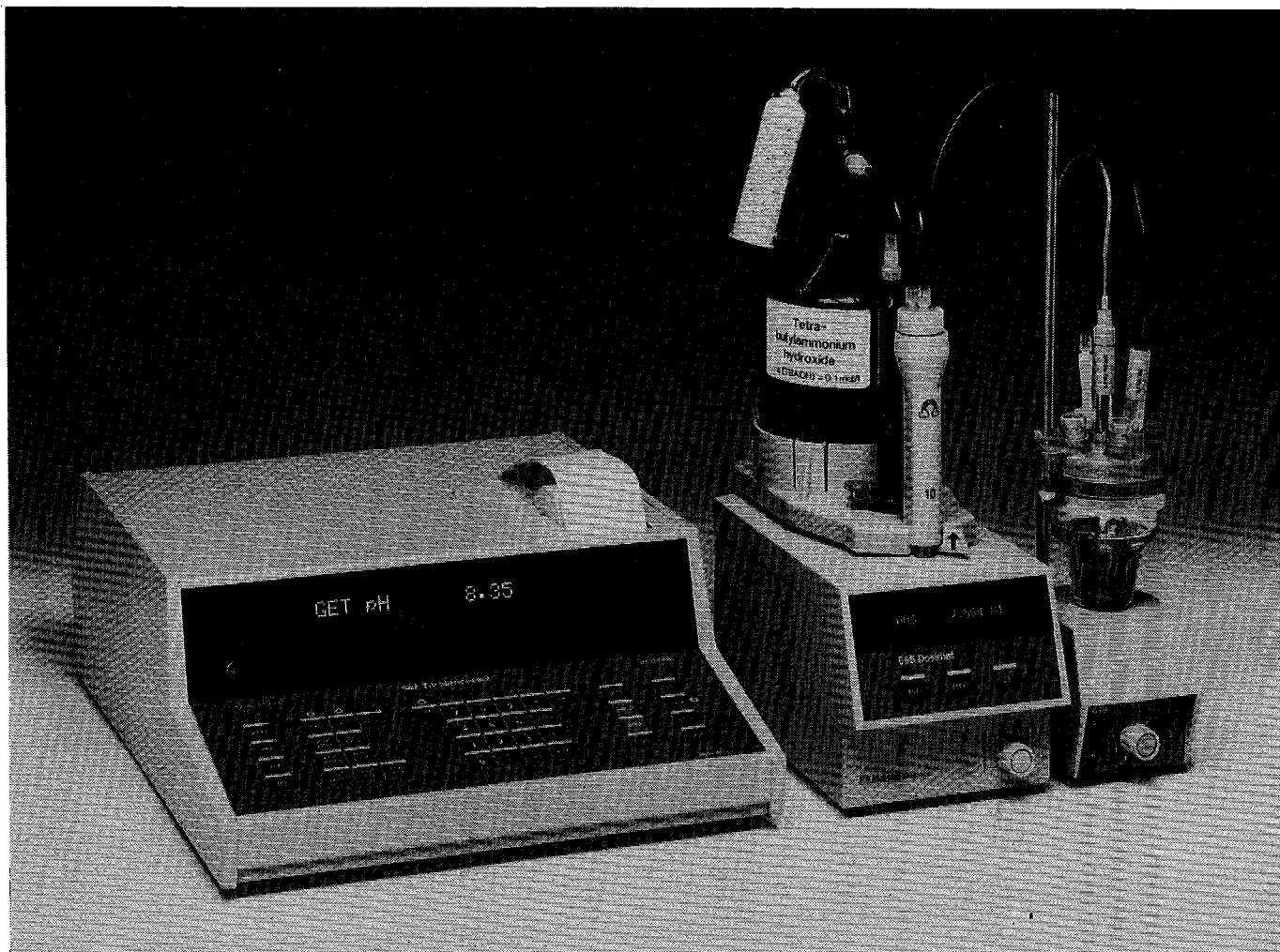

Metrohm**Instructions for use**

686 Titroprocessor

Series 04...



 **Metrohm**
Ion analysis

METROHM Ltd.
CH-9101 Herisau

Switzerland

Phone 071/53 85 85

Fax 071/53 89 01

Telex 882 712 metr ch

METROHM LTD CH-9100 Herisau (Switzerland)

Titroprocessor

686

Series 04 ...

686 /b
87.03 Ti

| Standard methods | | Loading standard methods | | |
|---|---|--|--|--|
| SET | Set Endpoint Titration | Select method by pressing the corresponding key (press key until the correct measured quantity is displayed) and confirm with <enter>. The standard method with its standard parameters is now in the register. | | |
| GET | Titration with continuous reagent feeding and automatic equivalence-point evaluation | | | |
| MET | Titration with incremental reagent feeding and automatic equivalence-point evaluation | | | |
| MEAS | Measurement of pH/U/temperature | | | |
| Parameters | | Changing | - inquire parameter - key in new value - press <enter> | |
| Method | Inquiry | Meaning | Initial val. | Range |
| SET | EP1 pH EP1 U | 1 st endpoint | OFF | pH: 0... ± 20.00 U: 0... ± 2000 mV |
| | dyn. ΔpH 1 dyn. ΔU 1 | Pulse range | OFF | pH: 0...20.00; OFF U: 0...2000 mV; OFF |
| | drift 1 | Drift: Next pulse is emitted if drift condition is fulfilled | 10 mV/s | 0.3...99.9 mV/s |
| | t(delay) 1 | Delay time | 10 s | 0...99 s; INF |
| | EP2 pH EP2 U | 2 nd endpoint: dyn. ΔpH 2/U 2; drift 2; t(delay) 2 are only inquired if EP2 is set | OFF | pH: 0... ± 20.00; OFF U: 0... ± 2000 mV; OFF |
| | temp. | Titration temperature | 25.0 °C | -20.0...200.0 °C |
| | stop V | Stop volume: Security stop if no endpoints are reached | 99.99 ml | 0...999.99 ml; OFF |
| GET | titr.rate | Titration rate: Feeding in ml/min | 1.00 ml/min | V _{min} : 0.01 ml/min V _{max} : V _B *0.3 ml/min |
| | anticip. | Slow down of titration rate depending on the slope of the titration curve | 0 | 0...99 |
| | stop V stop pH stop U stop #EP | Stop criteria { Stop if set volume is reached Stop if set voltage is reached Stop if number of EP is reached | 99.99 ml OFF OFF OFF | 0...999.99 ml; OFF pH: 0... ± 20.00; OFF U: 0... ± 2000 mV; OFF 1...9 |
| | start V start pH start U start slope | Start criteria { Start volume Feeding until set voltage is reached Feeding until set slope of titration curve is reached | 0.00 ml OFF OFF OFF | 0...999.99 ml pH: 0... ± 20.00; OFF U: 0... ± 2000 mV; OFF pH: 0...9.99 /ml; OFF U: 0...999 mV/ml; OFF |
| | temp. | Titration temperature | 25.0 °C | -20.0...200.0 °C |
| | EPA/B pH EPA/B U | Fixed end-points A and B | OFF OFF | pH: 0... ± 20.00; OFF U: 0... ± 2000 mV; OFF |
| | EP crit. | Sensitivity of equivalence point recognition. OFF = no automatic EP evaluation | 3 | 1...8; OFF |
| | MET | vol.step | Volume increment. Analogically controlled feeding rate. | 0.10 ml |
| drift or Δt(wait) | | Drift for the acquisition of measured values. Waiting time for acquisition of measured values. | 100 mV/min 5 s | 1...999 mV/min; OFF 1...999 s |
| stop V stop pH stop U stop #EP | | Stop criteria { Stop if set volume is reached Stop if set voltage is reached Stop if number of EP is reached | 99.99 ml OFF OFF OFF | 0...999.99 ml; OFF pH: 0... ± 20.00; OFF U: 0... ± 2000 mV; OFF 1...9 |
| start V start pH start U start slope | | Start criteria { Start volume Feeding until set voltage is reached Feeding until set slope of titration curve is reached | 0.00 ml OFF OFF OFF | 0...999.99 ml pH: 0... ± 20.00; OFF U: 0... ± 2000 mV; OFF pH: 0...9.99 /ml; OFF U: 0...999 mV/ml; OFF |
| temp. | | Titration temperature | 25.0 °C | -20.0...200.0 °C |
| EPA/B pH EPA/B U | | Fixed end-points A and B | OFF OFF | pH: 0... ± 20.00; OFF U: 0... ± 2000 mV; OFF |
| EP crit.pH EP crit. U | | Sensitivity of equivalence-point recognition | 0.50 30 mV | pH: 0.10...20.00 U: 1...999 mV |
| MEAS | | temp. auto | Automatic temperature measurement if Pt100 is connected | |
| | temp. | Temperature if no Pt100 is connected | 25.0 °C | -20.0...200.0 °C |

| prep steps | | | | |
|----------------------------|---------------------|---|--------------|-------------------|
| Method | Inquiry | Meaning | Initial val. | Range |
| SET GET MET | add V | Auxiliary reagent feeding | 0.00 ml | 0...999.99 ml |
| | pause | Waiting time | 0 s | 0...9999 s |
| | electr.input | Measuring input: 1;2 → high and low impedance input 12 → 2 high impedance inputs (differential pot.) | 1 | 1;2;12 |
| MEAS | t(print) | Periodic print-out of measured values (pH/U/temp) for mode MEAS | OFF | 0...9999 s; OFF |
| | el.cal. 0/1? | Calibration: 1 → yes; 0 → no | 0 | 1; 0 |
| | t.cal t.cal.m | Calibration temperature } Without Pt100 Automatic, with Pt100 | 25.0 °C | -20.0...200.0 °C |
| | pH(S) U cal XX | 1st buffer: enter pH of 1st buffer Measurement: Stop drift controlled | OFF | 0... ± 20.00 |
| | pH(S) 2 U cal XX | 2nd buffer: Enter pH of 2nd buffer; for 1 point calibration → QUIT or STOP Measurement → 2 point calibration | OFF | 0... ± 20.00; OFF |
| | res.cal. 0/1? | Resetting calibration data to standard values: 1 → yes; 0 → no | 0 | 1;0 |

| | | |
|--------------------------|---------------------------------------|---|
| def records | report XX | Entry of code numbers from data blocks for automatic print-out at the end of titration 1 Parameter report 2 Result report with list of EP 3 Measuring point list (for GET and MET) 4 Formulas and formula constants 5 Titration curve with optimized scale (for GET and MET) 7 Result report without list of EP |
| | m | Mean values from up to 3 results (RS) (mean "on") |
| | com.var. | Common variable of a result (RSX) or a mean value (mRX) |
| entry of formulas | Inquiry | 2nd fmla X X: 1...9 Use sequential indices |
| | Endpoints | EPX X: 1...9 |
| | Results | RSX X: 1...9 Results from former formulas may be used |
| | Constants | CXX X: 00...20 Index with 2 digits (e.g. 5 → C05) X: 30...34 Common variable X: 40...42 Special X: 51; 52 Fixed endpoints A, B |
| | Completion: | FX = Formula; number of decimal places; unit (to be selected) |
| | fmla const | Entry of formula constants |
| | smpl size | Entry of sample size C00 |
| user methods | User memory for user specific methods | |
| | Entry: | - Select correct function (recall/store/delete) pressing <user methods> - Key in identification of method - <enter> |
| | recall: | Loading a method from the user memory into the register |
| | store: | Storing a method from the register into the user memory |
| | delete: | Deleting a method in the user memory |
| silos memory | | With "silo on", sample specific data are loaded from the silo memory into the register and the inquiry sequence in key <smpl data> is extended: |
| | silos line | Highest line of silo memory is displayed. A smaller number may be entered and data from this line can be displayed. |
| | method | Method from user memory |
| | id.#1/id.#2 | Sample identifications |
| | c20 | Sample specific calculation constant |
| | c00 | Sample size: With this entry the whole data line is copied into the silo memory |

Operating Instructions

Titroprocessor 686

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1. Preparation

1.1 Setting up the instrument

The 686 Titroprocessor should be installed as shown in Fig. 1.1 in a vibrationfree location and protected from corrosive vapours and chemical splashes.

If there are additional interfaces to be inserted, see chapter 4 of this manual.

Insert interfaces only when the instrument is switched off.

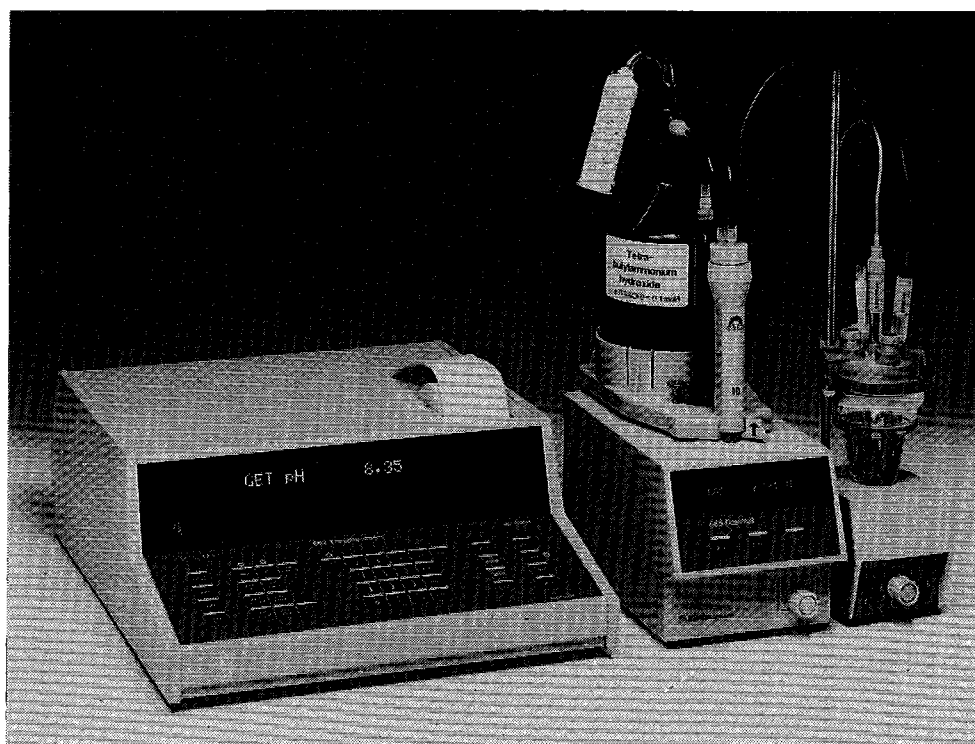


Fig. 1.1

(The stirrer may also be fixed on 686 Titroprocessor.)

1.2 Power connection

Before switching on the 686 Titroprocessor for the first time, check whether the voltage setting visible above the power socket is in accordance with the supply voltage. If the voltage setting has to be adjusted, proceed as follows:

- Unplug power cable.
- Open plastic cover above the socket by means of a screw-driver.
- Remove selector cylinder and reinsert it in the correct position.
(Never turn the inserted cylinder!).
- Pull out the fuse situated below the selector cylinder and check its rating. If the fuse rating does not correspond to that indicated on the instrument's rear plate, replace the fuse.
- Swing back plastic cover and press it until it is engaged.

Please note that the 686 Titroprocessor is equipped with an additional thermal fuse. If this fuse cuts off, please ask for METROHM service.

The power cable delivered with the instrument is three-cored and fitted with a plug carrying an earthing pin. If another plug has to be mounted, the yellow/green lead (IEC standard) must be connected to a protective earth.

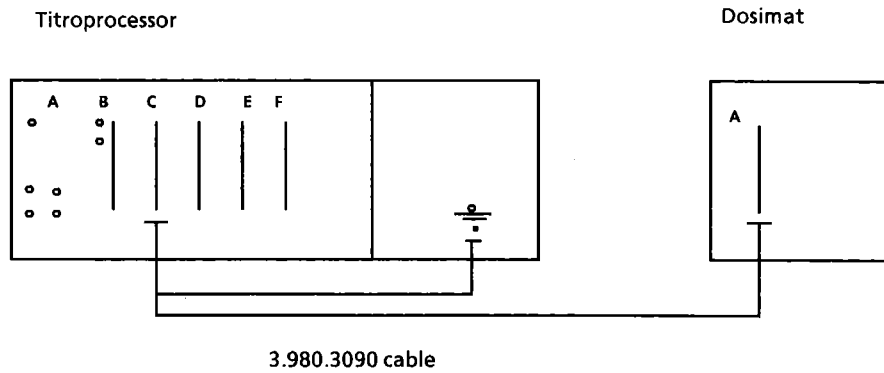
If no wall socket with an earth connection is available, the instrument should be connected to a good protective earth connection via the earthing socket (⌚).

All the earthing pins of the connection cables used must be plugged into the earthing socket (⌚).

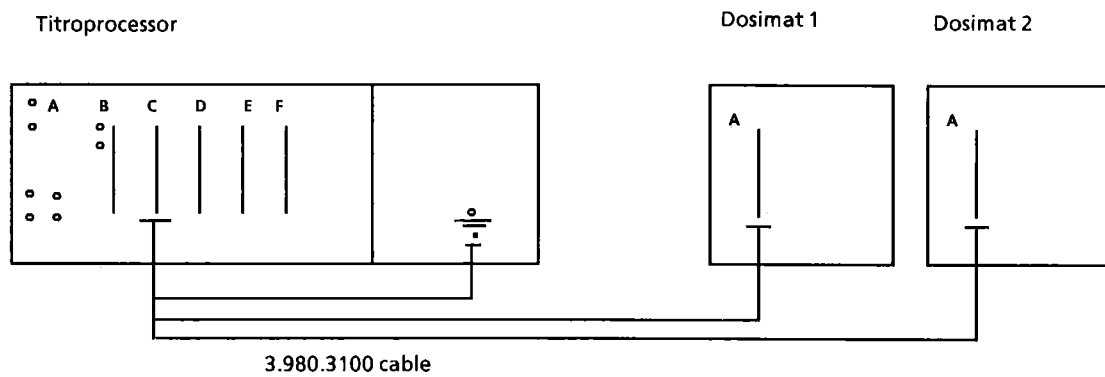
1.3 Connecting the Dosimat(s)

Set 665 Dosimats to "auto fill on" (see manual of 665 Dosimat).

Connecting one 665 Dosimat:



Connecting two 665 Dosimats:



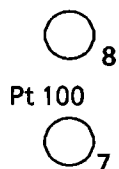
Dosimat 1: Titrating Dosimat

Dosimat 2: Auxiliary Dosimat

Connect or disconnect instruments only when they are switched off!

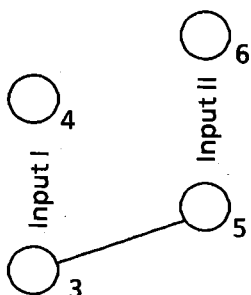
1.4 Sensor connections

Rear plate



Sockets (7) and (8):

Connection of a resistance thermometer Pt 100 (e.g. METROHM 6.1103.000 for universal measuring and titration vessels or 6.1103.040 for Sample Changer) Temperature measurement is connected with the actual measuring input.



Socket (4):

High resistance input I

Connection of a measuring electrode for input I

Socket (3):

Low resistance input I

Connection of a reference electrode for input I (empty if a combined measuring assembly is connected)

Socket (6):

High resistance input II

Connection of a measuring electrode for input II or

Connection of a second measuring electrode for differential potentiometry (see page 220)

Socket (5):

Low resistance input II

Galvanically connected with (3) (two different reference systems cannot be used at the same time in the same solution)

1.5 Inserting paper, printer

If the thermal paper has to be replaced, the instrument must be switched on. Pull out the old paper strip and cut the paper of the new roll into a triangle. When inserting the thermal paper, lift the hinged perspex plate and hold the roll such that the paper leaves from the bottom of the roll. Push the paper strip from behind under the transport roll and press the "paper" key until the paper is engaged. Insert the paper roll's spindle and mount the paper roll in its proper place.

- Please note:
- Always use the key <paper> for the paper-drive. Never pull out paper, as by doing this the printer could be damaged!
 - Thermal paper is light-sensitive.
 - Thermal paper may be rendered illegible by storing it in plastic envelopes (plasticizer).
 - Use the original thermal paper 6.2237.020, in order not to damage the printhead!
 - Do not run the printer without thermal paper!

If the printer does not work properly, this may be due to accumulation of foreign particles on the printhead. The printhead can be cleaned by inserting a sufficiently long thermal paper strip upside down into the printer and "printing out" a report several times.

1.6 Switching on and off

It is advisable to follow a certain sequence for switching on and off the instruments:

- . (peripheral units)
- . 686 Titroprocessor (depress mains switch firmly and wait for the display check).
- . Dosimat(s)

Switching off:

- . Dosimat(s)
- . 686 Titroprocessor
- . (peripheral units)

2. Fundamentals of Operation

2.1 Keyboard

The keyboard is divided into the following blocks:

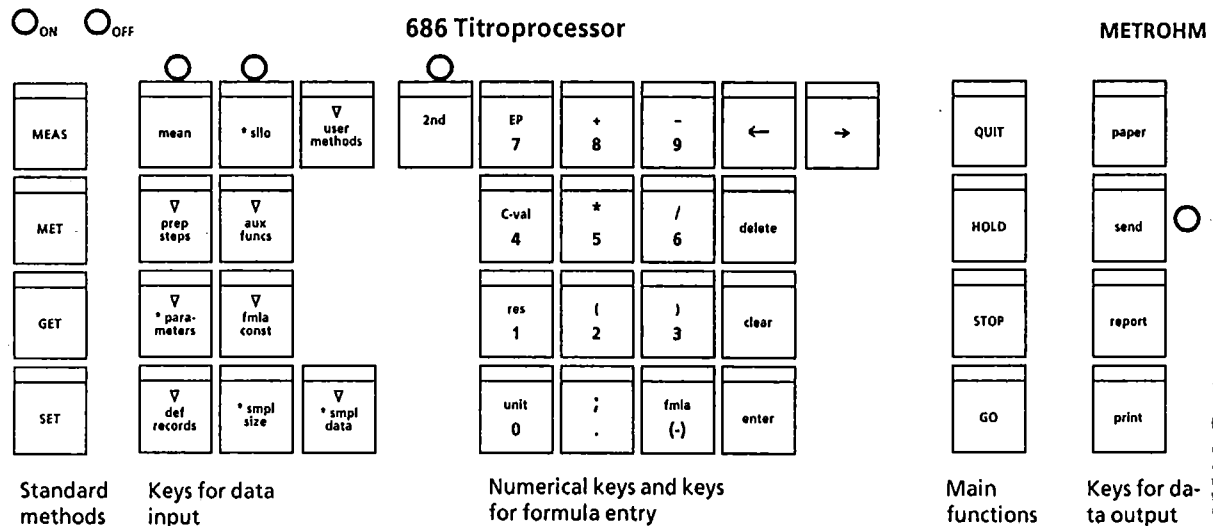


Fig. 2.1

Standard methods:

- . MEAS –measuring of pH, voltage and temperature
- . MET –Monotonic Equivalence-point Titration with incremental reagent feeding and automatic evaluation
- . GET –General Equivalence-point Titration with continuous reagent feeding and automatic evaluation
- . SET –(Pre-)Set Endpoint Titration

Data keys:

The special marks have the following meaning:

- * Live-keyboard keys, i.e. some parameters in these keys are also accessible during measurement or titration until data output starts. (Exception: No data keys are accessible during running of "prep steps" and when start criteria for GET or MET are worked off, see page 217).

- ∇ Keys with rolling inquiries, rolling keys (i.e. on repetitive (or continuous) pressing of these keys, one inquiry after the other is displayed. A new value is entered by means of the numerical keys and the key <enter>. After pressing <enter>, the next inquiry is displayed automatically. At the end of the inquiry sequence, the instrument returns to the starting point.

Example: Key <aux funcs>, setting of time, date, etc.

Switch the instrument on. It is now at its ready state, i.e. ready for titration with the method which was used last.

Press <aux funcs>.

Display shows sample # 0,
which tells you that your first titration will have number 1. Following titrations will be numbered consecutively.

Proceed to the next inquiry:

Press <aux funcs>

Display shows beep 1,
which means that 686 Titroprocessor announces the end of the work by one beep signal.

Proceed to the next inquiry:

Press <aux funcs>

Display shows actual time, e.g. time 14:10.

Is this the correct time? If not, enter the correct time i.e. 8:14
<0><8> <(-)> <1><4> <enter> .

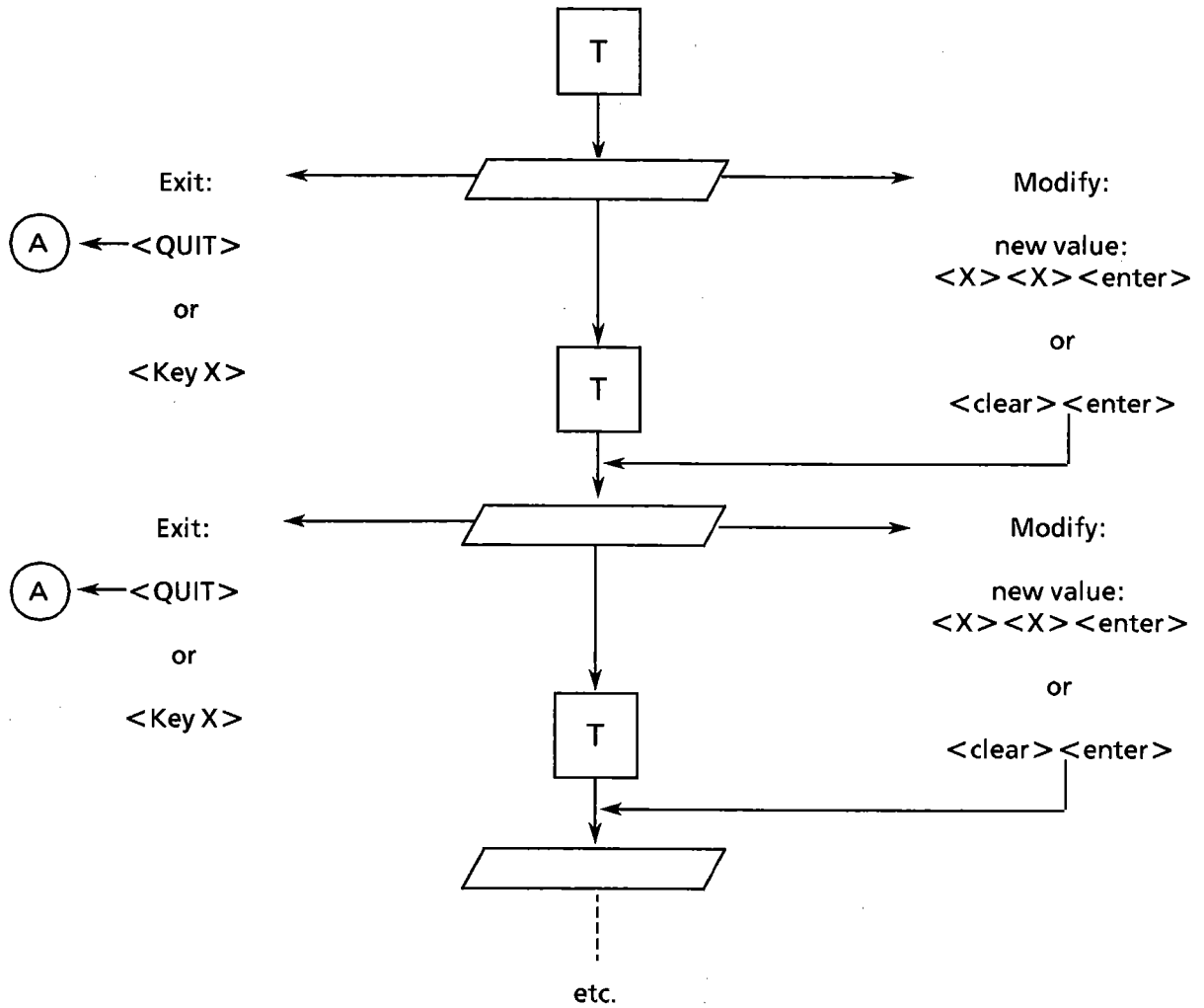
Display shows now the next inquiry

date 87-04-23 (year-month-day).

Is this the correct date? If not, enter the correct date (yy-mm-dd with <(-)> signs and <enter>).

After this entry or after pressing <aux funcs>, the instrument returns to the ready state.

