

Set simulator to high ohmic condition (with 642 = 1000 MΩ).

The displayed reading may vary slightly only (with 1500 mV ≤1 mV)

<clear>

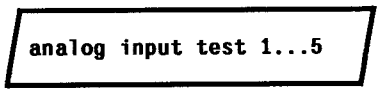
```
analog input test 1...5
```

Disconnect simulator from 'Ind I' input and connect to 'Ind II' input (***11***):

<2>

Carry out the same measurements as with Input I and compare the displayed value.

<clear>

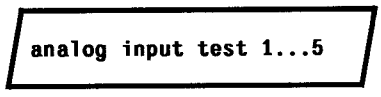


Short-circuit input 'Ind I' (e.g. with cable 3.496.5070)

<3>

The differencial voltage between inputs 'Ind I' and 'Ind II' is displayed.
Example: 0 – (+)1500 mV = –1500 mV

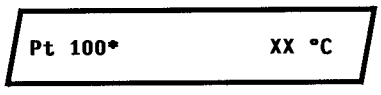
<clear>



7.2 To check Pt 100 / 1000 connection

Connect a Pt 100 or Pt 1000 sensor, a resistor switch-box or a single resistor of 100 Ω or 1 kΩ, respectively, to sockets 'Pt 100/1000' (***12***) by means of short cables.

<4>

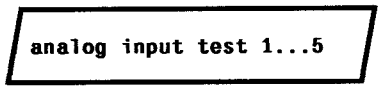


(* oder Pt 1000)

Tolerance: ±0.5 °C
(Note also tolerance of resistor switch-box.)

The sensor allows automatic displaying of the room temperature. (The resistances correspond to 0 °C.)

<clear>



Remove resistor switch-box.

7.3 Polarizer test

Press <5>

```
Polarizer test
```

<enter>

```
dummy resistor 14.3 kΩ ?
```

Connect resistor switch-box (or suitable resistor 14.3 k /0.1%) using 3.496.5070 Cable[3] to 'Pol' socket(***10***). Switch-box to14.3 k.

<enter>

```
polarizer test
```
—An asterisk flashes during the test

The test runs automatically. If no error is found, after about 15 s 'polarizer test o.k' appears. If not, an error message appears. (If the switch-box is not connected, Error 100 appears.)

In case of an error: depress <clear> several times until all error numbers are indicated.

<clear>

```
analog input test 1...5
```

<clear>

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

Remove cable and resistor switch-box.

≫ 8. External inputs and outputs

This test is meaningful only if the 720 KFS Titrino is used interconnected with other instruments via the 'Remote' connection. In addition, a 3.496.8510 Test Plug normally used in the repair service is required for this test. However, this plug can also be purchased by customers under the above number.
For the sake of completeness, the procedure is described here.
(If a diagnostic test of the external inputs and outputs is not required, continue with point 9.)

Plug 3.496.8510

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

Fig. 4-3 Connections in the 3.496.8510 Test Plug

Press key <4>

```
extern input/output test
```

[3] If cable not available see page 118.

<enter>

```
I/O-test-connector?
```

Insert the 3.496.8510 Test Plug in port B 'Remote' (**9**) (do not switch off instrument, pay attention to alignment of the plug!).

<enter>

The test runs automatically. If no error is found, 'extern input/output o.k.' appears. Otherwise, an error message is displayed. If no test plug is connected, 'error 50 01 HEX' appears.

Remove test plug

<clear>

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

≫ 9. RS 232 Test

This test is meaningful only if the KFS Titrino 720 is used interconnected with other instruments via the 'RS 232' connection. In addition, a 3.496.8480 Test Plug normally used in the repair service is required for this test. However, this plug can also be purchased by customers under the above number.

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

(If a diagnostic test of the RS232 interface is not required, continue with point 10.)

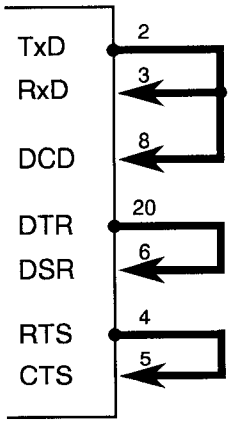


Fig. 4-4 Connections in the 3.496.8480 Plug

Press key <5>

```
RS232  test
```

<enter>

```
RS232 test-connector?
```

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

<enter>

The test runs automatically. If no error is found, 'RS 232 test o.k.' appears after ca. 3 s. Otherwise, an error message is shown. If no test plug is connected, 'error 68' appears.

Remove test plug

<clear>

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

⩾ 10. Spindle drive and stopcock changeover

<clear>

Titrino fills (only if an exchange unit is inserted).

```
XXX X          ********
```

X = according to the selected method

Remove Exchange Unit (if still inserted).

Check spindle zero position, see Fig. 4-5

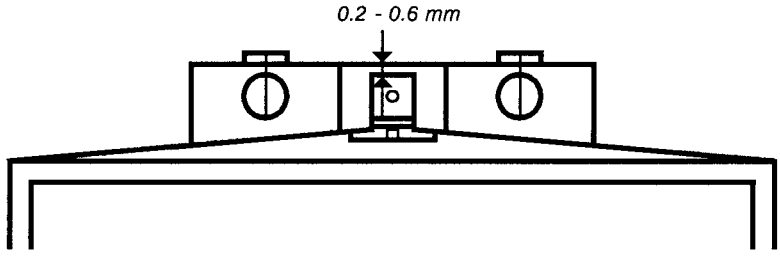


Fig. 4-5

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 Titrino

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 height (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> 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> 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. 76 ... 126 s.

set potentiometer 'dV/dt' to right stop.

<FILL>

End of test.

11. Setting up original arrangement

Reconnect all peripherals disconnected at the start of the diagnostic routine and perform a short function test with these.

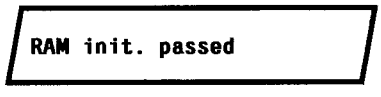
≫ 12. Initialise and test RAM

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.

Perform point 1 of the diagnostic routine.

Press <8>

<enter>



RAM is tested and initialised.

The lost data of the user memory must now be reentered.

Perform point 11.

If 'system error 3' appears in the display, <clear> can be used to exit 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.

⩾ 13. Releasing a locked spindle with inserted Exchange Unit

- The burette drive may very occasionally jam at the top or bottom end of the cylinder. If jamming occurs at the top or when the drive is out of function, the Exchange Unit can no longer removed. In this case, it is necessary to proceed as follows:

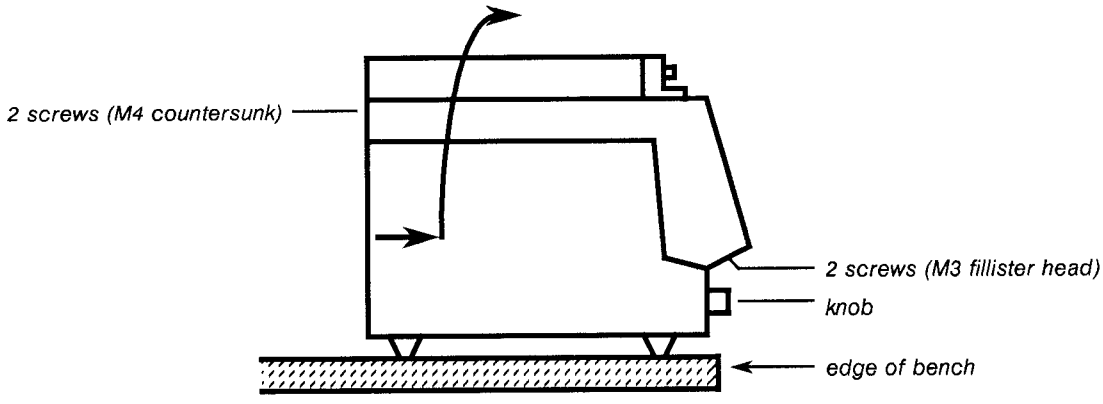


Fig. 4-6

- Disconnect instrument from power supply!
- Remove control knob
- Place instrument over edge of bench to allow the M3 screws to be removed (Fig. 4-6)
- 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.)

Overview of the key assignment in the diagnostic tests

via key <9> with power on→ `diagnose press key 0...9`

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

			page	point
Key	0	Display of date and time and the cylinder code	120	4
Key	1	Keypad test	119	3
Key	2	Display test	118	2
Key	3	Analog output test	120	5
Key	4	External input/output test	123	8
Key	5	RS232 interface test	124	9
Key	6	Motor timer test	121	6
Key	7	Polarizer test	121	7
Key	8	Test and initialise RAM	126	12
Key	9	not used		

5. Preparations

Ensure that the set operating voltage corresponds to the mains voltage before switching on the instrument.
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. If no socket with earthing is available, the instrument must be connected to a perfect earthing conductor via its earthing socket. Each break in the earthing inside or outside the instrument can make it a hazard.
When the instrument is opened or if parts of it are removed, certain components may be live if the instrument is connected to the 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 703 Ti-Stand or 728 Magnetic Stirrer

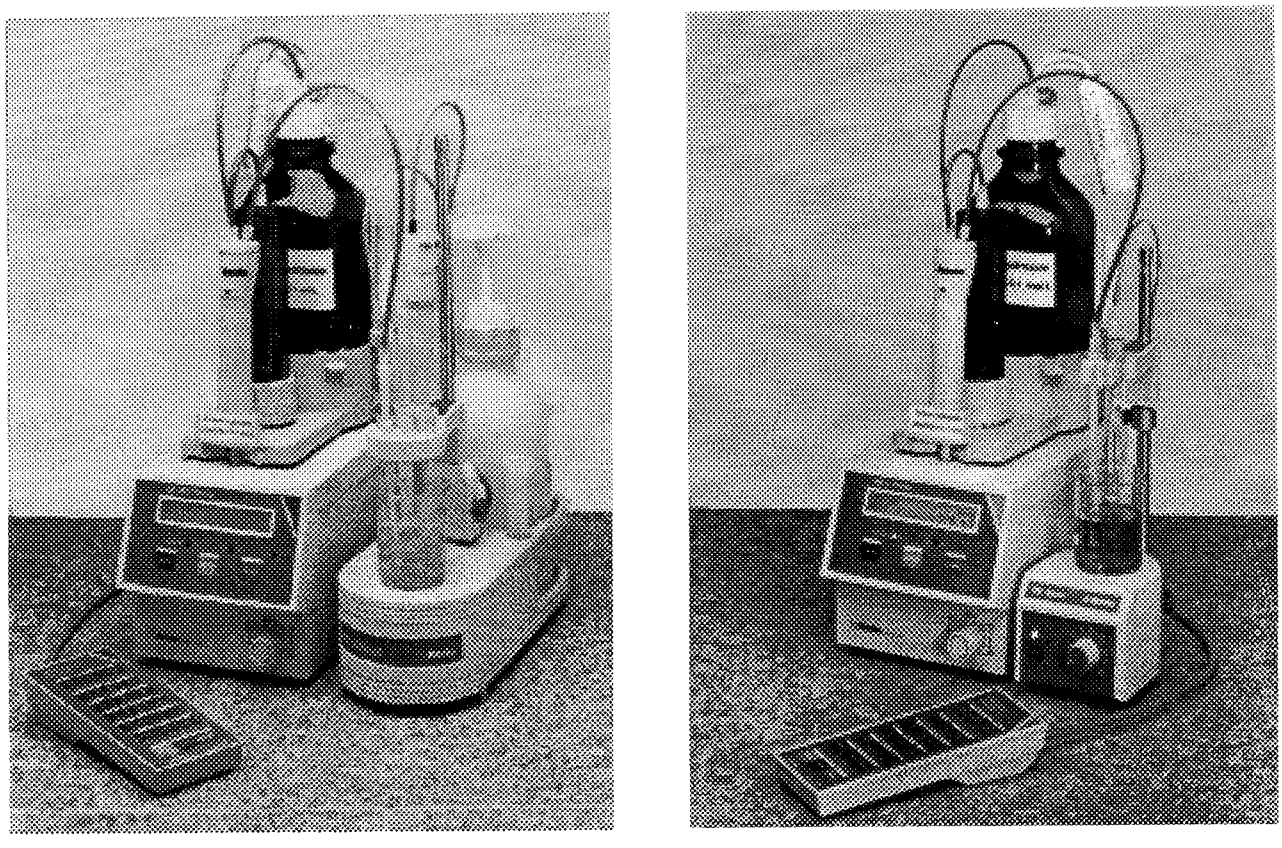


Fig. 5-1: Setting up the Titrino

The 722 Rod Stirrer or the 727 Ti Stand, can also be connected.

The instruments are set up and connected as shown in Fig. 5-1.

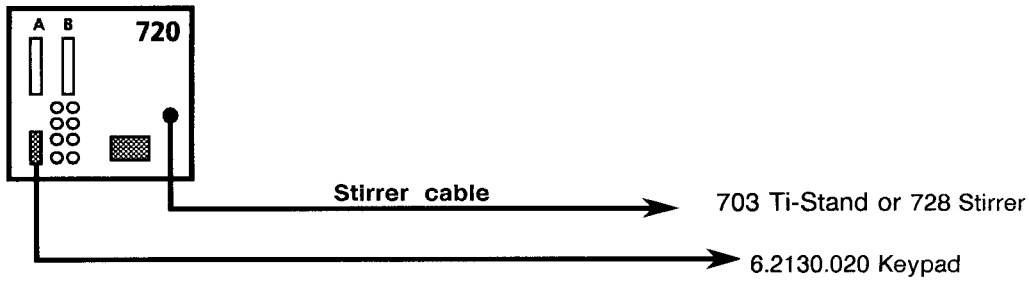


Fig. 5-2: Connecting the stirrer

5.1.2 Connecting a printer

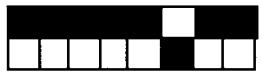
A variety of printers can be connected to the RS232 interface of the 719 S Titrino. If you connect a printer other than one of those mentioned below, ensure that the Epson mode is emulated or that it uses the international character set following the IBM Standard Table 437 and IBM-compatible graphics control characters.

If a **balance** is connected at the same time as a printer, the 6.2125.030 Adapter must be used. The printer must be plugged into the "data out" receptacle of the adapter. It can be operated only with the simple hardware handshake (HWs) or without handshake.

The connection of a selection of printers is facilitated by the following Table:

Printer type	Cable	Settings at Titrino	Settings at printer	
Citizen iDP560 RS	6.2125.050	baud rate: 9600 data bit: 7 stop bit: 1 parity: even handshake: HWs send to: Citizen	**DIP switches:** 1 on 2 off } 9600 baud 3 off 4 off 5 on 7 bit 6 – 7 off } even 8 on } parity Set printer to on-line with <sel>	**Jumpers:** 1 open } USA 2 open } char.set 3 open 4 open 5 closed
Seiko DPU–411	6.2125.020	baud rate: 9600 data bit: 7 stop bit: 1 parity: even handshake: HWs send to: Seiko	**DIP switches:** **DIP01** 1 off serial 2 off no auto LF 3 on 40 characters 4 on character style 5 off zero represent. 6 off 7 on USA 8 on -character set Set printer to on-line	**DIP02** 1 off 7 bit 2 off } even 3 off } parity 4 off 5 off } 9600 baud 6 off

The following printers can also be connected:

Printer	Cabel	Settings at Titrino	Settings at printer
Epson Printer with 6-pin circular connector [1)]	6.2125.040	send to: Epson data bit: 8 parity: none handshake: HWs	8 bit no parity
Epson Printer with #8148 interface	6.2125.050	send to: Epson data bit: 7 parity: even handshake: HWs	7 bit even parity
HP: Think Jet	6.2125.050	send to: Epson baud rate: 9600 data bit: 7 parity: even handshake: HWs	Switches: 
HP: Deskjet	6.2125.050	Send to: IBM baud rate: 9600 data bit: 8 parity: none handshake: HWs	A:  B: 
Kodak Diconix 180 si	6.2125.050	send to: Epson baud rate: 9600 data bit: 7 parity: even handshake: HWs	Epson emulation 7 bit even parity

1): When connecting a balance at the same time, which only is capable to work with 7 bit, set "parity space" on the balance, while Printer and Titrino work on 8 bit, no parity.

If a printer is not equipped with a serial interface (e.g. HP Deskjet 510), use a parallel-serial converter for the connection with your Titrino.

