Metrohm METROHM AG CH-9101 Herisau (Switzerland)

DMS Titrino716

Series 06 ...

Instructions for Use 8.716.1013

93.03 Ti

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 uA, **OFF**
dynamics	Distance from EP where constant dosing should stop and controlling begins. OFF means no constant dosing.	pH: 0.01...20.00, **OFF** U: 1...2000 mV, **OFF** I: 0.1...200.0 uA, **OFF**
max.rate	Maximum dosing rate.	0.01...**10**...150 ml/min, max.
min.rate	Minimum dosing rate.	0.01...**25.0**...999.9 ul/min
stop crit:	Type of stop criteria	**drift**, time
stop drift	Titration stops if stop drift is reached.	1...**20**...999 ul/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...999 999 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**
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	Waiting time, e.g. after start volume.	**0**...999 999 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
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 DET and MET

Go to next inquiry with
<parameters> and
<enter>.

Initial values are printed in **bold face**.

Display	Meaning	Input range
>titration parameters		
meas.pt.density	Measuring point density. 0 is highest density for DET.	0...**4**...9
min.incr.	Minimum increment to be dispensed at the beginning and in the EP region for DET.	0...**10.0**...999.9 ul
[V step]	Volume increment for MET.	0...**0.10**...9.999 ml
titr.rate	Dosing rate for increments.	0.01...150 ml/min, **max.**
signal drift	Drift criterion for measured value acquisition.	pH, U: 0.5...**50**...999 mV/min, OFF I: 0.05...**50**...99.9 uA/min, OFF
equilibr.time	Waiting time for measured value acquisition.	0...**26**...9999 s, OFF
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	Waiting time, e.g. after start volume.	**0**...999 999 s
meas.input:	Measuring input for pH and U or polarization current for Ipol or polarization voltage for 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
stop pH	Stop at measured value pH, U, I.	pH: 0.00... ± 20.00, **OFF** U: 0... ± 2000 mV, **OFF** I: 0.0... ± 200.0 uA, **OFF**
stop EP	Stop after a number of EP's have been found.	1...**9**, OFF
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
>evaluation		
EPC	Endpoint criterion.	DET 0...**5**...200 MET pH: 0.10...**0.50**...9.99 U: 1...**30**...999 mV I: 0.1...**2**...99.9 uA
EP recognition:	Type of EP recognition: all EP's, only greatest EP, only last EP, only EP's in windows, no evaluation. If "window" is selected, lower and upper limits of windows are inquired.	**all**, greatest, last, window, OFF
fix EP1 at pH	Interpolation of volume at given pH, U, or I, resp. Up to 9 fix EP's.	pH: 0.00... ± 20.00, **OFF** U: 0... ± 2000 mV, **OFF** I: 0.0... ± 200.0 uA, **OFF**
pK/HNP:	Evaluation of pK or half neutralization potential (HNP).	ON, **OFF**
>preselections		
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".	ON, **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, ul, pc, no unit or up to 5 ASCII characters

Configuration

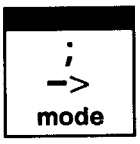
configu-ration

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**
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, portuguese, italiano, svenska
date		YYYY–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**...999 999 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

Mode Selection



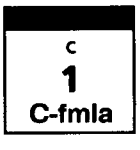
Press key <mode> until the desired mode is displayed, press <enter>, select desired measured quantity with <select>, and confirm with <enter>.
Or:
Recall method from user memory with <user meth>.
Select method with <select> or by entering its name.

DET pH, U, Ipol, Upol	**D**ynamic **E**quivalence Point **T**itration.
MET pH, U, Ipol, Upol	**M**onotonic **E**quivalence Point **T**itration.
SET pH, U, Ipol, Upol	**S**et **E**ndpoint **T**itration.
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, curve, deriv, comb, calc, param, calib, mplist, 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

Instructions for Use of 716 DMS Titrino

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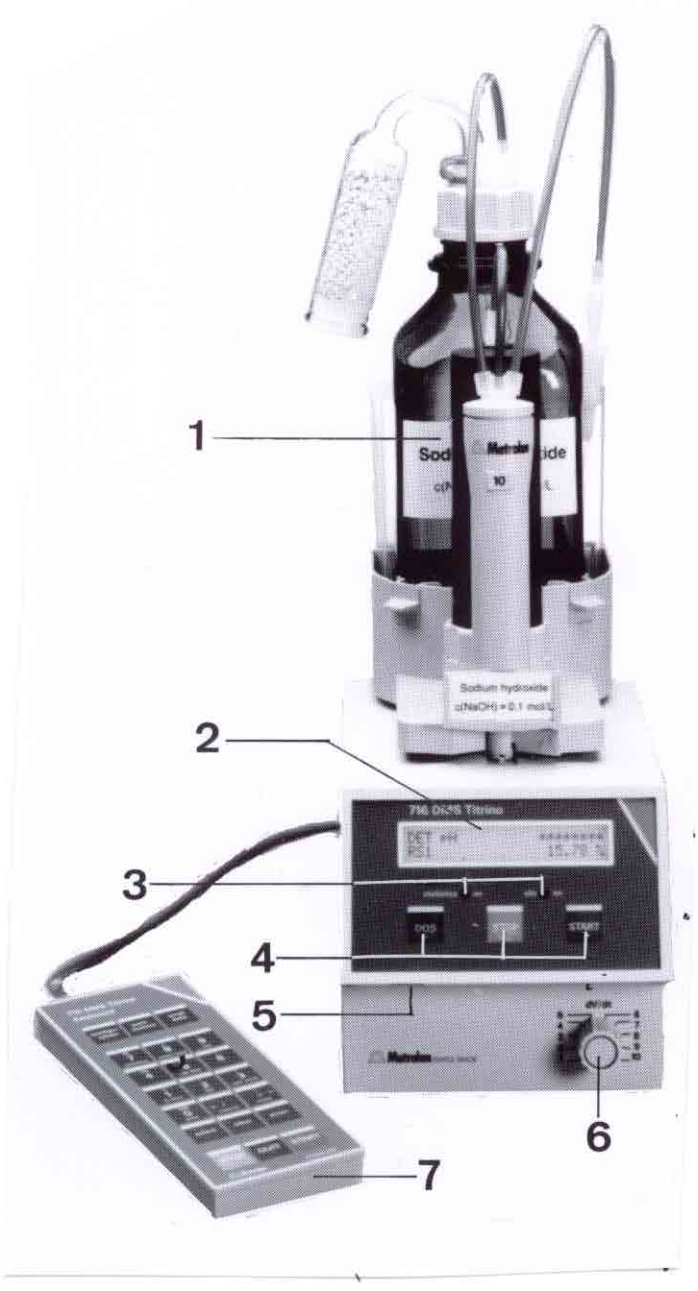
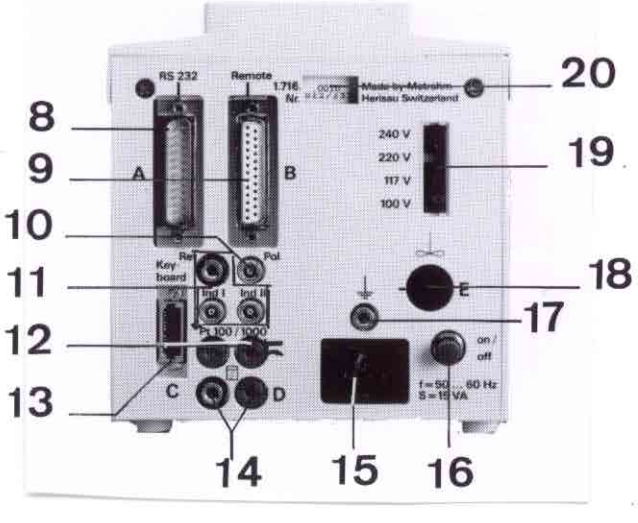

1
2
3
4
5
6
7
Sodium hydroxide
c(NaOH) = 0.1 mol/L
716 DMS Titrino
DOS
START


RS 232
Remote
1.716
Nr.
Made by Metrohm
Herisau Switzerland
240 V
220 V
117 V
100 V
A
B
Key board
Ref
Pol
Ind I
Ind II
100 / 1000
C
D
E
on / off
f = 50 ... 60 Hz
S = 15 VA
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.

(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 119.
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 649 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 112 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:

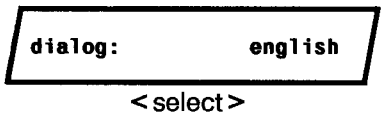
This is the title of the group "peripheral units". This group contains various inquiries about peripheral units.

<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>

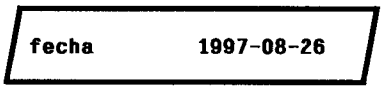


Pressing the <enter> key takes you to the inquiries of the group "auxiliaries". The display shows

<select>

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.

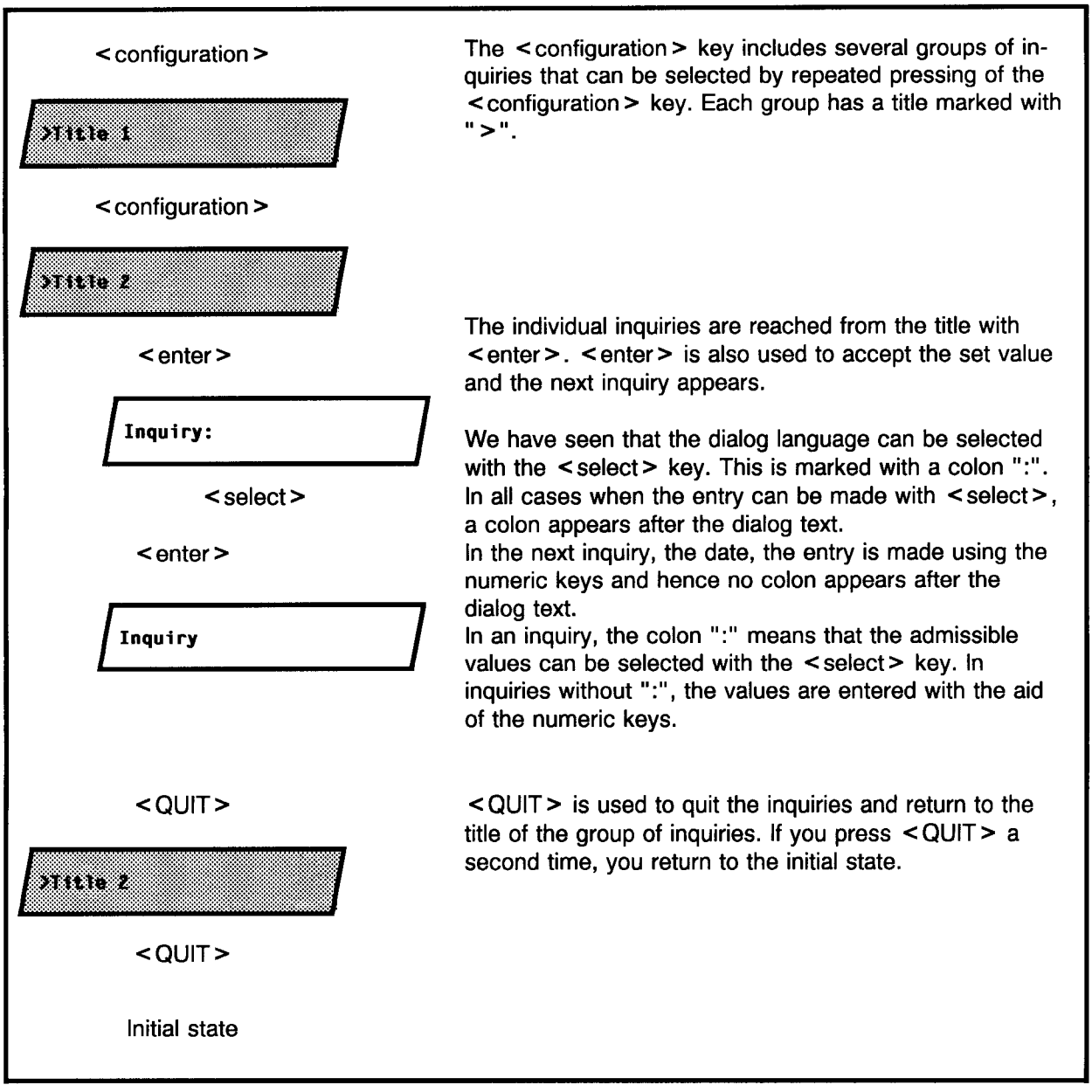
<enter>



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

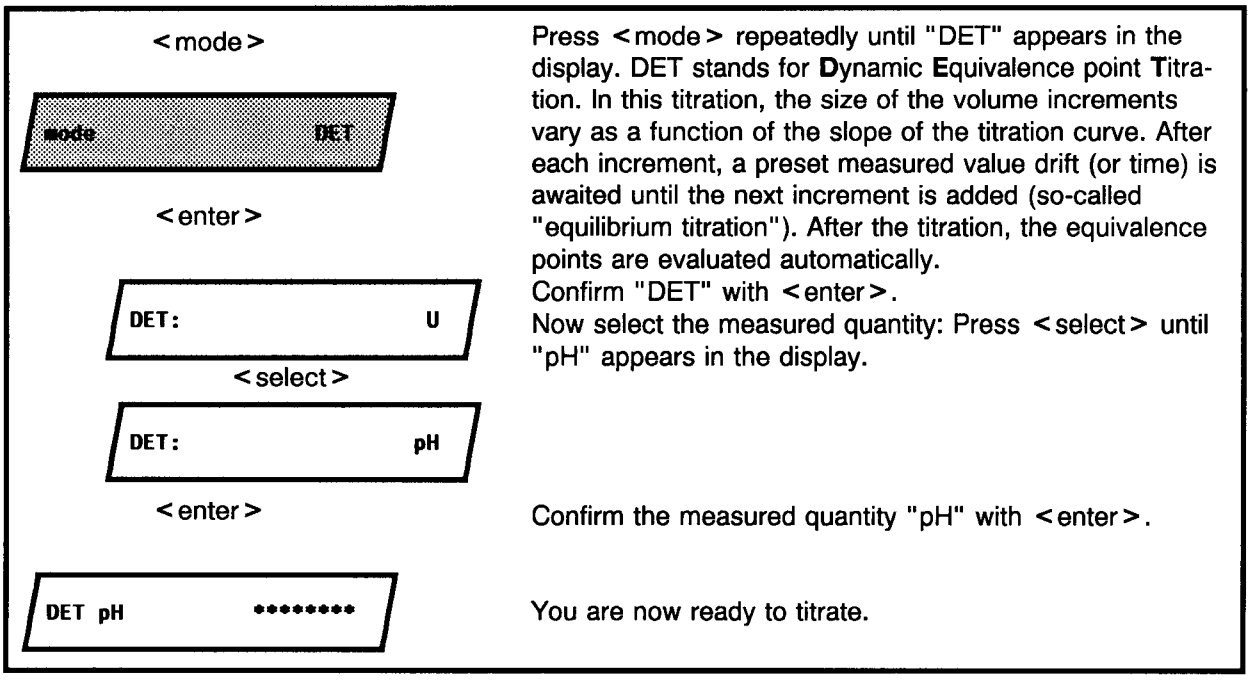


All data entries follow this principle.

Now perform your first titration.

2.1.2 Development of a method, titration of an acid

Selecting the mode



Press <mode> repeatedly until "DET" appears in the display. DET stands for **D**ynamic **E**quivalence point **T**itration. In this titration, the size of the volume increments vary as a function of the slope of the titration curve. After each increment, a preset measured value drift (or time) is awaited until the next increment is added (so-called "equilibrium titration"). After the titration, the equivalence points are evaluated automatically.
Confirm "DET" with <enter>.
Now select the measured quantity: Press <select> until "pH" appears in the display.

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

You are now ready to titrate.

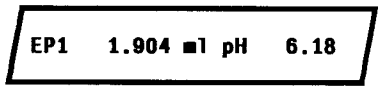
For the titration you need an Exchange Unit with NaOH, c = 0.1 mol/L. If you have not yet prepared an Exchange Unit, see page 120 ff.
Plug a combined pH glass electrode into measuring input 1 ("Ind I"). (Setting up the titration vessel, see page 118.)
Pipette 2 mL HCl, c ≈ 0.1 mol/L into your titration 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 current measured value and the volume already dispensed:

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

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

The first line now shows the mode "DET pH". Of interest is the second line, which shows the equivalence point found, e.g.:



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

With this equivalence point a result can be calculated:

Entry of a formula

<def>	Press <def>. The display shows
>formula	Press <enter> to move on to the formula entry. The display now shows "RS?".
<enter>	
RS?	Press "1", i.e. the first formula.
<1>	
RS1=EP1*C01*C02/C00	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
<enter>	Confirm the formula with <enter>.
RS1 text RS1	You may enter a text for the result output, see page 17.
<enter>	
RS1 decimal places 2	Enter the desired number of decimal places for the result
<enter>	and
RS1 unit: g/l	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	
<select>	Use <select> to select the unit "ml" and confirm the new value with <enter>.
<enter>	

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

Display of the result

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

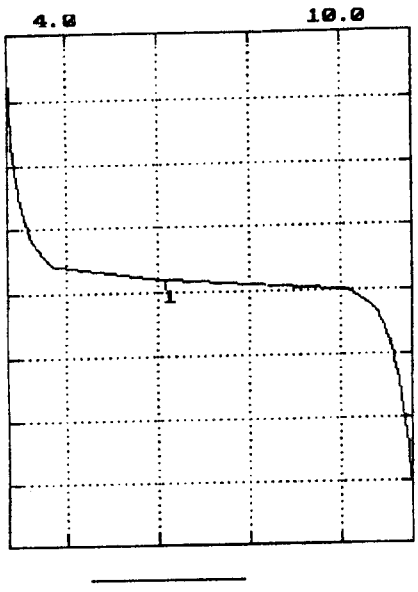
If you have a printer connected, you probably wish to have the curve and a result report printed out automatically at the end of a titration. If you are operating the printer for the first time, see page 113.

Selection of the automatic report

3 x <def>	Press <def> repeatedly until the display shows
>report	
<enter>	Press <enter> to move to the definition of reports.
report:	With <select> you select the individual report blocks. Use a ";" as delimiter between the report blocks. If you wish to print out a curve and a full result report, enter "curve;full".
<select>	
report:curve;full	Confirm the entry with <enter> and quit the inquiries with <QUIT>.
<enter>	
<QUIT>	

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

```
'cu
date  1998-08-21     time 09:07:54       1
start V      0.000 ml    DET pH    ********
0.5 ml/div        dpH=2.0/div.
```



- Identification of the report type (cu = curve)
- Start volume and method with identification
- Scaling of curve axis

```
'fr
date  1998-08-21     time 09:07:54       1
pH(init)        2.88      DET pH    ********
smpl size          2 ml
EP1             1.904 ml                6.18
RS1              3.47 g/l
manual stop
```

- Identification of the report type (fr = full report)
- Initial pH and method with identification
- Volume and pH value of EP1
- Calculated result, evtl. with result text

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

Entry of a stop criterion

2 x <parameters>	Press <parameters> twice to display the title ">stop conditions".
>stop conditions	
<enter>	
stop V: abs.	Absolute stop volume. This can be used as a safety measure to prevent overflow of the titration vessel.
<enter>	
stop V 99.99 ml	The magnitude of the absolute stop volume. Set a value that appears suitable for your titration vessel.
<enter>	
stop pH OFF	Set the pH value, e.g. 11.5 as the expected stop criterion. If several stop criteria have been set, the one that is reached first applies.
11.5 <enter>	
2 x <QUIT>	Quit the inquiry with <QUIT>.

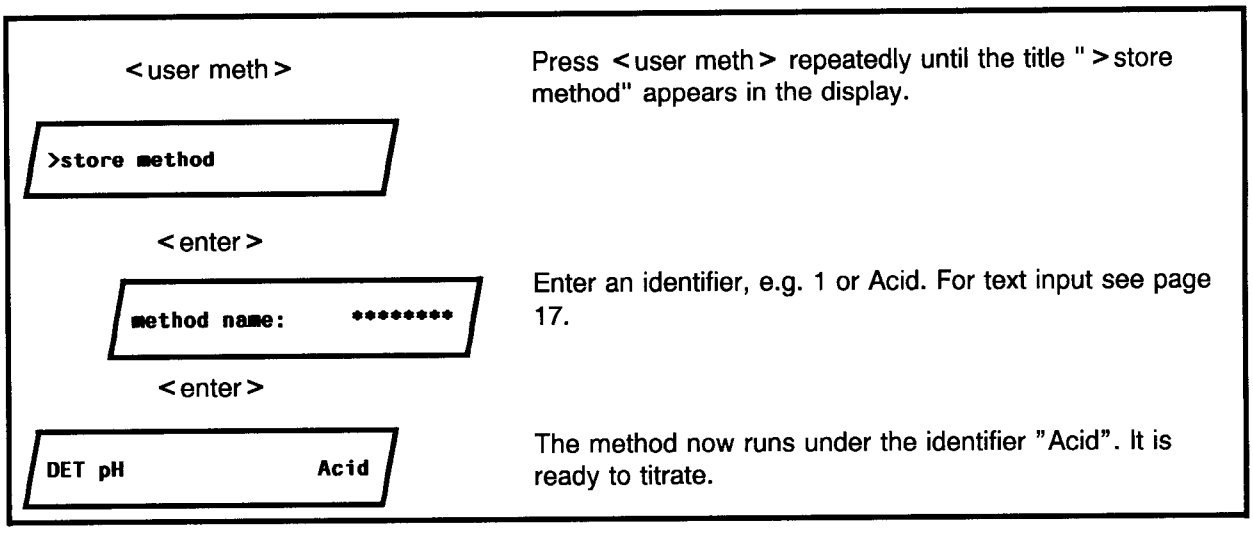
The development of your method is now complete. Before we store it in the method memory, you should check it again. Prepare a fresh sample and restart the titration with <START>.

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

2.1.3 Method memory, storage and loading of methods

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

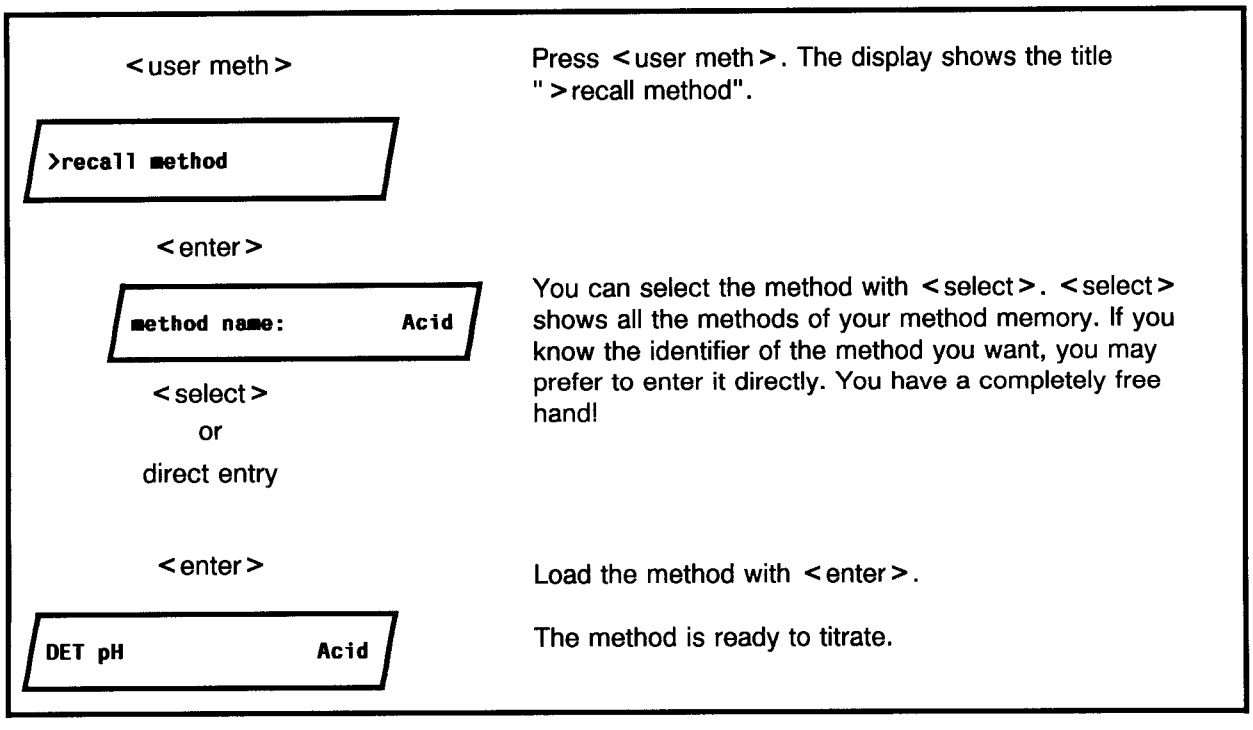
Storage of a method



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



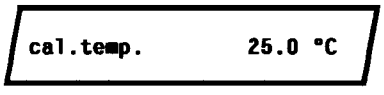
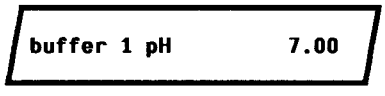
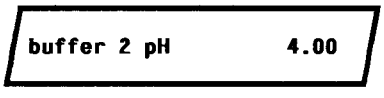
2.1.4 pH calibration

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

Selection of the CAL mode, calibration

<mode>	Press <mode> repeatedly until "CAL" appears in the display and confirm the mode with <enter>.
<enter>	
	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.
	Inquiry of the calibration temperature. Enter the current temperature. If you have a temperature sensor connected, this inquiry is skipped.
<enter>	
	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.
	
<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>	
	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 (end-point titration)

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

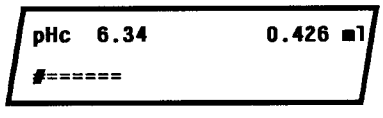
First select the mode SET pH (keys <mode> and <select>).

Now set the end point.

Entry of the end point and the control parameters

<parameters>	Press <parameters>. The display shows
>SET1	Control parameters for EP1.
<enter>	
EP at pH 4.30	End point at pH = 4.3
<enter>	
dynamics 3	Dynamics means the control range in which control is exercised slowly and carefully. With buffered systems such as drinking water, this value can be set low, e.g. to 3.
<enter>	
max.rate 10.0 ml/min	Maximum possible titration rate outside the control range.
<enter>	
min.rate 25.0 ul/min	Minimum titration rate inside the control range.
2 x <QUIT>	Quit the inquiry with <QUIT>.

Mount an Exchange Unit with HCl, c = 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 38.

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

Now enter the formula for calculation of the m value (<def> key): RS1 = EP1* C01* C02.
With the calculation constants (<C-fmla> key):
C01 Concentration of the titrant x 10: 1
C02 Factor for the sample size: 4 (100 mL/25 mL)

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

<print> <reports> <enter>.

