Metrohm

METROHM AG CH-9101 Herisau (Switzerland)

721 NET Titrino

Series 01 ...

Instructions for Use 8.721.1003

95.03 Ti

Instructions for Use of 721 NET Titrino

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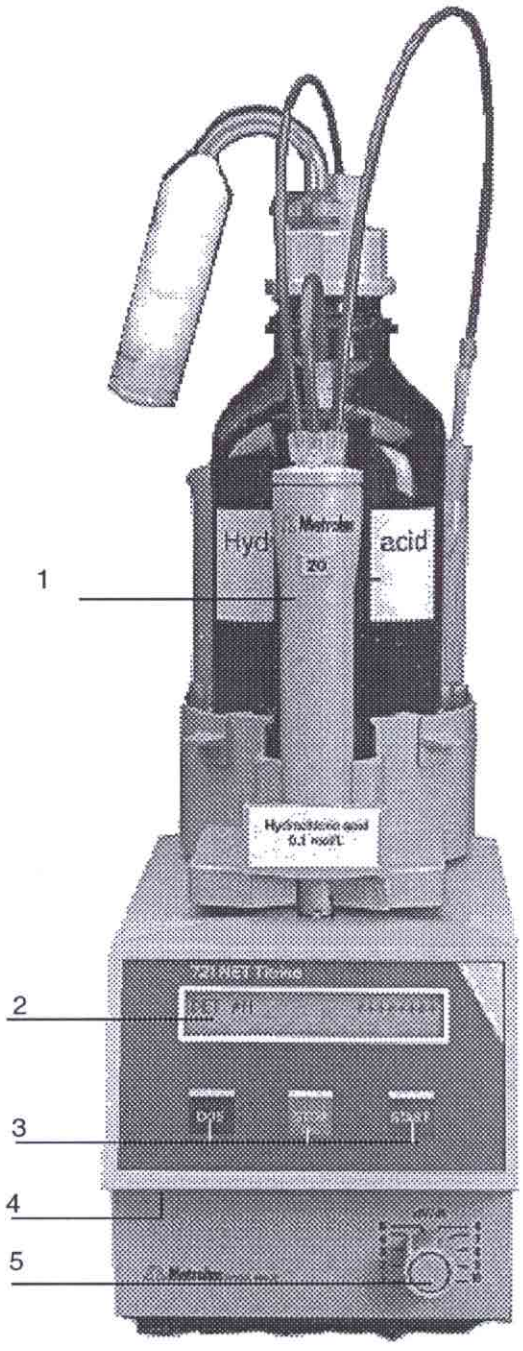
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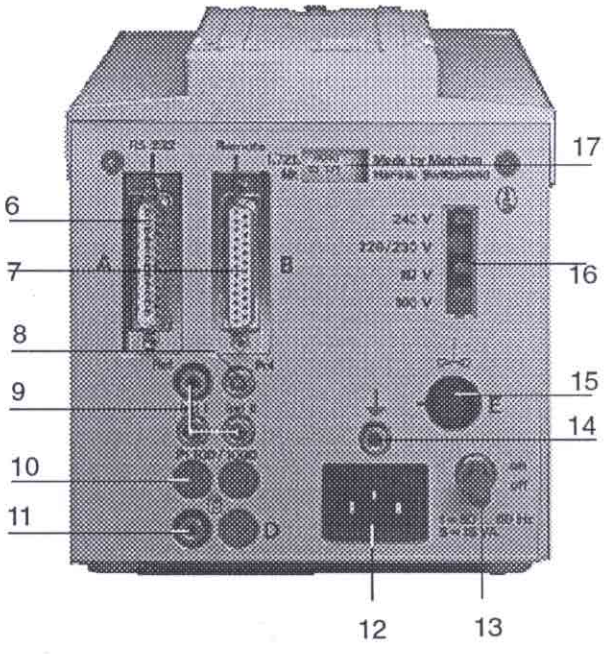
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1. Overview

Front view of instrument:

(1) **Exchange Unit**

(2) **Display**

(3) **Control keys of Titrino**

DOS: Dispensing is performed as long as <DOS> is pressed. Used to prepare the Exchange Unit. The dispensing rate can be set with potentiometer ⑤ .

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

START: Starts procedures, e.g. titration, conditioning.

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

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

Rear view of instrument:

6 **RS232 Interface**
for the connection of a printer and balance or a computer

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

8 **Connection for polarized electrodes**
for measured quantities Ipol and Upol

9 **Connection for potentiometric electrodes**
for measured quantities pH and U (voltage). 2 measuring inputs which can be used either separately or as a single differential potentiometric input for non-aqueous titrations, see also page 80.
Important: If work is performed in the same measuring vessel with both measuring inputs, the same reference electrode must be used.

