Metrohm METROHM AG CH-9101 Herisau (Switzerland)

KF Titrino 701

Series 01 ...

Instructions for Use 8.701.1003

89.12 Ti

Mode Selection

mode

Press key <mode> until the desired mode is displayed:

KFT	Karl Fischer titration	load desired mode with <enter>
TITER with H2O or std.	Titer determination with water or with a standard	
TITER with Na2Tart·2H2O	Titer determination with sodium tartrate	
BLANK determination	Blank determination	

Calculations for Mode KFT

calc data

Go to next inquiry with <calc data> and <enter>.

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

Display	Meaning	Input range
>calculation		
smpl size	Sample size	Up to 6 digits: ±X.XXXXX (**1 g**)
ident.	Sample identification	up to 8 ASCII characters
titer	Titer	0.0000...**5**...99.9991 mg/ml
factor	Factor	–1 000 000...**1**... + 1 000 000
divisor	Divisor, e.g. for density	–1 000 000...**1**... + 1 000 000
blank	Blank	**0.0**...99.9991 ml
drift corr:	Drift correction of KFR volume	auto, man., **OFF**
drift value	Input of drift value for manual drift correction	**0.0**...99.9 µl/min
>statistics		
mean n =	Statistics with n single results	2...20, **OFF**
res.tab:	Result table for statistics calculation	**original**, delete n, delete all
delete n =	Delete single result number n	**1**...20

Formula and units for Mode KFT

$$\text{water} = \frac{(\text{KFR volume} - \text{blank}) \cdot \text{titer} \cdot \text{factor}}{|\text{smpl size}| \cdot \text{divisor}}$$

Adapt factor and divisor to the selected units of result output and sample size :

unit	smpl size in...	factor	divisor
%	g	0.1	1
%	mg	100	1
ppm	g	1000	1
mg/ml	g	density [g/ml]	1
mg/ml	ml	1	1
mg	1	1	1
ml	1	1	1000 · density H_2O [g/ml] ≈ 1000
mg/pc	pc	1	1

Select unit of result output with key <unit>.

Possible units:
%, ppm, mg/ml, g, mg, ml, mg/pc, no unit

configu-ration

Configuration

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

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

Display	Meaning	Input range
>KF device settings		
limit KF reag.	Counter for KF reagent (buffer capacity, reagent supply)	0...999 ml, **OFF**
actual KF reag.	Actual value of counter	**0**...999 ml
polarizer:	Selection of polarisation type	**I(pol)**, U(pol)
I(pol)	Polarization current (voltametric indication)	–127...**50**...127 µA, OFF
EP	Endpoint	–1500...**250**...1500 mV
U(pol)	Polarization voltage (amperometric indication)	–1270...**500**...1270 mV
EP	Endpoint	–150...**25**...150 µA
filling rate	Filling rate after the titration	0.01...150 ml/min, **max.**
>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
>peripheral units		
send to:	Selection of character set, depends on printer	Epson, Seiko, **IBM**
balance:	Selection of balance	**Sartorius**, Mettler, AND, Precisa
record:	Selection of record type to be outputted at the analog output	**V vs. t**, dV/dt vs. t, U vs. t, –U vs. t
>auxiliaries		
dialog:	Selection of dialog language	**english**, deutsch, français, español
date		YYYY–MM–DD
time		HH–MM
run number	Current run number for result output	**0**...999
electrode test:	Titration sequence with or without electrode test	**ON**, OFF
display KFR vol.:	Result display with or without display of final volume	**ON**, OFF
device label	Device label to identify instrument for remote control	up to 8 ASCII characters
program	Program version	no input

para-meters

Parameters

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

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

Display	Meaning	Input range
>titration parameters		
extr.time	Extraction time. Negative number: no addtion of reagent during extraction time	–9999...**0**...9999 s
stop crit.:	Selection of type of stop criteria	**drift**, time
stop drift	Stops titration if stop drift is reached	1...**20**...999 µl/min
t(delay)	Stops titration if there is no dosing during t(delay)	0...**10**...99 s
stop V	Stop volume as security against titration vessel overflow	0.00...**99.99** ml, OFF
start V	Start volume in mode KFT. Predosing without controlling	**0.00**...99.99 ml
dos.rate	Dosing rate for start volume	0.01...150 ml/min, **max.**
max.rate	Maximum dosing rate during titration	0.01...150 ml/min, **max.**
min.volume incr.	Minimum volume increment during titration	0.1...9.9 µl, **min.**
>preselections		
conditioning:	Automatic conditioning of titration vessel	**ON**, OFF
req.ident:	Requests ident. after start of titration	ON, **OFF**
req.smpl size:	Requests sample size after start of titration	**ON**, OFF
report:	Selection of result report at the end of the titration	full, short, **OFF**

Instructions for Use of 701 KF Titrino

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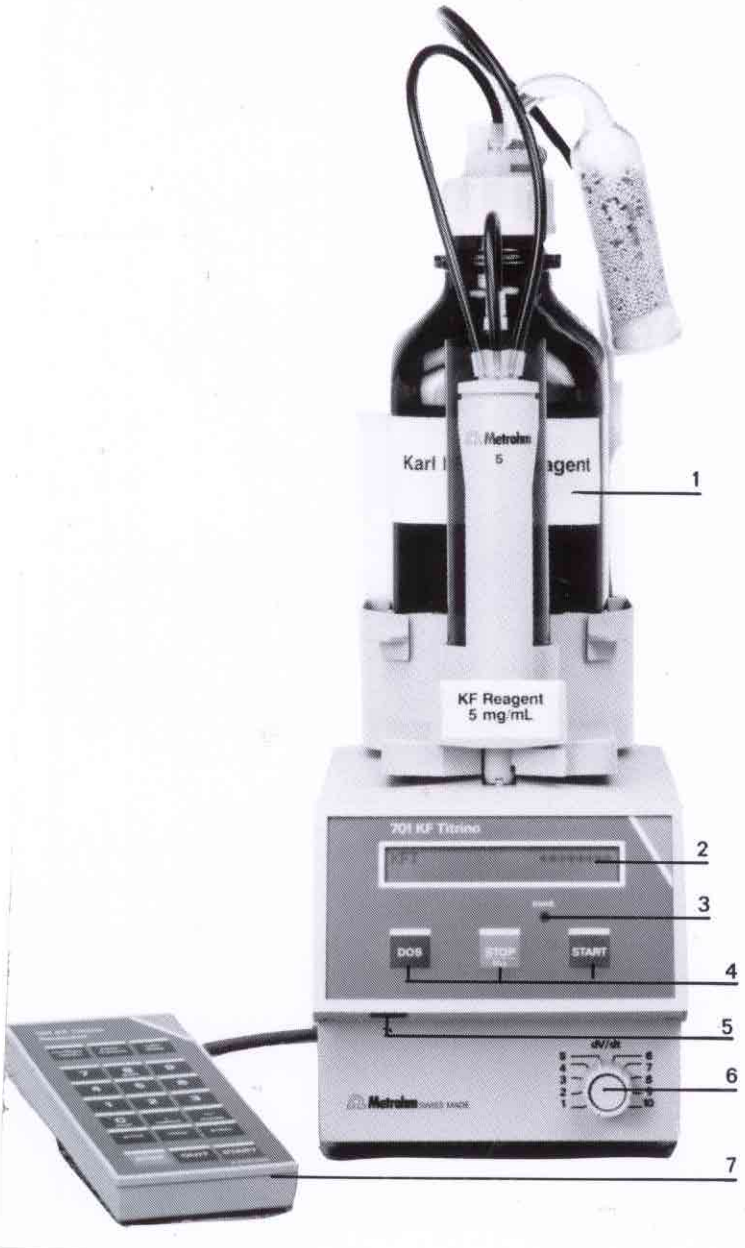
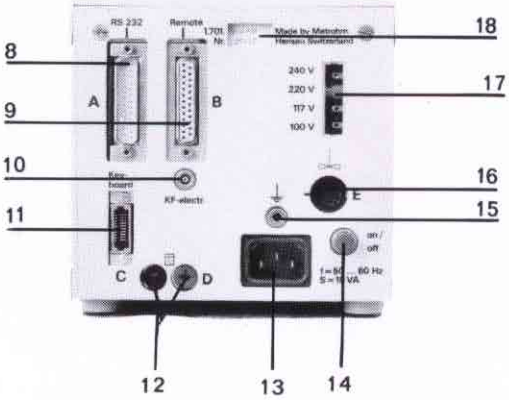

Metrohm
5
KF Reagent
5 mg/mL
701 KF Titrino
DOS
STOP
START
dV/dt
1
2
3
4
5
6
7


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

1. Overview

Front view of instrument:

(1) **Exchange Unit**

(2) **Display**

(3) **Conditioning lamp**
Lamp is on and lights continuously when the titration cell is dry during conditioning.
Lamp flashes when conditioning is being performed but the titration cell is wet.

(4) **Control keys on KF Titrino**

DOS: Dispensing is performed as long as <DOS> is pressed. Used to prepare the Exchange Unit.

STOP/FILL:
- Stops operations, e.g. titration, conditioning
- Fill command after <DOS> to prepare the Exchange Unit.

Identical with the <STOP> key of the separate keypad.

START: Starts operations, 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 the KF electrode**

11 **Connection for the separate keypad**

12 **Analog output**
for the connection of a recorder.

13 **Mains connection**
In the case of power supplies where severe HF disturbances are superimposed on the mains voltage, the KF Titrino should be operated via an additional mains filter, e.g. Metrohm 615 model.

14 **Mains switch**

15 **Earthing socket**
The KF Titrino must be properly and effectively earthed, if necessary by means of the earthing socket.

16 **Connection for 703 Ti Stand or 649 Stirrer**
Supply voltage: +9 V DC ($I \leq 200$ mA)

17 **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.

18 **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 and you have an Exchange Unit filled with KF reagent. If not, see pages 68 and 74.
Your titration vessel is correctly prepared and the electrode inserted. If not, see pages 72 and 73.

We can thus start: Add solvent to the titration vessel and press the <START> key. The green indicator lamp "cond." on the KF Titrino now flashes. This means that the titration cell is still wet and being dried (conditioned). Wait until this lamp lights continuously which means that the cell is dry and ready for titrations. Then prepare your first sample and press key <START> again. Add the sample. If necessary, enter your sample size and confirm it with <enter>. The titration now starts ...
On completion of the titration, the calculated result is shown in the second line of the display.

You could now continue to titrate. But perhaps you would like to learn something about the principle of data entry? If so, as an example, we can change the dialog language. Just for fun, would you like to have a Spanish dialog?

2.1.1 Entering data, setting the dialog language

<configuration>

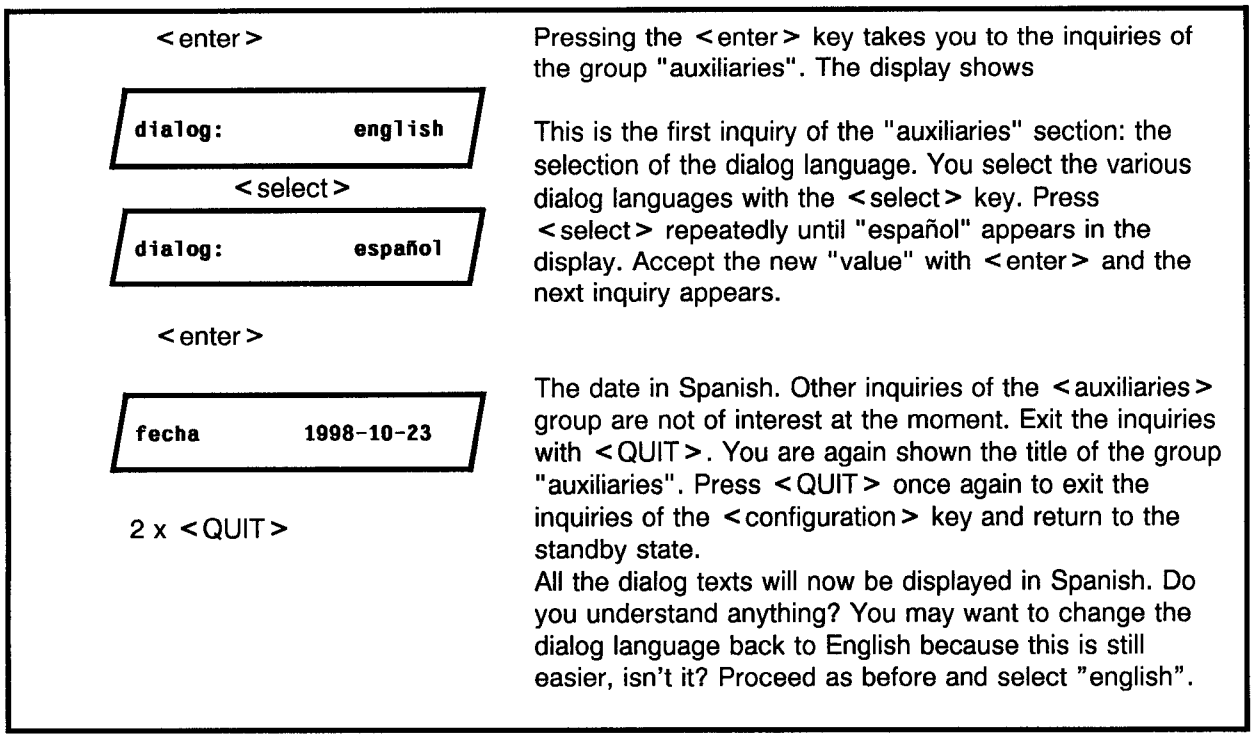
Press <STOP>. You are now in the inactive standby state of the instrument. Then press the <configuration> key. The display shows:

This is the title of the group "KF device settings". This group contains various inquiries for the KF titration.

3 x <configuration>

Press the <configuration> key 3 times. You will see the titles of various other groups. Continue until the display shows

This is the title of the "auxiliaries" group. Note the ">" sign. All titles are prefixed by this sign.



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

This is the first inquiry of the "auxiliaries" section: the selection of the dialog language. You select the various dialog languages with the <select> key. Press <select> repeatedly until "español" appears in the display. Accept the new "value" with <enter> and the next inquiry appears.

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 "auxiliaries". 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".

Summary:

The <configuration> key includes several groups of inquiries that can be selected by repeated pressing of the <configuration> key. Each group has a title marked with " >". The individual inquiries are reached from the title with <enter>. With <enter> the set value is accepted and the next inquiry appears.

<QUIT> is used to exit the inquiries and return to the title of the appropriate inquiries group. If you press <QUIT> again, you return to the standby state of the instrument (or any other state of the instrument, such as conditioning or titration).

We have seen that the dialog language can be selected with the <select> key. This is marked with a colon ":". In all cases where the entry is effected with <select>, a colon appears after the dialog text. In the next inquiry, the date (fecha), the entry is performed with the numeric keys. Hence, no colon appears.
If a colon ":" appears at the end of the dialog text, this means that the admissible values can be selected with the <select> key. In inquiries without ":", the values are entered using the numeric keys.

The <parameters> and <calc data> keys are organized identically.

Now perform a titer determination.

2.1.2 Titer determination

For this you need water and a syringe that allows the exact dispensing of 30 µL.

Selection of the mode

<mode>	Press <mode> repeatedly until the display shows
TITER with H2O or std.	i.e. titer determination with water or a standard liquid of known water content, e.g. standard methanol. Accept the mode with <enter>. The display shows
<enter>	
TITER ********	The instrument is in the TITER mode, in its standby state.

Briefly check a few settings under the <parameters> key:

2 x <parameters>	Press <parameters> twice so that the title "preselections" appears in the display.
>preselections	View the individual inquiries of this group with <enter>. The following values should be set:
<enter>	
conditioning: ON	Automatic drying of the titration cell before and between titrations: "ON".
<enter>	
req.ident: OFF	Request of the sample identification after the titration start: "OFF".
<enter>	
req.smpl size: ON	Request of the sample size after the titration start: "ON".
<enter>	
report: OFF	If no printer is attached, the report printout after the titration must be switched off.
or	
report: short	With a connected printer, the short report, for example, can be selected.
<enter>	

If you have to alter one of these settings, you can do this with the <select> key.

Your titration vessel already contains solvent. Start with <START>. First the titration cell is dried. The display shows

as long as the vessel is still wet and the green "cond." lamp flashes. As soon as the titration vessel is dry and hence ready for operation, this is shown by

and the "cond." lamp lights continuously.

To determine the titer we shall perform several titrations and store the mean value as "titer".

Calculating the mean value and standard deviation

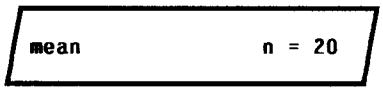
Check that the mean value calculation is switched on:

2 x <calc data>

Press <calc data> twice until the display shows

The title of the group is "statistics". Press <enter>.

<enter>



Number of single determinations for the calculation of the mean value. Since the mean value is recalculated after every determination, the maximum value can remain set at 20. The mean calculation is terminated when the operating mode is changed.

2 x <QUIT>

Exit the inquiry by pressing <QUIT> twice.

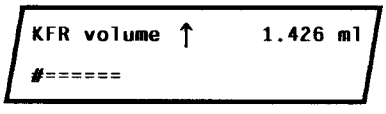
<START>

Now prepare the sample, e.g. 30 µL water and start the titration: <START>. The display shows:

Inject the sample and enter the weight in g:

0.030 <enter>

If you have connected a balance, you can also backweigh the syringe.



The titration now runs.
The first line of the display shows the current volume. In addition, a " ↑ " appears when dispensing is being performed.
A "control bar" appears on the second line and shows the control deviation of the current measured value from the set endpoint.

```
KFR volume        5.632 ml
titer          5.3267 mg/ml
```

On completion of the titration, the first line shows the dispensed volume and the second the calculated titer.

If you have connected a printer, a report is also printed

```
date 1998-11-23      time 14:21:23      3
smpl size        0.03 g
titer          5.3267 mg/ml
           ==========
```

Perform another titer determination.

On completion of the titration, the mean value of the two determinations is calculated. The report on the printer has the following appearance:

```
date 1998-11-23        time 14:23:43      4
smpl size        0.03 g
titer          5.3686 mg/ml
mean (2)       5.3477 mg/ml
+/-s          0.02973 mg/ml
s(rel)           0.56 %
           ==========
```

Viewing the statistics data on the display

If you have not connected a printer, you can view the statistics data on the display with <select>:

```
titer          5.3686 mg/ml
```

From the result display "titer", switch to the display of the mean value with <select>.

<select>

```
mean (2)       5.3477 mg/ml
```

Mean value of 2 determinations. Press <select> again and the standard deviation is shown.

<select>

```
+/-s          0.02973 mg/ml
```

Absolute standard deviation. Pressing <select> once more leads to the

<select>

```
s(rel)               0.56 %
```

relative standard deviation.
<select> returns you to the result display.

<select>

Repeat the titer determination once more.

With a connected printer you may want a printout of the single results that are used for the statistics calculation: press key sequence <print><1><enter>.

Let us assume that you have discovered that one of the values is an "outlier" and you would like to delete it.

Deleting a result in the mean value calculation

2 x <calc data>

```
>statistics
```

2 x <enter>

```
res.tab:        original
```

<select>

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

<enter>

```
delete              n =  1
```

2 <enter>

2 x <QUIT>

In our example, the deviation of the second result is excessive. We thus wish to delete it: Press <calc data> twice. The display shows

Enter the inquiries of the "statistics" group with <enter>. Press <enter> again and the display shows

Press <select> to display "delete n". This means that you wish to delete single results with the index n in the result table. Press <enter>.

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

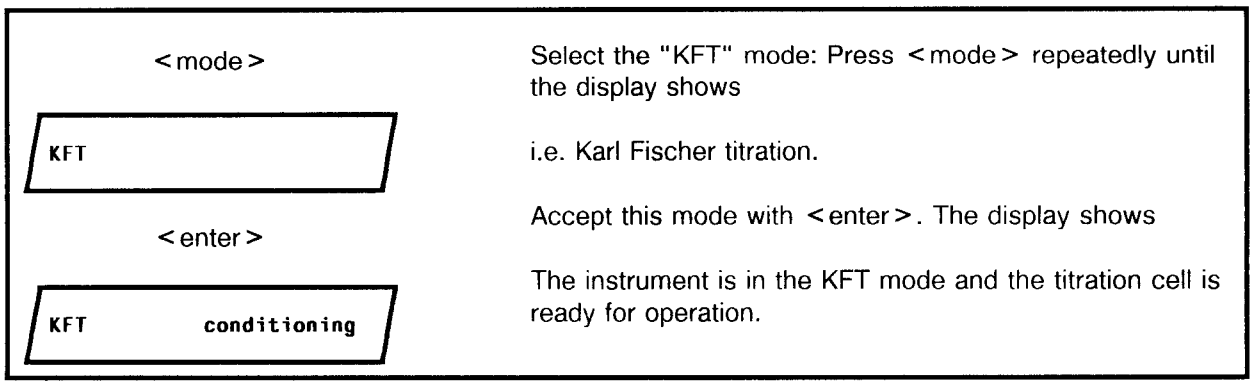
Exit the inquiry with <QUIT>. Mean value and standard deviation are recalculated and can be viewed in the display.

If you have connected a printer, a new report is printed out:

```
date 1998-11-23     time 14:30:33     5
smpl size      0.03 g
titer        5.3362 mg/ml
mean (2)     5.3326 mg/ml
+/-s        0.00642 mg/ml
s(rel)         0.12 %
          ==========
```

Following this titer determination, you now decide to perform Karl Fischer titrations. The titer just determined will be automatically used here.

2.1.3 Karl Fischer titrations

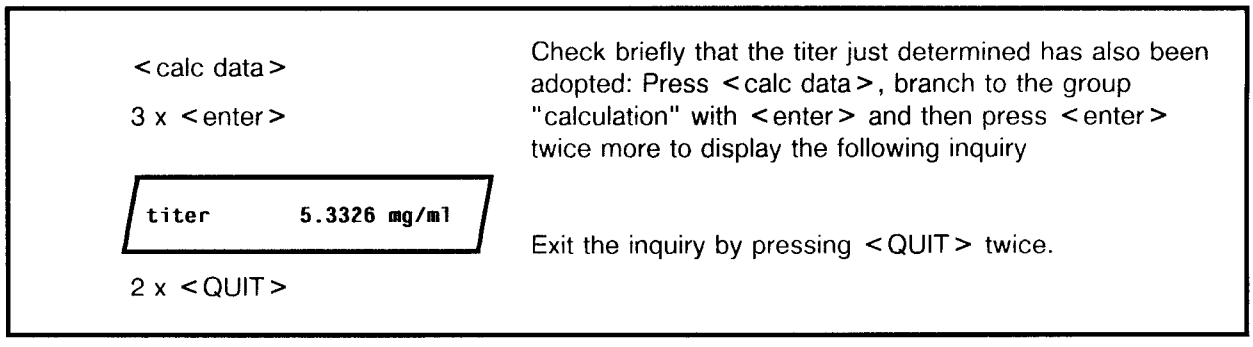


Select the "KFT" mode: Press <mode> repeatedly until the display shows

i.e. Karl Fischer titration.

Accept this mode with <enter>. The display shows

The instrument is in the KFT mode and the titration cell is ready for operation.



