Operating Instructions

Titration Unit TitroLine *easy*

C O N T E N T S PAGE

1 Properties of the Titration Unit TitroLine *easy*

Note on disclaimer of liability

The measurement or analysis results depend on a multitude of factors. So please verify the plausibility of the measurement or analysis results on a regular basis, accompanied by appropriate reliability tests. In this regard, please adhere to the usual methods.

With the Titration Unit TitroLine *easy* it is possible to perform all common titrations.

The most important prerequisite for accurate titration is the accurately functioning dosing technology. In addition to the high-precision glass cylinder made of DURAN® borosilicate glass, the virtually play-free spindle ensure correct titration results.

All parts coming into contact with the titration and dosing solutions are made of chemically resistant materials. Analysis accuracy is guaranteed by the high-precision glass cylinder and the spindle for the piston feed. The controlled three/two-way valve, the easy-to-read consumption display with ist additional status messages, the stand/stirrer system, and the practical manual key button make the Titration Unit TitroLine *easy* a device with a comfortable use properties.

1.1 Titration solutions

To save titration solution and to render the disposal of the chemicals after the analysis as simple as possible, we recommend to select any titration-solutions consumption between 5 ml and 15 ml for titration.

Solutions to be used:

In practice, any solutions and liquids with the viscosity of < = 10 mm² / s can be used, such as e.g. non aqueous titration (for example perchloric acid in glacial acetic acid). However, chemicals attacking glass, PTFE or FEP, or which are explosive, such as e.g. hydrofluoric acid, sodium acid or bromine must not be used! Suspensions with a high solid contents may block or damage the dosing system.

General rules:

The respectively applicable safety guidelines on handling chemicals are to be observed under all circumstances. This applies in particular to inflammable and/or etching liquids.

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KONFORMITÄTSERKLÄRUNG
DECLARATION OF CONFORMITY
DÉCLARATION DE CONFORMITÉ

Wir erklären in alleiniger Verantwortung, daß das Produkt	We declare under our sole responsibility that the products	Nous déclarons sous notre seule responsabilité que le produit
Titrator	**Titration Unit**	**Titrateur**
TitroLine *easy*	**TitroLine *easy***	**TitroLine *easy***
auf das sich diese Erklärung bezieht, übereinstimmt mit den Normen	to which this declaration relates is in conformity with the standards	auquel se réfère cette déclaration est conforme aux normes

DIN EN ISO 8655, Teil 3

und mit dem normativen Dokument	and the normative document	et au document normatif

Technische Daten

Titrator
TitroLine *easy*

13. Dezember 2000

SCHOTT Instruments GmbH
Hattenbergstrasse 10
55122 Mainz
Deutschland, Germany, Allemagne

SCHOTT

Translation of the legally binding German version

Technical data of the Titration Unit TitroLine *easy*

State December 13, 2000

Conformity: DIN EN ISO 8655, Part 5, Conformity mark

CE mark: CE according to the Council Directive 89/336/EMC (electromagnetic compatibility);
generic emission according to standard EN 50 081, Part 1
generic immunity according to standard EN 50 082, Part 2
according to the Council Directive 73/23/EMC (low-voltage directive)

Country of origin: Made in Germany

Propriety rights: Patents for the valve system and the titration regulation are applied for

Burette parts:

Cylinder: 20 ml DURAN® borosilicate glass cylinder

UV protection: Protective coating material: Ultem 1000, amber

Valve: Motor-driven 3/2-way valve made of PTFE/ETFE

Hoses: FEP with UV protection

Dosing accuracy: DIN EN ISO 8655, Part 3, or better
typical: systematic error < 0,1%
random error < 0,05%
according to table 1, DIN EN ISO 8655, Part 3

Volume display: 00.00 ... 50.00 ml with a resolution of 0.01 ml

Measuring input:
The built-in measuring inputs enable the following sensors to be connected:
pH single-rod measurement chain, pH single-rod measurement chain with integrated temperature sensor and/or temperature measuring sensor (Resistance Thermometer Pt 1000);
electrode with an mV signal between – 1400 and + 1400 mV
with built-in reference electrode or separate reference electrode

Measuring input: pH/mV input with 12 bit transducer for accurate resolution during the titration
Connection: electrode socket according to DIN 19 262 or BNC socket and reference electrode 1 x 4 mm socket

	Measuring range	Display resolution	Accuracy* without sensor	Input resistance [Ω]
pH	0 ... 14	0.01	0.05 ± 1 digit	$> 5 \bullet 10^{12}$
mV	– 1400 ... + 1400	1	2 ± 1 digit	$> 5 \bullet 10^{12}$

Measuring input: Connection of temperature measuring sensor for Resistance Thermometer Pt 1000, connection: 2 x 4 mm sockets and 1 x 2 mm socket

	Measuring range	Display resolution	Accuracy* without sensor
T [°C]	– 30 ... 115	0,1	0,5 K ± 1 digit

***Accuracy:** indicated in terms of measuring incertainty with a confidence of 95 %.
In addition the measuring incertainty of the sensor has to be taken in account as well.
For instance, it is for pH electrodes: Δ pH = 0.012 ... 0.03 according DIN 19 266, Part 3.

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Display:	Matrix LCD with 64 x 128 pixel and background illumination, contrast adjustable using knurled know (🕮 3.8 keyboard / display)
Calibration:	automatically using 2 out of 8 possible buffer solutions. Standard buffer solutions according to DIN 19 266 and NBS or with integral pH values pH = 2.00; 4.00; 4.01; 6.87; 7.00; 9.18; 10.00; 12.45
Connections:	
Electrode:	DIN socket according to DIN 19 262 or BNC
Reference electrode:	1 x 4 mm socket
Temp. Meas. Sensor	Resistance Thermometer Pt 1000: 2 x 4 mm sockets and 1 x 2 mm socket
Stirrer:	Plug connection in the casing bottom for Stirrer TM 96 low voltage for the TM 96 put in by the Titration Unit TitroLine *easy*
Interface RS-232-C:	for connection of a printer or a computer (PC) with serial interface RS-232-C
RS-232-C interface:	fixed settings: 4800 baud, word length 7 bits, 2 stop bits, no parity
Power supply:	corresponds to Protection Class II according to DIN EN 61 010, Part 1, not suitable for use in hazardous environments Mains: 230 V~, 50 / 60 Hz or 115 V~, 50 / 60 Hz; modification inside the device Power draw: 24 VA
Casing material:	Polypropylen with flame shield
Front foil:	Polyester
Casing dimensions:	135 x 310 x 205 mm (w x h x d), including dosing unit, without stirrer
Weight:	approx. 2.2 kg
Climate:	Environmental temperature: + 10 ... + 40 °C for operation and storage Humidity according to EN 61 010, Part 1: maximal relative humidity 80 % for temperatures up to 31 °C, linear decrease down to 50 % relative humidity at a temperature of 40 °C

® registered trademark for SCHOTT GLAS, Mainz

2 Warning and safety information

The Titration Unit TitroLine *easy* corresponds to protection class II. It was manufactured and tested according to DIN EN 61 010, Part 1, Protective Measures for Electronic Measurement Devices and has left the factory in an impeccable condition as concerns safety technology. In order to maintain this condition and to ensure safe operation, the user should observe the notes and warning information contained in the present operating instructions. Development and production is done within a system which meets the requirements laid down in the DIN EN ISO 9001 standard.

For reasons of safety, the Titration Unit TitroLine *easy* must be opened by authorised persons only; this means, for instance, that work on electrical equipment must only be performed by qualified specialists.

⚠ **In the case of nonobservance of these provisions the Titration Unit TitroLine *easy* may constitute a danger: electrical accidents of persons or fire hazard. Moreover, in the case of unauthorised intervention in the Titration Unit TitroLine *easy* as well as in the case of negligently or deliberately caused damage, the warranty will become void.** ⚠

Prior to switching the device on it has to be ensured that the operating voltage of the Titration Unit TitroLine *easy* matches the mains voltage. The operating voltage is indicated on the specification plate. Nonobservance of this provision may result in damage to the Titration Unit TitroLine *easy* or in personal injury or damage to property.

If it has to be assumed that safe operation is impossible, the Titration Unit TitroLine *easy* has to be put out of operation and secured against inadvertent putting to operation. In this case please switch the Titration Unit TitroLine *easy* off, pull plug of the mains cable out of the mains socket, and remove the Titration Unit TitroLine *easy* from the place of work.