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

Rapid measurement between titrations

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

Statistics calculations

Now switch on the statistics calculations. Press <statistics>. The "statistics" LED is on. Duplicate determinations are now performed.
Perform 2 titrations.
After the second titration you receive a printout with statistics calculations:

```
 'fr
date 1997-08-21     time 11:11          9
pHc(init)      6.29      SET pH  ********
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>.

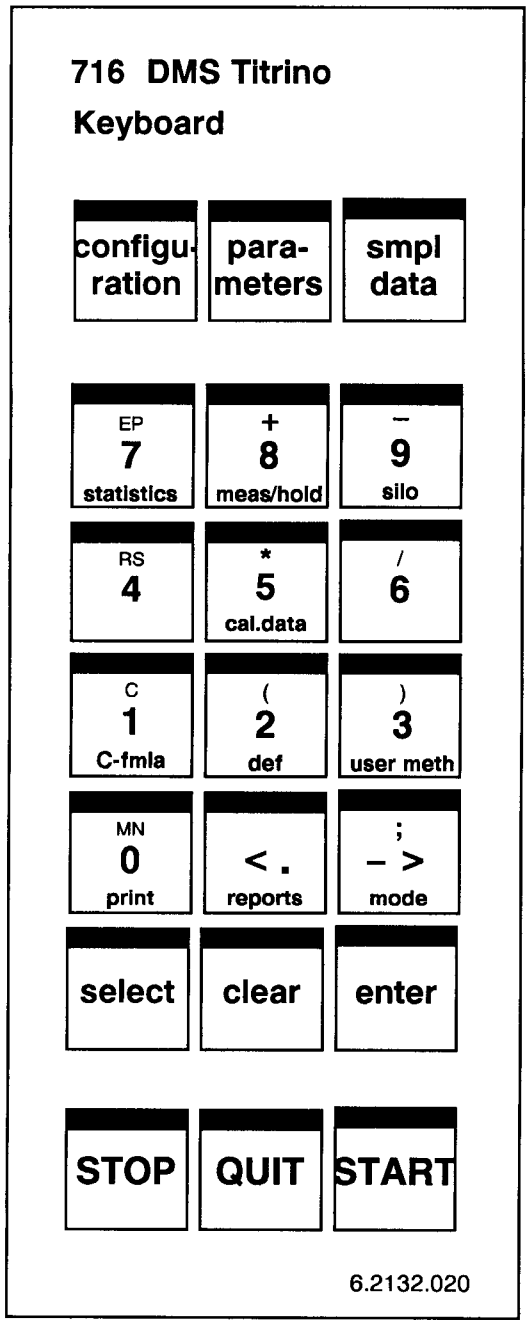
Enter index n of the result you wish to delete; in our example the second:

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 fresh report:
<print> <reports> <enter>.

2.2 Detailed description

2.2.1 Keypad



<configuration>: Configuration

<parameters>: Parameters

<smpl data>: Sample data

<statistics>: On/off switching of statistics calculations (see page 47)

<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 54 ff)

<cal.data>: Calibration data (see page 52)

<C-fmla>: Calculation constants (see page 46)

<def>: Formulas and information for result output (see page 45 ff)

<user meth>: Method memory (see page 51)

<print>: Printing of reports (see page 50)

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

<mode>: Mode selection

<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

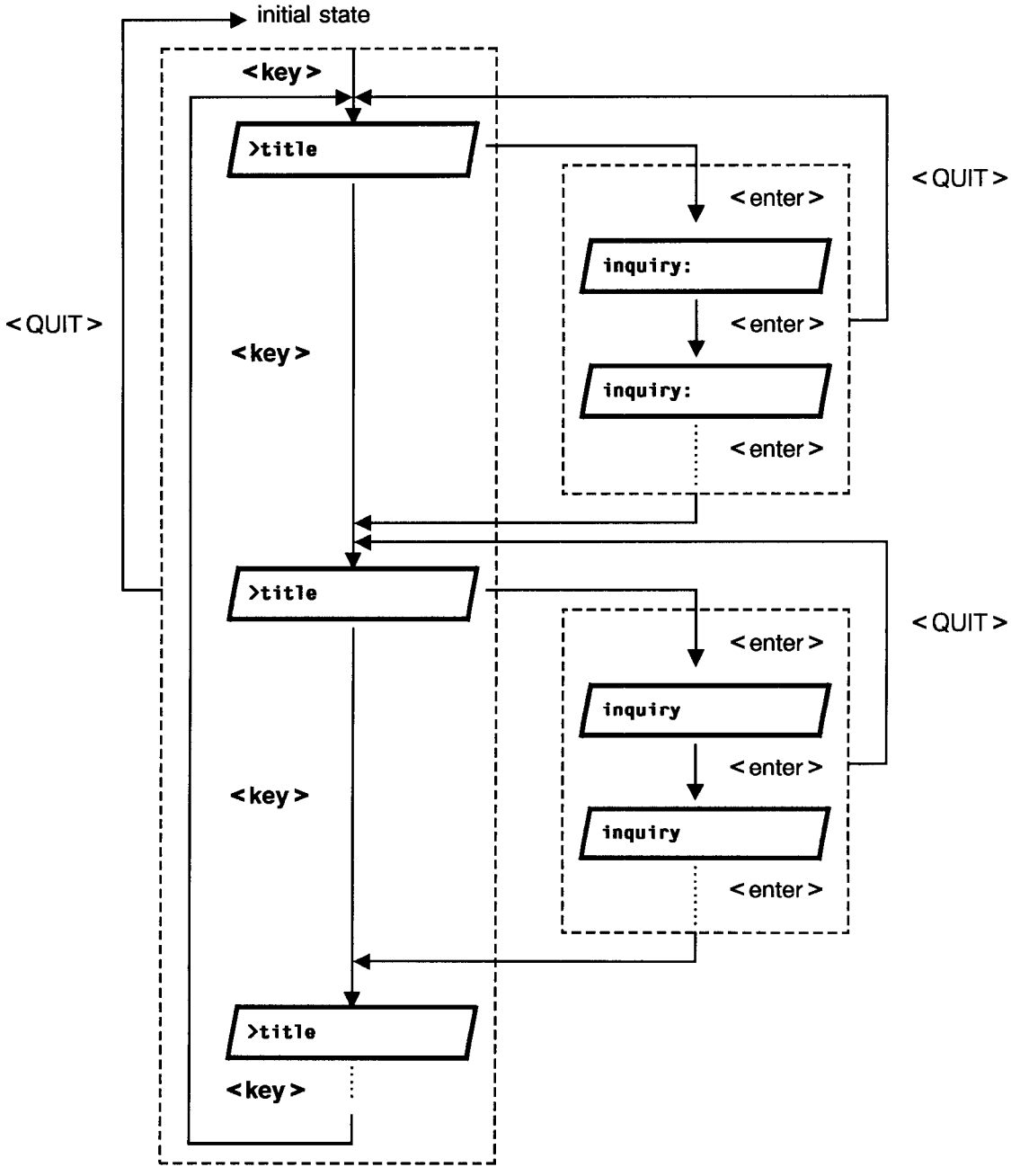
The third functions (topmost inscriptions) on the keys of the keypad are used for formula entry.

2.2.2. Keys with rolling inquiries

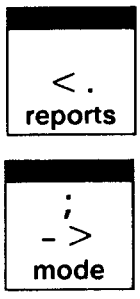
Inquiry keys are organised as rolling inquiries, i.e.

- 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 Input of texts, > 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.

Texts can be inputted for the following entries:

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

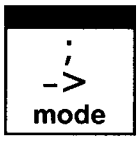
configu-ration	The <configuration> key serves to enter data specific to the instrument. The key is organised as a rolling inquiry. The set values apply to all modes. The values shown in the displays "/ ... /" are the default values.

>peripheral units	**Settings for peripheral devices**
send to: IBM	*Selection of the printer type/character set (Epson, Seiko, Citizen, IBM)* "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))* 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 1997-08-21	*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.
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 716.0010	*Display of program version*
>RS232 settings	**Settings for the RS232 interface** see also page 92 - 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 92ff
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 etc.	*Common variable C30...C39 (0... ±999 999)* The values of all common variables are displayed.

2.2.5 Selection of the mode, <mode> key



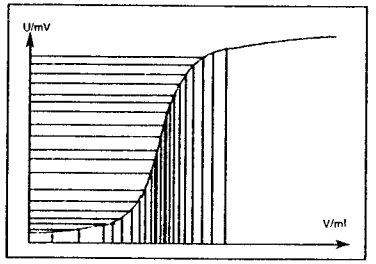
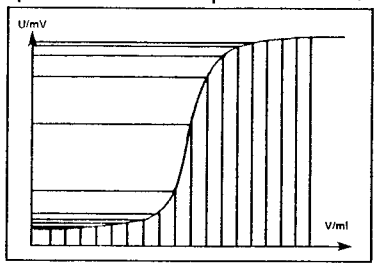
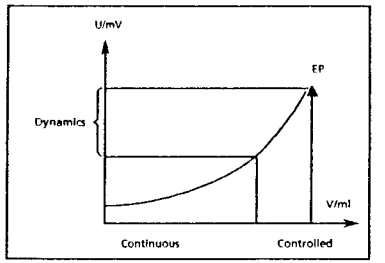
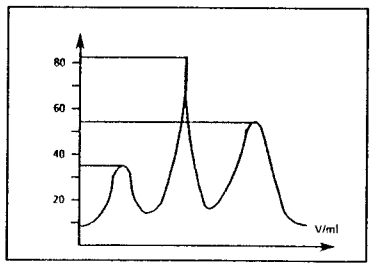
The <mode> key is pressed repeatedly until the desired mode is displayed. It is accepted with <enter>.

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

The following modes can be selected:

- DET, **D**ynamic **E**quivalence-point **T**itration
- MET, **M**onotonic **E**quivalence-point **T**itration
- 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.)

	DET Dynamic Equivalence point Titration	MET Monotonic Equivalence point Titration	SET Set Endpoint Titration
Reagent feeding	Variable volume increments, depending on the slope of the curve:  Parameters: meas.pt.density — Measuring point density min.incr. — Minimum Increment titr.rate — Dispensing rate for increments	Constant volume increments, independent of the slope of the curve:  Parameters: V step — Volume increment titr.rate — Dispensing rate for increments	Continuous and pulse dosing:  Parameters: dynamics — Control range max.rate — Maximum rate min.rate — Minimum rate
Acquisition of measured values	Drift controlled (equilibrium titration) and/or after a fixed equilibration time. Parameters: signal drift — Drift threshold equilibr.time — Waiting time	Drift controlled (equilibrium titration) and/or after a fixed equilibration time. Parameters: signal drift — Drift threshold equilibr.time — Waiting time	Continuous.
EP-Recognition and Evaluation	The evaluation of EP's is based on the zero crossing of the second derivative with a Metrohm correction for the distortion of the curve from superimposed jumps. Can be combined with selectable recognition criteria.  Parameters: EPC — Preset EP recognition criteria; compared to ERC. EP recognition — all, first, last, greatest, window	Fortuin interpolation for EP determination (see Metrohm Bulletin, Vol. 2, 1971) combined with selectable recognition criteria. The ERC has to be calculated from the differences of measured values, see page 30. Parameters: EPC — Preset EP recognition criteria; compared to ERC. EP recognition — all, first, last, greatest, window	Volume of the last measured value after the stop criteria have been met.
Application	– Suitable titration mode for most problems. Specially recommended if jumps lie very close together and for very flat jumps. – The reagent feeding algorithm works properly only if the curve does not deviate markedly from S-shape.	– For slow titration reactions (diazotations, coupling reactions) and/or sluggish electrode response. – If a standard method requires this mode.	– For very rapid determinations if the endpoint does not shift in the course of the determination series. – If a standard method requires this mode. – If an excess of titrant must be avoided.

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.

2.2.6.1 Parameters for DET and MET

>titration parameters	Titration parameters
DET meas.pt.density 4	*Measuring point density (0...9)* 0 means highest densitiy, 9 lowest. Selection of the meas.pt.density, see page 28.
DET min.incr. 10.0 ul	*Minimum increment (0...999.9 uL)* The increment is dispensed at the beginning of the titration and in the region of the equivalence point. If it is set to 0, measured values are stored as a function of time.
MET V step 0.10 ml	*Size of the volume increment (0...9.999 mL)* Dispensing step. Small volume increments are needed to determine blank values or to assure accuracy with highly unsymmetrical curves. Selection of the size of the increment, see page 29. If "V step = 0" is set, measured values are stored as a function of time.
titr.rate max. ml/min ** titr.	*Dispensing rate for volume increments (0.01...150 mL/min, max.)* <clear> sets "max". The maximum rate depends on the Exchange Unit: Exchange Unit — max. 5 mL — 15 mL/min 10 mL — 30 mL/min 20 mL — 60 mL/min 50 mL — 150 mL/min

signal drift 50 mV/min

** titr.

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

equilibr.time 26 s

** titr.

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, see page 28. The measured value is acquired as soon as the first criterion (drift or time) has been met.

start V: OFF

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

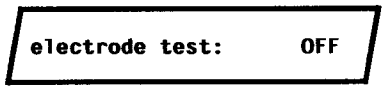
Exchange Unit	max.
5 mL	15 mL/min
10 mL	30 mL/min
20 mL	60 mL/min
50 mL	150 mL/min

** titr.

Pause (0...999 999 s)
Waiting time, e.g. for equilibration of the electrode after the start or reaction time after the dispensing of a start volume. The delay time can be aborted with <QUIT>.

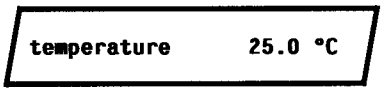
or

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 119.

With polarized electrodes, instead of the measuring input the
polarisation current (-127...127 uA)
or the
polarisation voltage (-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.



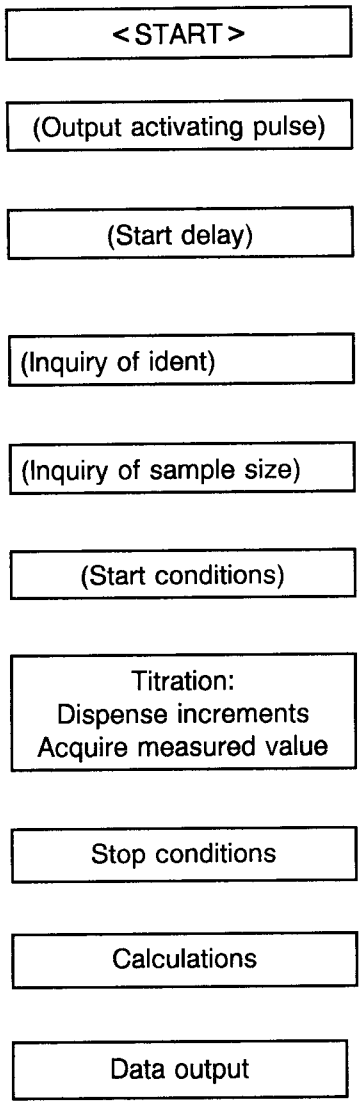
Titration temperature (-170.0...500.0 °C)
The temperaturte is measured at the the start of the titration if a T sensor is connected. This parameter is used for temperature compensation in pH titrations.

>stop conditions	**Conditions for titration termination** If several stop conditions have been set, the criterion which is met first applies.
stop V: abs. **titr.	*Type of stop volume (abs., rel., OFF)* "abs": absolute stop volume in mL "rel.": stop volume relative to sample size. "OFF": stop volume switched off. Stop volume is not monitored.
stop V 99.99 ml **titr.	If "abs." is set *Absolute stop volume (0...999.99 mL)*
factor 0 **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
stop pH OFF **titr.	*Stop measured value (input range dependent on measured variable:* *pH: 0... ± 20.00, OFF* *U, Ipol: 0... ± 2000 mV, OFF* *Upol: 0... ± 200.0 uA, OFF)* <clear> sets "OFF". "OFF" means that the criterion is not monitored.
stop EP 9 **titr.	*Stop after a certain number of equivalence points has been found (1...9, OFF)* <clear> sets "OFF". "OFF" means that the criterion is not monitored.
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 calculation** Mean value, absolute and relative standard deviation, see also page 47.
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 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.
>evaluation	**Equivalence point evaluation** See also page 28 ff.
EPC 5	*Equivalence point criterion (input range depends on mode.* *For DET:* *0...200* *For MET:* *pH: 0.10...9.99* *U, Ipol: 1...999 mV* *Upol: 0.1...99.9 uA)* Threshold for the size of the jump, see page 29.
EP recognition: all	*Equivalence point recognition (all, greatest, last, window, OFF)* Selection of equivalence point recognition: "all": All equivalence points are recognized. "greatest": Only the greatest equivalence point is recognized. "last": Only the last equivalence point is recognized. "window": Only EP's in specified windows are recognized. "OFF": Evaluation switched off.

low limit 1 pH -20.00 up limit 1 pH 20.00	If "window" has been selected, the following inquiries appear: *Lower limit of window 1* and *upper limit of window 1* *(Input ranges for both inquiries depend on the measured quantity):* *pH: 0... ± 20.00, OFF* *U, Ipol: 0... ± 2000 mV, OFF* *Upol: 0... ± 200.0 uA, OFF)* <clear> sets "OFF". Only equivalence points are recognized which lie within the set lower and upper limits. The equivalence point numbering is defined with the windows, see page 30. Window inquiries continue until the lower limit is set to "OFF". Up to 9 possible windows. Always set both limits to ≠ OFF for a valid window.
fix EP1 at pH OFF	*Fix end points (input range depends on the measured quantity:* *pH: 0... ± 20.00, OFF* *U, Ipol: 0... ± 2000 mV, OFF* *Upol: 0... ± 200.0 uA, OFF)* <clear> sets "OFF". If a fix end point has been set, the volume value for the inputted measured value is interpolated from the curve, see also page 31. The volume values are available as C5X. Fix EP's are inquired until "OFF" is set. Up to 9 fix EP's.
pK/HNP: OFF	*Evaluation of pK or HNP (ON, OFF)* pK evaluation in case of pH titrations and half neutralization potential (HNP) for U, see page 31.
>preselections	**Preselections for the titration 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 135.

Titration sequence of DET and MET



After the start,the activating pulse is outputted, then the start delay time is waited out.
Then the temperature is measued (if a T sensor is connected), "req.ident" and "req.smpl size" are requested and the start conditions are executed: The start volume is dispensed without measured value acquisition, the pause is waited out.

During the titration the volume increments are dispensed and after every increment a measured value is acquired.

The measured value acquisition is either drift controlled ("equilibrium titration") or after a fixed equilibration time. If you have not intentionally changed the equilibration time, it is calculated according to the formula:

$$\text{Equilibration time (in s)} = \frac{150}{\sqrt{\text{Drift} + 0.01}} + 5$$

The criterion which is first met applies. This avoids "infinite" titrations. If you enter the equilibration time yourself, this remains valid. If the parameter "signal drift" is set to "OFF", the measured values are acquired after a fixed equilibration time. If "signal drift" and "equilibration time" are set to "OFF", the measured value is acquired immediately.

In the case of the stop conditions, the criterion which is first met applies.

Finally, the the calculations are carried out and the data outputted. If you have a printer connected, see page 49.

Reagent feeding and EP evaluation of DET

The reagent feeding of DET is similar to the controlling, a human being would apply executing in manually controlled titrations: Great volume increments are dispensed far away from the EP, small increments in the region of the equivalence point.

The size of the volume increments dispensed by the DMS Titrino is determined by the following parameters:

meas.pt.density — The measuring point density is entered as a relative value from 0...9. Input of a low number means small volume increments, i.e. a large measuring point density on the curve. A curve results which reproduces all fine details. "Fine details", however, also include signal noise, which can easily lead to unwanted equivalence points.
A high number, i.e. low measuring density, on the other hand, allows a more rapid titration.
The standard value of 4 is suitable for most cases.

min.incr. — Defines the minimum possible increment. This minimum increment is dispensed at the beginning of the titration and in the region of the equivalence point (for steep curves). Use low minimum increments only if small volumes of titrant consumption are expected, e.g. in microtitrations; otherwise unwanted equivalence points may arise.
The standard value of 10.0 uL is suitable for most cases.

The EP's are evaluated according to a special METROHM procedure which is so sensitive that even weak equivalence points are determined correctly.
Parameter:

EPC — Equivalence Point Criteria.
The *preset* EPC is compared to the *found* ERC (Equivalence point Recognition Criteria) for each evaluated equivalence point. The ERC is given in the following reports: deriv (1st derivative), comb (combined titration and derivative curves) as well as in the mplist (measuring point list). The ERC is the first derivative of the titration curve overlayed with a mathematical function so that small maxima become higher and great maxima smaller. EP's whose ERC is below the preset EPC will not be recognized.
For most cases the standard value of 5 is suitable.
The evaluation can be repeated at any time after the titration in a "dry run" with changed evaluation criteria. The old titration data are not deleted until a new titration is started.

Reagent feeding and EP evaluation of MET

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

Parameter:

V step — Volume increment.
A prerequisite for good accuracy is the correct size of the volume increments. A good value is given by V step = 1/20 V_{EP} (V_{EP} = volume of the EP).
In any case, the increment size should always be between 1/10 V_{EP} and 1/100 V_{EP}; with steep jumps preferably in the region of 1/100 and with flat jumps preferably in the region of 1/10. The accuracy of the evaluation can not be increased by dispensing small increments as the changes in the measured value can then be of the same order of magnitude as the noise. This can produce "ghost EP's"!

The EP's are localised with an algorithm which is based on Fortuin and has been adapted by METROHM for numeric procedures. (METROHM Bulletin 2, No. 10, 1971). Here, the greatest change in the measured value is sought (Δ_n). The exact equivalence point is determined with an interpolation factor, which depends on the delta values before and after Δ_n:

$$V_{EP} = V_0 + \rho \cdot \Delta V$$

V_{EP}: EP volume
V_0: Total dispensed volume before Δ_n
ΔV: Volume increment
ρ : Interpolation factor (Fortuin)

The evaluation can be repeated at any time after the titration in a "dry run" with changed evaluation criteria. The old titration data are not deleted until a new titration is started.

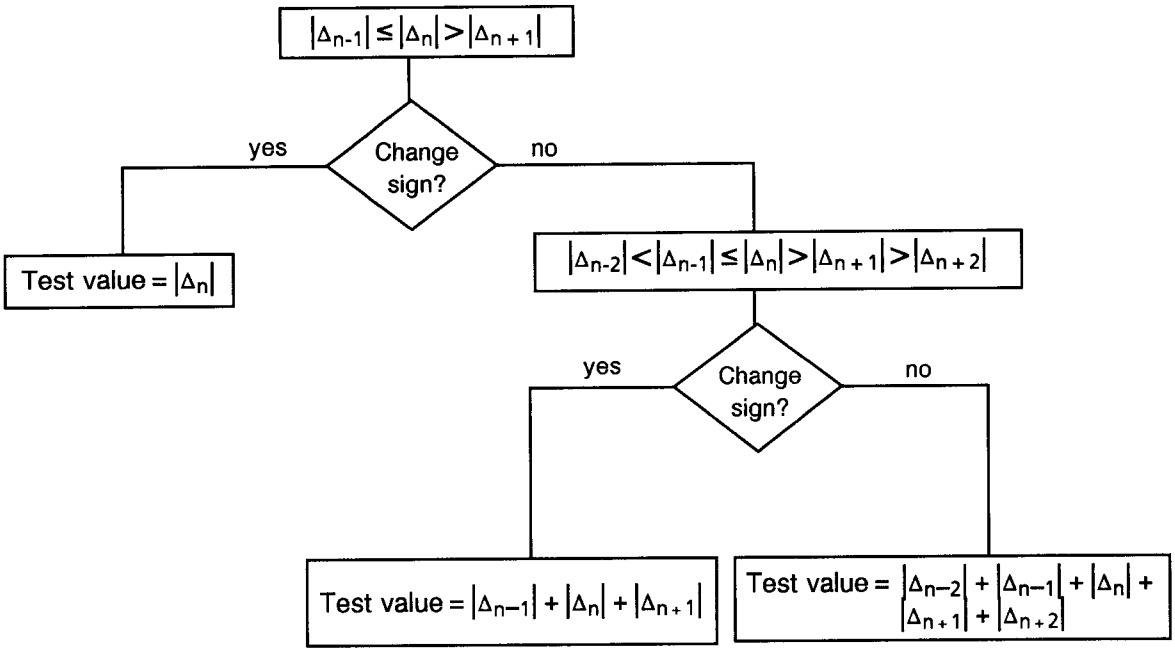
EPC in MET

Its value is a measure of the size of the jump. For most cases, the default values suffice to suppress noise maxima and to recognise the actual jumps. The current test value of each jump is compared with the set value. The equivalence point is recognised only when the test value is larger than the set value. The test value of the EPC can be calculated as follows with the aid of the measuring point list:

- Search the greatest change in the measured value → Δ_n
- Use the measured value changes before and after Δ_n to set up the series

$$\Delta_{n-2}\ \Delta_{n-1}\ \Delta_n\ \Delta_{n+1}\ \Delta_{n+2}$$

- Use the following scheme to decide how many Δ values your series needs for the calculation of the test value:



- Enter a value for the parameter "EPC" somewhat higher than your calculated test value if you wish to suppress an EP. Conversely, if you wish to record a non-recognised EP, set a value for the "EPC" parameter somewhat less than the calculated test value.

Selectable EP recognition criteria for DET and MET

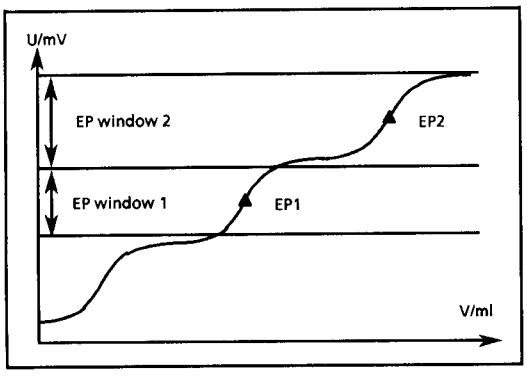
The parameter "EP recognition" offers you a range of possibilities to ensure selection of the EP you are interested in: If the desired jump is very large, you can select the "greatest". You thus always obtain just one EP per titration (EP1).
If you wish to determine the sum of different components (e.g.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

EP windows

EP windows are used

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

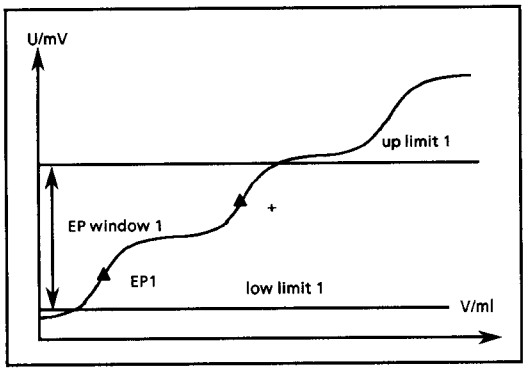
An EP window defines the range in which an EP is expected. EP's outside these ranges are not recognised. Windows are defined on the measured value axis.



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

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

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



The first jump is recognised as EP1, the second is not recognised. EP1 is marked as EP1 + to indicate that more than one EP has been found in the set window.

Fix EP's

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

pK and HNP evaluation

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

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

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

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

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

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

2.2.6.2 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 uA, 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 uA, OFF)* <clear> sets "OFF". "OFF" means largest control range, i.e. low titration. Outside the control range, dispensing is performed continuously, see also page 38.
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 38. 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 uL/min)* This parameter determines the addition rate right at the start and the end of the titration, see also page 38. This parameter influences the titration speed and therefore its accuracy very strongly: A smaller min.rate 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 uL/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.

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

Titration parameters
Apply globally for the entire titration.

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.

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.

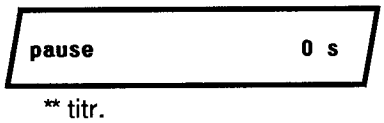
If "abs." is set:
Absolute start volume (0...999.99 mL)

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.

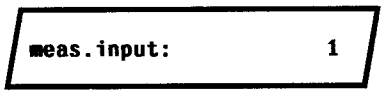
Dispensing rate for the start volume (0.01...150 mL/min, max.)
<clear> sets "max.".
The maximum rate depends on the Exchange Unit:

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

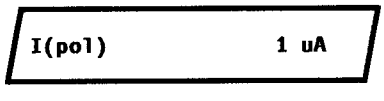


** titr.

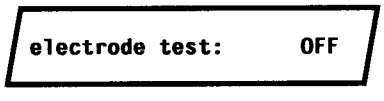
Pause (0...999 999 s)
Waiting time, e.g. for equilibration of the electrode after the start or reaction time after the dispensing of a start volume. The equilibration time can be aborted with <QUIT>.



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 119.

With polarized electrodes, instead of the measuring input the
polarisation current (-127...127 uA)
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.

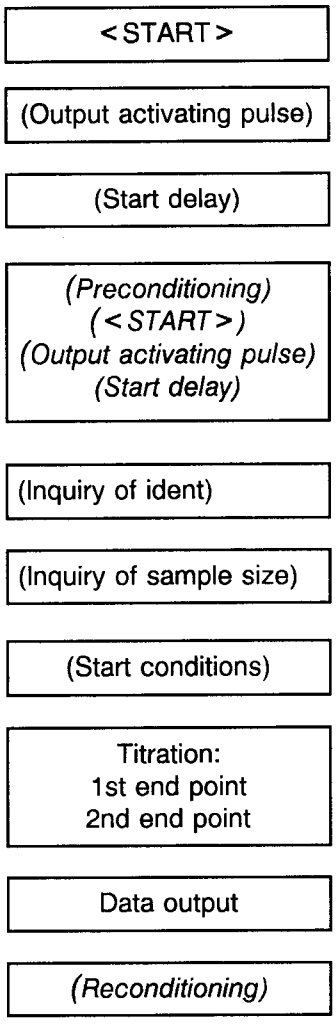
Titration temperature (-170.0...500.0° C).
The temperaturte is measured at the the start of the titration if a T sensor is connected. This parameter is used for temperature compensation in pH titrations.

>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 as a safety 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.
stop V 99.99 ml **titr.	If "abs." is set: *Absolute stop volume (0...999.99 mL)*
factor 0 **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
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 47.
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.
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 135, 136.

Titration sequence of SET

The titration sequence can be configured to match the application. The following parameters determine the sequence (see schematic diagram below):
- Start delay
- Conditioning (on, off)
- Inquiry of the sample identifications and the sample size after the start of titration
- Start conditions: start volume and pause



After the start, the start delay time is waited out.