Check briefly that the titer just determined has also been adopted: Press <calc data>, branch to the group "calculation" with <enter> and then press <enter> twice more to display the following inquiry

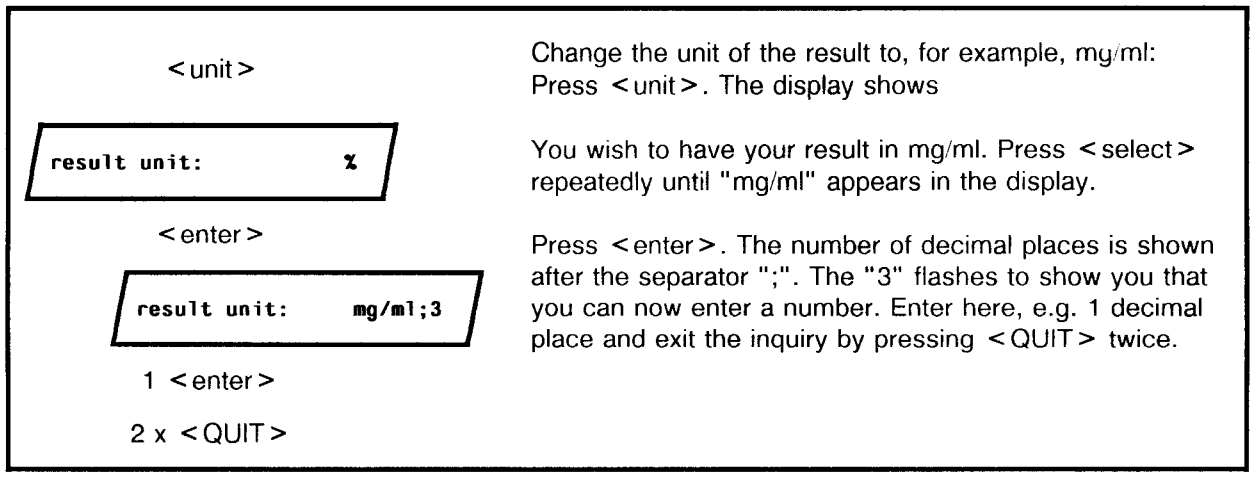
Exit the inquiry by pressing <QUIT> twice.

Now prepare your sample and titrate it.

Result calculation and unit of the result

The result is calculated by the following formula:

$$\text{water} = \frac{(\text{KFR volume} - \text{blank}) * \text{titer} * \text{factor}}{|\text{smpl size}| * \text{divisor}}$$



Change the unit of the result to, for example, mg/ml: Press <unit>. The display shows

You wish to have your result in mg/ml. Press <select> repeatedly until "mg/ml" appears in the display.

Press <enter>. The number of decimal places is shown after the separator ";". The "3" flashes to show you that you can now enter a number. Enter here, e.g. 1 decimal place and exit the inquiry by pressing <QUIT> twice.

The result is outputted in the new unit.
It is now necessary to match the factor to the new result unit. A table with a selection of matched quantities for factor, divisor and unit of the sample size can be found in the short operating guide.

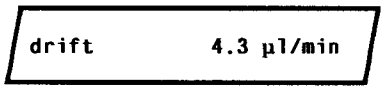
<calc data> + <enter>  	Enter a new factor: Press <calc data> and enter the inquiries of the "calculation" group with <enter>. Proceed with <enter> to the display
1 <enter>	Enter 1. As divisor enter the density of the sample.
2 x <QUIT>	Exit the inquiry by pressing <QUIT> twice. The result is recalculated and outputted.

2.1.4 Drift, Drift, Drift...

The drift is measured in µL/min. It specifies how much KF reagent is consumed per unit time to keep the titration cell dry. The reagent is needed
– to titrate moisture in the titration cell
– to compensate the iodine consumption of slow side reactions.
The drift value is generally of the order of a few µL/min for "dry conditioned" titration cells.

Checking the condition of the solvent

The drift can be displayed during the conditioning of the titration cell with the <drift> key:

<drift>	Press <drift>. The first line of the display shows
 	You can follow the progress of the drift. In fresh solvent the drift value should drop to less than 10 µL/min after a few minutes.
<drift>	Pressing <drift> once again switches the drift display off.

Drift correction of the results

You can correct your results by the drift. This is primarily necessary if you wish to determine very small amounts of moisture or when you have very long titration times.
For the correction "(drift * titration time)" is subtracted from the dispensed volume:

Corrected volume = dispensed volume – (drift value * titration time)

The drift value can be determined automatically or entered manually. In the automatic determination the current drift value at the start of the titration is stored and used for the correction. In the manual entry you yourself enter a fixed value, e.g. the stable drift value that you have read off from the display during conditioning.

<calc data> + <enter>

```
drift corr.:          OFF
```

<select> <enter>

```
drift value   0.0 µl/min
```

2 x <QUIT>

```
KFR volume -d   2.365 ml
```

Activate the drift correction: Enter the inquiries of the "calculation" group with <enter> and proceed until the display shows

Make your selection with <select>, e.g. "man."

Enter a drift value and exit the inquiry by pressing <QUIT> twice.

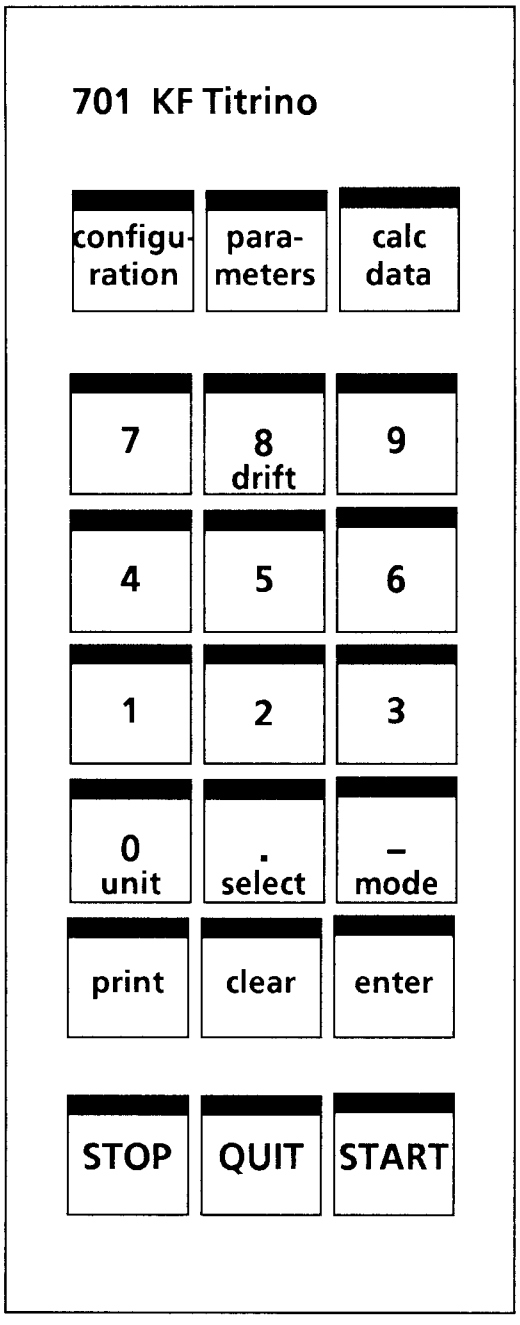
The result is recalculated and the first line of the display shows

–d means that a drift correction has been performed.
If you have connected a printer, the **full** report provides you with all data for recalculation of the result:

```
date 1998-11-23     time 14:45:27     6
smpl size      0.02 g
KFR volume    3.459 ml
titer        5.3326 mg/ml
drift man.      2.2 ul/min
(-d)time       1:03
water         922.2 mg/ml
          ==========
```

2.2 Detailed description

2.2.1 Keypad



<configuration>: Entry keys with rolling
<parameters>: inquiries. Principle of data
<calc data>: entry see page 14, example page 4.

<drift>: ON/OFF switching of the drift display (see page 29)

<unit>:
- result unit
- sample size unit

(see page 28)

<select>:
- selection of fixed values ":"
- switching result/mean

<mode>: Mode selection (see page 15)

<print> + key X + <enter>:
Printing out a report (see page 29)

<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 ">"
- closes command sequences, e.g. <mode> <enter>

<STOP>: Stops operations, e.g. conditioning, titration; instrument returns to standby state.

<QUIT>: Exit from
- rolling inquiries; leads to next highest level
- printing

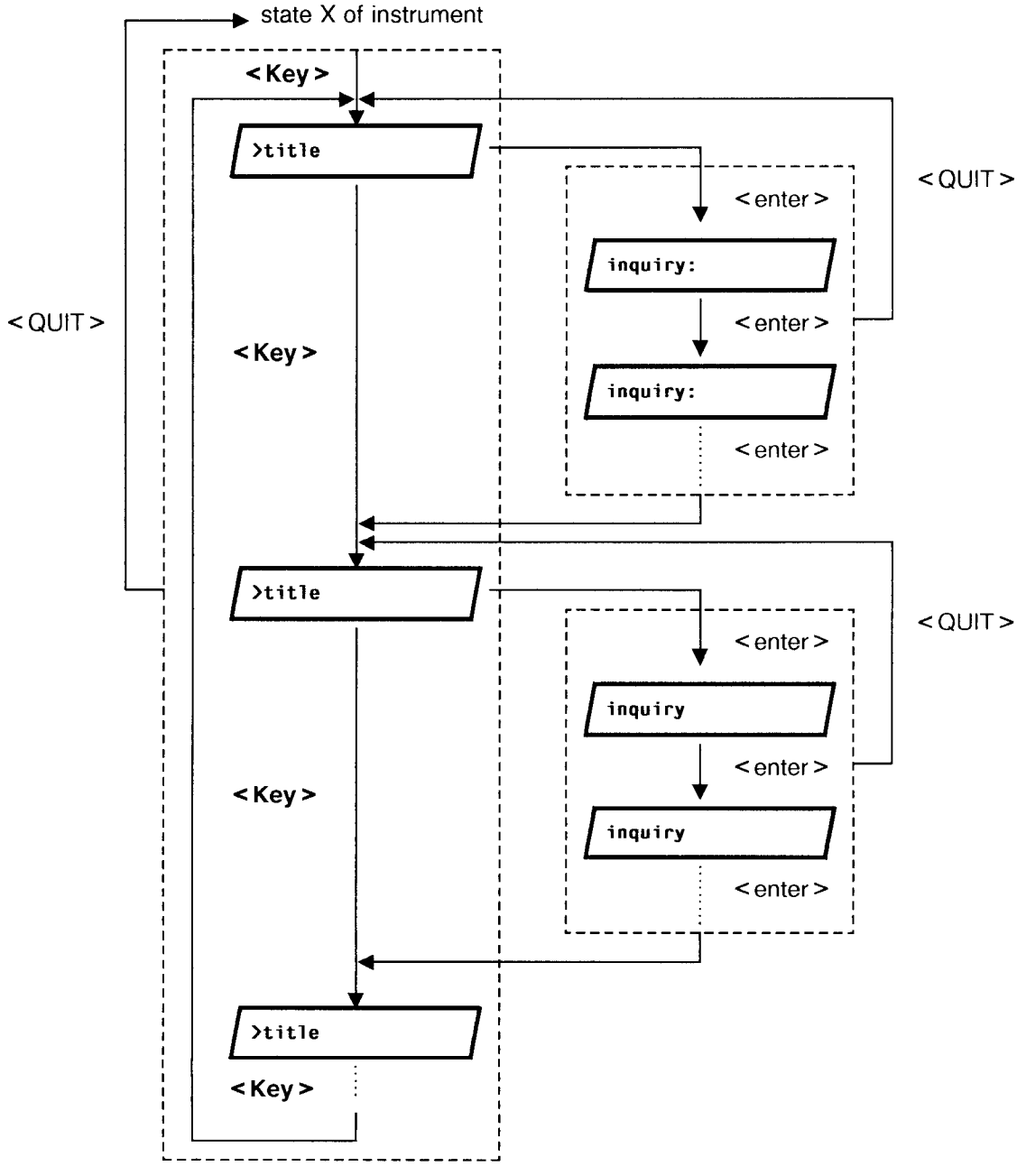
<START>: Starts operations, e.g. conditioning, titration.

2.2.2 Entry keys with rolling inquiries

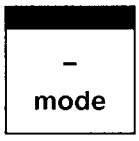
The keys <configuration>, <parameters>, and <calc data> are organised as rolling inquiries according to the following principles:

- The inquiries are combined in groups. Repeated pressing of the <configuration>, <parameters>, and <calc data> keys fetches the titles of the groups to the display. All titles are flagged with the character ">" before the dialog text. <enter> is used to branch to the individual inquiries of the associated group.
- 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 way of the selection of fixed values with the <select> key. All entries in which the <select> key is used are flagged with a colon ":" after the dialog text.
- <QUIT> can be used to exit the inquiries. The next highest level appears, i.e. return to the title of the inquiry group or the state X of the instrument (state X is any state, such as standby state, conditioning, or titration).

The organisation of the rolling inquiries is shown schematically below:



2.2.3 Mode selection, <mode> key



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

The following modes can be selected:
- KFT: Karl Fischer Titration
- Titer determination with water or a water-containing standard
- Titer determination with sodium tartrate
- Blank determination

The set values under the <configuration> and <parameters> keys apply to all modes, whereas the calculations differ for each mode. Once values have been set they remain effective even if the instrument is switched off.

2.2.4 Configuration, <configuration> key

The <configuration> key serves to enter data specific to the instrument. These entries apply to all modes. The key is organised as a rolling inquiry. The quantities marked with "* cond." are also accessible during the conditioning.

>Kf device settings	**KF device settings for all modes**
limit KF reag. OFF	*KF reagent volume counter (0...999 ml, OFF)* is used for monitoring of the – reagent supply – the buffer capacity of the solvent with 2-component reagents <clear> sets "OFF". If the KF reagent volume counter is activated, the inquiry of the current counter status follows
actual KF reag. 0 ml	*Current counter status (0...999 ml)*
polarizer: I(pol)	*Selection of the polarisation mode (I(pol), U(pol))*
I(pol) 50 µA	*Polarisation current (–127...127 µA)*
EP 250 mV	*Endpoint voltage (–1500...1500 mV)*
* cond.	

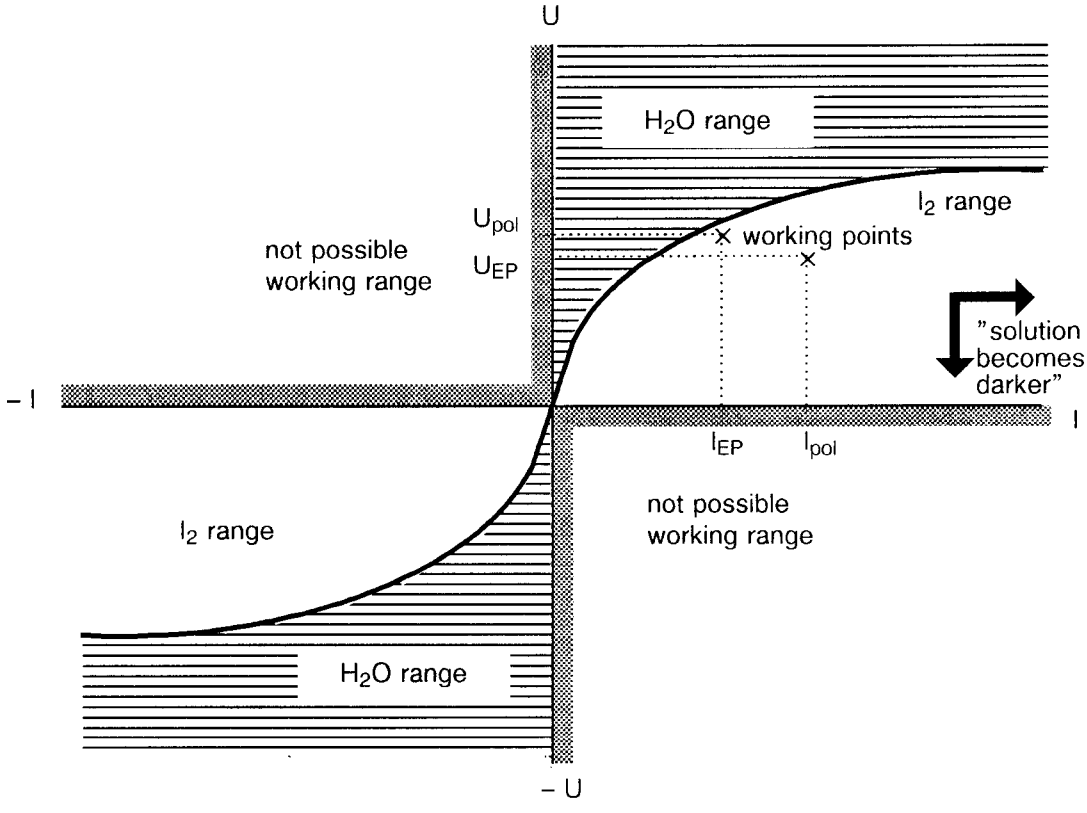
KF device settings for all modes, cont'd

U(pol) 500 mV	*Polarisation voltage (–1270...1270 mV)* Entry in steps of 10 mV, values in between are rounded off.
EP 25 µA * cond.	*Endpoint current (–150...150 µA)*
filling rate max. * cond.	*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
>RS232 settings	**Settings for the RS232 interface** see also page 48 – RS232 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)*
RS control: ON	*Control via RS232 interface (OFF, ON)* "OFF" means that data input via the RS232 interface is blocked. Data output is nonetheless possible.

>peripheral units	**Settings for peripheral units**
send to: IBM	*Selection of the printer type/character set (Epson, Seiko, IBM)* "Epson" e.g. for Epson P40, P80. "Seiko" e.g. for DPU-411 "IBM" for all printers with IBM character set table 437, as well as for the data transmission to a computer or a data system.
balance: Sartorius	*Selection of the balance type (Sartorius, Mettler, AND, Precisa)* Sartorius: Type MP8 Mettler: Types AT, AM, PM and balances with 011 and 016 interfaces AND: Types ER-60, 120, 180, 182, FR-200, 300 and FX-200, 300, 320 Precisa: Types with RS232C interface
record: V vs.t	*Selection of the type of the curve for the output at the analog output (V vs.t, dV/dt vs.t, U vs.t, –U vs.t)* "V vs. t": Volume vs.time curve "dV/dt vs.t": Drift vs.time curve "U vs.t": Control deviation of (current value–EP) vs.time curve
>auxiliaries	**Various auxiliary settings**
dialog: english	*Selection of the dialog language (english, deutsch, français, español)*
date 1998-11-23	*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 run number (0...999)* The run number is set to 0 when the instrument is switched on.
electrode test: ON	*Running of the electrode test on start of the conditioning or titration (ON, OFF)* "ON" means the test is performed and the error message "check electrode" appears if the test was unsuccessful.
display KFR vol.: ON	*Display of the dispensed KFR volume in the result display (ON, OFF)* "ON" means that the dispensed KFR volume will be displayed in the result output on the first line.
device label	*Device label for the individual identification of instruments in an instrument network (up to 8 ASCII characters)*
program 701.0010	*Display of the program version*

Relation between the polarisation mode and the associated titration endpoint



The solution becomes darker the higher the current and the lower the voltage is set.

2.2.5 Parameters, <parameters> key

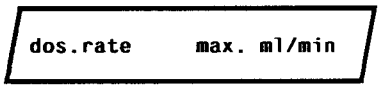
para-
meters

The <parameters> key is used for the entry of values that determine the titration sequence. These entries and values are the same for all modes. Deviations from this rule are specially marked. The key is organized as a rolling inquiry. Values marked with "* cond." are accessible during the conditioning, and "** titr" means that these entries are always possible, even during the titration.

>titration parameters	**Titration parameters**
extr.time 0 s ** titr.	*Extraction time (-9999...9999 s)* for – samples that evolve water slowly – work with the KF oven. With positive extraction times, titration is performed continuously during this time; with negative values no titrant is added during the extraction time. The extraction time can be aborted with <QUIT>.
stop crit.: drift ** titr.	*Type of stop criterion (drift, time)*
stop drift 20 µl/min ** titr.	*Switch off titration when endpoint and stop drift are reached (1...999 µl/min)*
t(delay) 10 s ** titr.	*t(delay) (0...99 s)* Switch off when the endpoint has been reached and the set time following the last dispensing operation has elapsed.
stop V 99.99 ml ** titr.	*Stop volume (0.00...99.99 ml, OFF)* Safety stop, e.g. if no endpoint is found. <clear> sets "OFF".

* cond.

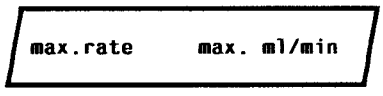
Start volume (0.00...99.99 ml)
Performed and inquired only in KFT mode. Start volume is dispensed before titration start. In the case of a negative extraction time, after the extraction time has elapsed. If a start volume has been entered, an inquiry appears regarding the dosing rate:



* cond.

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

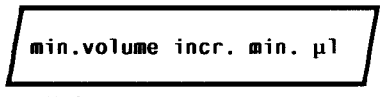
Exchange Unit	max.
5 ml	15 ml/min
10 ml	30 ml/min
20 ml	60 ml/min
50 ml	150 ml/min



** titr.

Maximum titration rate (0.01...150 ml/min, max.)
The max.rate can be limited, see also page 24.
<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.

Minimum volume increment in the titration (0.1...9.9 µl, min.)
The minimum volume increment can be increased to shorten the titration time, see also page 24.
<clear> sets "min.".
The minimum increment depends on the Exchange Unit:

Exchange Unit	min.
5 ml	0.5 µl
10 ml	1 µl
20 ml	2 µl
50 ml	5 µl

>preselections

Preselections for the titration sequence and the data output

---

conditioning: ON

Conditioning (ON, OFF)
Drying of the titration cell before and after the titration.

---

req.ident.: OFF

Automatic request of the sample identification after the titration start (ON, OFF)
Not performed or inquired in the "BLANK" mode.

---

req.smpl size: ON

Automatic request of the sample size after the titration start (ON, OFF)
Not performed or inquired in the "BLANK" mode.

---

report: OFF

Selection of the result report on titration completion (short, full, OFF).

```
date 1998-10-23      time 09:07:54      4
smpl size    0.12345 g     ident.      2-4
KFR volume     3.251 ml
blank         0.0315 ml
titer         5.3326 mg/ml
drift man.         3 µl/min
(-d)time        1:02
water          23.45 %
          ==========
```

Example of a **full** result report:
Date, time, current run number

The line "blank" is printed out only if a blank value ≠ 0 mL has been entered.