To connect several Titrino instruments with one single printer use a serial switch box, you can obtain from your electronics distributor.

5.1.3 Connecting a balance

The following balances can be connected to the RS232 output of the Titrino:

Balance		**Cable**
Sartorius	MP-8, MC1	6.2125.070
Mettler	AM, PM	From Mettler: ME 33995: Green lead to pin 2, brown to pin 3, white to pin 7, yellow to pin 20 of the 25-pin connector.
	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
	Interface 011 or 012:	6.2125.020

Mettler AT		From Mettler: ME 33995: Green lead to pin 2, brown to pin 3, white to pin 7, yellow to pin 20 of the 25-pin connector.
AND	Models ER-60, 120, 180, 182	6.2125.020
	Models FR-200, 300	6.2125.020
	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 <configuration> 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	Id#1	Id#2	Id#3
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)

5.1.4 Connecting a sample changer

The sample changer is connected as follows:

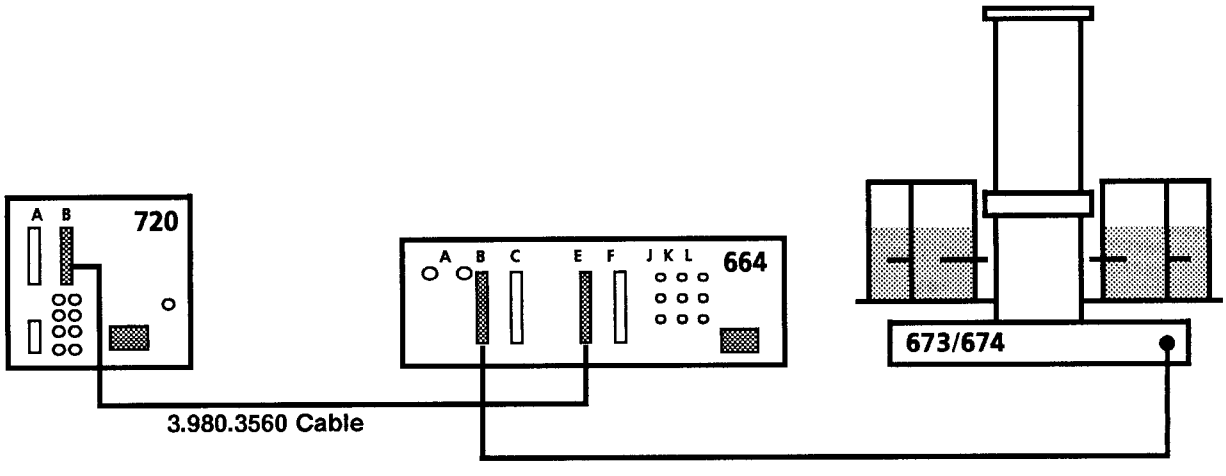


Fig. 5-3: Connection of a sample changer

- 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 151.
- 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 <configuration> key. The start command is given by the 664 Control Unit when the sample beaker is at the processing station.

5.1.5 Connecting a recorder

The recorder is connected to the analog output of the Titrino:

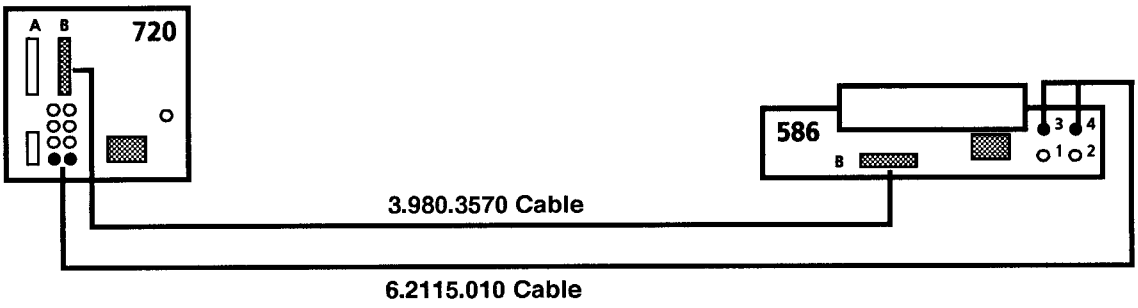


Fig. 5-4: Connection of a recorder

If the connection is set up with the 3.980.3570 cable, the chart feed axis of the recorder becomes the volume axis, i.e. the signal at the analog output is plotted against volume. The chart length per $V_{burette}$ corresponds to the set chart speed on the recorder in mm. For 400 mm/min and 200 mm/min the maximum dosing rate v_{max} has to be reduced to $\frac{1}{4}$ v_{max}, or $\frac{1}{2}$ v_{max}, respectively.

If the connection is not set up with the 3.980.3570 cable, the chart feed axis of the recorder becomes the time axis and the signal at the analog output is plotted against time. For such curves, another laboratory recorder can be connected instead of the 586 Labograph.

The signal at the analog output can be preselected on the Titrino (<configuration key>, " >peripheral units", "record:"). The following are available:

Preselection at Titrino	Meaning	Resolution, Signal at analog output
U	Voltage	pH = 0.00: −700 mV pH = 7.00: 0 mV pH = 14.00: +700 mV U = +1 mV: +1 mV U = −1 mV: −1 mV I = +1 µA: +10 mV I = −1 µA: −10 mV T = 0 °C: 0 mV T = +1 °C: +10 mV T = −1 °C: −10 mV
dU/dt	Measured value drift	1 mV/min: 1 mV 1 °C/min: 1 mV 1 µA/min: 10 mV
V	Volume	1 cylinder volume: 2000 mV
dV/dt	Volume drift	100 µl/min: 1000 mV
ΔU	Control deviation	ΔpH = 1: 100 mV ΔU = 1 mV: 1 mV ΔI = 1 µA: 10 mV

5.1.6 Connecting a computer

The computer is connected as follows:

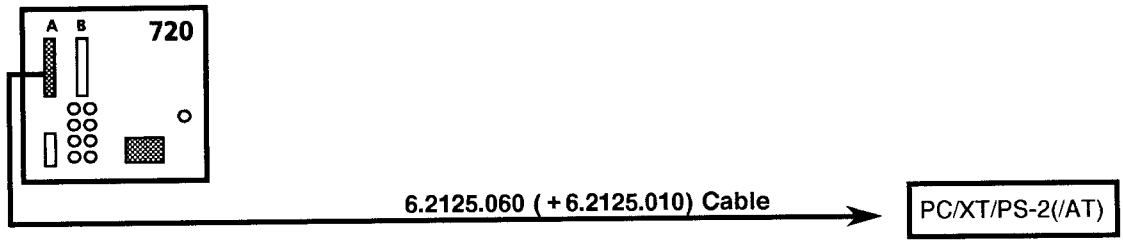


Fig. 5-5: Connection of a computer

For the connection of IBM® AT computers, the 6.2125.010 Adapter is also needed.

Preselections on Titrino:
RS232 settings: depend on the control program of the computer
Send to: IBM

Program package for the data transfer Titrino ↔ PC,
$3\frac{1}{2}$" disk 6.6019.000

5.1.7 Setting up the instruments for work with the 707 KF oven

For introduction of the gas into the KF titration vessel, the 6.2730.040 Stopper together with the 6.1819.060 PTFE Tubing must be used. For an optimized configuration of the instruments the use of the instrument bridge 6.2041.180 is recommended.

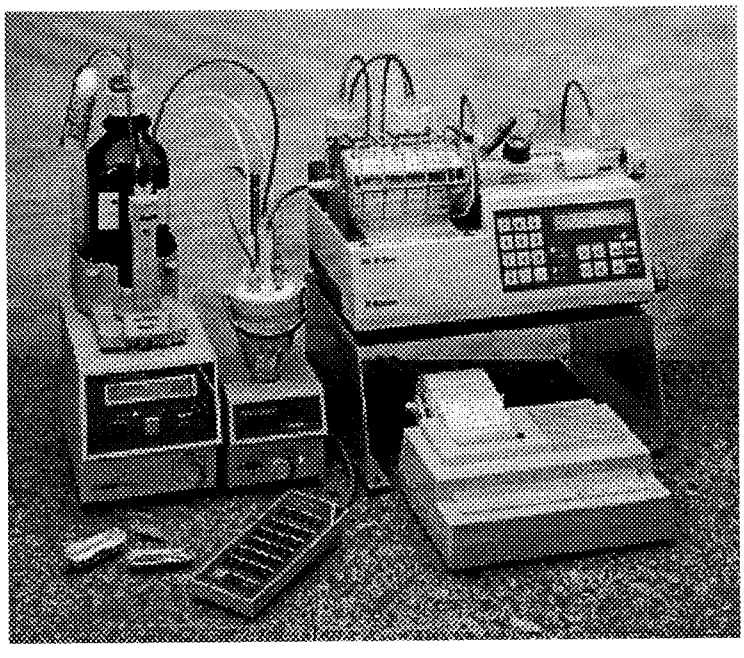


Fig. 5-6: Setting up with 707 KF Oven

5.2 Installation of the titration vessel, connecting electrodes

5.2.1 Setting up the titration vessel

The titration vessel is set up as shown in Fig. 5-7. 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.
- positioning the burette tip as centrally as possible, above the stirring bar.

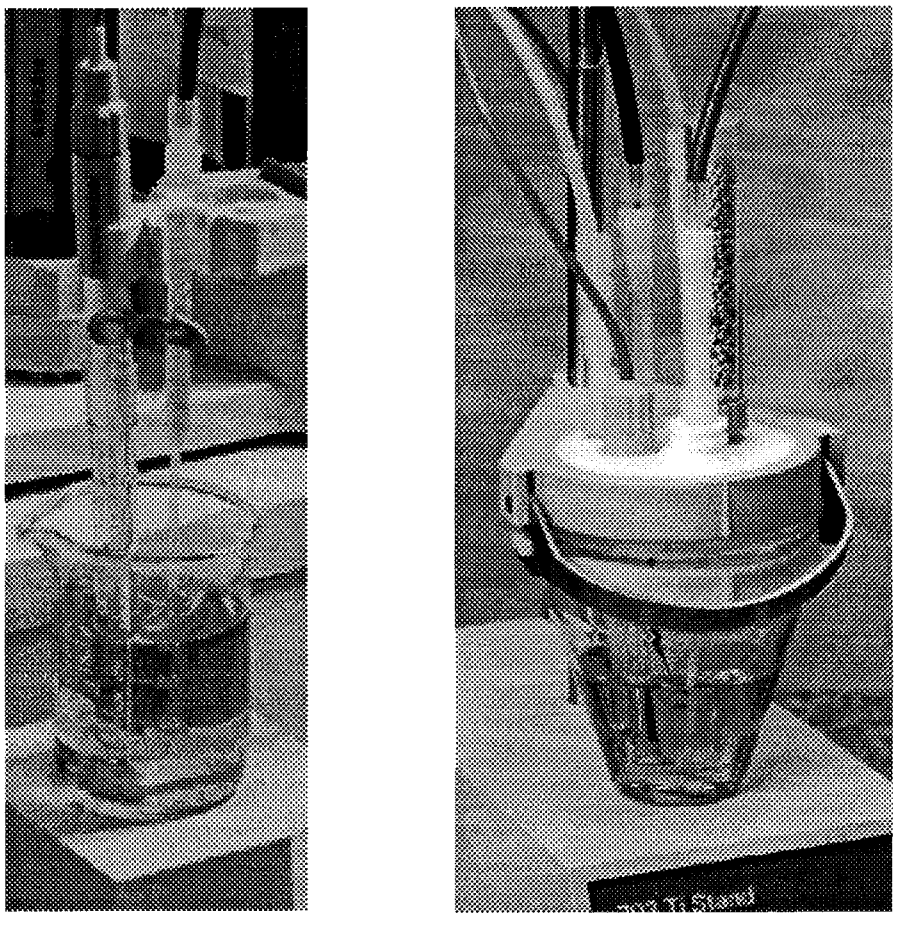
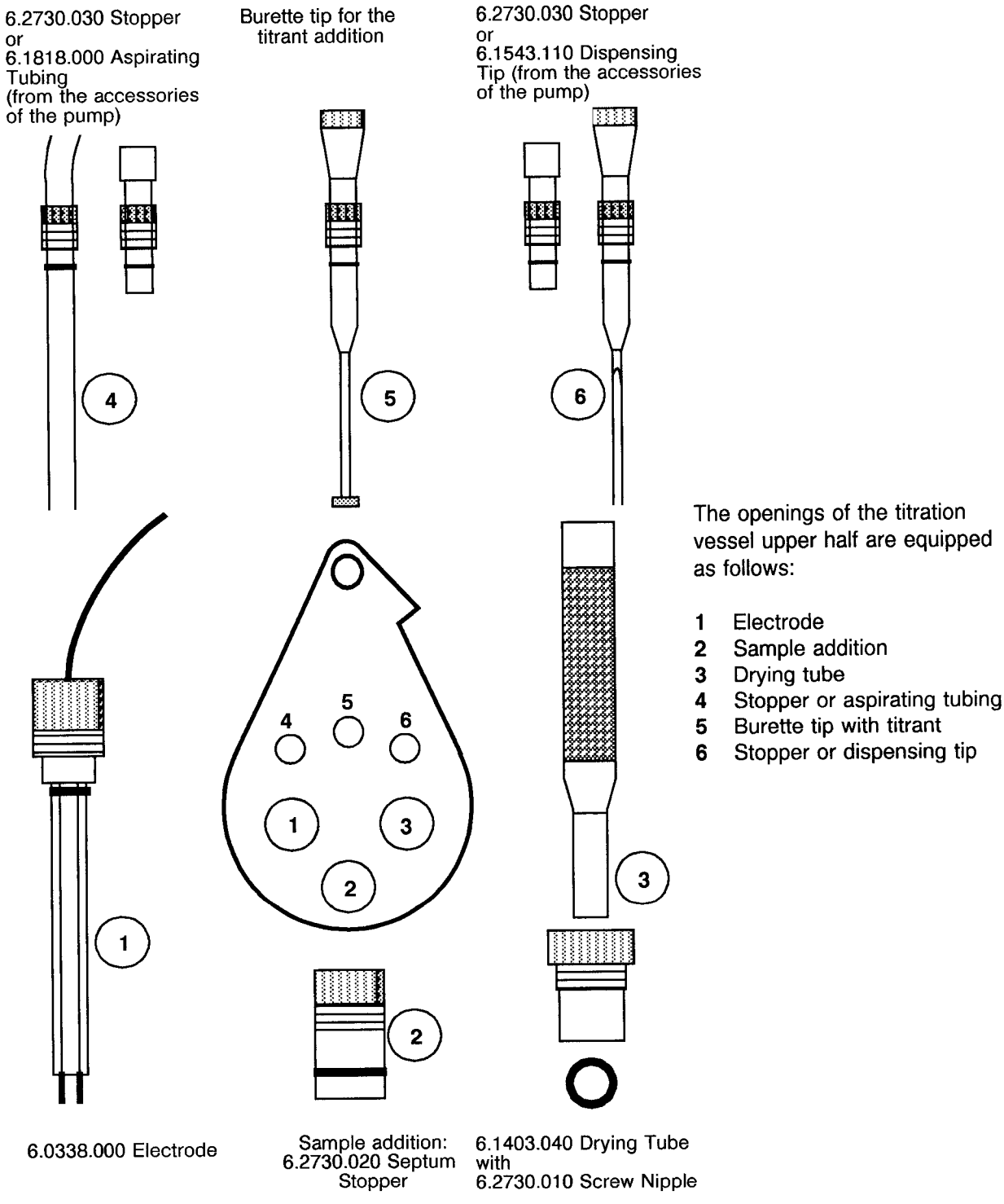


Fig. 5-7: Setting up the titration vessel

Equipping the KF titration vessel upper half

Before assembly, the individual parts must be clean and dry. Proceed carefully when screwing in the parts to ensure that the threads are not damaged. When equipping the small openings, first screw in 6.2730.030 Stopper with nipple and O-ring. Then take out stopper, insert desired tip and tighten screw until the tip no longer moves freely.



The openings of the titration vessel upper half are equipped as follows:

1 Electrode
2 Sample addition
3 Drying tube
4 Stopper or aspirating tubing
5 Burette tip with titrant
6 Stopper or dispensing tip

Fig. 5-8: Equipping the titration vessel upper half

Fit the large sealing ring to the bottom of the titration vessel upper half and clamp the upper half to the stand rod. Connect upper and lower half.