General scheme for rolling inquiries:



(A)

: Ready state

T

: Key of the corresponding rolling inquiry

<Key X>

: Keys which may be pressed (see list on page 204)

List of keys X:

| Key X | accessible with the instrument not busy | accessible with the instrument busy |
|--------------|---|-------------------------------------|
| user methods | X | - |
| prep steps | X | - |
| parameters | X | X |
| def records | X | - |
| aux funcs | X | - |
| fmla const | X | - |
| smpl size | X | X |
| smpl data | X | X |
| report | X | - |
| send | X | - |
| GO | X | (X) after HOLD |
| STOP | - | X |
| HOLD | - | X |
| MEAS | X | - |
| MET | X | - |
| GET | X | - |
| SET | X | - |

2.2 Organization of memories

The 686 Titroprocessor has four different non-volatile memories. Their organization is shown in Fig. 2.2.

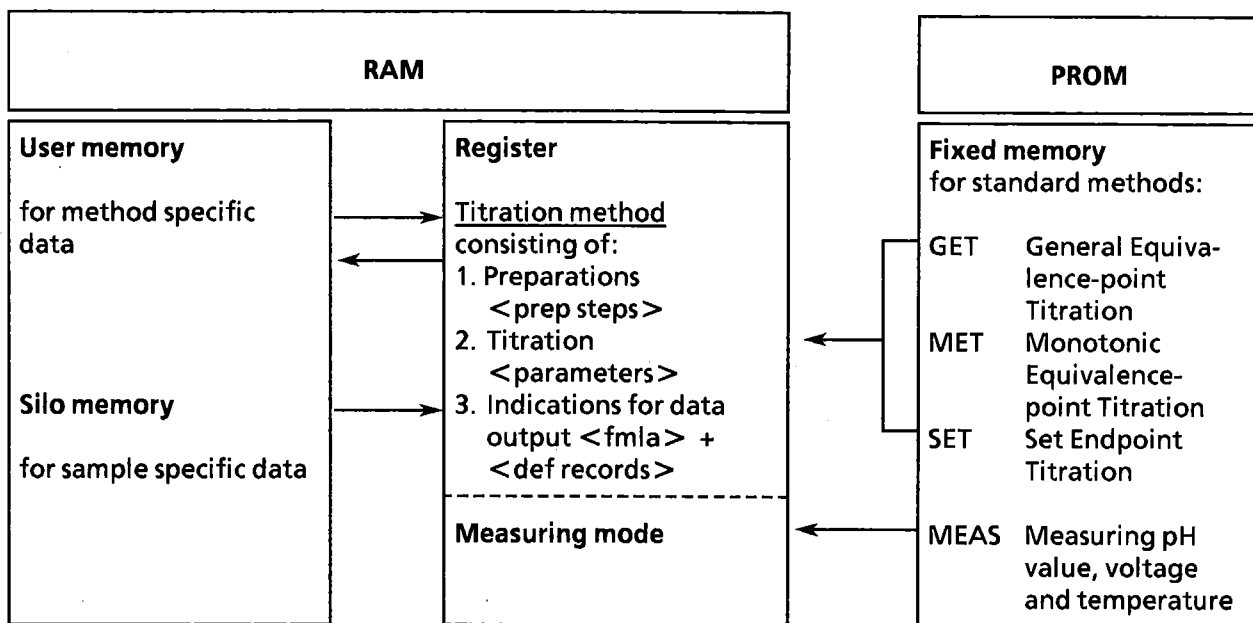


Fig. 2.2

The direction of communication between the memories is indicated by arrows:

- . Titration methods or the measuring mode can be loaded into the register from the fixed memory (see pages 208/209).
- . (Modified) titration methods with the method specific data can be stored in the user memory (see page 330).
- . User methods can be loaded from the user memory into the register (see page 330).
- . Sample specific data can be stored intermediately in the silo memory (see page 333).
- . With "silo on", sample specific data from the silo memory are loaded into the register for final treatment.

Register

In the register the following types of data can be stored:

- ▶ **Calibration data**
For the pH measuring assembly (U(as) and slope(rel)).
Calibration data are overwritten by a new calibration or on resetting (reset) calibration data.
- ▶ **Instrument specific data**
Entries in key <aux funcs>.
- ▶ **Method specific data**
One complete titration method with all its method-specific data (keys <prep steps>, <parameters>, <fmla const>, <def records> and all the formulas).
An actual titration method in the register is overwritten on loading a new titration method from the user memory or from the fixed memory into the register.
- ▶ **Sample specific data**
Sample specific data (keys <smpl size> and <smpl data> or from the silo memory) (see below).
 - Measuring point list
 - Endpoint list or equivalence-point list
 - List of resultsSample specific data are overwritten on starting a new titration with <GO>.

Fixed memory (PROM)

contains the standard methods. Each of them is equipped with a set of standard parameters.

- . Measuring mode (MEAS pH, MEAS U, MEAS temp)
- . Monotonic equivalence-point titration with incremental reagent feeding and automatic evaluation (MET pH, MET U)
- . General equivalence-point titration with continuous reagent feeding and automatic evaluation (GET pH, GET U)
- . Endpoint titration (SET pH, SET U)

User memory

offers 2800 bytes for storage of user methods. Normally, the user memory has space for 20 to 40 user methods, depending on their size. The key <user methods> serves for managing of the user memory (see page 329).

Silo memory

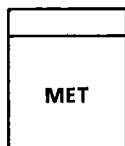
serves for storing up to 40 data lines with sample-specific data. A data line may consist of the following:

- . Line number.
- . Method identification.
A method from the user memory can be selected individually for each sample.
- . Two independent sample identifications id.#1 and id.#2.
- . One calculation variable c20.
- . Sample size c00.

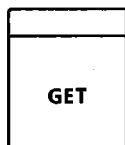
2.3 Keys for the standard methods <MEAS>, <MET>, <GET>, <SET>

The instrument is ready for use with standard parameters when method and measured quantity are selected.

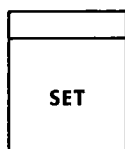
Titration, keys <MET>, <GET>, <SET>



MET: Monotonic Equivalence-point Titration
Titration with incremental reagent feeding and automatic evaluation,
measured quantities: pH, U/mV



GET: General Equivalence-point Titration
(GET the endpoint!)
Titration with continuous reagent feeding and automatic evaluation,
measured quantities: pH, U/mV



SET: Set Endpoint Titration
(SET the endpoint!)
Titration to preset endpoint,
measured quantities: pH, U/mV

Select the method by pressing the corresponding key. Press and repress this key until display shows the correct measured quantity, then load it into the register by pressing <enter>.

Example: *GET with measured quantity U/mV*
(Instrument is in its ready state)

Press <GET>.

*Display shows GET pH,
You need the measured quantity U/mV.*

Press <GET>.

Display shows now the correct measured quantity: GET U.

Press <enter>, loading the method into the register.

*Display shows GET U *****.*

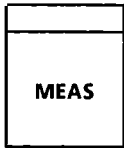
*The sign ***** tells you that the method from the fixed memory is ready to use.*

Titration is executed with a set of standard parameters.

Start titration with <GO>, interrupt with <HOLD> and stop with <STOP>.

Former titration data are overwritten on loading a new titration method into the register.

Measurement, key <MEAS>



MEAS: for measured quantities pH , U/mV, temp/°C

Press and repress key <MEAS> until display shows the correct measured quantity.

Example: MEAS with measuring quantity U/mV
(Instrument is in its ready state)

Press <MEAS>.

Display shows MEAS pH *****,
You need the measured quantity U/mV.

Press <MEAS>.

Display shows now MEAS U *****.

The sign ***** indicates that the instrument is ready to measure.

Start measurement with <GO>. If <MEAS> is pressed during measurement, the measured quantity is changed.

Example: Alternative measurement of U/mV and temp/°C

Display shows MEAS U ***** (see above).

Connect electrode(s) and Pt100 resistance thermometer (see page 104).

Start measurement, press <GO>.

Display shows U . XXXX mV (XXXX is the actual measured value.)

Now select temperature measurement: temp/°C.

Press <MEAS>.

Display shows temp. XX.X °C.

Select U/mV measurement again.

Press <MEAS> twice.

Display shows U . XXXX mV.

etc.

Measurement can be interrupted with <HOLD> and stopped with <STOP>. After pressing <STOP>, the instrument returns to the beginning of the titration method in the register and is ready for titration - it is in its ready state.

MEAS is linked with the titration methods as follows:

- . If <STOP> is pressed during measurement, the instrument returns to the beginning of the titration method in the register (ready state).
- . Titration data remain in the register when MEAS is used.
- . The electrode input, entered for the titration method (in key <prep steps>) is automatically the same for MEAS.
- . pH calibration is executed in mode MEAS (in key <prep steps>) and is valid for all pH measurements and pH titrations (calibration see page 302).
- . MEAS is an auxiliary mode, therefore it cannot be stored in the user memory.

2.4 Keys for the main functions <QUIT>, <HOLD>, <STOP>, <GO>

QUIT

HOLD

STOP

GO

QUIT: serves to leave a subroutine:

- . leave of rolling inquiries
- . leave of calibration
- . leave of formula entry
- . leave of standard method selection
- . leave of measuring function
- . leave of "pause" in running <prep steps > (leads to beginning of the next step)
- . leave of data output (leave of data block in print, prints next data block)

} leads to ready state

HOLD: serves to stop instrument's functions. Stored titration data is not deleted on restarting titration with <GO>; titration can therefore be continued from the interruption point.
(A <HOLD> in GET close by an equivalence-point may disturb its recognition; <HOLD> is inactive during start criteria in "GET" and "MET" are worked off.)

STOP: serves to stop instrument's functions and leads to the ready state, i.e. to the beginning of the titration in the register. Stored titration data remain in the register and are accessible for reproductions, if required.

GO: serves to start instrument's functions. Starting from the ready state deletes "old" titration data; restarting after <HOLD> , however, does not affect them.

Linkage of titration methods and keys for main functions:

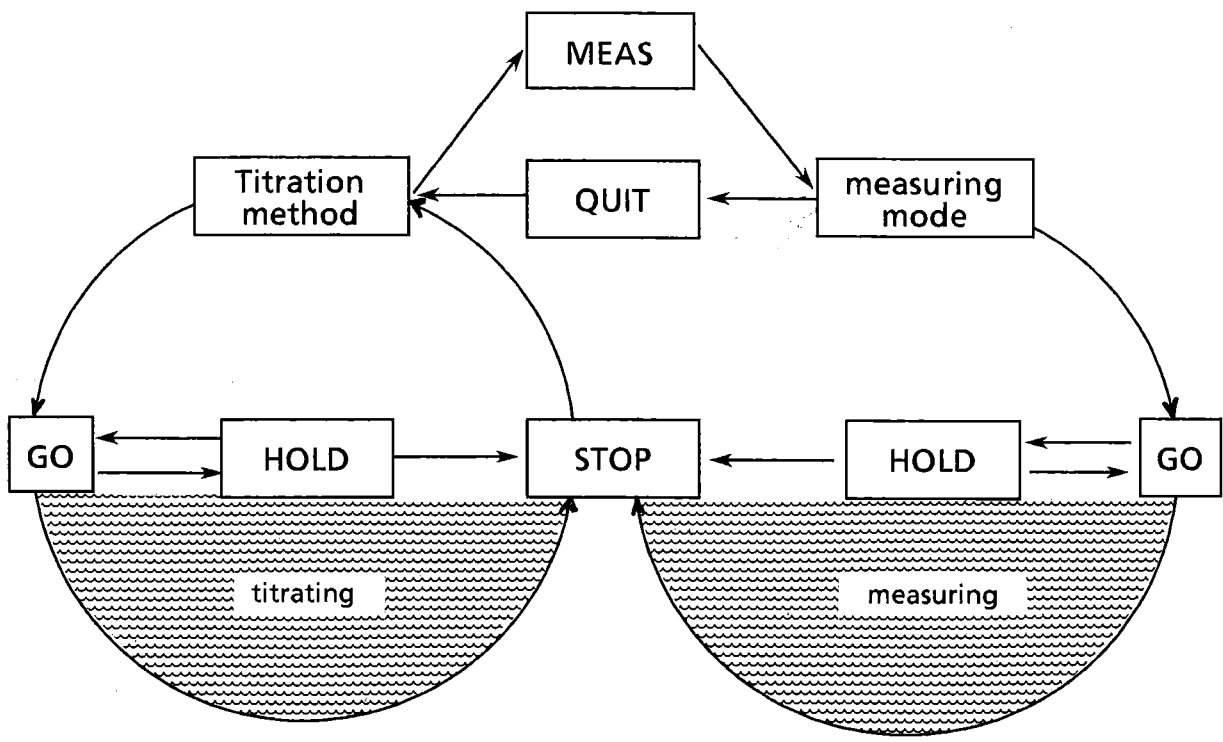


Fig. 2.3

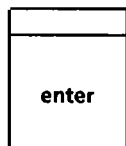
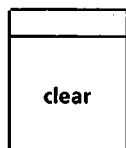
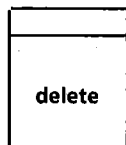
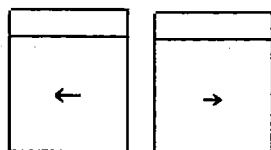
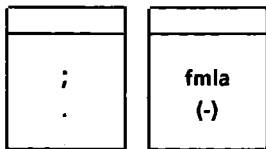
2.5 Block of numerical keys

Keys

1st functions of the numerical block are digits 0,1...9, decimal point <.> and minus sign <(-)>.

0,1...9

On entering a negative number, key in minus sign <(-)> first; <(-)> is not a change of sign key!



Cursor: serves
· to overwrite single digits of an entry
· to bring into view the whole display, where it has more than 16 places, e.g. for formulas or units of several entries

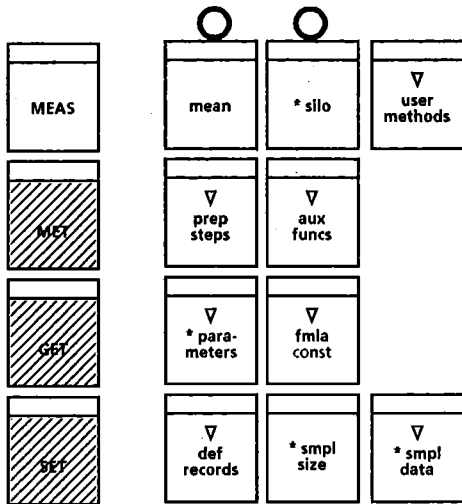
delete: serves
· to delete data lines, e.g. formulas, silo lines

clear: serves
· to clear entered values
· to introduce "OFF" for several entries (indicated separately)
· to set t(delay) to infinite ("INF") for pH stat applications with method SET

enter: serves
· to enter and store (standard methods, user methods, formulas, values for entries, etc.)
· to complete key sequences,
e.g. <report> <user methods> <enter>

2.6 Principle to work out user methods

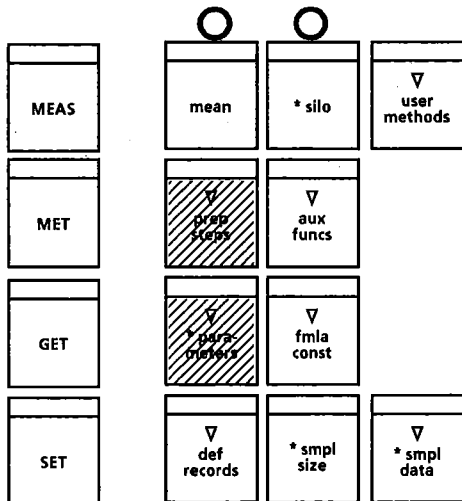
(Method specific entries)



Select a method from the fixed memory.

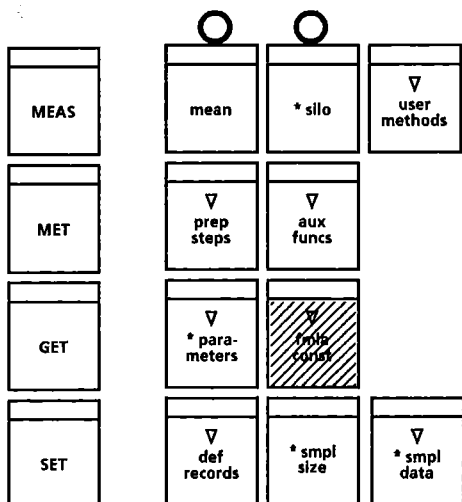
(Keys <MET>, <GET> or <SET> and <enter>; see page 208.)

Method is ready to use, equipped with a set of standard parameters.



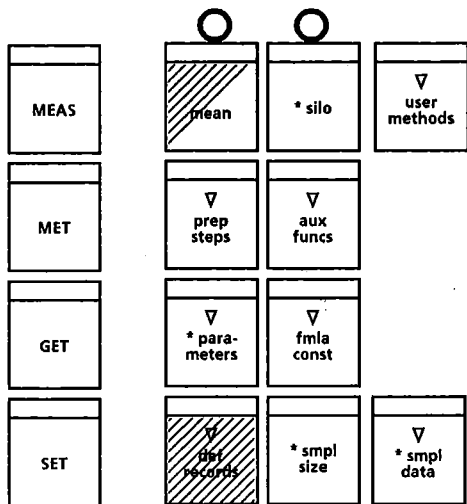
Enter data for (sample) preparation and parameters for the titration.

(Keys <prep steps> and <parameters>; see page 301 ff).



Program formula(s)
(2nd-functions of numerical blocks, see page 320)

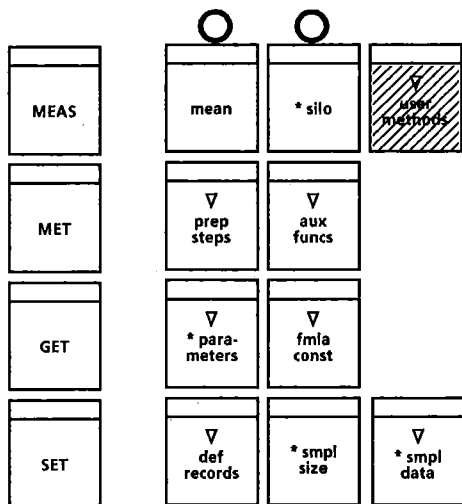
and enter formula constants.
(Key <fmla const> see page 323).



Define data output,
(key <def records> ; see page 324),

possibly with mean calculations.
(key <mean> ; see page 325).

Did you check your new method? Is it o.k.?
Then store it in the user memory:



Store method in user memory,
(key <user methods> ; see page 329).

2.7 General sequence of a titration method

The sequence of a titration method is shown in Fig. 2.4.

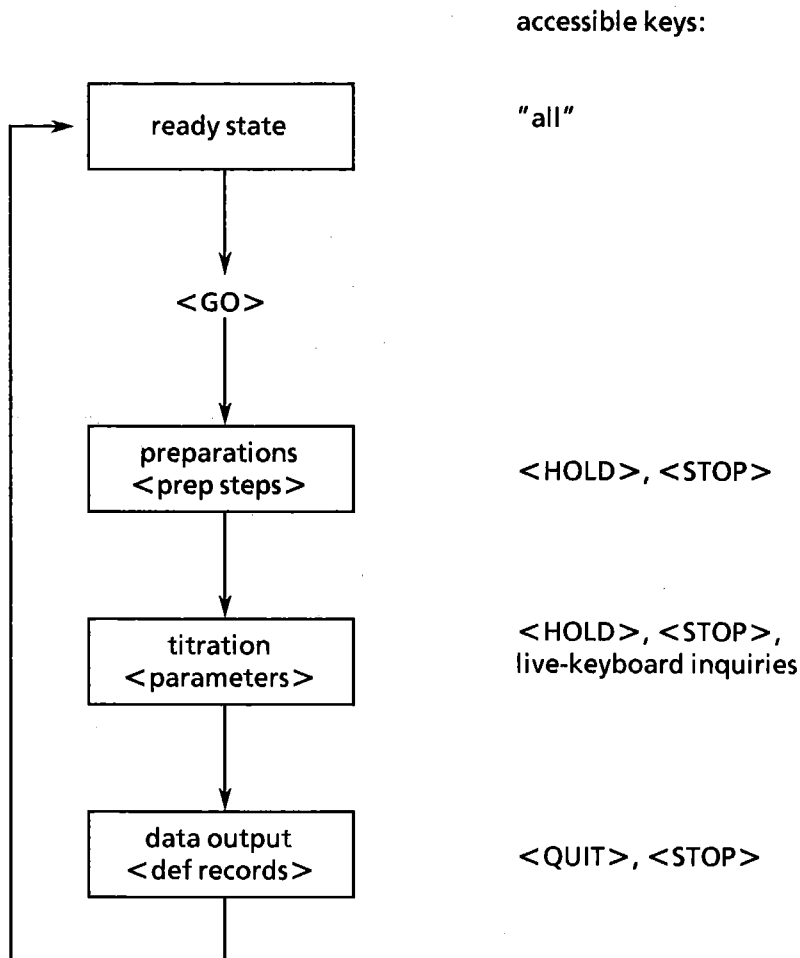


Fig. 2.4

After switching on the instrument, it is in its ready state, i.e. ready for titration with the method used last. A new method can now be selected, either from the fixed memory (see page 208) or from the user memory (see page 329). The method in the register can also be modified using the data keys and entering formulas. These entries can be left with <QUIT>.

<GO> starts the method.

Every titration method consists of 3 blocks:
preparations, titration itself and data output.

Preparations are performed first, according to the data given under key <prep steps> shown in the display as follows:

pH init XX.XX
U init -XXXX mV

}

measurement of initial pH and voltage,
respectively

then

(add V XX.XX ml)

if add V is set \neq 0 ml

then

(pause XXXX s)

If pause is set to \neq 0 s, a countdown of the
remaining pause time occurs.
"pause" can be aborted with <QUIT>.

During the running of preparations, data keys are not accessible.

Then titration starts and is running according to the programmed <parameters>. Display shows the method and the actual measured value during the titration:

GET pH XX.XX or MET pH XX.XX or SET pH XX.XX
GET U -XXXX mV or MET U -XXXX mV or SET U -XXXX mV

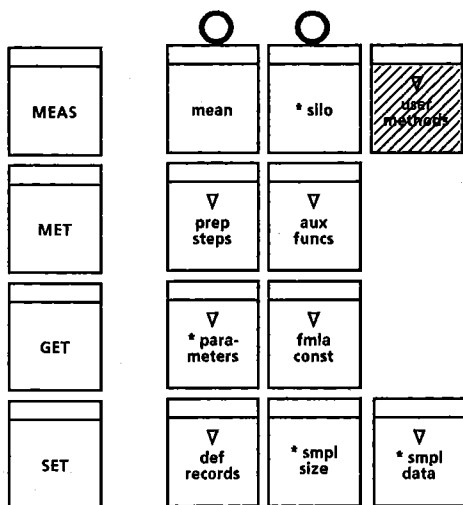
All the live-keyboard inquiries can be displayed and changed during titration (except during running of start criteria in GET or MET).

Preparations and titration can be interrupted pressing <HOLD> and restarted with <GO> (except during running of start criteria in GET or MET). <STOP> leads directly to the data output.

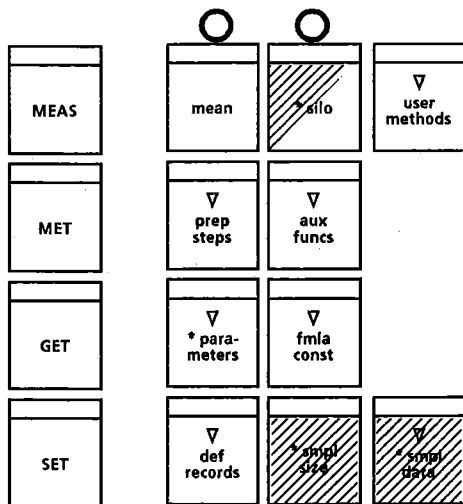
At the end of titration (stopped manually or by stop criteria), data are printed out as indicated in <def records>. Data output can be stopped with <STOP>. With <QUIT>, the data block in print is skipped and the next block is printed.

During data output, data keys are not accessible.

2.8 Routine operation



Load method from user memory into register
(key <user methods>; see page 329).



Enter sample specific data (sample
identifications, sample size)
(keys <smpl size> or <smpl data>;
see page 331 and possibly key <silo>;
see page 333).



Start determination.

2.9 Useful hints

Selection of the standard method: GET, MET or SET?

Select GET

- for your fast routine analyses
- to work out your SET method; determination of endpoint value and parameter "dyn."

Select MET

- for slow, kinetically inhibited chemical reactions or for indication systems with slow or instable response, such as diazotations or coupling reactions
- if a standard method recommends this mode, such as the determination of total acid and base numbers (TAN/TBN) according to the ASTM method

Select SET

- if you want to execute your routine analyses even faster
- for endpoint titrations according to your conventional procedures
- if you have to avoid an excess of titrating reagent

Selection of exchange unit and titrant concentration

You obtain best titration results with a titrant consumption of $0.1 \dots 1 V_{\text{burette}}$; e.g. if you work with a 10 ml exchange unit you should feed app. 1...10 ml titrant.

Setting up titration arrangement

A good arrangement of burette tip and electrode(s) can be essential for good titration results. The arrangement is good, if titrant is mixed as quickly as possible with the solvent, and the electrode is measuring the voltage of the mixed solution.

Fig. 2.5 shows a good arrangement:

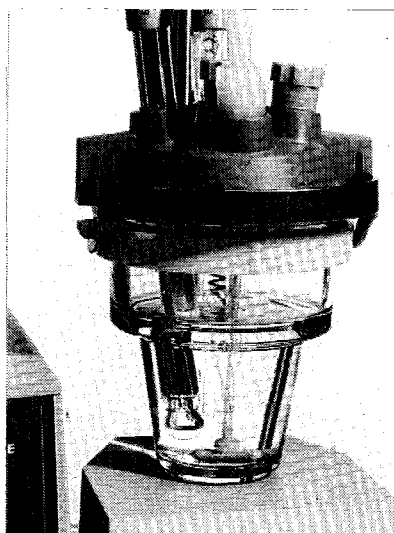


Fig. 2.5

Specially consider the following points:

- Place burette tip below the measuring electrode, in the center of the stirring bar.
- Do not place electrode(s) in the titrant stream.

Stir efficiently but not too vigorously in order not to introduce air bubbles, where CO₂ or O₂ could disturb the titration.

Measurements in non-aqueous solutions

- Use separate measuring and reference electrodes (no combined measuring assemblies)
- Apply differential potentiometry

Differential potentiometry

Measurements in solutions with small conductivities such as organic solvents, are often perturbed by electrostatic and electromagnetic fields, which are picked up by the measuring assembly.

This perturbation adds to the measuring signal and can either cause "ghost" equivalence-points or omit weak equivalence-points.

In these cases, we recommend differential potentiometry. (Measuring principle see Fig. 2.6.)

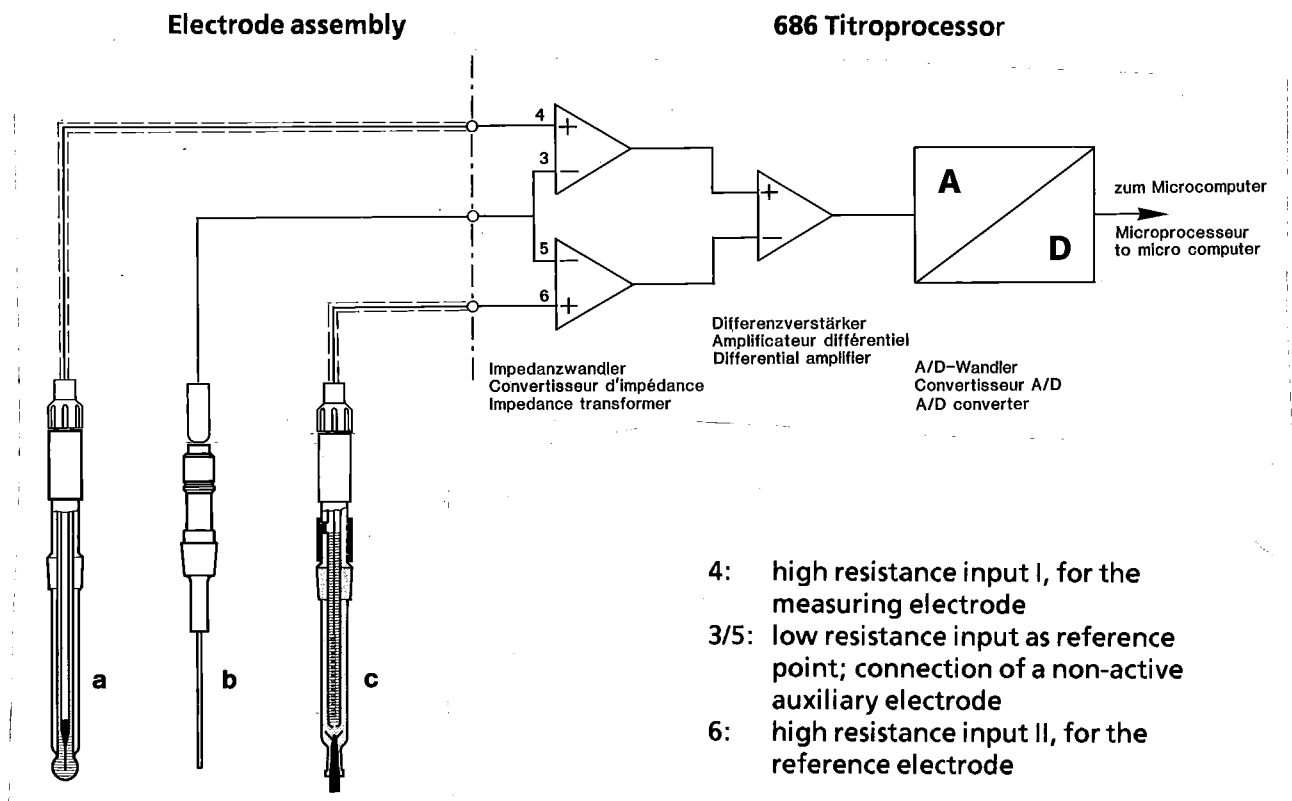


Fig. 2.6

The shielding of the measuring and reference electrode with the electrode cables should be equal. A suitable measuring assembly for non-aqueous acid/base titrations can be built up as follows:

For laboratory use

- a 6.0102.002 or 6.0102.100 pH glass electrode
- b 6.0808.000 glassy carbon rod electrode or
6.0331.000 Pt rod electrode or
6.1808.030 earthing piece for burette tip
- c 6.0729.100 specially shielded Ag/AgCl reference electrode

With Sample Changer

- a 6.0104.100 pH glass electrode
- b 6.0808.010 glassy carbon rod electrode or
6.0331.040 Pt rod electrode or
6.1808.030 earthing piece for burette tip
- c 6.0729.110 specially shielded Ag/AgCl reference electrode

"a" is the measuring electrode.