Examples for the assumption that a safe operation is no longer possible,
➲ the package is damaged,
➲ the Titration Unit TitroLine *easy* shows visible damages,
➲ the Titration Unit TitroLine *easy* does not function properly,
➲ liquid has penetrated into the casing.

The Titration Unit TitroLine *easy* must not be stored or operated in humid rooms.

For reasons of safety, the Titration Unit Titroline *easy* must only be used for the range of application described in the present operating instructions. In the case of deviations from the intended proper use of the device, it is up to the user to evaluate the occurring risks.

⚠ **The relevant regulations regarding the handling of the substances used have to be observed:** The Decree on Hazardous Matters, the Chemicals Act, and the rules and information of the chemicals trade. It has to be ensured on the side of the user that the persons entrusted with the use of the Titration Unit TitroLine *easy* are experts in the handling of substances used in the environment and in the Titration Unit TitroLine *easy*, or that they are supervised by specialised persons, respectively.

Liquids with a high vapour pressure and/or matters or mixed matters not qualified for use in the technical data of the titration unit must not be used.

During all work with titration solutions: ⚠ **Please wear protective glasses!** ⚠

When the piston moves upwards within the cylinder, owing to the design of the system, a microfilm of dosing liquid or titration solution will always remain adhered to the inner wall of the cylinder, but this has no influence on the dosing accuracy. This small residue of liquid, however, may evaporate and thus penetrate into the zone underneath the piston, and if inadmitted liquids are being used, the materials of the Titration Unit TitroLine *easy* may be dissolved or corroded (please refer also to "Maintenance and Care").

The Titration Unit TitroLine *easy* is equipped with integrated circuits (EPROMs). X rays or other high-energy radiation may penetrate through the device's casing and delete the program.

Please note also the corresponding operating instructions for the devices to be connected.

3 Setting and commissioning

3.1 Unpacking and setting up of the Titration Unit TitroLine *easy*

Please note that also all the small accessories are taken out of the packing.

Set up the Titration Unit TitroLine *easy* on any flat surface and connect the mains plug to the mains socket. Prior to plugging in the mains plug, it has to be ensured that the operating voltage of the device corresponds to the mains voltage. The operating voltage is indicated on the rating plate on the bottom of the Titration Unit TitroLine *easy*.

3.2 Installation of the stirrer

Insert the stirrer at the lower right side and fasten it by pushing backwards (🕮 Fig. 1). This automatically connects the power supply to the Stirrer TM 96.

Fig. 1:
Installing the stirrer:

Insert the stirrer from below into the contact openings of the titration unit, then push the stirrer TM 96 backwards until it latches.

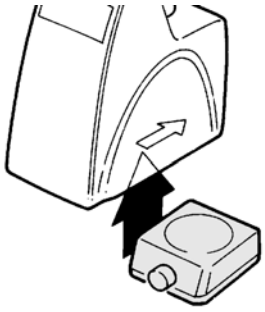


Fig. 2:
Titration Unit TitroLine *easy* viewed from below:

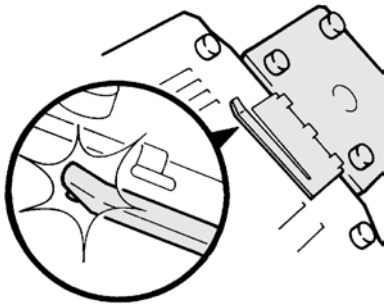
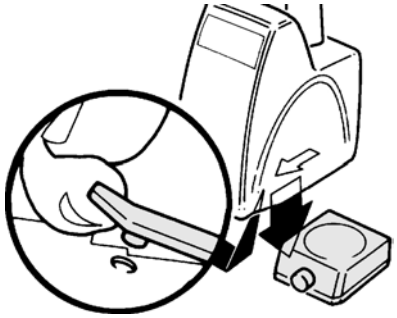


Fig. 3:
Remove the stirrer:
Lift latch slightly, push the stirrer forwards and remove it from downwards.



3.3 Installing the stand

Insert the TZ 3665 Strand Rod at the right side (🕮 Fig. 4) and fasten it on the back panel of the Titration Unit TitroLine *easy* using the two included screws M 3 x 10 mm (slot-screw driver). Install the electrode/burette tip holder as shown in Fig. 5.

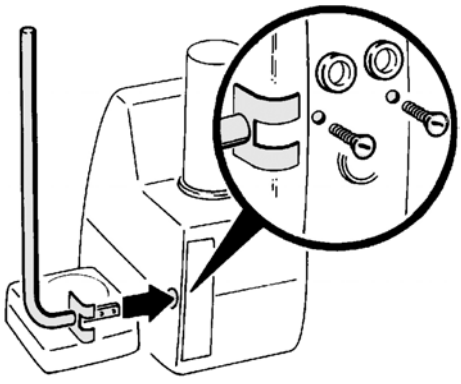


Fig. 4

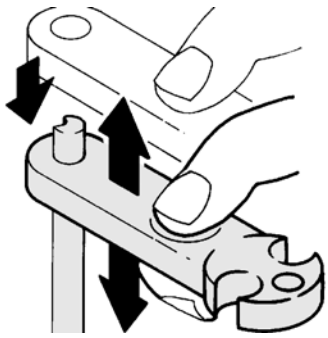


Fig. 5

3.4 Installing the burette tip

The burette tip consists of the elements shaft with threaded clamping joint, hose and slip-on tip.

Fig. 6 Disassembled burette tip:

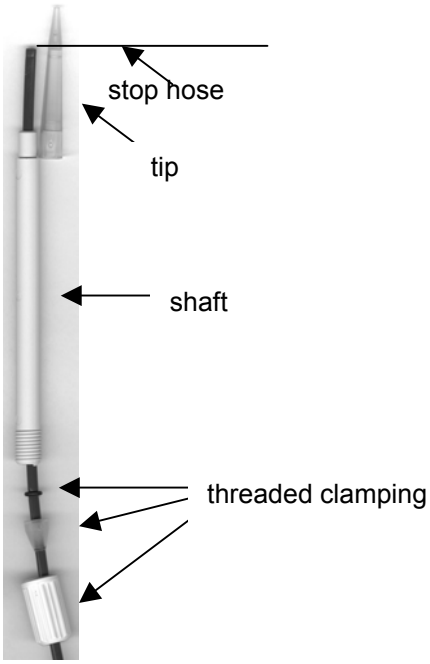


Fig. 7 Assembled burette tip

Burette tip - Sequence of assembly:

1. Cut of hose end evenly.
2. Slip parts of the threaded clamping joint on to the hose.
3. Guide hose through shaft.
4. Press burette tip onto the free hose end until it reaches the stop.
5. Push burette tip with pressed in hose onto the shaft.
6. Hold tip firmly, and screw threaded clamping joint to the shaft.

3.5 Installation of the manual key button and the printer / computer (PC)

(accessories)

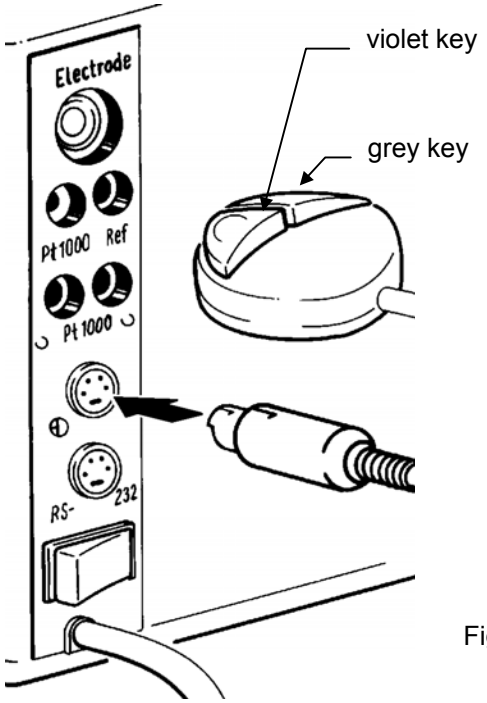


Fig. 8

The manual key button is only required for manual titration. It can also be used for a remote control for the <START/STOP> (violet key) and <FILL> (grey key) with automatic titrations.

Caution: The two 4-channel sockets on the side of the unit are identical. If the sockets are mixed up, the electronics of the Titration Unit TitroLine *easy* may be damaged.