For good titration results, it is important that the titrant be mixed with the initial solution as rapidly as possible. This can be achieved by
- efficient stirring
- ensuring that the burette tip points to the middle of the vessel directly above the stirring bar.

5.2.2 Connecting of sensors

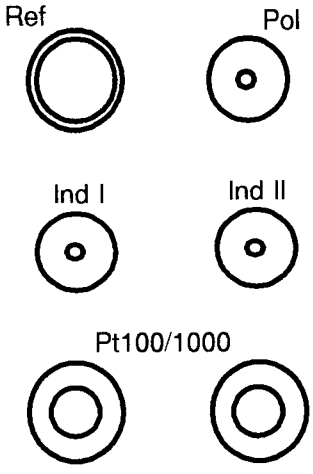


Fig. 5-9: Connection of electrodes

Ref: Separate reference electrode. Input is free when a combined electrode is used.

Pol: Connection for polarized electrodes. If measured quantity Ipol or Upol is selected, this measuring input is automatically active.

Ind I: Indicator electrode I. (pH, redox, ISE electrodes). Combined or separate electrode. If "meas. input: 1" is selected under the <parameters> key, this measuring input is active.

Ind II: Indicator electrode II: "meas. input: 2" must be selected.
Important:
The two measuring inputs Ind I and Ind II have a common reference. They can be used as a differential amplifier, see below. However, only 1 reference electrode can be used in the same analysis solution.

Pt100/1000: Pt100 or Pt1000 temperature sensor. If a temperature sensor is connected, the temperature correction in pH measurements and the parameter "temperature" are updated when starting a method. This measuring input is active in the "MEAS T" mode.

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. These disturbing voltages are superimposed on the measurement signal.
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:

Measuring input	Manual determinations	Determinations at sample changer
Ind I	6.0133.100 pH glass electrode	6.0130.100 pH glass electrode
Ind II	6.0729.100 double-shielded Ag/AgCl reference elecrode	6.0729.110 double-shielded Ag/AgCl reference electrode
Ref	6.0301.100 auxiliary elecrode	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!

5.3 Preparing the Exchange Unit

The Exchange Units are available in brown or clear glass with light protection. The models with light protection or in brown glass should be used for light-sensitive reagents (silver nitrate, Karl Fischer, etc.).

Accuracy data:

Burette volume V_{bur} (in ml)	Abs. error rel. to nominal value ± ΔV (in ml)	Reproductibility error Accuracy ± ΔV (in ml)	Resolution of the display ΔV (in ml)
1.000	0.003	0.001	0.001
5.000	0.015	0.005	0.001
10.000	0.02	0.005	0.001
20.000	0.03	0.01	0.002
50.000	0.05	0.04	0.005

Note:
In gravimetric checks of the dispensed volume, the air buoyancy (ca. 0.1%) must be taken into account in the weighing. Consideration should also be given to evaporation, see Metrohm application bulletin No. 238.

5.3.1 Setting up the 6.3011.XXX/6.3012.XXX Exchange Units

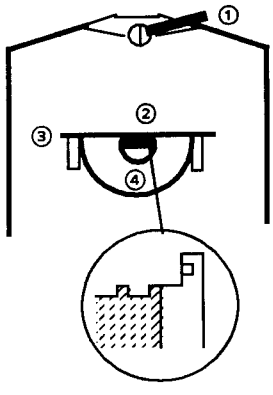


Fig. 5-10: Bottom of Exchange Unit

Before mounting the Exchange Unit, check that stopcock switch ① is on the right and coupling ② is parallel to ridge ③ and even with rings ④. The coupling can be adjusted with the 6.2739.010 key.

- Remove packing plate below the reagent bottle.
- Mount retaining clips for reagent bottle, see Fig. 6-1, page 169.

If you do not wish to use the reagent bottle supplied, convert your Exchange Unit as follows:
Snap in the reagent bottle retaining clips so that the reagent bottle sits snugly in the Exchange Unit. For different original reagent bottles, you need a special bottle siphon and possibly a threaded adapter. The following bottle siphons are available:

for bottles with GL45 thread, e.g. Riedel-de Haën (1 L), Baker (bottle siphon included in the standard equipment)	6.1602.100
for bottles with S40 thread, e.g. Merck	6.1602.110
for bottles with 32 mm thread, e.g. Fluka, Riedel-de Haën (500 mL)	6.1602.100 + 6.1618.000
for bottles with 28 mm thread, e.g. Fisher	6.1602.100 + 6.1618.010

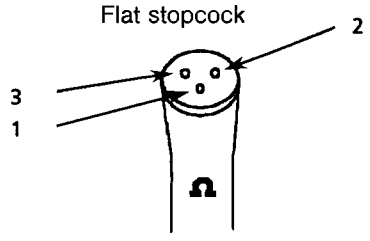
- Screw the appropriate bottle siphon onto the reagent bottle.
- If necessary, replace the 6.1602.100 bottle siphon with the combination you need.

The holder on the right serves to hold the burette tip; in the holder on the left you can store, for instance the electrode associated with the reagent.

5.3.2 Assembly of the 6.3006.XXX/6.3007.XXX Exchange Units

See also Fig. 6-2, page 170.

- The instrument without Exchange Unit is set to zero.
- Mount Exchange Unit (without glass cylinder) from the front on the sliding plate and push right back.
- Allow piston spindle to run out by ca. 2 cm.
- Carefully grease PTFE piston (see section 5.3.5), assemble coupling and carefully slide glass cylinder over it from above ensuring exact axial alignment. (If the PTFE piston slips out of the coupling, the 6.1546.010 piston rod can be used to shift the piston in the glass cylinder.)
- Center cylinder in the slot of the exchange support.
- Clamp cylinder with 6.2035.00 flange and 6.1549.00 clamping ring moderately tightly. (For 50 mL units, use 6.1551.000 plastic flange.)
- Fit remaining components of Exchange Unit.
  . Tubing connections:



1 Connection to glass cylinder
2 Connection to burette tip
3 Connection to reagent bottle

Fig. 5-11: Stopcock tubing connections

  . Tighten screw nipple by hand. Nipples should be tightened with the 6.2739.000 key only at inaccessible locations and not too tightly (tightening force ca. 100 p ≈ 1 N with 5 cm key). The tubing must not be pinched.
- Let piston move to zero position.

5.3.3 First-time filling

- Fill the reagent bottle with the titrant.
- Insert a cotton wool plug in the adsorption tube and add a suitable protective agent. Cover with another cotton wool plug and close with cover.
- Press <DOS> key until the piston is in the very top position.
- Press <STOP/FILL> .

Repeat filling process in both directions until the glass cylinder together with the connections up to the burette tip is filled. To allow air to escape better, hold burette tip up. Experience has shown that small air bubbles do not cause any disturbance as they remain connected to the wall even when the piston moves quickly.

5.3.4 Changing the Exchange Unit

When the Exchange Unit is mounted or removed, the burette must be in the zero position (filled + drive play taken up), otherwise the exchange support will be mechanically arrested by the piston spindle.

All Exchange Units are adjusted such that the spindle is even with the sliding plate when in the zero position thereby ensuring universal interchangeability.

If an Exchange Unit can not be mounted, the coupling of the PTFE piston must be adjusted with the aid of the 6.2739.010 Key in the case of the 6.3011.XXX/6.3012.XXX models or with the 6.1546.010 Piston Rod with the other models.

Caution: If no liquid is aspirated into the glass cylinder of the Exchange Unit upon filling – despite a filled reagent bottle and correct tubing connections – the cylinder can be under vacuum. In this case, it may be dangerous to remove the Exchange Unit (the cylinder may break). Aerate the cylinder by opening the tubing connection at the head of the cylinder.

5.3.5 Maintenance

It is best to store the burette tip in the same solvent as the reagent to prevent crystallisation of reagent: Fill glass holder with solvent, pass burette tip through the bulb stopper and place in the glass holder. In the case of KF reagent, use methanol as storage solution. Warning: Before dispensing check that the burette tip is not blocked!

Emptying and cleaning:
- Discharge as much titrant as possible.
- Burette in the zero position, disconnect connections to bottle and burette tip.
- With 6.3011.XXX and 6.3012.XXX Exchange Units, remove light protection.
- Undo attachment of the glass cylinder and let spindle run out until the piston can be disengaged.
- Completely empty cylinder with the aid of the 6.2739.010 Key or 6.1546.010 piston rod and carefully pull out piston.
- Rinse and clean individual parts properly. (Especially ensure that no reagent remains in the threaded hole of the PTFE tubing connections.)

PTFE piston

The PTFE piston must be handled with care to avoid damaging the lip seals. Residual grease should be wiped off with a soft, lint-free cloth. Carefully apply fresh grease with your finger to the lip seals and in the spaces. Wipe off leading edge to ensure that the reagent does not come into contact with the grease. When inserting the piston in the glass cylinder, ensure that it is introduced straight and not at an angle.

SISCO 3000 (Swedish Iron & Steel Corp.) grease - this is not silicon grease (!), the name refers to the manufacturer - has well proved its worth since our tests have shown that it is not only inert to all titrants in normal use, but also has a favourable viscosity.
A worn piston must be replaced immediately to prevent titrant leaking out and corroding the drive spindle.

Stopcock

The stopcock needs no maintenance. If a defect is suspected, it is best to return it to the manufacturer for checking unopened (improper handling can render the stopcock completely useless). It is thus advisable to keep a 6.1542.0X0 stopcock as a spare at all times.

Removing the stopcock:
- Switch lever to "↑" ≙ dispensing.
- Unscrew nipples of the tubing connections.
- Pull out 6.1542.0X0 stopcock upwards (pull hard!).

Refitting:
- Switch lever to "↑" ≙ dispensing.
- For PTFE stopcock: Align marking on shaft and housing of stopcock.
- Insert stopcock from above in the holder and press down until the quick-release coupling engages.
- Screw in screw nipples.

5.3.6 Mounting the thermostat jacket of the 6.3011.XXX/6.3012.XXX Exchange Units

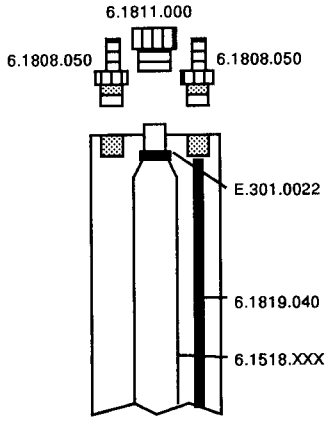
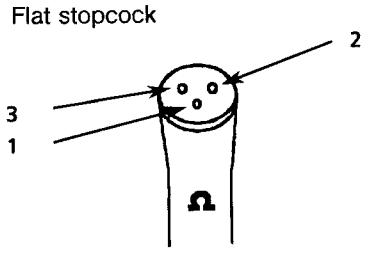


Fig 5-12: Thermostat jacket

1. Undo tubing connection of 6.1518.XXX glass cylinder.
2. Remove light protection.
3. Unscrew 6.1811.000 screw fitting at glass fitting.
4. Roll O-ring upwards out of groove on glass fitting. Do not use any hard objects to remove the O-ring, otherwise the edge of the glass fitting can splinter! If all else fails, cut O-ring. Ordering number for new O-ring: E.301.0022.
5. Lightly grease inside of 6.1536.010 thermostat jacket at the bottom and mount.
6. Lightly grease O-ring and attach to glass fitting.
7. Attach upper part of 6.1811.000 screw fitting to glass fitting.
8. Make connection to stopcock.
9. Insert 6.1819.040 PTFE tubing in thermostat jacket and attach thermostat tubing using 6.1808.050 coupling.

5.3.7 6.3006.113 Micromodel - 1 mL

Assembly:
See also Fig. 6-3, page 170.
- Dosimat without Exchange Unit is in the zero position.
- Mount Exchange Unit (without glass cylinder) from the front on the sliding plate and push right back.
- Allow piston spindle of Dosimat to run out by ca. 2 cm
- Mount 6.3022.113 Exchange Set and screw tightly.
- Join coupling of the piston spindle to that of the exchange set and move piston spindle of the Dosimat into the zero position.
- Fasten fitting with 6.2035.000 metal flange and V.911.0040 knurled nuts using 6.2035.000 metal flange.
- Turn glass piston until curve is aligned towards the handle.
- Attach remaining components of the Exchange Unit.
  . Tubing connections:



1 Connection to glass cylinder
2 Connection to burette tip
3 Connection to reagent bottle

Fig. 5-13: Stopcock tubing connections

  . Tighten tubing connections firmly by hand. Use 6.2739.000 key at all inaccessible positions and tighten using a moderate amount of force (tubing must not be pinched).
  Warning: Solids block the capillary tubing! Never pull on the tubing!
- Move piston to zero position.

Filling:

- Fill the reagent bottle with titrant.
- Insert a cotton wool plug in the adsorption tube and add a suitable protective agent. Cover with cotton wool and close with cover.
- Press <DOS> key until the piston is in the very top position.
- Press <STOP/FILL> .

Repeat filling process in both directions until the glass cylinder together with the connections up to the burette tip is filled. Drive any air bubbles to the top by lightly tapping the glass cylinder. If the air bubbles do not move, the Exchange Unit must be disassembled and the glass piston carefully degreased and dried.

Cleaning:
- Undo tubing connection to reagent bottle, repeat "dispensing" and "filling" until the piston is as empty as possible.
- Undo tubing connection to glass piston.
- Remove Exchange Unit from Dosimat.
- Unscrew knurled nuts and remove piston and fitting.
- Unscrew exchange set from fitting and disassemble Exchange Unit into its parts.
- Clean all parts thoroughly and dry (ensure that no reagent remains in the threaded holes of the tubing connections).
- If need be, replace 6.2712.000 Seal (round part pointing upwards).

6. Appendix

6.1 Technical specifications

Modes	SET: **S**et **E**nd point **T**itration KFT: **K**arl **F**ischer **T**itration MEAS: **MEAS**urement CAL: pH **CAL**ibration
Measuring input	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
Voltage	0... ± 2000 mV
Current	0... ± 200.0 µA
Temperature	–150.0... + 450.0 °C
Error of measurement of instrument (without sensors)	
at 25 °C and with a warmed-up Titrino	
pH value	± 0.02
Voltage	± 2 mV
Temperature	≤ 0.2 °C in the range of 0... + 100 °C
as a function of the ambient temperature	
pH value, voltage	typical 40 µV/K
Temperature	0.04 °C/K
Measuring amplifier	
Input resistence	$> 10^{13}\Omega$
Offset current	$< 3 \cdot 10^{-13}$ A
Deviation of offset voltage as a function of the ambient temperature	15 µV/K
Polarizer	Ipol: 0... ± 127 µA Upol: 0... ± 1270 mV, in 10 mV steps
Dosification	
Volume of a burette cylinder	1, 5, 10, 20 or 50 ml
Resolution	10 000 steps per burette cylinder
Materials	
Housing	polybutyleneterephthalate (PBTP)
Keypad covers	polycarbonate (PC)
Display	LCD, 2 lines of 24 characters each
Height of characters	5 mm
RS232 interface	for printer and balance connection or computer connection: completely remote controllable from external

Conventional input/output lines	for connection of sample changer or robot
Input lines	Start, Stop, Enter, Clear, Sample Ready
Output lines	Ready, Conditioning ok, Titration, End of titration, Error, Activate, lines to be set via RS232 Control
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)
Resolution	1 mV (12 bit), see also page 132
Ambient temperature	
Nominal operational range	5 ... 40 °C
Storage, transport	– 20 ... 60 °C
Safety specifications	Designed and tested in accordance to IEC publication 348, safety class I. This manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.
Mains connection	
Voltage	100, 117, 220, 240 V ± 10% (switchable)
Frequency	50 ... 60 Hz
Power consumption	15 VA
Fuse	Thermal fuse
Dimensions with Exchange Unit	
Width	150 mm
Height	450 mm
Depth	275 mm
Weight, incl. keypad	app. 3.4 kg