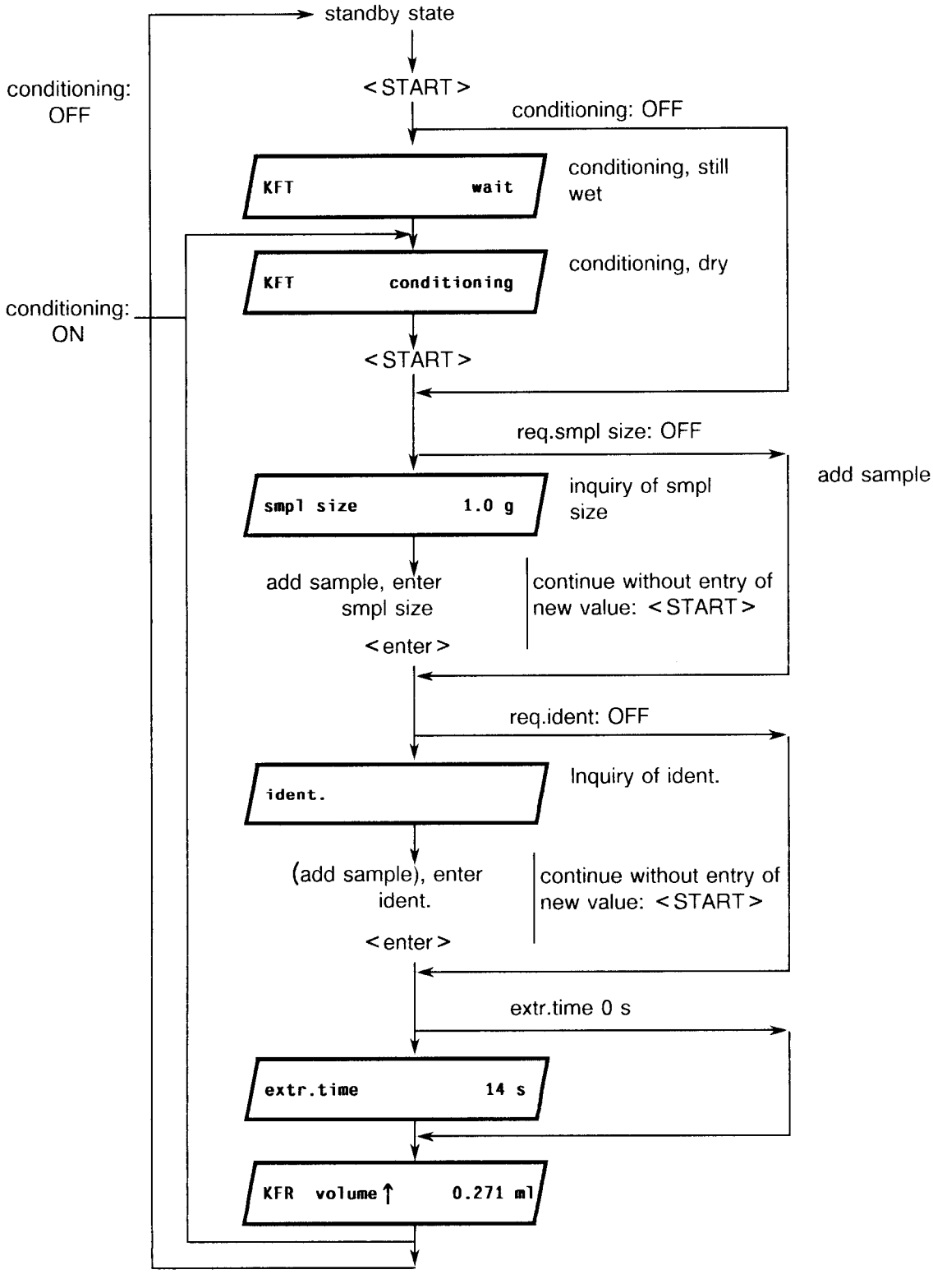
"(–d)time" is the time for reconciliation of the drift correction in the result calculation. The lines "drift" and "(-d)time" are printed out only if the drift correction has not been set to "OFF".

```
date 1998-10-23      time 09:12:31      5
smpl size    0.12345 g     ident.      2-5
water          23.45 mg/ml
mean (3)       23.76 mg/ml
+/-s           0.135 mg/ml
s(rel)          0.57 %
          ==========
```

Example of a **short** report. incl. statistics calculations
Mean value with 3 single results
Standard deviation
Relative standard deviation

2.2.6 Titration sequence

The titration sequence can be configured depending on your special needs. The following parameters determine the sequence (see scheme below):
- conditioning (ON, OFF)
- request of sample size after the start of the titration (ON, OFF)
- request of identification after the start of the titration (ON, OFF)
- extraction time (-9999...0...9999 s)



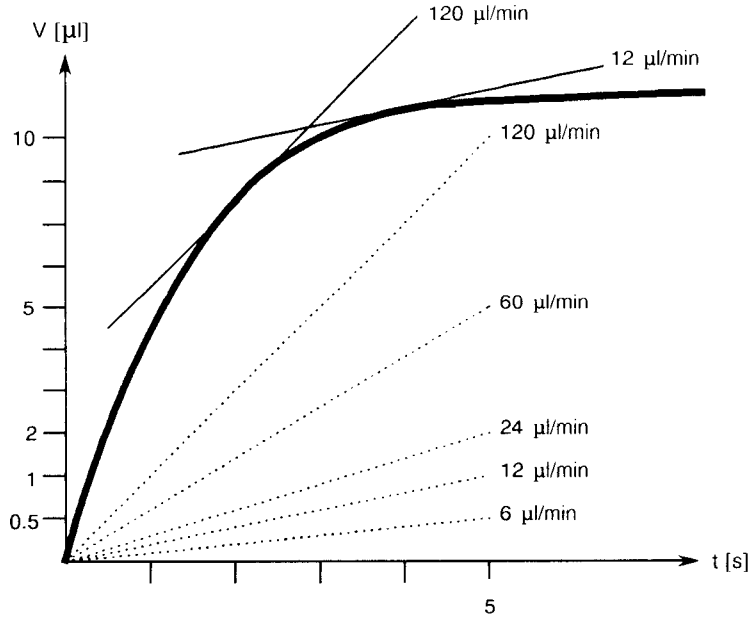
2.2.7 What titration parameters are best?

The standard settings of the 701 KF Titrino are suitable for rapid standard titrations using any KF reagent that is comercially available. If you wish to modify your existing titration instructions to take into account the new stop criterion "drift stop", you will find the following useful:

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

The stop criterion "time", t(delay), means that the endpoint must be exceeded over a certain period of time t. In other words, after the last dispensed increment the time t is waited for before the titration is terminated. The size of the last increment depends on the volume of the Exchange Unit used (or on the preset value for "min.volume increment"). With a 20 mL Exchange Unit the smallest increment is 2 µL. In the case of a t(delay) of 5 s the last 2 µL KF reagent must suffice for 5 s or longer. This produces a drift of ≤ 2 µL/5 s = 24 µL/min (the drift can be less than 24 µL/min since it is not known whether the last increment would also have sufficed e.g. for 10 s). If you have hitherto worked with a 20 mL Exchange Unit and a t(delay) of 5 s, you can set the stop drift to 24 µL/min. The following table shows a few reference values.

t(delay) / Min.Incr.	5 s	10 s	20 s
0.5 µl	6 µl/min	3 µl/min	1.5 µl/min
1 µl	12 µl/min	6 µl/min	3 µl/min
2 µl	24 µl/min	12 µl/min	6 µl/min
5 µl	60 µl/min	30 µl/min	15 µl/min
10 µl	120 µl/min	60 µl/min	30 µl/min



The same t(delay) and different smallest volume increments mean different stop points for the titration. Using the stop criterion "drift", however, the stop point for the titration remains constant.

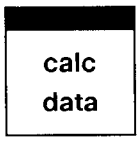
The determination of the free water is trouble-free provided the specifications of the reagent manufacturer regarding the "water capacity" of the reagents are considered. Problems can arise with special sample matrices. The relevant literature (see page 85) contains many precise analysis instructions. In the following table we attempt to show you solutions related more to the instrument's side:

What should you do if ...

Problem	Possible causes and remedial action
Dispensing at end too long and increments too small. "Is never finished!"	– Increase "min.volume incr.".Try, e.g. 1 µl for 5 ml Exchange Unit 5 µl for 10 ml und 20 ml Exchange Units – Change stop criterion. Try, e.g. stop drift = 50 µl/min or t(delay) = 5 s
The increments at the end of the titration are too large. "Overshoots".	– Lower "max.rate". The following experiment gives you a reference point for the optimum max.rate: Display the drift during conditioning and add sample without starting the titration. Select a value below the maximum drift as "max.rate". – Change stop point by changing the working point of the indication system, see page 18. – Optimize setup of electrode and burette tip and improve stirring, see page 72.
Solution becomes too brown at the end of the titration.	– The methanol fraction in the solvent is too low. Change the solvent. – Change stop point by changing the working point of the indication system, see page 18. – Electrode could be coated; wipe off with acetone.
Solution becomes darker with every titration.	– Renew solvent. – Electrode could be coated; wipe off with acetone.
The drift increases with every titration.	– Does your sample evolve water extremely sluggishly? Work with the KF oven. – Are acids esterified in your sample? Change solution more frequently. Increase buffer capacity of the solvent. – Does your sample contain ketones or aldehydes? Use special reagents suitable for ketones and aldehydes.
The endpoint is reached "too rapidly".	– Reduce max.rate. – Change stop point by changing the working point of the indication system, see page 18.
The titration times become longer and longer.	– With 2-component reagents the buffer capacity of the solvent can be exhausted. Change solution. Use the KF reagent volume counter to monitor the buffer capacity. – If the drift increases at the same time, see there.

2.2.8 Calculations

<calc data> key



The <calc data> key is used to enter the values for the calculations. The values are specific to a sample (sample size and identification) or to a mode (titer, factor, blank, mean value), and the drift correction applies to all modes. On exit, the result is always recalculated. Values flagged with "* cond." are accessible during the conditioning, and "** titr." means that these entries are always possible, even during the titration.

>calculation	Calculation
smpl size 1.0 g ** titr.	*Sample size (6-digit number: ±X.XXXXX)* The sample size can be entered – manually – via a balance. Sample sizes that are inquired automatically in the titration sequence can be viewed and modified with the <calc data> key. For calculation the absolute sample size is used (negative signs that appear, e.g. in backweighing are ignored). No inquiry of sample size in the "BLANK" mode.
ident. ** titr.	*Sample identification (up to 8 ASCII characters)* The sample identification can be entered – manually – via balance input device. Identifications that are inquired automatically in the titration sequence can be viewed and modified with the <calc data> key. No inquiry of ident. in the "BLANK" mode.
titer 5 mg/ml * cond.	*Titer (0.0000...99.9991 mg/ml)* The titer is written in automatically from the titer determination modes. Request only in the "KFT" mode.
factor 0.1 * cond.	*Factor (±1 000 000)* in the numerator of the calculation formula. Entries for factors with different units for results and sample size, see page 27.

* cond.

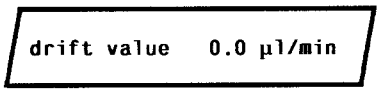
Divisor (± 1 000 000)
in the denominator of the calculation formula. Used mainly for the density, see page 27.
Request only in "KFT" mode.

* cond.

Blank (0.0000...99.9991 ml)
The blank value is written in automatically from the blank determination mode. Values that are corrected by a blank value are flagged with "–b".
Request only in "KFT" mode.

* cond.

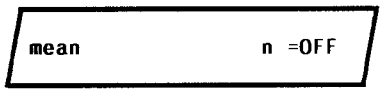
Drift correction for the titration result (auto, man., OFF)
With the drift correction switched on, the value (drift * titration time) is subtracted from the KFR volume. Values that have been corrected by the drift are flagged with "–d".
auto: The drift value at the start of the titration is subtracted.
man: A fixed value of the drift is entered and subtracted.
If the drift correction is set to "man.", the drift value is requested:



* cond.

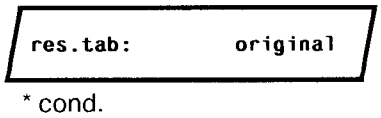
Drift value for the manual drift correction (0.0...99.9 µl/min)

Statistics



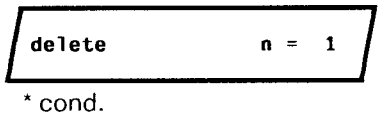
* cond.

Mean value calculation from n single results (2...20, OFF)
Calculation of the mean value and standard deviation.
If the mean value calculation is activated, the inquiry follows



* cond.

Result table for the statistics (original, delete all, delete n)
original: The original table is used. Deleted results are again incorporated in the evaluation.
delete all: The whole table is deleted.
delete n: A single result with index n is deleted.



* cond.

Index n of the result to be deleted (1...20)
Result with index n is excluded from statistics calculation.

Calculation formulas and units

The calculation formulas are preset and depend on the selected mode:

Formula for the "**KFT**" mode:

$$\text{water(content)} = \frac{(\text{KFR volume} - \text{blank}) * \text{titer} * \text{factor}}{|\text{smpl size}| * \text{divisor}}$$

Factor and divisor are used for the conversion of the result to different units:

unit of result	**smpl size in...**	**factor**	**divisor**
%	g	0.1	1
%	mg	100	1
%	ml	0.1	density of sample [g/ml]
ppm	g	1000	1
ppm	ml	1000	density of sample [g/ml]
ppm	µl	1	density of sample [g/ml]
mg/ml	g	density of sample [g/ml]	1
mg/ml	ml	1	1
mg	1	1	1
ml	1	1	1000 * density H_2O [g/ml]≈1000
mg/pc	pc	1	1

The unit of the result can be selected with the <unit> key, see page 28.

Formula for the titer determination modes "**TITER**":

$$\text{titer} = \frac{|\text{smpl size}| * \text{factor}}{\text{KFR volume}}$$

The factor is used to enter the water content of the standard:

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

Formula for the blank determination "**BLANK**":

$$\text{blank} = \text{KFR volume} * \text{factor}$$

If the blank is determined with an excessive solvent volume, the result can be converted to the amount used subsequently with the aid of the factor.

If the **drift correction** is switched on, the "KFR volume" is corrected in all modes as follows:

$$\text{KFR volume} - d = \text{KFR volume} - (\text{drift value} * (-d)\text{time})$$

"(–d)time" corresponds to the time during which control is exerted (i.e. during the positive extraction time and during the titration time, but not during the dispensing of the start volume and during negative extraction times).
With manual drift correction, the entered drift value is reconciled in the result calculation, whereas with automatic drift correction the drift value at the start of the titration is used.

The drift correction is used when the ingress of moisture during the titration needs to be compensated. A drift correction is appropriate when the ratio

$$\frac{\text{drift} * \text{titration time}}{\text{KFR volume}}$$

is large.

<unit> key

The <unit> key can be used to select the unit of the result in the KFT mode and of the sample size. It is accessible during the conditioning and in the standby state.
In the modes "TITER" and "BLANK", the result unit can be viewed only but not changed.

<unit>

result unit: %

<enter>

result unit: %;2

Unit of the result in the KFT mode (%, ppm, mg/ml, g, mg, ml, mg/pc, no unit).
The unit is selected with <select> and confirmed with <enter>.

Number of decimal places (0...9)
The number of decimal places in the result output follows the separator ";".
The number flashes to draw attention to the fact that this value can now be entered.

smpl size unit: g

Unit for the sample size (g, mg, ml, µl, pc, no unit)
The unit is selected with <select>.

Statistics calculations

If the mean value is active, the following quantities are calculated:
- mean value
- standard deviation
- relative standard deviation.

These values are printed out in the result report or they can be viewed with the <select> key: Press the <select> key repeatedly until the desired value appears in the display. The following are displayed in succession, see also page 8:

current result
mean
standard deviation
relative standard deviation.

A table of the single results can be printed out with the key sequence <print> <1> <enter>.

Remarks:
- If the number of single results n has been reached, the statistics calculation begins anew at the next start.
- When the mode is changed, the statistics instructions of the previous mode come to an end (res.tab. deleted) and the instructions of the new mode are followed.
- Old results that are no longer needed for the statistics calculation can be deleted with "delete all".
- Recalculated single results are immediately incorporated in the statistics calculation.
- If a result can not be calculated, the run counter is incremented. The counter for the number of reconciled single results remains unchanged, however.

2.2.9 Drift display, <drift> key

During the conditioning, the <drift> key can be used to switch the display of the current drift on and off.

The value provides an idea for
- the condition of the titration cell
- whether a drift correction should occur and the magnitude of the drift value
- the sample matrix. Do side reactions take place? Does the sample contain ketones or aldehydes? etc.
- the magnitude of the stop drift as a stop criterion (value above basic drift).

2.2.10 Data output on a printer

The following reports can be printed out:

- **Result reports**
  Printout automatic
  – at the end of the titration
  – after every recalculation of the result.
  Original reports have a line of double dashes = = = = at the end, whereas recalculations are identified by a line of single dashes – – – –.

  Depending on the preselection, a **full** or a **short** result report is printed out.

- **Contents of the <configuration> key** with the key sequence
  <print> <configuration> <enter>

- **Contents of the <parameters> key** with the key sequence
  <print> <parameters> <enter>

- **Contents of the <calc data> key** with the key sequence
  <print> <calc data> <enter>

- **Table of the single results for the statistics calculations** with the key sequence
  <print> <1> <enter>

Printouts can be aborted with key <QUIT>.

3. Operation via RS232 interface

3.1 General rules

The 701 KF 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 always used as terminators for the data transfer in both directions. More than one command per line is sent with semicolon (;) as a separator between the individual commands.

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

&Mode.**S**elect **"KFT"**

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

&M.S"KFT"

All quantities of the 701 KF Titrino are collected in groups. For example, the entries for the configuration are in the group

&Config

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

&Config.**R**SSet

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

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

or regarding the setting of the parity

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

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

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

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

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

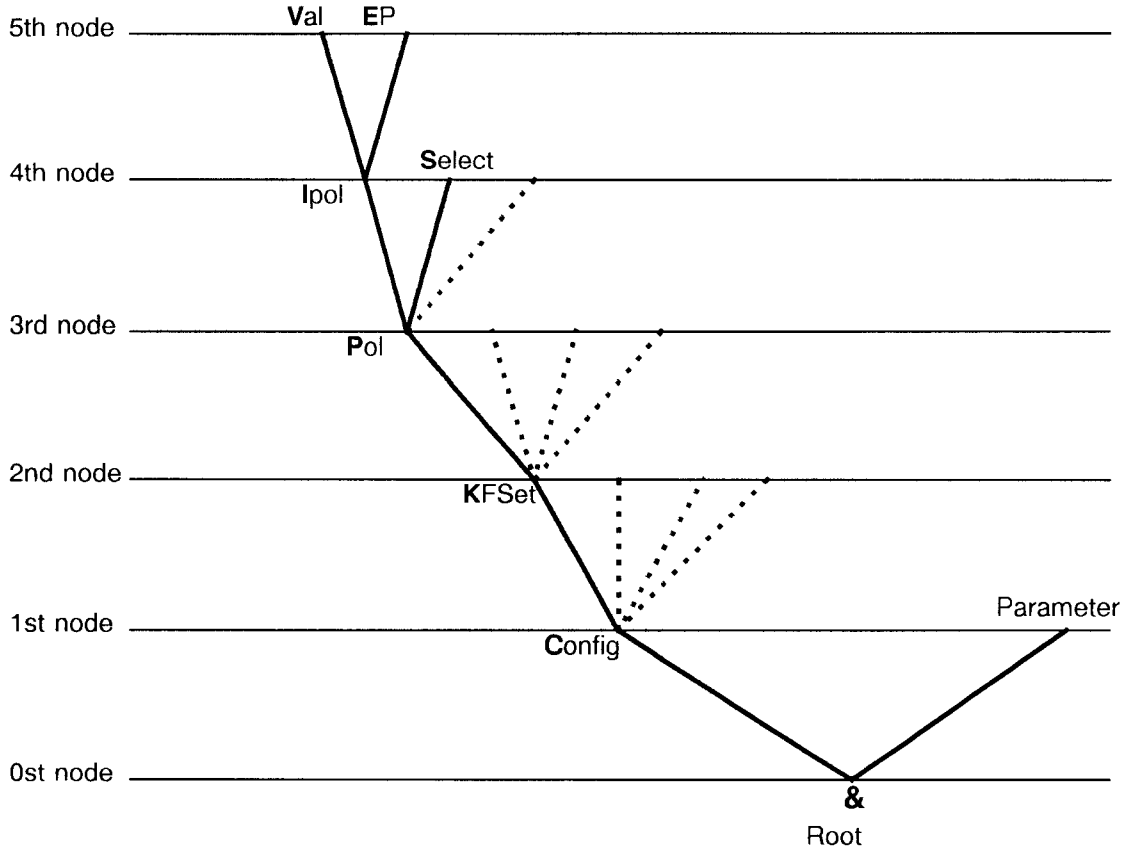
$Q triggers the output of the value from the 701 Titrino. Entries that are introduced with the character dollar ($) trigger something. They are thus called **triggers** in what follows.

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

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

3.1.1 Call up of objects

All objects of the KF 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 polarisation current:
&Config.**K**FSet.**P**ol.**I**Pol.**V**al
or **&C.K.P.I.V**

&C.K.P.I.V
or **&c.k.p.i.v**

Entry of "25" for the polarisation current:
&Config.**K**FSet.**P**ol.**I**Pol.**V**al **"25"**
Correct entries of values:
"-31.2273" or "0.1"
Incorrect entries:
"1,5" or " + 3" or ".1"

Entry of a different polarisation current: **"50"**

- 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 IPol:
&Config.**K**FSet.**P**ol.**I**Pol
Forwards from the node IPol to EP: **.E**P

Jump from EP onto the node IPol and selection of a new object Val: **..V**al
Jump from the object Val over the node Ipol to the node Pol and to the new node Select: **...S**elect

Change from the node Select via the root into the node Parameter:
&Parameter

3.1.2 Triggers

Triggers initiate an action at the KF 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
$Q	Query:	Used for inquiry of all information from the current node in the tree upwards up to and including the values
$P	Path:	Used for inquiry of the path from the root of the tree up to the current node
$I	Information:	Used for inquiry of the global status
$D	Detailed Info:	Used for inquiry of the detailed status
$U	qUit:	Used to abort the data flow, e.g. after $Q

The triggers $G and $S are linked to objects, see overview table, page 36.

The triggers $Q, $P, $I, $D and $U, on the other hand, 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 **$P**
Start of the current mode: **&M**ode **$G**
Inquiry of the detailed status: **$D**

3.1.3 Status conditions, error messages

So that a meaningful control by an external control device is possible, it must also be possible to query status conditions; they provide information on the status of the KF Titrino. The triggers $I and $D initiate output of the status. The KF Titrino can react with the following outputs:

- **$I** (global information):

$G	Go: The KF Titrino is executing the last command.
$G;E	Go with Error.
$R	Ready: The KF Titrino has executed the last command and is ready.
$R;E	Ready with Error.
$S;E	Stop with Error: A procedure has been stopped "in an unnatural manner", e.g. termination of the titration as the stop volume has been reached.

- **$D** (detailed information):
  To the inquiry regarding the detailed status, the KF Titrino responds with output of the global information as above. In addition, the complete path of the current operation and the current status is shown.

Detailed status conditions

Status conditions of the global $G:

$G	.Mode.KFT	.Cond	.Wet:	Instrument in KFT mode, being conditioned, wet.
			.Dry:	Instrument in KFT mode, being conditioned, dry.
		.Titr	.VSta:	Instrument in KFT mode, in titration sequence, dispensing of the start volume.
			.Extr:	Instrument in KFT mode, in titration sequence, waiting out the extraction time.
			.IReq:	Instrument in KFT mode, in titration sequence, waiting for entry of the sample identification.
			.SReq:	Instrument in KFT mode, in titration sequence, waiting for entry of the sample size.
			.Titr:	Instrument in KFT mode, in titration sequence, titration being performed.
$G	.Mode.H2O	.Cond	.Wet:	Instrument in H20Tit mode, being conditioned, wet.
			.Dry:	Instrument in H20Tit mode, being conditioned, dry.
		.Titr	.Extr:	Instrument in H20Tit mode, in titration sequence, waiting out the extraction time.
			.IReq:	Instrument in H20Tit mode, in titration sequence, waiting for entry of the sample identification.
			.SReq:	Instrument in H20Tit mode, in titration sequence, waiting for entry of the sample size.
			.Titr:	Instrument in H20Tit mode, in titration sequence, titration being performed.
$G	.Mode.Tar	.Cond	.Wet:	Instrument in TarTit mode, being conditioned, wet.
			.Dry:	Instrument in TarTit mode, being conditioned, dry.
		.Titr	.Extr:	Instrument in TarTit mode, in titration sequence, waiting out the extraction time.
			.IReq:	Instrument in TarTit mode, in titration sequence, waiting for entry of the sample identification.
			.SReq:	Instrument in TarTit mode, in titration sequence, waiting for entry of the sample size.
			.Titr:	Instrument in TarTit mode, in titration sequence, titration being performed.
$G	.Mode.Blk	.Cond	.Wet:	Instrument in Blank mode, being conditioned, wet.
			.Dry:	Instrument in Blank mode, being conditioned, dry.
		.Titr	.Extr:	nstrument in Blank mode, in titration sequence, waiting out the extraction time.
			.Titr:	Instrument in Blank mode, in titration sequence, titration being performed.
$G	.Assembly.Bur		.Dos:	Instrument in burette function, dispensing being performed.
			.Fill:	Instrument in burette function, filling being performed.