"b" is the conducting connection between the reference point of the circuitry and the titration solution.

"c" is the reference electrode. The solvent used in titration with added inert salt (LiCl or quaternary ammonia salts) may serve as reference solution with constant pH.

The electrodes should be conditioned in the solvent used for app. 1 h. If, after the first dosing, the voltage is not stable enough, a small start volume may help.

If such a measuring system is still susceptible to disturbances, the titrating stand can additionally be shielded by a Faraday cage. This cage is connected to the earthing socket of the 686 Titroprocessor

Use only shielded cables for all connections!

A good evaluation of the titration data is possible because of the excellent serial and common mode rejection of the amplifier.

Example for a MET titration with differential potentiometry:

Determination of the total base number (TBN) according to ASTM D 664-81:

- Electrodes: 6.0102.100 pH glass electrode
- 6.0729.100 specially shielded reference electrode
Ag/AgCl/c(KCl) = 3mol/l//c(LiCl) = sat. in ethanol
- 6.0331.000 Pt auxiliary electrode
- Solvent: Toluene/isopropanol/water = 500/495/5
- Reagent: HClO₄ in acetic acid (instead of alcoholic HCl)

```
MET U      4-8 # 7
pause 1    180 s
electr. input 12
vol.step   -10 ml
dt(wait)   90 s
stop V     6.00 ml
stop U     -203 mV
EP A U     -103 mV
temp.      25.0 °C
EP crit.U  30 mV
=====
```

Parameter report

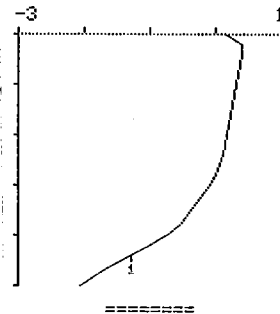
```
date 87-02-16 time 15:10
MET U      4-8 # 7
C00=       4.12 e
U(init)    14 mV
           V/ml U/mV
EP1        2.200 -128
EPA        2.112 -103
RS1        2.88
RS2        2.99
stop volt.reached
=====
```

Result report,
including curve

```
MET U      4-8 # 7
F1=(C51-C10)*C01*C02/C00
I2:
F2=(EP1-C10)*C01*C02/C00
I2:
C01=       .1
C02=      56.1
C10=       0
C51=      2.112
=====
```

Calculation report

```
date 87-02-16 time 15:11
MET U      4-8 # 7
.50ml/div  dU=100mV/div
start V    .000 ml
```



3. Operation in detail

3.1 Data input

3.1.1 Key <prep steps>



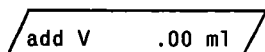
prep steps: preparative steps, i.e. for functions which are performed before titration or measurement.

Rolling key.

There are two different inquiry sequences: one for the titration methods and one for the measuring mode.

prep steps for titration methods SET, GET and MET

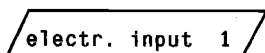
(With 3.540.2191 analogue output interface, see section 4, page 402.)



Addition of an auxiliary solution before titration (.00...999.99 ml) with a second 665 Dosimat.



Waiting time (0...9999 s).
(e.g. to wait for a reaction or mixing time of the dispensed reagent.)



Measuring input (1, 2, 12):

1 or 2 = high resistance input I or II, resp. (for measuring electrode) and low resistance input I or II, resp. (for reference electrode; empty if a combined measuring assembly is used). The two low resistance inputs are galvanically connected. Two different reference systems can therefore not be used simultaneously in the same solution.

12 = two high resistance inputs (for differential potentiometry → non-aqueous titrations, see page 220).

prep steps for measuring mode MEAS

t(print) OFF s Periodical print-out of measured values (period: 0...9999 s, OFF).

The measured quantity pH has the following additional inquiries:

e1.ca1. 0/1? 0 Electrode calibration (0, 1) (0 = no, 1 = yes).
If 1 is entered, calibration starts (see below), with 0 the next inquiry is:

reset ca1.0/1? 0 Reset of calibration data to standard values (0, 1) (0 = no, 1 = yes) (see below).

Calibration

Calibration data is valid for all the measuring inputs.
Answering inquiry **e1.ca1.0/1? 1** with 1 = yes starts calibration procedure automatically:
Immerse measuring assembly in first buffer solution and press <enter>.

t.ca1.m 23.2 °C
or
t.ca1. 25.0 °C If a Pt100 is connected, the measured calibration temperature is displayed. Measurement is stopped with drift control (drift ≤ 1.2 °C/min).

t.ca1. 25.0 °C Calibration temperature (-20.0...200.0 °C; without Pt100).
Key value in and press <enter>.
Next inquiry is:

pH(S) 1 OFF pH value of first buffer solution. Key in pH value, pressing <enter>, measurement begins. Display shows the actual measured value in mV:

U ca1.1 XX mV Measuring is stopped when drift criteria is satisfied (drift ≤ 1 mV/min) and display shows next inquiry:

pH(S) 2 OFF Calibration can either be broken off with <QUIT> (1 point calibration) or a second buffer solution can be measured:
Immerse measuring assembly in second buffer solution and enter the pH value.

U ca1.2 XX mV Display shows the actual measured value and measurement is stopped with drift criteria.

A calibration report is printed out after every calibration.

If a measurement has not satisfied the drift criteria after a certain time (3 minutes), <STOP> and check electrode(s)!

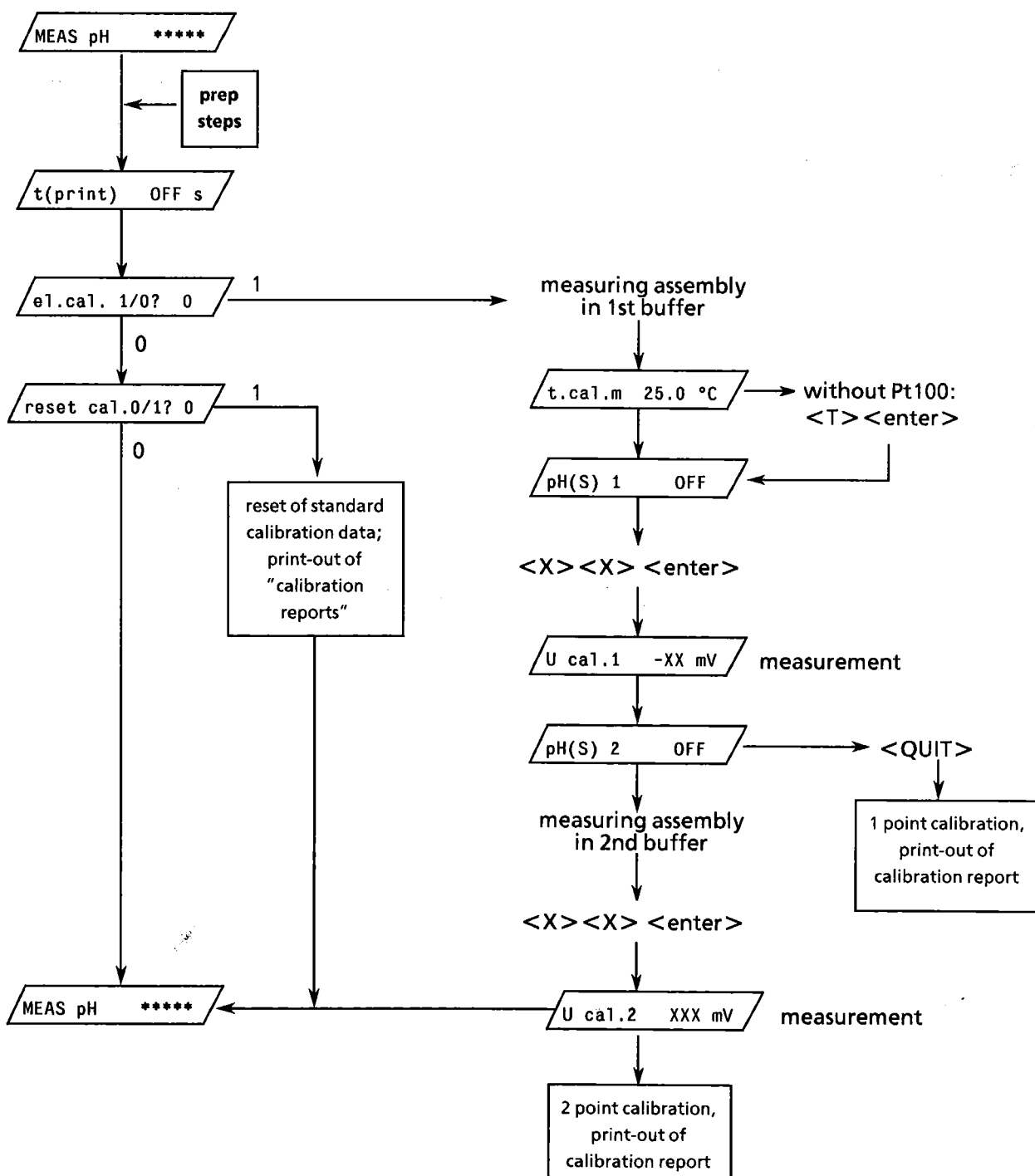
Resetting of calibration data

Answering inquiry `/reset cal. 0/1? 1/` with 1 = yes, resets calibration data to their standard values:

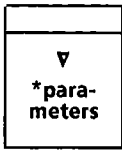
- t.cal. 25.0 °C (calibration temperature)
- U(as) 0 mV (asymmetry voltage)
- slope (rel) 1.000 (relative slope)

and the "calibration report" is printed out automatically.

Scheme of calibration procedures



3.1.2 Key <parameters>



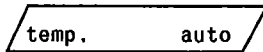
parameters: parameters for the corresponding titration method or for the measuring mode

Rolling key. Some inquiries are accessible during a running titration, live-keyboard inquiries.

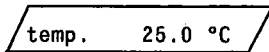
The inquiries in this key depend on the selected standard method as well as the measured quantity.

Parameters for MEAS

The measured quantities U/mV and temp/°C have no inquiries in key <parameters>. The only parameter for the measured quantity pH is the measuring temperature:



or



If a Pt100 is connected, the temperature is measured and the slope of the measuring assembly is actualized automatically.

(-20.0... + 200.0 °C).

Note:

Temperature is instrument specific, i.e. its value is valid for all titration methods and for MEAS until a new value is entered or measured.

Parameters for GET

titr.rate 1.00

< ->

titr.rate ml/min

Titration rate

The input range depends on the volume of the Exchange Unit:

1 ml EU .01... .30 ml/min
5 ml EU .01... 1.50 ml/min
10 ml EU .01... 3.00 ml/min
20 ml EU .01... 6.00 ml/min
50 ml EU .01... 15.00 ml/min

The effective feeding rate may vary by $\pm 10\%$ from the set value.

The unit ml/min can be displayed pressing cursor (< ->)

Accessible as live-keyboard inquiry.

anticip. 0

Adaptation of titration rate according to the slope of the titration curve (0...99).

High value \rightarrow maximum slow down,
0 \rightarrow unchanged titration rate (see Fig. 3.2).

Accessible as live-keyboard inquiry.

stop V 99.99 ml

Stop volume (.00...999.99 ml, OFF).

Accessible as live-keyboard inquiry.

With stop V .00 ml: print-out of initial pH, pH(init) or initial voltage, U(init) respectively, without starting a titration.

stop pH OFF

Stop pH (0... ± 20.00 , OFF).

resp.

stop U OFF mV

Stop voltage (0... ± 2000 mV, OFF).

Accessible as live-keyboard inquiry.

stop EP# OFF

Stop after a number of equivalence-points (1...9, OFF).

Accessible as live-keyboard inquiry.

start V .00 ml

Start volume (.00...999.99 ml).

Start condition: feed of titration reagent with max. burette feeding rate.

start pH OFF

Start pH (0... ± 20.00 , OFF).

resp.

start U OFF mV

Start voltage (0... ± 2000 mV, OFF).

Start condition: feed of titration reagent with max. titration rate (depending on the volume of the burette).

start slope OFF

Start at a certain slope of the titration curve.

< ->

start slope /ml

For measured quantity pH (.00...9.99 /ml, OFF).

resp.

start slope mV/ml

For measured quantity U/mV (0...999 mV/ml, OFF).

Start condition: feed of titration reagent with max. titration rate (depending on the volume of the burette), see Fig. 3.1.

The unit /ml or mV/ml resp. can be displayed pressing cursor < ->.

| | | | | | |
|-------|----|--------|---|------------------|-----------------------|
| EPA | pH | OFF | } | Fixed endpoint A | (0... ± 20.00, OFF) |
| resp. | | | | | (0... ± 2000 mV, OFF) |
| EPA | U | OFF mV | | | |
| EPB | pH | OFF | } | Fixed endpoint B | (0... ± 20.00, OFF) |
| resp. | | | | | (0... ± 2000 mV, OFF) |
| EPB | U | OFF mV | | | |

For fixed endpoints, the volume coordinates are interpolated from the titration curve and stored as:

C51 for volume of fixed EP A

C52 for volume of fixed EP B

temp. 25.0 °C

Titration temperature (-20.0... + 200.0 °C).

Inquired only if no Pt100 is connected. Temperature is measured automatically with Pt100.

Note:

Temperature is instrument specific, i.e. its value is valid for all titration methods and for MEAS until a new value is entered or measured.

EP crit. 3

Equivalence-point criterion (1...8, OFF).

1...4 Sensitivity of equivalence-point recognition.

Small value → high sensitivity.

High value → small sensitivity

5...8 corresponds to 1...4:

1 corresponds to 5

2 corresponds to 6

3 corresponds to 7

4 corresponds to 8

with additional damping for noisy signals

OFF automatic equivalence-point evaluation switched off, e.g. for indication methods with curves to be evaluated graphically.

GET (General Equivalence-point Titration)

In the GET method, the start conditions are performed first. Start conditions shorten titration times. If all three start conditions are set \neq "off", they are performed in the following sequence:

1. start V

Then, if the preset measured value is not yet reached

2. start pH or start U

and last

3. start slope (see Fig. 3.1)

Note: Don't set start pH or start U before the first measuring point of the titration!

During start criteria, data keys and <HOLD> are not accessible. <STOP>, however, is always active.

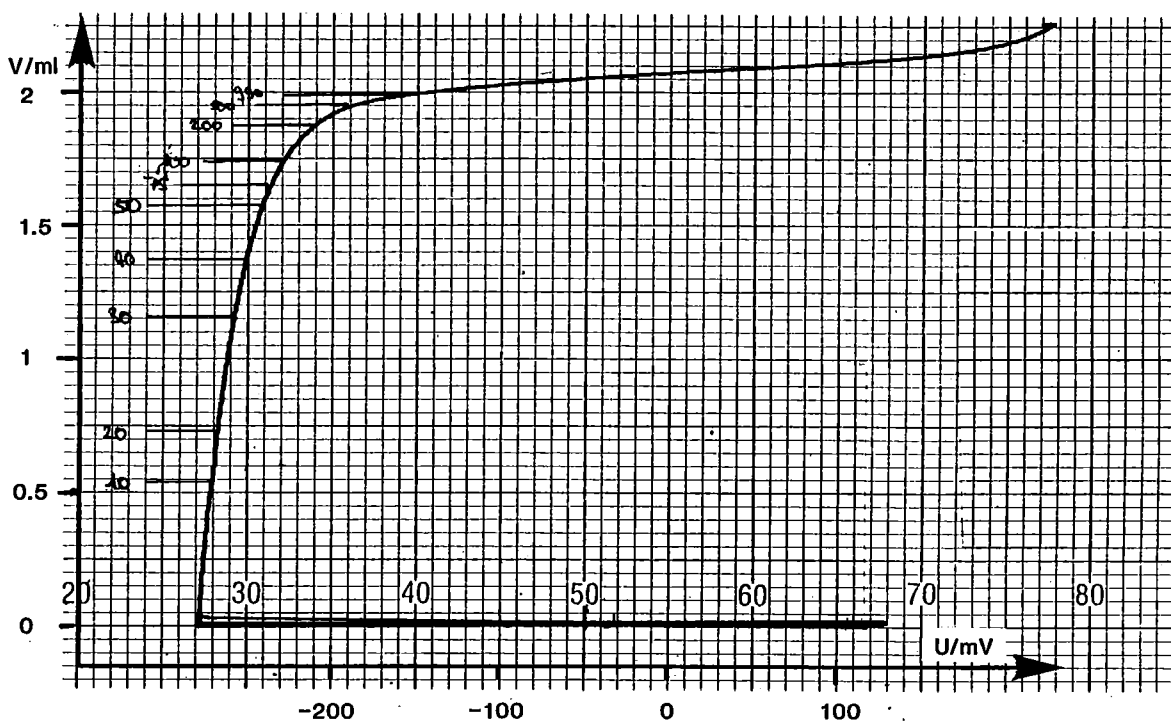


Fig. 3.1

Start of data acquisition for different values of "start/slope XXX mV/ml"

After the start criteria, data acquisition starts. The reagent feeding rate depends on the parameters "titr rate" in ml/min and the adaptation of the titration rate according to the slope of the curve - "anticip." (see Fig. 3.2).

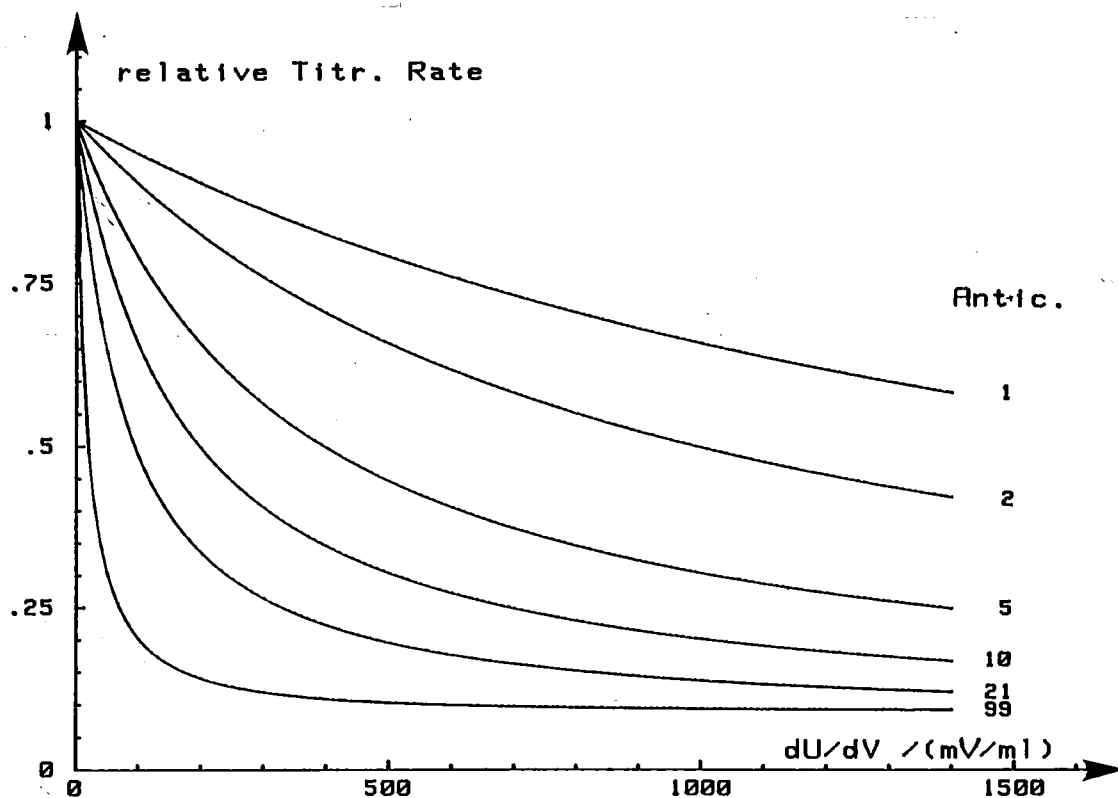


Fig. 3.2

In order to obtain best titration results in the shortest possible time, it is necessary to optimize the parameters "titr.rate" and "anticip.".

Rule of thumb for optimizing parameters "titr.rate" and "anticip.":

- High "titr.rate" for fast reactions,
e.g. neutralizations, with electrodes which are fast responding
- Low "titr.rate" for slow reactions,
e.g. diazotizations
- "anticip." is especially useful for steep breaks.

Examples for settings of parameters "titr.rate" and "anticip." are given in Fig. 3.3.

Examples of optimized titration parameters

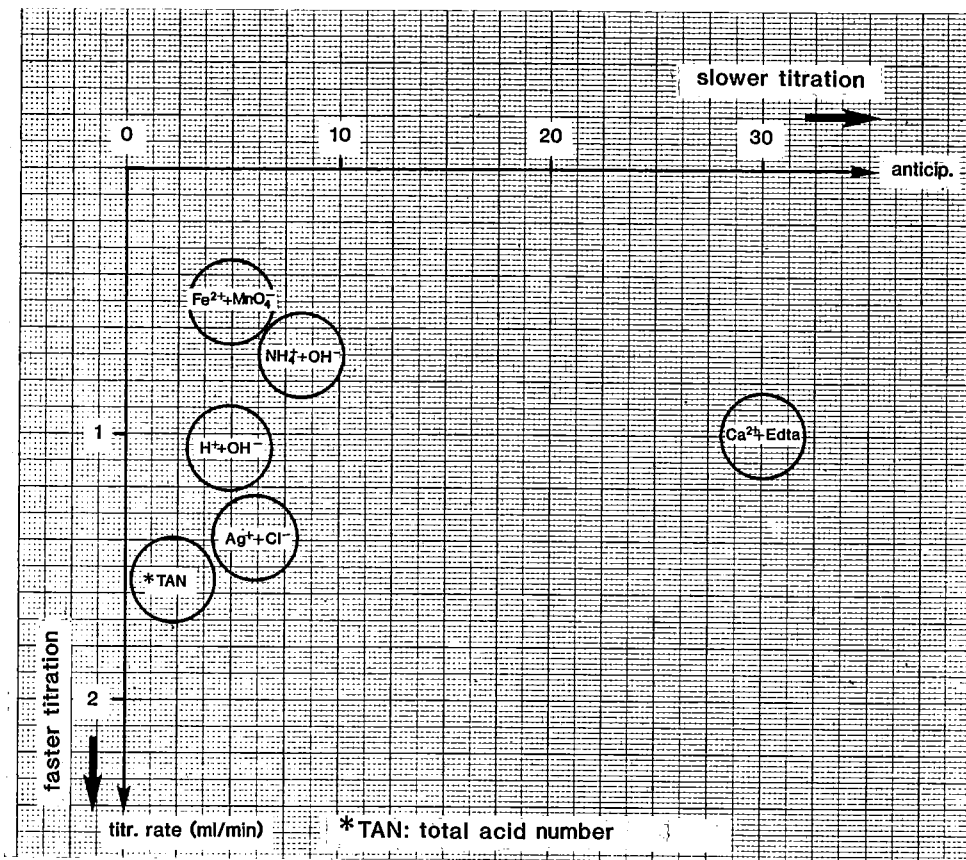


Fig. 3.3

Titration can be stopped automatically via the stop criteria. All the stop criteria are checked simultaneously and the first of the stop criteria which is reached terminates the titration. An equivalence point evaluation in progress is completed first, then the stop criteria are applied. An equivalence point evaluation is only stopped by

pressing key <HOLD>

pressing key <STOP>

"EP crit." is a measure for the sensitivity of the equivalence point recognition. With "EP crit.", "ghost" equivalence points can be eliminated.

Hints: - Set "EP crit. 1" for titrations with small consumption of titrating reagent, such as determinations of blank values.

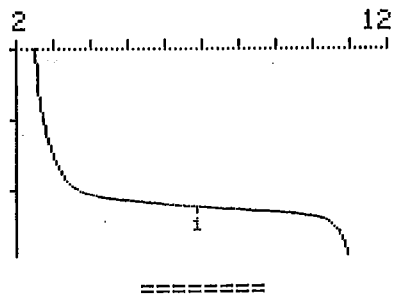
- "EP crit." can be optimized by reproducing titration results (see Fig. 3.4).

Optimization of "EPcrit"

EP crit = 4

```
date 86-02-25 time 15:57
GET pH ***** # 34
pH(init) 2.51
      V/ml      pH
EP1 1.122 6.89
stop volt.reached
=====
```

```
date 86-02-25 time 15:57
GET pH ***** # 34
.50ml/div      ΔpH=1/div
start V .000 ml
```

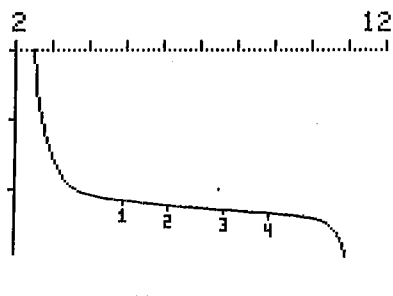


Original report

EP crit = 1

```
date 86-02-25 time 15:58
GET pH ***** # 34
pH(init) 2.51
      V/ml      pH
EP1 1.072 4.96
EP2 1.106 6.16
EP3 1.136 7.62
EP4 1.158 8.87
stop volt.reached
=====
```

```
date 86-02-25 time 15:59
GET pH ***** # 34
.50ml/div      ΔpH=1/div
start V .000 ml
```

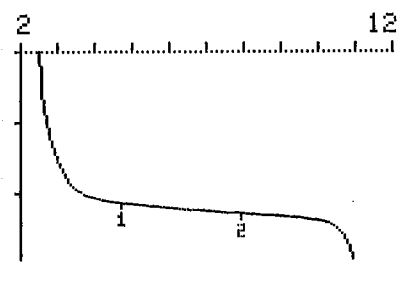


Reproduction

EP crit = 3

```
date 86-02-25 time 15:58
GET pH ***** # 34
pH(init) 2.51
      V/ml      pH
EP1 1.064 4.70
EP2 1.142 7.93
stop volt.reached
=====
```

```
date 86-02-25 time 15:58
GET pH ***** # 34
.50ml/div      ΔpH=1/div
start V .000 ml
```



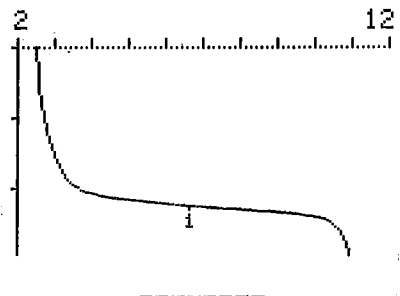
Reproduction

EP crit = 5

(corresponds to "EP crit = 1" with additional damping)

```
date 86-02-25 time 15:59
GET pH ***** # 34
pH(init) 2.51
      V/ml      pH
EP1 1.112 6.62
stop volt.reached
=====
```

```
date 86-02-25 time 15:59
GET pH ***** # 34
.50ml/div      ΔpH=1/div
start V .000 ml
```



Reproduction

Fig. 3.4

Parameters for MET

vol.step .10 ml

Volume increment (.01...9.99 ml)
The feeding rate of the volume increments is set analogically, i.e. controlled by the potentiometer of the 665 Dosimat.

drift 100 mV/min

Drift (1...999 mV/min, OFF)
Together with the set drift threshold a maximum waiting time is given automatically. If the drift is not reached within this waiting time, the measurement is stopped by means of this time and the next increment is fed.

resp.