If *conditioning* is switched on, after the first start the titration vessel is brought to the (1st) end point. If the conditioning is at an end, the display shows, e.g. /SET pH conditioning/ or when the drift display is switched on, /drift ok 5 ul/min/. The instrument is ready for titration. If the drift display is switched on, the volume drift is displayed continuously during conditioning. After the titration, conditioning is again performed to the (1st) end point.

After the start of the titration, the activate pulse is outputted (possibilities to activate pulse, see page 136) and the start delay time is waited out.

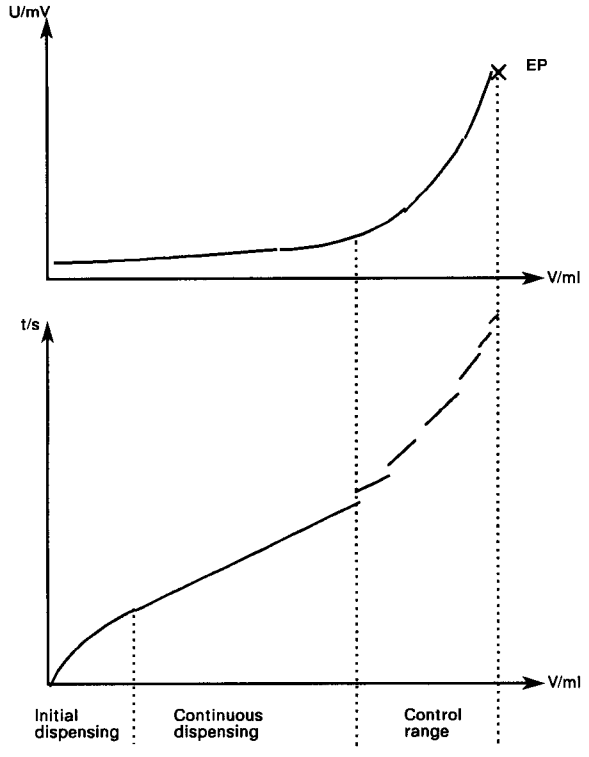
Then the temperature is measued (if a T sensor is connected), "req.ident" and "req.smpl size" are requested and the start conditions are executed: The start volume is dispensed and the pause is waited out. During dispensing of the start volume, no control is exerted. Then the titration is performed to the first then to the second end point.

At the end, the data are outputted. If you have a printer connected, see page 49.

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".

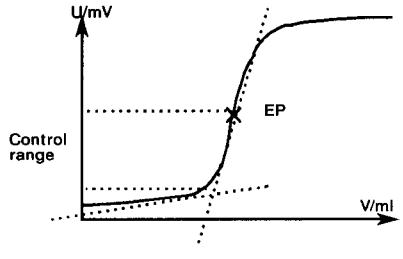
2) Continuous dispensing:
Dispensing is performed at the maximum rate "max.rate" until the control range (dynamics) is reached.

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

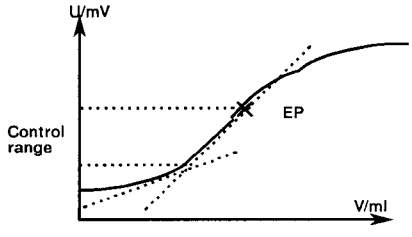
Trial settings for the size of the control range

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



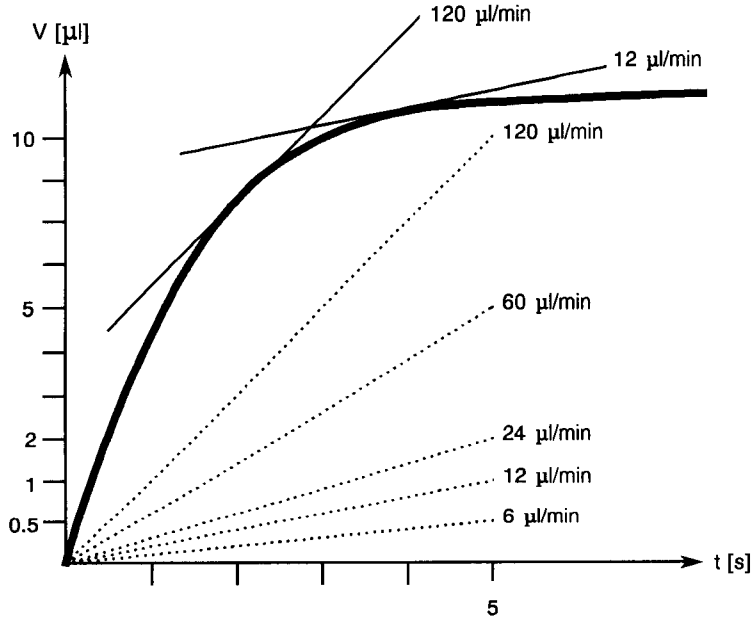
"flat" curves



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 118. This is particularly important with very fast titration reactions and with steep curves.
Titration time is too long.	– Set higher "min.rate". – Set higher "max.rate". – Lower "dynamics".
Scatter in titration results is too great.	– Set "min.rate" lower.

2.2.6.3 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 uA/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, 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 set to "OFF", measurement is continued indefinitely.
meas.input: 1 or I(pol) 1 uA 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 119. 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 temperature 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 47.
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.
>preselections	**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 135.

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 119.
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 pages 135, 136.

>statistics	**statistics** see page 42

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 49.

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.

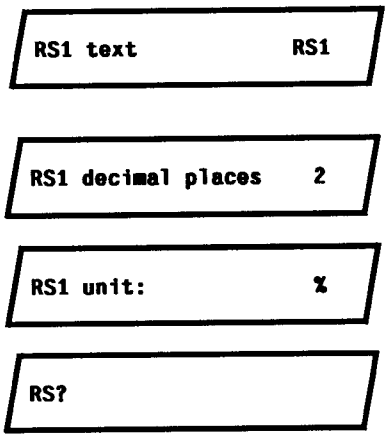
Calibration data can be viewed at any time with the <cal.data> key (see page 52) and the calibration report printed out using the key sequence <print> <cal.data> <enter>.

2.2.7 Result 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...9 RSX: Results which have already been calculdated with previous formulas. X = 1...9. CXX: Calculation constants. XX = 00...69. The constants have the following meaning: C00 Sample size C01 : C19 Method-specific operands, see page 46. Are stored in the method memory. C21 : C23 Sample-specific operands, see page 53ff. C30 : C39 Common variables which have been determined by other methods, see page 48. C40 Initial measured value of the sample C41 Titration end volume (with DET, MET, 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 DET, MET, SET) C46 Asymmetry pH, pH_{as} C47 Electrode slope C51 : C59 Volumes of the fix end points 1...9 (with DET and MET) C61 : C69 pK/HNP values 1...9 (with DET and MET)
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.

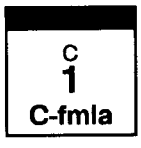
Text for result display and report (up to 8 characters)
Text input see page 17.

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 the 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.

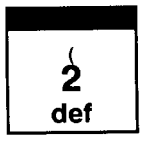
The entries are specific to a method and are stored in the method memory.

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 calculations

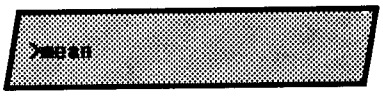
Mean values, absolute and relative standard deviations are calculated.

Allocations for the statistics calculations, <def> key



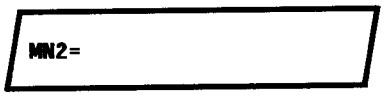
The <def> key is used to allocate results for statistics calculations.

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



Allocations for statistics calculations

Mean value number ? (1...9)
You can perform statistics calculations using up to 9 results. For MN1, the default value RS1 is entered.



Enter a number 1...9.

Allocation of a result (RS1...RS9).
Delete allocation with <clear> + <enter>.

How do you obtain statistics calculations?

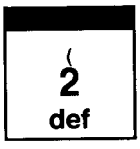
1) Enter the allocations for the statistics calculations, see above.
2) Switch on the statistics calculations: Either with the <statistics> key or set the status under the <parameters> key, " >statistics" to "on". The "statistics" LED is on. On storage of the method in the method memory, the status of 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.
- 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.
- 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.

Allocation for common variables

Common variable C3? (0...9)
Common variables are stored as C3X (X = 0...9).

Enter a number.

Allocation of a result (RS1...RS9) or a mean value (MN1...MN9)
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 19.
Delete allocation with <clear> + <enter>.

2.2.10 Data output

Definition of the report sequence 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

Definition of the report sequence on completion of a determination

report:

Report sequence (input range depends on the mode:

DET: param, calc, full, short, ff, mplist, curve, deriv, comb, calib
MET: param, calc, full, short, ff, mplist, curve, calib
SET: param, calc, full, short, ff, calib
MEAS: param, calc, full, short, ff, calib
CAL: param, calc, full, short, ff, calib)

report:full;curve

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.
mplist	Measuring point list with measured values, volumes and measured value change.
curve	Titration curve.
deriv	First derivative of titration curve.
comb	Combined first derivative and titration curves.
calib	Calibration data.

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

<print> <reports> <enter>

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

Report outputs can be stopped with <QUIT>.

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 outputted. 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	–
Measuring point list (DET and MET)	mplist	–
Titration curve (DET and MET)	curve	–
1st derivative of titration curve (DET)	deriv	–
Combined 1st derivative and titration curve (DET)	comb	–
All reports	all	–
Complete report sequence as defined under the <def> key	–	reports

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 fix EP's	C51...C59	fix EP's (DET and MET)
>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

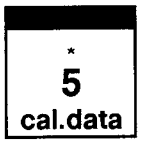
The <user meth> key is used to manage the method memory.
Method identifications can be entered directly or selected with the <select> key from the memory contents.

>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 17. 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 PC and program 6.6013.000, you should carry out a complete method backup from time to time.

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...500 °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 55.

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 27, 36 and 42.

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 114).
smpl size 1 g	*Sample size (6-digit number: ± X.XXXXX)* Entry using keypad or via a balance (see page 114).
smpl unit: g	*Unit of the sample (g, mg, mL, uL, pc, no unit or up to 5 characters).* Selection with <select>.

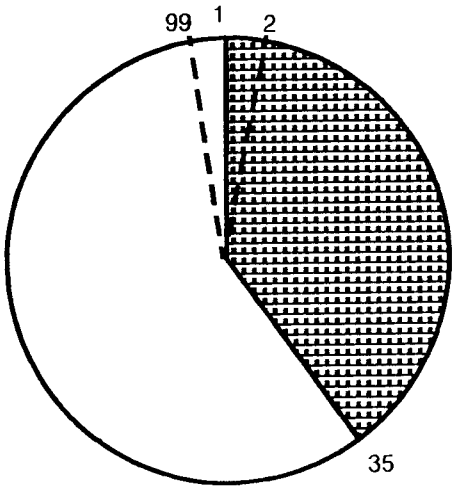
2.2.14 Silo memory for sample data

In the silo memory or pushup storage, sample data (method, identifications and smpl size) can be stored. This is useful, e.g. when you work with sample changers and other automatic sample addition systems.

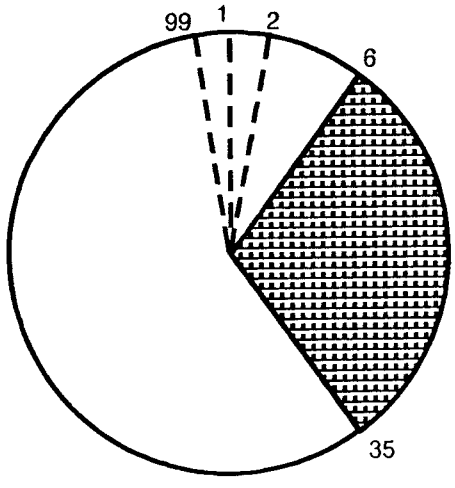
The <silo> key is used to switch the silo memory on and off. The status LED "silo" is on when the silo memory is switched on. The silo memory works by the FIFO principle (First In, First Out).

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.

1 silo line needs between 72 and 78 bytes memory capacity.

If the silo memory is filled from the balance, you must ensure that there is sufficient space in the silo memory for the required number of silo lines!

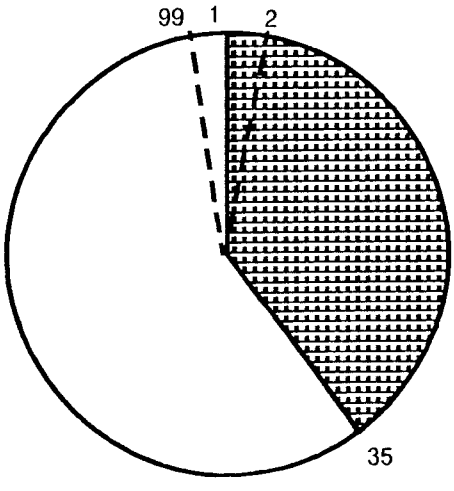
<smpl data> key with the silo memory switched on

>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, ul, 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.

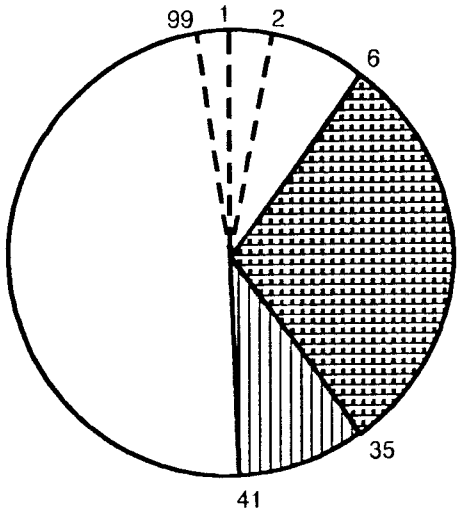
>delete all silo lines	**Deleting the entire silo memory**
delete all: no	*Delete all silo lines (yes, no)* When all silo lines are deleted, the silo is completely empty: The line numbering starts again with 1.
cycle lines: OFF	*Data cycling (ON, OFF)* Data cycling "on" is useful if you constantly have 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 716 DMS 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.

3. Operation via RS232 interface

3.1 General rules

The 716 DMS 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. 716 DMS 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 MET mode the command

&Mode.Select "MET"

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

&M.S"MET" .

All quantities of the 716 DMS 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.RSSet

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

&Config.RSSet.Baud

or regarding the setting of the parity

&Config.RSSet.Parity

The commands have a hierarchial structure (tree structure). The quantities that appear in this tree are called **objects** in what follows. The baud rate is an object that is called up with the command

&Config.RSSet.Baud

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.RSSet.Baud $Q Q for Query

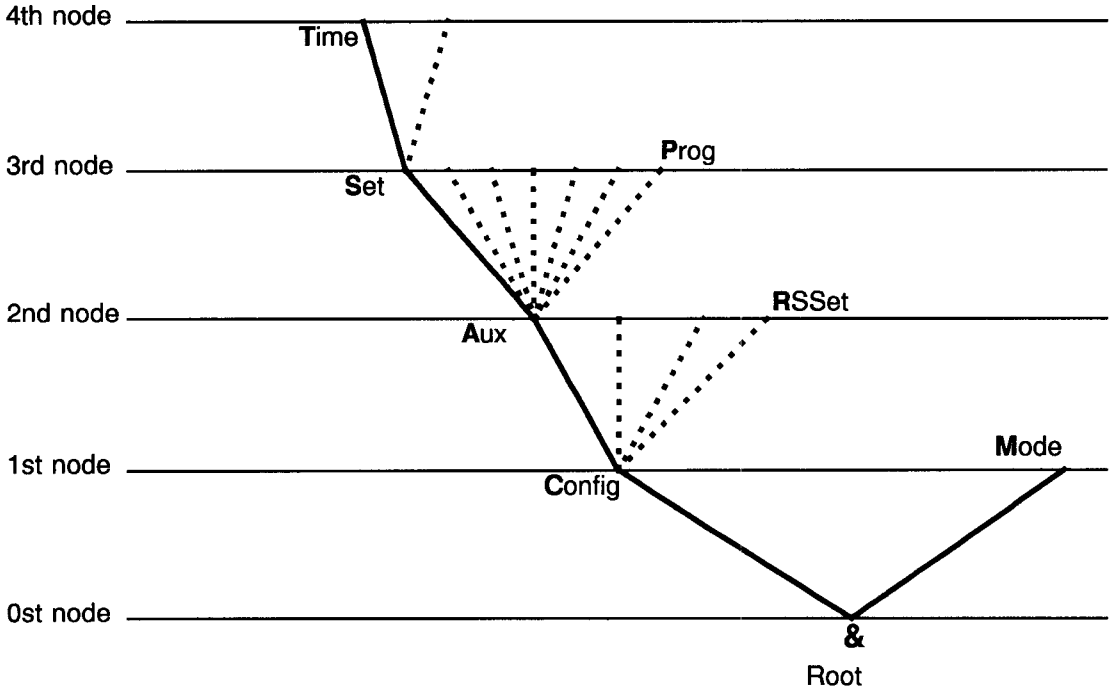
$Q triggers the output of the value from the 716 DMS Titrino. Entries that are introduced with the character dollar ($) trigger something. They are thus called **triggers** in what follows.

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

&Config.RSSet.Baud "9600"

3.1.1 Call up of objects

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 716 DMS Titrino, e.g. after $Q

The triggers $G, $S and $H, $C are linked to objects, see overview table, pages 64ff.

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.MET;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.DET	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in the DET mode, requesting Id1 after titration start.
	.Id2:	Instrument in the DET mode, requesting Id2 after titration start.
	.Id3:	Instrument in the DET mode, requesting Id3 after titration start.
	.Smpl:	Instrument in the DET mode, requesting sample size after titration start.
	.Unit:	Instrument in the DET mode, requesting unit of sample size after titration start.
	.Start:	Instrument in the DET mode, processing the start conditions.
	.Titr:	Instrument in the DET mode, titrating.
$G .Mode.MET	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in the MET mode, requesting Id1 after titration start.
	.Id2:	Instrument in the MET mode, requesting Id2 after titration start.
	.Id3:	Instrument in the MET mode, requesting Id3 after titration start.
	.Smpl:	Instrument in the MET mode, requesting sample size after titration start.
	.Unit:	Instrument in the MET mode, requesting unit of sample size after titration start.
	.Start:	Instrument in the MET mode, processing the start conditions.
	.Titr:	Instrument in the MET mode, titrating.
$G .Mode.SET	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in the SET mode, requesting Id1 after titration start.
	.Id2:	Instrument in the SET mode, requesting Id2 after titration start.
	.Id3:	Instrument in the SET mode, requesting Id3 after titration start.
	.Smpl:	Instrument in the SET mode, requesting sample size after titration start.
	.Unit:	Instrument in the SET mode, requesting unit of sample size after titration start.
	.Start:	Instrument in the SET mode, processing the start conditions.
	.SET1:	Instrument in the SET mode, titrating to the first end point.
	.SET2:	Instrument in the SET mode, titrating to the second end point.
	.Cond.Ok:	Instrument in the SET, 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.MEAS	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in the MEAS mode, requesting Id1 after start.
	.Id2:	Instrument in the MEAS mode, requesting Id2 after start.
	.Id3:	Instrument in the MEAS mode, requesting Id3 after start.
	.Smpl:	Instrument in the MEAS mode, requesting sample size after start.
	.Unit:	Instrument in the MEAS mode, requesting unit of sample size after start.
	.Meas:	Instrument in the MEAS mode, measuring.

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

Status conditions of the global $H:

$H .Mode.DET	.Inac:	Instrument in the DET mode, has been holded at the beginning.
	.Start:	Instrument in the DET mode, has been holded during the start conditions.
	.Titr:	Instrument in the DET mode, has been holded during titration.
$H .Mode.MET	.Inac:	Instrument in the MET mode, has been holded at the beginning.
	.Start:	Instrument in the MET mode, has been holded during the start conditions.
	.Titr:	Instrument in the MET mode, has been holded during titration.
$H .Mode.SET	.Inac:	Instrument in the SET mode, has been holded at the beginning.
	.Start:	Instrument in the MET mode, has been holded during the start conditions.
	.SET1:	Instrument in the SET mode, has been holded during titration to the first endpoint.
	.SET2:	Instrument in the SET mode, has been holded during titration to the second endpoint.
	.Cond:	Instrument in the SET mode, has been holded during conditioning.
$H .Mode.MEAS	.Inac:	Instrument in the MEAS mode, has been holded at the beginning.
	.Meas:	Instrument in the MEAS mode, has been holded during measurement.
$H .Mode.CAL	.Inac:	Instrument in the CAL mode, has been holded at the beginning.
	.Meas.Buf1:	Instrument in the CAL mode, has been holded during measurement of buffer 1.
	.Meas.Buf2:	Instrument in the CAL mode, has been 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.DET	.Inac:	Instrument in the DET mode, inactive.
$R .Mode.MET	.Inac:	Instrument in the MET mode, inactive.
$R .Mode.SET	.Inac:	Instrument in the SET mode, inactive.
	.Cond.Ok:	Instrument in the SET mode, conditioning, endpoint reached.
	.Cond.Prog:	Instrument in the SET mode, conditioning, endpoint not reached.
$R .Mode.MEAS.	Inac:	Instrument in the MEAS mode, inactive.
$R .Mode.CAL	.Inac:	Instrument in the CAL mode, inactive.
$R .Assembly.Bur	.ModeDis:	Burette in the 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 gives 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 up
Exit: Send correct path for object. Start path at root.

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

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

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

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

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

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

RS receive errors:

E36 Parity
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 716 DMS 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.

E121: Measuring point list overflow (more than 200 measuring points).
Exit: The error message disappears on next startup.

E122: EP overflow.
Exit: The error message disappears on next startup or on recalculation.

E123: Missing EP for calculation.
Exit: The error message disappears on next startup or on recalculation.

E124: Number of EP's does not correspond with the set windows.
Exit: The error message disappears on next startup or on recalculation.

E125: Missing fix EP for calculation, has not been defined.
Exit: The error message disappears on next startup or on recalculation.

E126: Fix-EP outside of measuring point list.
Exit: The error message disappears on next startup or on recalculation.

E128: No new mean.
Exit: The error message disappears on next startup or on recalculation.

E129: No new common variable, old value remains.
Exit: The error message disappears on next startup or on recalculation.

E130: Wrong sample. For SET with preset titration direction the first measured value lies behind the endpoint.
Exit: The error message disappears on next startup.

E131: No EP set for SET.
Exit: The error message disappears on next startup.

E132: Silo empty and it has been started with open silo or empty silo has been opened.
Exit: Send a silo entry.

E133: Silo full.
Exit: Send new command.

E134: No method. A method, which is required from the silo memory, 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
.QuickMeas	Quick measurement in inactive state	$G, $S	3.2.2.2
.Select	Selection of the mode	DET, MET, SET, MEAS, CAL	3.2.2.3
.DETQuantity	Measured quantity for DET	pH, U, Ipol, Upol	3.2.2.3
.METQuantity	Measured quantity for MET	pH, U, Ipol, Upol	3.2.2.3
.SETQuantity	Measured quantity for SET	pH, U, Ipol, Upol	3.2.2.3
.MEASQuantity	Measured quantity for MEAS	pH, U, Ipol, Upol, T	3.2.2.3
.Name	Name of the current method	read only	3.2.2.4
.Parameter*	Parameters of the current method, depend on the mode, see pages 65 to 68		
.Def	**Definitions for the data output**		
.Formulas	**Calculation formulas**		
.1	For result 1		
.Formula	Calculation formula	special	3.2.2.5
.TextRS	Text for the result designation	up to 8 ASCII char	3.2.2.5
.Decimal	Decimal places	0...5	3.2.2.5
.Unit	Unit for the result	up to 6 ASCII char	3.2.2.5
	up to 9 results		
.ComVar	**Assignment of common variables**		
.C30	Common variable C30	RS1...RS9, MN1...MN9	3.2.2.6
	up to C39		
.Report	**Data output at the end of titration**		
.Assign	Assignment	depends on mode	3.2.2.7
.Mean	**Assignments for statistics calculations**		
.1	Mean value 1, MN1		
.Assign	Assignment for MN1	RS1...RS9	3.2.2.8
	up to 9 assignments		
.CFmla	**Calculation constants**		
.1	Calculation constant C01		
.Value	Value for C01	0... ±999 999	3.2.2.9
	up to C19		
UserMeth	**Management of the method memory**		
.FreeMem	Memory still available	read only	3.2.2.10
.Recall	Recall method	$G	3.2.2.11
.Name	Method identification	up to 8 ASCII char	3.2.2.11
.Store	Store method	$G	3.2.2.11
.Name	Method identification	up to 8 ASCII char	3.2.2.11
.Delete	Delete method	$G	3.2.2.11
.Name	Method identification	up to 8 ASCII char	3.2.2.11
.DelAll	Delete all methods	$G	3.2.2.11
.List	List of all methods in the method memory		
.1	Method 1		
.Name	Name of the method	read only	3.2.2.12
.Mode	Mode	read only	3.2.2.12
.Quantity	Measured quantity	read only	3.2.2.12
.Bytes	Bytes used from the mewthod memory	read only	3.2.2.12
.Checksum	Checksum of the method for all the methods	read only	3.2.2.12

Object	Function	Input range	see...
*Parameter	**Tree part "Parameters for DET"**		
.TitrPara	**Titration parameters**		
.MptDensity	Measuring point density	0...9	3.2.2.13
.MinIncr	Minimum Increment	0...999.9	3.2.2.13
.DosRate	Dispensing rate for increments	0.01...150.0, max.	3.2.2.14
.SignalDrift	Drift for measured value acquisition	depends on meas quant.	3.2.2.15
.UnitSigDrift	Unit of the measured value drift	read only	3.2.2.15
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.15
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.16
.V	Volume for the absolute start volume	0...999.99	3.2.2.16
.Factor	Factor for the relative start volume	0... ± 999 999	3.2.2.16
.Rate	Dispensing rate	0.01...150, max.	3.2.2.16
.Pause	Waiting time	0...999 999	3.2.2.17
.MeasInput	Measuring input	1, 2, diff.	3.2.2.18
.Ipol	Polarisation current	0... ± 127	3.2.2.18
.Upol	Polarisation potential	0... ± 1270	3.2.2.18
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.18
.Temp	Titration temperature	–170.0...500.0	3.2.2.19
.StopCond	**Stop conditions**		
.VStop	Stop volume		
.Type	Type of stop volume	abs., rel., OFF	3.2.2.20
.V	Volume for the absolute stop volume	0...999.99	3.2.2.20
.Factor	Factor for the relative stop volume	0... ± 999 999	3.2.2.20
.MeasStop	Stop measured value pH, U, I	depends on meas quant.	3.2.2.21
.UnitMStop	Unit of the stop measured value	read only	3.2.2.21
.EPStop	Stop after a number of end points	1...9, OFF	3.2.2.22
.FillRate	Filling rate after the titration	0.01...150.0, max.	3.2.2.23
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.24
.MeanN	Number of individual determinations	2...20	3.2.2.24
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.24
.DelN	Deletion of individual results	1...20	3.2.2.24
.Evaluation	**Evaluation**		3.2.2.25
.EPC	EP criterion	0...200	3.2.2.25
.Recognition	EP recognition		
.Select	Type of EP recognition	all, greatest, last, window, OFF	3.2.2.25
.Window	Window		
.1			
.LowLim	Lower limit window 1	depends on meas quant.	3.2.2.25
.UpLim	Upper limit window 1	depends on meas quant.	3.2.2.25
	up to 9 windows		
.FixEP	Fix end points		
.1	Fix EP1		
.Value	Measured value for fix EP1	depends on meas quant.	3.2.2.25
	up to 9 fix EP's		
.pK	pK or HNP evaluation	ON, OFF	3.2.2.25
.Presel	**Preselections**		