Status conditions of the global $R:

$R	.Mode.KFT	.Cond	.Wet:	Instrument in KFT mode, being conditioned, wet.
			.Dry:	Instrument in KFT mode, being conditioned, dry.
		.Inac:		Instrument in KFT mode, in titration sequence, in standby state.
$R	.Mode.H2O	.Cond	.Wet:	Instrument in H20Tit mode, being conditioned, wet.
			.Dry:	Instrument in H20Tit mode, being conditioned, dry.
		.Inac:		Instrument in H20Tit mode, in titration sequence, in standby state.
$R	.Mode.Tar	.Cond	.Wet:	Instrument in TarTit mode, being conditioned, wet.
			.Dry:	Instrument in TarTit mode, being conditioned, dry.
		.Inac:		Instrument in TarTit mode, in titration sequence, in standby state.
$R	.Mode.Blk	.Cond	.Wet:	Instrument in Blank mode, being conditioned, wet.
			.Dry:	Instrument in Blank mode, being conditioned, dry.
		.Inac:		Instrument in Blank mode, in titration sequence, in standby state.
$R	.Assembly.Bur.Dos:			Instrument in burette function, in DOS mode, in standby state.

Status conditions of the global $S:
The detailed status conditions are displayed in an analogous manner to those of $R. The instrument is always inactive.

Error messages:

E20 Check exchange unit.
Exit: Mount Exchange Unit (properly).

E21 Check electrode, short circuit
Exit: Rectify fault.

E22 Check electrode, break
Exit: Rectify fault.

E23 Division by zero.
Exit: Enter different value for sample size or divisor and trigger recalculation.

E25 Change solvent.
Exit: Zero the current reagent volume counter (&Config.KFSet.ActReag). The error message disappears on next startup.

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

E27 Stop V reached.
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.
Exit: Send correct value or call up new object.

E30 Wrong trigger.
Exit: Send correct trigger (exception: $I and $D) or call up new object.

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

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

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 KF 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 KF 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.

3.2 Remote control commands

3.2.1 Overview

Object	Function	Input range	see...
&	**Root**		
Mode	**Mode**	$G,$S	3.2.2.1
.Select	Selection of the mode	KFT,H2OTit,TarTit,Blank	3.2.2.2
Config	**Configuration**		
.KFSet	**Settings for KF titrations**		
.LimReag	Reagent volume counter	0...999,OFF	3.2.2.3
.ActReag	Current reading of LimReag	0...999	3.2.2.3
.Pol	Polarisation of the electrode		
.Select	Selection of the polarisation mode	I(pol),U(pol)	3.2.2.4
.IPol	Polarisation current		
.Val	Value of polarisation current	-127...127	3.2.2.5
.EP	Associated endpoint	-1500..1500	3.2.2.5
.UPol	Polarisation voltage		
.Val	Value of polarisation voltage	-1270...1270	3.2.2.6
.EP	Associated endpoint	-150...150	3.2.2.6
.FillRate	Filling rate	0.01...150,max.	3.2.2.7
.RSSet	**Settings for RS232**	$G	3.2.2.8
.Baud	Baud rate	special (300...9600)	3.2.2.9
.DataBit	Data bit	7,8	3.2.2.9
.StopBit	Stop bit	1,2	3.2.2.9
.Parity	Parity	even,odd,none	3.2.2.9
.Handsh	Handshake	HWs,HWf,SWchar, SWline,none	3.2.2.9
.PeriphUnit	**Selection of external devices**		
.CharSet	Selection of the character set	Epson,Seiko,IBM	3.2.2.10
.Balance	Selection of the balance	Sartorius,Mettler AND,Precisa	3.2.2.11
.Plot	Selection of curve at analog output	V vs.t,dV/dt vs.t, U vs.t,-U vs.t	3.2.2.11
.Aux	**Setting of various auxiliary functions**		
.Language	Selection of the dialog language	english,deutsch, francais,espanol	3.2.2.12
.Date	Date	XXXX-XX-XX	3.2.2.13
.Time	Time	XX:XX	3.2.2.13
.RunNo	Current run number	0...999	3.2.2.14
.ElectrCheck	Electrode test	ON,OFF	3.2.2.15
.Display	Volume display on result output	ON,OFF	3.2.2.16
.MethName	Name of method	up to 8 ASCII characters	3.2.2.17
.DevName	Device name	up to 8 ASCII characters	3.2.2.17
.Prog	Program version	read only	3.2.2.18
Parameter	**Parameters**		
.Titr	**Titration parameters**		
.ExtrT	Extraction time	-9999...9999	3.2.2.19
.Type Stop	Stop criteria		
.Select	Selection of stop criterion	drift,time	3.2.2.20
.Drift	Magnitude of stop drift	1...999	3.2.2.21
.Time	Magnitude of t(delay)	0...99	3.2.2.21
.StopV	Stop volume	0.00...99.99,OFF	3.2.2.19
.StartVKFT	Start volume in KFT mode		
.Val	Value of the start volume	0.00...99.99	3.2.2.22
.DosRate	Dispensing rate for StartV	0.01...150	3.2.2.22
.MaxRate	Maximum titration rate	0.01...150,max.	3.2.2.19
.MinIncr	Minimum volume increment	0.1...9.9,min.	3.2.2.19

Object	Function	Input range	see...
&	**Root**		
	Parameters, cont'd		
.Presel	**Preselections**		
.Cond	Conditioning	ON,OFF	3.2.2.23
.IReq	Inquiry "Ident" after titration start	ON,OFF	3.2.2.24
.SReq	Inquiry "Smpl Size" after titration start	ON,OFF	3.2.2.24
.Report	Selection of report output	full,short,OFF	3.2.2.25
DataCalc	**Data for the calculation**	$G	3.2.2.26
.ComCalc	**Calculation parameters for all modes**		
.Titer	Titer	0.0000...99.9991	3.2.2.27
.Blank	Blank value	0.0000...99.9991	3.2.2.27
.DCor	Drift correction		
.Type	Type of drift value entry	auto,man.,OFF	3.2.2.28
.Val	Drift value	0.0...99.9	3.2.2.28
.DTime	Time for drift deduction	read only	3.2.2.29
.KFRVol	KFR volume at end of titration	read only	3.2.2.30
.ValRes	Numeric value of calculated result	read only	3.2.2.31
.ModeCalc	**Mode-dependent calculation parameters**		
.KFT	**Karl Fischer Titration**		
.SmplSize	Sample size, weight	±X.XXXXX	3.2.2.32
.Ident	Sample identification	up to 8 ASCII characters	3.2.2.33
.Factor	Factor	±1 000 000	3.2.2.34
.Divisor	Divisor	±1 000 000	3.2.2.34
.MeanN	Mean value calculation with n values	2...20,OFF	3.2.2.35
.Unit	Unit		
.Res	For the calculated result		
.Unit	Unit	%,ppm,mg/ml,g, mg,mg/pc,-	3.2.2.36
.Dpl	Number of decimal places	0...9	3.2.2.36
.Smpl	For the sample size		
.Unit	Unit	g,mg,ml,ul,pc,-	3.2.2.37
.H2OTit	**Titer determination with H_2O or standard**		
.SmplSize	Sample size, weight	±X.XXXXX	3.2.2.32
.Ident	Sample identification	up to 8 ASCII characters	3.2.2.33
.Factor	Factor	±1 000 000	3.2.2.34
.MeanN	Mean value calculation with n values	2...20,OFF	3.2.2.35
.Unit	Unit		
.Res	For the result		
.Unit	Unit	read only	3.2.2.36
.Dpl	Number of decimal places	read only	3.2.2.36
.Smpl	For the sample size		
.Unit	Unit	g,mg,ml,ul,pc,-	3.2.2.37
.TarTit	**Titer determination with sodium tartrate**		
.SmplSize	Sample size, weight	±X.XXXXX	3.2.2.32
.Ident	Sample identification	up to 8 ASCII characters	3.2.2.33
.Factor	Factor	±1 000 000	3.2.2.34
.MeanN	Mean value calculation with n values	2...20,OFF	3.2.2.35
.Unit	Unit		
.Res	For the result		
.Unit	Unit	read only	3.2.2.36
.Dpl	Number of decimal places	read only	3.2.2.36
.Smpl	For the sample size		
.Unit	Unit	g,mg,ml,ul,pc,-	3.2.2.37
.Blank	**Blank determination**		
.Factor	Factor	±1 000 000	3.2.2.34
.MeanN	Mean value calculation with n values	2...20,OFF	3.2.2.35
.Unit	Unit		
.Res	For the result		
.Unit	Unit	read only	3.2.2.36
.Dpl	Number of decimal places	read only	3.2.2.36

Object	Function	Input range	see...
&	**Root**		
	Data for the calculation, cont'd		
.Statistics	**Statistics**		
.ActN	Current number of single results	read only	3.2.2.38
.Mean	Mean value	read only	3.2.2.38
.Std	Standard deviation	read only	3.2.2.38
.RelStd	Relative standard deviation	read only	3.2.2.38
.ResTab	Result table		
.Select	Selection	original,delete all, delete n	3.2.2.39
.DelN	Delete single results	1...20	3.2.2.40
Info	**Information**		
.Report	**Transmission of formatted reports**	$G	3.2.2.41
.Config	Configuration report	$G	3.2.2.42
.Parameter	Parameter report	$G	3.2.2.42
.DataCalc	CalcData report	$G	3.2.2.42
.Res	Result report		
.Short	Short result report	$G	3.2.2.42
.Full	Full result report	$G	3.2.2.42
.Mean	Single results for statistical calculation	$G	3.2.2.42
.ActualInfo	**Current information**		
.SendMeas	Transmission of measured values		
.CyclNo	Cycle number	read only	3.2.2.43
.V	Volume	read only	3.2.2.44
.U	Control deviation	read only	3.2.2.44
.Vdt	Volume drift dV/dt	read only	3.2.2.44
.Udt	Measurement signal drift dU/dt	read only	3.2.2.44
.UdV	Derivative of titration curve dU/dV	read only	3.2.2.44
.Display	Display		
.1	1st line	up to 24 ASCII characters	3.2.2.45
.2	2nd line	up to 24 ASCII characters	3.2.2.45
Assembly	**Basic elements of assembly**		
.Bur	**Burette**		
.Dos	Dispensing function	$G,$S	3.2.2.46
.UpRate	Delivery rate		
.Select	Selection of the type of rate control	digital,analog	3.2.2.47
.Val	Entry of the digital rate	0.01...150,max.	3.2.2.47
.VLim	Limit volume	0.000...9999.999,OFF	3.2.2.48
.Pos	Piston position	read only	3.2.2.49
.Fill	Filling	$G	3.2.2.50
.DwnRate	Filling rate		
.Select	Selection of the type of rate control	digital,analog	3.2.2.51
.Val	Entry of the digital rate	0.01...150,max.	3.2.2.51
.ExV	Request Exchange Unit volume	read only	3.2.2.52

Object	Function	Input range	see...
&	**Root**		
Setup	**Setting of the operating mode**		
.Keycode	Send key code of pressed keys	ON,OFF	3.2.2.53
.Lock	**Disable various functions**		
.Keyboard	Disable all keys of 701	ON,OFF	3.2.2.54
.Config	Disable the <configuration> key	ON,OFF	3.2.2.54
.Parameter	Disable the <parameters> key	ON,OFF	3.2.2.54
.DataCalc	Disable the <calc data> key	ON,OFF	3.2.2.54
.Display	Disable the display facility of the 701	ON,OFF	3.2.2.54
.SendMeas	**Automatic transmission of measured values**		
.SendStatus	On/off switching of transmission	ON,OFF	3.2.2.55
.Interval	Time interval for transmission	0.08...16200	3.2.2.56
.CyclTime	Inquiry regarding cycle time of instrument	read only	3.2.2.57
.Select	Selection	val	
.Val	Values that are transmitted		
.CyclNo	Cycle number	ON,OFF	3.2.2.58
.V	Associated volume	ON,OFF	3.2.2.58
.U	Associated control deviation	ON,OFF	3.2.2.58
.Vdt	Associated volume drift	ON,OFF	3.2.2.58
.Udt	Associated measured value drift	ON,OFF	3.2.2.58
.UdV	Associated 1st derivative of titr. curve	ON,OFF	3.2.2.58
.AutoInfo	**Automatic message after status changes**		
.R	When instrument in "ready" status	ON,OFF	3.2.2.59
.S	When instrument in "stop" status	ON,OFF	3.2.2.59
.E	Error message	ON,OFF	3.2.2.59
.Dry	When titration vessel dry	ON,OFF	3.2.2.59
.Wet	When titration vessel wet	ON,OFF	3.2.2.59
.IReq	When instrument in inquiry "Ident"	ON,OFF	3.2.2.59
.SReq	When instrument in inquiry "Smpl Size"	ON,OFF	3.2.2.59
.Extr	When an extraction time is waited out	ON,OFF	3.2.2.59
.PowerOn	Simulation "power on"	$G	3.2.2.60
.Initialise	Initialise RAM	$G	3.2.2.61

3.2.2 Description of the remote control commands

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

Start or stop of the current mode, see 3.2.2.2.

3.2.2.2 **M**ode.**S**elect KFT, H2OTit, TarTit, Blank

Selection of the current mode:
KFT Karl Fischer Titration
H2OTit Titer determination with H_2O or standard
TarTit Titer determination with sodium tartrate
Blank Blank determination

3.2.2.3 **C**onfig.**K**FSet.**L**imReag 0...999, OFF
Config.**K**FSet.**A**ctReag 0...999

Reagent volume counter and current reading of this counter.
Entry in mL.

3.2.2.4 **C**onfig.**K**FSet.**P**ol.**S**elect I(pol), U(pol)

Selection of the polarisation mode:
I(pol): Polarisation current, voltametric indication
U(pol): Polarisation voltage, amperometric indication
Changing of the polarisation mode is possible in the standby state of the instrument only.
Relation between polarisation and endpoint, see page 18.

3.2.2.5 **C**onfig.**K**FSet.**P**ol.**I**pol.**V**al –127...127
Config.**K**FSet.**P**ol.**I**pol.**E**P –1500...1500

Polarisation current in µA and associated endpoint in mV. Changing of the polarisation current is possible in the standby state of the instrument only.

3.2.2.6 **C**onfig.**K**FSet.**P**ol.**U**pol.**V**al –1270...1270
Config.**K**FSet.**P**ol.**U**pol.**E**P –150...150

Polarisation voltage in mV in increments of 10 mV. Values in between are rounded off. Changing of the polarisation voltage is possible in the standby state of the instrument only.
Associated endpoint in µA.

3.2.2.7 **C**onfig.**K**FSet.**F**illRate 0.01...150, max.

Filling rate after the titration.
Entry in mL/min. Max. is the maximum possible filling rate with the Exchange Unit in current use.

3.2.2.8 **C**onfig.**R**SSet $G

$G sets all RS settings. Changes are executed in the standby state of the instrument only. After the setting of the interface parameters, wait at least 2 s to allow the components to stabilise.

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

Setting of the values for the data transmission via the RS interface: Baud rate, data bit, stop bit, parity, and the type of handshake, see also page 48ff.
The setting of the values must be triggered with $G, see 3.2.2.8.

3.2.2.10 **C**onfig.**P**eriphUnit.**C**harSet Epson, Seiko, IBM

Selection of the character set.
IBM means the IBM character set according to character set table 437. Select "IBM" for work with a computer.

3.2.2.11 **C**onfig.**P**eriphUnit.**B**alance Sartorius, Mettler, AND, Precisa
Config.**P**eriphUnit.**P**lot V vs.t, dV/dt vs.t, U vs.t, –U vs.t

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

3.2.2.12 **C**onfig.**A**ux.**L**anguage english, deutsch, francais, español

Selection of the dialog language.

3.2.2.13 **C**onfig.**A**ux.**D**ate YYYY-MM-DD
Config.**A**ux.**T**ime HH:MM

Date and time.
Input format of the date: Year-month-day, enter leading zeros.
Input format of the time: hours:minutes, two-digit, enter leading zeros.

3.2.2.14 **C**onfig.**A**ux.**R**unNo 0...999

Current run number.
Set to 0 on power on and on initialisation. After 999, returns to 0.

3.2.2.15 **C**onfig.**A**ux.**E**lectrCheck ON, OFF

Switch electrode test on and off.
ON means the tests for short circuit and break are performed on changeover from the standby state of the 701 Titrino to an active state (conditioning or titration). If a test is unsuccessful, the error messages E21 (break) or E22 (short circuit) appear.

3.2.2.16 **C**onfig.**A**ux.**D**isplay ON, OFF

Configuration of the display of the KFR volume on the 1st line of the result display.
ON means display 1st line.

3.2.2.17 **C**onfig.**A**ux.**M**ethName — up to 8 ASCII characters
Config.**A**ux.**De**vName — up to 8 ASCII characters

Method name that appears in place of ******** in the standby mode of the instrument or the name of the device for interconnections with several units, resp. It is advisable to use only the characters A...Z (ASCII Nos 65...90), a...z (ASCII Nos 97...122) and 0...9 (ASCII Nos 48...57) for the name of the device if the function Setup.AutoInfo (3.2.2.59) is used at the same time.

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

Output of the program version.
The KF Titrino sends "701.0010" on receipt of $Q.

3.2.2.19 **P**arameter.**T**itr.**E**xtrT — -9999...9999
Parameter.**T**itr.**S**topV — 0.00...99.99, OFF
Parameter.**T**itr.**M**axRate — 0.01...150, max.
Parameter.**T**itr.**M**inIncr — 0.1...9.9, min.

Titration parameters: Extraction time (in s), stop volume (in mL), maximum dispensing rate (in mL/min) and minimum increment (in µL). Max. means the maximum possible dispensing rate, and min. means the smallest possible volume increment of the Exchange Unit in current use.

3.2.2.20 **P**arameter.**T**ypeStop.**S**elect — drift, time

Selection of the stop criterion:
Drift: Termination after attainment of a set drift
Time: Termination after t(delay).

3.2.2.21 **P**arameter.**S**topCrit.**D**rift — 1...999
Parameter.**S**topCrit.**T**ime — 0..99

Stop drift in µL/min, t(delay) in s.

3.2.2.22 **P**arameter.**T**itr.**Sta**rtVKFT.**V**al — 0.00...99.99
Parameter.**T**itr.**Sta**rtVKFT.**D**osRate — 0.01...150, max.

Start volume in KFT mode; volume to be dispensed (in mL) and dispensing rate (in mL/min). Max. means the maximum possible dispensing rate with the Exchange Unit in current use.

3.2.2.23 **P**arameter.**P**resel.**C**ond — ON, OFF

Conditioning on/off.
If conditioning is switched on, the first start initiates the conditioning of the titration vessel from the standby state. A second start starts the titration. After the titration, the titration vessel is automatically reconditioned.

3.2.2.24 **P**arameter.**P**resel.**I**Req — ON, OFF
Parameter.**P**resel.**S**Req — ON, OFF

ON means automatic inquiry of the identification and the sample size after the start of the titration. Continuation of the titration from these inquiries by entry of "Ident" or "SmplSize" in the appropriate mode (see 3.2.2.32 and 3.2.2.33) or with &M $G (see 3.2.2.1).

3.2.2.25 **P**arameter.**P**resel.**R**eport — full, short, OFF

Selection of the result report for the output on completion of the titration. Data format, see page 21.

3.2.2.26 **D**ataCalc — $G

Recalculation of the result must be triggered with $G.

3.2.2.27 **D**ataCalc.**C**omCalc.**T**iter — 0.0000...99.9991
DataCalc.**C**omCalc.**B**lank — 0.0000...99.9991

Titer (in mg/mL) and blank (in mL). The current measured values of the titer determination modes and the blank determination mode are written into these registers directly. If the titer or blank is altered, the recalculation of the result must be triggered with &D $G (see 3.2.2.26).

3.2.2.28 **D**ataCalc.**C**omCalc.**D**Cor.**T**ype — auto, man., OFF
DataCalc.**C**omCalc.**D**Cor.**V**al — 0...99

Drift correction of the dispensed volume: Type of entry of the drift value (automatic or manual) and drift value (in µL/min). With "auto" the drift value at the start of the titration is stored and used for the correction. If the drift correction is changed, the recalculation of the result must be triggered with &D $G (see 3.2.2.26).

3.2.2.29 **D**ataCalc.**C**omCalc.**D**Time — read only

Time (in s) that has been used for the drift correction. $Q sends, e.g. "93", i.e. 93 seconds.

3.2.2.30 **D**ataCalc.**C**omCalc.**K**FRVol — read only

Current dispensed KF reagent as a number without unit. $Q sends, e.g. "2.316".

3.2.2.31 **D**ataCalc.**C**omCalc.**V**alRes — read only

Calculated result as a number with 4 decimal places (non-significant zeros are omitted) without unit. $Q sends, e.g. "21.6352".

3.2.2.32 **D**ataCalc.**M**odeCalc.**K**FT.**S**mplSize — 6-digit number plus sign and decimal point
DataCalc.**M**odeCalc.**H**2OTit.**S**mplSize — 6-digit number plus sign and decimal point
DataCalc.**M**odeCalc.**T**arTit.**S**mplSize — 6-digit number plus sign and decimal point

Value of the sample size. Maximum 5 decimal places are possible. If the sample size is changed, the recalculation of the result must be triggered with &D $G (see 3.2.2.26).

3.2.2.33 **D**ataCalc.**M**odeCalc.**K**FT.**I**dent — up to 8 ASCII characters
DataCalc.**M**odeCalc.**H**2OTit.**I**dent — up to 8 ASCII characters
DataCalc.**M**odeCalc.**T**arTit.**I**dent — up to 8 ASCII characters

Sample identification.

3.2.2.34 **D**ataCalc.**M**odeCalc.**K**FT.**F**actor — ±1 000 000
DataCalc.ModeCalc.**K**FT.**D**ivisor — ±1 000 000
DataCalc.**M**odeCalc.**H**2OTit.**F**actor — ±1 000 000
DataCalc.**M**odeCalc.**T**arTit.**F**actor — ±1 000 000
DataCalc.**M**odeCalc.**B**lank.**F**actor — ±1 000 000

Calculation values for factor and divisor. The factors are in the numerator, the divisor in the denominator of the formulas for the result calculation, see page 27. After alterations, the recalculation of the result must be triggered with &D $G (see 3.2.2.26).

3.2.2.35 **D**ataCalc.**M**odeCalc.**K**FT.**M**eanN 2...20, OFF
DataCalc.**M**odeCalc.**H**2OTit.**M**eanN 2...20, OFF
DataCalc.**M**odeCalc.**T**arTit.**M**eanN 2...20, OFF
DataCalc.**M**odeCalc.**B**lank.**M**eanN 2...20, OFF

Number of single determinations for the statistics calculation.

3.2.2.36 **D**ataCalc.**M**odeCalc.**K**FT.**U**nit.**R**es.**U**nit %, ppm, mg/ml, g, mg, mg/pc, –
DataCalc.**M**odeCalc.**K**FT.**U**nit.**R**es.**D**pl 0...9
DataCalc.**M**odeCalc.**H**2OTit.**U**nit.**R**es.**U**nit read only
DataCalc.**M**odeCalc.**H**2OTit.**U**nit.**R**es.**D**pl read only
DataCalc.**M**odeCalc.**T**arTit.**U**nit.**R**es.**U**nit read only
DataCalc.**M**odeCalc.**T**arTit.**U**nit.**R**es.**D**pl read only
DataCalc.**M**odeCalc.**B**lank.**U**nit.**R**es.**U**nit read only
DataCal**c**.ModeCalc.**B**lank.**U**nit.**R**es.**D**pl read only

Unit and number of decimal places for the titration result. – means no unit: Entry of the null string. If the unit is changed, the recalculation of the result must be triggered with &D $G (see 3.2.2.26).