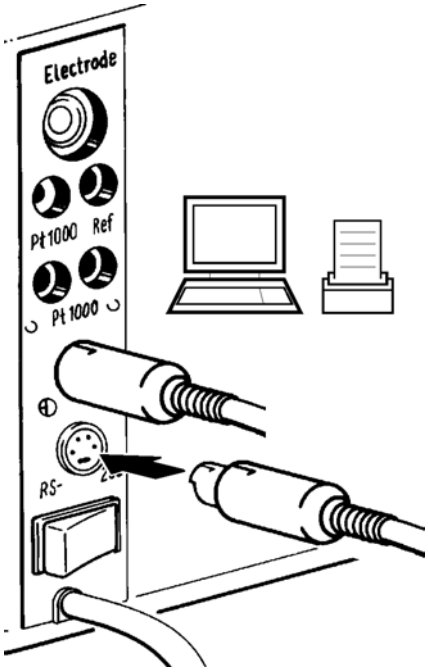


Fig. 9

Upper socket: manual key button,
lower socket: printer / computer (PC).

3.6 Connecting the electrode

- Single-rod measurement chains connect to the „Electrode“ DIN socket. If the unit is equipped with a BNC socket according to the user’s specification, the electrode with the BNC plug connects to the same location.
- Electrodes with integrated Temperature Measuring Sensor (Resistance Thermometer Pt 1000): the electrode plug (DIN or BNC plug) connects to the electrode socket, and, depending on the electrode design, the Pt 1000 banana plug connects to the „Pt 1000“ sockets directly next to the „Ref.“ socket or beneath it.
- Indicator electrodes (glass electrodes without reference electrode) connect to the „Electrode“ socket, and the separate reference electrode connects to the „Ref“ socket.

3.7 Switching on / off, connections

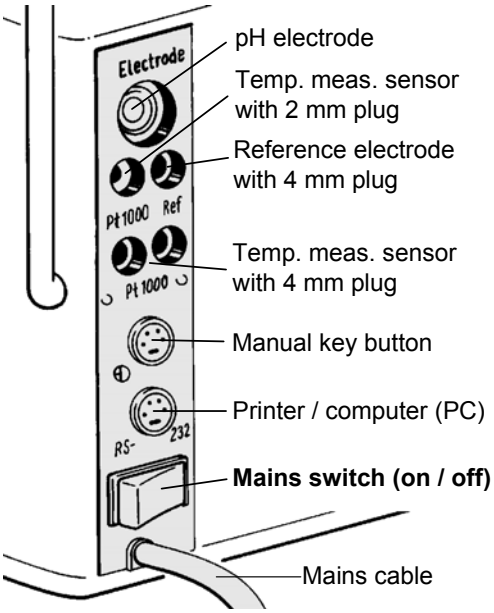
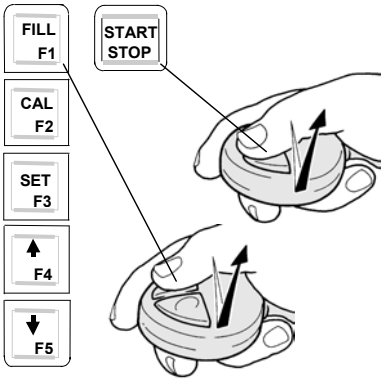


Fig. 10 Connections on the back panel

3.8 Keyboard / display / contrast

Fig. 11: Keyboard with manual key button (accessory)



All functions of the Titration Unit TitroLine *easy* are triggered using the keyboard. The display indicates in dialogue mode which active keys can be pressed to proceed with the work. If a manual key button is connected, the „Start/Stop“ and „FILL“ functions can also be started using the manual key button.

The contrast of the display can be adjusted using the knurled knob which is accessible at the right bottom front of the Titration Unit TitroLine *easy*.

4 What is to be noted before starting?

4.1 Setting the language of the country

The titration units are set ex works to the desired language. If a different language is to be set, the <SET> key on the start menu has to be kept depressed for more than 3 seconds. On the <<***setting***>> (Setting) menu, press the <F1> key to select a different language:
<F1> = German, <F2> = French, <F3> = English, <F4> = Spanish.
If you do not wish to change the set language, exit the menu by pressing the <STOP> key.

4.2 Titration solutions (standard solutions)

It has to be ensured in context with all titrations that the suction hose immerses in the titration solution in the storage bottle and that the titration solution is drawn off free of gas bubbles.

If the Titration Unit TitroLine *easy* has to be filled first, the „Rinsing/Initial filling“ working sequence has to be started by pressing the corresponding key. **A receptacle with a volume of at least 100 ml has to be placed under the burette tip, since titration solution will escape.**

It should be noted that the titration solution contained in the hoses may vary by diffusion of the components of the air in the case of long standing times. In case of doubt, rinsing of the system should also be started in the „Rinsing / initial filling“ sequence.

4.3 Rinsing and initial filling

After switching the unit on, press the <F1> key to start the „Rinsing / initial filling“ working sequence.

Start menu
End point titration

```
*** device ready ***

pH end point    <START>
   pH= 7.0      <↓><↑>
   neutral red
rince           < F1 >
calibrate       <CAL>
Mode: EQ/EP/Man <SET>
```

Start menu
Equivalence point titration

```
*** device ready ***

auto find (EQ)  <START>


rince           < F1 >
calibrate       <CAL>
Mode: EQ/EP/Man <SET>
```

Start menu
Manual titration

```
*** device ready ***
manual titration mode
        0.00 ml

rince           < F1 >

Mode: EQ/EP/Man <SET>
```

The „Rinsing“ function can be started in this status only. If a key other than <F1> is pressed, the display will switch to <FILL>.
A receptacle with a volume of at least 100 ml has to be placed under the burette tip, since titration solution will escape.
The Titration Unit TitroLine *easy* will perform two take-in and dosing operations. It will display <<device rinsing>>. The rinsing operation can be stopped by pressing the <STOP> key, the Titration Unit TitroLine *easy* will remain in this position. Using the <FILL> key, a normal filling process can subsequently be started. If it is intended to rinse the unit between individual titrations, it has to be switched off an then on again. The display will show <<rinsing <F1>> again. Changing different titration solutions is impossible in this way (🕮 chapter 11.1 „Changing the titration solution“).

4.4 Filling

For normal filling (or refilling) press the <FILL> key, e.g. after an interruption of a filling or rinsing process. The filling process will be performed automatically, with the display showing **<<device fills>>**.

4.5 End point

In this mode you can titrate to a set pH end point. Using the <↑> and <↓> keys you can set the end point by scrolling from pH = 0.0 and pH = 14.0. As soon as the end point of a colour indicator is reached, the name of the indicator will be displayed as well:

pH end point	**<START>**
pH = 7.0	**<↓><↑>**
neutral red	

The table shows the available indicators of a pH end point titration:

Indicator	Colour change	Titration ends at
Thymol blue 1st colour change	red-yellow	pH = 2.0
Methyl orange	red-yellow orange	pH = 4.3
Methyl red	red-yellow	pH = 4.8
Bromphenol red	yellow-purple	pH = 6.0
Neutral red	red-yellow	pH = 7.0
Phenolphthalein	colourless-red	pH = 8.8
Thymol blue 2nd colour change	yellow-blue	pH = 9.0
Thymolphthalein	colourless-blue	pH = 9.5

For pH end point titration the pH electrode has to be calibrated in each case, since the result is strongly depending on the condition of the electrode.

Subsequently, titration for a pH or mV end point can be started. As soon as the unit has completed the titration automatically, the ml result will be shown on the display. In the case of pH titration, the consumption will always be at the location where the titration stopped. The smallest step of resolution here is 0.01 ml. In this place, owing to the shape of the titration curve, the change of the pH or mV value is ten to one hundred times greater than at any other times of the titration. This means that a step which is only just being dosed will exceed the set pH or mV value without the result being corrupted thereby.

Analogous you may effect an mV end point titration (– 1400 mV ... + 1400 mV).

mV end point	**<START>**
mV = 840	**<↓><↑>**

4.6 Equivalence point

In the **„Auto Find (EQ)“** mode the Titration Unit TitroLine *easy* can recognize when the correct quantity of titration agent has been added. By way of a combined evaluation of electrode signal, time, added quantity and by using an intelligent control the device is capable of recognising the behaviour of the analysis. It controls the titration and the used recorded measurement values to calculate the completion of the titration. Unless the analysis specification contains a statement on the end point, we recommend to titrate in the „Auto Find EQ“ mode.

As soon as the unit has completed the titration automatically, the ml result will be calculated and shown on the display. In the case of automatic end point search the displayed consumption will always be slightly above the result, since automatic calculation requires some overtitration. In this automatic mode a calibration of the electrode is not necessarily required and rather serves for checking the condition of the electrode.