.IReq	Request of Id's after start	id1, id1&2, all, OFF	3.2.2.26
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.26
.ActPulse	Output of a pulse	ON, OFF	3.2.2.27

Object	Function	Input range	see...
*Parameter	**Tree part "Parameters for MET"**		
.TitrPara	**Titration parameters**		
.VStep	Volume increment	0...9.999	3.2.2.13
.DosRate	Dispensing rate for increments	0.01...150.0, max.	3.2.2.14
.SignalDrift	Drift for measured value acquisition	depends on meas quant.	3.2.2.15
.UnitSigDrift	Unit of the measured value drift	read only	3.2.2.15
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.15
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.16
.V	Volume for the absolute start volume	0...999.99	3.2.2.16
.Factor	Factor for the relative start volume	0... ± 999 999	3.2.2.16
.Rate	Dispensing rate	0.01...150, max.	3.2.2.16
.Pause	Waiting time	0...999 999	3.2.2.17
.MeasInput	Measuring input	1, 2, diff.	3.2.2.18
.Ipol	Polarisation current	0... ± 127	3.2.2.18
.Upol	Polarisation potential	0... ± 1270	3.2.2.18
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.18
.Temp	Titration temperature	–170.0...500.0	3.2.2.19
.StopCond	**Stop conditions**		
.VStop	Stop volume		
.Type	Type of stop volume	abs., rel., OFF	3.2.2.20
.V	Volume for the absolute stop volume	0...999.99	3.2.2.20
.Factor	Factor for the relative stop volume	0... ± 999 999	3.2.2.20
.MeasStop	Stop measured value pH, U, I	depends on meas quant.	3.2.2.21
.UnitMStop	Unit of the stop measured value	read only	3.2.2.21
.EPStop	Stop after a number of end points	1...9, OFF	3.2.2.22
.FillRate	Filling rate after the titration	0.01...150.0, max.	3.2.2.23
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.24
.MeanN	Number of individual determinations	2...20	3.2.2.24
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.24
.DelN	Deletion of individual results	1...20	3.2.2.24
.Evaluation	**Evaluation**		3.2.2.25
.EPC	EP criterion	depends on meas quant.	3.2.2.25
.Recognition	EP recognition		
.Select	Type of EP recognition	all, greatest, last, window, OFF	3.2.2.25
.Window	Window		
.1			
.LowLim	Lower limit window 1	depends on meas quant.	3.2.2.25
.UpLim	Upper limit window 1	depends on meas quant.	3.2.2.25
	up to 9 windows		
.FixEP	Fix end points		
.1	Fix EP1		
.Value	Measured value for fix EP1	depends on meas quant.	3.2.2.25
	up to 9 fix EP's		
.pK	pK or HNP evaluation	ON, OFF	3.2.2.25
.Presel	**Preselections**		
.IReq	Request of Id's after start	id1, id1&2, all, OFF	3.2.2.26
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.26
.ActPulse	Output of a pulse	ON, OFF	3.2.2.27

Object	Function	Input range	see...
***Parameter**	**Tree part "Parameters for SET"**		
.SET1	**Control parameters for EP1**		
.EP	End point 1	depends on meas quant.	3.2.2.28
.UnitEp	Unit of the end point EP1	read only	3.2.2.28
.Dyn	Dynamics	depends on meas quant.	3.2.2.29
.UnitDyn	Unit of dynamics	read only	3.2.2.29
.MaxRate	Maximum dispensing rate	0.01...150, max.	3.2.2.29
.MinRate	Minimum dispensing rate	0.01...999.9	3.2.2.29
.Stop	Titration stop		
.Type	Type of stop criterion	drift, time	3.2.2.30
.Drift	Stop drift	1...999	3.2.2.30
.TIme	Switch-off delay time	0...999, inf	3.2.2.30
.StopT	Stop time	0...999 999, OFF	3.2.2.30
.SET2	**Control parameters for EP2**, identical to SET1		
.TitrPara	**Titration parameters**		
.Direction	Titration direction	+, –, auto	3.2.2.31
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.16
.V	Volume for the absolute start volume	0...999.99	3.2.2.16
.Factor	Factor for the relative start volume	0... ± 999 999	3.2.2.16
.Rate	Dispensing rate	0.01...150, max.	3.2.2.16
.Pause	Waiting time	0...999 999	3.2.2.17
.MeasInput	Measuring input	1, 2, diff.	3.2.2.18
.Ipol	Polarisation current	0... ± 127	3.2.2.18
.Upol	Polarisation potential	0... ± 1270	3.2.2.18
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.18
.Temp	Titration temperature	–170.0...500.0	3.2.2.19
.StopCond	**Stop conditions**		
.VStop	Stop volume		
.Type	Type of stop volume	abs., rel., OFF	3.2.2.20
.V	Volume for the absolute stop volume	0...999.99	3.2.2.20
.Factor	Factor for the relative stop volume	0... ± 999 999	3.2.2.20
.FillRate	Filling rate after the titration	0.01...150.0, max.	3.2.2.23
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.24
.MeanN	Number of individual determinations	2...20	3.2.2.24
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.24
.DelN	Deletion of individual results	1...20	3.2.2.24
.Presel	**Preselections**		
.Cond	Conditioning	ON, OFF	3.2.2.32
.DriftDisp	Display of the drift during conditioning	ON, OFF	3.2.2.32
.IReq	Request of Id's after start	id1, id2, all, OFF	3.2.2.26
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.26
.ActPulse	Output of a pulse	first, all, cond., OFF	3.2.2.27

Object	Function	Input range	see...
*Parameter	**Tree part "Parameters for MEAS"**		
.Measuring	**Measurement parameters**		
.SignalDrift	Drift for measured value acquisition	depends on meas quant.	3.2.2.33
.UnitSigDrift	Unit of measured value drift	read only	3.2.2.33
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.33
.MeasInput	Measuring input	1, 2, diff.	3.2.2.33
.Ipol	Polarisation current	0... ± 127	3.2.2.34
.Upol	Polarisation potential	0... ± 1270	3.2.2.34
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.34
.Temp	Measurement temperature	–170.0...500.0	3.2.2.35
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.24
.MeanN	Number of individual determinations	2...20	3.2.2.24
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.24
.DelN	Deletion of individual results	1...20	3.2.2.24
.Presel	**Preselections**		
.IReq	Request of Id's after start	id1, id2, all, OFF	3.2.2.26
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.26
.ActPulse	Output of a pulse	ON, OFF	3.2.2.27

*Parameter	**Tree part "Parameters for CAL"**		
.Calibration	**Calibration parameters**		
.MeasInput	Measuring input	1, 2, diff.	3.2.2.36
.CalTemp	Calibration temperature	–20.0...120.0	3.2.2.37
.Buffer	pH value of the buffers		
.1	Buffer 1		
.Value	pH value of buffer 1	0... ± 20.00	3.2.2.38
.2	Buffer 2		
.Value	pH value of buffer 2	0... ± 20.00, OFF	3.2.2.38
	up to 9 buffers		
.SignalDrift	Drift for measured value acquisition	0.5...999, OFF	3.2.2.39
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.39
.ElectrodeId	Electrode identification	up to 8 ASCII char	3.2.2.40
.SmplChanger	Calibration at sample changer	ON, OFF	3.2.2.41
.ActPulse	Output of a pulse	first, all, OFF	3.2.2.42
.Statistics	**Statistics calculations**		
.Status	Status of the statistics	ON, OFF	3.2.2.24
.MeanN	Number of individual determinations	2...20	3.2.2.24
.ResTab	Result table		
.Select		original, delete n, delete all	3.2.2.24
.DelN	Deletion of individual results	1...20	3.2.2.24

Object	Function	Input range	see...
&	**Root**		
Config	**Configuration**		
.PeriphUnit	**Selection of external devices**		
.CharSet	Selection of the character set	Epson,Seiko,Citizen,IBM	3.2.2.43
.Balance	Selection of the balance	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, portuguese, italiano, svenska	3.2.2.45
.Set	Setting of date and time	$G	3.2.2.46
.Date	Date	XXXX-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...999 999	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, mplist, curve, derive, comb, 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
.MPList	Checksum of the measured point list	read only/read + write	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 meas.point list and C4X	ON, OFF	3.2.2.65
.Exch	Volume of the exchange unit	read only/read + write	3.2.2.65
.MPList	Measuring point list		
.1	Measuring point 1		
.Attribute	Attribute	read only/read + write	3.2.2.65
.X	X coordinate, volume	read only/read + write	3.2.2.65
.Y	Y coordinate, measured value for every measuring point	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 up to 9 results	read only	3.2.2.66
.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
.Mark	Mark if more than 1EP per window up to 9 endpoints	read only	3.2.2.66
.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
.FixEP	Fix end points		
.51	Fix EP 1, up to C59, volume of fix EP 9		
.Value	Volume value	read only	3.2.2.67
.pK	pK or HNP values		
.61	pK1 or HNP1, up to C69		
.Value	Value	read only	3.2.2.67

Object	Function	Input range	see...
&	**Root**		
	Information, continued		
.StatisticsVal	**Statistics values**		
.ActN	Number of results in statistics table	read only	3.2.2.68
.1	Data of MN1		
.Mean	Mean value	read only	3.2.2.68
.Std	Absolute standard deviation	read only	3.2.2.68
.RelStd	Relative standard deviation	read only	3.2.2.68
	up to 9 mean values		
.ActualInfo	**Current information**		
.Inputs	I/O inputs		
.Status	Status of the lines	read only	3.2.2.69
.Change	Change in the status of the lines	read only	3.2.2.69
.Clear	Clears the change byte	$G	3.2.2.69
.Outputs	I/O outputs		
.Status	Status of the lines	read only	3.2.2.69
.Change	Change in the status of the lines	read only	3.2.2.69
.Clear	Clears the change byte	$G	3.2.2.69
.Assembly	Regarding branch &Assembly		
.CyclNo	Cycle number	read only	3.2.2.70
.Counter	Counter in assembly		
.V	Volume counter	read only	3.2.2.71
.Clear	Clears above counter	$G	3.2.2.71
.Meas	Measured value	read only	3.2.2.72
.Titrator	Regarding the titrator		
.CyclNo	Cycle number	read only	3.2.2.73
.V	Volume	read only	3.2.2.73
.Meas	Measured value	read only	3.2.2.73
.dVdt	Volume drift dV/dt	read only	3.2.2.73
.dMeasdt	Measured value drift	read only	3.2.2.73
.dMeasdV	1st derivative of the titration curve	read only	3.2.2.73
.ERC	ERC of DET	read only	3.2.2.73
.MeasPt	Entry in the measuring point list		
.Index	Index of the input	read only	3.2.2.74
.X	X-coordinate (volume, time)	read only	3.2.2.74
.Y	Y-coordinate (measured value)	read only	3.2.2.74
.EP	Entry of an EP		
.Index	Index of the input	read only	3.2.2.74
.X	X-coordinate (volume)	read only	3.2.2.74
.Y	Y-coordinate (measured value)	read only	3.2.2.74
.Display	Display		
.L1	1st line	up to 24 ASCII char	3.2.2.75
.L2	2nd line	up to 24 ASCII char	3.2.2.75
.Assembly	**Assembly**		
.CycleTime	Cycle time	read only	3.2.2.76
.ExV	Volume of the Exchange Unit	read only	3.2.2.76

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	3.2.2.77
.Digital	Digital rate	0...150,max.	3.2.2.77
.Reverse	In direction "aspirate"		
.Select	Type of rate control	digital, analog	3.2.2.77
.Digital	Digital rate	0...150,max.	3.2.2.77
.Fill	Filling	$G, $H, $C	3.2.2.78
.ModeDis	Dispensing mode	$G, $S, $H, $C	3.2.2.79
.Select	Type of dispensing control	volume, time	3.2.2.79
.V	Volume to be dispensed	0.0001...9999	3.2.2.79
.Time	Time of dispensing	0.25...86400	3.2.2.79
.VStop	Limit volume	0.0001...9999,OFF	3.2.2.79
.AutoFill	Filling after every increment	ON, OFF	3.2.2.79
.Meas	**Measurement**		
.Status	On/off switching of measurement	ON, OFF	3.2.2.80
.MeasInput	Selection of the measuring input	1, 2, Diff., Ipol, Upol, Temp	3.2.2.80
.Ipol	Polarisation current	0... ± 127	3.2.2.80
.Upol	Polarisation potential	0... ± 1270	3.2.2.80
.Outputs	**I/O outputs**		
.AutoEOD	Output of pulse End Of Determination	ON, OFF	3.2.2.81
.SetLines	Set I/O lines	$G	3.2.2.81
.L1	Signal on line 1	active, inactive, pulse, OFF	3.2.2.81
.L2	Signal on line of the EOD	as L1	3.2.2.81
.ResetLines	Reset I/O outputs	$G	3.2.2.81
Setup	**Setting the operation mode**		
.Keycode	Send key code of pressed key	ON,OFF	3.2.2.82
.Tree			
.Short	Only necessary characters	ON,OFF	3.2.2.83
.ChangedOnly	Only changed values	ON,OFF	3.2.2.83
.Trace	Message when values change	ON,OFF	3.2.2.84
.Lock	**Disable key functions**		
.Keyboard	Disable all keys of 716	ON,OFF	3.2.2.85
.Config	Disable the <configuration> key	ON,OFF	3.2.2.85
.Parameter	Disable the <parameters> key	ON,OFF	3.2.2.85
.SmplData	Disable the <smpl data> key	ON,OFF	3.2.2.85
.UserMeth			
.Recall	Disable "recall" in key <user meth>	ON,OFF	3.2.2.85
.Store	Disable "store" in key <user meth>	ON,OFF	3.2.2.85
.Delete	Disable "delete" in key <user meth>	ON,OFF	3.2.2.85
.Display	Disable display service of 716	ON,OFF	3.2.2.85

Object	Function	Input range	see...
&	**Root**		
	Setting the operation mode, cont.		
.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, MPList	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
.ERC	Associated ERC in DET	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 instrument is started.	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
.M	Entry in measuring point list	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
.Graphics	Change of the curve output		
.Grid	Grid over the curve	ON,OFF	3.2.2.91
.Frame	Frame surrounding curve	ON,OFF	3.2.2.91
.Scale	Type of curve scaling of meas.value axis	Full, Auto	3.2.2.91
.Recorder			
.Right	Length of the measured value axis	0.2...1.00	3.2.2.91
.Feed	Length of the volume axis	0.01...1.00	3.2.2.91
.PowerOn	Simulation "power on"	$G	3.2.2.92
.Initialise	Set values to default settings	$G	3.2.2.93
.Select	Selection	ActMeth,Silo,Calib,Setup Config, Assembly, All	3.2.2.93
.RamInit	Initialisation, see page 110	$G	3.2.2.94

3.2.2 Description of the remote control commands

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

Start and stop ($G, $S) or hold of the current method (3.2.2.3) with $H and continue with $C.
$G also serves to continue after inquiries of identifications and sample size after the start of titration (see 3.2.2.26) as well as after inquiries of calibration temperature and pH values of buffers (see 3.2.2.37 and 3.2.2.38).

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

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

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

Name of the current method in the working memory. $Q sends 8 ASCII characters. Standard methods carry the name ********.

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

Entry of formulas. Rules for formula entry, see page 45.
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	RS1...RS9, MN1...MN9
	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 **Mode.Def.Report.Assign**

DET: full, short, ff, curve, derive, comb, mpList, calc, param,calib
MET: full, short, ff, curve, mpList, calc, param, calib
SET: full, short, ff, calc, param, calib
MEAS: full, short, ff, calc, param, calib
CAL: full, short, ff, calc, param, calib

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

3.2.2.8 **Mode.Def.Mean.1.Assign** **RS1**...RS9
Mode.Def.Mean.2.Assign
etc. up to **.9**

Assignment of the statistics calculations. Valid assignments are a requirement for statistics calculations. In addition, the statistics calculation must be switched on, see 3.2.2.24. Rules for statistics calculations see page 47.

3.2.2.9 **Mode.CFmla**
Mode.CFmla.1.Value **0**... ± 999 999
Mode.CFmla.2.Value
etc. up to **.19**

Calculation constants specific to a method. Stored in the method memory of the 716 DMS 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 **UserMeth.FreeMem** read only

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

3.2.2.11 **UserMeth.Recall** $G
UserMeth.Recall.Name up to 8 ASCII characters
UserMeth.Store $G
UserMeth.Store.Name up to 8 ASCII characters
UserMeth.Delete $G
UserMeth.Delete.Name up to 8 ASCII characters
UserMeth.DelAll $G

Management of the method memory from the 716 DMS 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.

3.2.2.12 **UserMeth.List.1.Name** read only
UserMeth.List.1.Mode read only
UserMeth.List.1.Quantity read only
UserMeth.List.1.Bytes read only
UserMeth.List.1.Checksum read only
for 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.

3.2.2.13 **M**ode.**P**arameter.**T**itrPara.**M**ptDensity 0...**4**...9
Mode.**P**arameter.**T**itrPara.**M**inIncr 0...**10.0**...999.9
Mode.**P**arameter.**T**itrPara.**V**Step 0...**0.10**...9.999

.MptDensity: Parameter for DET: Measuring point density.
.MinIncr: Parameter for DET: Minimum increment in uL. If the minimum increment is set to 0, measured values are stored vs. time.
.VStep: Parameter for MET: Volume increment in mL. With "0", there is no dispensing and measured values vs. time are entered in the measuring point list.

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

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

3.2.2.15 **M**ode.**P**arameter.**T**itrPara.**S**ignalDrift pH, U, Ipol: 0.5...**50**...999, OFF
Upol: 0.05...**50**...99.9, OFF
Mode.**P**arameter.**T**itrPara.**U**nitSigDrift read only
Mode.**P**arameter.**T**itrPara.**E**quTime 0...**26**...9999, OFF

Parameter for DET and MET: Criteria for the measured value acquisition. Measured value drift in mV/min (with pH, U, Ipol) or µA/min (with Upol), equilibration time in s. OFF means that the corresponding criterion is switched off. If both criteria are OFF, the measured values are acquired immediately after dispensing.
If the equilibration time has never been edited, it is automatically calculated by the instrument to match the drift, see page 28. After it has been edited once, it remains in force with the set value.

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

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

Start volume in mL = smpl size* factor

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

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

Parameter for DET, MET, and SET: Pause time in s. Expires after the dispensing of the start volume.

3.2.2.18 **M**ode.**P**arameter.**T**itrPara.**M**easInput **1**, 2, diff.
Mode.**P**arameter.**T**itrPara.**I**pol -127...**1**... + 127
Mode.**P**arameter.**T**itrPara.**U**pol -1270...**400**... + 1270
Mode.**P**arameter.**T**itrPara.**P**olElectrTest ON, **OFF**

Parameter for DET, MET, and SET:
Selection of the measuring input; valid with measured quantities pH and U. "diff." means differential amplifier, see page 119.
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).

3.2.2.19 **Mode.Parameter.TitrPara.Temp** –170.0...**25.0**...500.0

Parameter for DET, MET, and SET: 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.

3.2.2.20 **Mode.Parameter.StopCond.VStop.Type** **abs.**, rel., OFF
Mode.Parameter.StopCond.VStop.V 0...**99.99**...999.99
Mode.Parameter.StopCond.VStop.Factor **0**... ± 999 999

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

Stop volume in mL = smpl size* factor

The factor is valid.
OFF means that the criterion is not monitored.

3.2.2.21 **Mode.Parameter.StopCond.MeasStop** pH: 0... ± 20.00, **OFF**
U: 0... ± 2000, **OFF**
I: 0...200.0, **OFF**
Mode.Parameter.StopCond.UnitMStop read only

Parameter for DET and MET: Stop when a measured value is reached. Entry as pH value, in mV (with U and Ipol) and in µA (with Upol). The appropriate unit can be viewed with .UnitMStop.
OFF means that the criterion is not monitored.

3.2.2.22 **Mode.Parameter.StopCond.EPStop** 1...**9**, OFF

Parameter for DET and MET: Stop when a certain number of EP's has been found.
OFF means that the criterion is not monitored.

3.2.2.23 **Mode.Parameter.StopCond.FillRate** 0.01...150, **max.**

Parameter for DET, MET, and SET: Filling rate after the titration in mL/min. Max. means maximum possible filling rate with the Exchange Unit in current use.

3.2.2.24 **Mode.Parameter.Statistics.Status** ON, **OFF**
Mode.Parameter.Statistics.MeanN **2**...20
Mode.Parameter.Statistics.ResTab.Selected **original**, delete n, delete all
Mode.Parameter.Statistics.ResTab.DelN **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.

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

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

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

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

etc. up to 9 windows

Mode.Parameter.Evaluation.FixEP.1.Value pH: 0... ±20.00, **OFF**
U; Ipol: 0... ±2000, **OFF**

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

Mode.Parameter.Evaluation.pK ON, **OFF**

Parameters for DET and MET: Evaluation of the EP's, see page 28.
.EPC: EP criterion in pH, in mV (with U and Ipol) or in µA (with Upol).
.Recognition.Selected: EP recognition.
all: All end points found are recognised.
great: Only the largest EP is recognised.
last: Only the last EP is recognised.
window: Only EP's that lie within set windows are recognised.
OFF: The EP evaluation is switched off.
.Recognition.Window.1.LowLim: Lower limit for window in pH, mV (with U and Ipol) or µA (with Upol).
.Recognition.Window.1.UpLim: Upper limit for window in pH, mV (with U and Ipol) or µA (with Upol).
Windows are opened until the lower limit is set to OFF.
For every expected EP, an individual window must be set, see page 30.
.FixEP.1.Val: Fix-EP's in pH, mV (bei U, Ipol) resp. µA (bei Upol). Fix EP's are evaluated until the setting OFF is found.
.pK: pK or HNP evaluation. Possible only in pH and U titrations.

3.2.2.26 **Mode.Parameter.Presel.IReq** id1, id1&2, all, **OFF**
Mode.Parameter.Presel.SReq value, unit, all, **OFF**

Parameter for DET, MET, SET 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.

3.2.2.27 **Mode.Parameter.Presel.ActPulse** DET: ON, **OFF**
MET: ON, **OFF**
SET:first, all, cond.,**OFF**
MEAS: ON, **OFF**

Parameters for DET, MET, SET and MEAS: Output of a pulse on the I/O line "activate", see pages 135 and 136.

3.2.2.28 **Mode.Parameter.SET1.EP** pH: 0... ±20.00, **OFF**
U, Ipol: 0... ±2000, **OFF**
Upol: 0... ±200.0, **OFF**

Mode.Parameter.SET1.UnitEp read only

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.

3.2.2.29 **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.**U**nit**D**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 38.

.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.

3.2.2.30 **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.".

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