3.2.2.37 **D**ataCalc.**M**odeCalc.**K**FT.**U**nit.**S**mpl.**U**nit g, mg, ml, ul, pc, –
DataCalc.**M**odeCalc.**H**2OTit.**U**nit.**S**mpl.**U**nit g, mg, ml, ul, pc, –
DataCalc.**M**odeCal**c**.TarTit.**U**nit.**S**mpl.**U**nit g, mg, ml, ul, pc, –

Unit for the sample size. – means no unit: Entry of the null string.

3.2.2.38 **D**ataCalc.**S**tatistics.**A**ctN read only
DataCalc.**S**tatistics.**M**ean read only
DataCalc.**S**tatistics.**S**td read only
DataCalc.**S**tatistics.**R**elStd read only

The current values of the statistics calculation.

		Examples: $Q sends
ActN:	Current value of the single results	"3"
Mean:	Mean value (unit + decimal places as with result)	"3.421"
Std:	Standard deviation (unit as with result, 1 decimal place more than result)	"0.0231"
RelStd:	Relative standard deviation (in %, 2 decimal places)	"0.14"

3.2.2.39 **D**ataCalc.**S**tatistics.**R**esTab.**S**elect original, delete all, delete n

Selection of the result table that should be taken in account in the statistics calculation:

original:	Original table. The original table is set up again, i.e. single values that have been previously removed from the evaluation are again considered.
delete all:	All values are deleted. They can not be reactivated.
delete n:	Deletion of single values, see 3.2.2.40.

3.2.2.40 **D**ataCalc.**S**tatistics.**R**esTab.**D**elN 1...20

Deletion of single results with the index n. The result table must here be set to "delete n" (see 3.2.2.39). Recalculation of the mean must be triggered with &D $G (see 3.2.2.26).

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

$G sends all formatted reports of the current mode.

3.2.2.42 **I**nfo.**R**eport.**C**onfig $G
Info.**R**eport.**P**arameter $G
Info.**R**eport.**D**ataCalc $G
Info.**R**eport.**R**es.**S**hort $G
Info.**R**eport.**R**es.**F**ull $G
Info.**R**eport.**M**eanTab $G

The selected report is sent using $G.

3.2.2.43 **I**nfo.**A**ctualInfo.**S**endMeas.**C**yclNo read only

$Q sends the current cycle number of the voltage measurement cycle, e.g. "127". A time framework can be set up from the cycle number and the cycle time (see 3.2.2.57).
With burette functions that do not include U measurement, the last cycle number from the titration mode is sent.

3.2.2.44 **I**nfo.**A**ctualInfo.**S**endMeas.**V** read only
Info.**A**ctualInfo.**S**endMeas.**U** read only
Info.**A**ctualInfo.**S**endMeas.**V**dt read only
Info.**A**ctualInfo.**S**endMeas.**U**dt read only
Info.**A**ctualInfo.**S**endMeas.**U**d**V** read only

$Q sends the current values with 4 decimal places (without non-significant zeros):

	Examples: $Q sends
dispensed volume V (in mL)	"0.4325"
control deviation U (in mV)	"–432.21"
volme drift Vdt (in uL/s)	"2.5201"
measurement signaldrift Udt (in mV/s)	"10.763"
1st derivative of the titration curve UdV (in mV/uL)	"10.6326"

With burette functions, the values U, Vdt, Udt and UdV from the last titration mode are sent.

3.2.2.45 **I**nfo.**A**ctualInfo.**D**isplay.**1** up to 24 ASCII characters
Info.**A**ctualInfo.**D**isplay.**2** up to 24 ASCII characters

1st or 2nd line of the display. The display can be written into from a computer.
The display is not operated by the internal program of 701 if "Setup.Lock.Display" is ON, see 3.2.2.54.
$Q sends the contents of the appropriate display line.

3.2.2.46 **A**ssembly.**B**ur.**D**os $G, $S

$G starts the "DOS" mode of the burette function. Dispensing is continued until $S is sent.

3.2.2.47 **A**ssembly.**B**ur.**D**os.**U**pRate.**S**elect digital, analog
Assembly.**B**ur.**D**os.**U**pRate.**V**al 0.01...150, max.

Dispensing rate in DOS mode.
Digital or analog control. With digital control, the inputted value (in mL/min) applies. "max." means the maximum possible dispensing rate with the Exchange Unit in current use.
Analog means rate control with the analog potentiometer of the 701 KF Titrino.

3.2.2.48 **A**ssembly.**B**ur.**D**os.**V**Lim 0.000...9999.999, OFF

Limit volumes (in mL) for the DOS mode.

3.2.2.49 **A**ssembly.**B**ur.**D**os.**P**os — read only

Piston position.
0 = start position (filled)
10 000 = end position (empty)

3.2.2.50 **A**ssembly.**B**ur.**F**ill — $G

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

3.2.2.51 **A**ssembly.**B**ur.**F**ill.**D**wnRate**S**elect — digital, analog
Assembly.**B**ur.**D**os.**U**pRat**e**.**V**al — 0.01...150, max.

Filling rate after the dispensing function DOS.
Digital or analog control of the rate. With digital control, the inputted value (in mL/min) applies. "max." means the maximum possible filling rate with the Exchange Unit in current use. Analog means rate control with the analog potentiometer of the 701 KF Titrino.

3.2.2.52 **A**ssembl**y**.**B**ur.**E**xV — read only

$Q sends the volume of the Exchange Unit in current use (in mL), e.g. "10".

3.2.2.53 **S**etup.**K**eycode — ON, OFF

ON means that the key code of a key pressed on the KF Titrino is outputted. The key code comprises 2 ASCII characters; table of the keys with their code, see page 60. If key 11 is pressed, the following is sent:
#11$C_R L_F$

3.2.2.54 **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.**D**ataCalc — ON, OFF
Setup.**L**ock.**D**isplay — ON, OFF

ON means disable the appropriate function:

Keyboard:	Disables all keys of the 701 KF Titrino
Config:	Disables the <configuration> key
Parameter:	Disables the <parameters> key
DataCalc:	Disables the <calc data> key
Display:	Disables the display, i.e. it is not written into by the internal program of the KF Titrino and can be operated from a computer.

3.2.2.55 **S**etup.**S**endMeas.**S**endStatus — ON, OFF

ON means that the automatic transmission of measurement data (see 3.2.2.57 and 3.2.2.58) in the interval entered (see 3.2.2.56) is active.

3.2.2.56 **S**etup.**S**endMeas.**I**nterval — 0.08...16200

Time interval (in s) for the automatic transmission of associated measured values that are defined under point 3.2.2.58. The inputted value is rounded off to a multiple of 0.08. The smallest possible time interval depends on the number of measured values that have to be sent, on the baud rate, on the interface load and on the type of device interconnection. The set time interval is thus only an approximation.
The automatic transmission is switched on/off with "SendStatus" (see 3.2.2.55).

The values are sent with 4 decimal places (without non-significant zeros) with a space as separator. Example of the transmission of cycle number, volume V (in mL), control deviation U (in mV), volume drift Vdt (in uL/s), measurement signal drift (in mV/s) and first derivative of the titration curve UdV (in mV/(uL): "132 3.1235 -280.334 3.5123 1.6009 3.4333".

3.2.2.57 **S**etup.**S**endMeas.**C**yclTime read only

$Q sends the cycle time for the measured value acquisition (in ms), e.g. "80". A time framework can be set up with the aid of the cycle number (see 3.2.2.58).

3.2.2.58	**S**etup.**S**endMeas.**V**al.**C**yclNo	ON, OFF
	Setup.**S**endMeas.**V**al.**V**	ON, OFF
	Setup.**S**endMeas.**V**al.**U**	ON, OFF
	Setup.**S**endMeas.**V**al.**Vd**t	ON, OFF
	Setup.**S**endMeas.**V**al.**Ud**t	ON, OFF
	Setup.SendMeas.**V**al.**UdV**	ON, OFF

Selection of the values that are sent within the set time interval (see 3.2.2.56): Cycle number, volume V, control deviation U, volume drift Vdt, measurement signal drift Udt and first derivative of the titration curve UdV. Values that are ON are sent. Format, see 3.2.2.56.
With burette functions the values CyclNo, U, Vdt, Udt and UdV from the last titration mode are sent.

3.2.2.59	**S**etup.**A**utoInfo.**R**	ON, OFF
	Setup.**A**utoInfo.**S**	ON, OFF
	Setup.**A**utoInfo.**E**	ON, OFF
	Setup.**A**utoInfo.**D**ry	ON, OFF
	Setup.**A**utoInfo.**W**et	ON, OFF
	Setup.**A**utoInfo.IReq	ON, OFF
	Setup.**A**utoInfo.**SR**eq	ON, OFF
	Setup.**A**utoInfo.**E**xtr	ON, OFF

ON means that the KF Titrino reports automatically when the appropriate status change takes effect.

R	Ready. Status "ready" has been reached
S	Stop. Status "stop" has been reached
E	Error
Dry	Being conditioned, become dry
Wet	Being conditioned, become wet
IReq	In the inquiry regarding the identification after titration start
SReq	In the inquiry regarding the sample size after titration start
Extr	Waiting out the extraction time

If a status change that requires a message appears, the KF Titrino sends an exclamation mark (!) as an introducer. This is followed by the name of the device (see 3.2.2.17). Special ASCII characters in the device name are ignored. If no device name has been entered, only ! is sent.

3.2.2.60 **S**etup.**P**owerOn $G

Simulation of "power on". The status of the instrument is the same as that after power up: The cylinder is filled, error messages cleared and the current run number set to 0. The KF Titrino is in the measurement program with the mode last selected.

3.2.2.61 **S**etup.**I**nitialise $G

Initialises instrument: All parameters are set to their default value (see page 78) and error messages are cleared.

3.3. Characteristics of the RS232 interface

3.3.1 Data transmission protocol

The KF 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
Baud rates:	300, 600, 1200, 2400, 4800, 9600
Handshake:	software or hardware handshake (see section 3.3.2)
Word length:	7 or 8 bit
Parity:	even, odd or none
Stop bit:	1 or 2
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 701 KF 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).

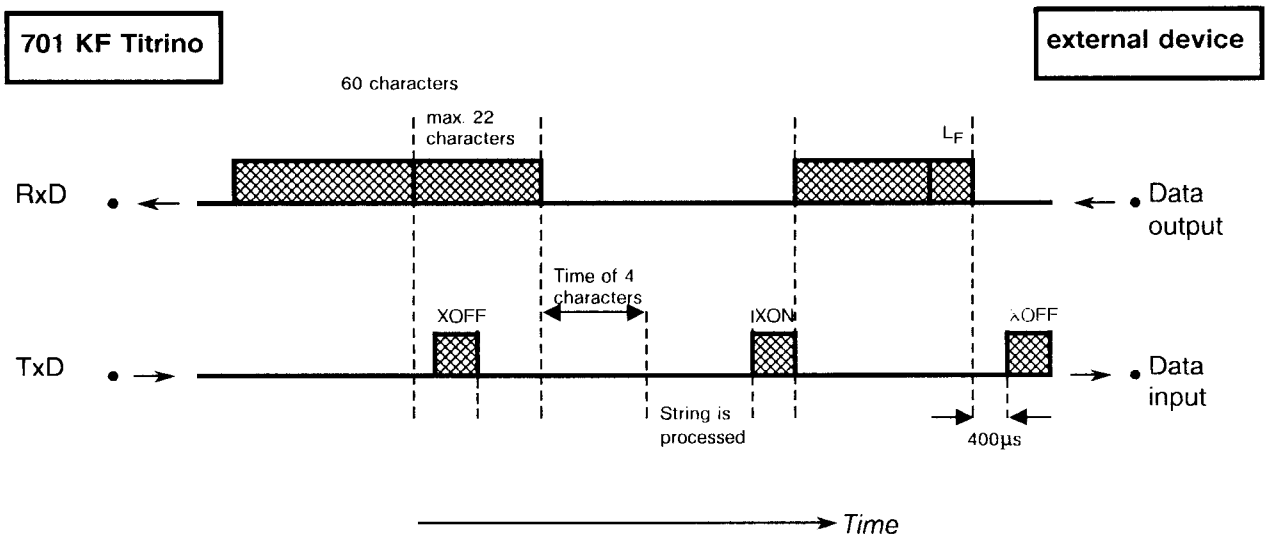
3.3.2 Handshake

3.3.2.1 Software handshake , SWChar

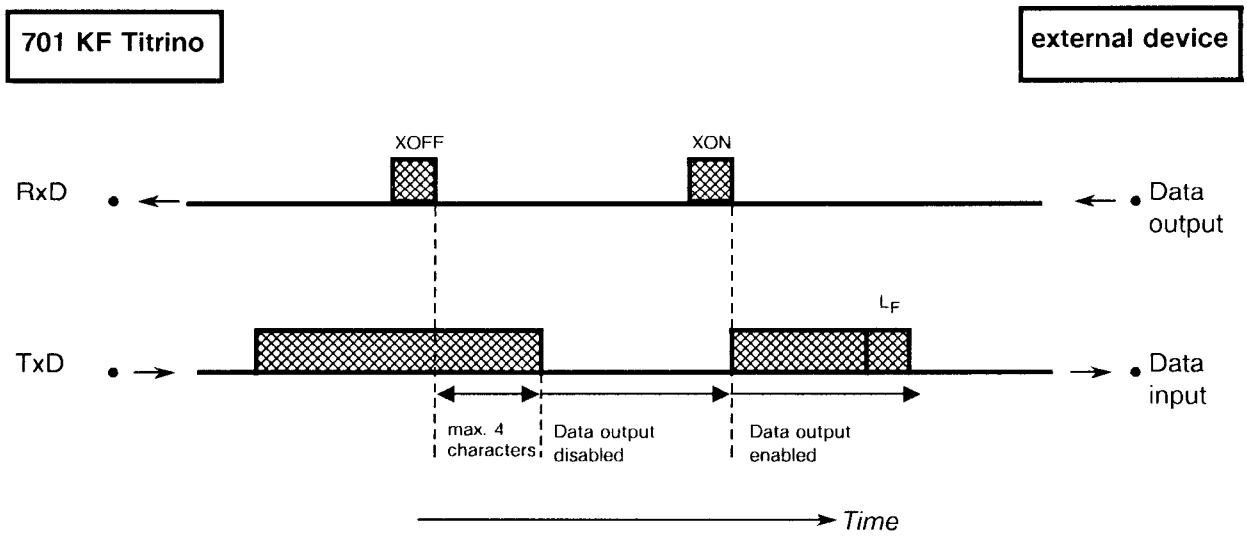
Handshake inputs at the KF Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the KF Titrino.

As soon as an L_F is recognised, the KF Titrino sends XOFF. It can then receive 6 extra characters and store them.
However, the KF 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 KF Titrino has sent XOFF, the string received earlier is processed even if no L_F has been sent.

KF Titrino as **receiver**:



KF Titrino as **sender**:

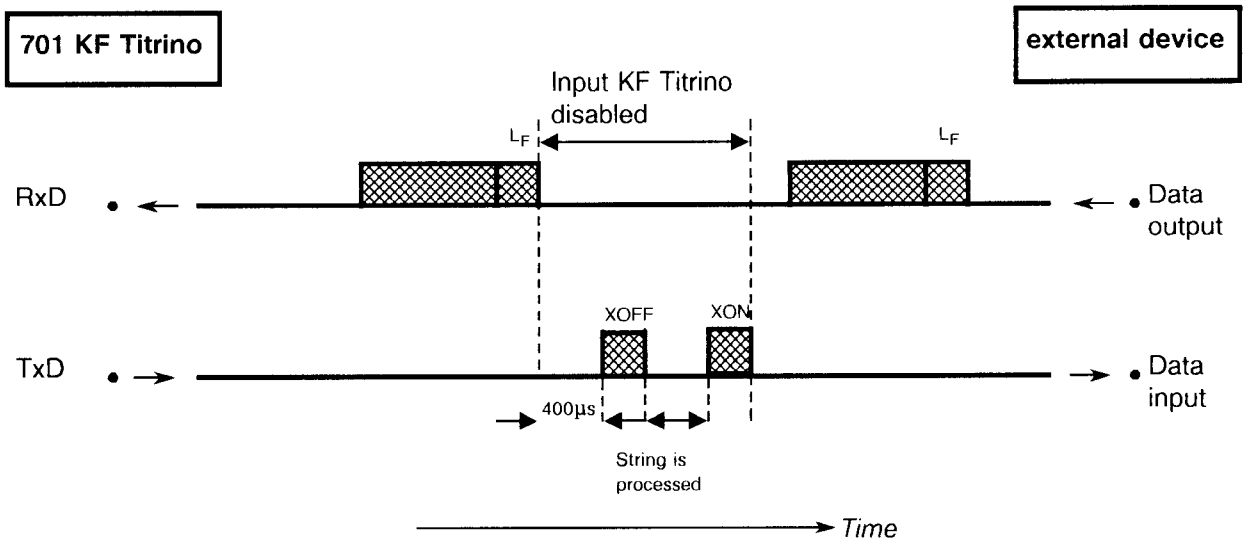


3.3.2.2 Software-Handshake , SWline

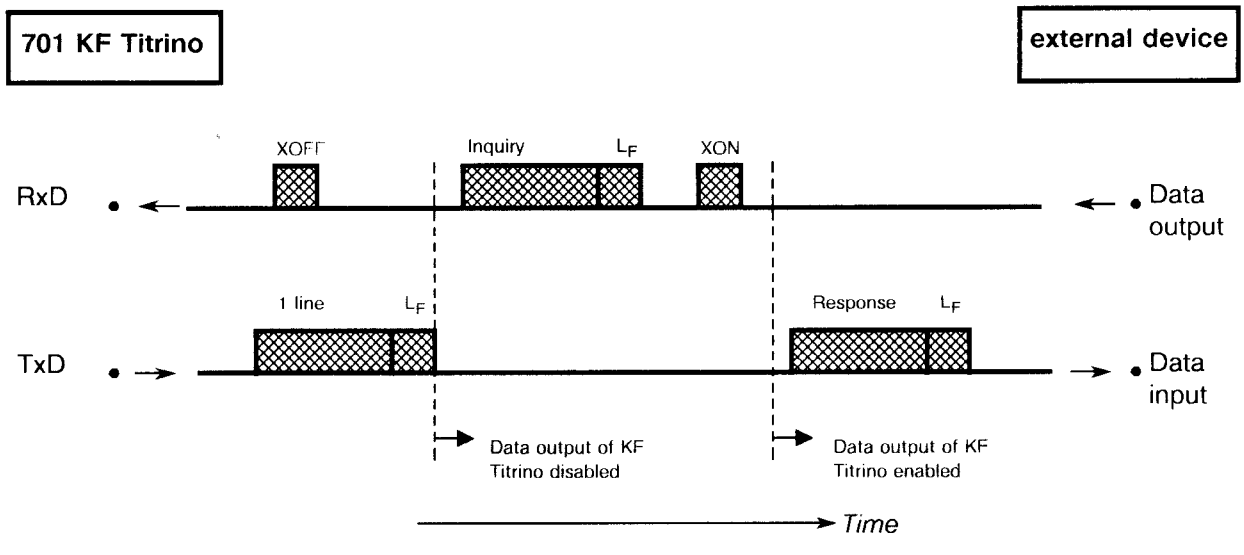
Handshake inputs at the KF Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the KF Titrino.

The KF 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 KF Titrino sends XOFF. After this, it can receive maximum 6 extra characters and store them. The string sent previously is now processed by the KF Titrino. Afterwards, the KF Titrino sends XON and is again ready to receive.

KF Titrino as **receiver**:



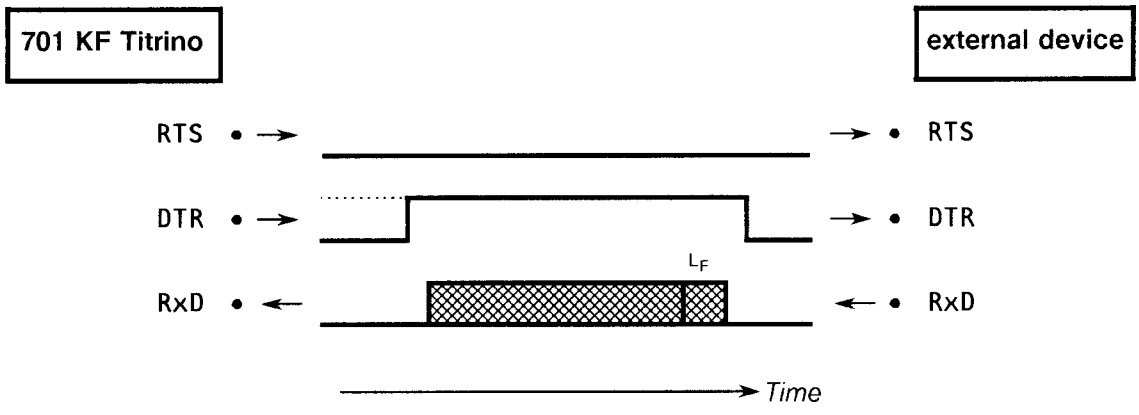
KF Titrino as **sender**:



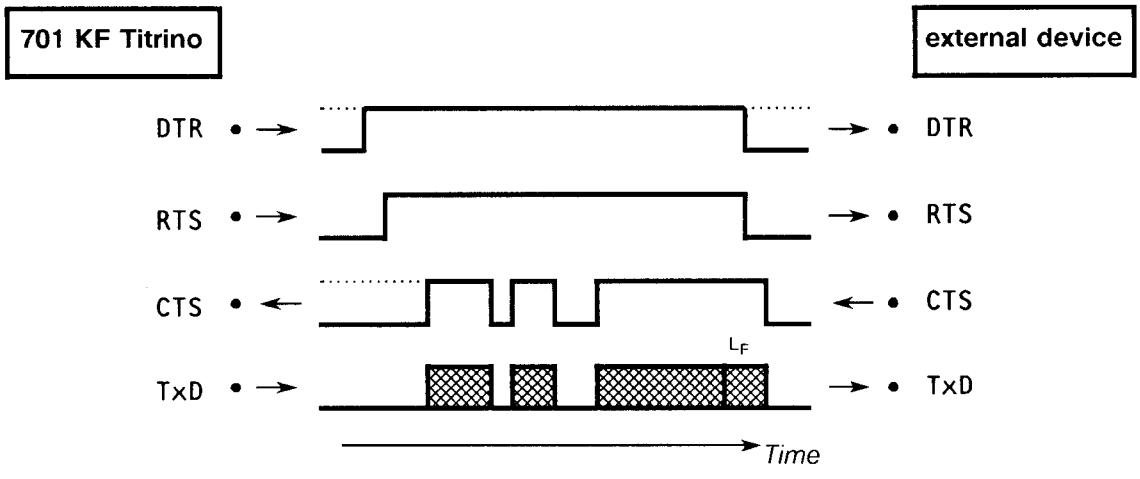
The transmission of the KF Titrino can be stopped by the external device with XOFF. After receipt of XOFF, the KF Titrino completes transmission of the line already started. If the data output is disabled for more than 3 s by XOFF, E43 appears in the display.