10 **Connection for temperature sensor**
Pt100 or Pt1000

11 **Analog output**
for the connection of a recorder

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

13 **Mains switch**

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

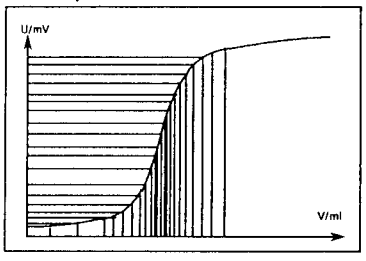
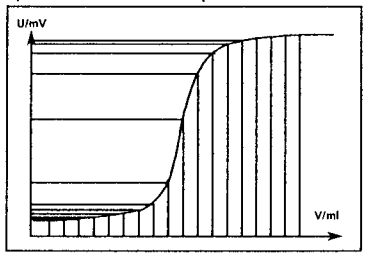
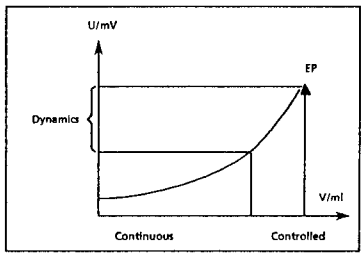
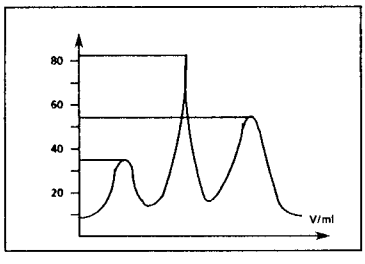
15 **Connection for 728 Magnetic Stirrer, 722 Rod Stirrer, 727 or 703 Ti Stand**
Supply voltage: +9 VDC ($I \leq 200$ mA)

16 **Display of the set mains voltage**
Before switching on for the first time, check that the set mains voltage matches the voltage of your power supply. If this is not the case, disconnect mains cable and change voltage.

17 **Rating plate**
with fabrication, series and instrument number

2. Titration modes

2.1 Overview

	DET Dynamic Equivalence point Titration	MET Monotonic Equivalence point Titration	SET Set Endpoint Titration
Reagent feeding	Variable volume increments, depending on the slope of the curve:  Parameters: meas.pt.density Measuring point density min.incr. Minimum Increment titr.rate Dispensing rate for increments	Constant volume increments, independent of the slope of the curve:  Parameters: V step Volume increment titr.rate Dispensing rate for increments	Continuous and pulse dosing:  Parameters: dynamics Control range max.rate Maximum rate min.rate Minimum rate
Acquisition of measured values	Drift controlled (equilibrium titration) and/or after a fixed equilibration time. Parameters: signal drift Drift threshold equilibr.time Waiting time	Drift controlled (equilibrium titration) and/or after a fixed equilibration time. Parameters: signal drift Drift threshold equilibr.time Waiting time	Continuous.
EP-Recognition and Evaluation	The evaluation of EP's is based on the zero crossing of the second derivative with a Metrohm correction for the distortion of the curve from superimposed jumps. Can be combined with selectable recognition criteria.  Parameters: EPC Preset EP recognition criteria; compared to ERC. EP recognition all, first, last, greatest, window	Fortuin interpolation for EP determination (see Metrohm Bulletin, Vol. 2, 1971) combined with selectable recognition criteria. The ERC has to be calculated from the differences of measured values, see page 7. Parameters: EPC Preset EP recognition criteria; compared to ERC. EP recognition all, first, last, greatest, window	Volume of the last measured value after the stop criteria have been met.
Application	– Suitable titration mode for most problems. Specially recommended if jumps lie very close together and for very flat jumps. – The reagent feeding algorithm works properly only if the curve does not deviate markedly from S-shape.	– For slow titration reactions (diazotations, coupling reactions) and/or sluggish electrode response. – If a standard method requires this mode.	– For very rapid determinations if the endpoint does not shift in the course of the determination series. – If a standard method requires this mode. – If an excess of titrant must be avoided.

2.2. Incremental titrations: DET and MET

Titration sequence of DET and MET

<START>

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

(Output activating pulse)

(Start delay)

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

(Inquiry of ident)

(Inquiry of sample size)

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

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

(Start conditions)

Titration:
Dispense increments
Acquire measured value

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

Stop conditions

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

Calculations

Finally, the the calculations are carried out and the data outputted.

Data output

Reagent feeding and EP evaluation of DET

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

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

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

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

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

EPC — Equivalence Point Criteria.
The *preset* EPC is compared to the *found* ERC (Equivalence point Recognition Criteria) for each evaluated equivalence point. The ERC is given in the mplist report (measuring point list). The ERC is the first derivative of the titration curve overlayed with a mathematical function so that small maxima become higher and great maxima smaller. EP's whose ERC is below the preset EPC will not be recognized.
For most cases the standard value of 5 is suitable.