Parameter for SET: Titration direction.

"auto" means the titration direction is determined automatically by the instrument. If 2 EP's have been set, the titration direction is given by the two EP's. The entry of the titration direction is then invalid.

3.2.2.32 **M**ode.**P**arameter.**P**resel.**C**ond — ON, **OFF**

Mode.**P**arameter.**P**resel.**D**riftDisp — **ON**, OFF

Parameter für SET:

.Cond: On/off switching of conditioning.

.DriftDisp: On/off switching of drift display during conditioning.

3.2.2.33 **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. For measuring point lists with measured value vs. time, see 3.2.2.13.

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.

3.2.2.34 **Mode.Parameter.Measuring.MeasInput** **1**, 2, diff.
Mode.Parameter.Measuring.Ipol -127...**1**... + 127
Mode.Parameter.Measuring.Upol -1270...**400**... + 1270
Mode.Parameter.Measuring.PolElectrTest ON, **OFF**

Parameter for MEAS:
Selection of the measuring input; valid with measured quantities pH and U. "diff." means differential amplifier, see page 119.
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.

3.2.2.35 **Mode.Parameter.Measuring.Temp** –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.

3.2.2.36 **Mode.Parameter.Calibration.MeasInput** **1**, 2, diff.

Parameter for CAL: Selection of the measuring input. "diff." means differential amplifier, see page 119.

3.2.2.37 **Mode.Parameter.Calibration.CalTemp** –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.

3.2.2.38 **Mode.Parameter.Calibration.Buffer.1.Value** -20.00...**7.00**... + 20.00
Mode.Parameter.Calibration.Buffer.2.Value -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.

3.2.2.39 **Mode.Parameter.Calibration.SignalDrift** 0.5...**2**...999, OFF
Mode.Parameter.Calibration.EquTime 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.

3.2.2.40 **Mode.Parameter.Calibration.ElectrodeId** up to 8 ASCII characters

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

3.2.2.41 **Mode.Parameter.Calibration.SmplChanger** 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.

3.2.2.42 **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 pages 135 and 136.

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

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)

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

3.2.2.47 **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.**St**artDelay — **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.**De**vName — bis 8 ASCII-Zeichen

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 "716.0011" on requests with $Q.

3.2.2.52 **C**onfig.**RS**Set $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.**RS**Set.**B**aud	300, 600, 1200, 2400, 4800, **9600**
	Config.**RS**Set.**D**ataBit	7, **8**
	Config.**RS**Set.**S**topBit	**1**, 2
	Config.**RS**Set.**P**arity	even, odd, **none**
	Config.**RS**Set.**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 92 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.

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.

3.2.2.57	**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 SmplData.**ON**Silo.**E**ditLine.**1.M**ethod — up to 8 ASCII characters
SmplData.**ON**Silo.**E**ditLine.**1.**Id1 — 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 SmplData.**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 SmplData.**ON**Silo.**DelA**ll — $G

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

3.2.2.61 SmplData.**ON**Silo.**C**ycleLines — ON, OFF

Silo data cycling.
With "ON", executed lines are copied to the next free silo lines, see page 56. Exercise caution if you edit the silo memory during the determinations!

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

$G sends the selected report:
configuration: Configuration report. Is not accessible during a running determination.
parameters: Parameter report of the current method. During a running determination only "live"-parameters are accessible.
smpl data: Current sample data.
statistics: Statistics table with the individual results.
silo: Contents of the silo memory.
cal.data: Calibration data of the measuring input in the current method.
C-fmla: Contents of the <C-fmla> key.
def: Contents of the <def> key.
user method: Contents of the method memory.
calc: Calculation report of the current method.
full: Full result report of the last completed determination.
short: Short result report of the last completed determination.
ff: Form feed on printer.
mplist: Measuring point list of the running determination (with DET and MET).
curve: Titration curve of the last determination (with DET and MET).
derive: 1st derivative of titration curve (with DET).
comb: Combined 1st derivative and titration curves (with DET).
all: All reports.
Reports which are sent from the 716 are marked with space (ASCII32) and ' at the beginning. Then an individual identifier for each report follows. Reports which are triggered by RS232 ($G) have the same introducer but without preceeding space, i.e. they start with '.

3.2.2.63	Info.**C**alibrationData	$G
	Info.**C**alibrationData.Inp1.**p**Has	-20.00...**7.00**... + 20.00
	Info.**C**alibrationData.Inp1.**S**lope	-9.999...**1.000**... + 9.999
	Info.**C**alibrationData.Inp1.**D**ate	read only
	Info.**C**alibrationData.Inp1.**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 3.2.2.40.
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	Info.**Ch**ecksums	$G
	Info.**Ch**ecksums.**M**PList	read only
	Info.**Ch**ecksums.**A**ctualMethod	read only

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

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

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

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

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

.Write: With "ON" .MPList as well as the variables C4X , X = 0...5, in node &Info.TitrResults.Var can be entered.

.Attribute: Attribute

.MPList.X: X coordinate, volume

.MPList.Y: Y coordinate, measured value

3.2.2.66	Info.**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
	Info.**T**itrResults.**EP**.**1**.**Ma**rk	read only
	etc. up to **.9**	
	Info.**T**itrResults.**V**ar.**C**40	read only/read + write
	etc. up to **.C47**	

.RS: Values of the calculated results.

.EP: Endpoints with DET, MET, and SET:

- 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".
- Marking in the case of DET and MET with EP windows when more than 1 EP has been found per window: " + ". In regular operation or when no window has been set, a blank string "" is sent.

.Var: Various variables.
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 DET, MET, and SET in mL, "12.536".
C42: Titration time from start to end in s, "62".
C43: Volume drift on start of a SET 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 DET, MET, and SET in mL, "2.800".
C46: Asymmetry pH of CAL, "6.89".
C47: Relative electrode slope of CAL, "0.995".

3.2.2.67 Info.**T**itrResults.**F**ixEP.**51**.**V**alue — read only
etc. up to **.59**
Info.**T**itrResults.**p**K.**61**.**V**alue — read only
etc. up to **.69**

Volume coordinate of the fix end points with DET and MET in mL. C5X corresponds to the fix end point X, X = 1...9.
pK or HNP in mV with DET and MET. C6X corresponds to the pKX or HNPX, X = 1...9.

3.2.2.68 Info.**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"

3.2.2.69 Info.**A**ctualInfo.Inputs.**S**tatus — read only
Info.**A**ctualInfo.Inputs.**C**hange — read only
Info.**A**ctualInfo.Inputs.**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.

Line No.	0 7	0 6	0 5	0 4	1 3	0 2	1 1	0 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 133ff):

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)

3.2.2.70 **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 3.2.2.76), 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.

3.2.2.71 **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.

3.2.2.72 **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)

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

$Q sends the current values in the following formats:

		DET	MET	SET	MEAS	CAL
Cycle number		127	127	127	127	127
Volume (ml)		1.2345	1.2345	1.2345	NV	NV
Meas.value:	pH	3.456	3.456	-345.6 (mV)	3.456	3.456
	U, Ipol (mV)	-345.6	-345.6	-345.6	-345.6	–
	Upol (uA)	-12.5	-12.5	-12.5	-12.5	–
	T (°C)	–	–	–	25.0	–
Volume drift (ul/s)		NV	NV	2.5	NV	NV
Meas.value-drift:	pH, U, Ipol (mV/s)	0.7	0.7	0.7	0.7	0.7
	Upol (uA/s)	0.7	0.7	0.7	0.7	–
	T (°C/s)	–	–	–	0.7	–
1st derivative (mV/ul)		NV	NV	10.6326	NV	NV
ERC		34	NV	NV	NV	NV

NV: Not valid. If the signal drift is OFF in modes DET, MET, 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 3.2.2.76). The cycle number is set to 0 at the start of a method and it is incremented until the end of the method.

3.2.2.74 Info.ActualInfo.MeasPt.Index — read only
Info.ActualInfo.MeasPt.X — read only
Info.ActualInfo.MeasPt.Y — read only
Info.ActualInfo.EP.Index — read only
Info.ActualInfo.EP.X — read only
Info.ActualInfo.EP.Y — read only

$Q sends the last entry into the measuring point list (.MeasPt) with DET and MET or the last entry into the list of EP's with DET, MET, and 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

3.2.2.75 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 716 if 'Setup.Lock.Display' is set to ON, see 3.2.2.84.
$Q sends the contents of the corresponding display line.

3.2.2.76 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.

3.2.2.77 Assembly.Bur.Rates.Forward.Selected — digital, **analog**
Assembly.Bur.Rates.Forward.Digital — 0...150, **max.**
Assembly.Bur.Rates.Reverse.Selected — digital, **analog**
Assembly.Bur.Rates.Reverse.Digital — 0...150, **max.**

Expel and aspirating rate.
Digital or analog control. With digital control, the inputted value applies (in mL/min). "max." means maximum possible rate with the Exchange Unit in current use.
Analog means rate control with the analog potentiometer on 716 DMS Titrino.

3.2.2.78 Assembly.Bur.Fill — $G, $H, $C

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

3.2.2.79 Assembly.Bur.Rates.ModeDis — $G, $S, $H, $C
Assembly.Bur.Rates.ModeDis.Selected — **volume**, time
Assembly.Bur.Rates.ModeDis.V — 0.0001...**0.1**...9999
Assembly.Bur.Rates.ModeDis.Time — 0.25...**1**...86400
Assembly.Bur.Rates.ModeDis.VStop — 0.0001...9999, **OFF**
Assembly.Bur.Rates.ModeDis.AutoFill — ON, **OFF**

Dispensing mode with parameters. The dispensing mode can only be started and stopped via the RS Control. During a running dosification, no method can be started at the 716.

.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.

3.2.2.80 **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 716.
.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.

3.2.2.81 **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.**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 134.
.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".
.ResetLines: Lines 1 and 2 are set to the inactive status (= high).

3.2.2.82 **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 103. A keystroke of key 11 is sent as follows:
#11
The beginning of the message is marked by a space (ASCII 32).

3.2.2.83 **S**etup.**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 branches of the tree:
&Mode
&User
&Config
&SmplData
A combination of .Short and .ChangedOnly is not possible.

3.2.2.84 **Se**tup.**Tra**ce — ON, **OFF**

The Titrino automatically reports when a value has been confirmed with <enter> at the 716 DMS Titrino. Message, e.g.:
&SmplData.OFFSilo.Id1"Trace"
The beginning of the message is marked by a space (ASCII 32).

3.2.2.85 **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 716 DMS 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.

3.2.2.86 **S**etup.**S**endMeas.**S**endStatus ON, **OFF**
Setup.**S**endMeas.**I**nterval 0.08...**4**...16200, MPList

.SendStatus: ON means the automatic transmission of measured values (see 3.2.2.88 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.
With "MPList" the measured values are sent at the time of their entry into the measured point list (in modes DET and MET; in the modes SET, MEAS, CAL nothing is being sent).
The automatic transmission is switched on/off with 'SendStatus'.

3.2.2.87 **S**etup.**S**endMeas.**S**elect 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 **S**etup.**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).

3.2.2.89

Setup.SendMeas.Titrator.CyclNo	ON, **OFF**
Setup.SendMeas.Titrator.V	ON, **OFF**
Setup.SendMeas.Titrator.Meas	ON, **OFF**
Setup.SendMeas.Titrator.dVdt	ON, **OFF**
Setup.SendMeas.Titrator.dMeasdt	ON, **OFF**
Setup.SendMeas.Titrator.dMeasdV	ON, **OFF**
Setup.SendMeas.Titrator.ERC	ON, **OFF**

Selection of the values from the titrator which are sent in the set time interval (see 3.2.2.86, formats see 3.2.2.73):

.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.
.ERC: associated ERC in DET.
The unit "titrator" must be preset (see 3.2.2.87).

3.2.2.90

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

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

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

Messages from node .T, Titrator:

.T.R Ready: Status 'Ready' has been reached.
.T.G Go: Instrument has been started.
.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 62.
.T.H Hold: Status 'Hold' has been reached.
.T.C Continue: Continue after hold.
.T.O Conditioning OK in SET with conditioning.
.T.N Conditioning Not OK in SET with conditioning.
.T.Re Request: In the inquiry of an identification or the sample size after start of titration.
.T.Si SiloEmpty: Silo empty, i.e. the last line has been removed from the silo memory.
.T.M MeasList: Entry in the measuring point list (with DET and MET).
.T.EP EPList: Entry into EP list (with DET, MET, and SET)
.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 716 DMS 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.**G**raphics.**G**rid **ON**, OFF
Setup.**G**raphics.**F**rame **ON**, OFF
Setup.**G**raphics.**S**cale **Full**, Auto
Setup.**G**raphics.**R**ecorder.**R**ight 0.2...**0.5**...1.00
Setup.**G**raphics.**R**ecorder.**F**eed 0.01...**0.05**...1.00

Change in the appearance and the format of the curve for the output:

.Grid: On/off switching of grid over curve.
.Frame: On/off switching of frame surrounding the curve. If grid and frame are switched off, the curve is printed faster as the print head does not have to move to the end of the paper.
.Scale: Type of scaling of the measured value axis:
Full means that the scale runs from the smallest up to the greatest measured point.
With auto, the smallest measured value is taken and the next smaller tick defines the beginning of the scale; the next greater tick to the greatest measured value is the end of the scale.
.Right: Relative specification of the width of the output medium (e.g. paper width) for the length of the measured value axis. 1 means the measured value axis is plotted over the entire width of the paper (largest possible width). In extrme cases, the writing of the right tick may lie outside.
.Feed: Length of the volume axis referred to the burette cylinder volume, V(B) per cm (0.1 means, e.g. 1 mL/cm with a 10 mL Exchange Unit). Depending on the printer, the measure in cm may not always be correct.

The settings can be made without a PC:
Press <configuration> key on switching on the instrument.

3.2.2.92 **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.

3.2.2.93 **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.

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

Initialises instrument as in the diagnosis, see page 110. All parameters are set to their default value and error messages are cleared.

3.3. Characteristics of the RS232 interface

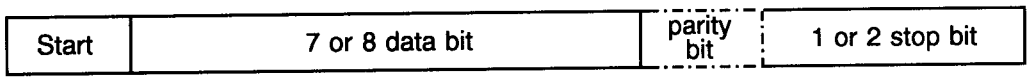
3.3.1 Data transfer protocol

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 19.

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 716 DMS 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).

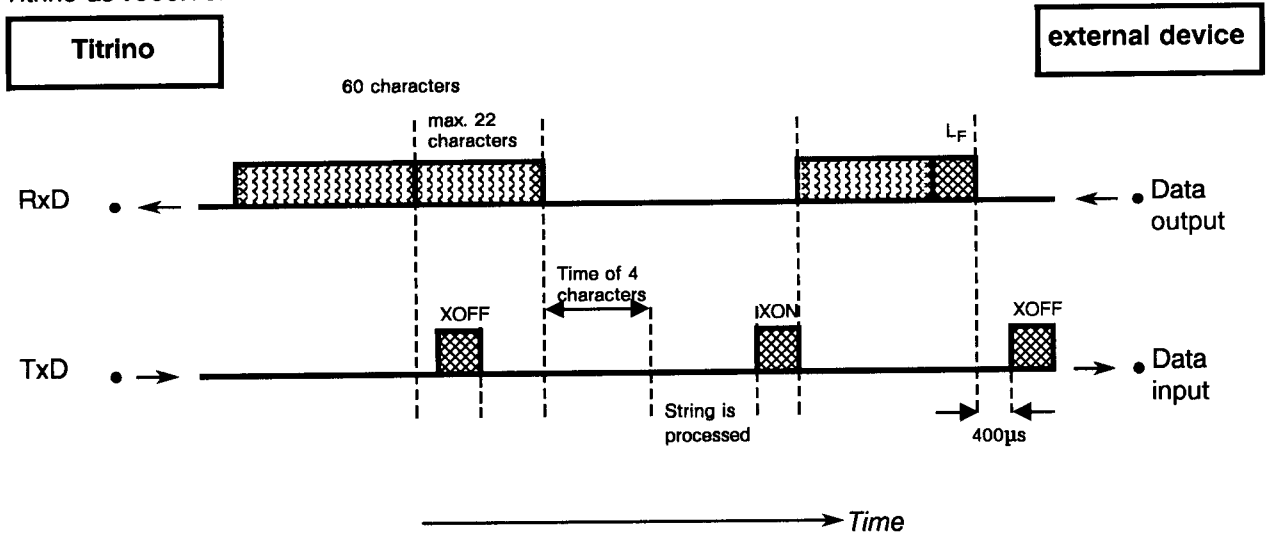
3.3.2 Handshake

3.3.2.1 Software handshake , SWChar

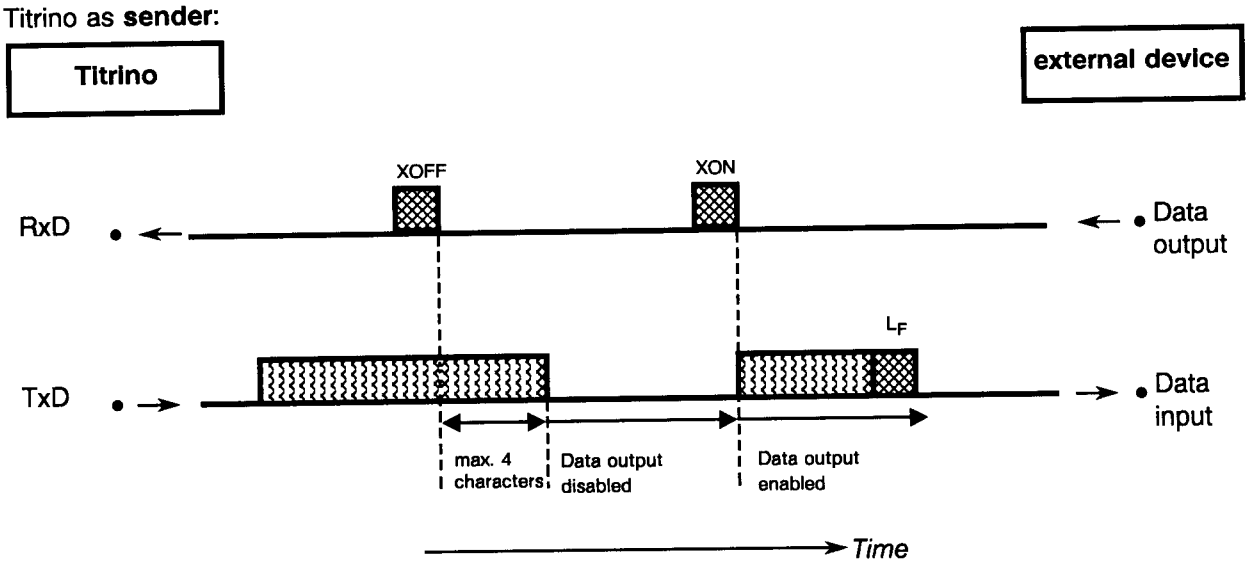
Handshake inputs at the Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the Titrino.

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:**

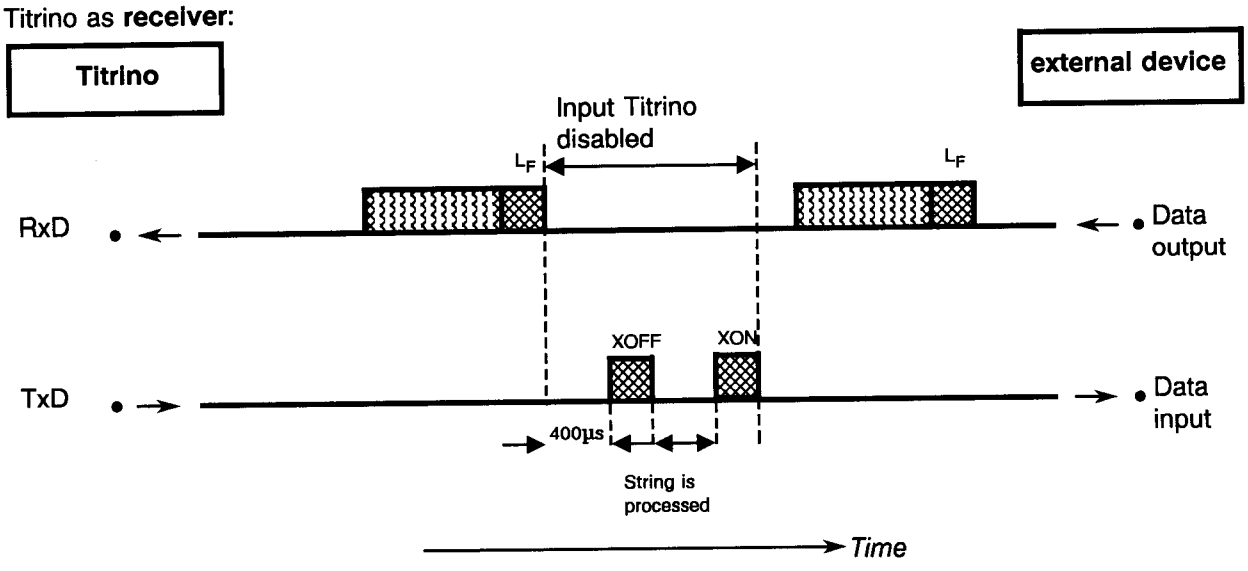


3.3.2.2 Software-Handshake , SWIine

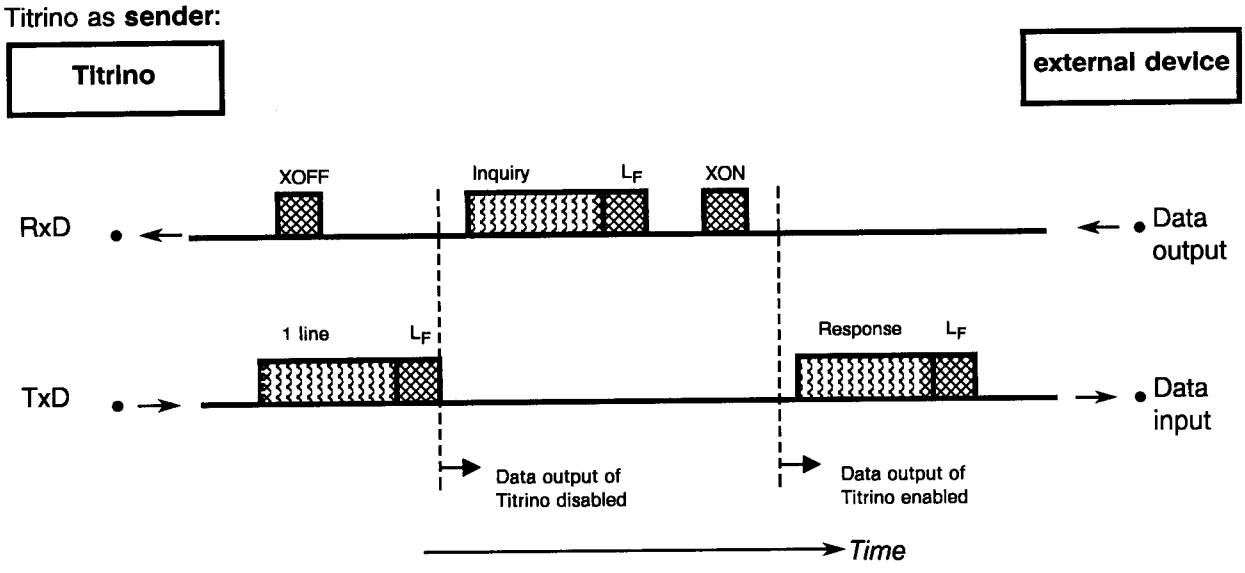
Handshake inputs at the Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the Titrino.

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:**



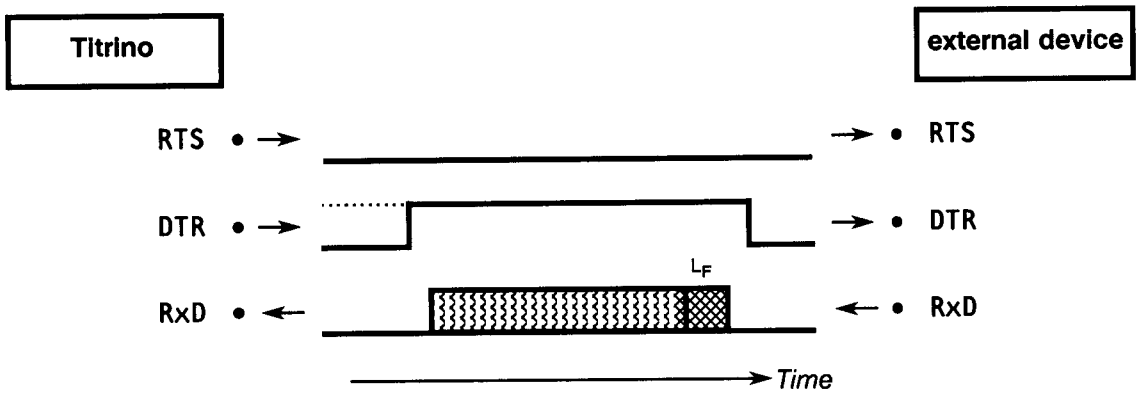
Titrino as **sender:**



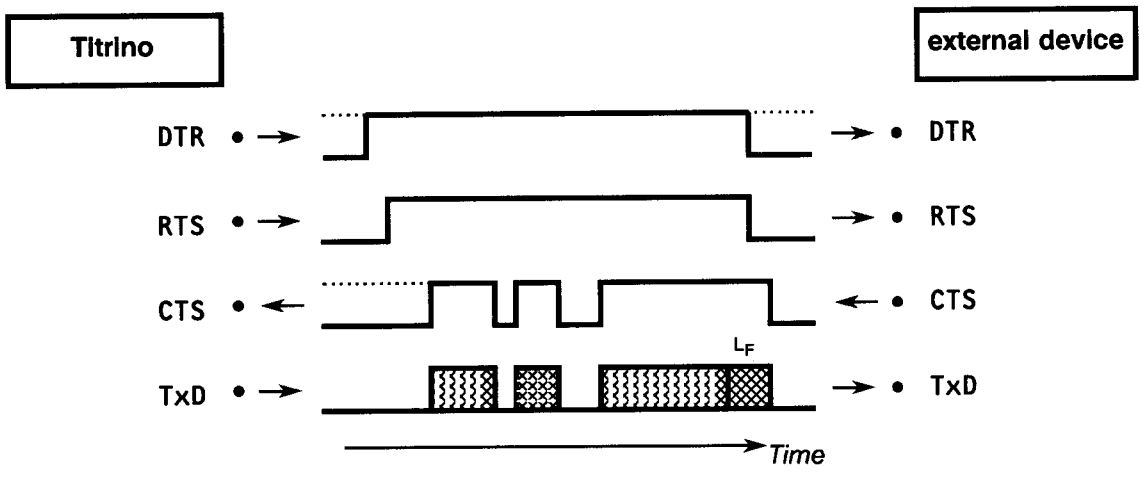
The transmission of the Titrino can be stopped by the external device with XOFF. After receipt of XOFF, the Titrino completes transmission of the line already started. If the data output is disabled for more than 3 s by XOFF, E43 appears in the display.

3.3.2.3 Hardware handshake, HWs

Titrino as **receiver:**



Titrino as **sender:**

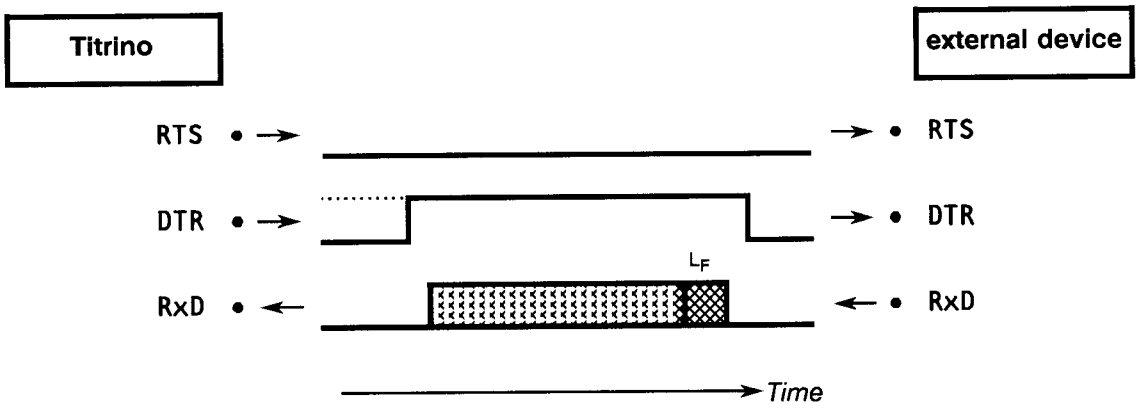


The data flow can be interrupted by deactivation of the CTS line.

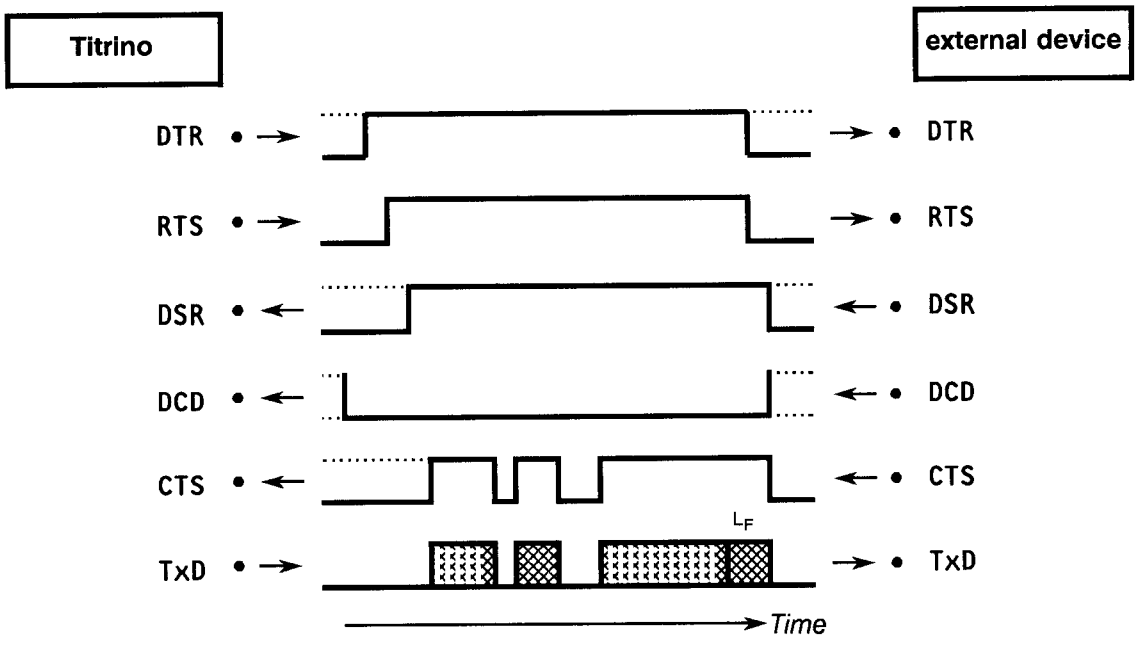
Hardware handshake, HWf

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 Interface

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

E 2
Transmitted Data

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

E 3
Received Data

Request to Send (RTS)
ON condition: 716 DMS Titrino is ready to send data.

E 4
Request to Send

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

E 5
Clear to Send

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

E 6
Data Set Ready

Signal Ground (GND)

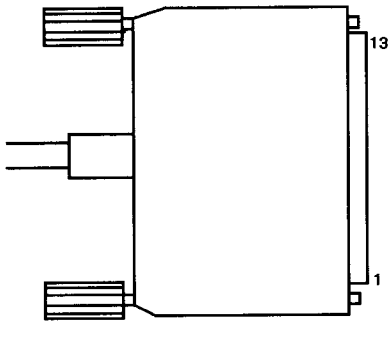
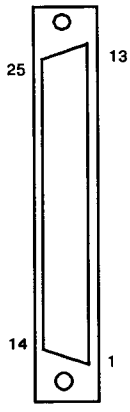
E 7
Signal Ground

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

E 8
Data Carrier Detect

Data Terminal Ready (DTR)
ON condition: 716 DMS Titrino is ready to receive data.

E 20
Data Terminal Ready

		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 can you do if the data transfer does not work?

Problem	Questions for remedial action
No characters can be received on a connected printer	– Are the instruments 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.
Wrong line spacing	The printout of a curve has been interrupted with <QUIT>. After the next completely finished curve printout, the line spacing will be okay again or switch printer off/on.
Printout of titration curve is not ok. Other reports are printed ok	Handshake is necessary for the printout of a titration curve. – Is your cable correctly wired? (The DTR of the printer has to be connected to the CTS of the 716 DMS Titrino.) – Set "HWs" for the handshake at the 716 DMS Titrino. Configure the printer such that its DTR is set (normally with DIP switches).

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 98.

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 24, 34 and 42. 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>.
data set reevaluation	Message if Titrino is reevaluating downloaded measuring point lists.
division by zero	The result could not be calculated as a divisor in the formula was equal to zero. Exit: Enter appropriate value.
EP overflow	In DET or MET titrations, more than 9 EP's have been found. The first 9 EP's are listed. Corrective measure: Recalculate data with higher EP crit.
manual stop	The determination has been terminated manually.
meas.pt list overflow	In DET or MET titrations, maximum 200 measured points can be stored. Corrective measure: Use start V or add larger volume increments.
missing EP	An EP needed in a formula for calculation purposes is missing.
missing fix EP	In a formula, a fix EP is required which has not been defined.
No.EP not corresponding	In DET or MET titrations, the number of EP's actually found does not match the set windows: Exactly 1 EP per window has not been found.
no EP set	In 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.
no titration data	In DET or MET titrations, no curve can be printed out as no titration data are available.
not valid	Value not existing.
outside	In DET or MET titrations, the set fix EP is outside the measurement range.
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 72 ... 78 bytes.
Exit: <clear>.

stop EP reached A DET or MET titration has been terminated as the stop criterion "stop EP" has been reached.

stop meas.val.reached A DET or MET titration has been terminated as the stop measured value pH, U or I has been reached.

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 5.716.001X Program)

The DMS 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 19) and specify possible error displays.

Procedure

- The diagnostic steps must be performed in sequence and compared with the reactions of the 716 DMS 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.

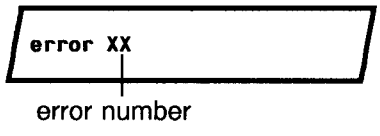
- The diagnostic steps marked with a triangle (≫) allow re-entry into the test routine for repetition if the following display appears:

  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 jumps back into 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 111.

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
- 6.2132.020 Keypad
- Digital or analog voltmeter (if need be, connect a calibrated recorder)

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' and 'silo' 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!)

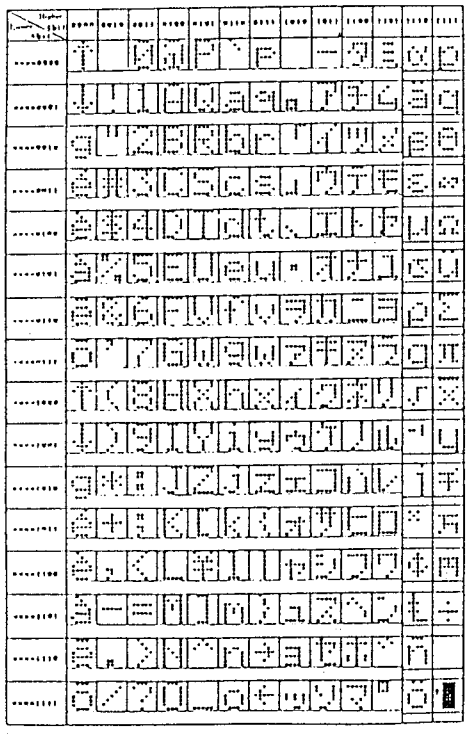


Fig. 4-1:
Character set

⩾ 3. Keypad test

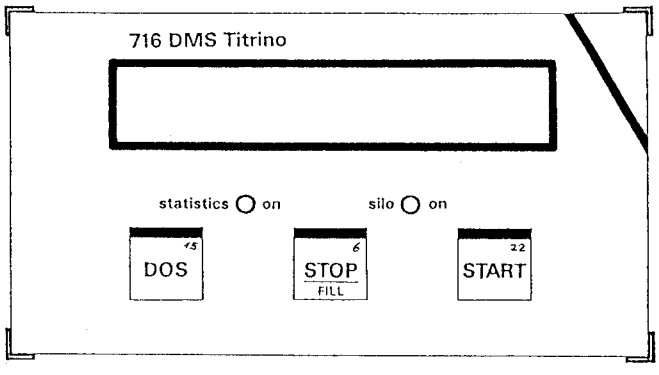
Press <1>