Accessible as live-keyboard inquiry.
If drift is set to "OFF" the waiting time will be inquired:

$\Delta t(\text{wait})$ 5 s

Fixed waiting time between volume increments (1...999 s)
Accessible as live-keyboard inquiry.

stop V 99.99 ml

Stop volume (.00...999.99 ml, OFF).
Accessible as live-keyboard inquiry.
With stop V .00 ml: print-out of initial pH, pH(init) or initial voltage, U(init) respectively, without starting a titration.

stop pH OFF

Stop pH (0... ± 20.00 , OFF).

resp.

stop U OFF mV

Stop voltage (0... ± 2000 mV, OFF).
Accessible as live-keyboard inquiry.

stop EP# OFF

Stop after a number of equivalence-points (1...9, OFF).
Accessible as live-keyboard inquiry.

start V .00 ml

Start volume (.00...999.99 ml).
Start condition: feed of titration reagent with max. burette feeding rate.

start pH OFF

Start pH (0... ± 20.00 , OFF).

resp.

start U OFF mV

Start voltage (0... ± 2000 mV, OFF).
Start condition: feed of titration reagent with max. titration rate (depending on the volume of the burette, as in GET, see page 305).

start slope OFF

Start at a certain slope of the titration curve.

< ->

start slope /ml

For measured quantity pH (.00...9.99 /ml, OFF).

resp.

start slopemV/ml

For measured quantity U/mV (0...999 mV/ml, OFF).
Start condition: feed of titration reagent with max. titration rate (depending on the volume of the burette, as in GET).
The unit /ml or mV/ml resp. can be displayed pressing cursor < -> .

| | | | | | |
|-------|----|--------|---|------------------|-----------------------|
| EPA | pH | OFF | } | Fixed endpoint A | (0... ± 20.00, OFF) |
| resp. | | | | | (0... ± 2000 mV, OFF) |
| EPA | U | OFF mV | | | |
| EPB | pH | OFF | } | Fixed endpoint B | (0... ± 20.00, OFF) |
| resp. | | | | | (0... ± 2000 mV, OFF) |
| EPB | U | OFF mV | | | |

For fixed endpoints, the volume coordinates are interpolated from the titration curve and stored as:

C51 for volume of fixed EP A

C52 for volume of fixed EP B

temp. 25.0 °C

Titration temperature (-20.0... + 200.0 °C).

Inquired only if no Pt100 sensor is connected. Otherwise temperature is measured automatically with Pt100.

Note:

Temperature is instrument specific, i.e. the actual value is valid for all titration methods and for MEAS until a new value is entered or measured.

EP crit.pH .50

(.10...20.00)

resp.

Equivalence-point criterion

EP crit.U 30 mV

(1...999 mV)

This parameter can be used to control the sensitivity of the endpoint recognition by controlling the size of the titration break, see page 314.

MET (Monotonic Equivalence-point Titration)

As in GET, the start criteria are performed first, see page 307.

Then titration with data acquisition starts. The constant volume increments are fed with a dosing rate that can be controlled by means of the dV/dt potentiometer of the 665 Dosimat.

The measured values are acquired either drift-controlled according to the set drift conditions ("equilibrium titration") or after a preset waiting time $\Delta t(\text{wait})$, respectively. If a drift is set, a maximum waiting time is given automatically in order to prevent "never-ending" titrations, i.e. if the drift condition is not fulfilled the measured value is acquired after a certain time and the next volume increment is fed. This waiting time is calculated according to the following formula:

$$\text{waiting time /s} = \frac{150}{\sqrt{\text{drift} + 0.01}} + 5$$

The parameter "drift" should be carefully optimized for good titration results.

The stop criteria are the same as in GET, namely stop V, stop U/pH, stop #EP, see page 309.

The equivalence-point location is determined using a procedure based on the Fortuin method and adapted by METROHM for numerical evaluation (METROHM Bulletin Vol. 2, No. 10, 1971). The greatest measured value change (delta value) is sought (Δ_n). The equivalence-point is located in this region. The exact position is determined by an interpolation factor ρ , which depends on the delta values before and after Δ_n .

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

with

V_{EP} : volume at the equivalence-point

V_0 : total volume fed before Δ_n

ΔV : volume step

ρ : interpolation factor according to Fortuin

Prerequisite for sufficient accuracy in this evaluation is the correct size of the volume steps ΔV . An optimal value for ΔV is given by

$$\Delta V = 1/20 V_{EP}$$

In any case, the size of ΔV should always lie between:

$$\Delta V_{\max} = 1/10 V_{EP} \leq \Delta V \leq \Delta V_{\min} = 1/100 V_{EP}$$

For steep breaks, ΔV is closer to ΔV_{\min} ; for flat breaks it is closer to ΔV_{\max} .

The accuracy can not be increased by feeding very small ΔV , because then only small measured value differences arise, which can be disturbed by noise. For flat breaks these differences are then all of the same order of magnitude and a noisy signal can cause an accidental Δ_n which results in a "ghost-EP".

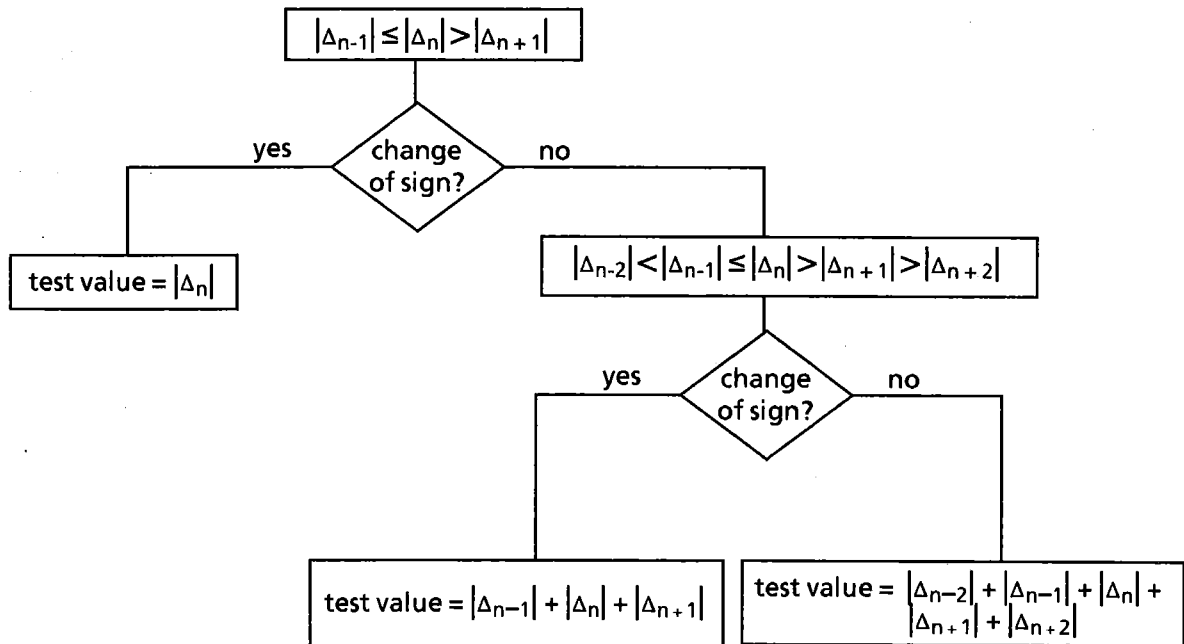
The parameter "EP crit." controls the sensitivity of equivalence-point recognition. Its value is a measure of the size of a break. In most cases, the standard values of "EP crit.pH = 0.50" resp. "EP crit.U = 30 mV" are sufficient to suppress noise maxima and recognize the real breaks.

The current test value for every equivalence-point is compared with "EP crit.". If this test value is higher than the preset value of "EP crit.", the equivalence-point is recognized. The test value can be calculated from the measuring point list as follows:

- Calculate the voltage differences (Δ -values) in the region of the expected equivalence-point.
- Determine the greatest Δ -value $\rightarrow \Delta_n$
- Take the two Δ -values before and the two Δ -values after Δ_n and form the sequence

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

- Decide by testing with the following scheme how many Δ -values of your sequence are used to calculate the test value for the actual equivalence-point and calculate the test value:



Note: The internal calculation is carried out with a resolution of 0.1 mV or 0.001 in pH. The test values from the Titroprocessor and your calculated values may therefore be slightly different. Sometimes you may even decide to add only three values instead of five!

- If you wish to suppress an equivalence-point, enter a value for "EP crit." which is slightly higher than the calculated test value. In order to get an equivalence-point which has not been recognized, enter a smaller value than your calculated test value.

Example:
Measuring point list

| MET U | 4-10 # | U/mV |
|-------|--------|------|
| .000 | | 256 |
| .100 | | 254 |
| .200 | | 253 |
| .300 | | 250 |
| .400 | | 247 |
| .500 | | 244 |
| .600 | | 240 |
| .700 | | 236 |
| .800 | | 230 |
| .900 | | 221 |
| 1.000 | 11 | 210 |
| 1.100 | 16 | 194 |
| 1.200 | 17 | 177 |
| 1.300 | 15 | 162 |
| 1.400 | 11 | 151 |
| 1.500 | | 141 |
| 1.600 | | 132 |
| 1.700 | | 122 |
| 1.800 | | 114 |
| 1.900 | | 103 |
| 2.000 | 13 | 90 |
| 2.100 | 21 | 69 |
| 2.200 | 140 | -71 |
| 2.300 | 129 | -200 |
| 2.400 | 21 | -221 |
| 2.500 | | -232 |
| 2.600 | | -240 |
| 2.700 | | -245 |

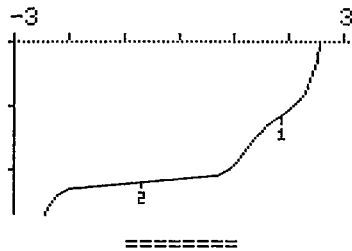
EP crit. = 30 mV

```

date 87-02-16 time 09:38
MET U      4-10 #    4
U(init)    255 mV
          V/ml      U/mV
EP1        1.130    189
EP2        2.200    -70
stop V reached
          =====
    
```

```

date 87-02-16 time 09:38
MET U      4-10 #    4
1.0ml/div  ΔU=100mV/div
start V    .000 ml
    
```



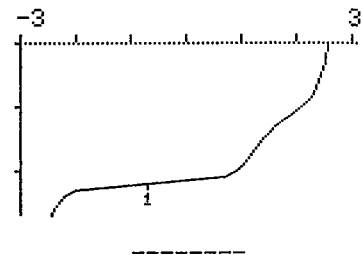
EP crit. = 71 mV

```

date 87-02-16 time 09:52
MET U      4-10 #    4
U(init)    255 mV
          V/ml      U/mV
EP1        2.200    -70
stop V reached
          =====
    
```

```

date 87-02-16 time 09:52
MET U      4-10 #    4
1.0ml/div  ΔU=100mV/div
start V    .000 ml
    
```



With EP crit. $U = 30$ mV two endpoints are recognized, left figure. Test values: 70 mV for EP1 and 324 mV for EP2.

With EP crit. $U = 71$ mV, EP 1 from the left figure is suppressed and the former EP 2 becomes EP 1.

Parameters for SET

EP1 pH OFF
resp.

Setting of the first endpoint (-20.00... + 20.00).

EP1 U OFF mV

(-2000... + 2000 mV).

Accessible as live-keyboard inquiry (until EP1 is reached).

dyn. ΔpH1 OFF
resp.

Parameter for reagent feeding (see Fig. 3.5),

(.00...20.00, OFF).

dyn. ΔU1 OFF mV

(0...2000 mV, OFF).

Small value → for small (flat) breaks,
large value → for large (steep) breaks
(see Fig. 3.6).

Accessible as live-keyboard inquiry (until EP1 is reached).

drift1 10.0 mV/s

Parameter applied in pulse range (0.3...99.9 mV/s).

A new feeding pulse is only emitted if drift condition is fulfilled.

Large value → fast titration,
small value → better reach of equilibrium.

Accessible as live-keyboard inquiry (until EP1 is reached).

t(delay) 1 10 s

Stop delay time (0...99 s, INF).

Stop condition.

May be set to "INF" - infinite - for maintaining a constant measured value
(stat mode) with <clear>.

Accessible as live-keyboard inquiry (until EP1 is reached).

EP2 pH OFF

Setting of second endpoint (-20.00... + 20.00, OFF).

resp.

EP2 U OFF mV

(-2000... + 2000 mV, OFF).

For titrations with 1 endpoint, EP2 is set "OFF" with <clear>.

In titrations with 2 endpoints, the titration parameters "dyn.ΔpH2" and
"dyn.ΔU2" resp., "drift2" and "t(delay) 2" can be set individually for each
endpoint.

The parameters for EP2 are accessible as live-keyboard inquiries.

EP2 is always performed after EP1.

temp. 25.0 °C

Titration temperature (-20.0... + 200.0 °C).

Inquired only if no Pt100 is connected. Temperature is measured
automatically with Pt100.

Accessible as live-keyboard inquiry.

Note:

Temperature is instrument specific, i.e. its value is valid for all titration
methods and for MEAS until a new value is entered or measured.

stop V 99.99 ml

Stop volume (.00...999.99 ml, OFF).

Security stop (if no endpoints are reached).

Accessible as live-keyboard inquiry.

With stop V .00 ml: print-out of initial pH, pH(init) or initial voltage,
U(init) resp., without starting a titration.

SET (Set Endpoint Titration)

Reagent feeding is executed in 3 phases (see Fig. 3.5):

- 1) Start feeding:
In this range, the feeding rate is increased continuously up to the maximum rate. For titrations with small reagent consumption, the maximum rate is never reached.
- 2) Continuous feeding:
This range is determined by the parameter "dyn.":
"dyn.ΔpH" is the difference $\Delta pH = pH(EP) - pH_1$ and "dyn.ΔU" $\Delta U = U(EP) - U_1$ resp. The feeding rate is fixed.
- 3) Pulse range:
This is the range between pH_1 and $pH(EP)$ or U_1 and $U(EP)$, resp. The next pulse is only emitted if the measured drift is lower than the set "drift" in mV/s. The maximum feeding rate is determined by the parameter "dV/dt" which is set by means of the potentiometer at 665 Dosimat.

For fast and precise titrations, the three parameters should be optimized carefully.

| | | |
|----------------------|---|--------------------|
| dyn.ΔU resp. dyn.ΔpH | } | 686 Titroprocessor |
| drift | | |
| dV/dt | } | 665 Dosimat |

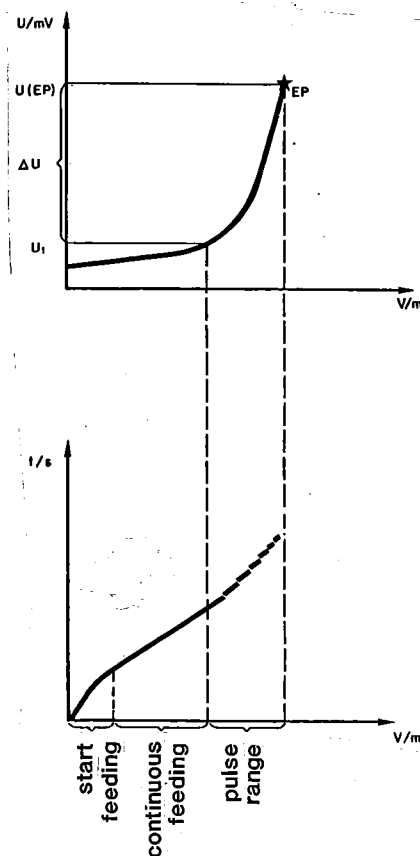


Fig. 3.5

Rule of thumb for the setting of these parameters:

- Optimize parameter "dyn. ΔU ", "dyn. ΔpH " resp., then select "drift".
- Select rather high values for "dyn." (\rightarrow "slower" titration), admitting, however, also higher values for "drift".
- Set "dV/dt" to a middle position, e.g. 5.

Fig. 3.6 shows how to get an idea about parameter "dyn." and Fig. 3.7 gives some concrete examples of titration parameters.

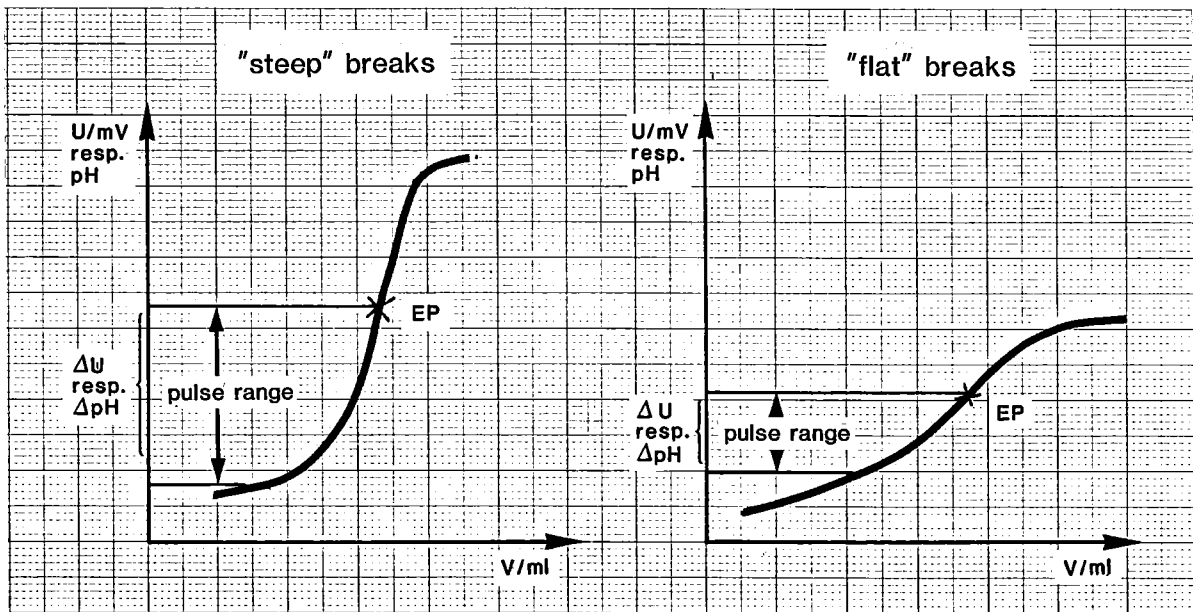


Fig. 3.6

Always optimize the titration parameters for the smallest possible sample concentration in serial analyses, in order to prevent overtitation.

Once the endpoint is reached and if it remains stable during the stop delay time ("t(delay)"), titration is concluded.

Examples of optimized titration parameters

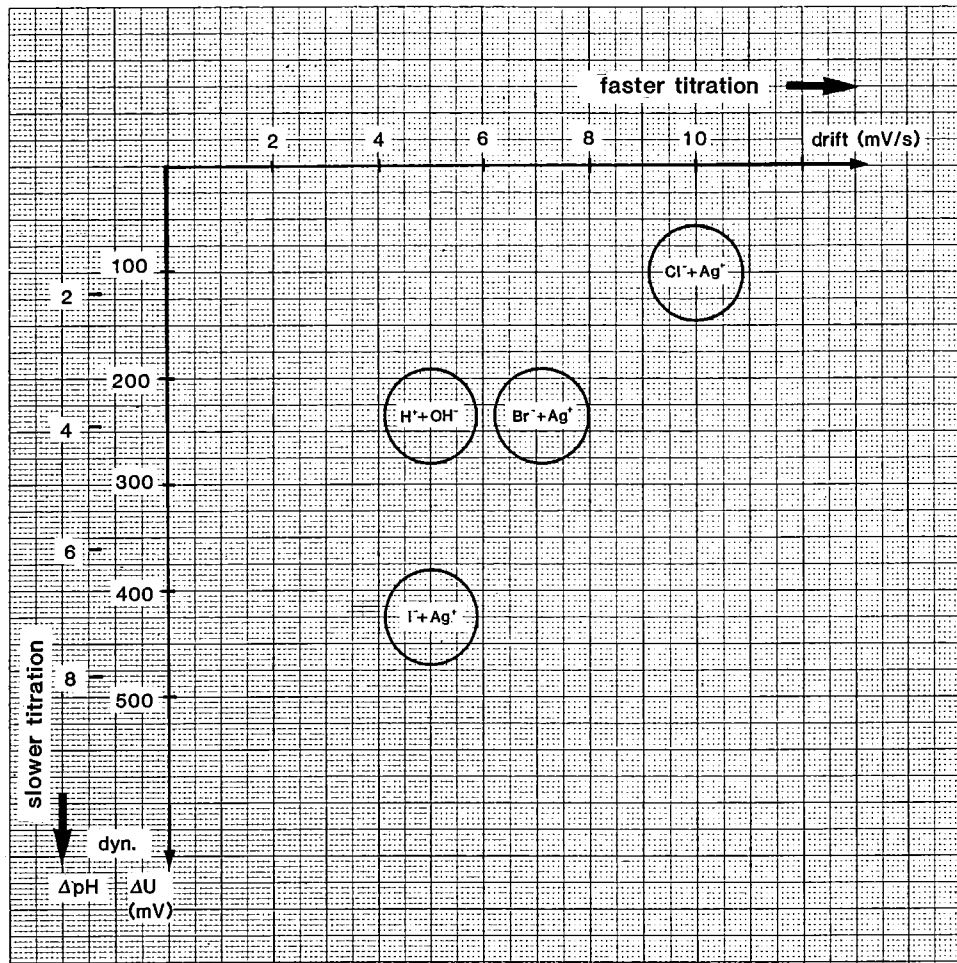


Fig. 3.7

3.1.3 Entry of formulas and key <fmla const>

Entry of formulas

Use the 1st and 2nd functions of the numerical key block for formula entry.

The entry is opened by <2nd> <fmla>. Then it is no longer necessary to use the "2nd" key: 686 Titroprocessor switches automatically between 1st and 2nd functions. Calculation variables (C), endpoints (EP) and results (RS) can be linked with arithmetical operations. Formulas are entered in algebraic notation and stored with <enter>. For the indication of the number of decimal places in the result a delimiter <;> may be set. After a second delimiter <;> a unit may be selected for the result using key <unit>.

For formula entry, the following rules are valid:

- The indices of the different calculation quantities are as follows:

| | | |
|-----|--------------|--|
| FX | X = 1...9 | Formulas |
| EPX | X = 1...9 | Endpoints are numbered continuously |
| RSX | X = 1...9 | Results from formulas with the same index X |
| | | Only use results with lower indices X for calculation |
| CXX | | Calculation values have two digits as indices |
| | XX = 00 | Sample size |
| | XX = 1...19 | Calculation values (fmla const) |
| | XX = 20 | Sample specific calculation value |
| | XX = 30...34 | Common variables (see page 326) |
| | XX = 40 | Initial measured value pH(init) or U(init), resp., accessible to calculation |
| | XX = 41 | Final titration volume, accessible for calculation |
| | XX = 42 | Volume of added auxiliary reagent <u>add V</u>) accessible for calculation |
| | XX = 51 | Volume coordinate of fixed endpoint A |
| | XX = 52 | Volume coordinate of fixed endpoint B |

- For arithmetic operations, the algebraic hierarchy is valid: * and / are prior to + and - .
- Terms in parentheses are calculated first. Nesting of parenthesis is not possible.
- After a first delimiter (;), the number of decimal places for the result may be defined (without indication: 4).
- After a second delimiter (;), a unit may be selected. The key <unit> contains the following units:

| | | | | |
|--------|-----------------------------|---------------------|---|--------------------|
| % | } | fractions, contents | } | substance portions |
| ppm | | | | |
| g/l | mass concentration β | | | |
| mol/l | amount-of-substance conc. c | | | |
| mol/kg | molality b | | | |
| g | } | mass m | | |
| mg | | | | |
| ml | volume V | | | |
| mmol | amount of substance n | | | |
| - | (none) | | | |

- . A formula may contain up to 48 characters; the last 7 are reserved for the unit. From character 35 onwards, every entry triggers a beep signal.
 - . A formula is stored with <enter>.
 - . Leave formula entry with <QUIT>.
 - . A formula may be cleared:
 - <clear> display shows $\boxed{\text{FX}=\}$.
 - <delete> The formula is deleted in the register and the instrument returns to the ready state.
- Note:** Results are only calculated from formulas with sequential indices. Delete therefore only the last formula.
- . A formula may be printed out using <print>.

Example: Entry of the following formulas:

$$F1 = (EP2-EP1)*C01$$

$$F2 = RS1*C02/C00;2;ppm \text{ (2 decimal places, unit, ppm)}$$

$$F3 = C51*C01*C03;4; \text{mg (calculation with Fix-EP A} \rightarrow \text{C51)}$$

Entry of formula F1:

Press <2nd><fmla>.

Display shows $\boxed{\text{F?}}$.

Enter index 1: <1>.

Display shows $\boxed{\text{F1}=\}$.

Enter the formula:

<(> <EP><2> <-> <EP><1> <)> <*> <C><0><1>.

Display shows $\boxed{F1=(EP2-EP1)*C01}$.

Store the formula with <enter>.

Entry of formula F2:

Press <2nd><fmla>.

Display shows $\boxed{\text{F?}}$.

Enter index 2: <2>

Display shows $\boxed{\text{F2}=\}$.

Enter the formula:

<res><1> <*> <C><0><2> </> <C><0><0>.

Display shows $\boxed{F2=RS1*C02/C00}$.

Set the first delimiter and enter the number of decimal places for the result:
<;> <2>.

Now, set the second delimiter and select the unit: <;> <unit>.

Press key <unit> repeatedly (or continuously) until the unit ppm is in the display.

Display shows now $\boxed{C02/C00:2;ppm}$

The formula has more than 16 places and therefore runs out of the display.

Check the entry: Press <print>.

The formula from the display is printed:

F2=RS1*C02/C00:2;ppm

The entry is o.k. and can be stored with <enter>.

Entry of formula F3:

Press <2nd> <fmla>.

Enter index: <3>.

Enter the formula: <C><5><1> <*> <C><0><1> <*> <C><0><3>.

Set the first delimiter and enter the number of decimal places: <;><4>.

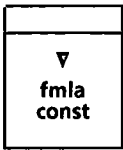
Set the second delimiter and select the unit: <;><unit>.

Check your entry, press <print>.

If everything is o.k., store the formula: <enter>

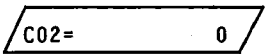
If you find an error, clear the formula: <clear> and enter it once more.

Key <fmla const>



fmla const: method specific formula constants C

Rolling key.



Inquiry of all the formula constants CXX (XX = 01,02,...19, 30...34), which are programmed in the formulas of the register. The inquiry for the sample specific constant C00, sample size, is placed in keys <smpl size> and <smpl data>.

Inquiry of formulas

All formulas FX in the register may be displayed by pressing keys

<2nd> <fmla> <X>

For formulas with more than 16 places, the display window can be shifted by means of the cursor.

Example: Display of formula F2 (from former example)

Inquire formula F2: <2nd> <fmla> <2>.

Display shows $F2=RS1 \cdot C02 / C00 : 2$.

Press now <→> (cursor) until the end of the formula is in the display.

Leave formula inquiry with <QUIT>.

3.1.4 Key <def records> and key <mean>

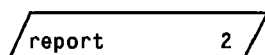
Key <def records>

(With 3.540.2210 or 3.540.2200 data transfer interface see page 408.)



def records: indication of data blocks for automatic data output at the end of titration and indication of values for mean calculations

Rolling key.

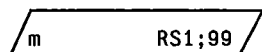


Entry of code number for the corresponding data blocks to be printed out automatically on the built-in printer at the end of the titration (up to 8 code numbers).

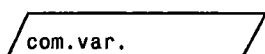
List of code numbers:

- 1 parameter report
- 2 extensive result report (with list of EP's)
- 3 measuring point list (for GET and MET, the former are data points of the titration curve)
- 4 formulas and formula constants
- 5 titration curve (for MET and GET), scale is optimized automatically
- 7 short result report (without list of EP's)
- OFF no data output on the built-in printer

See also section 3.2 "Data output", page 341

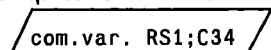


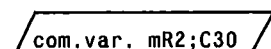
Definitions for calculating mean values and standard deviations. Indication of which results (RSX) (up to 3 values) mean values and standard deviations should be calculated. After the delimiter (;), the number of single values n to be added up may be entered. No inquiry if "mean" is activated (LED is on).