Reagent feeding and EP evaluation of MET

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

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

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

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

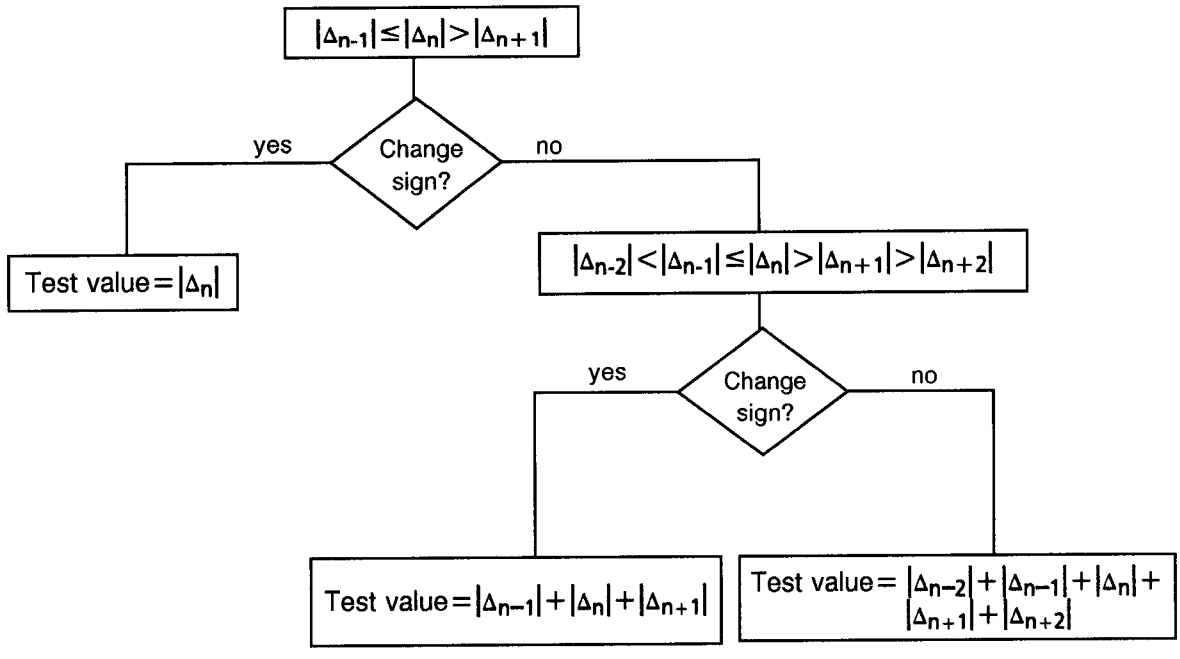
V_{EP}: EP volume
V_0: Total dispensed volume before Δ_n
ΔV: Volume increment
ρ : Interpolation factor (Fortuin)

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

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

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

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



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

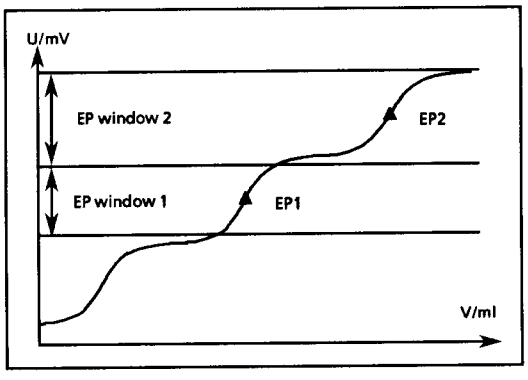
Selectable EP recognition criteria for DET and MET

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

EP windows

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

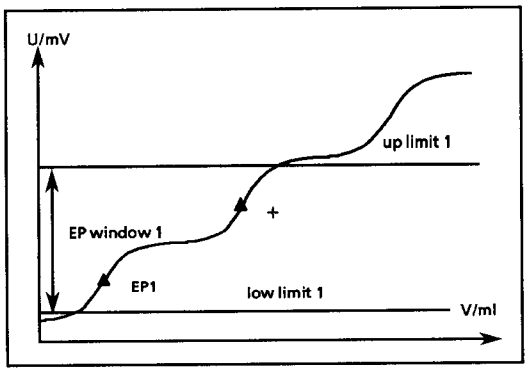
An EP window defines the range in which an EP is expected. EP's outside these ranges are not recognised. Windows are defined on the measured value axis.



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

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

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



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

Fix EP's

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

pK and HNP evaluation

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

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

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

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

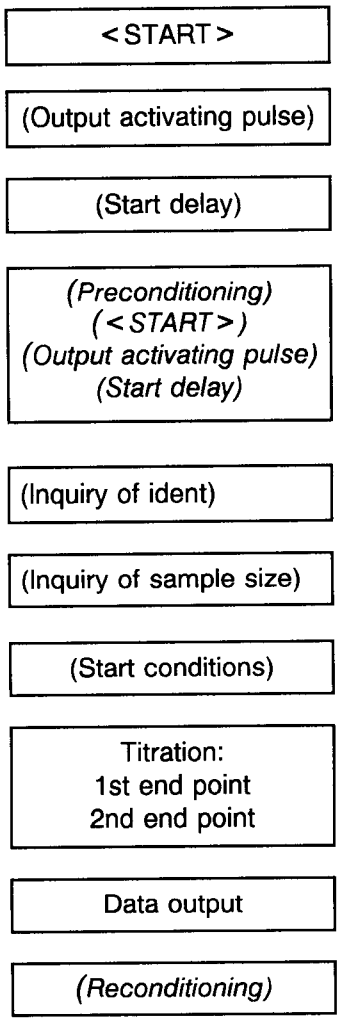
A start volume must be smaller than half of the equivalence point volume of the first EP.

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

2.3 Endpoint titration: SET

Titration sequence of SET

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



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

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

After the start of the titration, the activate pulse is outputted (possibilities to activate pulse, see page 88) and the start delay time is waited out.