```
keys test
```

Press <enter>

```
keys test
matrix code
```

If any key is now pressed (on the 6.2132.020 Keypad or on the front panel of the 716), the appropriate matrix code appears in the display (0...31).



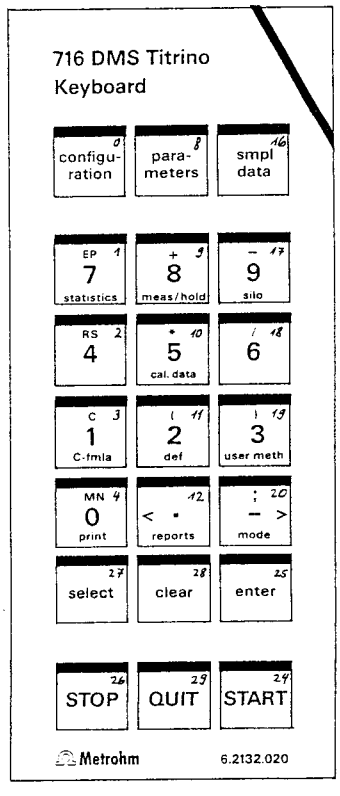


Fig. 4-2 Matrix code table

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 18 and 19.

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)

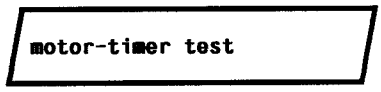
Exit: <QUIT>

Disconnect voltmeter.

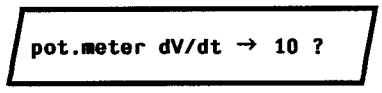
1 acurrent date
2 current time
3 Check that mL code of Exchange unit used is displayed
4 This value is incidental, but can be accepted with <enter>.

⩾ 6. Motortimertest

<6>



<enter>



Turn knob 'dV/dt' to the right stop

<enter>

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>

⩾ 7. Analog input test

Press <7>

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>

Tolerance: ±0.5 mV

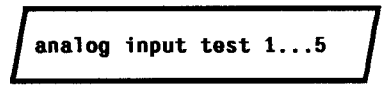
Set the calibrator voltage to different values (e.g. +1500 mV) and compare with the displayed value.

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>



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

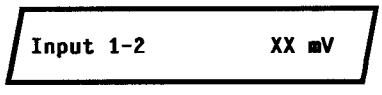
<2>

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.

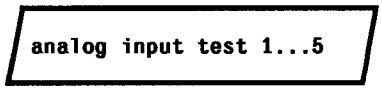
<4>

(* 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 716 DMS 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 102.

<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 DMS Titrino 716 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.)

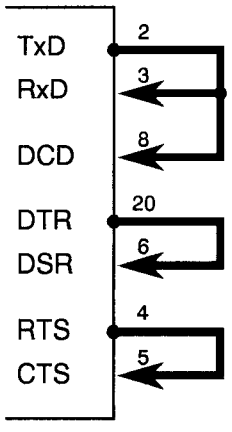


Fig. 4-4 Connections in the 3.496.8480 Plug

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

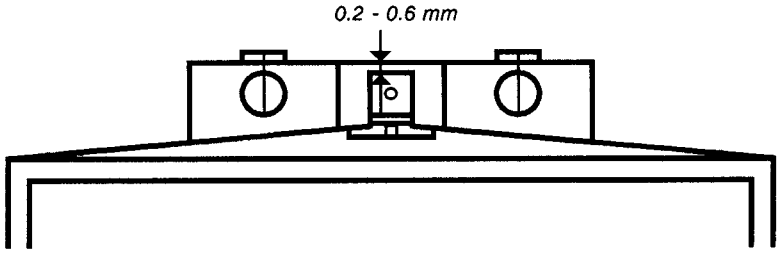


Fig. 4-5

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.

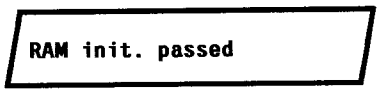
≫ 12. Initialise and test RAM

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:

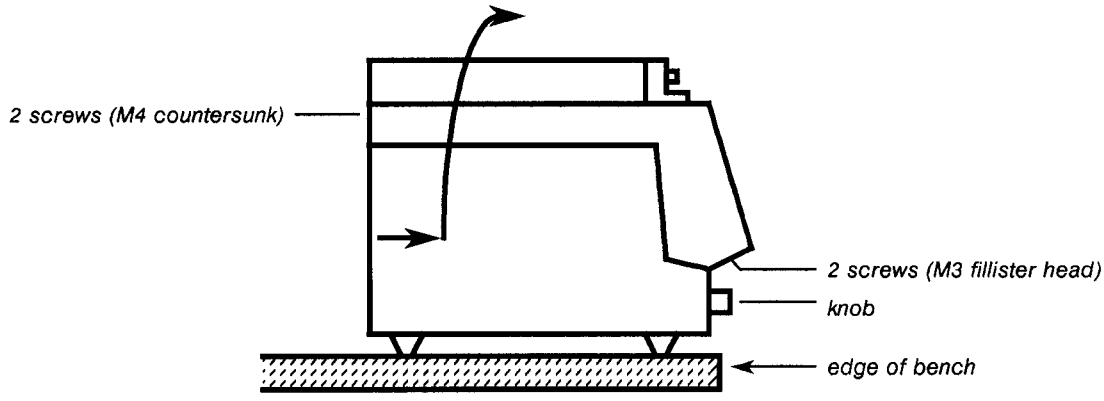


Fig. 4-6

- 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	104	4
Key	1	Keypad test	103	3
Key	2	Display test	102	2
Key	3	Analog output test	104	5
Key	4	External input/output test	107	8
Key	5	RS232 interface test	108	9
Key	6	Motor timer test	105	6
Key	7	Polarizer test	105	7
Key	8	Test and initialise RAM	110	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 649 Magnetic Swing-out Stirrer

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

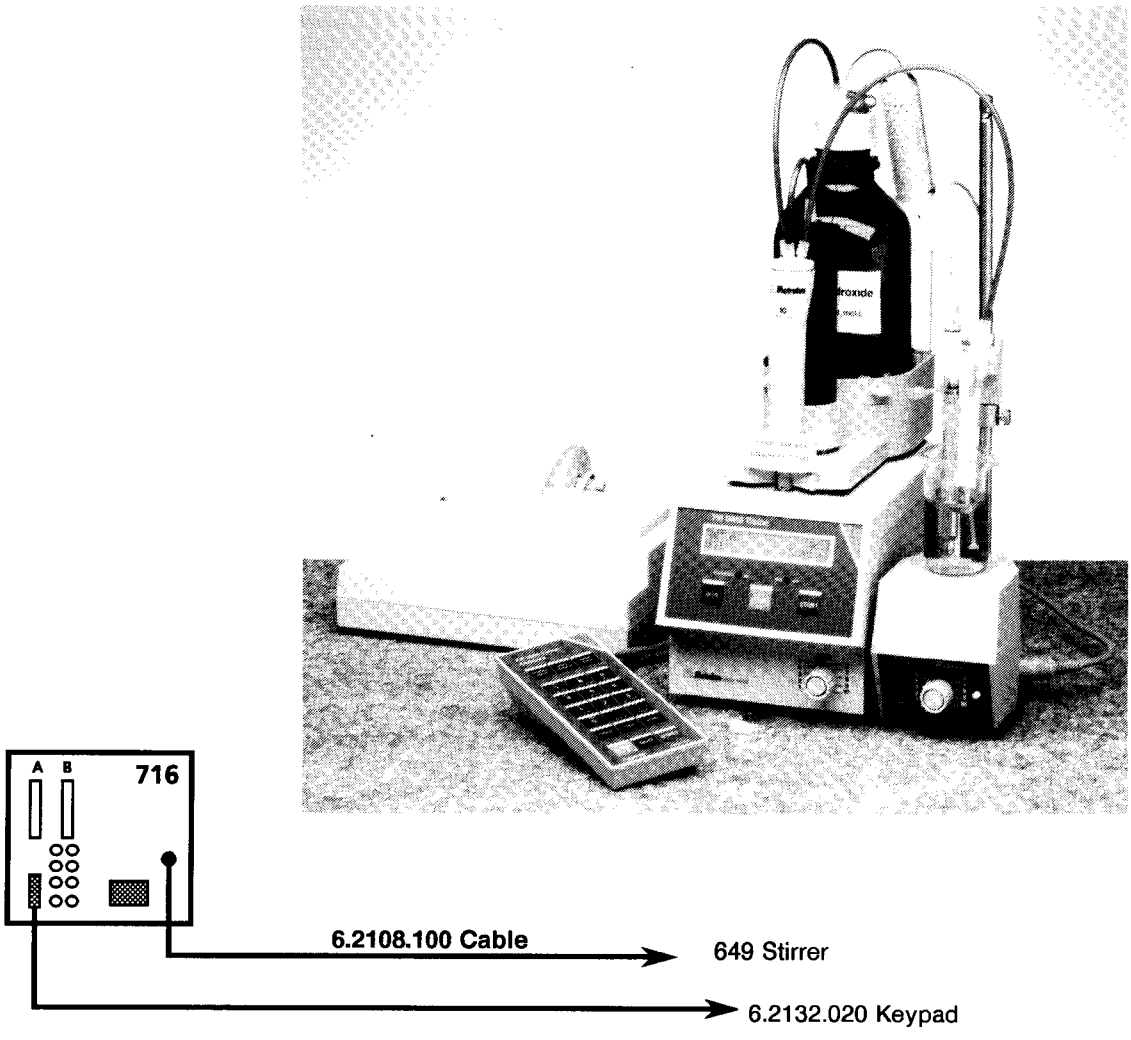


Fig. 5-1: Setting up the Titrino and connection of the stirrer

The 722 Rod Stirrer, the 727, or the 703 Ti Stand can also be connected instead of the 649 Magnetic Stirrer.

5.1.2 Connection of a printer

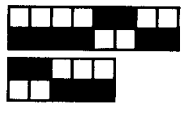
A variety of printers can be connected to the RS232 interface of the 716 DMS Titrino. If you connect a printer other than one of those mentioned below, ensure that the Epson mode is emulated or that it uses the international character set following the IBM Standard Table 437 and IBM-compatible graphics 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:

<table>
<tr><th>Printer type</th><th>Cable</th><th>Settings at Titrino</th><th>Settings at printer</th></tr>
<tr><td>Citizen
iDP560 RS</td><td>6.2125.050</td><td>baud rate: 9600
data bit: 7
stop bit: 1
parity: even
handshake: HWs
send to: Citizen</td><td>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</td></tr>
<tr><td>Seiko
DPU-411</td><td>6.2125.020</td><td>baud rate: 9600
data bit: 7
stop bit: 1
parity: even
handshake: HWs
send to: Seiko</td><td>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 } USA
7 on -character set
8 on
Set printer to on-line
DIP02
1 off 7 bit
2 off } even
3 off parity
4 off } 9600 baud
5 off
6 off</td></tr>
</table>

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: 

Printer	Cabel	Settings at Titrino	Dip switches at printer
HP: Quiet Jet [1]	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.

5.1.3 Connection of 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 Connection of a sample changer

The sample changer is connected as follows:

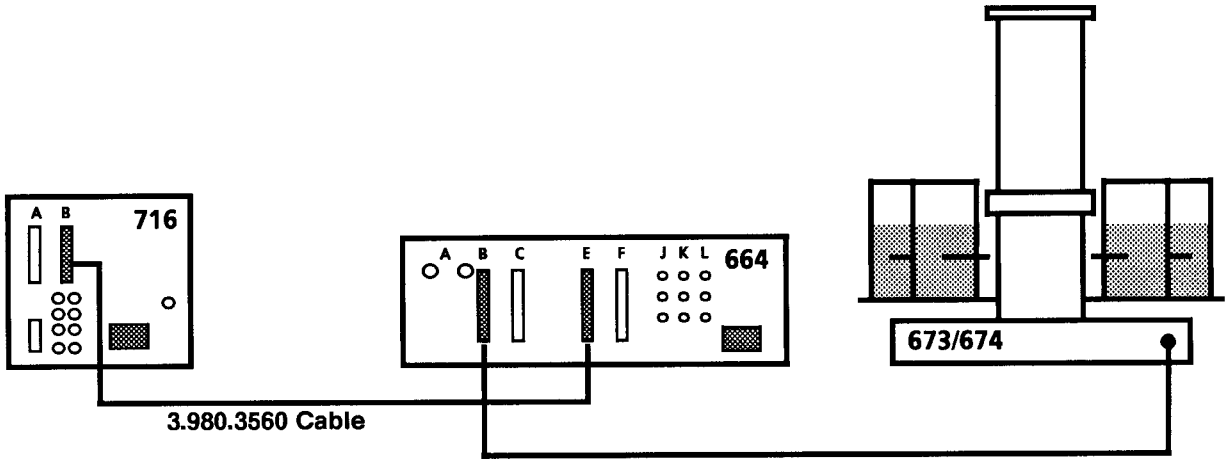


Fig. 5-2: Connection of a sample changer

- 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 133.
- 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 Connection of a recorder

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

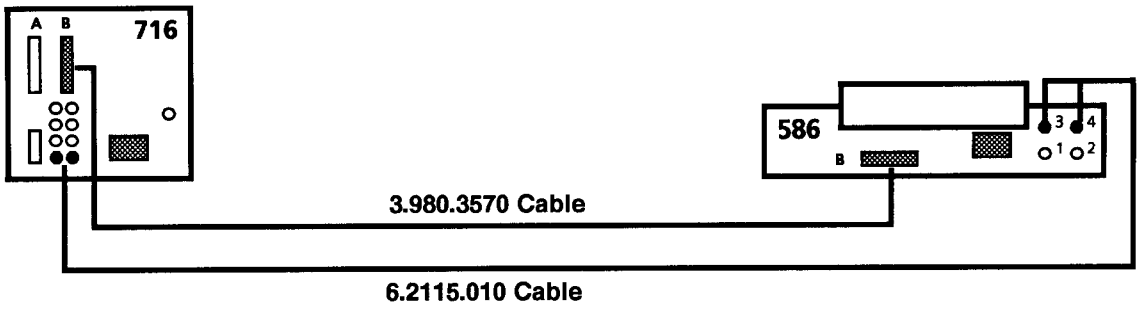


Fig. 5-3: Connection of a recorder

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 uA:	+10 mV
		I = −1 uA:	−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 uA/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 uA:	10 mV

5.1.6 Connection of a computer

The computer is connected as follows:

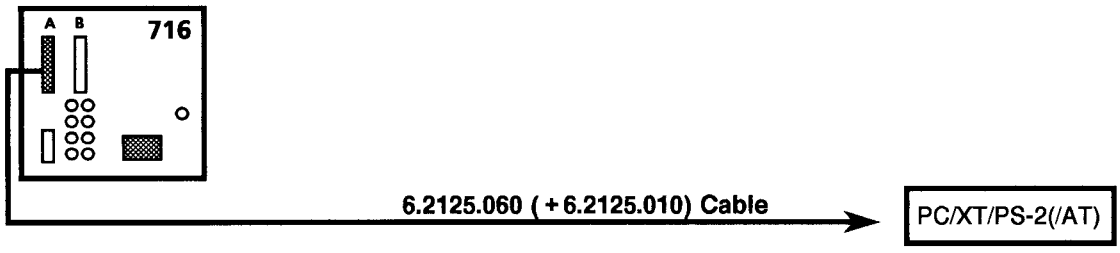
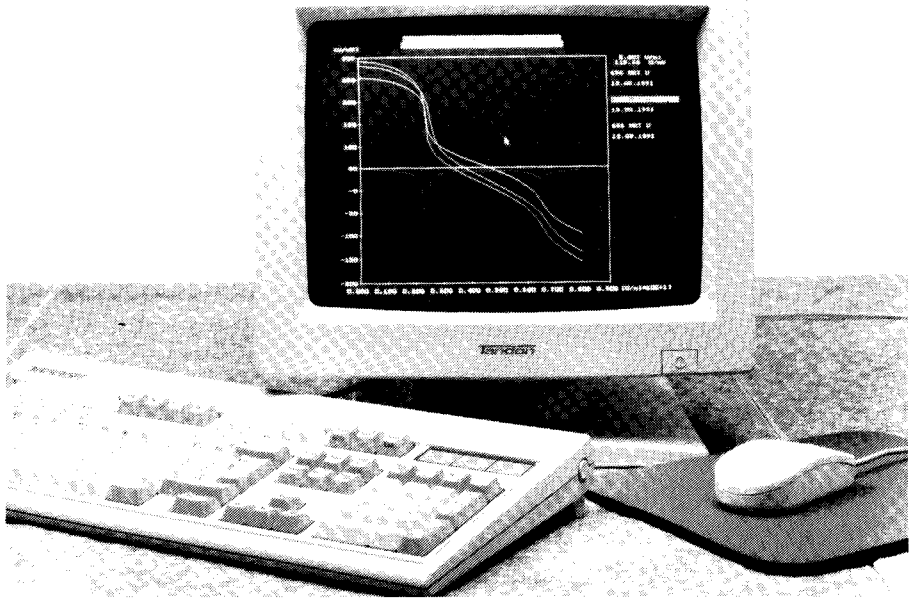


Fig. 5-4: Connection of a computer

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 ↔ computer,
$5\frac{1}{4}$" and $3\frac{1}{2}$" diskettes, in PASCAL and BASIC 6.6013.000



5.2 Installation of the titration vessel, connection of electrodes

5.2.1 Setting up the titration vessel

The titration vessel is set up as shown in Fig. 5-5. 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.

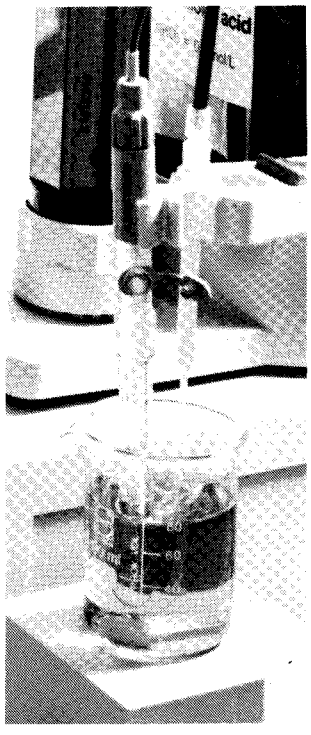
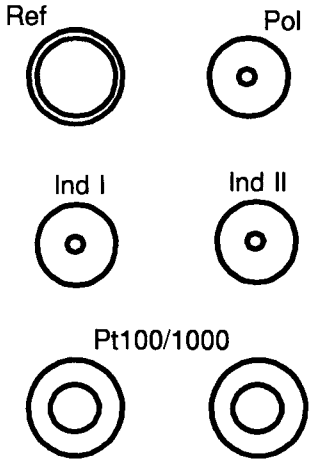


Fig. 5-5: Setting up the titration vessel

5.2.2 Connection of the sensors



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.

Fig. 5-6: Connection of electrodes

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 and when titration curves are recorded can lead to "ghost end points", which make an automatic evaluation virtually impossible.
Problems of this type can be solved by measurement using a differential amplifier. Here, the indicator and reference electrode are each connected to a high-impedance measuring input. It is important to ensure that both electrodes have identical shielding and are thus symmetrical with regard to the recording of noise signals. An auxiliary electrode provides the electrical connection between the reference point of the amplifier circuit and the measurement solution.

Recommended electrodes:

Measuring input	Manual determinations	Determinations at sample changer
Ind I	6.0102.102 pH glass electrode	6.0104.100 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.

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

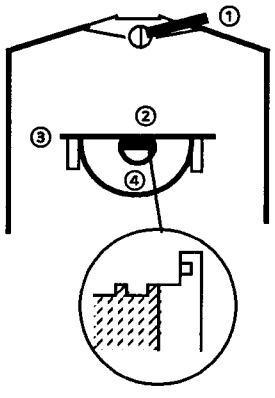


Fig. 5-7: Bottom of Exchange Unit

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 151.

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.

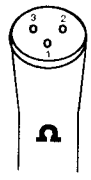
The holder on the right serves to hold the burette tip; in the holder on the left you can store, for instance the electrode associated with the reagent.

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

See also Fig. 6-2, page 152.

- 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:

Flat stopcock



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

Fig. 5-8: 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.

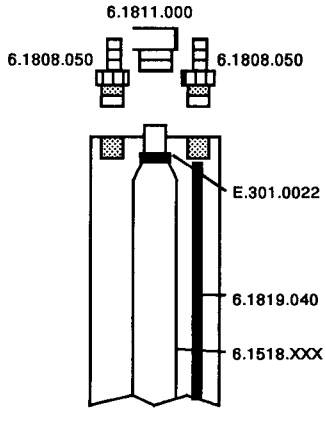
Stopcock

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



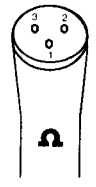
1. Undo tubing connection of 6.1518.XXX glass cylinder.
2. Remove light protection.
3. Unscrew 6.1811.000 screw fitting at glass fitting.
4. Roll O-ring upwards out of groove on glass fitting. Do not use any hard objects to remove the O-ring, otherwise the edge of the glass fitting can splinter! If all 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.

Fig 5-9: Thermostat jacket

5.3.7 6.3006.113 Micromodel - 1 mL

Assembly:
See also Fig. 6-3, page 153.
- 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:

Flat stopcock



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

Fig. 5-10: 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	DET: **D**ynamic **E**quivalence point **T**itration MET: **M**onotonic **E**quivalence point **T**itration SET: **S**et **E**nd point **T**itration MEAS: **MEAS**urement CAL: pH **CAL**ibration
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 116
Ambient temperature	
Nominal operational range	5 ... 40 °C
Storage, transport	– 20 ... 70 °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	>aparatos periféricos	>Peripheriegeräte	>Appareils périphériques
send to:	transmisión a:	Senden an:	transm.à:
balance:	balanza:	Waagentyp:	balance:
record:	curva:	Kurve:	courbe:
>auxiliaries	>ajustes varios	>Verschiedenes	>Réglages divers
dialog:	diálogo:	Dialog:	dialogue:
date	fecha	Datum	date
time	hora	Zeit	heure
run number	n.de muestra	Probenummer	numéro d'échant.
auto start	comienzo auto	Autostart	démarrage auto
start delay	t(espera)	Startverzögerung	délai de démarrage
device label	dirección	Gerätebez.	adresse
program	programa	Programm	programme
>RS232 settings	>ajustes para RS232	>RS232-Einstellungen	>Réglages RS232
baud rate:	baud rate:	Baud Rate:	baud rate:
data bit:	data bit:	Data Bit:	data bit:
stop bit:	stop bit:	Stop Bit:	stop bit:
parity:	paridad:	Parität:	parité:
handshake:	handshake:	Handshake:	handshake:
RS control:	control RS:	Kontrolle via RS:	contrôle RS:
>common variables	>variables comunes	>Common Variable	>Variables communes
C30	C30	C30	C30
:	:	:	:
C39	C39	C39	C39

Key <parameters>, DET and MET

English	Spanish	German	French
>titration parameters meas.pt.density min.incr. V step titr.rate signal drift equilibr.time start V: start V factor dos.rate pause meas.input: I(pol) U(pol) electrode test: temperature	>parámetros de titración densidad pts.med. incremento min. V incremento veloc.titr. deriva v.med. tiempo espera V inicial: V inicial factor veloc.dos. pausa entrada de med: I(pol) U(pol) prueba electrodo: temperatura	>Titrationsparameter Messpkt.dichte Min.Inkrement V Inkrement Titr.Geschw. Messw.Drift Wartezeit Start V: Start V Faktor Dos.Geschw. Pause Messeingang: I(pol) U(pol) Elektrodentest: Temperatur	>Paramètres de titrage densité pt.mes. incrément mini. V incrément débit titr. dérive du sig. temps d'attente V de départ: V de départ facteur débit dos. pause entrée de mes: I(pol) U(pol) test électrode: température
>stop conditions stop V: stop V factor stop pH stop EP filling rate	>condiciones de parada V parada: V parada factor parada pH EP parada veloc.rell.	>Abbruchbedingungen Stopp V: Stopp V Faktor Stopp pH Stopp EP Füllgeschw.	>Conditions d'arrêt V d'arrêt: V d'arrêt facteur arrêt pH EP# arrêt débit rempl.
>statistics status: mean n res.tab: delete n	>estadistica status: media n tab.res: borrar n	>Statistik Status: Mittelwert n Res.Tab: löschen n	>Statistique état: moyenne n tab.res: éliminer n
>evaluation EPC EP recognition: low lim.1 pH up lim.1 U fix EP1 at pH	>evaluación criterio de EP reconoc.EP: límite inf.1 U límite sup.1 pH EP fijado 1 pH	>Auswertung EP-Kriterium EP-Anerk: u.Grenze 1 pH o.Grenze 1 U Fix-EP1 bei pH	>Evaluation critère d'EP reconn.EP: limite inf.1 U limite sup.1 pH EP fixé 1 au pH