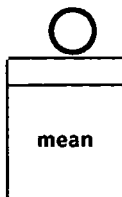
Indication for storing of a common variable. A result (RSX) or a mean value (MRX) (calculated in this method) is stored as calculation value C3Y (Y = 0...4). Calculation values C3Y are stored in a common memory from where they can be used by any following titrations.

Examples for entries:

 : result RS1 is stored as C34.

 : mean value from result RS2 is stored as C30.
(Press keys:
<2nd><mean><2>
<2nd><;>
<2nd><C-val><3><0>.)

Mean calculation, key <mean>



Mean calculation is switched on with key <mean>, the corresponding LED comes on.

The values for mean calculations, which are defined in key <def records>, are added up in the mean memory.

The key <mean> is accessible only in the ready state..

Example: Calculation of mean values and standard deviations from RS1, RS2 and RS3 in double determinations.

Press <def records>.

Display shows report 2,
which means that at the end of the titration an extensive result report is printed out.
Press again <def records>.

Display shows m RS1:99.

You need double determinations ($n = 02$) and mean calculations from RS1, RS2 and RS3.

Press therefore <clear>.

Display shows m.

Enter the values, separated by a delimiter (;): <2nd><RS><1> <2nd><;>
<2nd><RS><2> <2nd><;> <2nd><RS><3>.

Set the number $n = 02$ after another delimiter: <2nd><;> <0><2>.

Display shows m RS1:RS2:RS3:02.

Store your entry: <enter>

The instrument is now ready for titration.

Check your titration method first. If everything is o.k., start mean calculations:

Press <mean>.

The corresponding LED comes on and mean values and standard deviations from RS1, RS2 and RS3 are always printed out after two titrations, until you stop mean calculations by pressing <mean> again.

Note: Mean calculation is interrupted (mean of added values is printed out, mean memory is cleared) if:

- . number of single values n is reached
- . method is changed

Mean calculation is stopped (mean of added values is printed out, mean memory is cleared, mean is deactivated) if:

- . mean is switched off by pressing key < mean >
- . silo memory is switched on or off
- . error message "#EP not corresponding" or "formula missing" is printed out

Due to the limited calculation precision of the 7 digit format, the standard deviation $\pm s$ may be incorrect for great values which are very reproducible.

The mean memory is fed exclusively with original titration data (no reproduced values!).

Common Variable

A common variable can be useful e.g. for the following applications:

- Determination of the titer by method A. Automatic transfer of the determined value as a calculation constant in methods B, C, .. of the following titrations.
- Determination of a blank value by method A. Automatic transfer of the determined value as a calculation constant in the method B of the following titrations.
- Determination of a result in method A. Automatic transfer of the determined result as a calculation constant in method B of the following titration.

Up to 5 common variables can be stored as C30...C34. The values are stored automatically whenever a new calculation of a value occurs. If a result is recalculated on reproduction, the new value is stored as C3Y.

C30...C34, the common variables, are treated in the following titrations like normal calculation constants:

- If C3Y are programmed in a formula, they can be inquired and entered in key < fmla const >.
- C3Y can also be inquired and entered by keys <2nd> <C-val> <3> <Y> .

Example: You wish to determine a blank value out of 2 titrations before you start a series of samples. The determined blank value should be subtracted from your sample consumption.

To do this, you need two different methods:

Method 1 for the determination of the mean value of your blank
and
Method 2 for your sample titrations.

Method 1, determination of the blank value:

Complete your method with a formula for the calculation of the blank value, e.g. $F1 = EP1;3;ml$.

Press <def records> twice.

Display shows $\sqrt{m \quad RS1:99}$.

Change the value "99" to "02" by means of the cursor and press <enter>.
→ Calculation of the mean value.

Display shows $\sqrt{com.var. \quad}$.

Enter now the necessary indication:

<2nd><mean><1> <2nd><;> <2nd><C-val><3><0> <enter>.
→ Indication to store the mean value of result RS1 as common variable C30.

Store this method in the user memory (see page 329).

Press <user methods> twice and enter identification (1).

Method 2, following titration which uses the blank value determined by method 1.

Complete method by a formula containing the common variable C30, e.g. $F1 = EP1-C30;3;ml$.

Store this method in the user memory (see page 329).

Press <user methods> twice and enter identification (2).

Now enter sample data into the silo memory (see page 333).

Press <sil> (LED comes on) and <smpl data> and enter the following data:

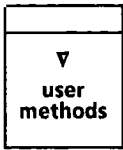
| <i>sil line</i> | <i>method</i> | <i>id. #1</i> | <i>id. #2</i> | <i>c20</i> | <i>c00</i> |
|-----------------|---------------|---------------|---------------|------------|------------|
| 1 | 1 | | | | 20 ml |
| 2 | 1 | | | | 20 ml |
| 3 | 2 | | | | 1.24 g |
| 4 | 2 | | | | 1.19 g |
| . | . | | | | . |
| . | . | | | | . |
| etc. | | | | | |

Start mean calculation:

Press <mean> (LED comes on).

Start titrations, <GO>.

3.1.5 Key <user methods>



user methods: for the management of the user memory

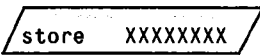
Rolling key. Every entry which is completed with <enter> leads to the ready state.



Recall of a user method into the register.

Entry of method identification string and <enter>.

Blinking identification string: no such method is stored in the user memory.

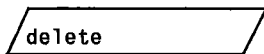


A method programmed in the register can be stored. Entry of method identification string and <enter>. The identification string may have up to 8 characters. Any character from the numerical block (1st and 2nd functions) may be used.

The following identification strings are not allowed:

***** reserved for the standard methods and all blanks.

Blinking identification string: a method with the same identification is already stored in the user memory and can be overwritten pressing <enter> a second time.



A method in the user memory can be deleted. Entry of method identification string and <enter>.

Blinking identification string: no such method is stored in the user memory.

Storing a user method

Example: You wish to store a method which you worked out in the register with the identification string 87-05-FE.

Press <user methods>.

Display shows .

Press <user methods>.

Display shows .

Enter the identification string (87-05-FE):

<8><7> <(-)> <0><5> <(-)> <2nd><fmla> <2nd><EP> and <enter>.

The instrument is now in its ready state. The method just stored in the user memory is still in the register, carrying its new identification 84-05-FE.

Loading a user method into the register

Example: You wish to recall a pH titration to preset endpoint, which is stored in your user memory with the identification 2-2

Press <user methods>.

Display shows .

Enter the identification string (2-2): <2><(-)><2> and <enter>.

Display shows .

A copy of the method 2-2 from the user memory is now in the register, ready for work.

Print-out of the content of the user memory

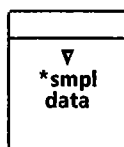
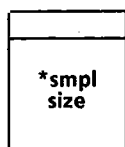
A table of contents can be printed out, pressing the following keys:

<report><user methods><enter>

3.1.6 Keys <smpl size> and <smpl data>

(For on-line entries with connected balance, see page 406)

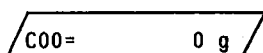
All data concerning the sample - sample specific data - can be entered with these keys. The sample specific data are deleted when the next titration begins.



smpl size: for the sample size.
Accessible as live-keyboard inquiry.

smpl data: for sample identifications and for sample size.
Accessible as live-keyboard inquiries.


Key <smpl size>



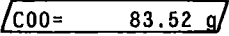
Calculation variable for the sample size.
A unit may be selected with the keys <2nd><unit>. The following units are possible: g, mg, ml, µl, pc (= pieces) and - (= none).
With <clear>, the digits are cleared, the unit remains.

Example: Entry of the sample size 83.52 mg

Press <smpl size>.

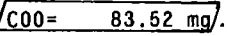
Display shows .

Enter <8><3> <.> <5><2>.

Display shows .

Select the unit:

Press and repress the keys <2nd><unit> until the correct unit (mg) is displayed.

Display shows .

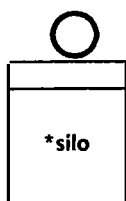
Store the sample size, pressing <enter>.

Note: Switching on the instrument sets C00 to 0.

Key <smpl data>

- Id.#1** Sample identification No. 1.
String with up to 8 characters. Any character from the numerical block (1st and 2nd functions) may be used.
- Id.#2** Sample identification No. 2.
String with up to 8 characters, see sample identification No. 1.
- C00= 0 g** Calculation variable for the sample size, see key <smpl size>.

3.1.7 Key <sil0>, sil0 memory



(For on-line entries with a connected balance, see page 407)

The sil0 memory is a memory, working by the FIFO (first in, first out) principle. The sil0 memory is connected and disconnected to the register with the key <sil0>. This key is accessible during titrations, it is live. It is not active during inquiries of keys <smpl data> and <smpl size>.

The key <sil0> acts like a switch for the sample specific data. When sil0 is "off", sample data is read directly into the register. When sil0 is "on", sample data is read into sil0 memory stack. (Enter data with sil0 "on".) Sil0 must be on (LED) for automatic transfer of sample data to register (see Fig. 3.8).

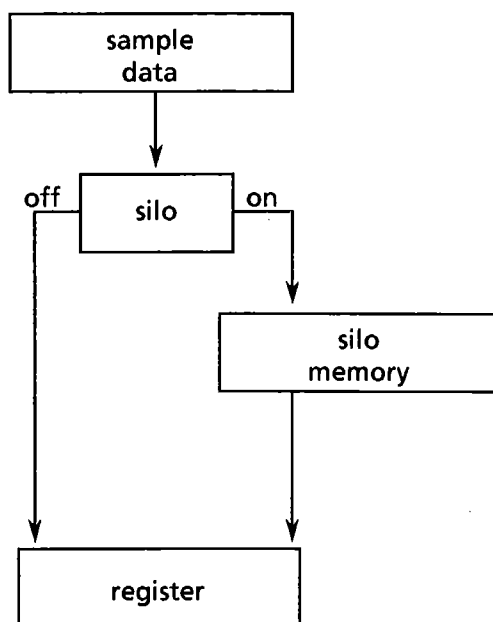


Fig. 3.8

The connection between the sil0 memory on one hand and the keyboard on the other hand is shown schematically in Fig. 3.9 (see also "Organization of memories, page 205).

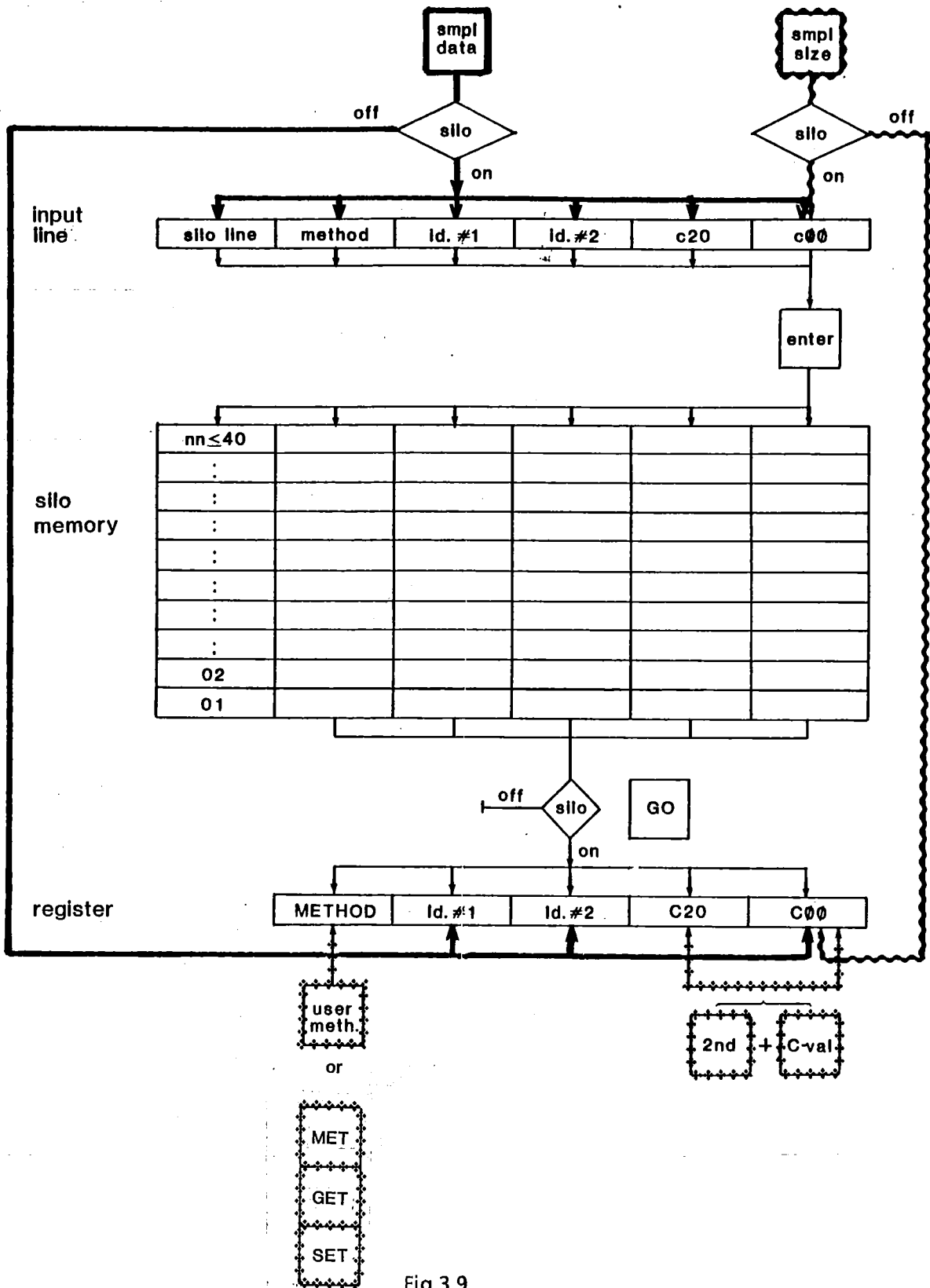


Fig.3.9

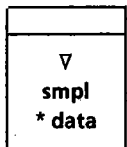
If silo is "on" (LED is on), the sample specific data from keys <smpl data> and <smpl size> come into the input line of the silo memory. The entry of the sample size c00 completes the data line. With this entry the input line is copied into the corresponding silo line. Entering the next silo line, the old data is still in the input line and can be accepted if it is unaltered.

Note: Check all the sample specific data from the input register (especially the method identification), if you enter the sample size via key <smpl size>.

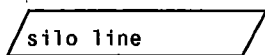
On starting the titration, silo line 1 is transferred into the register.

Remarks:

- Some data from the silo memory can be printed out with keys <report><smpl data><enter> or <report><smpl size><enter>.
- Sample specific data such as sample identifications (id.#1, id.#2) and calculation variables (c00, c20) are designated with lower case in the silo memory, whereas they have capital letters in the register: Id.#1, Id.#2, C20, C00.



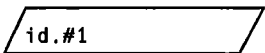
The inquiry sequence of key <smpl data> is extended if silo is on:



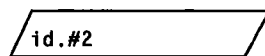
(Silo line \leq 40).
Display shows automatically the highest silo line to be filled. If a lower line number is entered, the data can then be modified, if necessary. If a complete silo line is deleted (<delete>), all the upper lines are decremented automatically.



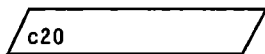
Selection of a method from the user memory.
A method must be entered.



Sample identification string #1.
String with up to 8 characters. Any character of the numerical block (1st and 2nd functions) may be used (ASCII).



Sample identification string #2.
String with up to 8 characters, see id. #1.



Sample specific calculation variable



Sample size.
the sample size must be entered because this entry terminates the silo line which is then stored in the silo memory.

If all the sample specific data are unaltered except the sample size, this can be entered via key <smpl size>. If silo is "on", it is always stored in the highest silo line.

Example: You wish to titrate several samples with a method which is stored in the user memory with identification 12. The batch number of your samples is 84-06. You take this number as sample identification id.#1. The determinations are carried out using the silo memory.

Switch on silo:

Press < silo > (LED comes on).

Now enter the first silo line, press < smpl data > .

Display shows .

Press < smpl data > .

Display shows .

Enter your method identification 12: < 1 > < 2 > < enter > .

Display shows .

Enter your batch number:

< 8 > < 4 > < - > < 0 > < 6 > < enter > .

Display shows .

You don't have a second sample identification. Neither do you have a calculation variable c20.

Press therefore < smpl data > twice.

Display shows .

Enter the sample size of your first sample, e.g. < 1 > < . > < 2 > < 3 > .

Display shows .

Terminate and store this silo line pressing < enter > .

For all the next samples you wish to change only the sample size.

Press <smpl size>.

Display shows c00= 1.23 g/.

Enter the new sample size: <1> <.> <2><4> <enter>.

Press <smpl size> again, enter the next sample size, etc. , etc.

Check your entries by printing silo data: <report> <smpl data> <enter>.

```
sample data
sl  id.#1      c00
 1  84-06      1.23 e
 2  84-06      1.24 e
 3  84-06      1.15 e
 4  84-06      1.40 e
 5  84-06      1.11 e
 6  84-06      1.16 e
 7  84-06      1.44 e
 8  84-06      1.26 e
 9  84-06      1.35 e
10  84-06      1.28 e
```

Access to silo data:

Example: You wish to correct silo line 5 because sample No. 5 has been destroyed and a new sample had to be prepared.

Correction of the error:

Press <smpl data>.

Display shows the highest silo line, e.g. .

Enter line 5: <5><enter>.

Display shows .

Now press <smpl data> until display shows: .

Enter the new sample size.

Or, alternatively, line 5 can be deleted:

Press <smpl data>.

Display shows again the highest silo line .

Press <delete>.

Display shows .

Enter line 5: <5><enter>.

Now display shows the highest silo line: .

Print out another silo memory report:

<report><smpl data><enter>.

```
sample data
s1   id.#1   c00
1    84-06   1.23 e
2    84-06   1.24 e
3    84-06   1.15 e
4    84-06   1.40 e
5    84-06   1.16 e
6    84-06   1.44 e
7    84-06   1.26 e
8    84-06   1.35 e
9    84-06   1.28 e
```

Deleting the whole silo memory

Example: You wish to delete the whole silo memory.

Press <smpl data>.

Display shows the highest silo line, e.g. .

Press <delete>.

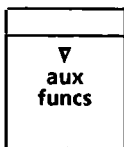
Display shows .

Enter 99: <9><9> <enter>.

The silo memory is now completely empty and display shows (in silo line 1).

Silo memory can now be filled again.

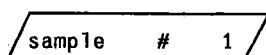
3.1.8 Key<aux funcs>



auxiliary functions: for auxiliary functions, such as time, data, etc.

Rolling key.

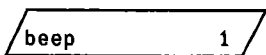
Inquiries in this key are instrument specific and are valid for all titration methods.



Continuous titration number (0...9999).

(Switching on the instrument sets number to 0.)

It is incremented by 1 after <GO> and is printed out with every automatic report as well as with manually triggered method specific reports.

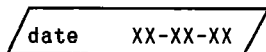


Number of beep signals at the end of the titration (OFF, 1...9; OFF: no beep signal)



Time (entry hh-mm), no live display.

In order to prevent erroneous changing of time, an entry will only be stored if the value has been changed (- is placed instead of :).



Date (entry yy-mm-dd), no live display.

Here too, an entry will only be stored if the value has been changed.

3.2 Data output

(With data transfer interface, see page 408.)

Three different possibilities for data output are offered:

- automatic print-out of data blocks at the end of the titration
- manually triggered print-out of data blocks
- manually triggered print-out of data lines

All the automatic print-outs at the end of the titration contain original data. The final mark of these reports is = = = = =. All the manually triggered print-outs of data blocks (e.g. reproductions) have a different final mark: ----- .Original reports can be distinguished from re-evaluation of data.

3.2.1 Automatic print-out of data blocks

Calibration report

Print-out at the end of the calibration

| | |
|------------------|----------|
| calibration data | |
| date | 86-02-25 |
| pH(S) 1 | 4.00 |
| pH(S) 2 | 7.00 |
| t.cal. | 20.7 °C |
| slope(rel) | .984 |
| U(as) | -5.6 mV |
| electr. input | 1 |
| | ===== |

| | |
|-------------------------|--|
| date | |
| buffer 1 | |
| buffer 2 | |
| calibration temperature | |
| relative slope | |
| asymmetry voltage | |
| measuring input | |

The following blocks have to be indicated in key <def records> (see page 324). They are printed at the end of the titration.

- Code 1 parameter report
- Code 2 extensive result report
- Code 3 measuring point list (for GET and MET; the former are data points of the titration curve)
- Code 4 formulas and formula constants
- Code 5 titration curve (for GET and MET)
- Code 7 short result report

Examples of reports

Code 1 Parameter reports

The reports contain only the important information. Values designated with * are only printed out if their values are different from 0 or OFF, resp. ("clear" value).

```
GET pH          12 #    17
(*)output t1    5
(*)pause 1     10 s
(*)output t2    52
(*)pause 2     60 s
  electr. input 1
  titr.rate    .50 ml/min
*anticip.      10
*stop V        5.00 ml
*stop pH       11.20
*stop EP#      1
*start V       .20 ml
*start pH      2.50
*start slope   2.00 /ml
*EP A pH       4.30
*EP B pH       8.30
  temp.        21.1 °C
  EP crit.     3
=====
```

} inquiry and print-out
only with analogue
output interface

```
SET U           1 #    18
*add V          1.20 ml
*pause          50 s
  electr. input 2
  EP1 U         230 mV
  dyn.ΔU 1     100 mV
  drift1        5.0 mV/s
  t(delay) 1    10 s
(*)EP2 U        -125 mV
(*)dyn.ΔU 2     90 mV
(*)drift2       5.0 mV/s
(*)t(delay) 2   10 s
  temp.        21.1 °C
*stop V         10.00 ml
=====
```

} print-out only if EP2 is not off

```
MET pH ***** #    1
  electr. input 1
  vol.step      .10 ml
  drift         100 mV/min
*stop V        99.99 ml
*stop pH       11.50
*stop EP#      2
*start V       .50 ml
*start pH      3.80
*start slope   2.00 /ml
*EP A pH       4.50
*EP B pH       6.00
  temp.        25.0 °C
  EP crit.pH   .50
=====
```

Code 2 Extensive result report

Sample specific data Id.#1, Id.#2 and C20 are only printed out if a value was entered. Sample size C00 is only printed out if it contains a value different from 0 and if it is used for calculations.

```
date 86-02-25 time 15:00
GET pH ***** # 20
pH(init) 2.62
      V/ml      pH
EP1      .772    4.80
EP2      .833    8.04
EPA      .764    4.30
EPB      .835    8.30
stop volt.reached
=====
```

date, time
method with identification and continuing titr. no.
initial measured value

} list of equivalence points
with FIX-EP

This method did not contain formulas
for result calculations.

```
date 86-02-25 time 15:31
MET pH 234 # 29
Id.#1 85-10-05
Id.#2 *1.1*
C00= 3.451 g
pH(init) 2.67
      V/ml      pH
EP1 1.016 8.00
RS1 3.533 %
RS1(m) 3.526 %
(+/-)s .0062 %
n 3
=====
```

sample identification 1
sample identification 2
sample size } sample specific data

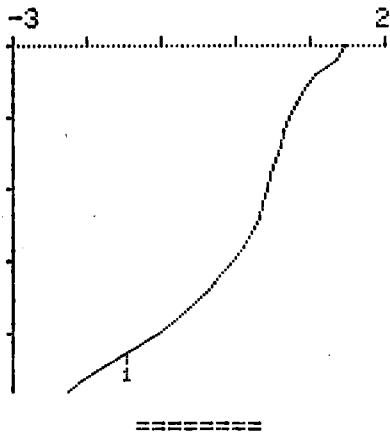
List of endpoints
List of calculated results

mean value
standard deviation
number of single values (n) } mean

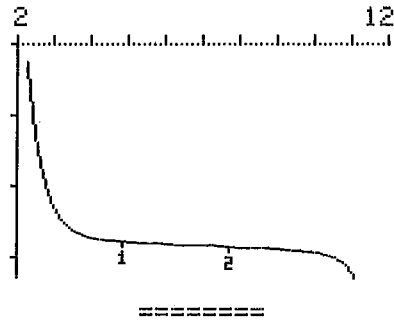
Code 5 Titration curve, scale is optimized automatically (for GET)

If a start volume has been fed, the volume axis begins with the next intercept of the axis. The exact start volume is printed out above the curve.

```
date 87-02-16 time 14:18
MET U      4-8 # 6
.50ml/div  ΔU=100mV/div
start V    .000 ml
```



```
date 86-02-25 time 08:38
GET pH ***** # 5
1.0ml/div  ΔpH=1/div
start V    2.260 ml
```



Code 7 Short result report

Sample specific data Id.#1, Id.#2, C20 and C00 are only printed out if values have been entered (see Code 2).

```
date 86-02-25 time 15:29
SET pH      234 # 28
Id.#1      85-10-05
Id.#2      *1.1*
C00=       3.451 %
pH(init)   2.67
RS1        3.522 %
=====
```

} sample specific data

} list of calculated results

3.2.2 Manual print-out of data blocks, key <report>



report: for manual print-out of data blocks

Reproduction of automatic reports

The print-out is triggered with keys
<report> <Code> <enter>

The code number corresponds to the code of the automatic reports:

Code 1 parameter report

Code 2 extensive result report

Code 3 measuring point list (for GET and MET; the former are data points of the titration curve)

Code 4 formulas and formula constants

Code 5 titration curve (for GET and MET)

Code 7 short result report

For reproductions of result reports (code 2 and 7) the following changes are taken into account:

changed or new formulas

formula constants CXX, mit XX = 01...19, 30...34

sample specific data Id.#1, Id.#2, C00, C20

for GET and MET: EP crit.
fixed endpoints A and B

After a reproduction of a result report, these changes are taken into account for the titration curve (code 5) too.

Calibration report can be reproduced with keys <report> <MEAS> <enter> if the instrument is in its ready state (<report> is not active in mode MEAS).

Manual print-out of additional data blocks

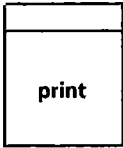
Print-out is triggered with the following keys:

<report><Key(s) X><enter>

The table below gives a synopsis on the possible reports and the keys X.

| Report | Key(s) X |
|---|----------------------------------|
| User memory report: containing standard method, measured quantity, method identification, number of bytes used by the method and remaining bytes | <user methods> |
| Silo memory report: containing silo line #, id.#1, c00 | <smpl data> or <smpl size> |
| List of parameters: containing list of parameters in key <parameters>. Print-out of important information only (see page 342) | <parameters> |
| List of prep steps: containing list of prep steps in key <prep steps>. Print-out of important information only (see page 342) | <prep steps> |
| List of formulas: containing all formulas | <2nd><fmla> |
| List of formula constants: containing all formula constants CXX, with XX = 01 ... 19, 30 ... 34, 40 ... 42 | <fmla const> |
| List of equivalence points or endpoints: containing all equivalence points or endpoints | <2nd><EP> |
| List of results: containing all results, changing of formulas, formula constants C00...C20, C30...C34, and/or fixed endpoints are taken into account | <2nd><res> |

3.2.3 Manual print-out of data lines, key <print>



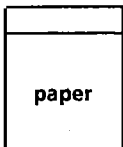
print: for print-out of display

e.g.

- . print-out of single measured values in mode MEAS
- . print-out of formulas
- . print-out of single entries
- . print-out of single equivalence points or endpoints
- . print-out of single results

etc.

3.2.4 Key <paper>



paper: for paper drive

3.3 Single inquiries

The 2nd functions "fmla", "EP", "res" and "C-val" may be inquired as single values, if necessary.

Inquiry of formulas see page 323.

Inquiry of equivalence-points or endpoints (EP)

EP's can be inquired with keys

<2nd><EP><X> (X = 1...9)

Example: Inquiry of EP1

Press <2nd><EP><1>.

Display shows $\overline{\text{EP1 V= 1.122 ml}}$.

The corresponding voltage value can be displayed with the cursor:

Press <→>.

Display shows $\overline{\text{EP1 pH= 7.11}}$.

The values can be printed out with <print>:

```
EP1 V= 1.122 ml
      pH= 7.11
```

Inquiry of results (res)

Results can be inquired with keys

<2nd><res><X> (X = 1...9)

Example: Inquiry of result RS1

Press <2nd><res><1>.

Display shows $\overline{\text{RS1= 12.3}}$.

The unit can be displayed with the cursor:

Press <→>.

Display shows $\overline{\text{RS1= %}}$.