3.3.2.3 Hardware handshake, HWs

KF Titrino as **receiver**:



KF Titrino as **sender**:

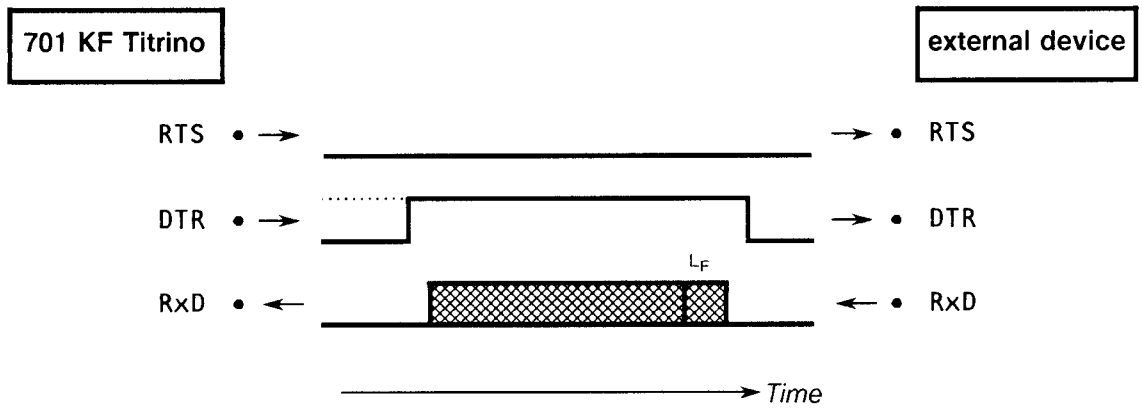


The data flow can be interrupted by deactivation of the CTS line.

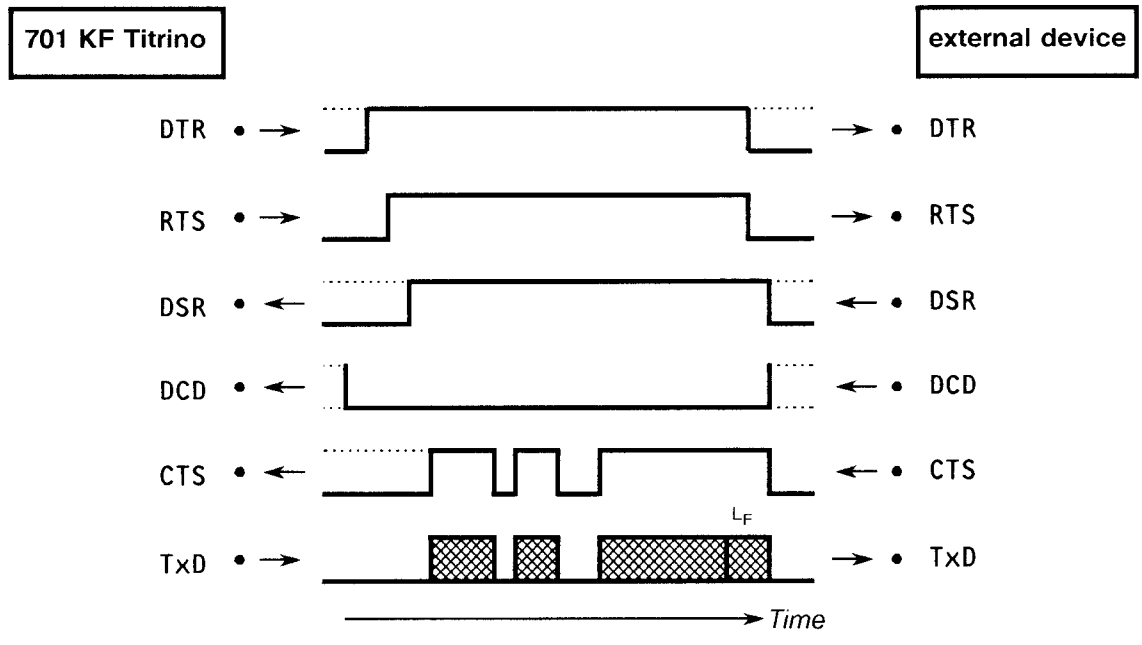
Hardware handshake, HWf

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

KF Titrino as **receiver**:



KF Titrino as **sender**:



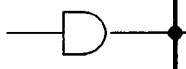
The data flow can be interrupted by deactivation of the CTS line.

3.3.3 Pin assignment

external

RS 232C Interface

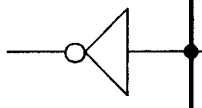
Transmitted data (TxD).
If no data are transmitted, the line is held in the "ON" condition. Data are transmitted only when CTS and DSR are in the "ON" condition and DCD is in the "OFF" condition.



E 2

Transmitted Data

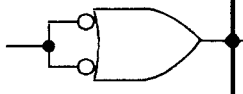
Received data (RxD)
Data are received only when DCD is "ON".



E 3

Received Data

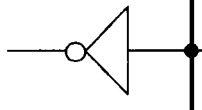
Request to Send (RTS)
ON condition: 701 KF Titrino is ready to send data.



E 4

Request to Send

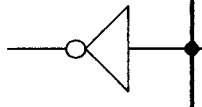
Clear to Send (CTS)
ON condition: Remote station is ready to receive data.



E 5

Clear to Send

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



E 6

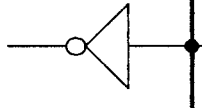
Data Set Ready

Signal Ground (GND)

E 7

Signal Ground

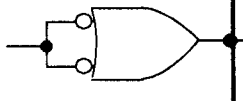
Data Carrier Detect (DCD)
ON condition: The level of the received signal is within the tolerance range (remote station is ready to send data).



E 8

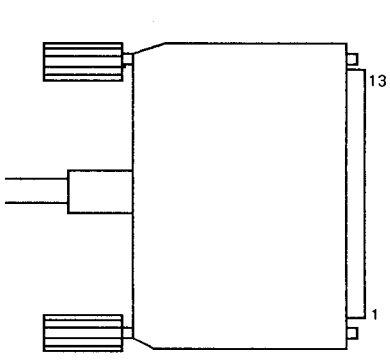
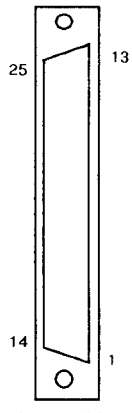
Data Carrier Detect

Data Terminal Ready (DTR)
ON condition: 701 KF 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 transmission 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 the baud rate, bit length 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> <calc data> <enter>. If this report is printed out correctly, check whether under the key <parameters>, "preselection" a result report is preselected.
No data transmission occurs and the display of the KF 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 KF 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 bit length and the parity settings the same for both devices? – Is the baud rate setting the same for both devices? – Has the correct character set been selected on the printer?

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The received characters are garbled	– Are the bit length and the parity settings the same for both devices? – Is the baud rate setting the same for both devices? – Has the correct character set been selected on the printer?

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 turn cock lever when the KF Titrino is switched on!
Problems with data transfer	See measures on page 55.

4.1 Error and special messages

change solvent	The limit volume of the reagent volume counter "limit KF reag." has been reached. Exit: Change solvent and press <clear>.
check electrode	There is a break or a short circuit. Possible causes and rectification of the fault: – the electrode is not plugged in → plug it in – the electrode is not immersed in solution → immerse it – the electrode is broken → use new electrode The electrode test can be switched off, see page 18.
check exchange unit	The Exchange Unit is not inserted (properly). Exit: Insert Exchange Unit (properly) so that the coupling engages or press <STOP>.
cylinder empty!	During dispensing with <DOS> an entire cylinder has been dispensed. Exit: Press <STOP/FILL>.
division by zero	The result could not be calculated because the sample size, the divisor or the reagent consumption was equal to zero. Exit: Enter appropriate value or perform new titer determination.
stop V reached	The titration has been aborted because the stop volume has been reached. No results are calculated. Exit: Set stop volume higher and perform new titration.

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	Exit: <QUIT> and ensure settings of appropriate parameters at both devices are the same.
E37	Stop bit	
E38	Overrun error. At least 1 character could not be read. Exit: <QUIT>	
E39	The receive buffer of the KF Titrino is full (>82 characters). Exit: <QUIT>	

Send errors:

E40	DSR = OFF	No proper handshake for more than 1 s. Exit: <QUIT> Is the receiver switched on and ready to receive?
E41	DCD = ON	
E42	CTS = OFF	
E43	The transmission of the KF Titrino has been interrupted with XOFF for at least 3 s. Exit: <QUIT>	
E44	The RS interface parameter settings are no longer the same for both devices. Reset them.	

4.2 Diagnosis (for 5.701.001X Program)

The KF 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 18) and specify possible error displays.

Procedure

- The diagnostic steps must be performed in sequence and compared with the reactions of the 701 KF 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.

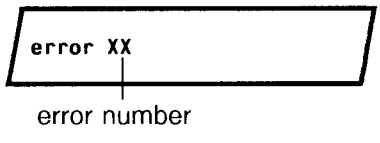
- The diagnostic steps marked with a triangle (≫) allow re-entry into the test routine for repetition if the following display appears:

  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:



  Error displays are acknowledged with <clear>, and '...test end' then appears in the display.

- If a fault causes the burette drive to stick at the top or bottom end of the cylinder, see point 13, page 66.

Instruments needed:
- Resistor switch-box, class 0.1% (or resistor 14.3 k 0.1%)
- 3.496.5070 Cable[1]
- Exchange Units, if possible with different cylinder volumes (or 3.496.0070 Dummy Exchange Unit)
- Stop watch or watch with second hand
- 6.2130.000 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 as the moving display, the LEDs are switched on and off.

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

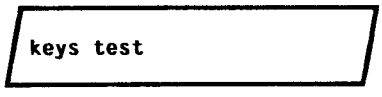
Block 2 is quit with the <clear> key.

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

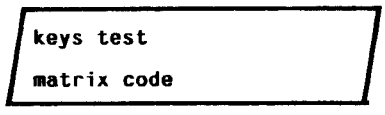
Fig. 4-1:
Character set

≫ 3. **Keypad test**

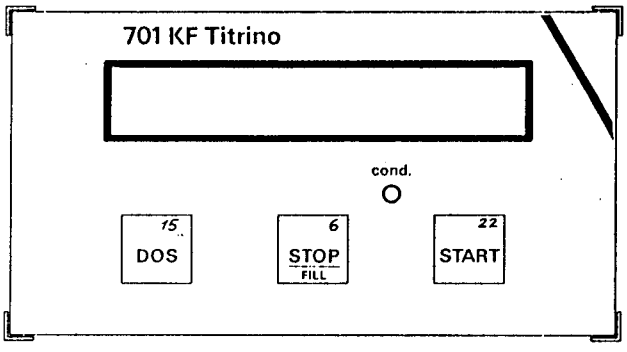
Press <1>



Press <enter>



If any key is now pressed (on the 6.2130.000 Keypad or on the front panel of the 701), the appropriate matrix code appears in the display (0...31).



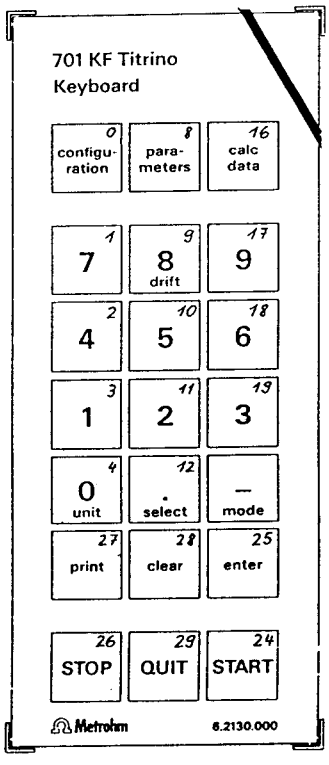


Fig. 4-2 Matrix code table

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 17.

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.

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. [Warning: The configuration of the analog output in regard to polarity is also effective here (see page 17).] This voltage can also be used for the calibration of an connected recorder.

Connect a voltage measuring instrument (voltmeter, DVM, recorder) to the analogue output.

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 ±1 mV)

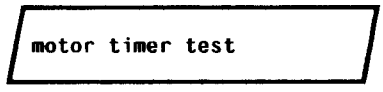
Exit: <QUIT>

Disconnect voltmeter.

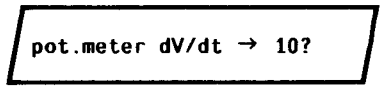
[1] acurrent date
[2] current time
[3] Check that mL code of Exchange unit used is displayed
[4] This value is incidental, but can be accepted with <enter>.

≫ 6. Motor timer test

<6>

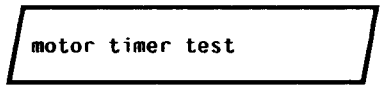


<enter>



Turn knob 'dV/dt' to the right stop

<enter>



Test sequence

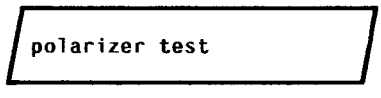
- In a first step, the frequency of the RC oscillator (analog rate) is tested over a period of 1 second.
- In a second step, the frequency of the quartz oscillator (digital rate) is tested over a period of 1 second.

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

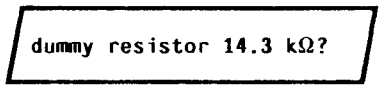
<clear>

≫ 7. Polarizer test

Press <7>

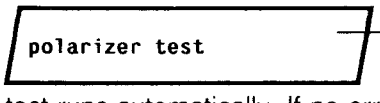


<enter>



Connect resistor switch-box (or suitable resistor 14.3 k /0.1%) using 3.496.5070 Cable[1] to KF electrode socket. Switch-box to 14.3 k.

<enter>



An asterisk flashes during the test

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

[1] If cable not available, see page 59.

<clear>

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

Remove cable and resistor switch-box.

≫ 8. External inputs and outputs

This test is meaningful only if the 701 KF 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.)

3.496.8510 Test Plug

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

Fig. 4-3: Connections in the 3.496.8510 Test Plug

Press key <4>

```
extern input/output test
```

<enter>

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

Insert the 3.496.8510 Test Plug in port B 'Remote' (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 701 KF Titrino 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.)

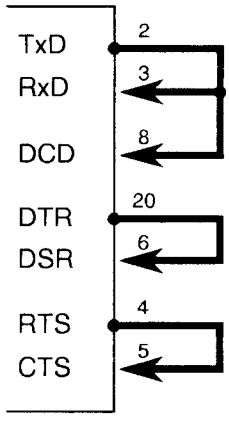
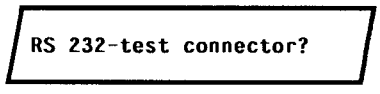


Fig. 4-4: Connections in the 3.496.8480 Plug

Press key <5>

<enter>



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.

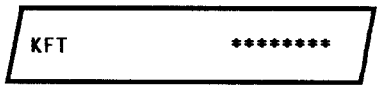
Remove test plug

<clear>

⩾ 10. Spindle drive and stopcock changeover

<clear>

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



Remove Exchange Unit (if still inserted).

Check spindle zero position, see Fig. 4-5.

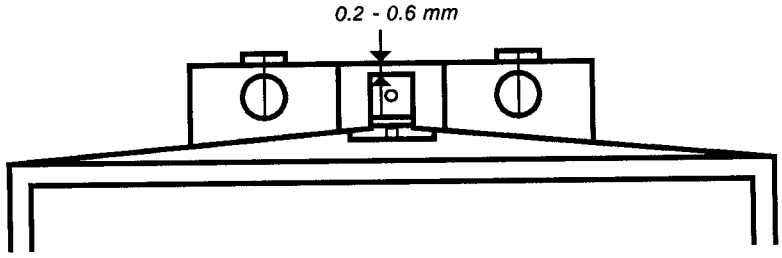


Fig. 4-5

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 Dosimat.

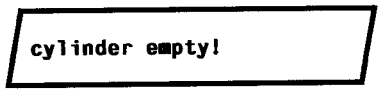
Reinsert Exchange Unit.

Dosimat fills.

The display 'KFT ********' 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.



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 Dosimat is again in the 'ready' position.

Time 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.

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.

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

Press <8>

```
RAM init
```

<enter>

RAM is tested and initialised.

```
RAM init passed
```

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

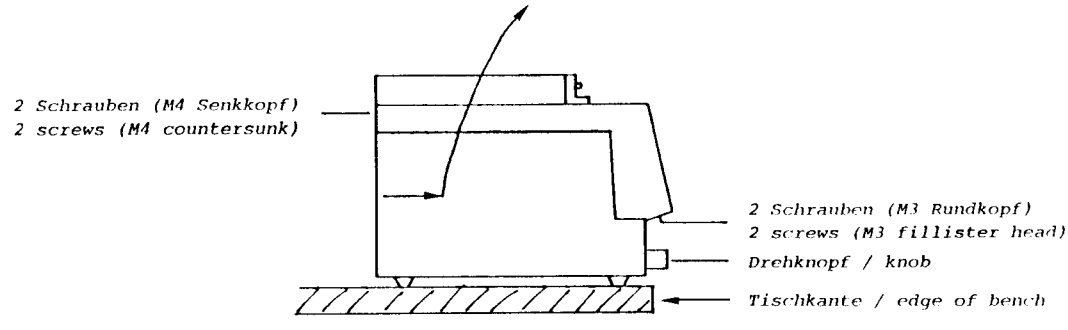


Fig. 4-6

- 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.

Warning: 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.

5. Preparations

Before switching on the apparatus, make sure that it is set to the voltage of the power supply.
The mains cables supplied with the instrument are of the three-core type and are fitted with a plug carrying an earthing pin. If a different plug has to be mounted, 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 the earthing socket. Any interruption of the protective conductor inside or outside the apparatus or disconnection of the protective earth terminal is likely to make the apparatus dangerous.
When the apparatus is connected to its supply, terminals may be live, and the opening of covers or removal of parts is likely to expose live parts. The apparatus shall be disconnected from all voltage sources before it is opened for any adjustment, replacement, maintenance or repair.

5.1. Setup and interconnection of instruments

5.1.1 KF Titrino with 703 Ti Stand or 649 Stirrer

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

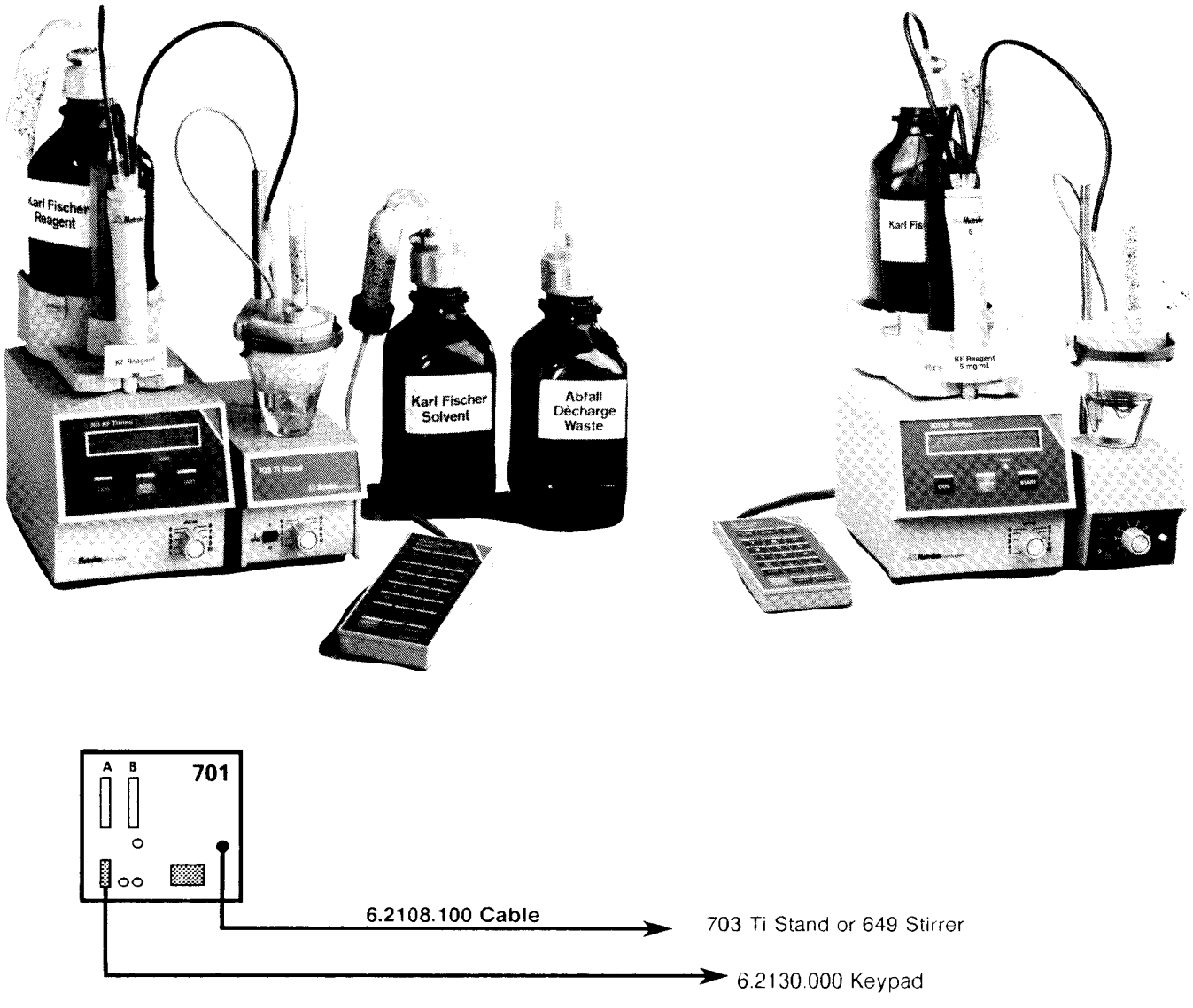


Fig. 5-1: Setup of KF Titrino and connection of the Ti Stand or stirrer

5.1.2 Connecting a printer

A variety of printers can be connected to the RS232 interface of the 701 Titrino. If you connect a printer other than one mentioned below, please ensure that this employs the international character set following the IBM standard table 437 and select "send to: IBM" on the 701 KF Titrino. This will give you printouts that include correct special characters.

The connection of several printers is facilitated by the following table:

Printer type	Cable	Settings on KF Titrino	Settings on printer	
Epson P40	6.2125.040	baud rate: 9600 data bit: 7 stop bit: 1 parity: even handshake: HWs send to: Epson	**DIP-Schalter:** 1 off auto feed 2 on with parity 3 on even parity 4 on 7 bits 5 off, 6 on, 7 off, 8 off: 9600 baud	
Citizen iDP560 RS	6.2125.050	baud rate: 9600 data bit: 7 stop bit: 1 parity: even handshake: HWs send to: Epson	**DIP switches:** 1 on 2 off, 3 off, 4 off: 9600 baud 5 on 7 bits 6 – 7 off, 8 on: even parity Set printer to "on-line" with <sel>	**Jumpers:** 1 open, 2 open: USA char.set 3 open 4 open 5 **closed**
Seiko DPU-411	6.2125.020	baud rate: 9600 data bit: 7 stop bit: 1 parity: even handshake: HWs send to: Seiko	**DIP switches:** **DIP01** 1 off serial 2 off no auto LF 3 on 40 characters 4 on character type 5 off zero depiction 6 off, 7 on, 8 on: USA character set Set printer to "on-line"	**DIP02** 1 off 7 bits 2 off, 3 off: even parity 4 off, 5 off, 6 off: 9600 baud

If a balance should be 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.

5.1.3 Connecting a balance

The following balances can be connected to the KF Titrino:

Balance		Cable
Sartorius	MP-8	6.2125.070
Mettler	Models AT, AM, PM	from Mettler: ME 33995: Green wire to pin 2, brown to pin 3, white to pin 7, yellow to pin 20 of the 25-pin connector.
	Interface 016	Cable in standard equipment of interface 016: Red wire to pin 3, white wire to pin 7 of the 25-pin connector.
	Interface 011	6.2125.020
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 on the KF Titrino with the <configuration> key.
Balance and printer can be connected simultaneously with the aid of the 6.2125.030 Adapter. The balance must then be connected to the "data in" receptacle of the 6.2125.030 Adapter.