>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>, 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: start V: start V factor dos.rate pause meas.input: I(pol) U(pol) electrode test: temperature	>parámetros de titración sentido de titr.: V inicial: V inicial factor veloc.dos. pausa entrada de med: I(pol) U(pol) prueba electrodo: temperatura	>Titrationsparameter Titr.Richtung: Start V: Start V Faktor Dos.Geschw. Pause Messeingang: I(pol) U(pol) Elektrodentest: Temperatur	>Paramètres de titrage sens de titrage: V de départ: V de départ facteur débit dos. pause 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: req.ident: req.smpl size: activate pulse:	>preselecciones acondicion: indicar deriva: llamada ident: llamada peso: puls.activación:	>Vorwahl Konditionieren: Driftanzeige: Ident.abfragen: Einmass abfr.: Aktivierpuls:	>Présélections conditionner: indic.dérive: 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, curve, deriv, comb, mplist, calc, param, calib	Report sequence: compl, breve, curva, deriv, comb, p.med, calc, param, calib	Report sequence: voll, kurz, Kurve, 1.Abl, komb, MpListe, Rechn, Param, Kalib	Report sequence: compl, court, courbe, dériv, comb, p.mes, 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
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 fix EP's	>indic.EP's fijados	>Fix EP's anzeigen	>Indic.des EP's fixés
overwrite	sobreescribir	überschreiben	recouvrir
remaining bytes	bytes libres	Freie bytes	bytes libres

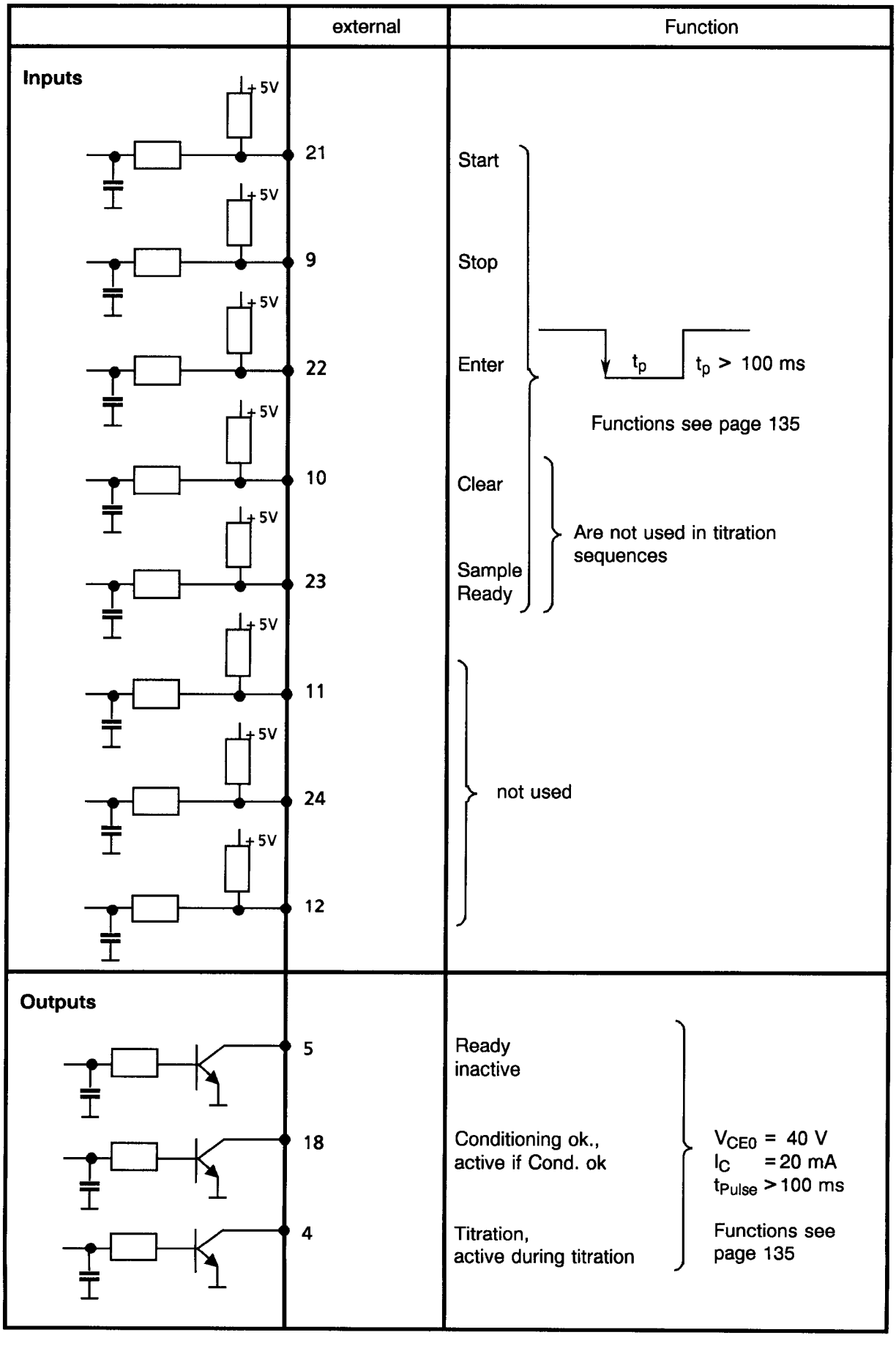
Error messages

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.
data set reevaluation	reeval.juego de datos	Datensatz Nachauswertung	reéval.jeu de données
division by zero	división por cero	Division durch Null	division par zéro
EP overflow	más de 9 EP's	Mehr als 9 EP's	plus de 9 EP's
error	error	error	error
manual stop	parada manual	Manueller Abbruch	arrêt manuel
meas.pt list overflow	más de 200 puntos med.	Überlauf Messpunktliste	plus de 200 points mes.
missing EP	falta EP	EP fehlt	manque d'EP
missing fix EP	falta EP fijado	Fix EP fehlt	manque d'EP fix
No.EP not corresponding	No.EP no hallado	No.EP stimmt nicht	No.EP ne correspond pas
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
no titration data	no datos de titración	Keine Titrationsdaten	pas de données de titr.
not valid	no válido	ungültig	non valable
outside	fuera	Ausserhalb	extérieur
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 EP reached	EP parada alcanzado	Stopp EP erreicht	EP d'arrêt atteint
stop meas.val.reached	val.med.parada alcanzado	Stopp Messw.erreicht	val.mes.d'arrêt atteint
stop time reached	tiempo parada alcanzado	Stoppzeit 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

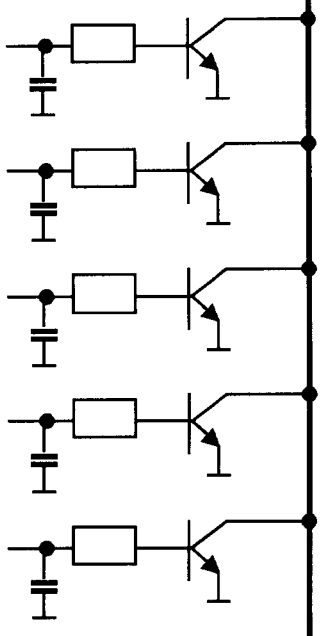
Input values which depend on language

	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, SWcar, 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
EP recognition:	all, greatest, window, last	todos, mayor, ventana, último	alle, grösster, Fenster, letzter	tous, plus gr., fenêtre, dernier
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

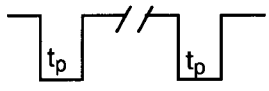
Error: active with errors

Activate, as set in method (see also page 136)

V_{CE0} = 40 V
I_C = 20 mA
t_{Pulse} > 100 ms

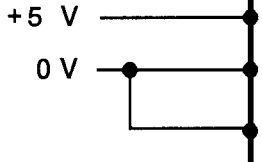
Functions see page 135

Pulses for recorder



t_p = 150 µs

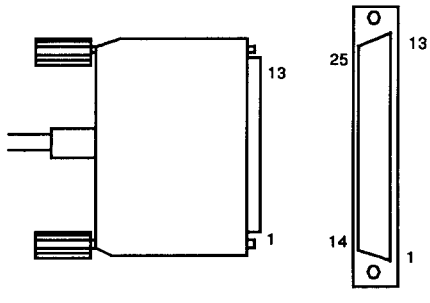
Voltage



I ≤ 75 mA

0 V: active
5 V: inactive

Contact arrangement at socket (male) for connector "Remote" (female)

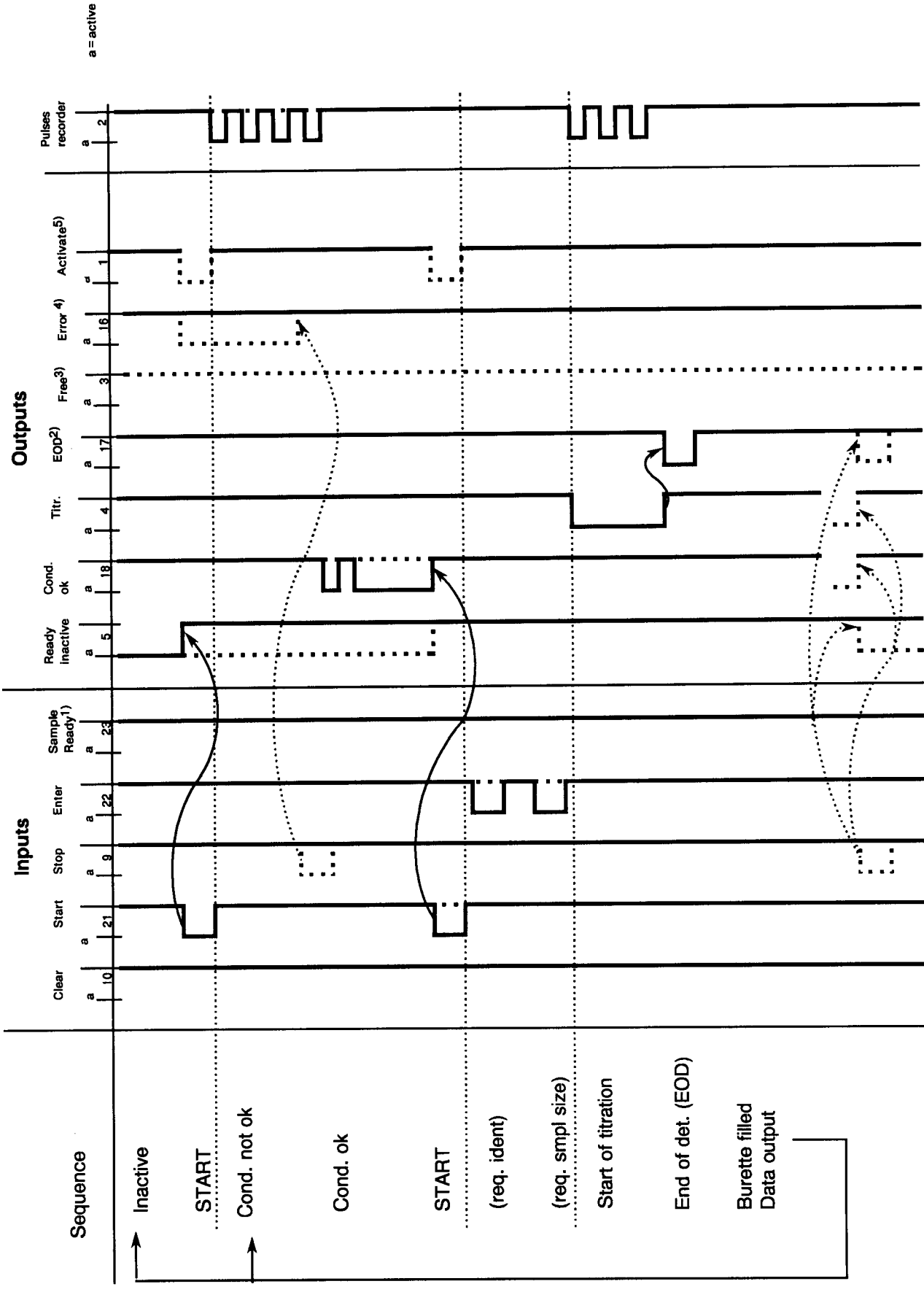


View from solder side of connector

Ordering numbers:
K.210.9004 (shell) and K.210.0002

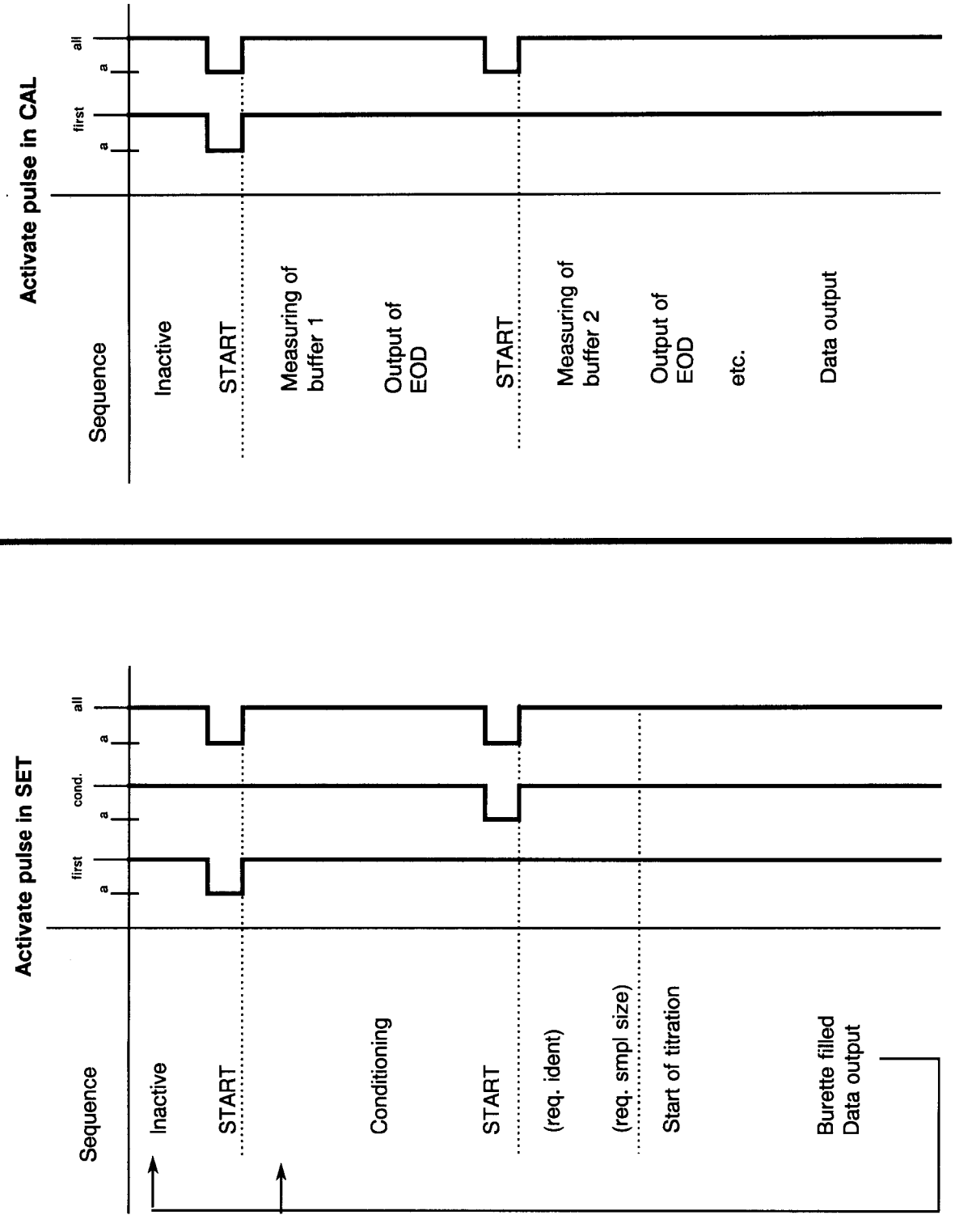
No liability whatsoever will be accepted for damage caused by improper interconnection of instruments.

6.3.1 Lines of the "Remote" socket 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 88.
3) Line can be set via RS232, see page 88.
4) The error line is reset when the error is rectified.
5) According to method configuration, see pages 27, 36, 42 and 43.

Possible configurations of the activate pulse in SET 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 some methods the molar mass, blank value etc. should be entered under key <C-fmla>, see page 46.
- Stop volumes or other stop conditions should be entered depending on sample.
- If a printer is connected, the methods should be completed with report instructions, see pages 8 and 49.

6.4.2 "Titer_pH"

The titer is calculated as a factor without dimension out of 5 determinations and stored as common variable C31. It can therefore be used directly by subsequent methods.

Electrode: 6.0202.100 combined pH glass electrode, at measuring input 1.

Titrant: NaOH, c = 0.1 mol/L (free of carbonate)

Sample: Weigh in app. 300 mg potassium hydrogen phthalate (PHP). Dried 2 h at 105 °C, diluted in 40 mL dist. water (free of carbonate).

Reference: Metrohm Application Bulletin No. 206

```
 'pa
date 92-08-24       time 09:07
DET  pH            Titer_pH
parameters
>titration parameters
  meas.pt.density          4
  min.incr.             10.0 ul
  titr.rate             max. ml/min
  signal drift            50 mV/min
  equilibr.time           26 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:                abs.
  stop V                20.00 ml
  stop pH                 OFF
  stop EP                   9
  filling rate          max. ml/min
>statistics
  status:                  ON
  mean              n=     5
  res.tab:          original
>evaluation
  EPC                      5
  EP recognition:        all
  fix EP1 pH             OFF
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:       value
  activate pulse:        OFF
         ------------


 'fm
date 92-08-24       time 09:07
DET  pH            Titer_pH
>calculations
Titer=C00*C01/C02/EP1;4;
C00=                     1.0
C01=                   10000
C02=                  204.23
         ------------
```

Result as a digit without dimension
Sample size potassium hydrogen phthalate (PHP) in g
Theoretical consumption for 1 mol PHP
Molar mass PHP

6.4.3 "Blank"

Treat the "blank sample" in the same way as you treat your real samples. Can be used e.g. for the methods Sapon.No. and Perox.No, see pages 143 and 147.

The blank value is stored as common variable C30 and can therefore be used directly by subesequent methods.

Reference: Metrohm Application Bulletin No. 210

```
 'pa
date 92-08-24        time 09:07
DET  U                 Blank
parameters
>titration parameters
  meas.pt.density          4
  min.incr.             10.0 ul
  titr.rate             max. ml/min
  signal drift            50 mV/min
  equilibr.time           26 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:                abs.
  stop V                30.00 ml
  stop U                  OFF mV
  stop EP                  9
  filling rate          max. ml/min
>statistics
  status:                  ON
  mean              n=     5
  res.tab:          original
>evaluation
  EPC                      5
  EP recognition:        all
  fix EP1 U              OFF mV
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:         OFF
  activate pulse:        OFF
          ------------


 'fm
date 92-08-24        time 09:07
DET  U                 Blank
>calculations
Blank=EP1/C01;3;ml
C01=                     1
          ------------
```

Result as reagent consumption in mL.
Division factor if multiple quantities of solvent are used for the blank determination.

6.4.4 "Chloride"

Electrode: 6.0404.100 combined Ag electrode, at measuring input 1.

Titrant: $AgNO_3$, c = 0.01 mol/L for low Cl^- contents, e.g. in tap water
$AgNO_3$, c = 0.1 mol/L for higher Cl^- contents, e.g. in food

Sample: Dissolve sample and add HNO_3.

Remarks: Select the appropriate formula. The other may be deleted.

Reference: Metrohm Application Bulletin No. 130

```
 'pa
date 92-08-24       time 09:07       2
DET  U             Chloride
parameters
>titration parameters
  meas.pt.density          4
  min.incr.             10.0 ul
  titr.rate             max. ml/min
  signal drift            50 mV/min
  equilibr.time           26 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:                abs.
  stop V                99.99 ml
  stop U                  OFF mV
  stop EP                   1
  filling rate          max. ml/min
>statistics
  status:                OFF
>evaluation
  EPC                       5
  EP recognition:        all
  fix EP1 U              OFF mV
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:         all
  activate pulse:        OFF
          ------------


 'fm
date 92-08-24       time 09:07
DET  U             Chloride
>calculations
Chloride=EP1*C01*C02*C03/C00;2;ppm
NaCl=EP1*C04*C05*C06/C00;2;%
C00=                     1.0
C01=                    0.01
C02=                   35.45
C03=                    1000
C04=                   58.44
C05=                     0.1
C06=                     0.1
          ------------
```

Content of Cl^- in ppm
Content of table salt in %
Sample size in g
Concentration of titrating agent
Molar mass of Cl
Factor for ppm
Molar mass of NaCl
Concentration of titrating agent
Factor for %

6.4.5 "TAN-TBN"

Determination of the acid or base number in petroleum products according to ASTM D 2896-80 (DIN 51 596).

Electrode: 6.0102.102 pH glass electrode at measuring input 1 ("Ind I")
6.0729.100 Ag/AgCl reference electrode (outer electrolyte solution LiCl in sat. ethanol) at measuring input 2 ("Ind II")
6.0301.100 Pt electrode at measuring input "Ref"
Differential input

TAN titrant: TBAOH (tetrabutylammoniumhydroxide), c = 0.1 mol/L in isopropanol
TBN-Titriermittel: $HClO_4$, c = 0.1 mol/L in acetic acid

TAN solvent: Isopropanol/chlorbenzene 1:2
TBN solvent: Acetic acid/chlorbenzene 1:2

Sample: 0.5...4 g sample in 50 mL solvent.

Remarks:
- Store glass electrode in dist. water over night. Before titrating, precondition it in solvent during 10...30 min.
- ASTM requires an equilibration time of 100 s between volume increments. In most cases it is possible to titrate with shorter equilibration times.
- ASTM uses 100 mL solvent. Our tests have shown that 50 mL are usually sufficient.
- If fix endpoints are evaluated, the voltage value to be set has to be determined with buffers.

Reference: Metrohm Application Bulletin No. 80

```
 'pa
date 92-08-24        time 09:07
MET  U               TAN-TBN
>titration parameters
  V step               0.10 ml
  titr.rate            max. ml/min
  signal drift          aus mV/min
  equilibr.time          50 s
  start V:              OFF
  pause                 100 s
  meas.input:          diff.
  temperature           25.0 °C
>stop conditions
  stop V:               abs.
  stop V               10.00 ml
  stop U                 OFF mV
  stop EP                  9
  filling rate          max. ml/min
>statistics
  status:               OFF
>evaluation
  EPC                    20 mV
  EP recognition:       last
  fix EP1 U              OFF mV
  pK/HNP:               OFF
>preselections
  req.ident:            OFF
  req.smpl size:       value
  activate pulse:       OFF
          ------------


 'fm
date 92-08-24        time 09:07
MET  U               TAN-TBN
>calculations
TAN/TBN=(EP1-C01)*C02*C03/C00;2;mg/g
C00=                    1.0
C01=                      0
C02=                    0.1
C03=                 56.106
          ------------
```

Differential potentiometry, see page 119

Makes sure that the sum value is evaluated

Result in mg KOH per g sample
Sample size in g
Consumption of blank sample in mL
Normality of the titrant (0.1 * titer)
Molar mass of KOH

6.4.6 "Diazo"

Diazotation of sulfonamides and primary amines.

Electrode: 6.0413.100 combined gold cap electrode

Titrant: $NaNO_2$, c = 0.1 mol/L

Solvent: 30% HBr

Sample: Dilute 0.2...0.5 mmol of the substance to be determined in 30 mL solvent and add 20 mL dist. water. Titrate immediately.