The result can be printed out with <print>:

```
RS1= 12.3 %
```

Inquiry of C values (C-val)

Single C values can be inquired with keys:

<2nd><C-val> <X><X> (XX = 00...99)

Additional possibilities of inquiring C values:

Key <fmla const> for CXX, XX = 01...19, 30...34, 40...42

Keys <smpl size> and <smpl data> for C00 (and C20)

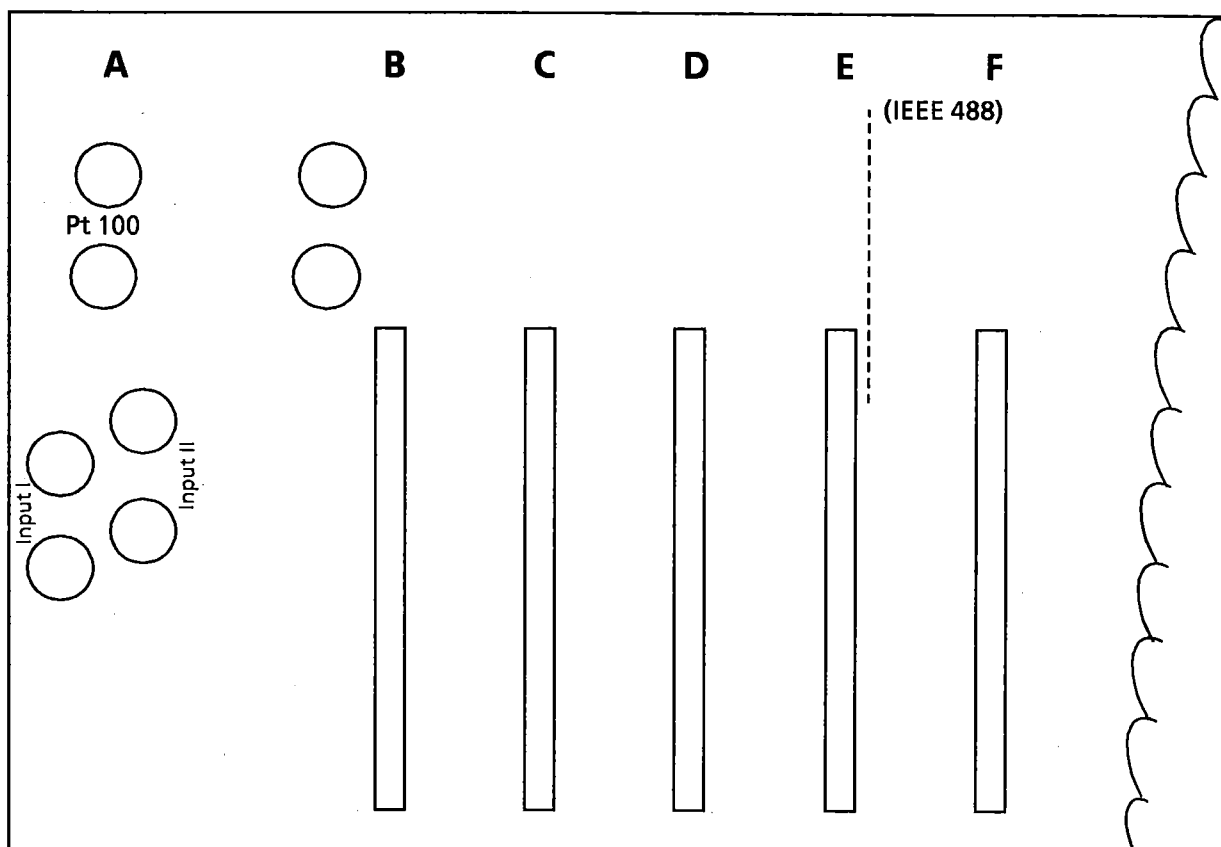
The following list gives the C values and their signification:

- C00 sample size
(sample specific)
- C01 }
: } formula constants
: } (method specific)
C19 }
- C20 calculation variable from silo memory
(sample specific)
- C30 }
: } common variables
: }
C34 }
- C40 initial measured value pH(init) or U(init)
- C41 final titration volume
- C42 volume of added auxiliary reagent (add V)
- C51 volume coordinate of fixed endpoint A
- C52 volume coordinate of fixed endpoint B
- C91 output t1 {
C92 output t2 { An entry can be deleted in a method
C94 send { if the corresponding interface is missing
(see page 503).
- C99 Display of date and time, live display.
(No changes here. They have to be made in key <aux funcs>, see page 340).

4. Options

The following interfaces can be inserted in the 686 Titroprocessor:

Rear panel of 686 Titroprocessor:



3.540.2430-
analogue
input
(standard)

3.540.2191
analogue
output
for connec-
tion of
sample
changer or
recorder
(option)

3.540.2170
Dosimat
interface
(standard)

3.540.2210
balance-
interface
(option)

3.540.2210
data
transfer
interface
according
to RS 232 C
or
3.540.2200
according
to IEEE 488
(option)

none, empty

Fig. 4.1

Connect and disconnect interconnecting cables only when instruments are switched off!

4.1 Connection of Sample Changer

3.540.2191 interface is available for the connection of a Sample Changer. The interface is inserted in slot B of 686 Titroprocessor and the Sample Changer is connected according to Fig. 4.2.

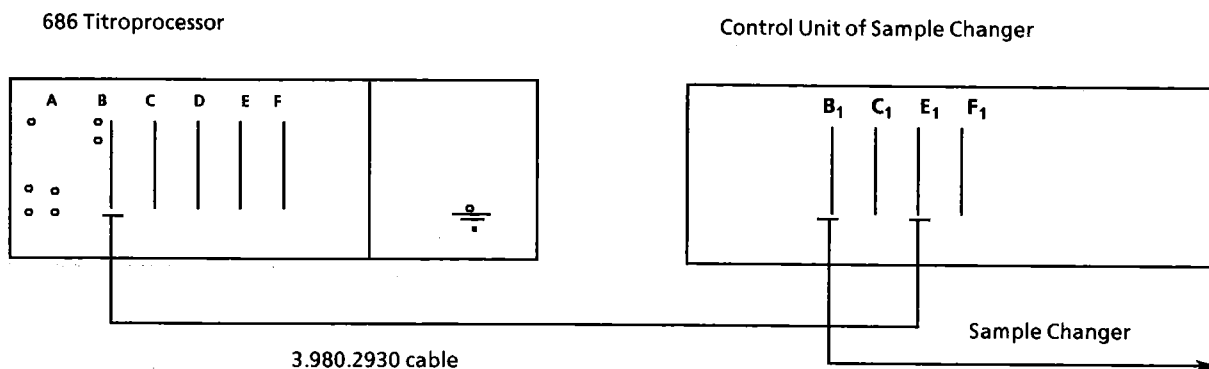


Fig. 4.2

prep
steps

Operation:

Start and stop are sent from the Control Unit of the Sample Changer.

The inquiry sequence in key <prep steps> runs as follows:

output t1 OFF

Electronic signals may be set at time t1, i.e. just after <GO>, before measuring of the initial measured value pH(init) or U(init), respectively. The signals may be set on four different outputs, either as pulses of 150 ms length or as a static line.

Parameters for entries:

| output No. | I | II | III | IV |
|-------------|---|----|-----|----|
| pulse | 1 | 2 | 3 | 4 |
| static line | 5 | 6 | 7 | 8 |

pause 1 0 s

Waiting time after output t1 (0...9999 s).

output t2 OFF

Electronic signals may be set at time t2, i.e. after measuring of the initial measured value pH(init) or U(init), respectively.
Entries as per output t1.

Important:

Without any entry in output t2 a static line set in output t1 is lowered. If you wish to carry on a static line during the whole titration, repeat the corresponding entry from output t1 in output t2 (see diagram below).
At the end of the titration (before data output), all signals from output t1 and output t2 are lowered.

pause 2 0 s

Waiting time after output t2 (0...9999 s).

add V .00 ml

Dosing of auxiliary reagent (00...999.99 ml).

pause 0 s

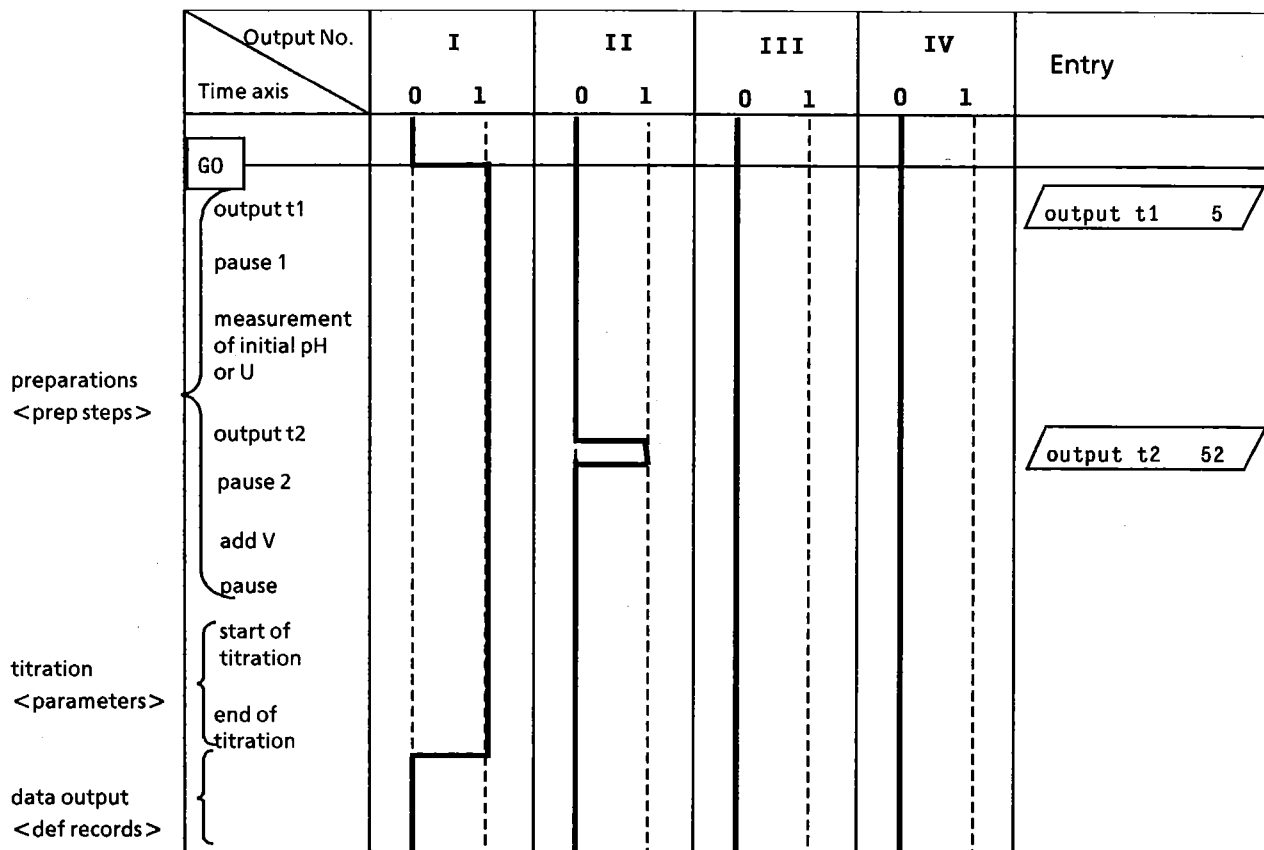
Waiting time (0...9999 s).

electr. input 1

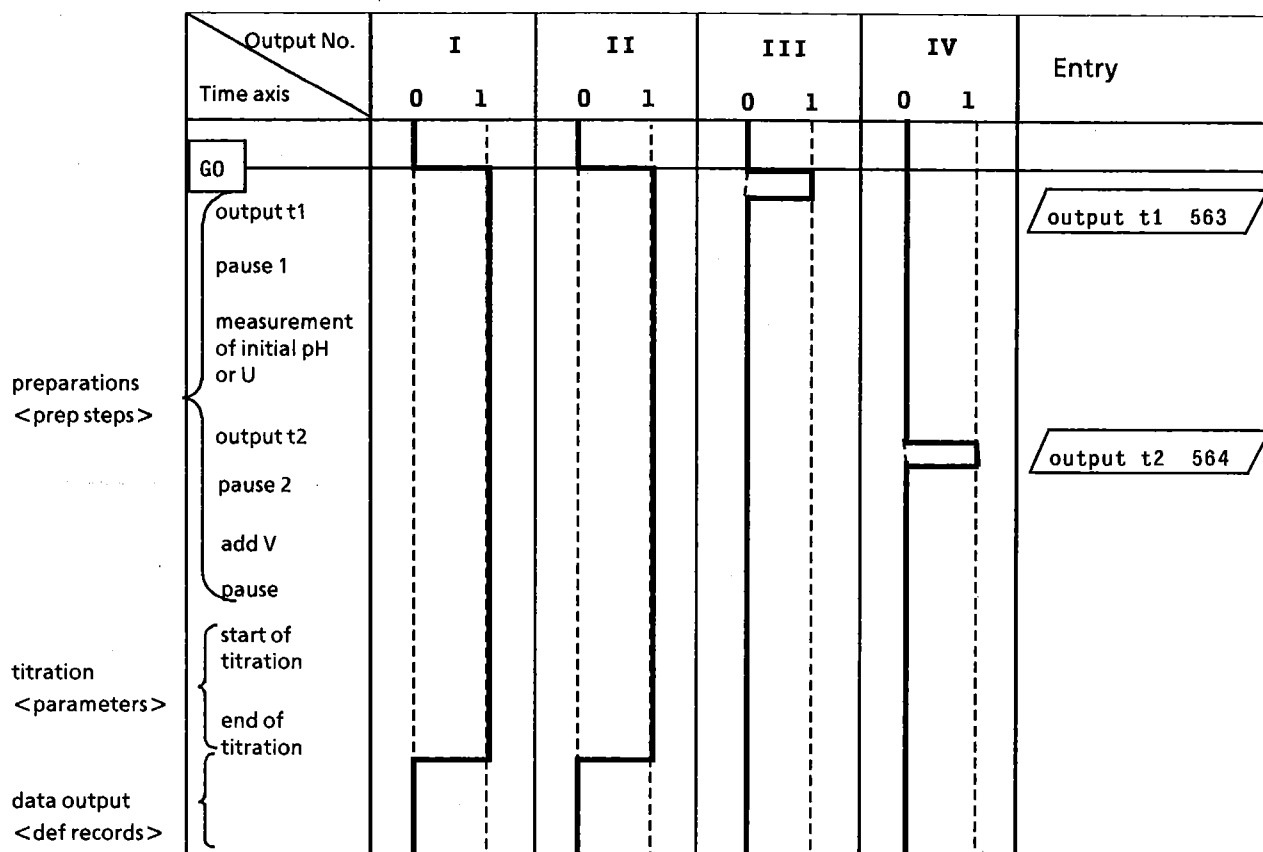
Definition of measuring input (1, 2, 12).

Example: Scheme of outputs t1 and t2 on time axis

a) Static line on output I, pulse at time t2 on output II



b) Static lines on outputs I and II, pulse at time t1 on output III and pulse at time t2 on output IV



For positions of output t1/t2 signals on 3.540.2191 interface see page 607.

The use of the electronic signals from output t1 and output t2 is not fixed: any function may be triggered. The corresponding interconnecting cables are available on request.

Examples:

- Triggering a Dosimat

After measuring the initial measured value, a 665 Dosimat can be triggered with the following entry:

```
output t2 1/
```

- Selecting a measuring assembly with 671 Switch Box

671 Switch Box is a selector unit for measuring inputs. The four measuring inputs of the Switch Box are controlled by two lines:

| Measuring input | Input e5(2 ⁰) / e2(2 ¹) of 671 Switch Box | |
|-----------------|---|---|
| 1 | 1 | 1 |
| 2 | 0 | 1 |
| 3 | 1 | 0 |
| 4 | 0 | 0 |

0 = not activated, high (+ 5 V)

1 = activated, low (0 V)

If output I and II of 686 Titroprocessor are dedicated for controlling 671 Switch Box (3.980.3020 interconnecting cable), the following entries are necessary:

| Measuring input | Entry for output t1 und t2 |
|-----------------|----------------------------|
| 1 | 56 |
| 2 | 6 |
| 3 | 5 |
| 4 | - |

4.2 Connection of balance

Sample specific data (e.g. sample size) can be transferred directly from the balance into the 686 Titroprocessor if a balance is connected.

A 3.540.2210 serial interface is necessary for the balance connection. The interface has to be prepared and inserted according to the installation instructions supplied with every interface. Additionally, the following (instrument specific) settings have to be carried out:

switch 21: on
switch 22: off

The interface is inserted in slot D of 686 Titroprocessor and the balance is connected according to Fig. 4.3.

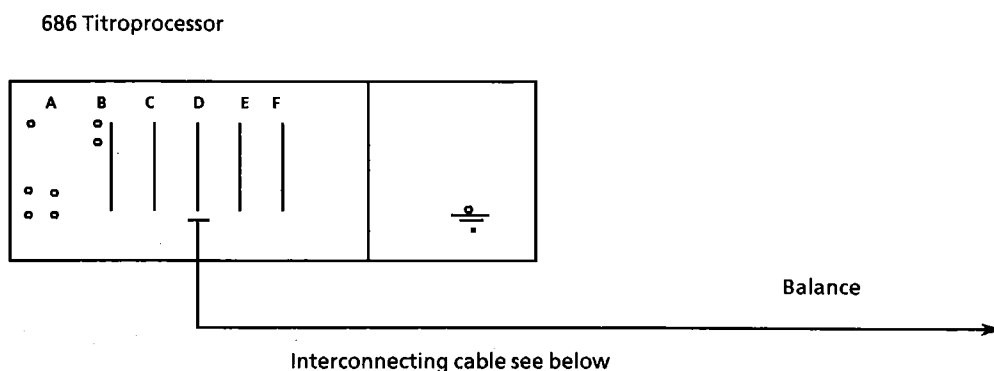


Fig. 4.3

Interconnecting cables

Sartorius balances:

6/7/8 digits, bit-parallel/decade-serial data output 3.980.2770
Serial data output (RS 232 C/V 24 S) 3.980.2850

Mettler balances:

Mettler balances with serial data output can be connected
(data output 03, 05, 011 or data interface CL)
Data output 03, 05, 011 (CL) or 016 3.980.2780
Data output 017 (CL) 3.980.2790
Data output 011 (RS 232 C) 3.980.2800

Sauter balances:

Sauter balances with serial data output can be connected
Data output 03 3.980.2780

Please contact us regarding interconnecting cables for balance types not listed above!

Operation

Data transfer is triggered with a transfer key from the balance. Every value received by the Titroprocessor is acknowledged by a beep signal. Always wait for this beep signal in order to avoid errors! If the silo memory is connected (silo on), data are filled into the highest silo line. Silo lines are terminated with the entry of the sample size.

The sample size is transferred with up to 10 places: 8 digits, sign and decimal point.

The unit transferred with the sample size depends on the type of the balance.

For transfer of other sample specific data such as Id.#1, Id.#2 etc., an input device can be purchased from the balance manufacturer. The addresses for such devices are as follows:

| <u>Input device</u> | | <u>686 Titroprocessor</u> | |
|---------------------|------------|---------------------------|----------|
| Sartorius... | Mettler... | Silo memory | Register |
| 27 | D | method | - * |
| 26 | C | id.#1 | Id.#1 * |
| 24 | B | id.#2 | Id.#2 |
| 23 | A | c20 | - |

* Files for ASCII characters

Note:

If you wish to enter method identifications from a balance input device, select these identifications such that they can be entered with the characters of the input device! Check the characters which are actually sent from the balance to 686 Titroprocessor using diagnosis (see page 514).

4.3 Connection to an external data system

For data transfer the following interfaces are available:

3.540.2210 interface for RS 232 C

3.540.2200 interface for IEC (4.686.0080 rear panel)

The interface has to be prepared and inserted according to the installation instructions supplied with every interface.

Additionally, the following (instrument specific) settings have to be carried out:

3.540.2210 interface:

switch 12: off (→ internal)

switch 21: on

switch 22: off

3.540.2200 interface:

switch 11: off

switch 12: on

switch F2: any setting

switch F3: any setting

The interface is inserted in slot E of 686 Titroprocessor and connected to the external data system according to Fig. 4.4.

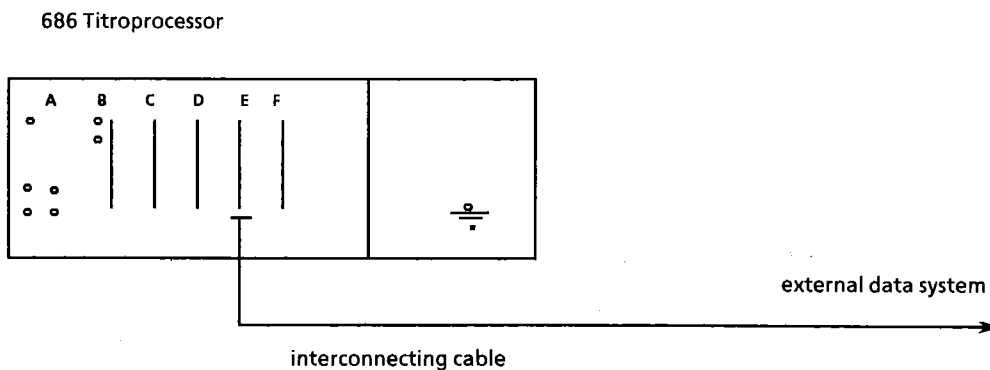


Fig. 4.4

Interconnecting cables:

Interconnection RS 232 C-DCE with 25-pin D subminiature plug,
for HP-85 calculator 3.980.2810

3.980.2810

Interconnecting cable IEC Bus - data system
(24-pin Amphenol plug): Available from specialized dealers

Operation

686 Titroprocessor may receive the following signals, sent from the controller:

| | |
|--------------------|--------------------------------------|
| \$RUN | GO from controller |
| \$INT | internal defined, see below |
| \$EXT | external defined, see below |
| \$END | end of data transfer |
| \$X; X = 1,2,3,4,7 | code number of data block to be sent |

Additionally, the 686 Titroprocessor may receive from a controller sample data:

| | |
|-----------------|---|
| method: | <D> <,> <u> <u> <identification> (<CR>)<LF> |
| id.#1 or Id.#1: | <C> <,> <u> <u> <identification> (<CR>)<LF> |
| id.#2 or Id.#2: | <,> <u> <u> <identification> (<CR>)<LF> |
| c20: | <A> <,> <number> (<CR>)<LF> |
| c00 or C00: | <u> <,> <number> <u> <unit> (<CR>)<LF> |

Possible units:

g is received as g
m is received as mg
P is received as Pcs

If no unit is sent, the "old" unit remains and the new value will be stored.

<u>:

space.

<,>:

may be replaced by any character.

<identification>:

8 characters.

Note:

All characters are only overwritten. Identification with less than 8 characters have to be completed with preceding <u>.

<number>:

10 characters, sign or <u>, up to 8 digits, decimal point.

<CR> <LF>:

may be replaced by <LF> only, according to the setting on the data transfer interface.

Note: Errors may occur if the above conditions are not exactly followed.

Sample data can be received from the Titroprocessor in the ready state as well as during a titration.

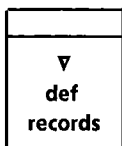
With "silo off", a "method" or "c20" sent via data transfer interface will be ignored. Other sample data are loaded directly into the register.

With "silo on", the instrument reacts according to the rules for data storing in silo memory, see page 333.

686 Titroprocessor sends the data blocks in the same format as used by the built-in printer (see section 3.2). The first data line denotes the source of information

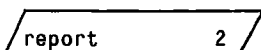
METROHM 686 TITRATOR

If data receiver is not ready to receive data from 686 Titroprocessor, the "send" mode of 686 Titroprocessor can be left pressing <STOP> several times.



- Automatic data print-out

Key <def records> has the following inquiry sequence if a data transfer interface is inserted:



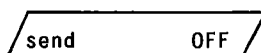
Indication of data blocks for automatic print-out at the end of the titration on the built-in printer.

Entry of code numbers (up to 8) with the following significations:

- 1 parameter report
- 2 result report with list of EP's
- 3 measuring point list (for GET and MET, the former are data points of the titration curve)
- 4 formulas and list of C values
- 5 titration curve (for GET and MET) with optimized scale (data points of the titration curve)
- 7 short result report without list of EP's

OFF no print-out on the built-in printer

see also section 3.2, page 341.

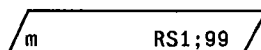


Indication of data blocks for automatic transfer at the end of titration to an external data system.

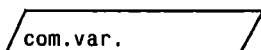
Code numbers and formats of data blocks are as above.

Titration curves cannot be sent, because of the individual plotting properties of every system.

OFF: no print-out on external data system.



Definitions for mean calculations, see page 325.

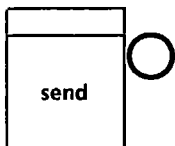


Definition for storing a common variable, see page 326.

Two different modes for automatic transfer of data blocks to an external data system are possible:

internal defined
external defined

- Internal defined:
Data blocks indicated in "send" are sent one after the other with the display of 686 Titroprocessor showing send internal X. (X is the code number of sent data block.)
- External defined
686 Titroprocessor asks at the end of titration for code numbers (with \$N) and sends (after receiving \$X) the corresponding data block until the data system sends "\$END".
Display of 686 Titroprocessor shows: send external X.
(X is the code number of sent data block.)
- Switching internal - external defined:
After switching on the instrument, "internal defined" is set automatically. The controller can change the setting with "\$EXT".



- Manual data transfer key <send>

Data can be sent to an external data system activating key <send>. Key <send> is only active, if data transfer is "internal defined". Key <send> offers the same possibilities as key <report> (see page 345), except that the titration curve (code 5) cannot be sent to an external data system.

4.4 Connection of recorder

3.540.2191 analogue output interface is available for the connection of 586 Labograph. The interface is inserted in slot B of 686 Titroprocessor and connected to the 586 Labograph as shown in Fig. 4.5. (The inquiry sequence in key "prep steps" is extended if 3.540.2191 interface is inserted, see page 402.)

The connection 686 Titroprocessor - 586 Labograph is established according to Fig. 4.5:

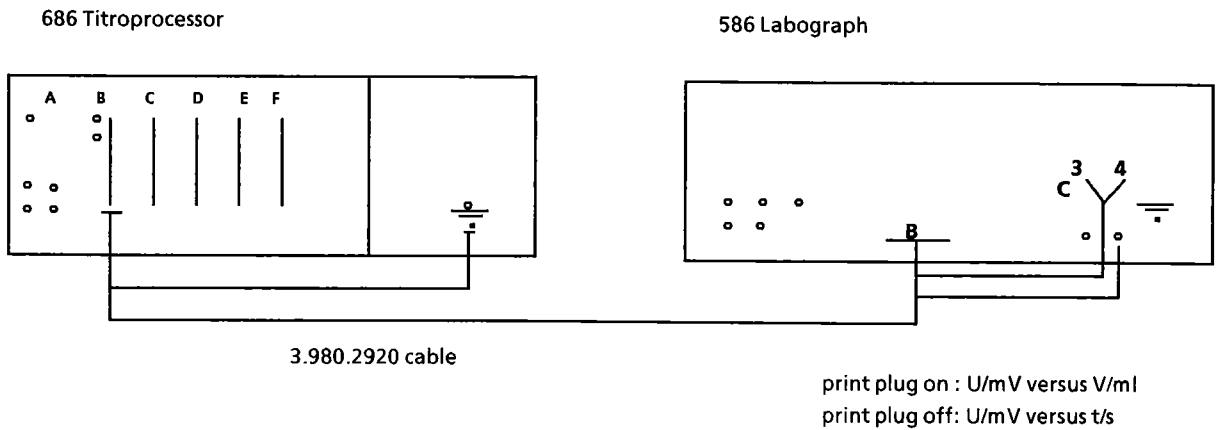


Fig. 4.5

If the interface plug of 3.980.2920 cable is plugged in in slot B of 586 Labograph, dosed volume (paper drive axis) versus measured value is recorded. The length per V_{burette} is given by the selected paper drive speed in mm. Paper drive speed has to be ≤ 200 mm/min.

With the interface plug not plugged in, the paper drive axis is a time axis, "measured value vs. time" is recorded.

Such graphs can be recorded with any recorder, using the banana plugs of the analogue output interface.

The measured value signal is transferred to the analogue output as follows:

| Measuring input | Analogue output |
|--------------------|-----------------|
| pH = 0.00 | -700 mV |
| pH = 7.00 | 0 mV |
| pH = 14.00 | + 700 mV |
| U = +X mV | + X mV |
| U = -X mV | - X mV |
| t = 0 °C | 0 mV |
| Δt = +1 °C | -20 mV |
| Δt = -1 °C | + 20 mV |

A further possibility for recording graphs is given with the analogue output of 665 Dosimat: Graphs of V/ml vs. t/s, e.g. for pH stat applications. The apparatus have to be connected according to Fig. 4.6.