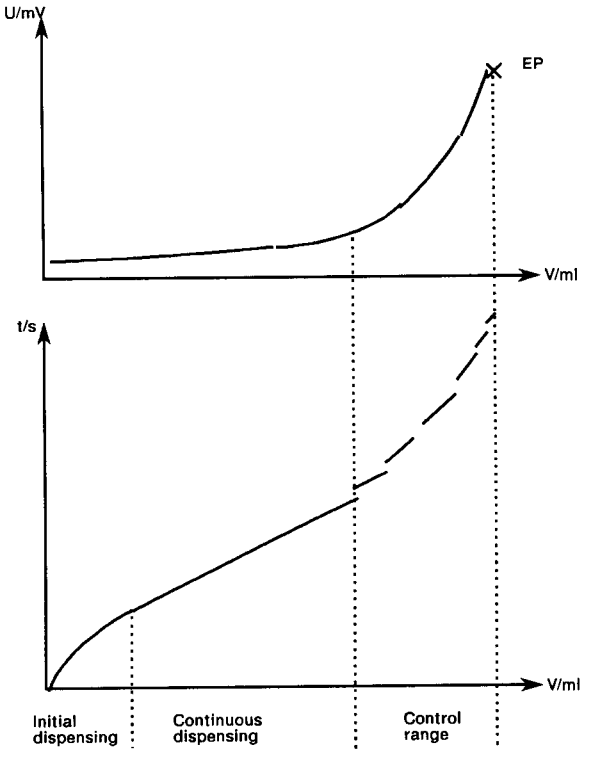
Then the temperature is measued (if a T sensor is connected), "req.ident" and "req.smpl size" are requested and the start conditions are executed: The start volume is dispensed and the pause is waited out. During dispensing of the start volume, no control is exerted. Then the titration is performed to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

At the end, the data are outputted.

Control parameters

The control parameters can be set separately for each end point. Optimize your control parameters for routine analyses for samples with a rather low content.

During the titration, reagent dispensing occurs in 3 phases:



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

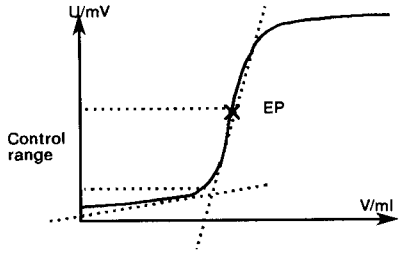
2) Continuous dispensing:
Dispensing is performed at the maximum rate "max.rate" until the control range (dynamics) is reached.

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

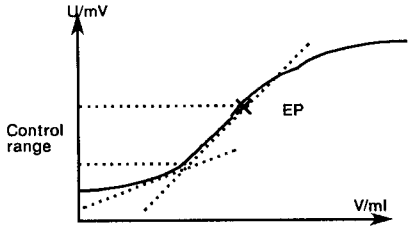
Trial settings for the size of the control range (dynamics)

Set a large control range for steep curves. Relatively flat curves, on the other hand, need a smaller control range. You can get an initial, good approximation for the start of the control range from the intersection point of the tangents:

"steep" curves



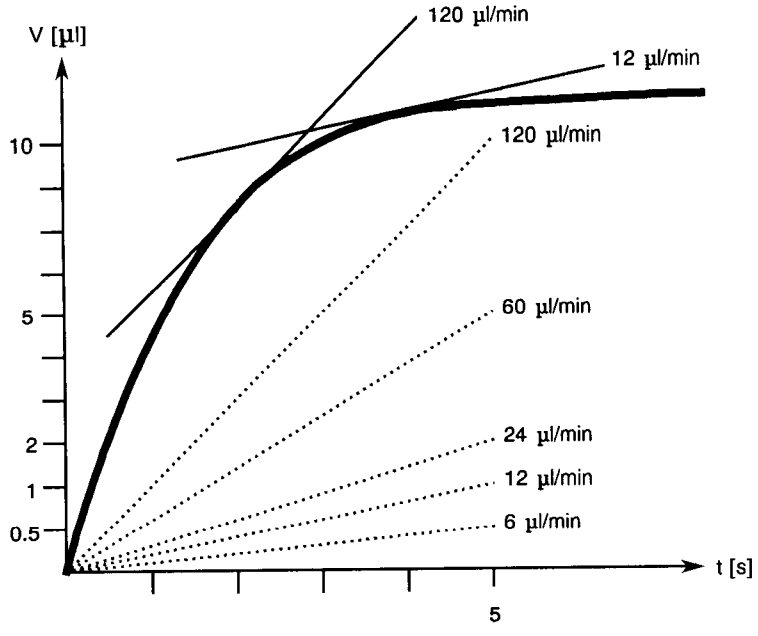
"flat" curves



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

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

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



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

If you have entered the end point and the control range (dynamics), the default values for the other control parameters should suffice for the first titration. If you encounter difficulties in optimizing your titration, the following Table will be of use:

How to proceed if ...

Problem	Possible causes and corrective measures
Dispensing at the end too long and with too small increments. "Never ends!"	– Increase "min.rate". Perform an experiment with a much higher min.rate. – Change switch-off criterion. Attempt, e.g. to increase the stop drift or use a shorter t(delay) as stop criterion. – Possibly pass an inert gas through the titration vessel.
"Overshoots". Titration is not controlled, i.e. at the end single pulses are not dispensed.	– Lower "max.rate". – Set larger control range. – Set "min.rate" much lower. – Optimize arrangement of electrode and burette tip and improve stirring, see page 118. This is particularly important with very fast titration reactions and with steep curves.
Titration time is too long.	– Set higher "min.rate". – Set higher "max.rate". – Lower "dynamics".
Scatter in titration results is too great.	– Set "min.rate" lower.