```
 'pa
date 92-08-24       time 09:07
MET  U                Diazo
>titration parameters
  V step               0.10 ml
  titr.rate            max. ml/min
  signal drift          OFF mV/min
  equilibr.time          20 s
  start V:             abs.
  start V               0.5 ml
  dos.rate             max. ml/min
  pause                  80 s
  meas.input:             1
  temperature          25.0 °C
>stop conditions
  stop V:              abs.
  stop V               6.00 ml
  stop U                OFF mV
  stop EP                 9
  filling rate         max. ml/min
>statistics
  status:               OFF
>evaluation
  EPC                    30 mV
  EP recognition:  greatest
  fix EP1 U             OFF mV
  pK/HNP:               OFF
>preselections
  req.ident:            OFF
  req.smpl size:      value
  activate pulse:       OFF
         ------------

 'fm
date 92-08-24       time 09:07
MET  U                Diazo
>calculations
Content=EP1*C01*C02*C03/C00;2;%
C00=                   1.0
C01=                     1
C02=                     1
C03=                   0.1
         ------------
```

Sample size in g
Molar mass of the substance to be determined
Normality of the titrant (0.1 * titer)
Factor for %

6.4.7 "Br-Index"

Determination of the bromine index in petroleum hydrocarbons according to ASTM D 2710-72. The bromine index is defined as the quantity of mg bromine which reacts with 100 g sample.

Electrode: 6.0308.100 double Pt electrode, at measuring input "Pol".

Titrant: Solution of bromide/bromate, c(bromate) = 0.05 mol/L. Dilute 5.1 g KBr and 1.4 g $KBrO_3$ separately and make up to 1 L.

Solvent: 714 mL glacial acetic acid, 134 mL CCl_4, 134 mL methanol and 18 mL sulphuric acid (diluted 1 + 5).

Sample: app. 3 g sample in 20...100 mL solvent. Titrate blank sample in the same way.

Remarks: The bromine index can be determined easily by endpoint titration (SET), see Application file for 716 DMSTitrino, Example 6-4.

Reference: Metrohm Application Bulletin No. 177

```
 'pa
date 91-07-04       time 09:07
MET  Ipol          Br-Index
>titration parameters
  V step               0.05 ml
  titr.rate            max. ml/min
  signal drift          OFF mV/min
  equilibr.time          20 s
  start V:              OFF
  pause                   0 s
  I(pol)                  1 uA
  electrode test:       OFF
  temperature          25.0 °C
>stop conditions
  stop V:              abs.
  stop V              10.00 ml
  stop U                  5 mV
  stop EP                 9
  filling rate         max. ml/min
>statistics
  status:               OFF
>evaluation
  EPC                    30 mV
  EP recognition:  greatest
  fix EP1 U             OFF mV
>preselections
  req.ident:            OFF
  req.smpl size:      value
  activate pulse:       OFF
          ------------


 'fm
date 91-07-04       time 09:07
MET  Ipol          Br-Index
>calculations
Br-Index=(EP1-C01)*C02*C03/C00;1;mg
C00=                    1.0
C01=                      0
C02=                   0.05
C03=                   7990
          ------------
```

Result in mg bromine/100g
Sample size in g
Consumption of blank sample in mL
Normality of the titrant (0.05 * titer)
Calculation factor

6.4.8 "Sapon.No"

Electrode: 6.0203.100 combined pH glass electrode, at measuring input 1.

Titrant: HCl, c = 0.5 mol/L

Sample: Weigh out app. 2 g of sample. Add 25 mL of KOH, c = 0.5 mol/L in ethanol and allow to boil lightly for at least 30 minutes. Rinse the content into a beaker and titrate the excess KOH with HCl.
Determine a blank sample in the same way.

Remarks: Change the result unit to e.g. mg KOH

Reference: Metrohm Application Bulletin No. 141

```
 'pa
date 92-08-24       time 09:07
DET  U             Sapon.No
parameters
>titration parameters
  meas.pt.density         4
  min.incr.            10.0 ul
  titr.rate            max. ml/min
  signal drift           50 mV/min
  equilibr.time          26 s
  start V:              OFF
  pause                   0 s
  meas.input:             1
  temperature          25.0 °C
>stop conditions
  stop V:              abs.
  stop V              99.99 ml
  stop U                OFF
  stop EP                 1
  filling rate         max. ml/min
>statistics
  status:               OFF
>evaluation
  EPC                     5
  EP recognition:       all
  fix EP1 U             OFF mV
  pK/HNP:               OFF
>preselections
  req.ident:            OFF
  req.smpl size:      value
  activate pulse:       OFF
         ------------


 'fm
date 92-08-24       time 09:07
DET  U             Sapon.No
>calculations
Sapon.No=(C30-EP1)*C01/C00;2;%
C00=                    1.0
C01=                  28.05
C30=                    0.0
         ------------
```

Saponification number in mg KOH per g of sample
Sample size in g
Molar mass of KOH * normality of titrant (56.10 * 0.5)
Consumption of "blank sample"

6.4.9 "Ca-Mg"

Electrode: 6.0504.100 Ca electrode and 6.0726.100 Ag/AgCl reference electrode (outer electrolyte KNO_3 sat.), at measuring input 1.

Titrant: Na_2EDTA, c = 0.05 mol/L in KOH, c = 0.1 mol/L

Aux. reagent: Acetyl acetone, c = 0.1 mol/L + TRIS, c = 0.2 mol/L (TRIS = Trishydroxymethyl amino-methane)

Sample: Add auxiliary complexing agent to sample.

Remarks: The volume of added auxiliary reagent can be optimized: As a rule of thumb, the ratio Mg/acetyl acetone should be app. 0.05.

Reference: Metrohm Application Bulletin No. 125

```
 'pa
date 92-08-24       time 09:07
DET  U                Ca-Mg
parameters
>titration parameters
  meas.pt.density          1
  min.incr.             10.0 ul
  titr.rate             max. ml/min
  signal drift            20 mV/min
  equilibr.time           38 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:               abs.
  stop V                   5 ml
  stop U                OFF mV
  stop EP                  9
  filling rate          max. ml/min
>statistics
  status:                OFF
>evaluation
  EPC                      5
  EP recognition:        all
  fix EP1 U              OFF mV
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:         all
  activate pulse:        OFF
          ------------


 'fm
date 92-08-24       time 09:07
DET  U                Ca-Mg
>calculations
Ca++=EP1*C01*C02/C00;2;mmol/l
Mg++=(EP2-EP1)*C01*C02/C00;2;mmol/l
Total=EP2*C01*C02/C00;2;mmol/l
C00=                     1.0
C01=                    0.05
C02=                    1000
          ------------
```

Calcium hardness in mmol/L
Magnesium hardness in mmol/L
Total hardness in mmol/L
Sample size in mL
Concentration of titrating agent
Factor for mmol

6.4.10 "EDTA-NTA"

EDTA and NTA in detergents.

Electrode: 6.0502.140 Cu electrode and 6.0726.100 Ag/AgCl reference electrode (outer electrolyte KNO_3 sat.), at measuring input 1.

Titrant: $CuNO_3$, c = 0.01 mol/L

Sample: Weigh 0.5...1 g sample into a 100 mL measuring flask and add 50 mL dist. water. Heat to app. 40 °C. Allow to cool and fill up to mark.
Pipette 10 mL into a beaker, add 2 mL of EDTA or NTA standard solution (c = 0.01 mol/L) and 10 mL of buffer solution (NH_3/NH_4NO_3, c = 1 mol/L; pH = 9.6) and titrate.

Remarks: Select the appropriate formula. The other may be deleted.

Reference: Metrohm Application Bulletin No. 143

```
 'pa
date 92-08-24       time 09:07
DET  U             EDTA-NTA
parameters
>titration parameters
  meas.pt.density          4
  min.incr.             10.0 ul
  titr.rate             max. ml/min
  signal drift            50 mV/min
  equilibr.time           26 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:               abs.
  stop V                   4 ml
  stop U                 OFF mV
  stop EP                  9
  filling rate          max. ml/min
>statistics
  status:                OFF
>evaluation
  EPC                      5
  EP recognition:        all
  fix EP1 U              OFF mV
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:         all
  activate pulse:        OFF
         ------------


 'fm
date 92-08-24       time 09:07
DET  U             EDTA-NTA
>calculations
EDTA=(EP1-C01)*C02*C03/C00;2;%
NTA=(EP1-C01)*C02*C04/C00;2;%
C00=                     1.0
C01=                       2
C02=                     100
C03=                  2.9225
C04=                  1.9114
         ------------
```

EDTA content in %
NTA content in %
Sample size in g
Amount of standard solution added
Factor for %
Molar mass of EDTA * concentration of titrant
Molar mass of NTA * concentration of titrant

6.4.11 "Metals"

Electrode: 6.0502.140 Cu electrode and 6.0726.100 Ag/AgCl reference electrode (outer electrolyte KNO_3, sat.), at measuring input 1.

Titrant: EDTA, c = 0.1 mol/L

Buffer pH = 10: 54 g NH_4Cl and 350 mL w(NH_3) = 0.25 are dissolved in 1 L dist. water.

Buffer pH = 4.7: 123 g Naac and 86 mL glacial acetic acid are dissolved in 1 L dist. water.

Sample: Add 5 mL of buffer solution to sample and 1 mL CuEDTA, c = 0.05 mol/L. Wait for 20...30 s and titrate.

Remarks: The following metals can be determined according to this method:

		buffer solution	molar mass
Water, total hardness	(Ca + Mg)	pH = 10	64.40
Barium	Ba	pH = 10	137.36
Cadmium	Cd	pH = 10	112.41
Cobalt	Co	pH = 10	58.94
Nickel	Ni	pH = 10	58.71
Zinc	Zn	pH = 10	65.38
Lead	Pb	pH = 4.7	207.21

Reference: Metrohm Application Bulletin No. 101

```
 'pa
date 92-08-24       time 09:07
DET  U               Metals
parameters
>titration parameters
  meas.pt.density          2
  min.incr.             10.0 ul
  titr.rate             max. ml/min
  signal drift            20 mV/min
  equilibr.time           38 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:               abs.
  stop V                  10 ml
  stop U                 OFF mV
  stop EP                  9
  filling rate          max. ml/min
>statistics
  status:                OFF
>evaluation
  EPC                      5
  EP recognition:        all
  fix EP1 U              OFF mV
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:         all
  activate pulse:        OFF
          ------------


 'fm
date 92-08-24       time 09:07
DET  U               Metals
>calculations
Content=EP1*C01*C02/C00;2;g/l
C00=                     1.0
C01=                     0.1
C02=                       1
          ------------
```

Content of metal in g/L
Sample size in mL
Concentration of titrant
Molar mass of metal

6.4.12 "Perox.No"

Determination of the peroxide number in edible oils and fats.

Electrode: 6.0415.100 combined massive Pt electrode, at measuring input 1.

Titrant: $Na_2S_2O_3$, c = 0.01 mol/L, to be prepared daily from 0.1 mol/L.

Sample: Weigh app. 5 g sample into an Erlenmeyer flask and dissolve in 50 mL glacial acetic acid/chloroform 3:2. Add 1 mL saturated KI solution, shake for 5 s and store in the dark for 1 min. Rinse solution into the titration vessel with dist. water and titrate immediately. Same treatment for blank sample.

Remarks: The sample must be stirred well during the titration, in order to obtain a good emulsion.

Reference: Metrohm Application Bulletin No. 141

```
 'pa
date 92-08-24       time 09:07
DET  U             Perox.No
>titration parameters
  meas.pt.density          4
  min.incr.             10.0 ul
  titr.rate             max. ml/min
  signal drift            50 mV/min
  equilibr.time           26 s
  start V:               OFF
  pause                    0 s
  meas.input:              1
  temperature           25.0 °C
>stop conditions
  stop V:               abs.
  stop V               99.99 ml
  stop U                 OFF mV
  stop EP                  1
  filling rate          max. ml/min
>statistics
  status:                OFF
>evaluation
  EPC                      5
  EP recognition:        all
  fix EP1 U              OFF mV
  pK/HNP:                OFF
>preselections
  req.ident:             OFF
  req.smpl size:       value
  activate pulse:        OFF
         ------------


 'fm
date 92-08-24       time 09:07
MET  U             Perox.No
>calculations
Perox.No=C01*(EP1-C30)/C00;2;mE/kg
C00=                     1.0
C01=                      10
C30=                     0.0
         ------------
```

Result in milli-equivalent O_2/kg
Sample size in g
Calculation factor
Consumption of the blank sample in mL

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

6.6.1 716 DMSTitrino

716 DMSTitrino	**2.716.0010**
including the following accessories:	
1 Keypad to 716 DMSTitrino	6.2132.020
1 Key for exchange units	6.2739.010
1 Mains cable with cable socket, type CEE(22),V	
Cable plug to customer's specifications:	
type SEV 12 (Switzerland...)	6.2122.020
type CEE(7),VII (Germany...)	6.2122.040
type NEMA/ASA (USA...)	6.2122.070
1 Instructions for Use for 716 DMSTitrino	8.716.1003
1 Application file	8.716.0003

Options

Accessories to separate order and on payment of extra charge:

649 Magnetic Stirrer	
Magnetic Swingout Stirrer 649	2.649.0040
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.	
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 716 DMSTitrino – 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 716 DMSTitrino – Seiko Printer DPU 411	6.2125.020
Cable 716 DMSTitrino – EPSON printer with 6 pin plug	6.2125.040
Cable 716 DMSTitrino – EPSON printer with RS interface #8148	6.2125.050
Cable 716 DMSTitrino – HP Think Jet, HP Quiet Jet	6.2125.050
Cable 716 DMSTitrino – 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 716 DMSTitrino – IBM® PC/XT/PS-2 or compatible	6.2125.060
Cable 716 DMSTitrino – IBM® AT	6.2125.060 + 6.2125.010
RS232 C extension cable	6.2125.020
Program package for the data transfer 716 DMSTitrino – IBM® PC or compatible, $5\frac{1}{4}$" and $3\frac{1}{2}$" diskettes, PASCAL and BASIC	6.6013.000

Analog recorder

Labograph 586, 50 Hz	2.586.0012
Labograph 586, 60 Hz	2.586.0013
Cable 716 DMS 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 716 DMSTitrino – 664 Control Unit	3.980.3560
Cable 716 DMSTitrino – 664 Control Unit and 665 or 725 Dosimat	3.980.3610

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.

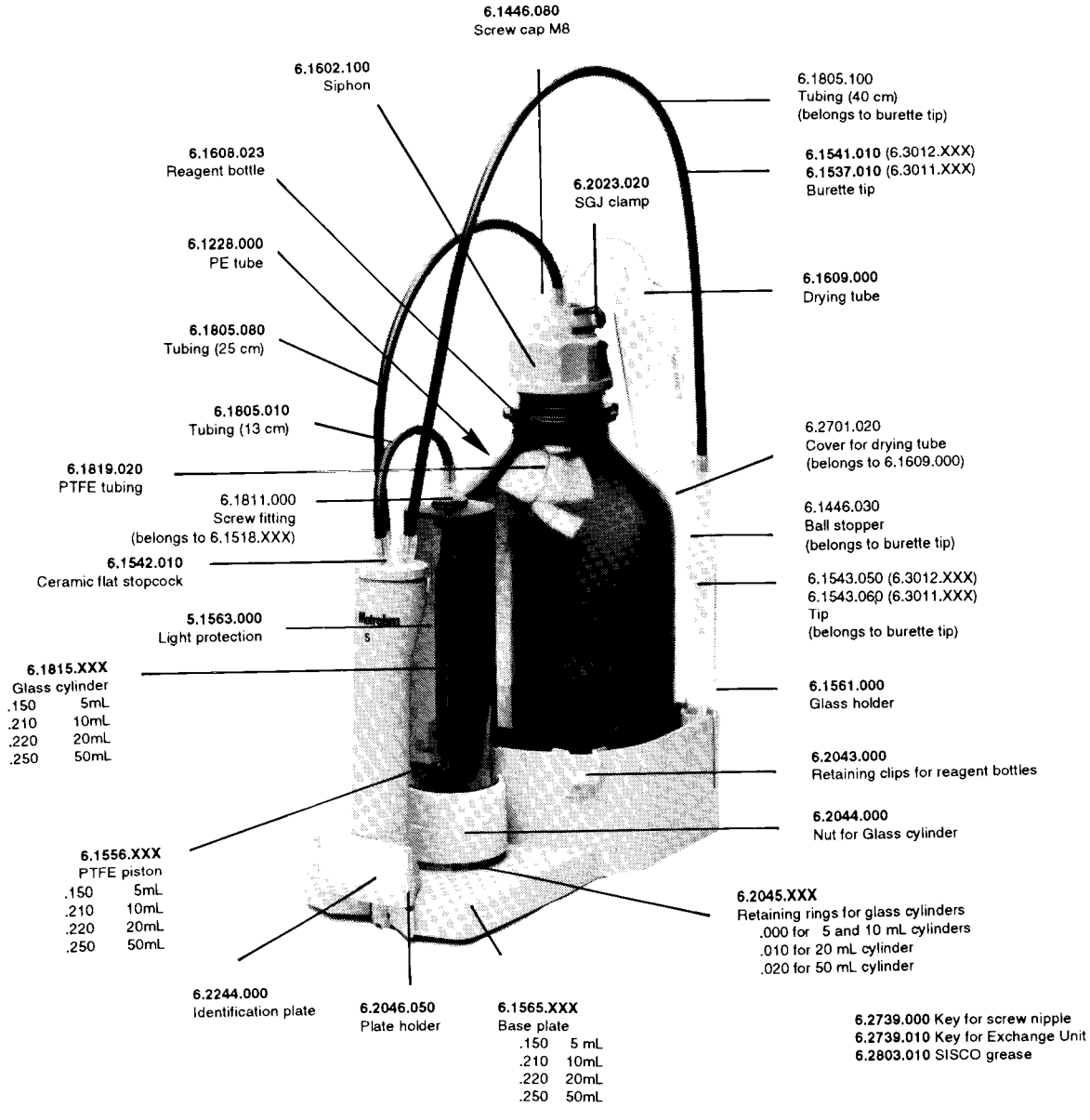


Fig. 6-1: Standard accessories and ordering designations for the 6.3011.253 and 6.3012.XXX Exchange Units

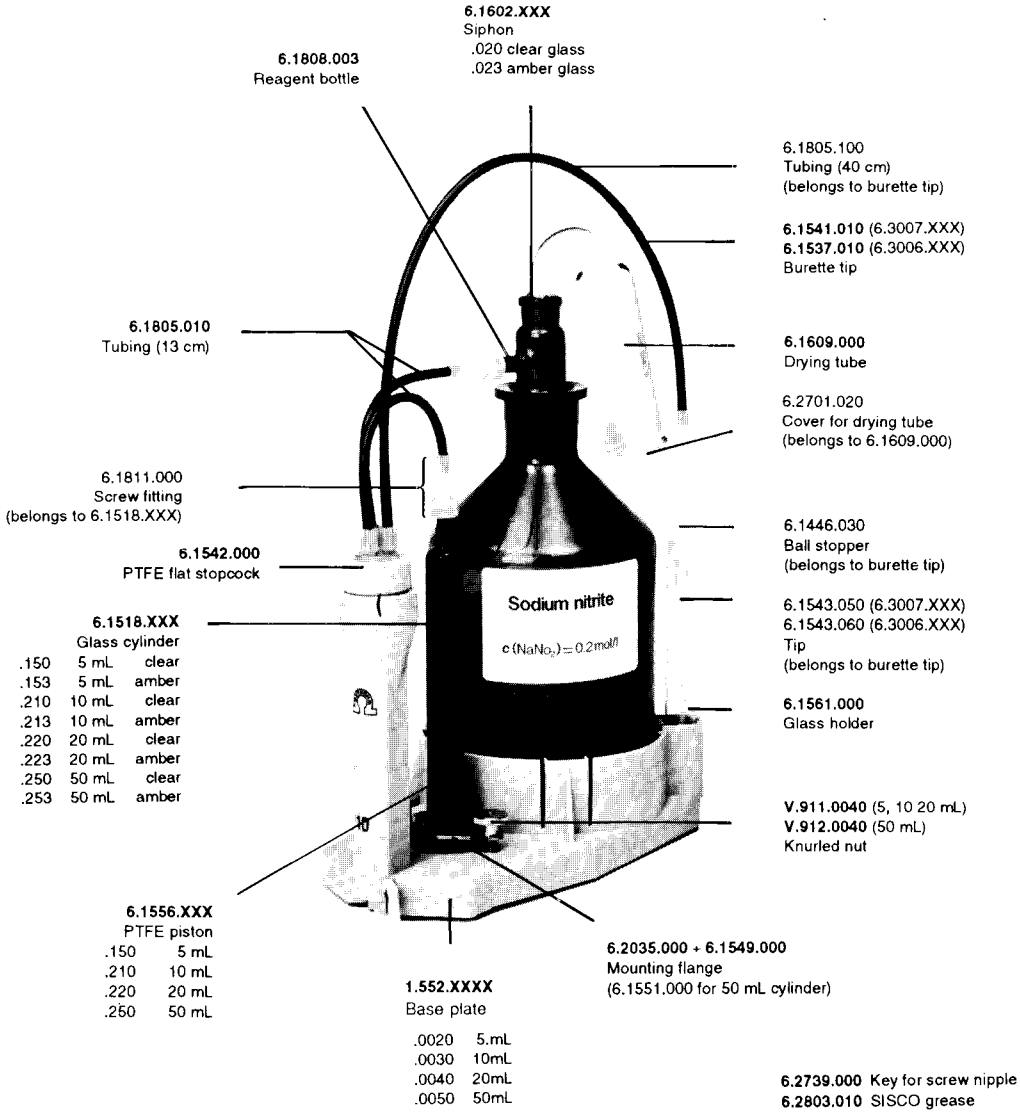


Fig. 6-2: Standard accessories and ordering designations for the 6.3006.XXX and 6.3007.XXX Exchange Units

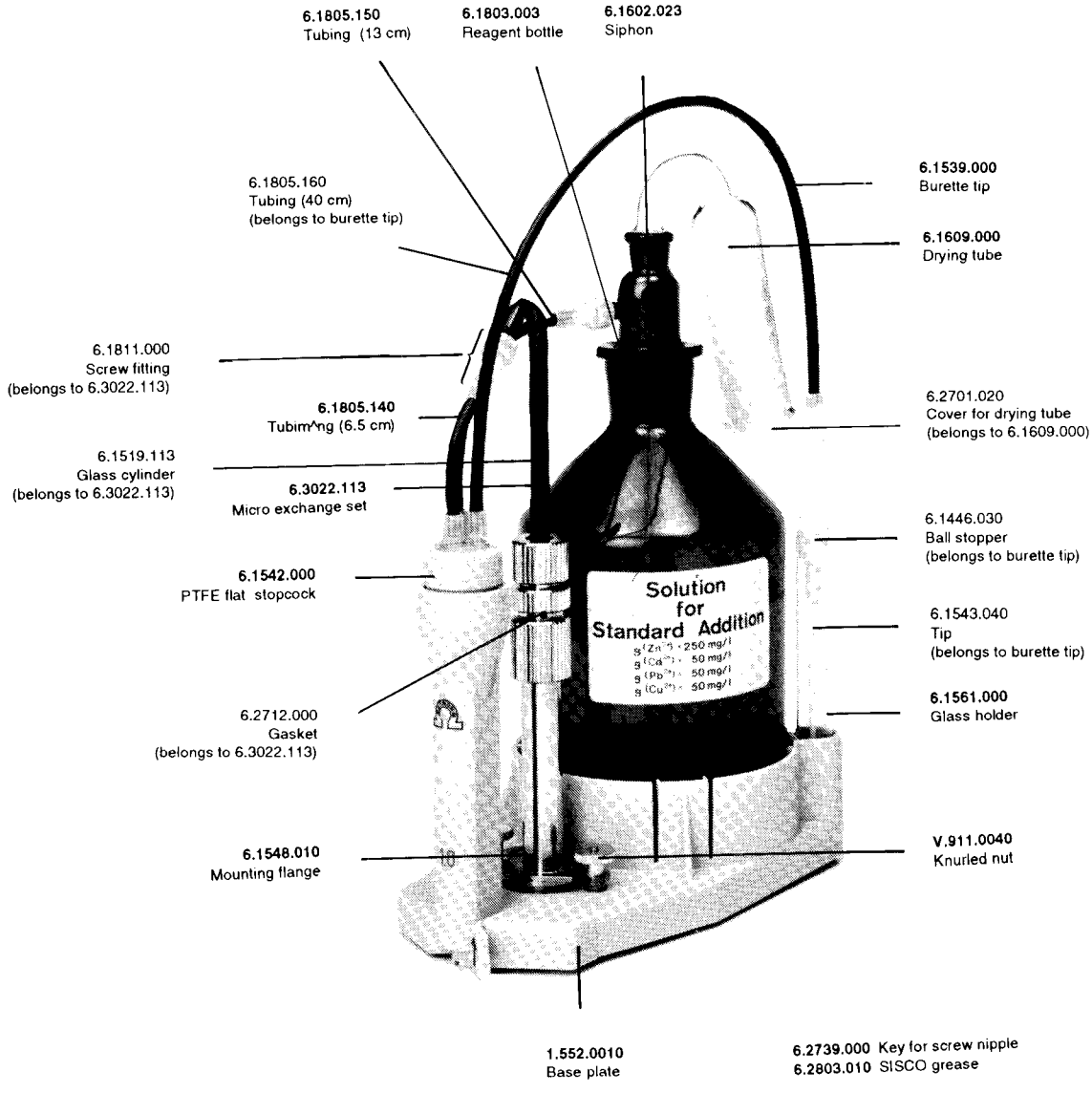


Fig. 6-3: Standard accessories and ordering designations for the 6.3006.113 1 mL Exchange Unit

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

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Texts which appear in the display are **printed in bold face**. Pages concerning the operation via RS232 interface (green leaves) are *printed in italic*.

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Ionenanalytik • Analyse des ions • Ion analysis • Análisis iónico

716 DMS Titrino

CE

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EC Declaration of Conformity

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

716 DMS 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 dynamic and monotonic titrations with automatic end-point detection, as well as potentiometric end-point titrations and pK value determination.

Herisau, December 5, 1995

Dr. J. Frank	Ch. Buchmann
Development Manager	Production and Quality Assurance Manager