The sample size is transmitted as a number with up to 6 digits, sign and decimal point. Units and control characters sent by the balance are not transferred.
With the aid of a special input device supplied by the balance manufacturer, the identification can be entered from the balance in addition to the weight. The address of the identification must be preselected at the input device for this:

Sartorius	Id#1 or 26
Mettler	C

5.1.4 Setting up the instruments for work with the KF oven

For work with a KF Oven we recommend the 661 Pump Unit. It produces a dry air stream. Mount the KF Oven at the stand rod above the 661 Pump Unit, see Fig. 5-2.

For introduction of the gas into the KF titration vessel, the 6.2730.040 Stopper together with the 6.1819.060 PTFE Tubing must be used.

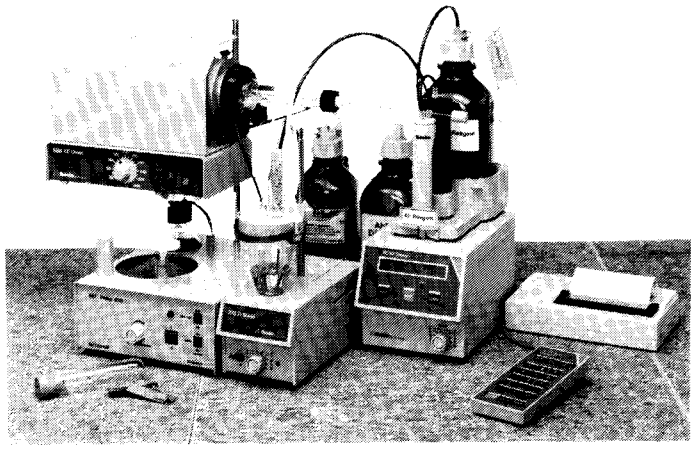


Fig. 5-2: Setting up with KF Oven

5.1.5 Connecting a recorder

The recorder can be connected to the analog output of the KF Titrino:

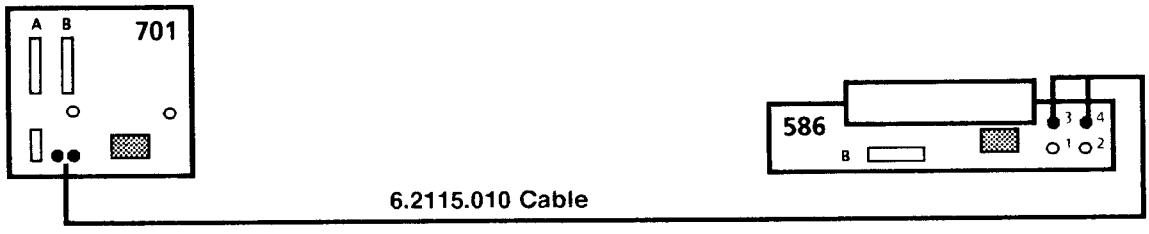


Fig. 5-3: Connecting a recorder

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

Depending on the preselection on the KF Titrino, different curves are plotted by the recorder:

Curve on recorder	Preselection on KF Titrino	Resolution
Volume vs. time Dispensing curve, e.g. in work with the KF oven	V vs. t	1 cylinder volume = 2000 mV
Drift vs. time Drift curve, e.g. to observe the basic drift	dV/dt vs. t	100 µl/min = 1000 mV
Control deviation vs. time	U vs. t or –U vs. t	+ 1 mV = + 1mV + 1 mV = – 1 mV

5.1.6 Connecting a computer

A computer is connected as follows:

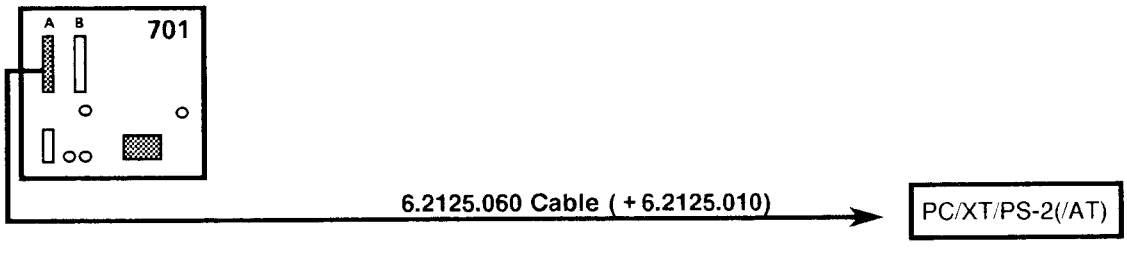


Fig. 5-4: Connecting a computer

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

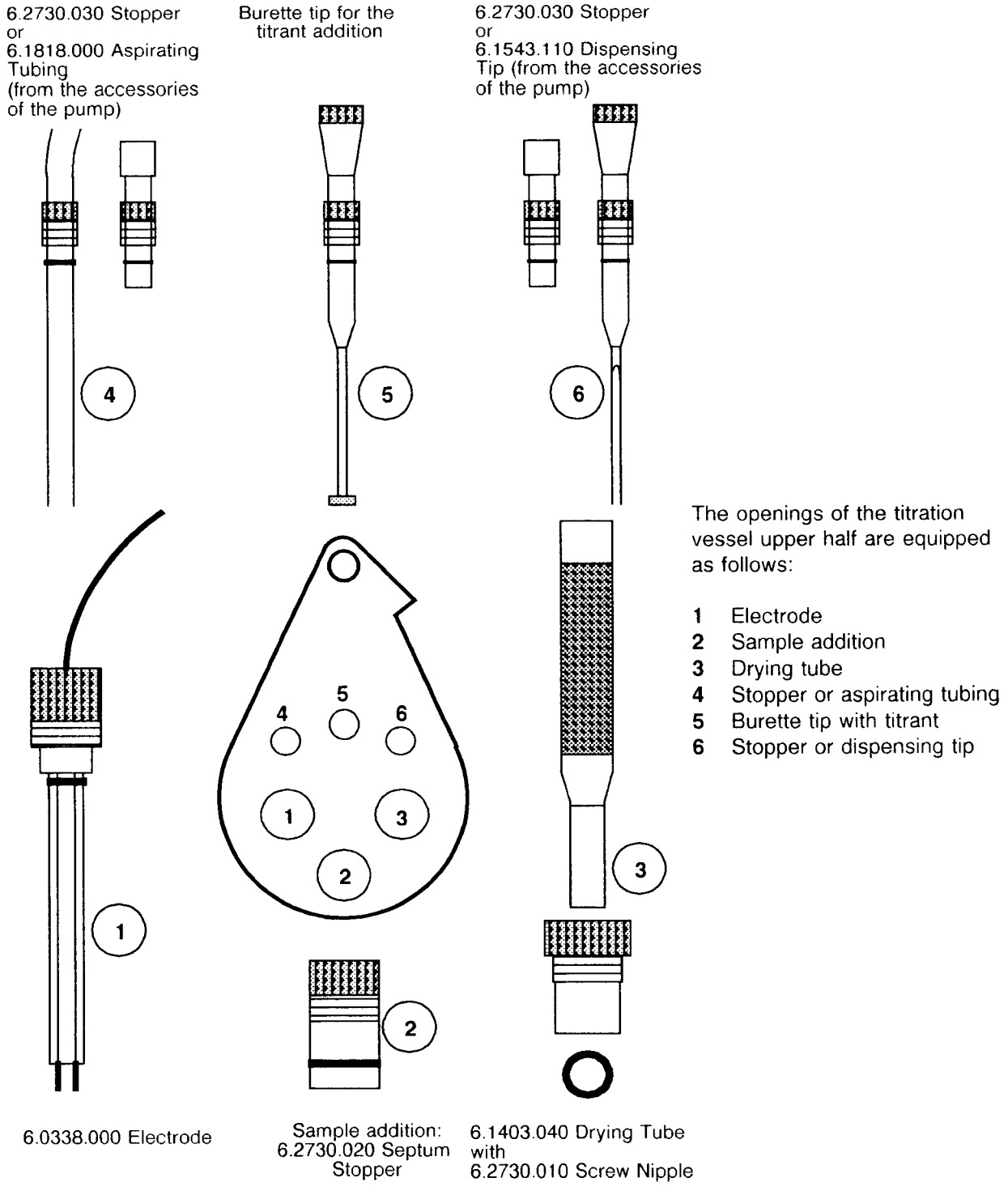
Preselections on KF Titrino:
RS232 settings: depend on the control program of the computer
send to: IBM

Program package for the data transfer KF Titrino <–> computer,
$5\frac{1}{4}$" and $3\frac{1}{2}$" diskettes, in PASCAL and BASIC 6.6007.000

5.2 Titration vessel

5.2.1 Equipping the titration vessel upper half

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



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

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

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

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

For good titration results, it is important that the titrant be mixed with the initial solution as rapidly as possible. This can be achieved by

- efficient stirring
- ensuring that the burette tip points to the middle of the vessel directly above the stirring bar.

5.2.2 Sample addition

Solid samples are added with the 6.2412.000 Glass Weighing Spoon. The septum stopper is removed for the addition.

Liquid samples are injected through the septum. Thick injection needles can leave holes in the septum stopper. If it is necessary to use thick needles, the 6.2730.040 Stopper together with the 6.1446.040 Screw Stopper can be used in place of the 6.2730.020 Septum Stopper. The injection needle is inserted through the opening in the 6.2730.040 Stopper.

For the introduction of **gaseous samples**, the 6.2730.040 Stopper together with the 6.1819.060 PTFE Tubing is used in place of the 6.2730.020 Septum Stopper.

5.2.3 Connecting the electrode

Fig. 5-6: Connecting the electrode

5.3. Preparing the Exchange Unit

The Exchange Units are available with light protection, in brown, or clear glass. The versions with light protection or in amber 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 volume ± ΔV (in ml)	Reproduciblity error accuracy ± ΔV (in ml)	Resolution of the display ΔV (in ml)
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 (app. 0.1%) in the weighing must be taken into account. Consideration should also be given to evaporation.

5.3.1 Setting up 6.3011.XXX and 6.3012.XXX Exchange Units

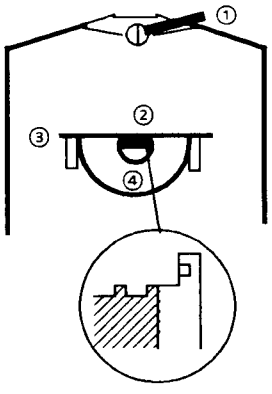


Fig. 5-7: Bottom view

Before plugging-in the Exchange Unit, check if the stopcock turn lever ① is to the right and if the coupling ② stands parallel to the ridge ③ and is even with the rings ④. The coupling can be adjusted with the 6.2739.010 key.

- Remove packaging plate from under the reagent bottle.
- Mount retaining clips for the reagent bottle, see Fig. 6-1, page 88.
- Fill reagent bottle with titrant.
- Insert cotton wool in the 6.1609.000 Drying Tube and add 6.2811.000 Molecular Sieves. Cover with cotton wool and close with cover.
- Press <DOS> key until the piston is in the top end position.
- Press <FILL/STOP> key.

The delivery and filling rates can be set with the potentiometer of the 701 KF Titrino. If your reagent requires a lower filling rate, this should also be set for the filling after the titration with the parameter "filling rate" under the <configuration> key, see page 16.

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

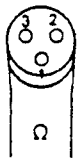
If you do not wish to use the reagent bottle supplied, convert your Exchange Unit as follows:
- Snap in the reagent bottle retaining clips so that the reagent bottle sits snugly in the Exchange Unit.
- For different original reagent bottles, you need a special bottle siphon and possibly also a threaded adapter. The following bottle siphons are available:
  - for bottles with GL45 thread, e.g. Riedel-de Haën (1 L), Baker (bottle siphon included in standard equipment) — 6.1602.100
  - for bottles with S40, 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 the electrode associated with the reagent, for example.

5.3.2 Assembly and setting up 6.3006.XXX and 6.3007.XXX Exchange Units

See also Fig. 6-2, page 89
- The instrument 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 to run out by app. 2 cm.
- Carefully grease PTFE piston (see Section 5.3.4), 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 flange in the slot of the exchange support.
- Clamp cylinder with 6.2035.000 Flange and 6.1549.000 Clamping Ring moderately tightly. (For 50 mL units, use 6.1551.000 Plastic Flange.)
- Fit remaining components of Exchange Unit.
  . Tubing connections:

Flat cock



1 Connection to glass cylinder

2 Connection to burette tip

3 Connection to reagent bottle

Fig. 5-8: Stopcock tubing connections

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

Filling:
- Fill the reagent bottle with the titrant.
- Insert cotton wool in the 6.1609.000 Adsorption Tube and add 6.2811.000 Molecular Sieves. Cover with cotton wool and close with cover.
- Press <DOS> key until the piston is in the top end position.
- Press <FILL/STOP> key.

The delivery and filling rates can be set with the potentiometer of the 701 KF Titrino. If your reagent requires a lower filling rate, this should also be set for the filling after the titration with the parameter "filling rate" under the <configuration> key, see page 16.

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

5.3.3 Exchanging 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 6.3006.XXX/6.3007.XXX 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.

5.3.4 Maintenance

It is best to store burette tips in methanol to prevent crystallisation of the KF reagent: Fill glass holder with methanol, pass burette tip through the ball stopper and place it in the glass holder. 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. (Take special care to 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 without cogging.

SISCO 3000 (Swedish Iron & Steel Corp.) grease - this is not a 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.

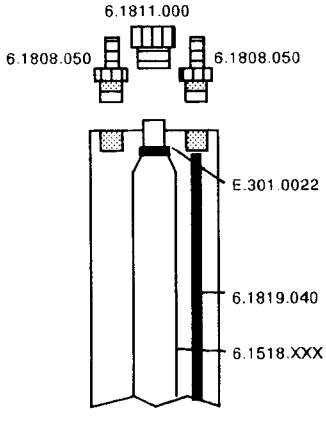
Stopcock

The stopcock needs no maintenance. If a defect is suspected, it is best to return it for checking to the manufacturer unopened (improper handling can render the stopcock completely useless). It is thus advisable to always keep a 6.1542.0X0 Stopcock as a spare.

Removing stocock:
. 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 markings on shaft and housing of stopcock.
. nsert stopcock from above in the holder and press down until the quick-release coupling engages.
. Screw in screw nipples.

5.3.5 Thermostat jacket of 6.3011.XXX and 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. Grease 1536.010 Thermostat Jacket slightly at its lower inner end and mount it.
6. Grease O-ring slightly and mount it onto the 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

6. Appendix

6.1 Technical specifications

Titration modes	KF titration Titer determination with water or a water-containing standard Titer determination with sodium tartrate Blank determination
Lower limit of determination	app. 500 µg water
Typical determination times for samples with free water	30 s ... several minutes; depending on titrant
Endpoint indication	either voltametric or amperometric
Resolution of burette	10 000 steps per burette volume
Display	LCD, 2 lines comprising 24 characters
Character height	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 and robot
Input lines	Start, Stop, Enter, Clear
Output lines	Ready, Conditioning ok, Titration, End of titration, Change solvent, Error, Activate
Analog output	the following curves can be recorded: – volume vs. time – drift vs. time – control deviation vs. time
Output signal	– 2000 ... 2000 mV
Resolution	
Volume vs. time	1 cylinder volume = 2000 mV
Drift vs. time	100 µl/min = 1000 mV
Control deviation vs. time	1 mV = 1 mV
Ambient temperature	
Nominal operational range	5 ... 40 °C
Storage, transport	– 20 ... 60 °C
Safety specifications	Designed and tested in accordance to IEC publication 348, safety class I.This manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.
Mains connection	
Voltage	100, 117, 220, 240 V ± 10% (switchable)
Frequency	50 ... 60 Hz
Power consumption	15 VA
Fuse	Thermal fuse
Dimensions with Exchange Unit	
Width	150 mm
Height	450 mm
Depth	275 mm
Weight, incl. keypad	app. 3.4 kg

6.2 Standard parameters

<configuration> key

Display	Input range	Default value
>KF device settings		
limit KF reag.	0...999 ml, OFF	OFF
actual KF reag.	0...999 ml	0 ml
polarizer:	I(pol), U(pol)	I(pol)
I(pol)	-127...127 µA	50 µA
EP	-1500...1500 mV	250 mV
U(pol)	-1270...1270 mV	500 mV
EP	-150...150 µA	25 µA
filling rate	0.01...150 ml/min, max.	max.
>RS232 settings		
baud rate:	300, 600, 1200, 2400, 4800, 9600	9600
data bit:	7, 8	8
stop bit:	1, 2	1
parity:	even, odd, none	none
handshake:	HWs, HWf, SWline, SWchar, none	HWs
RS control:	ON, OFF	ON
>peripheral units		
send to:	Epson, Seiko, IBM	IBM
balance:	Sartorius, Mettler, AND, Precisa	Sartorius
record:	V vs. t, dV/dt vs. t, U vs. t, -U vs. t	V vs. t
>auxiliaries		
dialog:	english, deutsch, francais, español	english
date	YY-MM-DD	date
time	HH:MM	time
run number	0...999	0
electrode test:	ON, OFF	ON
display KFR vol.:	ON, OFF	ON
device label	up to 8 ASCII characters	-
program	-	701.0010

<parameters> key

Display	Input range	Devault value
>titration parameter		
extr.time	-9999...9999 s	0 s
stop crit.:	drift, time	drift
stop drift	1...999 µl/min	20 µl/min
t(delay)	0...99 s	10 s
stop V	0.00...99.99 ml, OFF	99.99 ml
start V	0.00...99.99 ml	0.00 ml
dos rate	0.01...150 ml/min, max.	max.
max.rate	0.01...150 ml/min, max.	max.
min.volume incr.	0.1...9.9 µl, min.	min.
>preselections		
conditioning:	ON, OFF	ON
req.ident:	ON, OFF	OFF
req.smple size:	ON, OFF	ON
report:	full, short, OFF	OFF

<calc data> key in the KFT mode

Display	Input range	Default value
>calculation		
smpl size	6-digit number	1.0 g
ident.	up to 8 ASCII characters	–
titer	0.0000...99.9991 mg/ml	5.0 mg/ml
factor	±1 000 000	0.1
divisor	±1 000 000	1.0
blank	0.0000...99.9991 ml	0.0 ml
drift corr.:	auto, man., OFF	OFF
drift value	0.0...99.9 µl/min	0.0 µl/min
>statistics		
mean n =	2...20, OFF	OFF
res.tab:	original, delete n, delete all	original
delete n =	1...20	1

<calc data> key in the modes TITER with H_2O or std. and TITER with $Na_2tart \cdot 2H_2O$

Display	Input range	Default value
>calculation		
smpl size	6-digit number	1.0 g
ident.	up to 8 ASCII characters	–
factor	6-digit number	1000 (H_2O) or 156.6 ($Na_2Tart \cdot 2H_2O$)
drift corr:	auto, man., OFF	OFF
drift value	0.0...99.9 µl/min	0.0 µl/min
>statistics		
mean n =	2...20, OFF	20
res.tab:	original, delete n, delete all	original
delete n =	1...20	1

<calc data> key in the BLANK mode

Display	Input range	Default value
>calculation		
factor	6-digit number	1.0
drift corr.:	auto, man., OFF	OFF
drift value	0.0...99.9 µl/min	0.0 µl/min
>statistics		
mean n =	2...20, OFF	20
res.tab:	original, delete n, delete all	original
delete n =	1...20	1

<unit> key in the KFT mode

Display	Input range	Default value
result unit:	%, ppm, mg/ml, g, mg, ml, mg/pc, no unit	%
result unit: ;2	0...9	2
smpl size unit:	g, mg, ml, ul, pc, no unit	g

In the "TITER" and "BLANK" modes, the result unit is just displayed, it can not be entered.

6.3 Translations of dialog texts

<configuration> key

English	Spanish	German	French
>KF device settings	>ajustes generales KF	>KF Geräteeinstellungen	>Réglages KF généraux
limit KF reag.	límite vol.KF	Limit KFR	réac.KF limité à
actual KF reag.	vol.KF actual	Aktuelles KFR	réac.KF actuel
polarizer:	polarizador:	Polarizer:	polariseur:
I(pol)	I(pol)	I(pol)	I(pol)
U(pol)	U(pol)	U(pol)	U(pol)
EP	punto final	Endpunkt	point final
filling rate	veloc.rell.	Füllgeschw.	débit rempl.
>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:
>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.
electrode test:	prueba electrodo:	Elektroden-Test:	test électrode:
display KFR vol.:	indic.volumen KF:	KFR-Vol.-Anzeige:	afficher volume KF:
device label	dirección	Gerätebez.	adresse
program	programa	Programm	programme

<parameters> key

English	Spanish	German	French
>titration parameters	>parámetros de titración	>Titrationsparameter	>Paramètres de titrage
extr.time	tiempo extracción	Extr.zeit	temps d'extr.
stop crit.:	crit.parada:	Stoppkrit.:	crit.d'arrêt:
stop drift	deriva parada	Stopp Drift	dérive d'arr.
t(delay)	t(espera)	Abschaltzeit	délai de l'arrêt
stop V	V parada	Stopp V	V d'arrêt
start V	V inicial	Start V	V de départ
dos.rate	veloc.dos.	Dos.Rate	débit dos.
max.rate	veloc.máx.	Max.Rate	débit max.
min.volume incr.	incremento min.	Min.Volumeninkr.	incrément mini.
>preselections	>preselecciones	>Vorwahl	>Présélections
conditioning:	acondicion.:	Konditionieren:	conditionner:
req.ident:	llamada ident:	Ident.abfragen:	demande ident:
req.smpl size:	llamada peso:	Einmass abfr.:	demande p.d'essai:
report:	impresión:	Report:	rapport:

<calc data> key in the KFT mode

English	Spanish	German	French
>calculation smpl size ident. titer factor divisor blank drift corr.: drift value	>cálculo peso ident. titulo factor divisor blanco corr.deriva: valor deriva	>Berechnung Einmass Ident. Titer Faktor Divisor Blindwert Driftkorr.: Driftwert	>Calcul p.d'essai ident. titre facteur diviseur blanc corr.dérive: valeur dérive
>statistics mean n = res.tab: delete n =	>estadística media n = tab.res: borrar n =	>Statistik Mittelw. n = Res.Tab: löschen n =	>Statistique moyenne n = tab.res: éliminer n =

<unit> key

English	Spanish	German	French
result unit:	unidad resultado:	Einheit Resultat:	unité résultat:
smpl size unit:	unidad del peso:	Einheit Einmass:	unité p.d'essai:

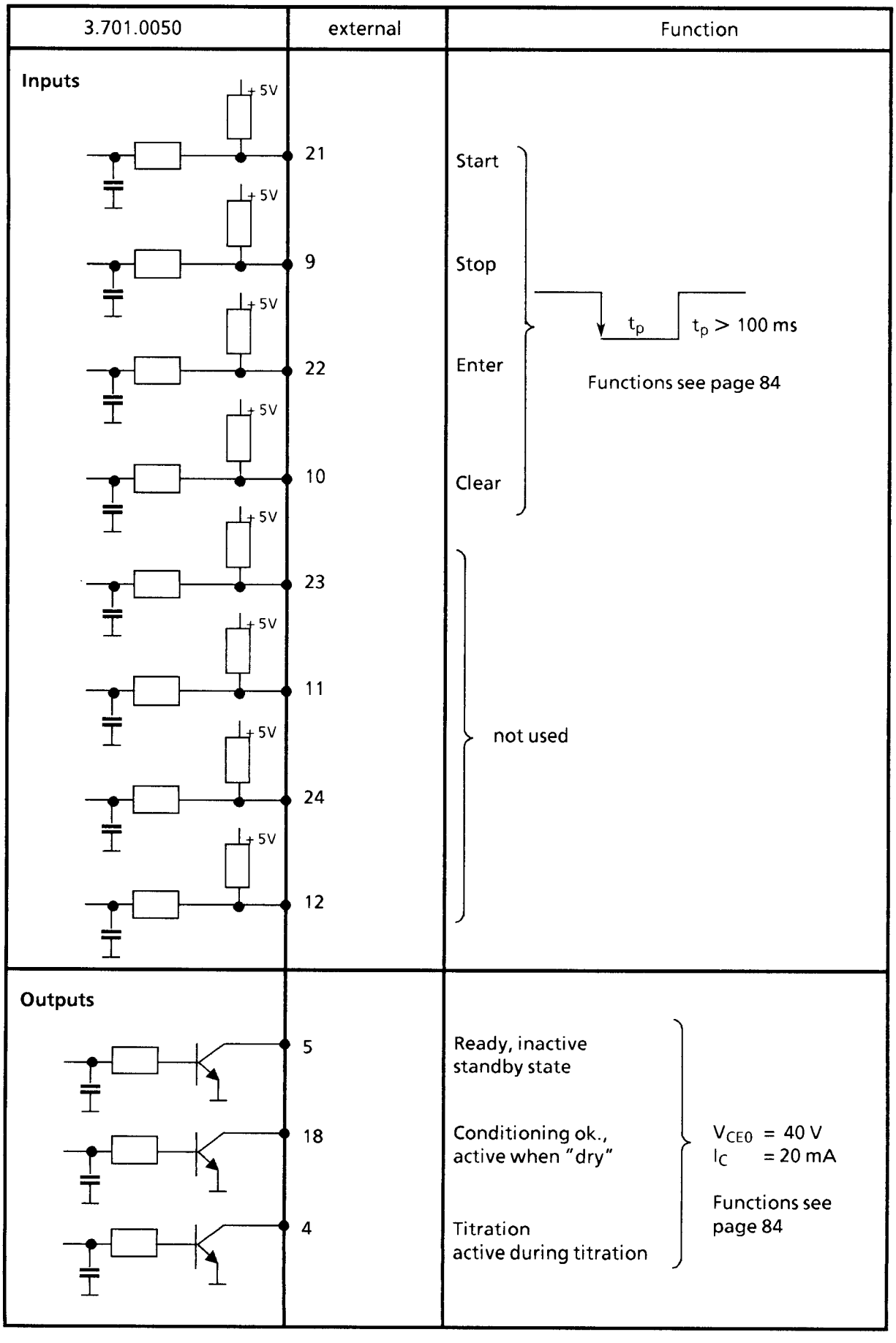
Displays for modes and titration sequences

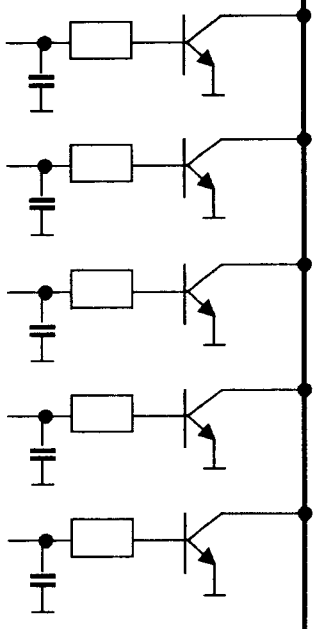
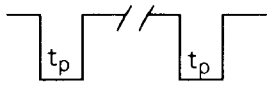
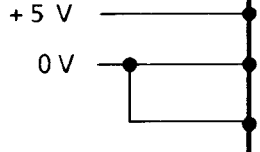
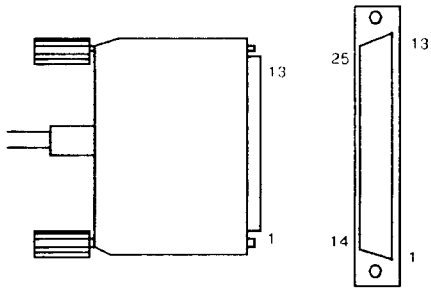
English	Spanish	German	French
KFT	KFT	KFT	KFT
water	agua	Wasser	eau
TITER with H2O or std.	TITULO con H2O o std.	TITER mit H2O oder Std.	TITRE avec H2O ou std.
TITER with Na2Tart·2H2O	TITULO con Na2Tart·2H2O	TITER mit Na2Tart·2H2O	TITRE avec Tartrate Na
BLANK determination	BLANCO valoración	BL-Wert Bestimmung	BLANC détermination
blank	blanco	Blindwert	blanc
wait	espere	warten	attente
conditioning	acondicion.	konditioniert	conditionné
add sample	adicione muestra	Probe zugeben	ajout d'échant.
drift	deriva	Drift	dérive
print calc data	imprim.calc data	Drucken calc data	impression calc data
print parameters	imprim.parameters	Drucken parameters	impression parameters
print configuration	imprim.configuration	Drucken configuration	impression configuration
print mean	imprim.media	Drucken Mittelw.	impression moyenne

Error and special messages

English	Spanish	German	French
change solvent	cambie disolvente	Lösung wechseln	changer le solvant
check electrode	revise electrodo	Elektrode prüfen	contrôler l'électrode
check exchange unit	revise bureta	Wechseleinheit prüfen	contrôler la burette
cylinder empty!	cilindro vacío	Zylinder leer!	cylindre vide!
division by zero	división por cero	Division durch Null	division par zéro
stop V reached	V parada alcanzado	Stopp V erreicht	V d'arrêt atteint

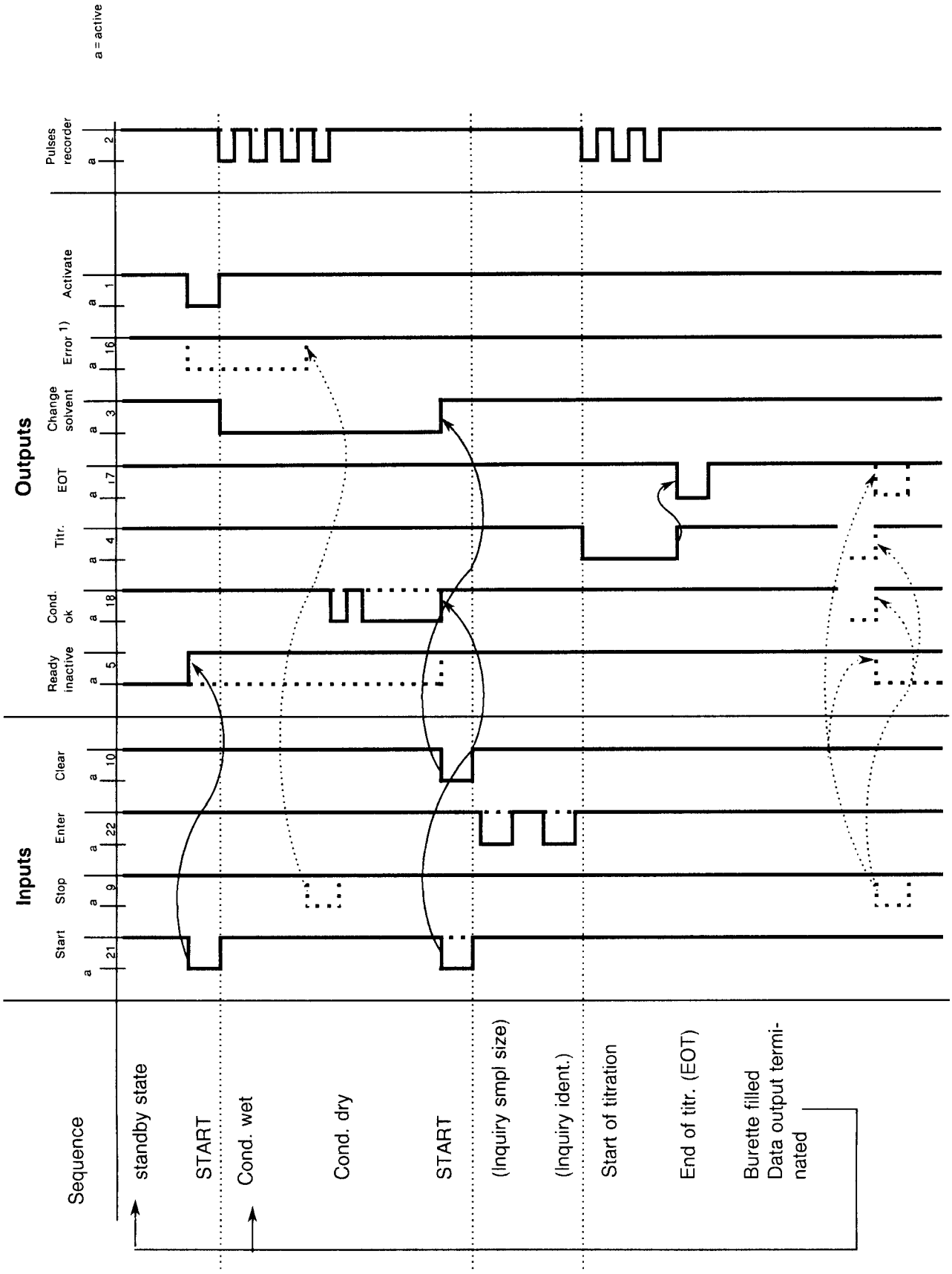
6.4 Pin assignment of the "Remote" socket



3.701.0050	external	Function
Outputs		
	17 3 16 1 2	End of titration EOT Change solvent Error: active on errors "check electrode" and "check exchange unit" Activate: Transition from standby state to active state (cond. or titr.) Pulses for recorder  t_p = 150 µs
		V_{CE0} = 40 V I_C = 20 mA Functions see page 84
Voltage		
	15 14 25	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.

6.4.1 Lines of the "Remote" socket during the titration



1): The error signal is reset when the error is eliminated.

6.5 Bibliography for KF titration

There is a whole series of recent and excellent references and application instructions regarding the KF titration. The following shows a selection:

- Metrohm Application Bulletins:
  No. 77: Karl Fischer water determinations
  No. 88: Bibliography concerning Karl Fischer water determinations
  No. 109: Karl Fischer water determination with the Drying Oven
  No. 141: Analysis of edible oils and fats
  No. 142: Karl Fischer moisture determinations in gases

- E. Scholz, Karl Fischer Titration, Determination of Water, Springer-Verlag, Berlin-New York 1984

- G. Wieland, Water Determination by Karl Fischer Titration, GIT Verlag, Darmstadt 1987

- Hydranal®, practical course, Water reagents according to Eugen Scholz for Karl Fischer titration, Riedel-de Haën, Seelze, 1987
  or
  Hydranal®, Reagents for Karl Fischer Titration, Eugen Scholz, Riedel-de Haën, Seelze

- Hydranal® Guide PC, Applications for the Karl Fischer titration, Ed. by Eugen Scholz, PC diskette

6.6 Warranty

The warranty regarding our products is limited to rectification free of charge in our workshops of defects that can be proved to be due to material, design or manufacturing faults which appear within 12 months from the day of delivery. Transport costs are chargeable to the 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.

6.7 Scope of Delivery and Ordering Designations

6.7.1 701 KF Titrino

701 KF Titrino	**2.701.0010**
including the following accessories:	
1 Double Pt electrode	6.0338.100
1 Set O-rings	6.1244.040
1 Drying tube	6.1403.040
1 Titration vessel upper half	6.1414.030
1 Titration vessel lower half, 20...90 ml	6.1415.220
1 Titration vessel lower half, 50...150 ml	6.1415.250
2 Sets septa, 5 per set	6.1448.010
2 Magnetic stirring bars, length 16 mm	6.1903.020
2 Magnetic stirring bars, length 25 mm	6.1903.030
1 Electrode cable	6.2104.020
1 Keypad for 701 KF Titrino	6.2130.000
1 Glass weighing spoon with protective cover	6.2412.000
1 KF screw nipple	6.2730.010
1 Septum stopper	6.2730.020
3 Stoppers with nipple and O-ring	6.2730.030
1 Key for Exchange Units	6.2739.010
1 Bottle molecular sieves, 250 g	6.2811.000
1 Mains cable with cable socket, type CEE(22),V	
Cable plug to customer's specifications:	
Type SEV 12 (Switzerland...)	6.2122.020
Type CEE(7),VII (Federal Republic of Germany...)	6.2122.040
Type NEMA/ASA (USA...)	6.2122.070
1 Dust cover	6.2723.130
1 Instructions for Use for 701 KF titrino	8.701.1003

Options

Accessories to separate order and on payment of extra charge:

703 Ti Stand	2.703.0010
Magnetic stirrer, stand, siphoning device for waste solvent, addition of fresh solvent.	
649 Magnetic Stirrer	
649 Magnetic Swing-out Stirrer	2.649.0010
Stand for workstation	6.2001.010
Adjustable collar to position titration vessels	6.2013.010
681 Pump Unit	
Separate pump to siphon off titrated solution and for the addition of fresh solvent.	
110...117 V, NEMA/ASA plug (USA...)	2.681.0021
220...240 V, Euro plug	2.681.0024
110...117 V, Euro plug	2.681.0025
Titration equipment	
Titration vessel, 70...200 ml	6.1415.310
Titration vessel with drain cock, 20...90 ml	6.1417.220
Titration vessel with drain cock, 50...150 ml	6.1417.250
Titration vessel with drain cock, 70...200 ml	6.1417.310
Thermostatable titration vessel, 20...90 ml	6.1418.220
Thermostatable titration vessel, 50...150 ml	6.1418.250
Stopper and PTFE tubing for the introduction of gaseous samples	6.2730.040 + 6.1819.060
Stoppers without septum for the insertion of thick injection needles	6.2730.040 + 6.1446.040

Printer connection	
Cable 701 KF Titrino – EPSON printer P40/P80	6.2125.040
Cable 701 KF Titrino – Seiko printer DPU-411	6.2125.020
Cable 701 KF Titrino – Citizen printer iDP560 RS	6.2125.050
Adapter for simultaneous connection of printer and balance	6.2125.030
Balance connection	
Sartorius balances MP8, Connection cable	6.2125.070
Mettler AT, AM, and PM balances and balances with interface 016	Cable from Mettler
Mettler balances with interface 011	6.2125.020
AND balances, connecting cable	6.2125.020
Precisa balances, connecting cable	6.2125.080
Adapter for simultaneous connection of balance and printer	6.2125.030
Control via RS232 C interface	
Cable 701 KF Titrino – IBM® PC/XT/PS-2 or compatible	6.2125.060
Cable 701 KF Titrino – IBM® AT	6.2125.060 + 6.2125.010
RS232 C extension cable	6.2125.020
Program package for the data transfer 701 KF Titrino – IBM® PC or compatible, $5\frac{1}{4}$" and $3\frac{1}{2}$" diskettes, PASCAL and BASIC	6.6007.000
586 Labograph, analogue recorder	
586 Labograph, 50 Hz	2.586.0012
586 Labograph, 60 Hz	2.586.0013
688 KF Oven	
220 ... 240 V	2.688.0014
110 ... 117 V	2.688.0015
Stand mounting for the oven	6.2048.000
Stopper and PTFE tubing for the gas introduction	6.2730.040 + 6.1819.060
661 Pump Unit	2.661.0010
For the generation of a dry air stream for work with the 688 KF Oven	

6.7.2 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.

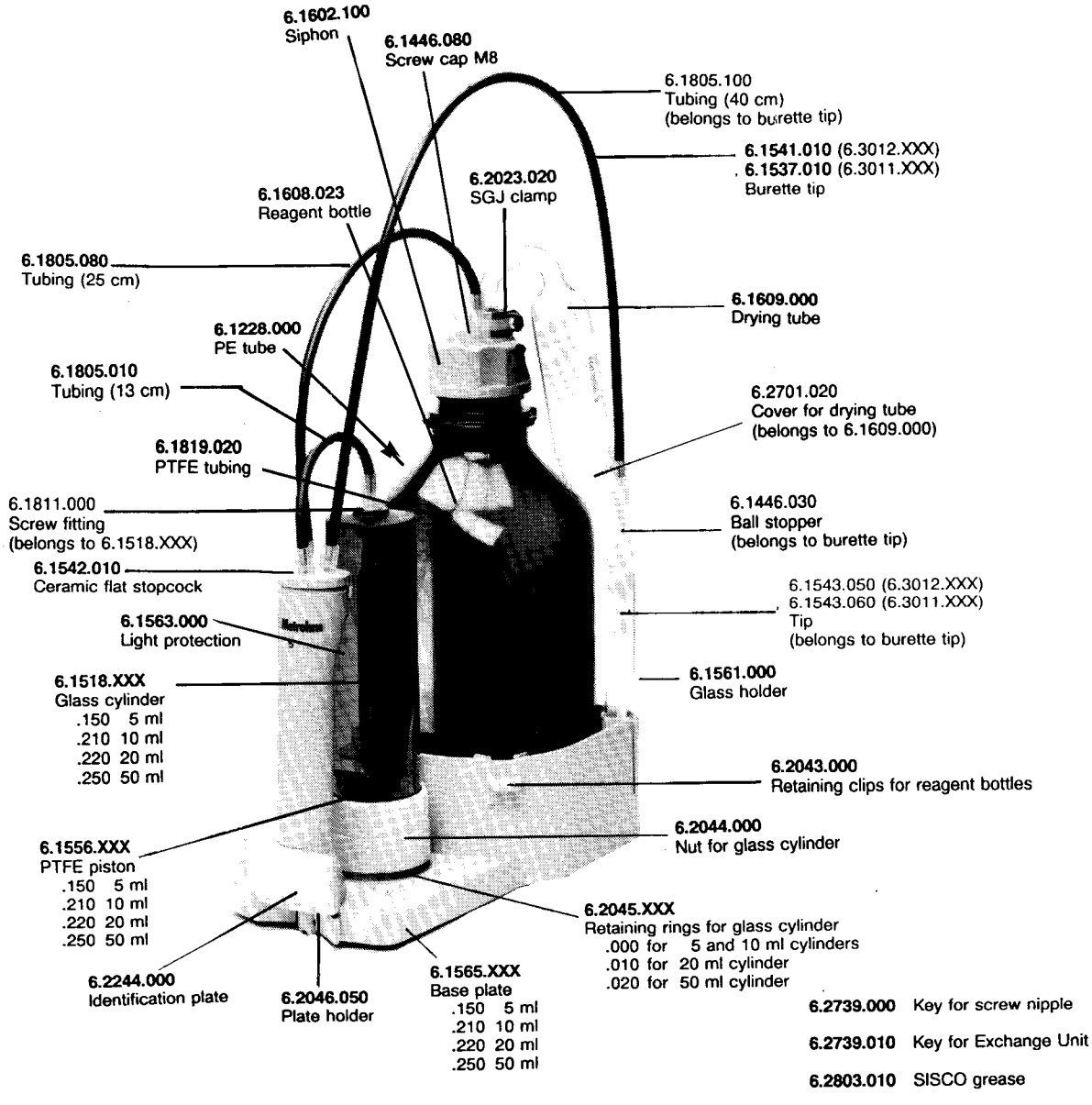


Fig. 6-1: Standard accessories and ordering designations for the 6.3011.253 and 6.3012.XXX Exchange Units

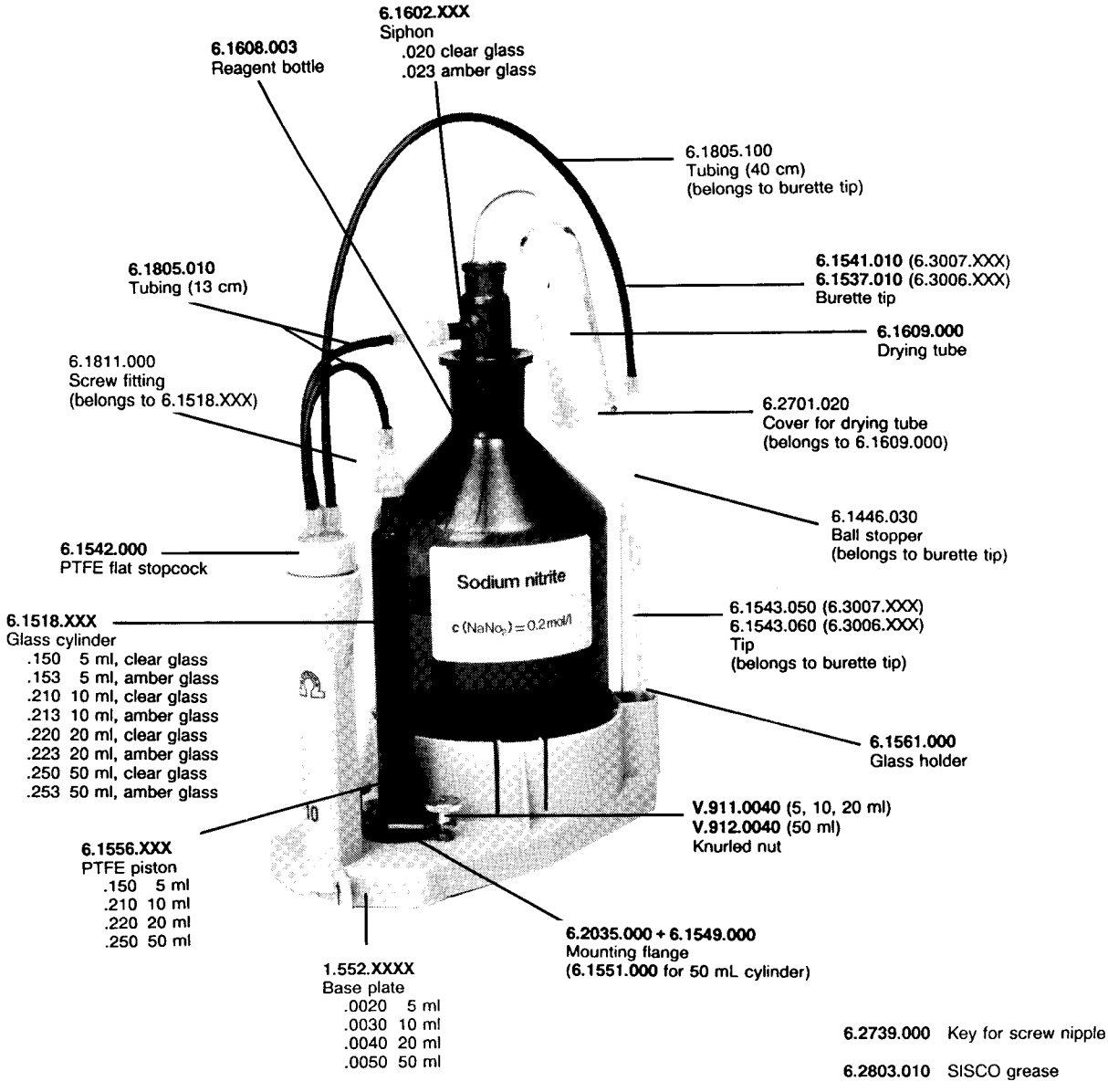


Fig. 6-2: Standard accessories and ordering designations for the 6.3006.XXX and 6.3007.XXX Exchange Units

Option

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 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

Index

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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T

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V

W

Ionenanalytik • Analyse des ions • Ion analysis • Análisis iónico
701 KF Titrino

CE

Metrohm

Metrohm Ltd.
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Switzerland
Phone +41 71 53 85 85
Fax +41 71 53 89 01

EC Declaration of Conformity

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

701 KF Titrino

meets the requirements of EC Directives 89/336/EWG and 73/23/EWG.

Source of the specifications:

EN 50081-1	Electromagnetic compatibility, basic specification Emitted Interference
EN 50082-1	Electromagnetic compatibility, basic specification Interference Immunity
EN 61010	Safety requirements for electrical laboratory measurement and control equipment

Description of the instrument:

Titrator for precise water determinations in analytical laboratories.

Herisau, December 5, 1995

Dr. J. Frank
Development Manager

Ch. Buchmann
Production and
Quality Assurance Manager

Ionenanalytik • Analyse des ions • Ion analysis • Análisis iónico

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