6.2 Translations of dialog texts

Key <configuration>

English	Spanish	German	French
>peripheral units send to: balance: record:	>aparatos periféricos transmisión a: balanza: curva:	>Peripheriegeräte Senden an: Waagentyp: Kurve:	>Appareils périphériques transm.à: balance: courbe:
>auxiliaries dialog: date time run number auto start start delay device label program	>ajustes varios diálogo: fecha hora n.de muestra comienzo auto t(espera) dirección programa	>Verschiedenes Dialog: Datum Zeit Probenummer Autostart Startverzögerung Gerätebez. Programm	>Réglages divers dialogue: date heure numéro d'échant. démarrage auto délai de démarrage adresse programme
>RS232 settings baud rate: data bit: stop bit: parity: handshake: RS control:	>ajustes para RS232 baud rate: data bit: stop bit: paridad: handshake: control RS:	>RS232-Einstellungen Baud Rate: Data Bit: Stop Bit: Parität: Handshake: Kontrolle via RS:	>Réglages RS232 baud rate: data bit: stop bit: parité: handshake: contrôle RS:
>common variables C30 : C39	>variables comunes C30 : C39	>Common Variable C30 : C39	>Variables communes C30 : C39

Key <parameters>, SET

English	Spanish	German	French
>SET1 EP at pH dynamics max.rate min.rate stop crit: stop drift t(delay) stop time	>SET1 punto final EP pH gama regulación veloc.max. veloc.min. crit.parada: deriva parada t(espera) tiempo de parada	>SET1 EP bei pH Regelbereich Max.Rate Min.Rate Stoppkrit: Stopp Drift Abschaltzeit Stoppzeit	>SET1 point final EP pH plage régul. débit max. débit mini. crit.d'arrêt: dérive d'arr. délai d'arrêt temps d'arrêt
>titration parameters titr.direction: pause 1 start V: start V factor dos.rate pause 2 extr.time meas.input: I(pol) U(pol) electrode test: temperature	>parámetros de titración sentido de titr.: pausa 1 V inicial: V inicial factor veloc.dos. pausa 2 tiempo extracción entrada de med: I(pol) U(pol) prueba electrodo: temperatura	>Titrationsparameter Titr.Richtung: Pause 1 Start V: Start V Faktor Dos.Geschw. Pause 2 Extr.zeit Messeingang: I(pol) U(pol) Elektrodentest: Temperatur	>Paramètres de titrage sens de titrage: pause 1 V de départ: V de départ facteur débit dos. pause 2 temps d'extr. entrée de mes: I(pol) U(pol) test électrode: température
>stop conditions stop V: stop V factor filling rate	>condiciones de parada V parada: V parada factor veloc.rell.	>Abbruchbedingungen Stopp V: Stopp V Faktor Füllgeschw.	>Conditions d'arrêt V d'arrêt: V d'arrêt facteur débit rempl.
>statistics status: mean n res.tab: delete n	>estadística status: media n tab.res: borrar n	>Statistik Status: Mittelwert n Res.Tab: löschen n	>Statistique état: moyenne n tab.res: éliminer n
>preselections conditioning: display drift: drift corr: drift value req.ident: req.smpl size: activate pulse:	>preselecciones acondicion: indicar deriva: corr.deriva valor deriva llamada ident: llamada peso: puls.activación:	>Vorwahl Konditionieren: Driftanzeige: Driftkorr: Driftwert Ident.abfragen: Einmass abfr.: Aktivierpuls:	>Présélections conditionner: indic.dérive: corr.derivé valeur derivé demande ident: demande p.d'essai: activation impuls:

Key <parameters>, KFT

English	Spanish	German	French
>titration parameters titr.direction: pause 1 start V: start V factor dos.rate pause 2 extr.time meas.input: I(pol) U(pol) electrode test: temperature	>parámetros de titración sentido de titr.: pausa 1 V inicial: V inicial factor veloc.dos. pausa 2 tiempo extracción entrada de med: I(pol) U(pol) prueba electrodo: temperatura	>Titrationsparameter Titr.Richtung: Pause 1 Start V: Start V Faktor Dos.Geschw. Pause 2 Extr.zeit Messeingang: I(pol) U(pol) Elektrodentest: Temperatur	>Paramètres de titrage sens de titrage: pause 1 V de départ: V de départ facteur débit dos. pause 2 temps d'extr. entrée de mes: I(pol) U(pol) test électrode: température
>control parameters EP at U dynamics max.rate min.volume incr. stop crit: stop drift t(delay) stop time	>paramétros de regul. punto final EP U gama regulación veloc.max. incremento min. crit.parada: deriva parada t(espera) tiempo de parada	>Regelparameter EP bei U Regelbereich Max.Rate Min.Volumeninkr. Stoppkrit: Stopp Drift Abschaltzeit Stoppzeit	>Paramètres de régul. point final EP U plage régul. débit max. incrément mini. crit.d'arrêt: dérive d'arr. délai d'arrêt temps d'arrêt
>stop conditions stop V: stop V factor filling rate	>condiciones de parada V parada: V parada factor veloc.rell.	>Abbruchbedingungen Stopp V: Stopp V Faktor Füllgeschw.	>Conditions d'arrêt V d'arrêt: V d'arrêt facteur débit rempl.
>statistics status: mean n res.tab: delete n	>estadística status: media n tab.res: borrar n	>Statistik Status: Mittelwert n Res.Tab: löschen n	>Statistique état: moyenne n tab.res: éliminer n
>preselections conditioning: display drift: drift corr: drift value req.ident: req.smpl size: activate pulse:	>preselecciones acondicion: indicar deriva: corr.deriva valor deriva llamada ident: llamada peso: puls.activación:	>Vorwahl Konditionieren: Driftanzeige: Driftkorr: Driftwert Ident.abfragen: Einmass abfr.: Aktivierpuls:	>Présélections conditionner: indic.dérive: corr.derivé valeur derivé demande ident: demande p.d'essai: activation impuls:

Key <parameters>, MEAS

English	Spanish	German	French
>measuring parameters signal drift equilibr.time meas.input: I(pol) U(pol) electrode test: temperature	>parámetros de medición deriva v.med. tiempo espera entrada de med: I(pol) U(pol) prueba electrodo: temperatura	>Messparameter Messw.Drift Wartezeit Messeingang: I(pol) U(pol) Elektrodentest: Temperatur	>Paramètres de mesure dérive du sig. temps d'attente entrée de mes: I(pol) U(pol) test électrode: température
>statistics status: mean n res.tab: delete n	>estadística status: media n tab.res: borrar n	>Statistik Status: Mittelwert n Res.Tab: löschen n	>Statistique état: moyenne n tab.res: éliminer n
>preselections req.ident: req.smpl size: activate pulse:	>preselecciones llamada ident: llamada peso: puls.activación:	>Vorwahl Ident.abfragen: Einmass abfr.: Aktivierpuls:	>Présélections demande ident: demande p.d'essai: activation impuls:

Key <parameters>, CAL

English	Spanish	German	French
>calibration parameters meas.input: cal.temp. buffer 1 pH signal drift equilibr.time electr.id sample changer cal: activate pulse:	>parámetros de cal. entrada de med: temp.de cal. tampón 1 pH deriva v.med. tiempo espera id.electrodo cambiador muestras: puls.activación:	>Kalibrierparameter Messeingang: Kal.Temp. Puffer 1 pH Messw.Drift Wartezeit Elektr.Id Probenwechsler: Aktivierpuls:	>Paramètres de calibrage entrée de mes: temp.de cal. tampon 1 pH dérive du sig. temps d'attente id.d'électr. passeur d'échant: activation impuls:
>statistics status: mean n res.tab: delete n	>estadística status: media n tab.res: borrar n	>Statistik Status: Mittelwert n Res.Tab: löschen n	>Statistique état: moyenne n tab.res: éliminer n

Key <smpl data>

English	Spanish	German	French
>edit silo lines silo line method: id#1 or C21 id#2 or C22 id#3 or C23 smpl size smpl unit:	>editar silo línea del silo método: id#1 o C21 id#2 o C22 id#3 o C23 peso unidad del peso:	>Silo editieren Silozeile Methode: Id#1 oder C21 Id#2 oder C22 Id#3 oder C23 Einmass Einmass-Einheit:	>Editer silo ligne du silo méthode: id#1 ou C21 id#2 ou C22 id#3 ou C23 p.d'essai unité p.d'essai:
>delete silo lines delete line n	>borrar silo borrar línea n	>Silo Zeilen löschen Zeile löschen n	>Eliminer silo éliminer ligne n
>delete all silo lines delete all:	>borrar todo borrar todo:	>Silo ganz löschen Alle löschen:	>Eliminer tout le silo éliminer tout:
cycle lines:	ciclo datos:	Datenzirkulation:	circ.de données:

Dialog elements of other keys

English	Spanish	German	French
<user methods> >recall method >store method >delete method method name:	<user methods> >cargar método >memorizar método >borrar método método:	<user methods> >Methode laden >Methode speichern >Methode löschen Methode:	<user methods> >charger méthode >mémoriser méthode >éliminer méthode méthode:
<def> >formula RS1 text RS1 decimal places RS1 unit: >common variables >report >mean	<def> >fórmula RS1 texto RS1 núm.decimales RS1 unidad: >variables comunes >impresión >media	<def> >Formel RS1 Text RS1 Nachkommastellen RS1 Einheit: >Common Variable >Report >Mittelwert	<def> >Formule RS1 texte RS1 nombre décimales RS1 unité: >Variables communes >Rapport >Moyenne
<cal.data> >input 1 pH(as) slope cal.date electr.id >input 2 >input diff.	<cal.data> >entrada de med.1 pH(as) pendiente fecha de cal. id.electrodo >entrada de med.2 >entrada de med.dif.	<cal.data> >Messeingang 1 pH(as) Steilheit Kal.Datum Elektr.Id >Messeingang 2 >Differenzeingang	<cal.data> >entrée de mes.1 pH(as) pente date de cal. id d'électr. >entrée de mes.2 >entrée de mes.diff.
Report sequence: full, short, ff, calc, param, calib	Report sequence: compl, breve, ff, calc, param, calib	Report sequence: voll, kurz, ff, Rechn, Param, Kalib	Report sequence: compl, court, ff, calc, param, calib

Display for modes , titration sequences and display of results

English	Spanish	German	French
SET:	SET:	SET:	SET:
conditioning	acondicion.	konditioniert	conditionné
wait	espere	warten	attente
drift	deriva	Drift	dérive
add sample	adicione muestra	Probe zugeben	ajout d'échant.
CAL:	CAL:	CAL:	CAL:
buffer 1	tampón 1	Puffer 1	tampon 1
>calculations	>cálculos	>Berechnungen	>Calculs
>display results	>indic.resultados	>Resultate anzeigen	>Indic.des résultats
>display EP's	>indic.EP's	>EP's anzeigen	>Indic.des EP's
>display mean	>indic.media	>Mittelwerte anzeigen	>Indic.des moyennes
>display meas.val	>indic.valor medido	>Messwert anzeigen	>Indic.valeur mesurée
>display std.deviation	>indic.desviación std.	>Std.Abweichung anzeigen	>Indic.écart type
>display messages	>indic.mensajes	>Meldungen anzeigen	>Indic.des messages
>display calibration	>indic. calibración	>Kalibrierung anzeigen	>Indic. calibrage
overwrite	sobreescribir	überschreiben	recouvrir
remaining bytes	bytes libres	Freie bytes	bytes libres

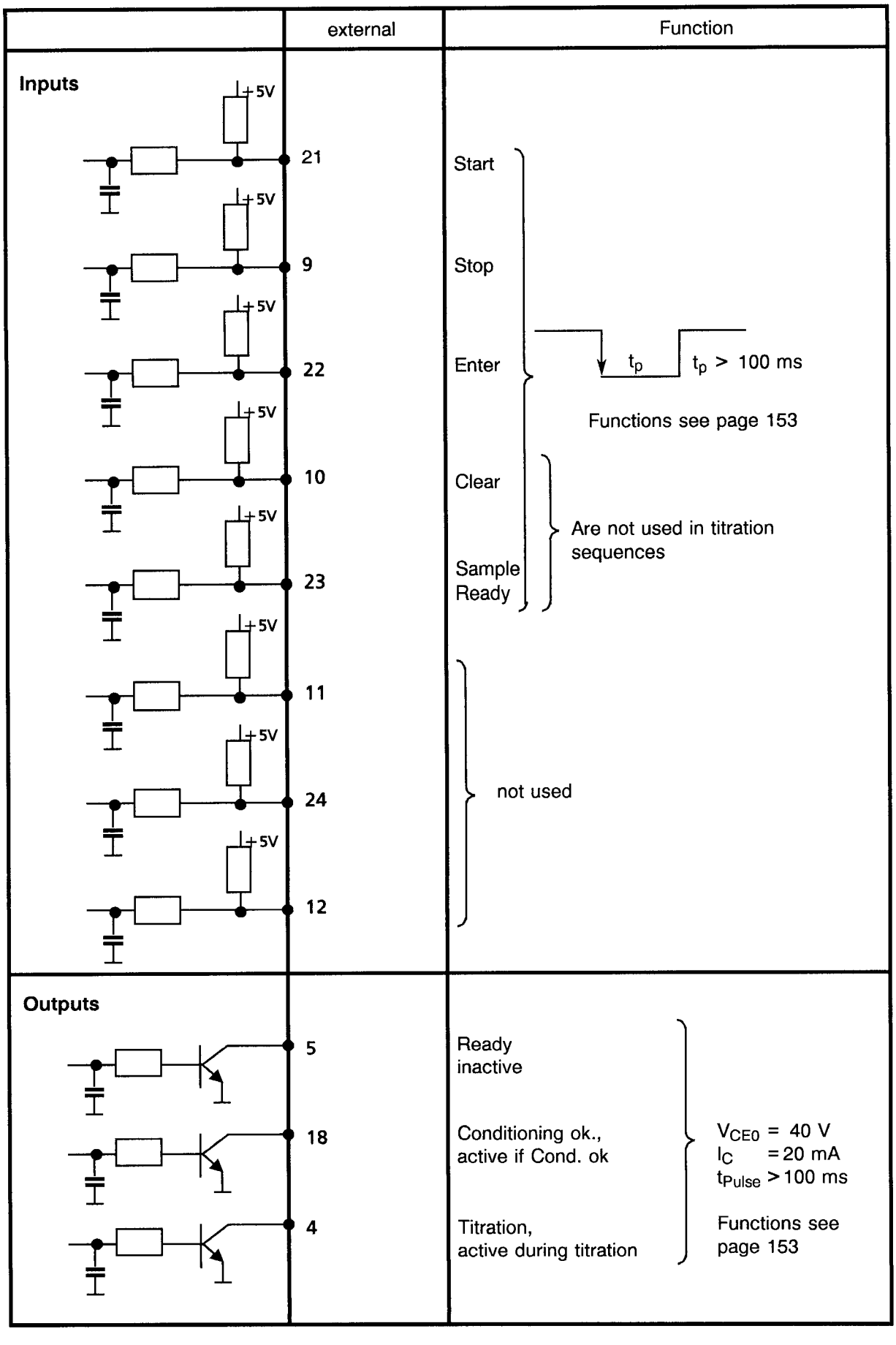
Error messages

English	Spanish	German	French
XXX bytes missing	XXX bytes faltan	XXX Bytes fehlen	XXX bytes manquent
check electrode	revise electrodo	Elektrode prüfen	contrôler l'électrode
check exchange unit	revise bureta	Wechseleinheit prüfen	contrôler la burette
check temp.sensor	revise termosonda	Temp.Sensor prüfen	contrôler sonde temp.
division by zero	división por cero	Division durch Null	division par zéro
error	error	error	error
manual stop	parada manual	Manueller Abbruch	arrêt manuel
missing EP	falta EP	EP fehlt	manque d'EP
no EP set	no EP prefijado	Kein EP gesetzt	pas d'EP choisi
no method	no método	Keine Methode	pas de méthode
no new com.var.	no var.com. nueva	Keine neue Com.Var.	pas de nlle var.com.
no new mean	no media nueva	Kein neuer Mittelw.	pas de nlle moyenne
not valid	no válido	ungültig	non valable
overrange	med.fuera	Überbereich	mes.dépassée
same buffer	mismo tampón	Gleicher Puffer	même tampon
silo empty	silo vacío	Silo leer	silo vide
silo full	silo lleno	Silo voll	silo plein
stop time reached	tiempo parada alcanzado	Stopp EP erreicht	temps d'arrêt atteint
stop V reached	V parada alcanzado	Stopp V erreicht	V d'arrêt atteint
wrong sample	muestra errónea	Falsche Probe	échantillon erroné

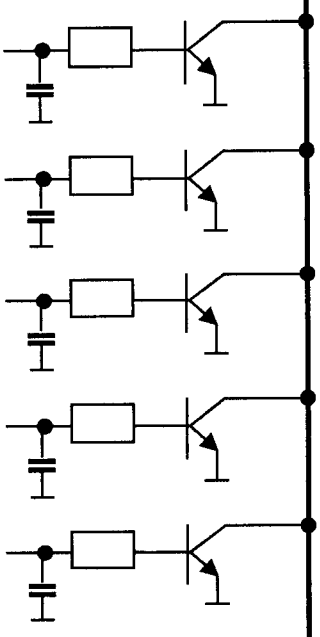
Input values depending on language

	English	Spanish	German	French
general:	ON, OFF	sí, no	ein, aus	oui, non
parity:	even, odd, none	par, impar, ninguna	gerade, ungerade, keine	paire, impaire, non
handshake:	HWs, HWf, SWchar, SWline, none	HWs, HWc, SWchar, SWlínea, ninguno	HWeinf, HWvoll, SWChar, SWZeile, kein	HWs, HWc, SWchar, SWligne, non
start V:	rel., abs.	rel., abs.	rel. abs.	rel. abs.
dos.rate:	max.	max.	max.	max.
res.tab:	delete all, delete n, original	borrar todo, borrar n, original	löschen alle, löschen n, Original	éliminer tout, éliminer n, original
req.ident:	id1, id1 & 2, all	id1, id1 & 2, todo	Id1, Id1 & 2, alle	id1, id1 & 2, tous
req.smpl size:	value, unit, all	val, unidad, todo	Wert, Einh, alle	val, unité, tous
titr.dir:	auto	auto	auto	auto
stop crit:	drift, time	deriva, tiempo	Drift, Zeit	dérive, temps
stop time	INF	inf.	inf.	inf.
meas.input:	diff.	dif.	diff.	diff.
activate pulse:	first, all, cond.	prim., todo, acond.	erster, alle, kond.	prem., tous, cond.