2.4 Measuring: MEAS

Sequence of MEAS

<START>

After the start,the activating pulse is outputted, then the start delay time is waited out.
Then the temperature is measued (if a T sensor is connected). This value is used for temperature compensation in pH measurements.

(Output activating pulse)

(Start delay)

Then "ident" and "smpl size" are requested.

(Inquiry of ident)

(Inquiry of sample size)

Acquire measured value

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

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

The criterion which is first met applies. If "signal drift" and "equilibration time" are set to "OFF", the measurement doesn't stop (infinte measurement).

Calculations

Finally, the the calculations are carried out and the data outputted.

Data output

2.5 pH calibration: CAL

Calibration sequence

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

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

In calibrations with the sample changer, there are no hold points for entries in the calibration sequence. Those values which have previously been entered are valid.

2.5 pH calibration: CAL

Calibration sequence

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

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

In calibrations with the sample changer, there are no hold points for entries in the calibration sequence. Those values which have previously been entered are valid.

3. Operation via RS232 interface

3.1 General rules

The Titrino has an extensive remote control facility that allows full control of the titrator via the RS232 interface, i.e. the titrator can receive data from an external controller or it can send data to an external controller. C_R and L_F are used as terminators for the data transfer. Tirino sends 2xC_R and L_F as termination of a data block, to differentiate between a data line which has C_R and L_F as terminator. The controller terminates its commands with C_R and L_F. If the controller sends more than one command per line, the character ';' is used as separator between the commands.

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

&Mode.Select "MET"

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

&M.S"MET" .

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

&Config

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

&Config.RSSet

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

&Config.RSSet.Baud

or regarding the setting of the parity

&Config.RSSet.Parity

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

&Config.RSSet.Baud

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

&Config.RSSet.Baud $Q Q for Query

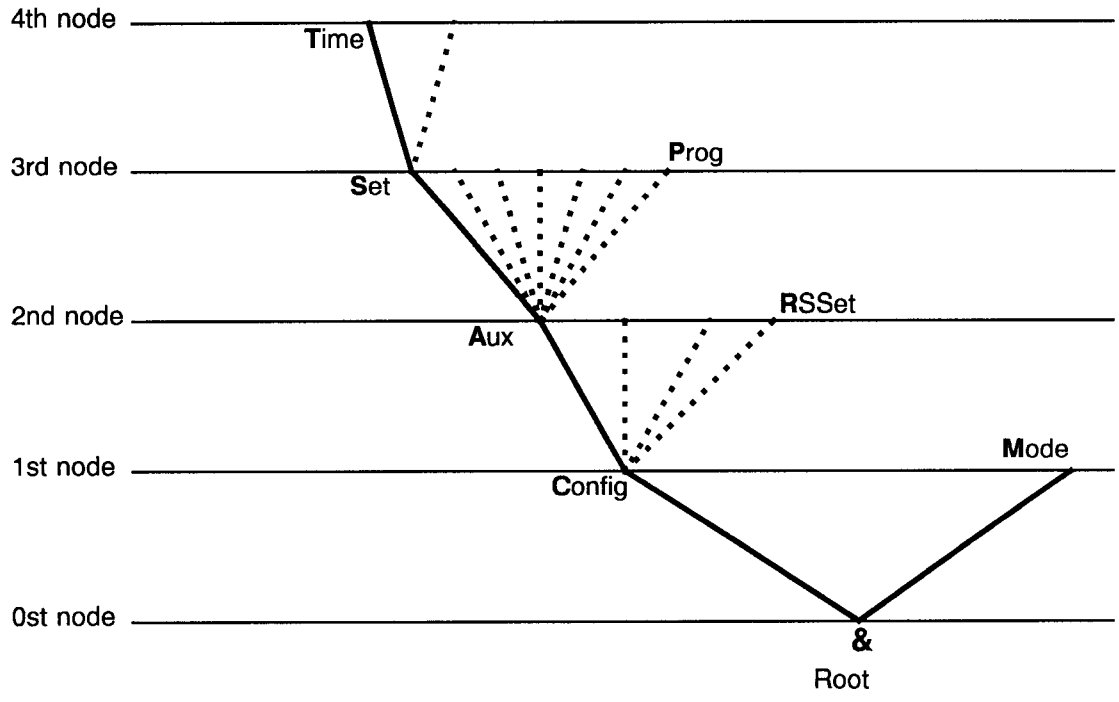
$Q triggers the output of the value from the Titrino. Entries that are introduced with the character dollar ($) trigger something. They are thus called **triggers** in what follows.

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

&Config.RSSet.Baud "9600"

3.1.1 Call up of objects

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



Rules:

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

Examples:

Call up of the time:
&Config.**A**ux.**S**et.**T**ime
or **&C.A.S.T**

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

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

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

Entry of a different time:
"08:15"

– New objects can also be addressed relative to old objects: **A preceding point** moves one node **forwards** in the tree.	From the root to the node 'Aux': **&C.A** Forwards from the node 'Aux' to 'Set': **.S**
More than one preceding point moves one node **backwards** in the tree. n nodes backwards require n + 1 preceding points.	Jump from 'Set' onto the node 'Aux' and selection of a new object at this node 'Prog': **..P** Jump from the object 'Prog' over the node 'Aux' to the node 'Config' and to the new node 'RSSet': **...R**
– If a jump is to be made back to the root, a preceding & is entered.	Change from the node 'RSSet' via the root into the node 'Mode': **&M**

3.1.2 Triggers

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

The following triggers are possible:

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

The triggers $G, $S and $H, $C are linked to objects, see overview table, pages 24ff.