4.7 Internal methods

The titrator features 10 internally stored methods. A list and description of the individual methods if given below.

No.	Name	Description
1	pH fast strong	Fast pH titration for strong acids and bases. *Example*: Hydrochloric acid with caustic soda.
2	pH fast weak	Fast pH titration for weak acids and lyes. *Example*: Citric acid, acetic acid, or tartaric acid with diluted caustic soda.
3	pH exact strong	Accurate pH totration for strong acids and bases. *Example*: Hydrochloric acid with caustic soda.
4	pH exact weak	Accurate pH titration for weak acids and lyes. *Example*: Citric acid, acetic acid, or tartaric acid with diluted caustic soda.
5	pH 0.1 ml 10 sec	Linear titration in equal increments of 0.1 ml at repeated regular intervals of 10 seconds. Used in difficult titrations.
6	mV fast strong	Fast titration with steep jumps. *Example*: Iodometry with thiosulphate as titration agent.
7	mV fast flat	Fast titration with flat jumps. *Example*: Chloride under favourable conditions with large quantities of silver nitrate.
8	mV exact strong	Accurate titration with steep jumps. *Example*: Titrations with $KMnO_4$ or Cerium.
9	mV exact flat	Accurate titration with flat jumps. *Example*: Chloride under normal or difficult conditions.
10	mV 0.1 ml 10 sec	Linear titration in equal increments of 0.1 ml at repeated regular intervals of 10 seconds. Used in difficult titrations, or titrations in which other parameters fail.

From a basic menu (EP/EQ/Man), an extended depression of the <F3> key (> 3 sec) will take you to the <setting> menu. Another short depression of the <F3> key the screen will change to <select parameter record>. This menu can be used to invoke the individual methods using the arrow keys. To select the desired method, press the <F1> key. Pressing the <F2> key will take you to the Standard pH titration method, whereas the <F3> key leads to the Standard mV titration method.

4.8 Manual titration

Manual titration can be used to carry out any titration to a change of colour without using an electrode. To do so, press the <F3> key to switch the titrator to the manual titration mode. The addition of the titration agent is done using the keys of the manual keying unit. The left, i.e. violet key controls the addition of the titration agent.

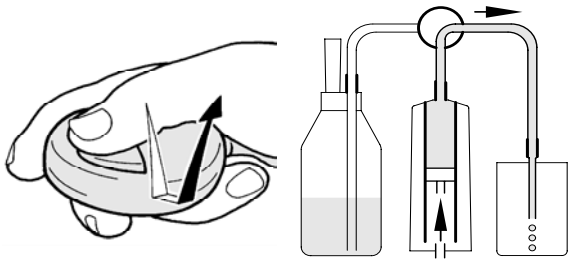


Fig. 12

Normal titration (🕮 Fig. 12)

Immerse the titration tip in the sample solution. This will increase the accuracy.

Press the violet key to the first stage. The titration solution will be dosed slowly as long as the key is held depressed.

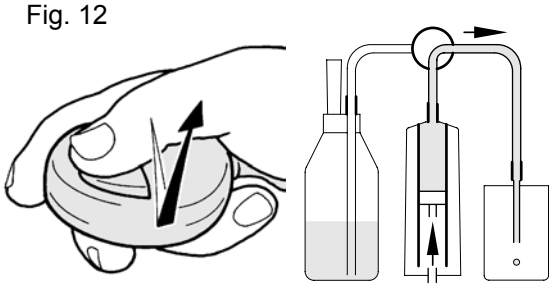


Fig. 13

0.01 ml - titration / stepwise titration (🕮 Fig. 13)

Press shortly violet key (max. 0.3 s). 0.0 ml will be ejected each time the key is depressed again.

The display shows the volume.

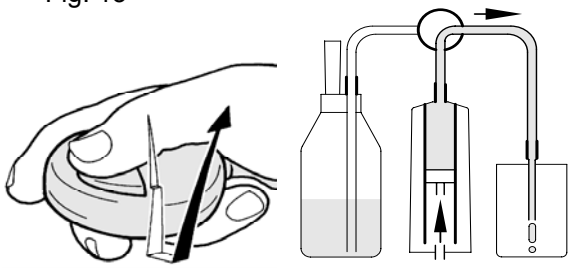


Fig. 14

Fast titration (🕮 Fig. 14)

Press violet key fully (to second stage) and keep depressed.

The titration solution will be dosed as long as the key is being depressed.

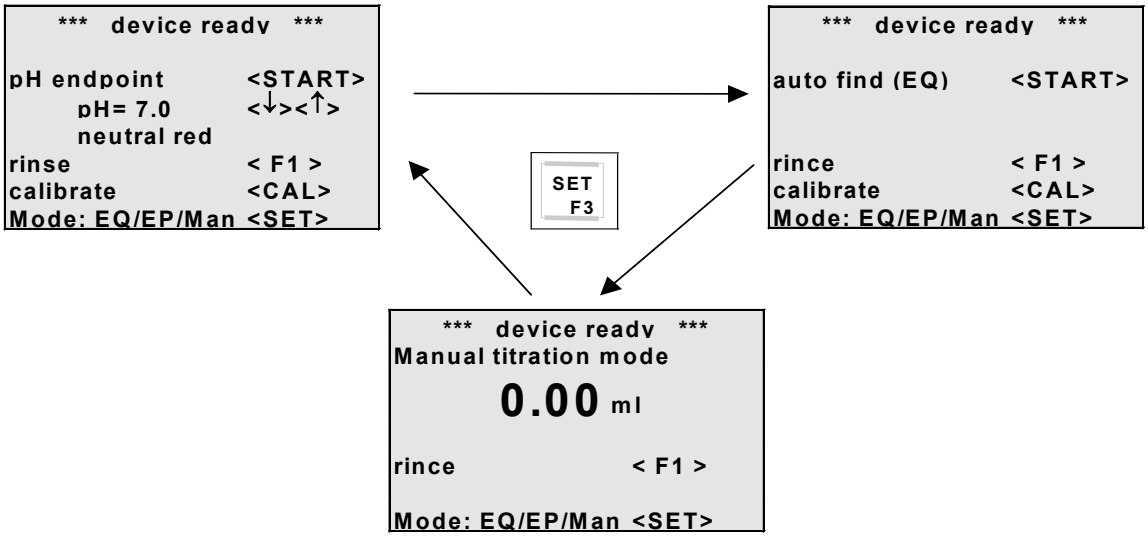
4.9 Calibration

When calibrating the electrode using the Titration Unit TitroLine *easy*, a classic 2-point calibration is performed, with one buffer solution being close to the zero point of the electrode and a second being in the acid or basic range, e.g. pH = 7.00 and pH = 4.00. This calibration is described in chapter 6 „Calibration“.

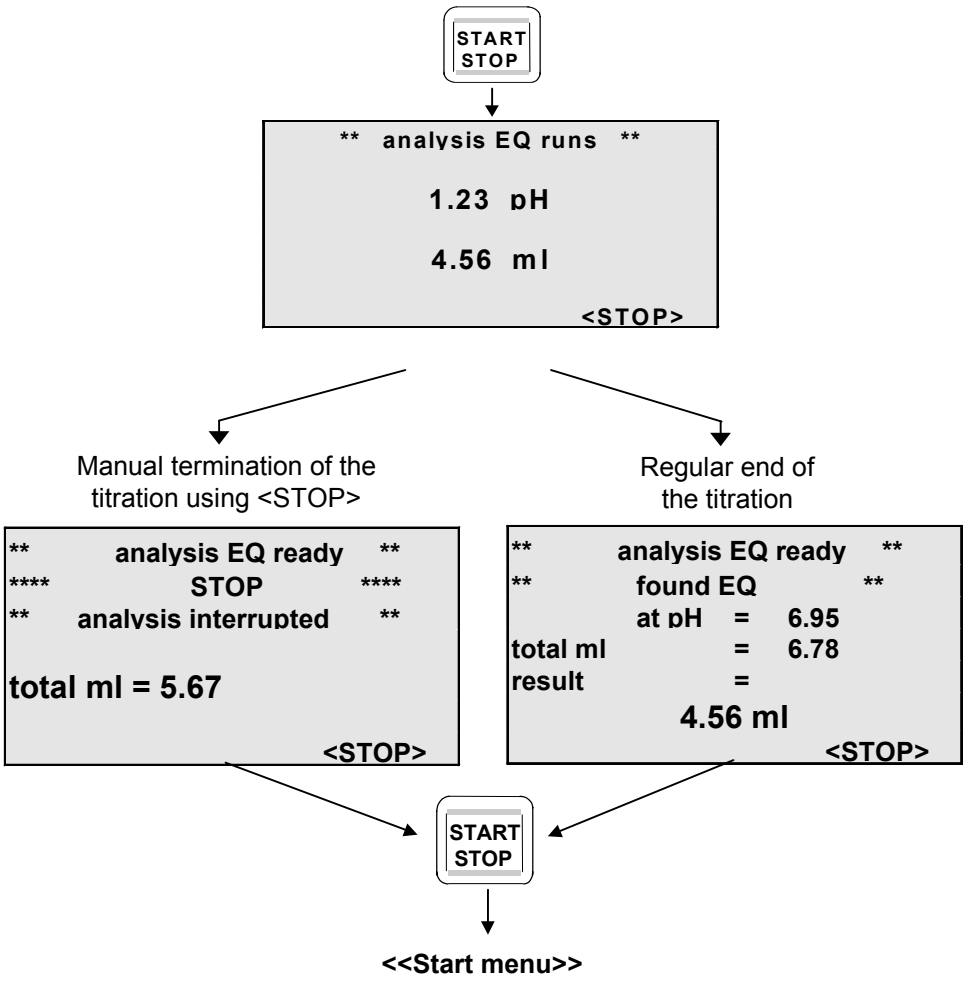
4.10 What should not be forgotten?