6.3 Pin assignment of the "Remote" socket



Outputs



End of determination
EOD

To be set via RS232 control

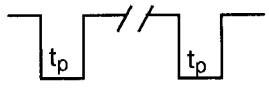
Error: active with errors

Activate, as set in method (see also page 154)

V_{CE0} = 40 V
I_C = 20 mA
t_{Pulse} > 100 ms

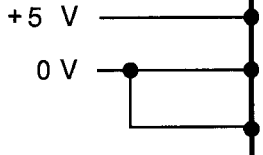
Functions see page 153

Pulses for recorder



t_p = 150 µs

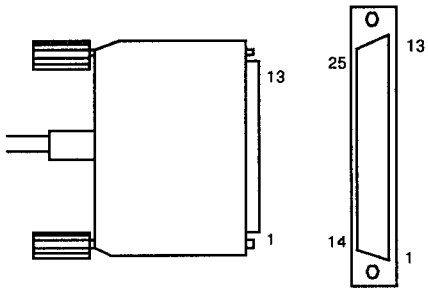
Voltage



I ≤ 75 mA

0 V: active
5 V: inactive

Contact arrangement at socket (male) for connector "Remote" (female)

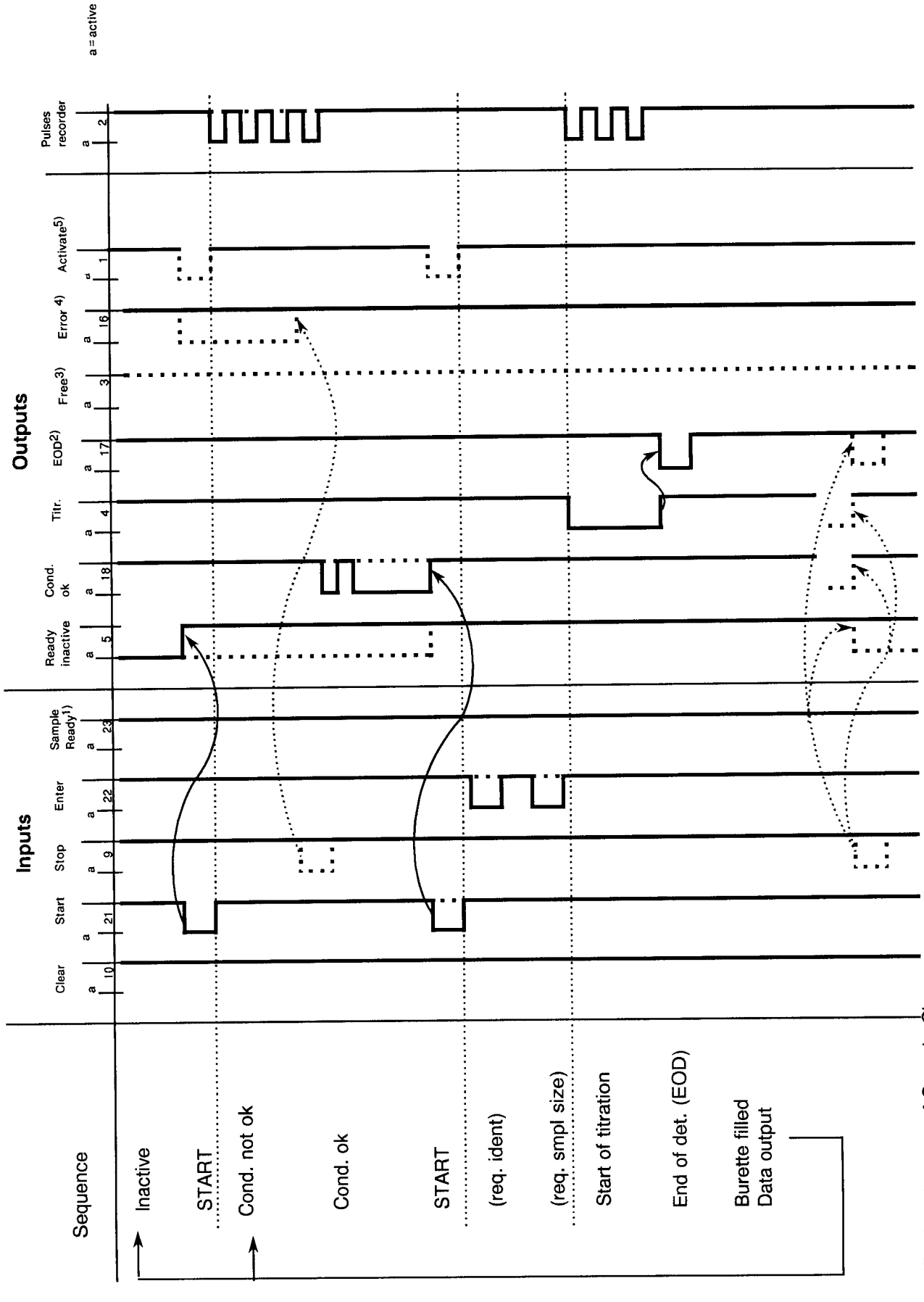


View from solder side of connector

Ordering numbers:
K.210.9004 (shell) and K.210.0002

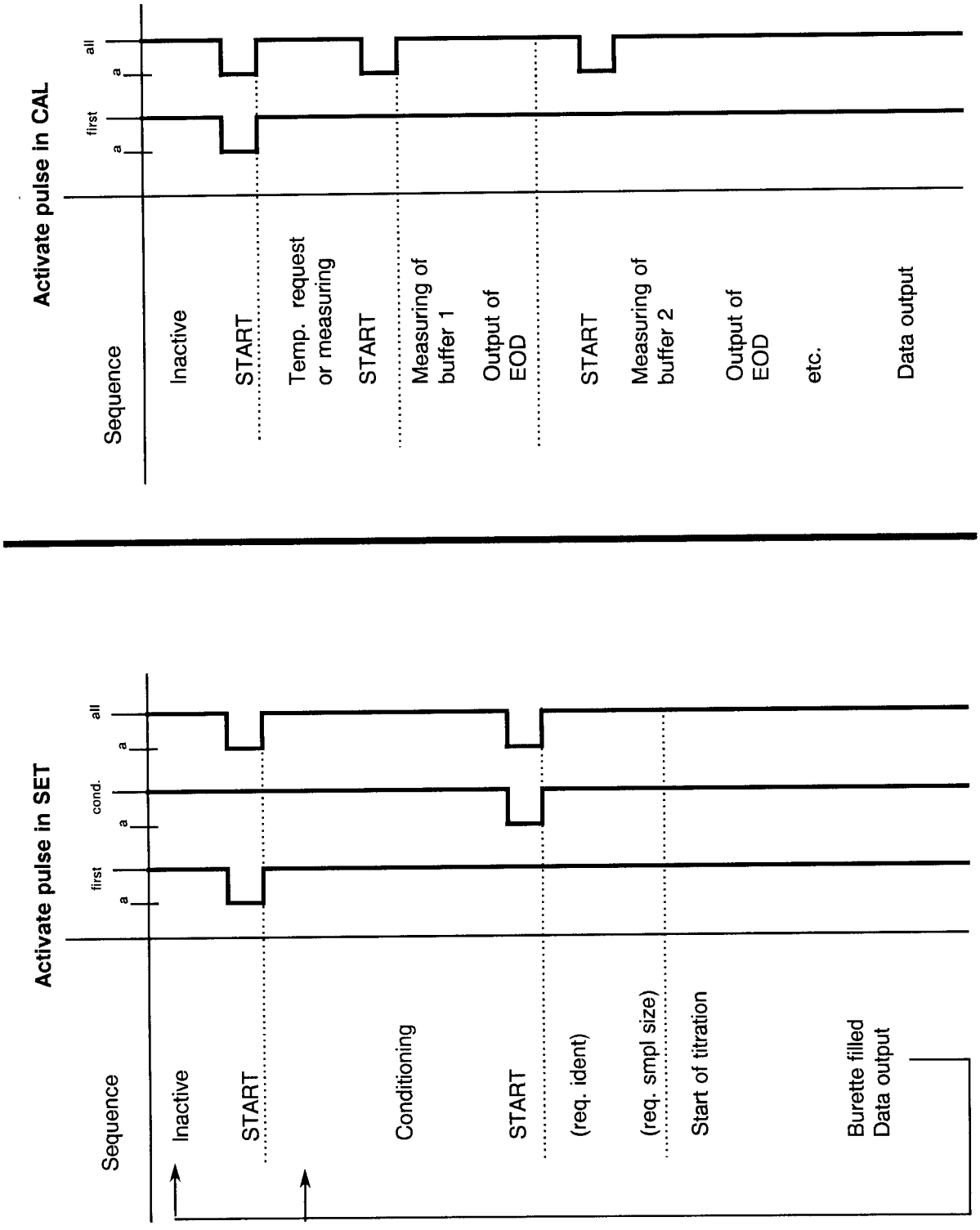
No liability whatsoever will be accepted for damage caused by improper interconnection of instruments.

6.3.1 Remote lines status during the titration



1) Beaker detector of Sample Changer.
2) In CAL, EOD is sent after every buffer. Automatic output of EOD can be switched off via RS232, see page 102.
3) Line can be set via RS232, see page 102.
4) The error line is reset when the error is rectified.
5) According to method configuration (see pages 28, 37 and 44f) or can be set via RS232 (see page 102).

Possible configurations of the activate pulse in SET, KFT and CAL



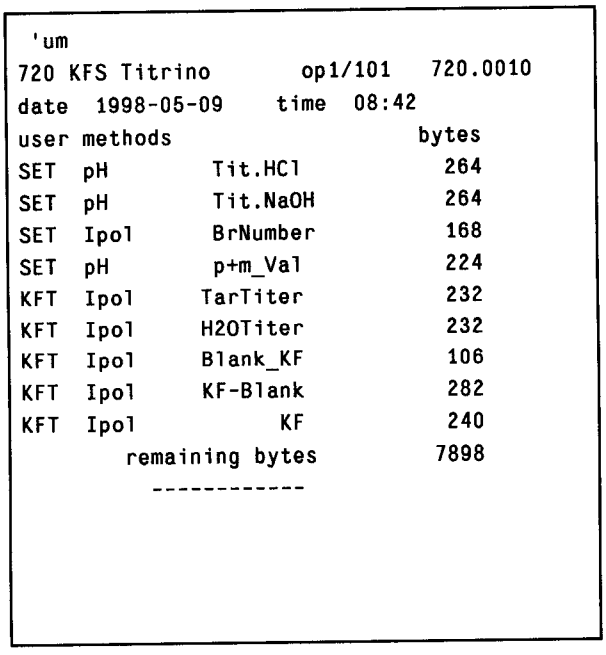
6.4 User methods

6.4.1 General

The methods are stored ready for use in the user memory. They can be loaded, modified and overwritten. Depending on sample and instrument configuration, the methods should be completed with the following settings:

- For method "BrNumber" the blank value. should be entered under keys <C-fmla>, <C01> see page 48.
- If a printer is connected, the methods should be completed with report instructions, see page 51.

The following methods are available:



- Titer determination of hydrochloric acid
- Titer determination of sodium hydroxide
- Bromine number according to ASTM D1159-84
- p- and m-value (acid capacity or $pK_{S\ 8.2}$ and $pK_{S\ 4.3}$)
- KF-titer with sodium tartrate
- KF-titer with H_2O or methanol standard solution
- Blank determination for KFT
- KF-titration with blank value subtraction
- KF-titration without blank value subtraction

6.4.2 "Tit.NaOH"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42        1
SET  pH             Tit.NaOH
parameters
>SET1
  EP at pH              8.65
  dynamics                 3
  max.rate                 5 ml/min
  min.rate               0.5 µl/min
  stop.crit:           drift
  stop drift              20 µl/min
>SET2
  EP at pH               OFF
>titration parameters
  titr.direction:       auto
  pause 1                  0 s
  start V:               rel.
  factor                  35
  dos.rate               max. ml/min
  pause 2                  5 s
  extr.time                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:                  ON
  mean                n=     5
  res.tab:            original
>preselections
 conditioning:             OFF
  req.ident:               OFF
  req.smpl size:         value
  activate pulse:          OFF
         ------------

'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42        1
SET  pH             Tit.NaOH
>calculations
"Titer=C00*C01/C02/EP1;4;"
C00=                   1.0
C01=                 10000
C02=                204.23
         ------------

'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42
def
>formula
  Titer=C00*C01/C02/EP1
  RS1 text              Titer
  RS1 decimal places        4
  RS1 unit:
>common variables
  C37=MN1
>report
>mean
  MN1=RS1
         ------------
```

Titer determination of NaOH) using potassium hydrogen phthalate (PHP)

The titer is calculated as a factor without dimension out of 5 determinations and stored as common variable C37. It can therefore be used directly by subsequent methods.

Electrode:	Combined pH glass electrode 6.0232.100, at measuring input 1.
Titrant:	c(NaOH) = 0.1 mol/l (free of carbonate)
Sample:	Weigh in potassium hydrogen phthalate (KHP), dried 2 h at 105°C. Sample size according to the burette volume. Dissolve it in 40 ml dist. water (free of carbonate)
Reference:	Metrohm Application Bulletin No. 206

- Result as a digit without dimension.
- Sample size in g
- Theoretical consumption for 1 mol PHP
- Molar mass of PHP

C37 common variable for the titer NaOH

6.4.3 "Tit.HCl"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42        1
SET  pH             Tit.HCl
parameters
>SET1
  EP at pH              5.10
  dynamics                 3
  max.rate                 5 ml/min
  min.rate               0.5 µl/min
  stop.crit:           drift
  stop drift              20 µl/min
>SET2
  EP at pH               OFF
>titration parameters
  titr.direction:       auto
  pause 1                  0 s
  start V:              rel.
  factor                  70
  dos.rate              max. ml/min
  pause 2                  5 s
  extr.time                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:                 ON
  mean               n=     5
  res.tab:           original
>preselections
  conditioning:           OFF
  req.ident:              OFF
  req.smpl size:        value
  activate pulse:         OFF
         ------------

'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42        1
SET  pH             Tit.HCl
>calculations
"Titer=C00*C01/C02/EP1;4;"
C00=                  1.0
C01=                10000
C02=               121.14
         ------------

'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42
def
>formula
  Titer=C00*C01/C02/EP1
  RS1 text                Titer
  RS1 decimal places          4
  RS1 unit:
>common variables
  C36=MN1
>report
>mean
  MN1=RS1
         ------------
```

Titer determination of HCl using TRIS

The titer is calculated as a factor without dimension out of 5 determinations and stored as common variable C36. It can therefore be used directly by subsequent methods.