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

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

3.1.3 Status and error messages

In order to have an efficient control by an external control device, it must also be possible to query status conditions; they provide information on the status of the Titrino. The trigger $D initiates output of the status. Status messages consist of the global status, the detailed status and eventual error messages, e.g. $S.Mode.MET;E20. The global status informs on the activity of the process, while the detailed status conditions show the exact activity within the process.

The following **global status conditions** are possible:

$G	Go:	The Titrino is executing the last command.
$H	Hold:	The Titrino has been holded ($H or by an error which effects the hold status)
$C	Continue:	The Titrino has been restarted actively after hold
$R	Ready:	The Titrino has executed the last command and is ready
$S	Stop:	A process has been stopped in an "unnatural manner".

Detailed status conditions

Status conditions of the global $G:

$G .Mode.DET	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in the DET mode, requesting Id1 after titration start.
	.Id2:	Instrument in the DET mode, requesting Id2 after titration start.
	.Id3:	Instrument in the DET mode, requesting Id3 after titration start.
	.Smpl:	Instrument in the DET mode, requesting sample size after titration start.
	.Unit:	Instrument in the DET mode, requesting unit of sample size after titration start.
	.Start:	Instrument in the DET mode, processing the start conditions.
	.Titr:	Instrument in the DET mode, titrating.
$G .Mode.MET	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in the MET mode, requesting Id1 after titration start.
	.Id2:	Instrument in the MET mode, requesting Id2 after titration start.
	.Id3:	Instrument in the MET mode, requesting Id3 after titration start.
	.Smpl:	Instrument in the MET mode, requesting sample size after titration start.
	.Unit:	Instrument in the MET mode, requesting unit of sample size after titration start.
	.Start:	Instrument in the MET mode, processing the start conditions.
	.Titr:	Instrument in the MET mode, titrating.
$G .Mode.SET	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in the SET mode, requesting Id1 after titration start.
	.Id2:	Instrument in the SET mode, requesting Id2 after titration start.
	.Id3:	Instrument in the SET mode, requesting Id3 after titration start.
	.Smpl:	Instrument in the SET mode, requesting sample size after titration start.
	.Unit:	Instrument in the SET mode, requesting unit of sample size after titration start.
	.Start:	Instrument in the SET mode, processing the start conditions.
	.SET1:	Instrument in the SET mode, titrating to the first end point.
	.SET2:	Instrument in the SET mode, titrating to the second end point.
	.Cond.Ok:	Instrument in the SET, conditioning, end point reached (after the first startup from the standby mode).
	.Cond.Prog:	Instrument in the SET mode, conditioning, end point not reached (Conditioning progressing).
$G .Mode.MEAS	.Inac:	Instrument at the beginning or the end of a titration.
	.Req .Id1:	Instrument in the MEAS mode, requesting Id1 after start.
	.Id2:	Instrument in the MEAS mode, requesting Id2 after start.
	.Id3:	Instrument in the MEAS mode, requesting Id3 after start.
	.Smpl:	Instrument in the MEAS mode, requesting sample size after start.
	.Unit:	Instrument in the MEAS mode, requesting unit of sample size after start.
	.Meas:	Instrument in the MEAS mode, measuring.

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

Status conditions of the global $H:

$H .Mode.DET	.Inac:	Instrument in the DET mode, has been holded at the beginning.
	.Start:	Instrument in the DET mode, has been holded during the start conditions.
	.Titr:	Instrument in the DET mode, has been holded during titration.
$H .Mode.MET	.Inac:	Instrument in the MET mode, has been holded at the beginning.
	.Start:	Instrument in the MET mode, has been holded during the start conditions.
	.Titr:	Instrument in the MET mode, has been holded during titration.
$H .Mode.SET	.Inac:	Instrument in the SET mode, has been holded at the beginning.
	.Start:	Instrument in the MET mode, has been holded during the start conditions.
	.SET1:	Instrument in the SET mode, has been holded during titration to the first endpoint.
	.SET2:	Instrument in the SET mode, has been holded during titration to the second endpoint.
	.Cond:	Instrument in the SET mode, has been holded during conditioning.
$H .Mode.MEAS	.Inac:	Instrument in the MEAS mode, has been holded at the beginning.
	.Meas:	Instrument in the MEAS mode, has been holded during measurement.
$H .Mode.CAL	.Inac:	Instrument in the CAL mode, has been holded at the beginning.
	.Meas.Buf1:	Instrument in the CAL mode, has been holded during measurement of buffer 1.
	.Meas.Buf2:	Instrument in the CAL mode, has been holded during measurement of buffer 2.
	etc.	
$H .Assembly.Bur.ModeDis:		Burette has been holded in the Dis mode.