- The intake hose has to be immersed in the titration solution.
- An appropriate stirring speed has to be selected in order to ensure proper mixing of the sample.
- The burette tip and the electrodes are immersed into the sample, with the diaphragm of the electrode being fully immersed. A standard value of 30 mm will suffice for this immersion.
- The stopper at the filling hole of the electrode has to be removed (not applicable for electrodes without filling hole).
- All plugs have to be plugged in properly.
- No hoses must be wrinkled or contain air bubbles.

5 Titration with the Titration Unit TitroLine *easy*

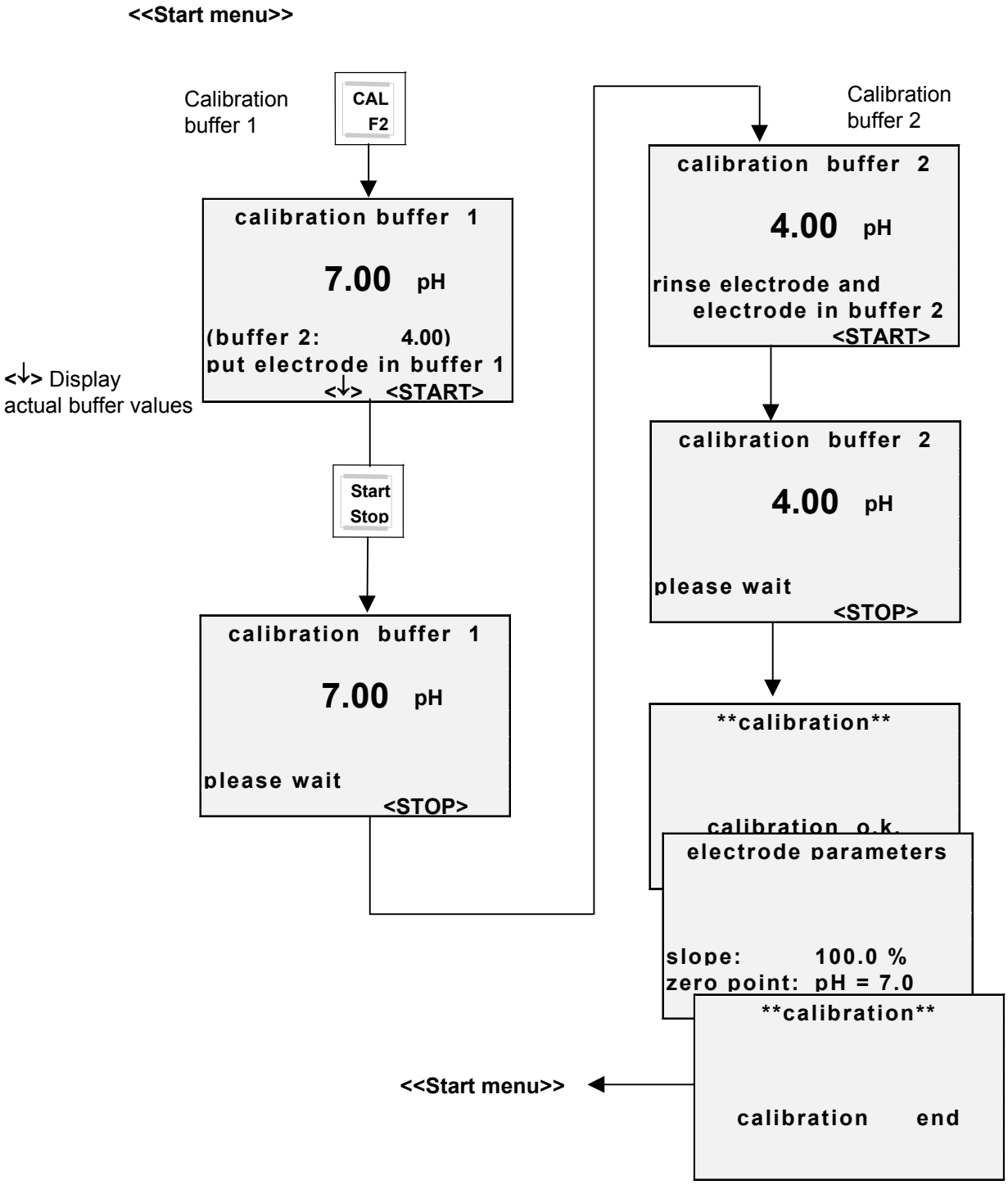


Display example showing a method start, a termination and a regular end of the titration.