Electrode:	Combined pH Glass electrode 6.0232.100, at measuring input 1.
Titrant:	c(HCl) = 0.1 mol/l
Sample:	Weigh in Tris(hydroxymethyl)-aminomethane (TRIS) dried 2 h at 105°C. Sample size according to the burette volume. Dissolve it in 40 ml dist. water
Reference:	Metrohm Application Bulletin No. 206

- Result as a digit without dimension
- Sample size in g
- Theoretical consumption for 1 mol TRIS
- Molar mass of TRIS

C36 Common variable for the titer HCl

6.4.4 "p + m_Val"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42        1
SET  pH             p+m_Val
parameters
>SET1
  EP at pH               8.2
  dynamics                 2
  max.rate                 5 ml/min
  min.rate                 5 µl/min
  stop.crit:           drift
  stop drift              20 µl/min
>SET2
  EP at pH               4.3
  dynamics                 3
  max.rate                 5 ml/min
  min.rate                 5 µl/min
  stop.crit:           drift
  stop drift              20 µl/min
>titration parameters
  titr.direction:       auto
  pause 1                  0 s
  start V:               OFF
  pause 2                  0 s
  extr.time                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:                  ON
  mean               n=     3
  res.tab:           original
>preselections
  conditioning:            OFF
  req.ident:               OFF
  req.smpl size:           OFF
          ------------
'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42        1
SET  pH             p+m_Val
>calculations
"p value=(EP1*C36*C01-C02)*C03;2;"
"m value=(EP2*C36*C01-C02)*C03;2;"
C01=                1.00
C02=                 1.0
C03=                   4
C36=                   1
          ------------
'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42
def
>formula
  p value=(EP1*C36*C01-C02)*C03
  RS1 text             p value
  RS1 decimal places         2
  RS1 unit:
  m value=(EP2*C36*C01-C02)*C03
  RS2 text             m value
  RS2 decimal places         2
  RS2 unit:
>common variables
>report
>mean
  MN1=RS1
  MN2=RS2
          ------------
```

p + m Value

Determination of the acid capacity or $pK_{S\,8.2}$ and $pK_{S\,4.3}$ resp. of water and waste water.

The p value represents the amount of acid to be added, to reach the pH value 8.2 (colour change of phenolphthalein).

The m value represents the amount of acid to be added, to reach the pH value 4.3 (colour change of methyl orange).

Electrode:	Combined pH glass electrode 6.0232.100, at measuring input 1.
Titrant:	c(HCl) = 0.1 mol/l
Sample:	25 ml water 0.1 ml $c(Na_2CO_3)$ = 1 mol/l
Reference:	DIN 38 409, part 7 (1979)

- Results in mmol/l

- Concentration of titrant * 10
- Amount of carbonate addition in mmol
- Factor for 100 ml Sample
- Titer c(HCl) = 0.1 mol/l

Remarks

- When working without carbonate addition, set the calculation variable C02 to 0 (key <C-fmla>).
- C03 has to be 1 for sample size 100 ml (instead of 25 ml)
- This method can easily be modified to match the particular specifications of each country, e.g. the specified pH value may vary slightly.

6.4.5 "BrNumber"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42        1
KFT  Ipol            BrNumber
parameters
>titration parameters
  titr.direction:            -
  pause 1                    0 s
  start V:                 OFF
  pause 2                    0 s
  extr.time                  0 s
  I(pol)                    10 µA
  electrode test:          OFF
  temperature             25.0 °C
>control parameters
  EP at U                  500 mV
  dynamics                 500 mV
  max.rate                10.0 ml/min
  min.rate                25.0 µl/min
  stop.crit:             drift
  stop drift                20 µl/min
>stop conditions
  stop V:                  abs.
  stop V                  99.99 ml
  filling rate             max. ml/min
>statistics
  status:                    ON
  mean                n=     3
  res.tab:            original
>preselections
  conditioning:            OFF
  req.ident:               OFF
  req.smpl size:         value
  activate pulse:          OFF
          ------------
 'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42        1
KFT  Ipol            BrNumber
>calculations
BrNumber=(EP1-C01)*C02*C03*C04/C00;0;
C00=                   1.0
C01=                     0
C02=                   0.5
C03=                  7.99
C04=                   100
          ------------
 'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-10    time  08:42
def
>formula
  BrNumber=(EP1-C01)*C02*C03*C04/C00
  RS1 text              BrNumber
  RS1 decimal places           0
  RS1 unit:
>common variables
>report
>mean
  MN1=RS1
          ------------
```

Bromine number according to ASTM D1159-84

Determination of the bromine number in petroleum hydrocarbons according to ASTM D1159-84.

The bromine number is defined as the quantity of bromine in mg which reacts with 100 g of sample.

Electrode:	Double Pt-electrode 6.0308.100, at measuring input "Pol".
Titrant:	Bromide/bromate solution, c(bromate) = 0.5 mol/l.
	Dissolve 51 g KBr and 13.92 g $KBrO_3$ in water and make up to 1 L.
Solvent:	714 ml glacial acetic acid, 134 ml 1,1,1-trichlorethane, 134 ml methanol and 18 ml sulfuric acid (diluted 1 + 5).
Sample:	Dissolve the appropriate amount of sample (depending on the expected bromine number) in 20...100 ml solvent. Titrate blank sample in the same way.
References:	ASTM D1159-84 Metrohm Application Bulletin No. 177

- Result in mg Bromine/100g
- Sample size in g
- Consumption of blank sample in ml
- Normality of Titrant
- Molar mass of Br_2 * 0.05
- Dilution factor

Remark:

In this titration sharp changes of the measured potential may occur, therefore the KFT mode is preferred to the SET mode.

6.4.6 "TarTiter"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol          TarTiter
parameters
>titration parameters
  titr.direction:            -
  pause 1                    0 s
  start V:                 OFF
  pause 2                    0 s
  extr.time                  0 s
  I(pol)                    50 µA
  electrode test:          OFF
  temperature             25.0 °C
>control parameters
  EP at U                  250 mV
  dynamics                 100 mV
  max.rate                max. ml/min
  min.volume incr.        min. µl
  stop.crit:              drift
  stop drift                20 µl/min
>stop conditions
  stop V:                 abs.
  stop V                  99.99 ml
  filling rate             max. ml/min
>statistics
  status:                    ON
  mean                 n=     5
  res.tab:             original
>preselections
  conditioning:              ON
  display drift:             ON
  drift corr:               OFF
  req.ident:                OFF
  req.smpl size:          value
  activate pulse:           OFF
          ------------
'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol          TarTiter
>calculations
"Titer=C00/EP1*C01;4;mg/ml"
C00=                   1.0
C01=                 156.6
          ------------
'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40
def
>formula
  Titer=C00/EP1*C01
  RS1 text               Titer
  RS1 decimal places         4
  RS1 unit:              mg/ml
>common variables
  C39=MN1
>report
>mean
  MN1=RS1
          ------------
```

KF titer determination with sodium tartrate

The titer is calculated as a factor without dimension out of 5 determinations and stored as common variable C39. It can therefore be used directly by subsequent methods.

Electrode:	Double Pt-electrode 6.0308.100, at measuring input "Pol".
Titrant:	One- or two-component KF reagent, with or without pyridine.
Solvent:	20 mL methanol or specific solvent (see literature), conditioned to complete dryness.
Sample:	Disodium tartrate dihydrate, 200 – 300 mg, stir to complete dissolution.
References:	Water determination by Karl Fischer titration, GIT Verlag, Darmstadt (Germany) Hydranal® –Manual, Riedel de Haën, Seelze (Germany)

- Result in mg/mL
- Sample size in g
- Water content * 10

6.4.7 "H2OTiter"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol          H2OTiter
parameters
>titration parameters
  titr.direction:            -
  pause 1                    0 s
  start V:                 OFF
  pause 2                    0 s
  extr.time                  0 s
  I(pol)                    50 µA
  electrode test:          OFF
  temperature             25.0 °C
>control parameters
  EP at U                  250 mV
  dynamics                 100 mV
  max.rate                max. ml/min
  min.volume incr.        min. µl
  stop.crit:              drift
  stop drift                20 µl/min
>stop conditions
  stop V:                  abs.
  stop V                  99.99 ml
  filling rate             max. ml/min
>statistics
  status:                    ON
  mean                n=     5
  res.tab:            original
>preselections
  conditioning:              ON
  display drift:             ON
  drift corr:              OFF
  req.ident:               OFF
  req.smpl size:         value
  activate pulse:          OFF
          ------------
'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol          H2OTiter
>calculations
"Titer=C00/EP1*C01;4;mg/ml"
C00=                   1.0
C01=                  1000
------------
'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40
def
>formula
  Titer=C00/EP1*C01
  RS1 text               Titer
  RS1 decimal places         4
  RS1 unit:              mg/ml
>common variables
  C39=MN1
>report
>mean
  MN1=RS1
          ------------
```

KF titer determination with water or methanol standard solution

The titer is calculated as a factor without dimension out of 5 determinations and stored as common variable C39. It can therefore be used directly by subsequent methods.

Electrode:	Double Pt-electrode 6.0308.100, at measuring input "Pol".
Titrant:	One- or two-component KF reagent, with or without pyridine.
Solvent:	20 mL methanol or specific solvent (see literature), conditioned to complete dryness.
Sample:	Distilled water, approx. 30 mg or 30 µL or methanol standard solution (5 or 10 mg water/mL).
References:	Water determination by Karl Fischer titration, GIT Verlag, Darmstadt (Germany) Hydranal® –Manual, Riedel de Haën, Seelze (Germany)

- Result in mg/mL
- Sample size in g
- Water content * 10

6.4.8 "Blank_KF"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol          Blank_KF
parameters
>titration parameters
  titr.direction:           -
  pause 1                   0 s
  start V:                OFF
  pause 2                   0 s
  extr.time                 0 s
  I(pol)                   50 µA
  electrode test:         OFF
  temperature            25.0 °C
>control parameters
  EP at U                 250 mV
  dynamics                100 mV
  max.rate               max. ml/min
  min.volume incr.       min. µl
  stop.crit:             drift
  stop drift               20 µl/min
>stop conditions
  stop V:                 abs.
  stop V                 99.99 ml
  filling rate            max. ml/min
>statistics
  status:                   ON
  mean                n=     3
  res.tab:            original
>preselections
  conditioning:             ON
  display drift:            ON
  drift corr:              OFF
  req.ident:               OFF
  req.smpl size:           OFF
  activate pulse:          OFF
          ------------
'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol          Blank_KF
>calculations
"Blank=EP1;4;ml"
          ------------
'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40
def
>formula
  Blank=EP1
  RS1 text              Blank
  RS1 decimal places        4
  RS1 unit:                 ml
>common variables
  C38=MN1
>report
>mean
  MN1=RS1
          ------------
```

Blank determination with KF titration

The consumption of KF reagent is not involved in a calculation, but is directly assigned to the common variable C38 as a mean value out of 3 determinations.

Electrode:	Double Pt-electrode 6.0308.100, at measuring input "Pol".
Titrant:	One- or two-component KF reagent, with or without pyridine.
Solvent:	20 mL methanol or specific solvent (see literature), conditioned to complete dryness.
Sample:	e. g. any solvent
References:	Water determination by Karl Fischer titration, GIT Verlag, Darmstadt (Germany) Hydranal® –Manual, Riedel de Haën, Seelze (Germany)

C38 as the common variable for the KF blank value

6.4.9 "KF-Blank"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol          KF-Blank
parameters
>titration parameters
  titr.direction:            -
  pause 1                    0 s
  start V:                 OFF
  pause 2                    0 s
  I(pol)                    50 µA
  electrode test:          OFF
  temperature             25.0 °C
>control parameters
  EP at U                  250 mV
  dynamics                 100 mV
  max.rate                max. ml/min
  min.volume incr.        min. µl
  stop.crit:              drift
  stop drift                 20 µl/min
>stop conditions
  stop V:                  abs.
  stop V                  99.99 ml
  filling rate             max. ml/min
>statistics
  status:                    ON
  mean                n=      3
  res.tab:            original
>preselections
  conditioning:              ON
  display drift:             ON
  req.ident:               OFF
  req.smpl size:           all
  activate pulse:          OFF
          ------------
'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol          KF-Blank
>calculations
"Water=(EP1-C38)*C39*C01/C00/C02;2;%"
"Titer=C39;4;mg/ml"
"Blank=C38;4;ml"
C00=                   1.0
C01=                   0.1
C02=                     1
C38=                   0.0
C39=                5.1323
          ------------
'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40
def
>formula
  Water=(EP1-C38)*C39*C01/C00/C02
  RS1 text                 Water
  RS1 decimal places           2
  RS1 unit:                    %
  Titer=C39
  RS2 text                 Titer
  RS2 decimal places           4
  RS2 unit:                mg/ml
  Blank=C38
  RS3 text                 Blank
  RS3 decimal places           4
  RS3 unit:                   ml
>common variables
>mean
  MN1=RS1
          ------------
```

KF titration with blank value deduction

KF titration regarding a blank value (e. g. of a solvent), being determined before and stored as common variable C38 (see user method Blank_KF

Electrode: Double Pt-electrode 6.0308.100, at measuring input "Pol".

Titrant: One- or two-component KF reagent, with or without pyridine.

Solvent: 20 mL methanol or specific solvent (see literature), conditioned to complete dryness.

Sample: Samle size depending on expected consumption of titrant.

References: Water determination by Karl Fischer titration, GIT Verlag, Darmstadt (Germany)

Hydranal® –Manual, Riedel de Haën, Seelze (Germany)

- Result in %

- Sample size in g
- Factor for %
- Divisor
- Blank value in mL
- KF titer

6.4.10 "KF"

```
 'pa
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol                KF
parameters
>titration parameters
  titr.direction:          -
  pause 1                  0 s
  start V:               OFF
  pause 2                  0 s
  extr.time                0 s
  I(pol)                  50 µA
  electrode test:        OFF
  temperature           25.0 °C
>control parameters
  EP at U                250 mV
  dynamics               100 mV
  max.rate              max. ml/min
  min.volume incr.      min. µl
  stop.crit:            drift
  stop drift               20 µl/min
>stop conditions
  stop V:                abs.
  stop V                99.99 ml
  filling rate           max. ml/min
>statistics
  status:                  ON
  mean               n=     3
  res.tab:           original
>preselections
  conditioning:            ON
  display drift:           ON
  drift corr:             OFF
  req.ident:              OFF
  req.smpl size:          all
  activate pulse:         OFF
         ------------

'fm
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40        0
KFT  Ipol                KF
>calculations
"Water=EP1*C39*C01/C00/C02;2;%"
"Titer=C39;4;mg/ml"
C00=                   1.0
C01=                   0.1
C02=                     1
C39=               5.1323
         ------------

'de
720 KFS Titrino       op1/101   720.0010
date  1998-03-09    time  16:40
def
>formula
  Water=EP1*C39*C01/C00/C02
  RS1 text              Water
  RS1 decimal places        2
  RS1 unit:                 %
  Titer=C39
  RS2 text              Titer
  RS2 decimal places        4
  RS2 unit:             mg/ml
>common variables
>report
>mean
  MN1=RS1
         ------------
```

KF titration with no blank value deduction

KF titration without regarding a blank value.

Electrode:	Double Pt-electrode 6.0308.100, at measuring input "Pol".
Titrant:	One- or two-component KF reagent, with or without pyridine.
Solvent:	20 mL methanol or specific solvent (see literature), conditioned to complete dryness.
Sample:	Samle size depending on expected consumption of titrant.
References:	Water determination by Karl Fischer titration, GIT Verlag, Darmstadt (Germany) Hydranal® –Manual, Riedel de Haën, Seelze (Germany)

- Result in %

- Sample size in g
- Factor for %
- Divisor
- KF titer

6.5 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 orderer.

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 orderer has no rights or claims except those mentioned above.