Status conditions of the global $C:

The status conditions of the global $C are identical with the ones of the global status $G. They appear when the process has been restarted actively from the status "Hold" ($C or automatically after elimination of an error).

Status conditions of the global $R:

$R .Mode.XXXX.QuickMeas: Quick manual measurement from the initial status in mode XXXX.
$R .Mode.DET .Inac: Instrument in the DET mode, inactive.
$R .Mode.MET .Inac: Instrument in the MET mode, inactive.
$R .Mode.SET .Inac: Instrument in the SET mode, inactive.
.Cond.Ok: Instrument in the SET mode, conditioning, endpoint reached.
.Cond.Prog: Instrument in the SET mode, conditioning, endpoint not reached.
$R .Mode.MEAS.Inac: Instrument in the MEAS mode, inactive.
$R .Mode.CAL .Inac: Instrument in the CAL mode, inactive.
$R .Assembly.Bur .ModeDis: Burette in the Dis mode, inactive.

Status conditions of the global $S:

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

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

Error messages:

Error messages are added to the status messages and separated from them by the sign ";".

E20 Check exchange unit
Exit: Mount Exchange Unit (properly).
E21 Check electrode, short circuit
Exit: Rectify fault or &m $S.
E22 Check electrode, break
Exit: Rectify fault or &m $S.
E23 Division by zero.
Exit: The error message disappears on next startup or on recalculation.
E26 Manual stop.
Exit: The error message disappears on next startup.
E27 Stop V reached in SET.
Exit: The error message disappears on next startup.
E28 Wrong object call up
Exit: Send correct path for object. Start path at root.
E29 Wrong value or no value allowed.
Exit: Send correct value or call up new object.
E30 Wrong trigger, this trigger is not allowed or carrying-out of action not possible.
Exit: Send correct trigger (exception: $D) or call up new object.
E31 Command is not possible in active status. Repeat command in inactive status.
Exit: Send new command.
E32 Command is not possible during titration. Repeat command during the conditioning phase or in inactive status.
Exit: Send new command.
E33 Value has been corrected automatically.
Exit: Send new command.
E34 Instrument at the end of the titration and sample data is edited; the instrument at rest or editing during filling.
Exit: &m $S.

RS receive errors:

E36 Parity
E37 Stop Bit
} Exit: Switch Titrino OFF/ON and ensure settings of appropriate parameters at both devices are the same.

E38 Overrun error. At least 1 character could not be read.
Exit: Switch Titrino OFF/ON.

E39 The internal receive buffer of the Titrino is full (>82 characters).
Exit: Switch Titrino OFF/ON.

RS send errors:

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

E43 The transmission of the Titrino has been interrupted with XOFF for at least 3 s.
Exit: Send XON or switch Titrino OFF/ON.

E44 The RS interface parameters are no longer the same for both devices. Reset.

E45 The receive buffer of the Titrino contains an incomplete command (L_F missing). Sending from the Titrino is therefore blocked.
Exit: Send L_F or switch Titrino OFF/ON.

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

E121: Measuring point list overflow (more than 500 measuring points).
Exit: The error message disappears on next startup.

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

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

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

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

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

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

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

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

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

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

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

3.2 Remote control commands

3.2.1 Overview

Object	Function	Input range	see...
&	**Root**		
.Mode	**Mode**	$G, $S, $H, $C	3.2.2.1
.QuickMeas	Quick measurement in inactive state	$G, $S	3.2.2.2
.Select	Selection of the mode	DET, MET, SET, MEAS, CAL	3.2.2.3
.DETQuantity	Measured quantity for DET	pH, U, Ipol, Upol	3.2.2.3
.METQuantity	Measured quantity for MET	pH, U, Ipol, Upol	3.2.2.3
.SETQuantity	Measured quantity for SET	pH, U, Ipol, Upol	3.2.2.3
.MEASQuantity	Measured quantity for MEAS	pH, U, Ipol, Upol, T	3.2.2.3
.Name	Name of the current method	read only/read + write	3.2.2.4
.Parameter*	Parameters of the current method, depend on the mode, see pages 25 to 28		
.Def	**Definitions for the data output**		
.Formulas	**Calculation formulas**		
.1	For result 1		
.Formula	Calculation formula	special	3.2.2.5
.TextRS	Text for the result designation	up to 8 ASCII char	3.2.2.5
.Decimal	Decimal places	0...5	3.2.2.5
.Unit	Unit for the result	up to 6 ASCII char	3.2.2.5
	up to 9 results		
.ComVar	**Assignment of common variables**		
.C30	Common variable C30	CXX, EPX, RSX	3.2.2.6
	up to C39		
.Report	**Data output at the end of titration**		
.Assign	Assignment	depends on mode	3.2.2.7
.CFmla	**Calculation constants**		
.1	Calculation constant C01		
.Value	Value for C01	0... ± 999 999	3.2.2.9
	up to C19		
UserMeth	**Management of the method memory**		
.FreeMem	Memory still available	read only	3.2.2.10
.Recall	Recall method	$G	3.2.2.11
.Name	Method identification	up to 8 ASCII char	3.2.2.11
.Store	Store method	$G	3.2.2.11
.Name	Method identification	up to 8 ASCII char	3.2.2.11
.Delete	Delete method	$G	3.2.2.11
.Name	Method identification	up to 8 ASCII char	3.2.2.11
.DelAll	Delete all methods	$G	3.2.2.11
.List	List of all methods in the method memory		
.1	Method 1		
.Name	Name of the method	read only	3.2.2.12
.Mode	Mode	read only	3.2.2.12
.Quantity	Measured quantity	read only	3.2.2.12
.Bytes	Bytes used from the mewthod memory	read only	3.2.2.12
.Checksum	Checksum of the method for all the methods	read only	3.2.2.12