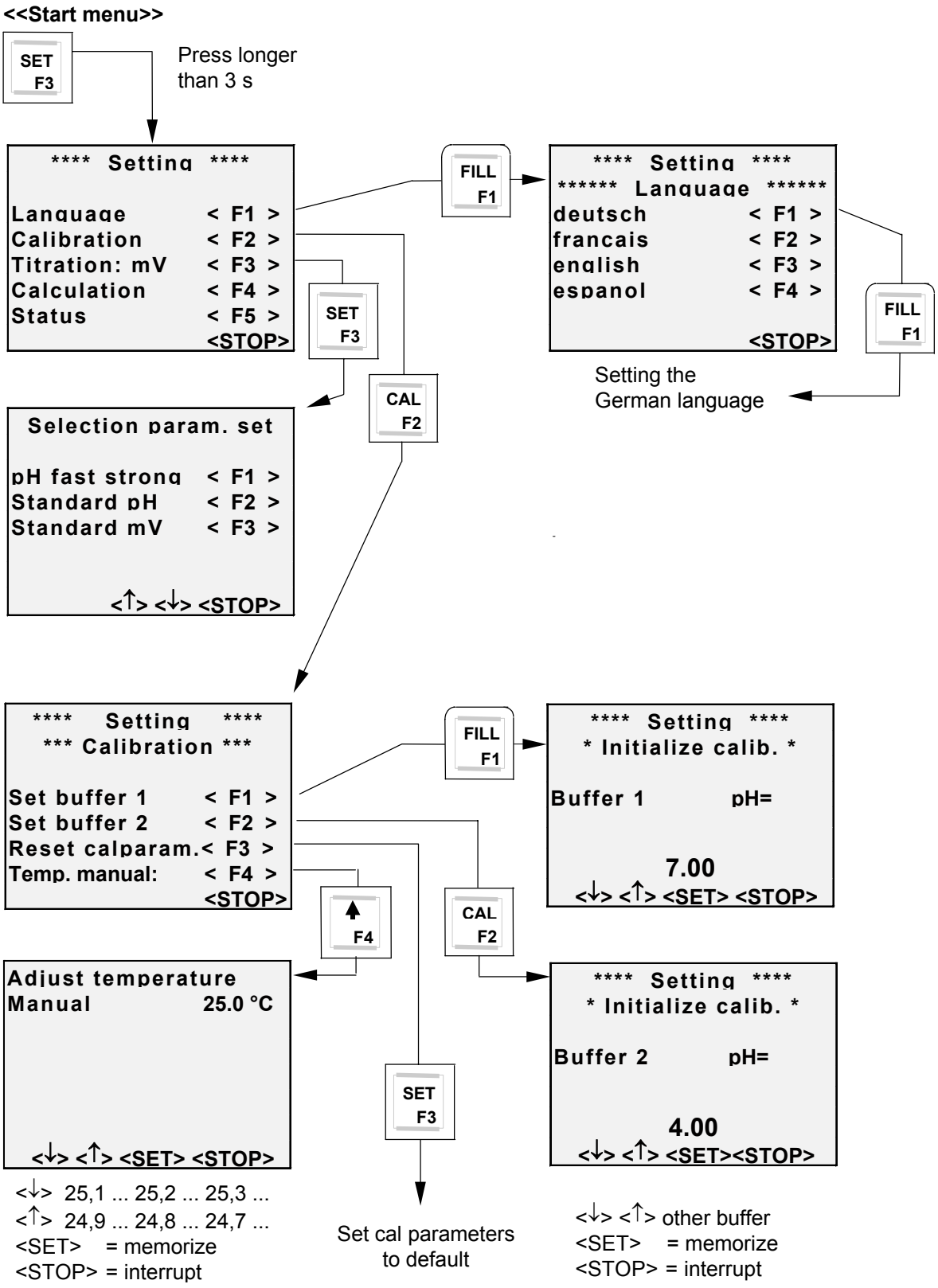


6 Calibration with the Titration Unit TitroLine *easy*

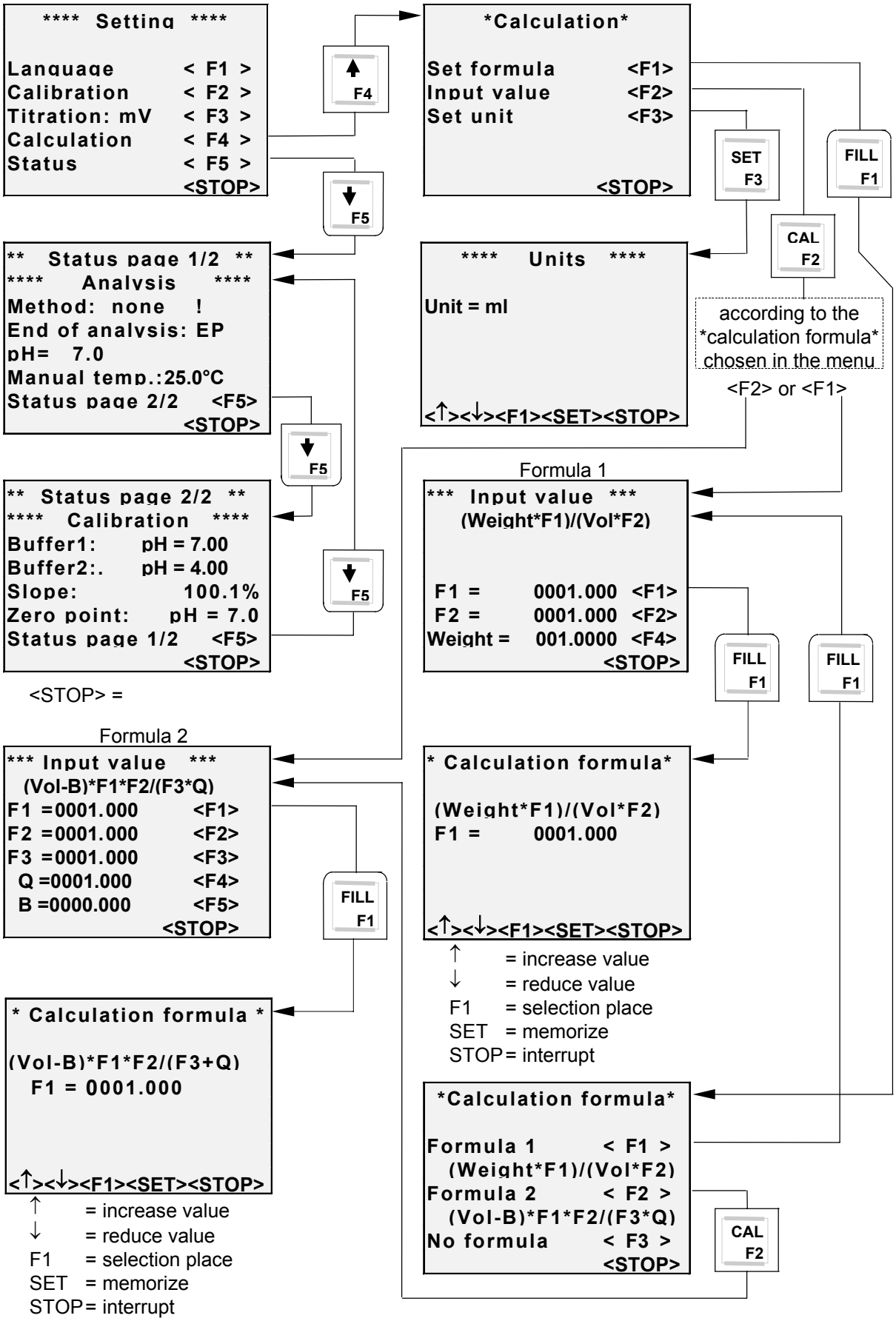
Rinse electrode (without protection cap) with water and start calibration. Dip electrode into the first buffer, until the junction is covered. The display shows <<please wait>> during buffer identification. In the next step (which is not illustrated here) wait until the buffer value is stable. After this procedure rinse the electrode with water and dip into the second solution. If calibration is done, slope and zero point are shown. If a wrong buffer is recognised, calibration can be repeated.



7 Settings


<<Start menu>>
SET F3
Press longer than 3 s
**** Setting ****
Language < F1 >
Calibration < F2 >
Titration: mV < F3 >
Calculation < F4 >
Status < F5 >
<STOP>
FILL F1
**** Setting ****
****** Language ******
deutsch < F1 >
francais < F2 >
english < F3 >
espanol < F4 >
<STOP>
FILL F1
Setting the German language
SET F3
CAL F2
Selection param. set
pH fast strong < F1 >
Standard pH < F2 >
Standard mV < F3 >
<↑> <↓> <STOP>
**** Setting ****
*** Calibration ***
Set buffer 1 < F1 >
Set buffer 2 < F2 >
Reset calparam. < F3 >
Temp. manual: < F4 >
<STOP>
FILL F1
**** Setting ****
* Initialize calib. *
Buffer 1 pH=
7.00
<↓> <↑> <SET> <STOP>
F4
CAL F2
Adjust temperature
Manual 25.0 °C
<↓> <↑> <SET> <STOP>
<↓> 25,1 ... 25,2 ... 25,3 ...
<↑> 24,9 ... 24,8 ... 24,7 ...
<SET> = memorize
<STOP> = interrupt
SET F3
Set cal parameters to default
**** Setting ****
* Initialize calib. *
Buffer 2 pH=
4.00
<↓> <↑> <SET><STOP>
<↓> <↑> other buffer
<SET> = memorize
<STOP> = interrupt

7.1 Setting calculation formula and input value



7.2 Setting „mV titrations“

In addition to pH titrations, the Titration Unit TitroLine *easy* is capable of performing mV titrations. EQ and EP titration methods can be performed in analogy to the pH titrations.

The upper line of the display shows the current measurement value (pH or mV) until the value does not change any more over a period of two minutes. Subsequently, the display will change to "READY".

EQ and EP titrations are possible. You can perform a equivalence-point titration with automatic detection (EQ) or an end-point titration to a defined end point (EP). In contrast to pH titration the “calibration” menu item is no longer necessary.

If the <SET> key is held depressed for more than five seconds, the “Setup” menu will appear. Use <F3> to change between mV and pH mode. Pressing the <STOP> key will take you back to the main and start menu.

The calculation formulae and the unit of the result can be selected using the <F4> key.

To switch over to the “calibration” menu, use the <F4> key. Here you can set the temperature manually.

To change from the “Setup” menu to “select calculation”, press the <F4> key. This item can be used to select two formulae, enter the values and select a unit for representation on the display.

<F1> is used to display the formulae for making a selection. The first formula, <F1>, serves for titer determination and hence contains the weighed-in quantity in the numerator. The <F1> factor can be used for molarity conversion. “F2” can be used for the molecular weight. The <F2> formula 2 serves for contents determination and takes into account a blank value of “B” as subtractive member. Using <F3> you can switch calculation off.

After selecting the formula you can enter the individual numeric values. To enter the factor of “F1”, you have to select this factor using <F1>, then use the <FILL> key to determine the place to be set. Using the "arrow up" and "arrow down" keys, adjust the digits until the proper value is being displayed.