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

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

6.6 Scope of delivery and ordering designations

6.6.1 720 KFS Titrino

720 KFS Titrino	**2.720.0010**
including the following accessories:	
1 Keypad for 720 KFS Titrino	6.2130.020
1 Double Pt electrode	6.0338.000
1 Set O-rings	6.1244.040
1 Drying tube	6.1403.040
1 Titration vessel upper half	6.1414.030
1 Titration vessel lower half, 20...90 ml	6.1415.220
1 Titration vessel lower half, 50...150 ml	6.1415.250
2 Sets septa, 5 per set	6.1448.010
2 Magnetic stirring bars, length 16 mm	6.1903.020
2 Magnetic stirring bars, length 25 mm	6.1903.030
1 Glass weighing spoon with protective cover	6.2412.000
1 KF screw nipple	6.2730.010
1 Septum stopper	6.2730.020
3 Stoppers with nipple and O-ring	6.2730.030
1 Key for exchange units	6.2739.010
1 Dust cover	6.2723.130
1 Bottle molecular sieves, 250 g	6.2811.000
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 Instructions for Use for 720 KFS Titrino	8.720.1003

Options

Accessories to separate order and on payment of extra charge:

728 Magnetic Stirrer	
Magnetic Stirrer 728	2.728.0040
727 Ti Stand	
For rinsing and addition of fresh solvent	2.727.0010
Rod stirrer	2.722.0010
or	
727 Ti Stand with built-in magnetic stirrer and rinsing and addition of fresh solvent	2.727.0100
703 Ti Stand	2.703.0010
Magnetic stirrer, stand, siphoning device for waste solvent, addition of fresh solvent.	

681 Pump Unit

Separate pump to siphon off titrated solution and for the addition of fresh solvent.

110...117 V, NEMA/ASA plug (USA...)	2.681.0021
220...240 V, Euro plug	2.681.0024
110...117 V, Euro plug	2.681.0025

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
Thermostatable titration vessel, volumes	
1... 50 mL	6.1418.110
5... 70 mL	6.1418.150
20... 90 mL	6.1418.220
50... 150 mL	6.1418.250
Titration vessel upper half for electrodes and burette tips (5 openings)	6.1414.010
Magnetic stirring bars, length	
12 mm	6.1903.010
16 mm	6.1903.020
25 mm	6.1903.030
Electrode holder	6.2021.020
Equipment for KF titrations	6.5609.000

Printers

Citizen printer iDP560 RS	2.140.0014
Cable 720 KFS Titrino – Citizen printer iDP560 RS	6.2125.050
Seiko printer DPU-411, 220 V	2.141.0014
Seiko printer DPU-411, 120 V	2.141.0015
Cable 720 KFS Titrino – Seiko Printer DPU 411	6.2125.020
Cable 720 KFS Titrino – EPSON printer with 6 pin plug	6.2125.040
Cable 720 KFS Titrino – EPSON printer with RS interface #8148	6.2125.050
Cable 720 KFS Titrino – HP Think Jet, HP Quiet Jet, HP Deskjet	6.2125.050
Cable 720 KFS Titrino – Kodak Diconix 180 si	6.2125.050
Adapter for simultaneous connection of printer and balance	6.2125.030

Balance connection

Sartorius balance MP8, connecting cable	6.2125.070
Mettler AT, PM balances and balances with interface 016	Cable from Mettler
Mettler balances with interface 011 or 012	6.2125.020
AND balances (with RS232 interface OP-03), connecting cable	6.2125.020
Precisa balances, connecting cable	6.2125.080
Adapter for simultaneous connection of printer	6.2125.030

PC connection, control via RS232 C interface

Cable 720 KFS Titrino – IBM® PC/XT/PS-2 or compatible	6.2125.060
Cable 720 KFS Titrino – IBM® AT	6.2125.060 + 6.2125.010
RS232 C extension cable	6.2125.020
Program package for the data transfer 720 KFS Titrino – IBM® PC or compatible, $3\frac{1}{2}$" disk	6.6019.000

Analog recorder

Labograph 586, 50 Hz	2.586.0012
Labograph 586, 60 Hz	2.586.0013
Cable 720 KFS Titrino – Labograph 586	3.980.3570 + 6.2115.010

Sample Changer	
With 10 sample beakers, 1 work station	2.673.0020
With 10 sample beakers, 2 work stations	2.673.0010
With 32 sample beakers, 1 work station	2.674.0010
With 32 sample beakers, 2 work stations	2.674.0020
Control Unit for all Sample Changers	2.664.0010
Cable 720 KFS Titrino – 664 Control Unit	3.980.3560
Cable 720 KFS Titrino – 664 Control Unit and 665 or 725 Dosimat	3.980.3610
Dosimat	
Cable 720 KFS Titrino – 665 or 725 Dosimat	6.2139.000
Cable 720 KFS Titrino – 664 Control Unit and 665 or 725 Dosimat	3.980.3610
707 KF Oven	2.707.0010
With built-in air pump and automatic control of weighing boat	
Cable 720 KFS Titrino – 707 KF Oven	6.2141.010
Instrument bridge for 707 KF Oven	6.2041.180
688 KF Oven	
220 ... 240 V	2.688.0014
110 ... 117 V	2.688.0015
Stand mounting for the oven	6.2048.000
Stopper and PTFE tubing for the gas introduction	6.2730.040 + 6.1819.060
661 Pump Unit	2.661.0010
For the generation of a dry air stream for work with the 688 KF Oven	

6.6.2 Exchange Units

Burette cylinder volume 5 mL	
Light protection, burette tip with microvalve	6.3012.153
Amber glass, burette tip with microvalve	6.3007.153
Amber glass, burette tip without microvalve	6.3006.153
Burette cylinder volume 10 mL	
Light protection, burette tip with microvalve	6.3012.213
Amber glass, burette tip with microvalve	6.3007.213
Amber glass, burette tip without microvalve	6.3006.213
Burette cylinder volume 20 mL	
Light protection, burette tip with microvalve	6.3012.223
Amber glass, burette tip with microvalve	6.3007.223
Amber glass, burette tip without microvalve	6.3006.223
Burette cylinder volume 50 mL	
Light protection, burette tip without microvalve	6.3011.253
Amber glass, burette tip without microvalve	6.3006.253

Accessories, see Fig. 6-1 and 6-2.

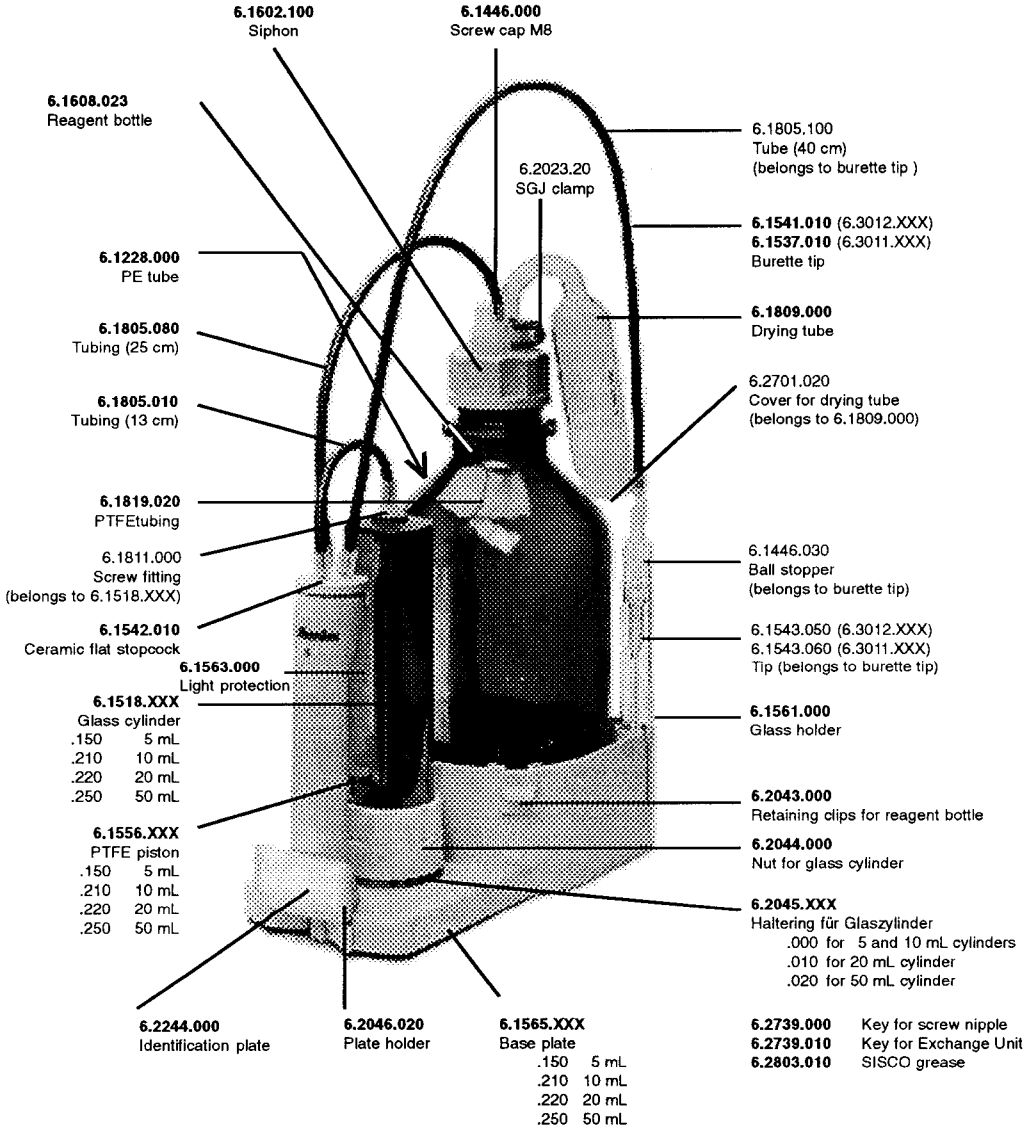


Fig. 6-1: Standard accessories and ordering designations for the 6.3011.253 and 6.3012.XXX Exchange Units

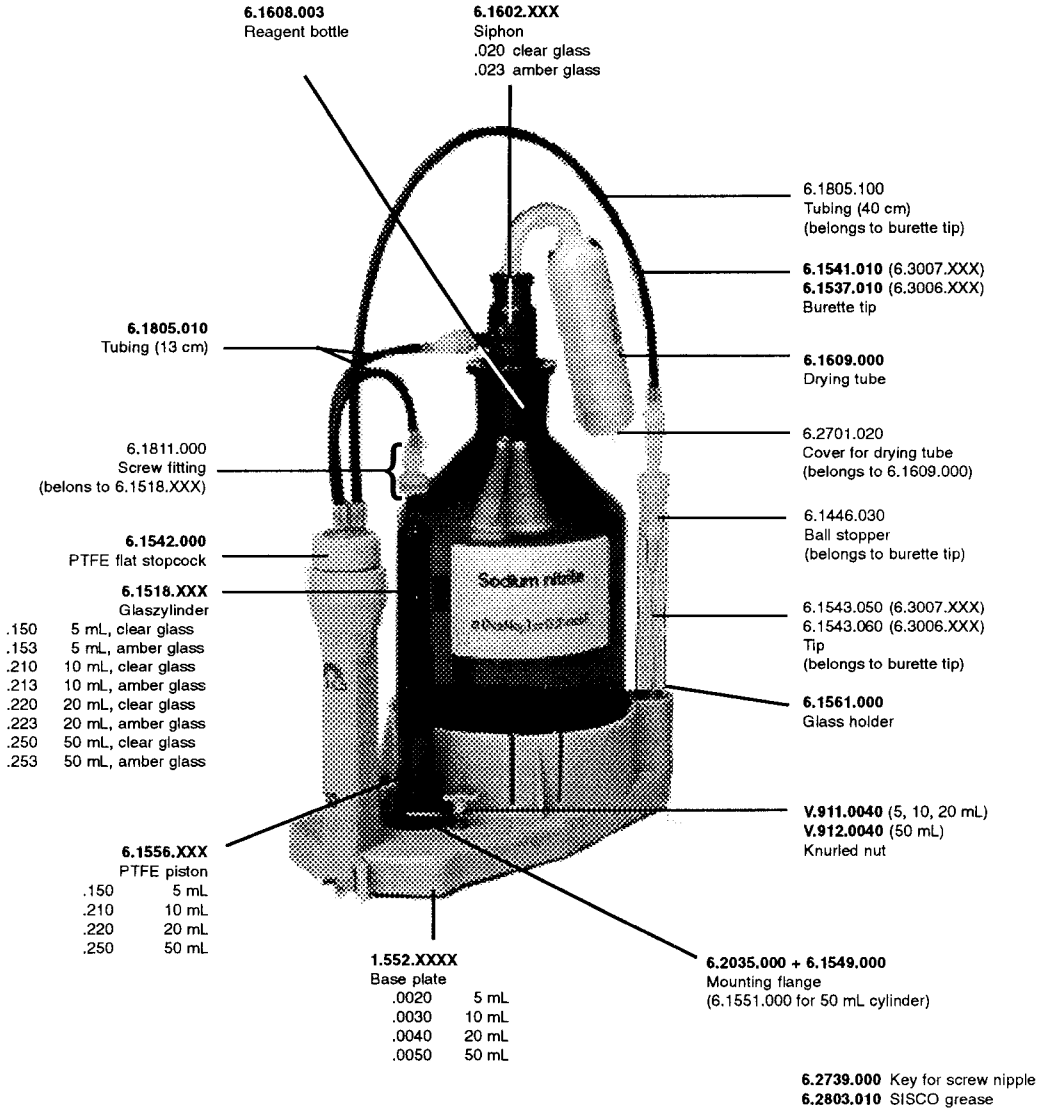


Fig. 6-2: Standard accessories and ordering designations for the 6.3006.XXX and 6.3007.XXX Exchange Units

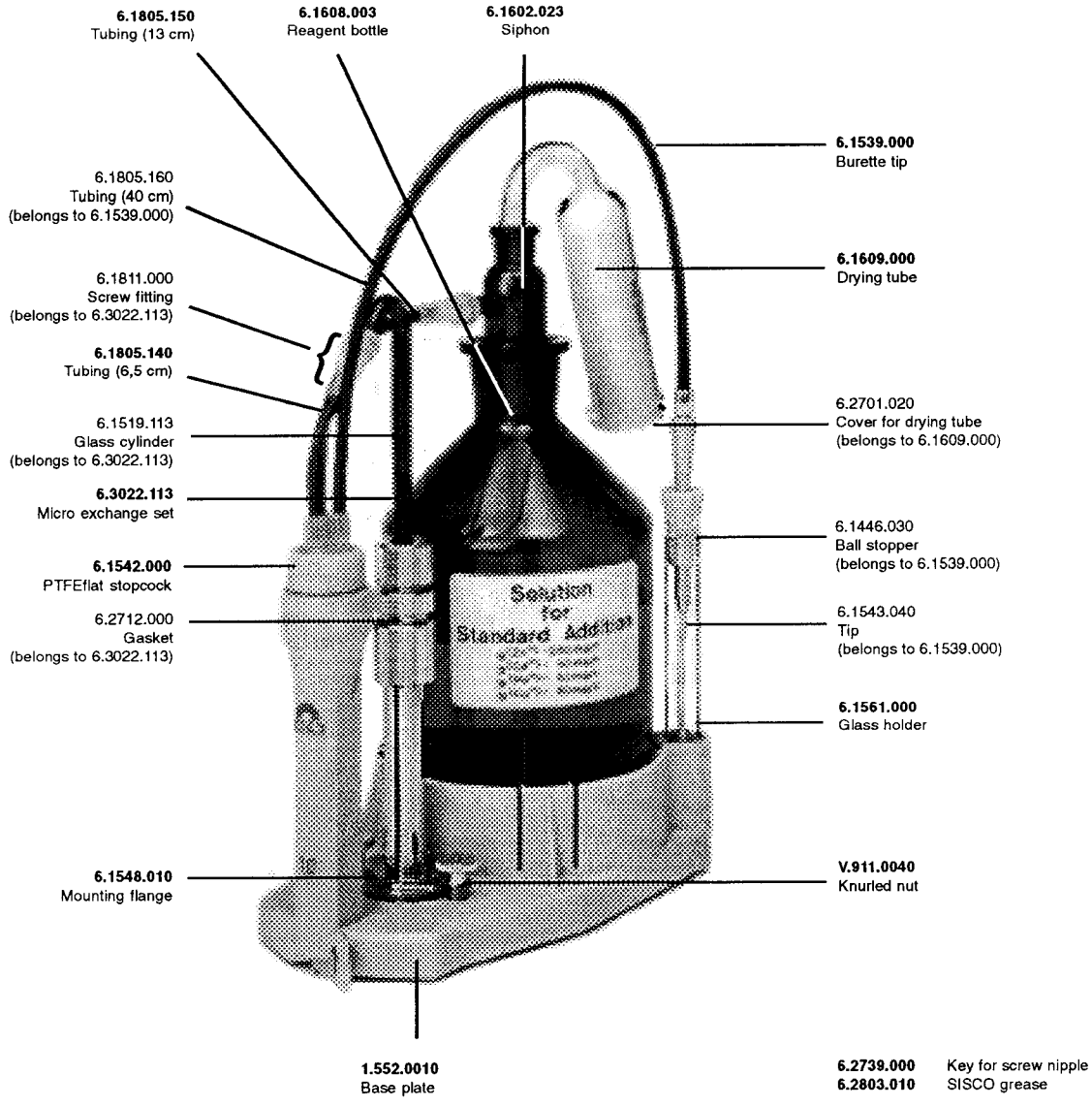


Fig. 6-3: Standard accessories and ordering designations for the 6.3006.113 1 mL Exchange Unit

Options for Exchange Units
Accessories to separate order and on payment of extra charge:

Bottles and accessories:

Siphon with GL 45 thread (bottles from Riedel de Haën, ...)	6.1602.120
Siphon with S40 thread (bottles from Merck ...)	6.1602.130
Amber glass bottle with GL 45 thread	6.1608.023
Bottle made of PE with thread GL45	6.1608.040
Bottle made of PP with ground-glass joint SGJ 29	6.1608.004
Siphon for bottles with SGJ 29	6.1602.023
Thread adapter 32 mm/GL 45	6.1618.000
Thread adapter 28 mm/GL 45	6.1618.010

Tubing and accessories:
The standard screw fitting of the Exchange Units has M6 thread size. On change to M8 thread, the 6.1808.040 Thread Adapter is needed.