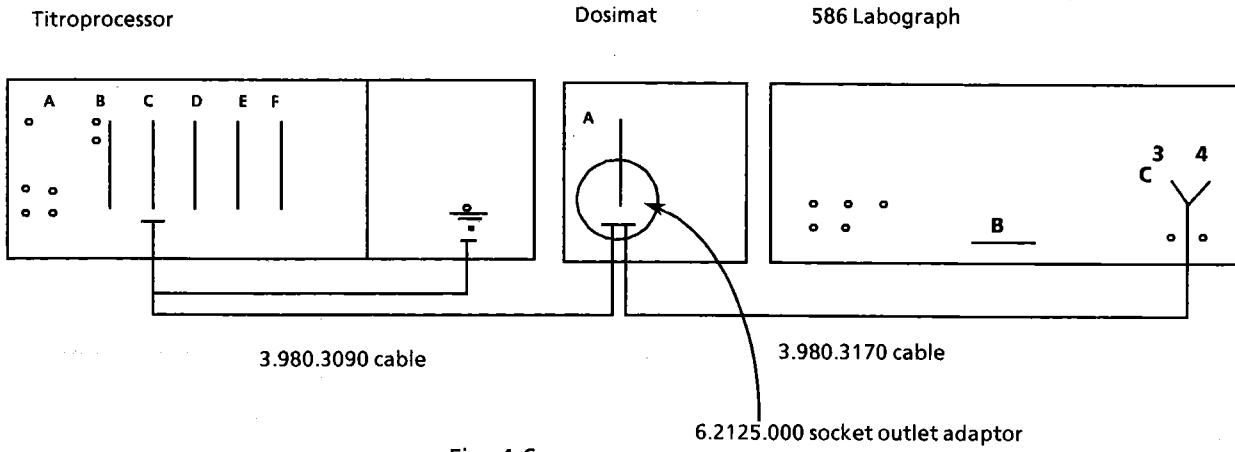


Fig. 4.6

5. Special messages, error messages, troubleshooting

If 8 digits are entered, the last digit may be erroneous.

5.1 Special messages, error messages in display

General error messages:

blinking value The value is not in the allowed input range (see list of entries, page 604).

Exit: entering of new value or <clear>.

Special cases:

- recall XXXXXXXX: User memory contains no method with the entered method identification.

- store XXXXXXXX: User memory contains already a method with the entered identification. This method may be overwritten by pressing <enter>.

- delete XXXXXXXX: User memory contains no method with the entered method identification.

- method XXXXXXXX: No such method is in the user memory.

?????

A value cannot be displayed in the format indicated. (Data may have been lost.)

Possible remedy: Switch off instrument and switch it on after a while. Or reset calibration data for measured quantity pH.

The following list of special messages and error messages, respectively, is alphabetical:

XXX btes missing The method cannot be stored in the user memory because XXX bytes are missing.

Exit: <QUIT> or <STOP>.

change buffer The voltage difference between first and second buffer solution is less than 6 mV.

Exit: <clear> (or <STOP> / <QUIT> → 1 point calibration).

check dosimat 1 Titrating Dosimat is not (properly connected, not switched on or exchange unit is not mounted (properly)).

Exit: Correct error (or <STOP>).

check dosimat 2 Auxiliary Dosimat is not (properly) connected, not switched on or exchange unit is not mounted (properly).
Exit: Correct error (or <STOP> and set "add V" to 0 ml).

check electrode Calibration:
After error message change buffer, the voltage difference is still less than 6 mV.
Exit: <STOP> or <QUIT>.

delete not acc. In key <user methods>, <enter> was pressed with display delete.
Exit: <clear>

E1 Check sum PROM IC 1 faulty
E2 Check sum PROM IC 2 faulty
E3 Check sum PROM IC 3 faulty
E4 Check sum PROM IC 4 faulty
E5 Check sum PROM IC 5 faulty
E6 Check sum PROM IC 6 faulty
E7 RAM test not OK
E8 Wrong program on .2210 (balance interface) selected
E9 PROM test on .2210 (balance interface) not OK
E10 PROM test on .2210 (RS 232) not OK
E11 Wrong program on 2210 (RS 232) selected → switches 23 + 24?

Exit:
Switch 686
Titroprocessor
off, correct
error and
switch on
again

E12 IEC-IF: NRFD and NDAC = H
Exit: <clear> and correct error.

E13 Data interface: too many signs received.
Exit: <clear> (string has not been accepted).

input overrange The measured value is out of the analogue input range (-2V... + 2V).
Exit: <STOP> .

method not acc. In key <smpl data>, <enter> has been pressed with "silo on" and method.
Exit: <clear> .

m not acc. In key <def records>, <enter> has been pressed with display m.
Exit: <clear> .

no analogue input 3.540.2430 analogue input interface is missing or defective.
Exit: Switch off instrument and correct error.

| | |
|-------------------|--|
| no DT interface | 3.540.2210 or 3.540.2200 data transfer interface is missing or defective. In the actual method, there are entries in key <def records> for "send". Exit: <STOP> and correct error or delete inquiry "send" with keys <2nd> <C-val><9><4> <clear> <enter> (If working with "silos on", the corrected method has to be restored in the user memory.) |
| no EP set | No EP is set for a SET method. Exit: <STOP> and set the endpoint. (If working with "silos on", the corrected method has to be restored in the user memory.) |
| no fmla const | There are no inquiries in key <fmla const> for CXX. Exit: <QUIT> or any allowed key for rolling inquiries. |
| no man. send | Key <send> has been pressed and data transfer is "external defined". Exit: <STOP> or <QUIT> . |
| no meth. | Key <GO> has been pressed with "silos on" without any method in silo line 1. Exit: <STOP>. |
| no meth. XXXXXXXX | The method asked from the silo memory is not in the user memory. Exit: <STOP> . |
| no printer IF | 3.650.0030 printer interface is missing or defective. Exit: Switch off instrument and correct error. |
| no SC interface | 3.540.2191 sample changer interface is missing or defective. In the actual method, there are entries in key <prep steps> for "output t1", "pause 1", "output 2" and/or "pause 2". Exit: <STOP> and correct error or delete inquiries "output t1" with keys <2nd><C-val><9><1><clear><enter> and "output t2" with keys <2nd><C-val><9><2><clear><enter> (If working with "silos on", the corrected method has to be restored in the user memory.) |
| offset overrange | The offset voltage is out of the allowed range of -2 V... + 2 V. Exit: <STOP>. |
| pH overrange | The measured pH value is out of the allowed range of the analogue input (-2 V... + 2 V). Exit: <STOP>. |

| | |
|-------------------|---|
| recall not acc. | In key <user methods>, <enter> has been pressed with display <u>recall</u> . Exit: <clear>. |
| sil0 empty | Silo memory is "on" but empty. Exit: <STOP> and fill silo memory or switch silo "off". |
| sil0 filled | Silo memory is filled. Exit: <QUIT>. |
| store not acc. | In key <user methods>, <enter> has been pressed with display <u>store</u> . Exit: <clear>. |
| system err. stack | Software error. Exit: Switch off instrument and switch it on after a while. |
| system err. silo | Software error with silo memory. The silo memory is deleted. Exit: <STOP> . |
| t.cal.m no Pt100 | Pt100 has been disconnected during measurement of calibration temperature. Exit: <STOP> or <QUIT>: |
| temp. no Pt100 | "Measurement of temperature" without Pt100. Exit: <MEAS> or <STOP> . |
| U overrange | The measured U value is out of the allowed range of the analogue input (-2 V... + 2 V). Exit: <STOP> |

5.2 Special messages, error messages in the print-out

General error messages:

????? A value cannot be printed in the format indicated (content of RAM may be destroyed).
Possible remedy: Switch off instrument and switch it on after a while. Or reset calibration data for measured quantity pH.

The following list of special messages and error messages, respectively, is alphabetical:

| | |
|--------------------------|--|
| arithmetic overflow | The digital range for calculation has been outranged. Remedy: Check CXX. |
| data error | For GET in report 3 and/or 5: Spikes in the measured data. |
| division by zero | Calculation could not be carried out. Remedy: Check and enter CXX. |
| dummy sample size! | Sample size C00 is 0 and is used in a calculation formula. Its value is automatically set to 1. Remedy: Enter C00. |
| #EP not corresponding | The number of EP's is not corresponding to the number of EP's from the formulas. Remedy: <ul style="list-style-type: none">- for GET and MET:<ul style="list-style-type: none">. change "EP crit.". optimize "titr. rate" and "anticip." for GET or "drift" and "vol.step" for MET. work with start criteria- check formulas |
| Fix-EP not corresponding | For GET and MET: A programmed formula has C5X without a definition for fixed endpoints. Remedy: Define fixed endpoint(s). |
| Fix-EP outside | A fixed endpoint lies outside the measuring range. |
| formula missing | An RSX is asked for mean calculations or for a common variable without formula FX. |
| invalid number | Calculation is not carried out because it is out of the digital range (content of RAM may be destroyed). Possible remedy: Switch off instrument and switch it on after a while. |

| | |
|----------------------|---|
| manual quit | Data output has been interrupted or stopped, resp., with <QUIT> or <STOP> , resp. |
| manual stop | Titration has been stopped manually with <STOP>. |
| meas pt. overflow | For GET and MET: Overflow of measuring point list (≥ 200 points). Possible remedy: Work with start criteria. |
| no EP1 | There was no EP1 in a SET titration. |
| no EP2 | There was no EP2 in a SET titration. |
| no new com.var. | The common variable could not be stored according to the indication in <def records> because the corresponding result or mean value could not be calculated. |
| no statistic data | Mean calculations are requested without values in the mean memory. |
| no titration data | For GET and MET: A titration curve is requested without titration data available. |
| stop #EP reached | For GET and MET: The automatic stop was due to "stop #EP". |
| stop volt. reached | For GET and MET: The automatic stop was due to "stop pH" or "stop U", respectively. |
| stop V reached | Titration stopped at the stop volume. |
| wrong sample | Either an already titrated sample has been used in a SET titration or the first measured value of your sample lies outside the range of EP1 and EP2 in a SET titration. |
| wrong titr.direction | The titration direction was wrong in a SET titration. Possible remedy: If the curve is strongly retrograde, a waiting time under key <prep steps> may help. |

5.3 Diagnosis instructions

Die vorliegende Diagnoseanleitung erlaubt dem Kunden die Kontrolle sämtlicher Arbeitsfunktionen des 686 Titroprocessors ohne spezielle Hilfsmittel und Prüfgeräte. Dies versetzt ihn in die Lage, Fehlerquellen am Gerät selbst zu orten, damit Störungen rascher zu beheben oder einfach den Kundenservice genauer zu informieren.

Vorgehen

- Die Diagnoseschritte sind der Reihe nach auszuführen und mit den Reaktionen des Titroprocessors (eingerückt) zu vergleichen. Im "Ja"-Fall ist mit der nächsten Anweisung weiterzufahren.
- Zeigt das Gerät nicht die erwartete Reaktion ("Nein"-Fall), so empfiehlt sich vorerst eine Wiederholung des Diagnoseschrittes, da auch ein Bedienungsfehler vorliegen könnte. Mehrmalige Falschreaktionen deuten jedoch mit grosser Wahrscheinlichkeit auf eine Störung hin.
- Die mit einem Dreieck (\triangle) bezeichneten Diagnoseschritte erlauben bei Wiederholungen einen Wiedereinstieg in den Testablauf unter folgender Voraussetzung:

Anzeige: Diagn. key \emptyset ...9 (blinkt)

Wenn nicht: Taste "clear" drücken und warten oder das Netz AUS und nach einigen Sekunden wieder EIN schalten. Dabei muss innerhalb 2,5 s nach Netz EIN die Taste "0" gedrückt werden.

- Nach zweimaligem Drücken der Taste "clear" springt das Gerät ins Geräteprogramm zurück. Für den Wiedereinstieg in die Diagnose siehe vorgängigen Punkt.

Regenerieren der Anzeige

Eine einseitige Beanspruchung der Anzeige kann die Ursache für unterschiedliche Helligkeit der Leuchtpunkte sein. Die Diagnose ermöglicht deshalb ein Regenerieren der Anzeige. Dazu wird die "Diagnose Drucker, Anzeige" (Schritt 4.2) benutzt und deren letzter Teil solange laufen gelassen, bis sich ein befriedigendes Resultat einstellt.

Benötigte Geräte

1 (evtl. 2) Dosimat 665

1 Dosimatverbindungskabel:
3.980.3090 für 1 Dosimaten 665 oder
3.980.3100 für 2 Dosimaten
(kann auch für den Anschluss von nur 1 Dosimaten verwendet werden)

DVM oder Linienschreiber
(nur wenn Analoginterface eingesetzt)

- | | |
|---|--|
| 1 Eichspannungsgeber, z. B. pH-Simulator 642 | } nicht unbedingt erforderlich, siehe Punkt 6.3 bzw. 6.6 |
| 1 Präzisionswiderstandsdekade | |
| 1 Pt 100-Simulator | |
| 1 Prüfkabel 3.496.5070 | |
| 1 " 6.2108.060* | |

* Zubehör von 642

These diagnoses instructions allow the user to check all the 686 Titroprocessor's functions without requiring any specialized auxiliary or test equipment. It is thus possible to localize instrument malfunctions and to give precise informations to the Service Agent.

Procedure

- Carry out the test steps one after the other and check whether the Titroprocessor responds as described by the indented sections of the text. If this is the case, carry out the next step.
- If the instrument does not respond as expected repeat the corresponding diagnosis step to check whether it has been carried out correctly. If the instrument's response differs repeatedly from what it should be the instrument is likely to be defective.
- The diagnosis steps denoted by a triangle (\triangle) can be used as re-entry points for repetitions provided the display shows:

Diagn. key \emptyset ...9 (flashing).

If the above message is not in the display, press "clear" key and wait or switch off and, after a few seconds, on again, pressing "0" within 2.5 s after switching on.

- If "clear" is pressed twice, the instrument is switched back to the Titroprocessor programme. To re-assume diagnosis, proceed as described above.

Regeneration of display

Under certain conditions the matrix points of the display may show differences in brightness. To regenerate the display, apply "Printer and display diagnosis" (step 4.2) and leave running until the result is satisfactory.

Instruments required

1 (or 2) 665 Dosimat(s)

1 Connecting cable for 665 Dosimat(s):
3.980.3090 for one Dosimat or,
3.980.3100 for two Dosimats
(can also be used to connect one Dosimat)

DVM or Yt recorder
(if analogue interface fitted, only)

- | | |
|--|--|
| 1 Calibrating voltage generator e.g. pH Simulator 642 | } not mandatory! see item 6.3 or 6.6 resp. |
| 1 Precision resistor switch-box | |
| 1 Pt 100 Simulator | |
| 1 Test cable 3.496.5070 | |
| 1 " 6.2108.060* | |

* accessory of 642

Für die Diagnose können die zuschaltbaren Einheiten wie Dosimat, Dateninterface und Rechner angeschlossen bleiben.

To carry out the diagnosis the plug-in units like Dosimat, data interface and calculator may remain connected.

Im Störfall jedoch sind diese vom Gerät zu trennen und sukzessive wieder anzuschließen.

In case of trouble, however, separate them from the instrument and successively connect again.

1. Programmnummer anzeigen

1. Displaying the programme number

1.1 Netz EIN und innerhalb 2,5 s Taste "7" drücken

1.1 Switch on and press "7" within 2.5 s

Anzeige: Alle Punkte leuchten.
Alle LEDs auf Tastatur "EIN"
Anzeige ändert auf: P686 XXX*

Display: All matrix points alight
All keyboard LEDs on
Display changes to: P686 XXX*

* Programmnummer der Software: Für allfällige Rückfragen beim Service notieren!

* Software programme number: Please indicate this number when making service inquiries!

(Nach "Netz EIN" läuft automatisch ein Checksummentest (für PROM) sowie ein zerstörungsfreier RAM-Test ab!)

(After the instrument has been switched on, a check sum test of the PROM as well as a non-destructive RAM test are carried out automatically!)

2. Diagnoseprogramm

2. Diagnosis programme

2.1 Taste "clear" betätigen und innerhalb 2,5 s Taste "0" drücken

2.1 Press "clear" key and, within 2.5 s, the "0" key

Anzeige: Alle Punkte leuchten
Alle LEDs auf Tastatur "EIN"
Anzeige ändert auf:
Diagn. key 0...9 (blinkt)

Display: All matrix points alight
All keyboard LEDs on
Display changes to:
Diagn. key 0...9 (flashing)

▷ 3. Diagnose Tastatur

▷ 3. Keyboard diagnosis

3.1 Taste "0" drücken

3.1 Press "0"

Anzeige: Diagn. key 0

Display: Diagn. key 0

3.2 Taste "enter" drücken

3.2 Press "enter" key

Anzeige: Matrix code

Display: Matrix code

3.3 Alle Tasten in beliebiger Reihenfolge drücken und mit dem Matrixcode (XX) für das Tastenfeld vergleichen!

3.3 Press all the keys in arbitrary sequence and compare resulting display with the keyboards matrix code:

| | | | | | | | | | | | | | | | |
|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| 00 | 01 | 02 | 03 | 04 | 05 | 06 | 07 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 |
| 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 60 | 61 | 62 | 63 | 64 | 65 | 66 | 67 |
| 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 |

Achtung: Im Tastenfeld sind alle möglichen Tastenpositionen aufgeführt.

Please note: The above matrix code comprises all possible key positions.

Anzeige: Matrix code XX

Display: Matrix code XX

3.4 Austritt aus "Diagnose Tastatur": Taste "clear" zweimal betätigen und warten

3.4 Leave keyboard diagnosis by pressing "clear" key twice and wait

Anzeige: Diagn. key 0...9 (blinkt)

Display: Diagn. key 0...9 (flashing)

▷ 4. Diagnose Drucker, Anzeige

4.1 Taste "1" drücken
Anzeige: Diagn. key 1

4.2 Taste "enter" drücken
Anzeige: Diagn. Printer

Der gesamte Zeichenvorrat wird ausgedruckt (abwechselnd links- und rechtsbündig):

```
!"#$%&'()*+,-./
0123456789:;<=>?
@ABCDEFGHIJKLMNO
PQRSTUVWXYZ[\]^_
`abcdefshijklmno
parstuvwxyz{|}~*
¡¢£¤¥¦§¨ª«
```

Anschliessend wird der ganze Zeichenvorrat als Laufschrift angezeigt (siehe: Ausdruck Printer) Anzeige inkl. Sonderzeichen! Die LEDs auf der Tastatur leuchten abwechselnd für ca. 400 ms. Nach 5 Umgängen leuchten alle Punkte der Anzeige, und ein "Space" wandert von rechts nach links.

4.3 Durch Drücken der Taste "5" kann in beiden Anzeigetests die Bewegung der Anzeige angehalten und wieder gestartet werden. Drücken der Taste "5" löst ein "Beep"--Signal aus.

4.4 Austritt aus "Diagnose Drucker, Anzeige": Taste "clear" drücken und warten
Anzeige: Diagn. key Ø...9 (blinkt)

▷ 5. Diagnose Analogausgang (nur wenn eingebaut, sonst weiter mit Schritt 6)

DVM oder Linienschreiber an Analogausgang anschliessen

5.1 Taste "5" drücken
Anzeige: Diagn. key 5

5.2 Taste "enter" drücken
Anzeige: An.out.key 1...2 (blinkt)

5.3 Taste "1" drücken
Anzeige: An.out.key 1

5.4 Taste "enter" drücken
Anzeige: An.out. 0000mV
DVM oder Linienschreiber zeigt 0 mV (Toleranz: ±0.5 mV)

5.4.1 Taste "clear" drücken
Anzeige: An.out. 1000mV
DVM oder Linienschreiber zeigt 1000 mV (Toleranz: ±1 mV)

5.4.2 Taste "clear" drücken
Anzeige: An.out. 2000mV
DVM oder Linienschreiber zeigt 2000 mV (Toleranz: ±1 mV)

▷ 4. Printer and display diagnosis

4.1 Press "1"
Display: Diagn. key 1

4.2 Press "enter"
Display: Diagn. Printer

The whole set of symbols available is printed out, alternatingly adjusted to the left or right margins:

After the printer has stopped, the whole set of symbols (including special symbols, see printer output) is shown as a moving display. The keyboard LEDs go on sporadically one after the other for approximately 400 ms. After five turns of the symbols, all points of the display come alight and a space moves from right to left.

4.3 By pressing "5" the moving display can be stopped and restarted during the two above display tests. Pressing "5" also triggers the KF Processor's buzzer signal.

4.4 Leave printer and display diagnosis by pressing key "clear" and wait
Display: Diagn. key Ø...9 (flashing)

▷ 5. Diagnosis of analogue output (only if fitted, otherwise go on with item 6)

Connect DVM or xy-recorder to the analogue output

5.1 Press key "5"
Display: Diagn. key 5

5.2 Press "enter"
Display: An.out.key 1...2 (flashing)

5.3 Press key "1"
Display: An.out.key 1

5.4 Press "enter"
Display: An.out. 0000mV
DVM or xy-recorder reads 0 mV (Tolerance: ±0.5 mV)

5.4.1 Press "clear"
Display: An.out. 1000mV
DVM or xy-recorder reads 1000 mV (Tolerance: ±1 mV)

5.4.2 Press "clear"
Display: An.out. 2000mV
DVM or xy-recorder reads 2000 mV (Tolerance: ±1 mV)

5.4.3 Taste "clear" drücken
Anzeige: An.out.key 1...2 (blinkt)

5.5 Taste "2" drücken
Anzeige: An.out.key 2

5.6 Taste "enter" drücken
Anzeige: An.out. ramp
DVM zeigt eine wechselnde Anzeige von +2 - -2 V
Linienschreiber schreibt entsprechende Rampe
Anzeige wechselt anschliessend auf: An.out.key 1...2 (blinkt)

5.7 Taste "clear" drücken
Anzeige: Diagn. key 0...9 (blinkt)

6. Diagnose Analogeingang

6.1 Taste "6" drücken
Anzeige: Diagn. key 6

6.2 Taste "enter" drücken
Anzeige: An.inp.key 1...6* (blinkt)

6.2.1 Taste "1" drücken
Anzeige: An.inp.key 1

6.2.2 Taste "enter" drücken
Anzeige: Offset 0000.0mV (Tol. 13 mV)
Offsetwert notieren oder sich merken.

6.2.3 Taste "clear" drücken
Anzeige: An.inp.key 1...6 (blinkt)

6.3 Messeingänge I und II prüfen
Messeingang I (4) mit in Puffer getauchter Elektrode oder über Kabel 6.2108.060 mit pH-Simulator verbinden.

6.3.1 Taste "2" drücken
Anzeige: An.inp.key 2

6.3.2 Taste "enter" drücken
Anzeige: Input1 XXXX.XmV
(angelegte Spannung + Offset gemäss 6.2.2, Toleranz: ± 0.5 mV)
Simulator auf 1000 MOhm: Spannung muss innerhalb der Toleranz bleiben. *

* Diesen Test unbedingt nur mit hochohmigem Kabel, z. B. 6.2108.060, durchführen. Ueber den Adapter 6.2104.000 (im Zubehör zum 682) können auch die Kabel 6.2105.020 und .030 verwendet werden.

5.4.3 Press "clear"
Display: An.out.key 1...2 (flashing)

5.5 Press key "2"
Display: an.out.key 2

5.6 Press "enter"
Display: An.out. ramp
DVM reading alters stepwise from +2 V to -2 V
xy-recorder traces a ramp
Then display changes to: An.out.key 1...2 (flashing)

5.7 Press "enter"
Display: Diagn. key 0...9 (flashing)

6. Diagnosis of analogue input

6.1 Press key "6"
Display: Diagn. key 6

6.2 Press "enter"
Display: An.inp.key 1...6* (flashing)

6.2.1 Press key "1"
Display: An.inp.key 1

6.2.2 Press "enter"
Display: Offset 0000.0mV (Tol. 13 mV)
Bear in mind or note down offset value.

6.2.3 Press "clear"
Display: An.inp.key 1...6 (flashing)

6.3 To check measuring inputs I and II
Connect electrode to measuring input I (4) and immerse it into a buffer or, use pH-simulator with cable 6.2108.060.

6.3.1 Press key "2"
Display: An.inp.key 2

6.3.2 Press "enter"
Display: Input1 XXXX.XmV
(voltage applied + offset, acc. to 6.2.2, tolerance: ± 0.5 mV)
Simulator to 1000 Mohm: voltage must remain within tolerance. *

* Carry out this test with the high insulated cable only, e.g. 6.2108.060. Via the adapter 6.2104.000 (in the accessory of 682) also the cables 6.2105.020 and .030 can be used.

- | | |
|---|---|
| <p>6.3.3 Taste "clear" drücken Anzeige: An.inp.key 1...6 (blinkt)</p> <p>6.4 Messeingang II (6) mit Elektrode oder pH-Simulator verbinden</p> <p>6.4.1 Taste "3" drücken Anzeige: An.inp.key 3</p> <p>6.4.2 Taste "enter" drücken Anzeige: Input2 XXXX.XmV (angelegte Spannung + Offset mit umgekehrter Polarität, Toleranz: ± 0.5 mV)</p> <p>6.4.3 Taste "clear" drücken Anzeige: An.inp.key 1...6 (blinkt)</p> <p>6.5 Beide Messeingänge (4) + (6) mit je 1 Spannungsgeber (in Puffer getauchte Elektrode oder Simulator) verbinden. (Weitere Möglichkeit: Einen der beiden Eingänge kurzschliessen*).</p> <p>6.5.1 Taste "4" drücken Anzeige: An.inp.key 4</p> <p>6.5.2 Taste "enter" drücken Anzeige: In1-In2 XXXX mV (Differenz der angelegten Spannung, Anzeigeformat ist 3 1/2 stellig d. h. Wert max. 1999)</p> <p>6.5.3 Taste "clear" drücken Anzeige: An.inp.key 1...6 (blinkt)</p> <p>6.6 Diagnose des Pt 100-Einganges Pt 100-Temperaturfühler, Pt 100-Simulator oder Präzisionswiderstandsdekade an den Pt 100-Eingängen (7) + (8) anschliessen.</p> <p>6.6.1 Taste "5" drücken Anzeige: An.inp.key 5</p> <p>6.6.2 Taste "enter" drücken Anzeige: Temp. -XXXX.XmV (entsprechend dem eingestellten Widerstandswert x 5)</p> | <p>6.3.3 Press "clear" Display: An.inp.key 1...6 (flashing)</p> <p>6.4 Connect electrode or pH-simulator to measuring input II (6)</p> <p>6.4.1 Press key "3" Display: An.inp.key 3</p> <p>6.4.2 Press "enter" Display: Input2 XXXX.XmV (voltage applied + offset, with reversed polarity, tolerance: ± 0.5 mV)</p> <p>6.4.3 Press "clear" Display: An.inp.key 1...6 (flashing)</p> <p>6.5 Connect two voltage generators to each measuring input (4) + (6) (Use electrode(s) immersed into buffer or simulator(s)). (Further possibility: short-circuit one of the two inputs*.)</p> <p>6.5.1 Press key "4" Display: An.inp.key 4</p> <p>6.5.2 Press "enter" Display: In1-In2 XXXX mV (difference of the applied voltages, 3 1/2 digit display i.e. max. value 1999)</p> <p>6.5.3 Press "clear" Display: An.inp.key 1...6 (flashing)</p> <p>6.6 Diagnosis of Pt 100-input Connect Pt 100-temperature sensor, Pt 100-simulator or precision resistor switch-box to Pt 100-inputs (7) + (8).</p> <p>6.6.1 Press key "5" Display: An.inp.key 5</p> <p>6.6.2 Press "enter" Display: Temp. -XXXX.XmV (corresponding to selected resistance value x 5)</p> |
|---|---|

| Pt 100 Einstellung/setting | Widerstandswert/resistance | Anzeige/display |
|----------------------------|----------------------------|-----------------|
| 0° | 100.0 Ohm | -0500.0 mV |
| 20° | 107.79 Ohm | -0538.9 mV |
| 40° | 115.53 Ohm | -0577.6 mV |
| 60° | 123.23 Ohm | -0616.1 mV |
| 80° | 130.89 Ohm | -0654.4 mV |
| 100° | 138.50 Ohm | -0692.5 mV |

- | | |
|---|---|
| <p>6.6.3 Taste "clear" drücken Anzeige: An.inp.key 1...6 (blinkt)</p> | <p>6.6.3 Press "clear" Display: An.inp.key 1...6 (flashing)</p> |
|---|---|

* z. B. mit Prüfkabel 3.496.5070

* e.g. with test cable 3.496.5070

6.6.4 *Achtung: In diesem Gerät ist keine Hardware für KF eingebaut. Die Position 6 von 'An. inp. 1..6' ist daher nicht verwendet.*

6.6.4 *Please mind: No hardware for KF is built-in in this instrument. The position 6 of 'An. inp. 1..6' is therefore not used.*

Taste "clear" betätigen

Press "clear"

Anzeige: Diagn. key \emptyset ...9

Display: Diagn. \emptyset ...9



7. Diagnose Ein-/Ausgang-Interface



7. Diagnosis of input/output interface

7.1 Dosimat 1 und evtl. Dosimat 2 über Standardkabel (3.980.3090 bzw. 3.980.3100) anschliessen.
Dosimat betriebsbereit machen.