Example chloride percentage with 1 mol/l solution

F1 =	35.45	(mol weight of chlorine)
F2 =	100	(conversion %)
F3 =	1000	(conversion weighed-in quantity g to mg)
Q =	1	(no conversion required)
B =	0	(no blank value in the case of concentrations of this kind)

The units are selected using the arrow keys.
Available options: ml, mmol/l, mol/l, ppm, g/l, mg/l, n, %
To store the setting, press <SET>.
<STOP> will take you back to the formula-selection window.

7.3 Working with internal methods

The memory of the titration contains 10 different methods which can be selected if necessary (please refer to chapter 4.7). These methods include various, practice-based parameter settings for titration. To start titration as usual, simply press the <Start> key.

8 RS-232 interface

The serial interface connects a printer (equipped with a serial interface) or a computer to the titrator. The interface is bi-directional and is used for result printout or communication with computer programs. For details, please refer to the following chapters.

8.1 Connecting a printer

The results are automatically output via the RS-232 interface. To record the results, a printer with a serial interface can be used. We recommend the use of a TZ 3460 printer.
Upon the end of titration, the following information is transferred to the printer:

```
Printout mV titration EQ:

************************
  Sample number:  1
  Date: _________________
  Time: _________________
  Name: _________________
  Result:=          337 mV
  Total consumpt.:   2.28
  Result:         2.084  ml
```

Fig. 15

```
Printout mV end point titration

************************
  Sample number:  1
  Date: _________________
  Time: _________________
  Name: _________________
  Result:=           257 mV
  Total consumpt..:   4.30  ml
                    4.305
```

Fig. 16

8.2 Connecting a computer

The titrator can be connected to a PC using a cable of the TZ 3098 type. The functions of the titrator can be remote-controlled using the set of commands below. The commands can be sent to the titrator using so-called "terminal" programs, and the responses of the titrator can also be followed on the screen.

8.3 Commands set

The commands of the titrator are to be interpreted as ASCII characters. The commands use only capital letters. All commands have to end on <CR> <LF>. The <CR> <LF> characters correspond to the ASCII characters 13 and 10 of the ASCII character table.

Command	**Response**	**Action**
VE	Version: 99/01	Output of the version number
RH	Ident: TitroLine *easy*	Hardware identification
RC	Last command	Repeat last command
RA	UNIT: 20 ml	Inquire size of unit
SH	Y	Stop titration
SM	Y	Start selected method
SR	Y	Stop burette
SS7.0		Send desired pH value prior to EP titration to TL *easy*
FP	Y	Measurement function in pH range
FV	Y	Measurement function in mV range
FT	Y	Measurement function in temperature range
M	Measurement value	Inquire measurement value within set range
LC		Output calibration parameter
LR		Output of results printout
LD		Output data
EX	Y	„EXIT“ function, return to execution level
BF	Y	Burette is filling
KR	Y	Extend piston
DA2.5	Y	Dose e.g. 2.5 ml

8.4 Properties of the RS-232 interface

The data transmission properties of the RS 232 interface are firmly set. The parameters include:
4800 baud, 7 bits word length, 2 stop bits and NO parity. No further settings are required. Please make sure that the connected device is set to the same transmission parameters. In the case of an incorrect setting, no data transfer can occur, or else no readable results will be obtained.

The data transmission uses the TxD, RxD and GROUND lines. No handshake lines are present. Software handshake (XON XOFF) is not supported.

The RS-232 socket must not be confused with the socket for the manual keying unit in order to avoid damage to the device.

PIN configuration of the RS 232 socket (4-channel mini DIN):

PIN 1:	TxD
PIN 2:	RxD
PIN 3:	Gnd
PIN 4:	not used

9 Error messages

Which are the causes leading to the error messages?
(<STOP> returns you to the start menu)

Error message after calibration:

- old buffer solution
- electrode defective
- electrode plug defective

- electrode defect

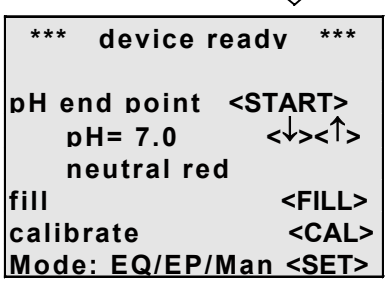
- electrode not connected
- wrong buffer solution
- old buffer solution
- electrode defective
- electrode plug defective or humid

- electrode defective or too old
- electrode not enough immersed

Error message after titration started:

- wrong titration reagent
- electrode has not overtaken the pH value of the sample
- electrode defective
- already titrated sample titration

quit error message



10 Maintenance and care of the Titration Unit TitroLine *easy*

To retain the function of the Titration Unit TitroLine *easy* the following inspection and maintenance work are to be carried out.

Note on wear and tear

In a larger sense, the valve and the glass cylinder are parts being subject to wear and tear; this means that their glass surfaces may wear down in use. This wear and tear may lead to an adulteration of the dosed volumes. For this reason, the dosing accuracy of the device should be checked.

Maintenance intervals

Normal operation:

➲ As a rule, the max. intervals for carrying out all maintenance work are 3 months.

In the case of special load:
Special load is present if, for instance, solutions are used which are suitable to attack glass, e.g. solutions containing alkali, fluoride or phosphate, or if the average use exceeds 40 titrations per day.

➲ Once per month, the dosing unit has to be inspected visually in order to check damages, and in addition a test according to DIN 12 650, Part 6 or Part 7, or ISO DIS 8655, Part 3, has to be carried out.
➲ Once per quarter the electrical contacts (plugs, stirrer, manual key button) have to be inspected for corrosion, if the titration unit is used in premises with an occasional occurrence of corrosive matters in their atmosphere.
➲ If there is suspicion that a solution is attacking the glass excessively, the maintenance intervals are to be reduced accordingly.

In case of disturbances:

➲ If a disturbance, a malfunction or another defect becomes obvious, the maintenance work has to be carried out immediately.
➲ If it has to be assumed that ⚠ safe operation is no longer possible ⚠, please refer to chapter 1 „Warning and safety information“.

Maintenance work to be carried out

➲ Check whether humidity has penetrated below the dosing unit. To do so remove the dosing unit (chapter 3, Fig. 1 to 4 resp. Fig. 7 to 10). If humidity can actually be found there, one can conclude that the piston in the cylinder is no longer tight.
➲ Check the hoses, the threaded connections and the seals for visible damage, contamination and leakage. Installation of the screw connections 🕮 Fig. 11.
➲ Check the electrical plug-in contacts for corrosion and mechanical damage.
➲ Defective parts have to be repaired or replaced by new parts. Defective glass parts have to be replaced in any case.

After each maintenance process the measurement-technical reliability according to DIN 12 650, Part 6 or Part 7, or ISO DIS 8 655, Part 3, has to be verified.

Use interruptions

➲ If the titration unit is not being used over a longer period of time, the liquids contained in the system have to be removed, and the titration unit has to be flushed out with distilled water. If this is omitted the piston may be destroyed, and the Titration Unit TitroLine *easy* will become untight. If the liquid is left in the system, one has to reckon with corrosion and an alteration of solutions used over the time. Since the state of the art does not provide plastic hoses which are absolutely free of diffusion occurrences, these precaution measures apply in particular to the hose-line section.

Cleaning

➲ The titration unit can be cleaned using a moist piece of cloth with normal household cleaning agents.
➲ The bottom and rear side have to be treated dry. In no case must liquid penetrate into the interior of the titration unit.

11 Replacing the dosing unit (disassembly and installation)

As a rule, the need for replacing the dosing unit occurs only rarely. The dosing unit has to be replaced, if such a replacement becomes necessary as a result of a defect or of an inspection of the titration unit.

The dosing unit is equipped with lateral ribs around its circumference, with one of these ribs being in double design. This double rib serves as a mark for the correct placement of the dosing unit (🕮 Fig. 17, Pos. 2 resp. Fig. 19, Pos. 2).

Important note: The disassembly of the dosing unit as such is only possible using a special tool (TZ 3630) and should only be done by experienced persons. The sealing lip of the PTFE piston and the sealings of the liquid system may be damaged or incorrectly positioned in the course of such a disassembly. As a result,
titration liquid would leak in unwanted places.

⚠ **Caution! Wear protective glasses!** ⚠

Runoff:

- ➲ Press the <FILL/F1> key for five seconds, and keep it depressed until the display shows <<change of the dosing unit>>.
  ⚠ **Caution, place a receptable under the titration tip!** ⚠
  When the piston moves upwards, titration solution will be dosed out of the burette tip.
- ➲ If <<unlock unit !!>> is displayed, the dosing unit has to be unlocked by rotating it by rotating it by 90° to the left (counter-clockwise, 🕮 Fig. 17).
- ➲ Press <START>. The motor of the Titration Unit TitroLine *easy* will now automatically move the dosing unit upwards. After the display shows <<remove unit / set on new unit>> remove the dosing unit (🕮 Fig. 18). The process is completed.