Extension tubing with screw nipples, M6 thread	
Length 80 cm	6.1805.110
Length 150 cm	6.1805.030
additional lengths, see Accessories catalogue	
Extension tubing with screw nipples, M8 thread	
Length 50 cm	6.1805.200
Length 25 cm	6.1805.210
Connecting sleeve for tubing extensions (tubing with M6 thread)	6.1808.000
T-connection for tubing with M6 thread	6.1808.060
T-connection for tubing with M8 thread	6.1808.070
Coupling with M6 thread and stub for tubing with internal diameter app. 3 mm	6.1808.020
Coupling with M8 thread and stub for tubing with internal diameter app. 3 mm	6.1808.050
Screw cap, seals tubing with M6 thread together with 6.1808.000 Connecting Sleeve	6.1446.040
Screw fitting for glass cylinder and tubing with M6 thread	6.1811.000
Screw fitting for glass cylinder and tubing with M8 thread	6.1811.010

Tubing connections with larger internal diameter and M8 thread at Exchange Unit:

For the connection bottle-stopcock:	
Stopper, M6 thread	6.1446.040
PTFE tubing	6.1819.030
Tubing with screw nipples, 25 cm, M8 thread	6.1805.210
Thread adapter with M6 outer thread, M8 inner thread	6.1808.040
For the connection stopcock-tip:	
Thread adapter with M6 outer thread, M8 inner thread	6.1808.040
Tubing with screw nipples, 50 cm, M8 thread	6.1805.200
Tip, M8 thread	6.1543.120

Burette tips:

Earthing for burette tip	6.1808.030
Tip without anti-diffusion valve	6.1543.060
Tip with anti-diffusion valve	6.1543.050

Miscellaneous:

Thermostat jacket for 6.3011.XXX and 6.3012.XXX Exchange Units with M8 thread	6.1563.010
PTFE tubing for thermostat jacket, 105 mm	6.1819.040
Coupling for thermostat jacket tubing	6.1808.050
Coupling for 6.1542.010 Ceramic Flat Stopcock in 6.3006.XXX and 6.3007.XXX Exchange Units	6.1564.000
SISCO 300 grease, 1 oz. (28.35 g)	6.2803.000

6.7 Bibliography

Titrations, general

- Instrumental Titration Techniques, *F. Oehme and W. Richter*, Hüthig Verlag, Heidelberg, 1983
- Practical Aspects of Modern Titration, *W. Richter and U. Tinner*, Monographs Metrohm Ltd, 1988
- Elektrodes in Potentiometry, *U. Tinner*, Monographs Metrohm Ltd, 1989

KF titrations

There is a whole series of excellent references and application instructions regarding the KF titration. The following shows a selection:

- Karl Fischer Titration, Determination of Water, *E. Scholz,* Springer-Verlag, Berlin-New York 1984
- Water Determination by Karl Fischer Titration, *G. Wieland*, GIT Verlag, Darmstadt 1987
- Hydranal®, practical course, Water reagents according to Eugen Scholz for Karl Fischer titration, Riedel-de Haën, Seelze, 1987
  or
  Hydranal®, Reagents for Karl Fischer Titration, *Eugen Scholz*, Riedel-de Haën, Seelze
- Metrohm Application Bulletins:

  No. 77: Karl Fischer water determinations
  No. 88: Bibliography concerning Karl Fischer water determinations
  No. 109: Karl Fischer water determination with the Drying Oven
  No. 141: Analysis of edible oils and fats
  No. 142: Karl Fischer moisture determinations in gases
  No. 217: Karl Fischer water determinations in pharmaceutical preparations by the KF oven method

Index

Texts which appear in the display are **printed in bold face.** Pages concerning the operation via RS232 interface (green pages) are *printed in italic.*

E

F

G

H

I

K

L

M

Ionenanalytik • Analyse des ions • Ion analysis • Análisis iónico
720 KFS Titrino

CE

Metrohm

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

EC Declaration of Conformity

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

720 KFS Titrino

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

Source of the specifications:

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

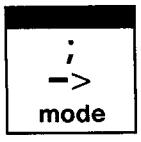
Description of the instrument:

Titrator for precise water determinations and potentiometric end-point titrations in analytical and synthesis laboratories.

Herisau, December 5, 1995

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

Mode Selection



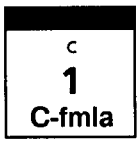
Press key <mode> until the desired mode is displayed, press <enter>, select desired measured quantity with <select>, and confirm with <enter>.
Or:
Recall method from user memory with <user meth>.
Select method with <select> or by entering its name.

KFT Ipol, Upol	Karl Fischer Titration	
SET pH, U, Ipol, Upol	**S**et **E**ndpoint Titration.	
MEAS pH, U, Ipol, Upol, T	**MEAS**uring.	
CAL	pH **CAL**ibration.	

Calculations and Data Output Definitions

Initial values are printed in **bold face**.

Display	Meaning	Input range
>formula	Input of formula.	
RS?	Enter result number.	1...9
RS1=EP1*C01/C00	Enter formula by means of 3rd functions of keyboard and <enter>. Calculation constants have 2 digits such as C01. C00 stands for sample size.	
RS1 text	Text for result output.	**RS1** or up to 8 ASCII char.
RS1 decimal places	Number of decimal places for result output.	1...**2**...5
RS1 unit:	Select result unit.	**%**, ppm, g/l, mg/ml, mol/l, mmol/l, g, mg, ml, mg/pc, no unit or up to 6 ASCII characters
	Enter values of calculation variables with <C-fmla>.	
>com.var.	Allocations of common variables C3X.	
C3?=	Enter number of common variable and result RS# or mean MN#.	1...9 and RS1...RS9 or MN1...9
>report	Selection of report blocks for data output.	
report:	Depends on selected mode. If you wish several reports, use ";" as separator.	full, short, calc, param, calib, ff
>mean	Allocations for statistics.	
MN?=	Enter mean number and result RS#.	1...9 and **RS1**...RS9



Calculation Variables

Display	Meaning	Input range
CXX	All CXX (XX = 1...19) which are used in the formulas are displayed and can be inputted.	**0**... ±999 999

para-
meters

Parameters for SET

Go to next inquiry with
<parameters> and
<enter>.

Initial values are printed in **bold face**.

Display	Meaning	Input range
>SET1	Individual parameters for EP1.	
EP at pH	Preset EP1 at pH, U, or I, resp.	pH: 0.00... ±20.00, **OFF** U: 0... ±2000 mV, **OFF** I: 0.0... ±200.0 µA, **OFF**
dynamics	Distance from EP where constant dosing stops and controlling begins. OFF means no constant dosing.	pH: 0.01...20.00, **OFF** U: 1...2000 mV, **OFF** I: 0.1...200.0 µA, **OFF**
max.rate	Maximum dosing rate.	0.01...**10**...150 ml/min, max.
min.rate	Minimum dosing rate.	0.01...**25.0**...999.9 µl/min
stop crit:	Type of stop criteria.	**drift**, time
stop drift	Titration stops if stop drift is reached.	1...**20**...999 µl/min
t(delay)	Titration stops if there is no dosing during t(delay).	0...**10**...999 s, INF
stop time	If t(delay) is "INF" stop after a time.	0...99999 s, **OFF**
>SET2	Individual parameters for EP2. Identical as SET1.	
>titration parameters	General titration parameters.	
titr.direction:	+: Titration to higher pH, voltage, or current. auto: Direction is set automatically.	+, –, **auto**
pause 1	Waiting time, **before** start volume.	**0**...9999 s
start V:	Type of start volume: absolute, relative or none.	abs., rel., **OFF**
start V	Volume for **absolute** start volume.	**0**...999.99 ml
factor	Factor for calculation of **relative** start volume: factor * smpl size.	**0**... ±999 999
dos.rate	Dosing rate for start volume.	0.01...150 ml/min, **max.**
pause 2	Waiting time, **after** start volume.	**0**...9999 s
extr.time	Extraction time.	**0**...9999 s
meas.input:	Measuring input for SET pH and SET U or polarization current for SET Ipol or polarization voltage for SET Upol in steps of 10 mV and test for polarized electrodes.	**1**, 2, diff.
temperature	Titration temperature.	-170.0...**25.0**...500.0 °C
>stop conditions		
stop V:	Type of stop volume: absolute, relative or none.	**abs.**, rel., OFF
stop V	Volume for **absolute** stop volume.	0...**99.99**...999.99 ml
factor	Factor for calculation of **relative** stop volume: factor * smpl size.	0... **±999 999**
filling rate	Filling rate after the titration.	0.01...150 ml/min, **max.**
>statistics		
status	Status of statistics calculation.	ON, **OFF**
mean n=	Number n of single values for statistics calculation.	**2**...20
res.tab:	Result table for statistics calculation.	**original**, delete n, delete all
delete n=	Delete data from sample number n.	**1**...20
>preselections		
conditioning:	Automatic conditioning of titration vessel.	ON, **OFF**
display drift:	Display of drift during conditioning.	**ON**, OFF
drift corr:	Type of drift correction.	auto, man., **OFF**
drift value	Value for manual drift correction.	**0.0**...99.9 µl/min
req.ident:	Request of identifications after start of titration.	id1, id1 & 2, all, **OFF**
req.smpl size:	Request of sample size after start of titration.	value, unit, all, **OFF**
activate pulse:	Pulse output on remote line "activate".	first, all, cond., **OFF**

para-
meters

Parameters for KFT

Go to next inquiry with
< parameters > and
< enter >.

Initial values are printed in **bold face**.

Display	Meaning	Input range
>titration parameters	General titration parameters.	
titr.direction:	+: Titration to higher voltage or current. auto: Direction is set automatically.	+, –, auto
pause 1	Waiting time, **before** start volume.	**0**...9999 s
start V:	Type of start volume: absolute, relative or none.	abs., rel., **OFF**
start V	Volume for **absolute** start volume.	**0**...999.99 ml
factor	Factor for calculation of **relative** start volume: factor * smpl size.	**0**... ± 999 999
dos.rate	Dosing rate for start volume.	0.01...150 ml/min, **max.**
pause 2	Waiting time, **after** start volume.	**0**...9999 s
extr.time	Extraction time.	**0**...9999 s
electrode test:	Performing of electrode test; "OFF" means no test	ON, **OFF**
temperature	Titration temperature.	-170.0...**25.0**...500.0 °C
>control parameters	Controlling parameters for KFT.	
EP at U	Preset EP for Ipol or	U: -2000 ... **250**...2000 mV
EP at I	Upol, resp.	I: -200.0... **25.0**...200.0 µA
dynamics	Distance from EP where constant dosing stops and controlling begins. OFF means no constant dosing.	U: 1...**100**...2000 mV I: 0.1...**10**...200.0 µA
max.rate	Maximum dosing rate.	0.01...**10**...150 ml/min, max.
min.incr.	Minimum volume increment	0.1...9.9 µl, **min**
stop crit:	Type of stop criteria.	**drift**, time
stop drift	Titration stops if stop drift is reached.	1...**20**...999 µl/min
t(delay)	Titration stops if there is no dosing during t(delay).	0...**10**...999 s, INF
stop time	If t(delay) is "INF" stop after a time.	0...99999 s, **OFF**
>stop conditions		
stop V:	Type of stop volume: absolute, relative or none.	**abs.**, rel., OFF
stop V	Volume for **absolute** stop volume.	0...**99.99**...999.99 ml
factor	Factor for calculation of **relative** stop volume: factor * smpl size.	0... ± **999 999**
filling rate	Filling rate after the titration.	0.01...150 ml/min, **max.**
>statistics		
status	Status of statistics calculation.	ON, **OFF**
mean n=	Number n of single values for statistics calculation.	**2**...20
res.tab:	Result table for statistics calculation.	**original**, delete n, delete all
delete n=	Delete data from sample number n.	**1**...20
>preselections		
conditioning:	Automatic conditioning of titration vessel.	ON, **OFF**
display drift:	Display of drift during conditioning.	**ON**, OFF
drift corr:	Type of drift correction.	auto, man., **OFF**
drift value	Value for manual drift correction.	**0.0**...99.9 µl/min
req.ident:	Request of identifications after start of titration.	id1, id1 & 2, all, **OFF**
req.smpl size:	Request of sample size after start of titration.	value, unit, all, **OFF**
activate pulse:	Pulse output on remote line "activate".	first, all, cond., **OFF**

Sample Data

smpl data

Go to next inquiry with <smpl data> and <enter>.

Initial values are printed in **bold face**.

Display	Meaning	Input range
	Inquiries with silo = OFF (LED "silo" is OFF):	
id#1 or C21 **id#2 or C22** **id#3 or C23**	Sample identifications. Can be used as sample specific calculation constants.	up to 8 ASCII characters
smpl size	Sample size.	–999 999...**1**...999 999
smpl unit:	Unit of sample size.	**g**, mg, ml, µl, pc, no unit or up to 5 ASCII characters

Configuration

configu-ration

Go to next inquiry with <configuration> and <enter>.

Initial values are printed in **bold face**.

Display	Meaning	Input range
>peripheral units		
send to:	Selection of character set, depends on printer.	Epson, Seiko, Citizen, **IBM,** HP
balance:	Selection of balance.	**Sartorius**, Mettler, Mettler AT, AND, Precisa
record:	Selection of record type to be outputted at the analog. output. U(rel) is the controlling deviation in SET titrations.	**U**, dU/dt, V, dV/dt, U(rel)
>auxiliaries		
dialog:	Selection of dialog language.	**english**, deutsch, français, español
date		YY–MM–DD
time		HH:MM
run number	Current run number for result output.	**0**...9999
auto start	Automatic starts of titrations ("number of samples").	1...9999, **OFF**
start delay	Waiting time before start of titration.	**0**...9999 s
device label	Device label to identify instrument for remote control.	up to 8 ASCII characters
program	Program version.	no input
>RS232 settings		
baud rate:	Baud rate.	300, 600, 1200, 2400, 4800, **9600**
data bit:	Data bit.	7, **8**
stop bit:	Stop bit.	**1**, 2
parity:	Parity.	even, odd, **none**
handshake:	Handshake.	**HWs**, HWf, SWline, SWchar, none
RS control:	Receiving of commands via RS; "OFF" means no reception.	**ON**, OFF
>com.var.	Common variables.	
C30	Value of common variable C30.	**0**... ± 999 999
:		
C39		**0**... ± 999 999