7.1 Connect Dosimat 1 and Dosimat 2 (if available) via standard cable (3.980.3090 or 3.980.3100).
Get dosimat ready for use.

7.2 Taste "8" drücken

7.2 Press "8"

Anzeige: Diagn. key 8

Display: Diagn. key 8

7.3 Taste "enter" drücken

7.3 Press "enter"

Anzeige: Dosimat (1/2)? (blinkt)

Display: Dosimat (1/2)? (flashing)

7.4 Taste "1" (für Dosimat 1) oder Taste "2" (für Dosimat 2) drücken

7.4 Press "1" (for Dosimat 1) or "2" (for Dosimat 2)

Anzeige: Dosimat 1 oder Dosimat 2

Display: Dosimat 1 or Dosimat 2

7.5 Taste "enter" drücken

7.5 Press "enter"

Anzeige: Exch. Unit X ml
X entspricht der aufgesetzten Wechseleinheit

Display: Exch. Unit X ml
X depending on exchange unit fitted

Fehleranzeige:

- "no Dosimat", wenn gewählter Dosimat nicht angeschlossen oder nicht eingeschaltet
- "no Exch. Unit", wenn Wechseleinheit nicht aufgesetzt

Error indication:

- "no Dosimat" if selected dosimat not connected or not switched on
- "no Exch. Unit" if exchange unit not fitted

7.6 Taste "clear" drücken und warten

7.6 Press "clear" and wait

Anzeige: Dosimat (1/2)? (blinkt)

Display: Dosimat (1/2)? (flashing)

7.7 Wenn vorhanden, zweiten Dosimaten anwählen und prüfen (7.4), wenn nicht vorhanden, weiter bei 7.8.

7.7 If available, select and check second 665 Dosimat (7.4), if not available go on with 7.8.

7.8 Taste "clear" drücken und warten

7.8 Press "clear" and wait

Anzeige: Diagn. key \emptyset ...9 (blinkt)

Display: Diagn. key \emptyset ...9 (flashing)



8. Diagnose "Batterie"



8. Battery diagnosis

8.1 Taste "9" drücken

8.1 Press "9"

Anzeige: Diagn. key 9

Display: Diagn. key 9

8.2 Taste "enter" drücken

8.2 Press "enter"

Anzeige: bat. ready for t

Display: bat. ready for t

8.3 Netz "AUS" und ca. 5 s warten, dann

8.3 Switch off and wait for appr. 5 s, then

8.4 Netz "EIN" und innerhalb 2,5 s Taste "9" (Batterietest) drücken

8.4 Switch on and press "9" (battery test) within 2.5 s

Anzeige: Alle Punkte leuchten

Display: all matrix points alight

Anzeige: bat. test ok

Display: bat. test ok

- | | |
|--|--|
| <p>8.5 Taste "clear" drücken und innerhalb 2,5 s Taste "0" drücken</p> <p>Anzeige: Alle Punkte leuchten Alle LEDs auf Tastatur "EIN" Anzeige ändert auf: Diagn. key 0...9 (blinkt)</p> | <p>8.5 Press "clear" and, within 2.5 s, the "0" key</p> <p>Display: All matrix points alight All LEDs on keyboard on Display changes to: Diagn. key 0...9 (flashing)</p> |
|--|--|

- | | |
|---|---|
| <p>9. Diagnose Datenschnittstelle (nur wenn eingebaut, sonst weiter bei Schritt 10)</p> <p>Die "Diagnose Datenschnittstelle" erlaubt das Ueberprüfen des Interfaces für die Datenübertragung (3.540.2200 oder ..2210 an Platz E).</p> | <p>9. Diagnosis of data interface (if no interface is installed, continue with step 10)</p> <p>This diagnosis allows to check the installed interface for data transfer (3.540.2200 or ..2210 at location E).</p> |
|---|---|

- | | |
|--|--|
| <p>9.1 Diagnose "Senden"</p> <p>Voraussetzung: Empfänger bereit zum Empfang von Daten!</p> <p>Beispiel für Listing von HP 85</p> | <p>9.1 Diagnosis "send"</p> <p>Condition: Receivers ready to accept data!</p> <p>Listing example for HP 85</p> |
|--|--|

```

686 → HP 85

10 STATUS 8,2 ; S
20 IF BIT(S,5)=1 THEN GOTO 40
30 GOTO 10
40 S=SPOLL(801)
50 IF BIT(S,6) <> 1 THEN GOTO 20
60 ENTER 801 ; C#
70 SEND 8 ; UNT
80 RESUME 8
90 DISP C#
100 GOTO 10
110 END
    
```

Select Code für/
for Interface
HP 82 939 A

Geräteadresse 686
device address 686
(3.540.2200)

- | | |
|---|--|
| <p>9.1.1 Taste "3" drücken</p> <p>Anzeige: Diagn. key 3</p> | <p>9.1.1 Press "3"</p> <p>Display: Diagn. key 3</p> |
| <p>9.1.2 Taste "enter" drücken</p> <p>Anzeige: Data-IF, send</p> | <p>9.1.2 Press "enter"</p> <p>Display: Data-IF, send</p> |
| <p>9.1.3 Beliebige Zifferntaste betätigen</p> <p>Anzeige: Data-IF, send ok Empfänger zeigt an oder druckt: TEST DATA-IF</p> | <p>9.1.3 Press any figure key</p> <p>Display: Data-IF, send ok Receiver displays or prints: TEST DATA-IF</p> |
| <p>9.1.4 Schritt 9.1.4 kann beliebig oft wiederholt werden.</p> | <p>9.1.4 Step 9.1.4 can be repeated as often as desired</p> |
| <p>9.2 Taste "clear" drücken</p> <p>Anzeige: Diagn. key 0...9 (blinkt)</p> | <p>9.2 Press "clear"</p> <p>Display: Diagn. key 0...9 (flashing)</p> |
| <p>9.3 Diagnose Empfangen</p> <p>Voraussetzung: Sender bereit zum Senden von Daten!</p> | <p>9.3 Receiving diagnosis</p> <p>Requirement: transmitter ready for data transmission</p> |

HP 85 → 686

```

30 DIM B$(100)
40 DISP "TEXT="
50 INPUT B$
60 OUTPUT 801 USING "K" ; B$
70 GOTO 40
80 END

```

Select Code für/ Geräteadresse 686
for Interface device address 686
HP 82 939 A (3.540.2200)

- | | |
|---|--|
| <p>9.3.1 Taste "4" drücken Anzeige: Diagn. key 4</p> <p>9.3.2 Taste "enter" drücken Anzeige: Data-IF; receive</p> <p>9.3.3 Am Datensender (z. B. HP 85) beliebigen Text mit max. 24 Zeichen (incl. Begrenzungszeichen) eintippen. Der übertragene Text erscheint in der Anzeige des 686.</p> <p>9.4 Taste "clear" drücken Anzeige: Diagn. key 0...9 (blinkt)</p> <p>▷ 10. Diagnose Waagenanschluss (nur wenn eingebaut, sonst weiter mit Schritt 10.2) <i>Dieser Diagnoseschritt erlaubt das Überprüfen des Interfaces für den Waagenanschluss (GS 3.540.2210 auf Plats D)</i></p> <p>10.1 Taste "2" drücken Anzeige: Diagn. key 2</p> <p>10.1.1 Taste "enter" drücken Anzeige: Diagn. balance</p> <p>10.1.2 Uebernahmetaste (Waage) betätigen 686 Titroprocessor "beep" Wägeresultat wird in die Anzeige übernommen</p> <p>10.1.3 Taste "clear" drücken Anzeige: Diagn. key 0...9 (blinkt)</p> <p>10.2 Taste "clear" drücken Anzeige: Gerätegrundzustand (Methode, die zuletzt im Arbeitsspeicher war) Sämtliche Testverbindungen entfernen</p> | <p>9.3.1 Press "4" Display: Diagn. key 4</p> <p>9.3.2 Press "enter" Display: Data-IF; receive</p> <p>9.3.3 On data transmitter (e.g. HP 85) key in any arbitrary text with max. 24 characters (incl. delimiter). The transmitted text appears on the 686 display.</p> <p>9.4 Press "clear" Display: Diagn. key 0...9 (flashing)</p> <p>▷ 10. Diagnosis of balance interface (if no interface is installed, continue with step 10.2) <i>This diagnosis step allows to check the installed interface for balance connection (board 3.540.2210 at location D)</i></p> <p>10.1 Press "2" Display: Diagn. key 2</p> <p>10.1.1 Press "enter" Display: Diagn. balance</p> <p>10.1.2 Actuate transfer button (balance) 686 Titroprocessor "beep" Sample weight is transferred into the display</p> <p>10.1.3 Press "clear" Display: Diagn. key 0...9 (flashing)</p> <p>10.2 Press "clear" Display: basic state of instrument (method that has been in the working memory before) Remove all facility connections</p> |
|---|--|

TESTENDE

END OF TEST

11. RAM-Test

Falls die Diagnose Batterie (Punkt 8) negativ verläuft oder der Verdacht besteht, dass das Gerät gespeicherte Daten verliert, so kann zusätzlich der Galpat RAM-Test durchgeführt werden. Es ist aber zu beachten, dass in diesem Fall die gespeicherten Methoden im User Memory gelöscht werden!

Netz aus

Gerät öffnen:

Netzkabel an der Rückwand herausziehen.

An der Rückwand 2 Schrauben M4 herausdrehen.

Netzschalter eindrücken und gleichzeitig das Deckblech vorsichtig nach vorne abkippen und abheben*.

Schalter S 1/1 (auf Anzeigeschaltung 3.650.0050 links oben) auf on

11. RAM test

If the battery diagnosis (item 8) is negative or if there is reason to suspect that the instrument loses stored data, the Galpat RAM-test can be carried out as additional test. However, take note that this test deletes all methods stored in the User Memory!

Power off

Open instrument:

Withdraw power connector from rear panel.

Remove 2 screws M4 at the rear panel.

Depress mains switch and simultaneously hinge the cover plate forward and lift off carefully*.

Set switch S 1/1 (on display board 3.650.0050 at the left hand-side above) to ON

normal

| | | | | |
|-----|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| ON | | | x | |
| OFF | x | x | | |

beliebig any

*galpat
RAM Test*

| | | | | |
|-----|---|---|---|---|
| | 1 | 2 | 3 | 4 |
| ON | x | | x | |
| OFF | | x | | |

beliebig any

Netz ein

Auf der Anzeige erscheint zuerst der Anzeigetest (Punktemuster) und anschließend das Datum (Monat, Tag) und die Zeit (h, min, s). Alle LEDs auf der Frontplatte sind eingeschaltet: der RAM-Test läuft (Dauer ca. 46 min). Bei positivem Verlauf werden anschließend alle LEDs gelöscht. Erscheint eine Fehleranzeige 'GTE # mit Adresse' (wird zudem jede Minute mit 'beep signalisiert'), so muss der Metrohmservice angefordert werden.

Vorgehen zur Rückkehr zum normalen Programm, s. 12.

Power on

The display test (dotted pattern) is displayed first, followed by the date (month, day) and time (h, min, s). All LED's on the front panel are alight, signalling that the RAM test is in process (duration about 46 min). In case of an error message "GTE # with address", which is signalled additionally every minute by an audible "beep", call for the Metrohm service.

Procedure to return to the normal program, see 12.

12. RAM-Initialisierung

In bestimmten Fällen (z. B. beim Austausch des Programms, nach dem RAM-Test oder bei Störimpulsen) kann es passieren, dass das Programm bei 'Netz ein' nicht richtig initialisiert wird. In diesen

12. RAM initializing

It may happen in certain cases that the program is not initialized correctly after "power on" (e.g. when changing the program, after performing the RAM test or because of interferences). In such a case

* Sollte bei (unsachgemäßem) Abheben des Deckbleches die Plexiglasplatte an der Netzschalter-Drucktaste abspringen, so können die beiden evtl. herausgefallenen schwarzen Blendenteile in der Senkrechtlage (Gerät auf die Rückwand legen) wieder eingesetzt und die Kappe aufgesteckt werden.

* If the cover plate is removed without due care and the perspex cap on the mains power pushbutton jumps off, the two black partitions, should they drop out, can be replaced vertically by laying the instrument on its back and then snapping the cap in place.

Fällen soll daher das RAM wie folgt initialisiert werden:

(Schalter S 1/1 auf on, siehe Tabellen unter 11.)

Netz aus- und (nach ca. 5 s) wieder einschalten.

Abwarten, bis Uhr wieder in der Anzeige erscheint.

Netz aus

Schalter S 1/1 aus (s. oben)

Bei Wiedereinschalten erscheint das normale Programm mit 'GET pH XXXXXXXX'

Programm im User Memory sowie Datum und Zeit wieder eingeben.

the RAM can be initialized as follows:

(Switch S 1/1 to ON; see tables in item 11.)

Power off and (after about 5 s) on again.

Wait until the clock is displayed again.

Power off

Switch S 1/1 to "off" (see above)

Power on
The normal program is displayed again (GET pH XXXXXXXX)

Enter program in user memory and also date and time again.

6. Appendix

6.1 Technical data

| | |
|--------------------------------------|--|
| Measuring range | |
| pH value | pH = 0.00...14.00 (pX = -20.00... + 20.00) |
| voltage | U = -2000...0... + 2000 mV |
| temperature | temp = -20.0...0... + 200.0 °C |
| Measuring error | |
| pH value, voltage | |
| absolute | ± 10 ⁻⁴ |
| as a function of ambient temperature | typ. 20 µV/K |
| Temperature | |
| absolute | ≤ 0,1 °C |
| as a function of ambient temperature | typ. 0,002 °C/K |
| Amplifier | |
| input resistance | app. 10 ¹³ Ω |
| offset current | app. 3 x 10 ⁻¹³ A |
| offset voltage drift | |
| as a function of ambient temperature | typ. 20 µV/K |
| as a function of time | 0 µV |
| | <u>Note:</u> |
| | Every time the keys <STOP> and <HOLD> are actuated, any offset voltage drift is automatically taken into account. |
| Serial rejection 50 Hz | 89 dB |
| Common mode rejection 50 Hz | 115 dB |
| Input I parallel Input II | 90 dB |
| Data memory | non-volatile |
| Display | vacuum fluorescence display, 16 characters 5 x 7 point matrix |
| Printer | thermal printer, 24 characters per line, 5 x 7 point matrix |
| Power supply | |
| voltage | U = 100, 120, 220, 240 V ± 10 % (changeable) |
| frequency | f = 50...60 Hz |
| consumption | S app. 50 VA (with printer running) |
| fuses | safety fuses Ø 5 mm, 20 mm long for 100, 120 V: 1.6 A (slow) for 220, 240 V: 0.8 A (slow) thermal fuse if this fuse responds, please ask for METROHM Service |

Safety specifications

construction in accordance with safety specifications of IEC Publication 348

**Dimensions
w x h x d**

365 mm x 147 mm x 455 mm

Weight

app. 8.3 kg

6.2 Guarantee

Under the METROHM guarantee, all faults which can be proved to be due to material, constructions or manufacturing defects occurring within 12 months of the day of delivery will be repaired free of charge in our works. Only freight charges will be invoiced to the customer.

Inspection work not necessitated by material or manufacturing defects will be charged for even during the guarantee period. For components of outside manufacture, in so far as these form a major part of the apparatus, the guarantee conditions of the outside manufacturer will be held valid.

For performance and accuracy guarantees, the technical data given in these Operating Instructions will be held binding.

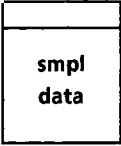

If damage to a package is visible on delivery or if transport damage is observed when the goods are unpacked, the suppliers should be informed at once and a written statement should be made out. In the absence of an official damage report we cannot be held legally responsible for the cost of replacements.

When returning apparatus and accessories for servicing, etc., the original packaging materials should be used as far as possible. Before being embedded in shavings or similar material, parts should be wrapped so as to protect them against dust (for instruments and apparatus units a plastic bag is indispensable). The guarantee does not cover damage due to unsuitable or careless packaging.

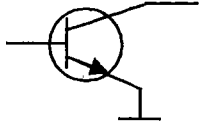
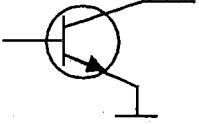
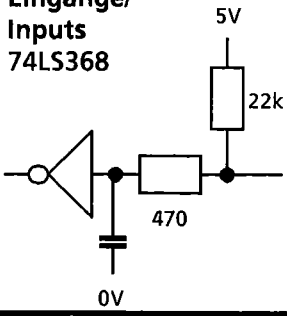

6.3 List of entries

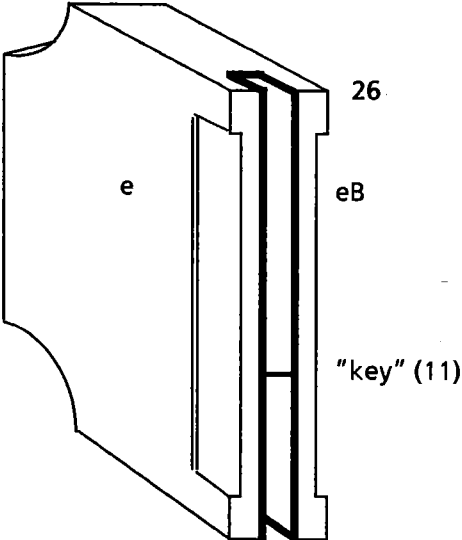

| | <u>Entry</u> | <u>Input range</u> | <u>Initial value</u> |
|-----------------|---------------------------|----------------------|----------------------|
| prep steps | <u>Titration methods:</u> | | |
| | output t1 | see page 402 | OFF |
| | pause 1 | 0...9999 s | 0 s |
| | output t2 | see page 403 | OFF |
| | pause 2 | 0...9999 s | 0 s |
| | add V | .00...999.99 ml | .00 ml |
| | pause | 0...9999 s | 0 s |
| | electr. input | 1; 2; 12 | 1 |
| | <u>MEAS:</u> | | |
| | t(print) | 0...9999 s, OFF | OFF |
| el.cal. 0/1 ? | 0; 1 | 0 | |
| reset cal.0/1 ? | 0; 1 | 0 | |
| t.cal. | -20.0... + 200.0 °C | 25.0 °C | |
| pH(S) 1 | 0.00... ± 20.00 | OFF | |
| pH(S) 2 | 0.00... ± 20.00, OFF | OFF | |
| para- meters | <u>MEAS:</u> | | |
| | temp. | -20.0... + 200.0 °C | 25.0 °C |
| | <u>GET:</u> | | |
| | titr. rate | see page 305 | 1 ml/min |
| | anticip. | 0...99 | 0 |
| | stop V | .00...999.99 ml, OFF | 99.99 ml |
| | stop pH | .00... ± 20.00, OFF | OFF |
| | stop U | 0... ± 2000 mV, OFF | OFF |
| | stop #EP | 1...9, OFF | OFF |
| | start V | .00...999.99 ml | .00 ml |
| | start pH | .00... ± 20.00, OFF | OFF |
| | start U | 0... ± 2000 mV, OFF | OFF |
| | start slope | .00...9.99 /ml, OFF | OFF |
| | start slope | 0...999 mV/ml, OFF | OFF |
| | EPA/B | 0... ± 20.00, OFF | OFF |
| | EPA/B | 0... ± 2000 mV, OFF | OFF |
| | temp. | -20.0... + 200.0 °C | 25.0 °C |
| | EP crit. | 1...8, OFF | 3 |
| | <u>SET:</u> | | |
| | EP1 pH | .00... ± 20.00 | OFF |
| | EP1 U | 0... ± 2000 mV | OFF |
| | dyn.ΔpH1 or 2 | .00...20.00, OFF | OFF |
| | dyn.ΔU1 or 2 | 0...2000 mV, OFF | OFF |
| | drift 1 or 2 | 0.3...99.9 mV/s | 10.0 mV/s |
| | t(delay) | 0...99 s, INF | 10 s |
| | EP2 pH | .00... ± 20.00, OFF | OFF |
| | EP2 U | 0... ± 2000 mV, OFF | OFF |
| | temp. | -20.0... + 200.0 °C | 25.0 °C |
| | stop V | .00...999.99 ml, OFF | 99.99 ml |

| | <u>Entry</u> | <u>Input range</u> | <u>Initial value</u> |
|--|--------------|--|----------------------|
| <div style="border: 1px solid black; padding: 5px; width: fit-content;"> para- meters </div> | MET: | | |
| | vol.step | .01...9.99 ml | .10 ml |
| | drift | 1...999 mV/min, OFF | 100 mV/min |
| | Δt(wait) | 1...999 s | 5 s |
| | stop V | .00...999.99 ml, OFF | 99.99 ml |
| | stop pH | .00... ± 20.00, OFF | OFF |
| | stop U | 0... ± 2000 mV, OFF | OFF |
| | stop #EP | 1...9, OFF | OFF |
| | start V | .00...999.99 ml | .00 ml |
| | start pH | .00... ± 20.00, OFF | OFF |
| | start U | 0... ± 2000 mV, OFF | OFF |
| | start slope | .00...9.99 /ml, OFF | OFF |
| | start slope | 0...999 mV/ml, OFF | OFF |
| | EPA/B pH | 0... ± 20.00, OFF | OFF |
| | EPA/B U | 0... ± 2000 mV, OFF | OFF |
| | temp. | -20.0... + 200.0 °C | 25.0 °C |
| EP crit. pH | .10...20.00 | .50 | |
| EP crit.U | 1...999 mV | 30 mV | |
| <div style="border: 1px solid black; padding: 5px; width: fit-content;"> def records </div> | report | see page 324 | 2 |
| | send | see page 410 | OFF |
| | m | see page 324 | RS1; 99 |
| | com. var. | see page 324 | - |
| <div style="border: 1px solid black; padding: 5px; width: fit-content;"> aux funcs </div> | sample # | 0...9999 | 0 |
| | beep | 1...9, OFF | OFF |
| | time | hh-mm | |
| | date | yy-mm-dd | |
| <div style="border: 1px solid black; padding: 5px; width: fit-content;"> fmla const </div> | CXX | 0... ± 8 digits plus decimal point | 0 |
| | C00 | 0... ± 8 digits plus decimal point and unit | 0 |
| <div style="border: 1px solid black; padding: 5px; width: fit-content;"> smpl size </div> | C00 | 0... ± 8 digits plus decimal point and unit | 0 |

| | <u>Entry</u> | <u>Input range</u> | <u>Initial value</u> |
|--|--------------|---|----------------------|
|  | silol line | 1...40, 99 | 1 |
| | method | identification which is used in the user memory | |
| | id.#1, Id.#1 | up to 8 ASCII characters | - |
| | id.#2, Id.#2 | up to 8 ASCII characters | - |
| | c20 | 0... ± 8 digits plus decimal point | 0 |
| | c00, C00 | 0... ± 8 digits plus decimal point and unit | 0 |
|  | recall | identification which is used in the user memory | - |
| | store | up to 8 ASCII characters | - |
| | delete | identification which is used in the user memory | - |

6.4 Positions on 3.540.2191 interface

| 3.540.2191 | extern | Funktion/Function 686 |
|--|--|---|
| <p>Ausgänge/ outputs</p>  <p>V_{CE0} 16 V I_C 30 mA</p> | <p>e25 e22 e23 e24 e26</p> | <p>Ausgang/output Nr. I Ausgang/output Nr. II Ausgang/output Nr. III Ausgang/output Nr. IV</p> <p>} L = aktiv/active</p> <p>Impulslänge/pulse width: 240 ms \pm 40 ms</p> <p>Stop = L (250 ms)</p> |
| <p>Ausgänge/ outputs</p>  <p>V_{CE0} 16 V I_C 30 mA</p> | <p>e13 e14 e15 e16 e17 e19 e20</p> | <p>Anschluss 586</p> <p>Schreibstift senken/ lowering of recorder-pen = L</p> <p>Schreibstift heben/ lifting of recorder-pen = L</p> <p>Papiervorschubsteuerung ext./ paper feed control extern = L</p> <p>Stand by = L</p> <p>Vorwärts/forward = L</p> <p>Rückwärts/backward = L</p> <p>Papiervorschubimpulse extern/ paper feed pulses from external</p> |
| <p>Analog-Signal $I \leq 5$ mA</p> | <p>e18 e21</p> | <p>0 V *</p> <p>U analog</p> |
| <p>Eingänge/ Inputs 74LS368</p>  | <p>e6 e7 e8 e9 e10</p> | <p>L = Stop (≥ 1.2 s)</p> <p>L = GO (≥ 1.2 s)</p> |
| <p>Spannungen/ voltages</p> | <p>e4/e5 e3</p> | <p>0 V</p> <p>+ 5 V</p> |
| <p>Datum/date 26.1.87</p> | <p>Steuer-Ein- und Ausgänge/Control Inputs and Outputs</p> <p>PSM1-Analogausgang/Fernsteuerung mit 686</p> <p>PSM1 Analogue Output/Remote Control with 686</p> | |
|  | | <p>3.540.2191/686 4 E 1</p> |

| | | |
|--|--|--|
| <p>3.540.2191</p> | <p>extern</p> | <p>Funktion/Function 686</p> |
| | | <p>Kontaktanordnung am Stecker/ Contact location at the plug</p>  <p>Bestellnummer/ordering number: 3.540.8440</p> |
| <p>Nicht belegte Anschlüsse/ non-occupied pins</p> | <p>e1, e2, e12</p> | |
| | | |
| <p>Für Schäden, die durch unsachgemäßes Zusammenschalten von Geräten entstehen, wird jede Haftung abgelehnt. Any liability for damages due to wrong interconnections between instruments is refused.</p> | | |
| <p>Datum/date 26.1.87</p>  | <p>Steuer-Ein- und Ausgänge/Control Inputs and Outputs PSM1-Analogausgang/Fernsteuerung mit 686 PSM1 Analogue Output/Remote Control with 686</p> <p style="text-align: right;">3.540.2191/686 4 E 2</p> | |

6.5 List of accessories

| | |
|---|-------------------|
| <u>Standard accessories of 686 Titroprocessor</u> | 2.686.0010 |
| 1 interconnecting cable 686 Titroprocessor - 665 Multi Dosimat | 3.980.3090 |
| 1 adapter cable with type E socket and type F plug | 6.2104.000 |
| 3 rolls of thermal paper, 57 mm wide, 35 m long | 6.2237.020 |
| 1 spindle for thermal paper roll | 6.2241.000 |
| 1 Software VESUV 2.0 | 6.6008.010 |
| 1 mains cable with CEE(22),V straight cable socket cable plug to customer's order: | |
| type SEV 12 (Switzerland ...) | 6.2122.020 |
| type CEE(7),VII (Germany ...) | 6.2122.040 |
| type NEMA/ASA (USA ...) | 6.2122.070 |
| 1 dust cover | 6.2723.250 |
| 1 instructions for use | |
| <u>Options:</u> | |
| Sample Changer interface | 3.540.2191 |
| interconnecting cable | 3.980.2930 |
| | |
| Balance interface | 3.540.2210 |
| interconnecting cable: | |
| Sartorius, bit parall/decade serial data output | 3.980.2770 |
| Sartorius, serial data output (RS 232 C/V 24 S) | 3.980.2850 |
| Mettler, data output 03, 05, 011 (CL) oder 016 | 3.980.2780 |
| Mettler, data output 017 (CL) | 3.980.2790 |
| Mettler, data output 011 (RS 232 C) | 3.980.2800 |
| Sauter, data output 03 | 3.980.2780 |
| | |
| Data transfer interface, RS 232 | 3.540.2210 |
| | |
| Data transfer interface, IEC | 3.540.2200 |
| interconnecting cable, available from specialized dealers rear panel | 4.686.0080 |
| | |
| Recorder interface | 3.540.2191 |
| interconnecting cable | 3.980.2920 |
| | |
| Interconnecting cable | |
| for Sample Changer and 586 Labograph | 3.980.2990 |
| for 671 Switch Box | 3.980.3020 |
| for Sample Changer and 671 Switch Box | 3.980.3030 |
| for 586 Labograph and 671 Switch Box | 3.980.3040 |
| for Sample Changer and 586 Labograph and 671 Switch Box | 3.980.3050 |

6.6 Index

Texts in the display are designated with , print-outs with " ", and keys with < >.

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