Detaching the dosing unit:
Fig. 17 Unlocking

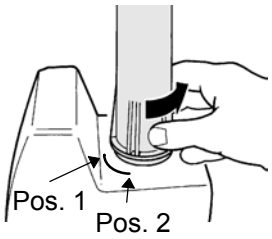
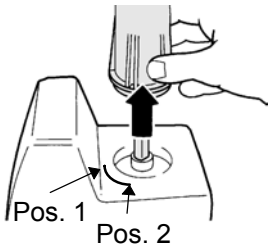


Fig. 18 Removal



Placement of the dosing unit
Fig. 19 Placement

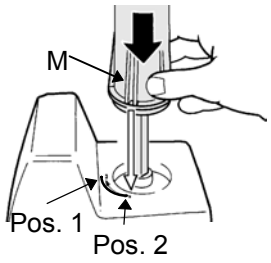
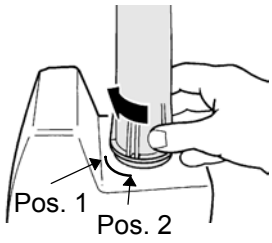


Fig. 20 Locking



- ➲ Set on new (inspected, if necessary repaired) dosing unit vertically. When doing so the „M“ double rib (🕮 Fig. 3) must point at the position 2 of the casing marking. Subsequently, switch the Titration Unit TitroLine *easy* on. The running motor will now pull the dosing unit downwards. If any noise should become audible at this point, please stop the process immediately by pressing the <START/STOP> key. The cause of this “rattling noise” will be eliminated by setting the dosing unit **vertically** on again!
- ➲ As soon as the dosing unit moving downwards has reached the edge of the casing, the display requests you to lock the dosing unit manually by rotating it by 90° to the right (clockwise, 🕮 Fig. 20).
- ➲ After locking it, start the rinsing and initial filling process using the <FILL / F1> (Rinsing/F1) key.

11.1 Replacing the titration solution

If titration solutions are to be changed, since differing analysis methods are used, one should first consider whether the time required for frequent changes is not more expensive than the acquisition of another dosing unit.

As a principle and in the case of all piston burette systems, a substitution of the titration solution by another one involves mixing and carry-over processes. The reason for this is the dead volume above the piston in the cylinder and in the hoses. The disturbances to be anticipated are the greater, the more the new solution differs from the previous type and concentration. In the case of highly different solutions, the first substitution liquid (rinsing) should be distilled water, and the new titration solution should be filled in only subsequently.

The possible disturbances are very much different in the individual cases and cannot be predicted without knowledge of the specific case. Therefore the replacement of titration solutions must always be performed under the supervision of experts who ensure the correctness of the future analyses.

If the decision to change the titration solution has been made, the first thing to do is to remove the dosing unit as it is described in chapters 11.1 or 11.2 respectively. If possible, the residue of the titration solution should be removed by hand by carefully pushing the projecting piston rod towards the hoses. When doing so, more liquid will leak out of the titration tip, and the residual volume is furthermore reduced. Removing the old titration solution can be accelerated by moving the piston rod of the dosing unit positioned top down. The suction hose is then immersed in the new solution or in water as intermediate liquid. By moving the piston several times in both directions (pumping) the previous liquid is gradually replaced by new liquid. Subsequently, the dosing unit is set on again according to the description in chapter 11.1 and 11.2.

12 Storage, transportation and environment

If the titration units are to be stored temporarily or transported, the best solution to protect the devices is to use the original packing. In many cases the original packing will no longer be available, so that an alternative packing has to be put together. Welding the titration units in a foil is an advantageous solution. Prior to this it has to be made sure that no liquid is left in the dosing unit.

If the titration unit is to be sent to a service shop, it is necessary to indicate the titration solution last used on the accompanying documents or on the piston burette. Otherwise the service shop will dispose of the parts damaged or to be replaced as special waste at the charge of the customer.

The room selected for storage should provide the following conditions:

- ➲ temperature between + 10 and + 40 °C for operation and storage,
- ➲ humidity according to EN 61 010, Part 1:
  maximal relative humidity 80 % for temperatures up to 31 °C,
  linear decrease down to 50 % relative humidity at a temperature of 40 °C.

Although you will use your titration device for a very long time, so that the following information comes far too early: But if your system has reached the end of its life, please observe the regulations applicable for your land and town as to its disposal.

13 Scope of delivery, accessories and spare parts

Delivery scope

- Basic device (TitroLine *easy*)
- Dosing unit 20 ml TZ 3130
  including hoses and screw connectors fitted ready for use on the titration device
- Stand Rod TZ 3665
  including 2 pieces M 3 x 10 mm fastening screws, DIN 964
- Electrode / titration tip holder TZ 3660
- Titration tip TZ 3620

All parts included in the scope of delivery are available as spare parts under the stated TZ number.

Accessories

BlueLine12 pH electrode

TZ 2004 Bottle set for titration agent with brown-glass bottle
TZ 2007 Bottle set for titration agent with square Duran bottle
TZ 2008 Bottle set-on with S 40 thread for reagent bottle, e.g. Merck make
TZ 2005 Bottle set-on with GL 45 thread for reagent bottle, e.g. Riedel-de Haën, Schott make

TZ 3025 Stirrer TM 96 with PTFE stirring rod
TZ 3460 Printer with RS-232-C interface, incl. printer cable
TZ 3095 1.5 m data cable RS-232-C with plug for printer connection:
1. side: 4-channel mini DIN plug
2. side: 25-channel sub-miniature D socket
TZ 3098 Data cable set:
1.5 m data cable RS-232-C: 1. side: 4-channel mini DIN plug
2. side: 9-channel sub-miniature D socket
Adapter: 9-channel plug → 25-channel socket
TZ 3680 Manual key button

Spare parts

TZ 3000 valve
TZ 3280 hose set
TZ 3630 mounting wrench
TZ 3660 electrode / titration tip holder
TZ 3665 stand rod
TZ 3680 manual key button
TZ 3130 dosing unit 20 ml, complete assembled

14 Elimination of disturbances

The display does not respond to keys being pressed, the display is dark.

The internal program is disturbed (e.g. by electrostatic loading or a mains overvoltage.	Switch the device off, and switch it on again after 10 seconds.
The display contrast is misadjusted.	Use the knurled knob at the right sid of the bottom to adjust the contrast.

The stirrer does not work.

The connection contacts are dirty.	Clean contacts.

The dosing unit is not properly filled.

The reagent bottle is empty.	Replace or refill the reagent bottle.
The hose is not immersed deeply enough in the reagent bottle.	Immerse the hose deeper in the bottle, or fill up reagents.
Hoses of the dosing unit are mixed up.	Exchange hose connections.
The dosing unit is not properly locked.	Lock the dosing unit by a quarter rotation at the lower position

Air bubbles in the titration system

The valve is defective.	Exchange 3/2-way valve.
The hose connections are not tight.	Check: Has the hose been pulled out of threaded connection? Screw hose manually on.
	Replace hoses including threaded connections.

When setting on a new dosing unit, the piston rod is not properly pulled in, the device rattles.

Inclined piston rod.	Set on piston rod vertically again.

Titration solution is not titrated / dosed.

The dosing unit is not properly filled.	Perform initial filling.
The dosing unit is not properly locked.	Lock dosing unit in the lower position by a quarter rotation to the right (Fig. 20).
The hose or the titration tip are wrinkled or blocked.	Check clear passage through hose and titration tip, replace if necessary.
The system contains air bubbles.	Please refer to „Air bubbles in the dosing system“.
Undissolved parts in the titration solution.	Filter or replace titration solution.

The data transfer to the printer / computer does not work.

Set transfer parameters properly.	Settings: 4800 baud, 7 data bits, no parity, no handshake.
Are you using a suitable cable?	Use a TZ 3095 for the printer or a TZ 3096 / 3097 for the PC.
Are the cables properly connected?	The **lower** socket is the RS-232-C interface.
	Check cable connection, are the screws on the PC side tightened??
	PC: „COM 1“ and „COM 2“ possibly were mixed up!
Defective cable?	Replace cable.
Are the cables properly connected?	Switch the devices off, switch them on again after 10 seconds.