Object	Function	Input range	see...
*Parameter	**Tree part "Parameters for DET"**		
.TitrPara	**Titration parameters**		
.MptDensity	Measuring point density	0...9	3.2.2.13
.MinIncr	Minimum Increment	0...999.9	3.2.2.13
.DosRate	Dispensing rate for increments	0.01...150.0, max.	3.2.2.14
.SignalDrift	Drift for measured value acquisition	depends on meas quant.	3.2.2.15
.UnitSigDrift	Unit of the measured value drift	read only	3.2.2.15
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.15
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.16
.V	Volume for the absolute start volume	0...999.99	3.2.2.16
.Factor	Factor for the relative start volume	0... ± 999 999	3.2.2.16
.Rate	Dispensing rate	0.01...150, max.	3.2.2.16
.Pause	Waiting time	0...999999	3.2.2.17
.MeasInput	Measuring input	1, 2, diff.	3.2.2.18
.Ipol	Polarisation current	0... ± 127	3.2.2.18
.Upol	Polarisation potential	0... ± 1270	3.2.2.18
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.18
.Temp	Titration temperature	–170.0...500.0	3.2.2.19
.StopCond	**Stop conditions**		
.VStop	Stop volume		
.Type	Type of stop volume	abs., rel., OFF	3.2.2.20
.V	Volume for the absolute stop volume	0...9999.99	3.2.2.20
.Factor	Factor for the relative stop volume	0... ± 999 999	3.2.2.20
.MeasStop	Stop measured value pH, U, I	depends on meas quant.	3.2.2.21
.UnitMStop	Unit of the stop measured value	read only	3.2.2.21
.EPStop	Stop after a number of end points	1...9, OFF	3.2.2.22
.FillRate	Filling rate after the titration	0.01...150.0, max.	3.2.2.23
.Evaluation	**Evaluation**		3.2.2.25
.EPC	EP criterion	0...200	3.2.2.25
.Recognition	EP recognition		
.Select	Type of EP recognition	all, greatest, last, window, OFF	3.2.2.25
.Window	Window		
.1			
.LowLim	Lower limit window 1	depends on meas quant.	3.2.2.25
.UpLim	Upper limit window 1	depends on meas quant.	3.2.2.25
	up to 9 windows		
.FixEP	Fix end points		
.1	Fix EP1		
.Value	Measured value for fix EP1	depends on meas quant.	3.2.2.25
	up to 9 fix EP's		
.pK	pK or HNP evaluation	ON, OFF	3.2.2.25
.Presel	**Preselections**		
.IReq	Request of Id's after start	id1, id1&2, all, OFF	3.2.2.26
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.26
.ActPulse	Output of a pulse	ON, OFF	3.2.2.27

Object	Function	Input range	see...
*Parameter	**Tree part "Parameters for MET"**		
.TitrPara	**Titration parameters**		
.VStep	Volume increment	0...9.999	3.2.2.13
.DosRate	Dispensing rate for increments	0.01...150.0, max.	3.2.2.14
.SignalDrift	Drift for measured value acquisition	depends on meas quant.	3.2.2.15
.UnitSigDrift	Unit of the measured value drift	read only	3.2.2.15
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.15
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.16
.V	Volume for the absolute start volume	0...999.99	3.2.2.16
.Factor	Factor for the relative start volume	0... ± 999 999	3.2.2.16
.Rate	Dispensing rate	0.01...150, max.	3.2.2.16
.Pause	Waiting time	0...999999	3.2.2.17
.MeasInput	Measuring input	1, 2, diff.	3.2.2.18
.Ipol	Polarisation current	0... ± 127	3.2.2.18
.Upol	Polarisation potential	0... ± 1270	3.2.2.18
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.18
.Temp	Titration temperature	–170.0...500.0	3.2.2.19
.StopCond	**Stop conditions**		
.VStop	Stop volume		
.Type	Type of stop volume	abs., rel., OFF	3.2.2.20
.V	Volume for the absolute stop volume	0...9999.99	3.2.2.20
.Factor	Factor for the relative stop volume	0... ± 999 999	3.2.2.20
.MeasStop	Stop measured value pH, U, I	depends on meas quant.	3.2.2.21
.UnitMStop	Unit of the stop measured value	read only	3.2.2.21
.EPStop	Stop after a number of end points	1...9, OFF	3.2.2.22
.FillRate	Filling rate after the titration	0.01...150.0, max.	3.2.2.23
.Evaluation	**Evaluation**		3.2.2.25
.EPC	EP criterion	depends on meas quant.	3.2.2.25
.Recognition	EP recognition		
.Select	Type of EP recognition	all, greatest, last, window, OFF	3.2.2.25
.Window	Window		
.1			
.LowLim	Lower limit window 1	depends on meas quant.	3.2.2.25
.UpLim	Upper limit window 1	depends on meas quant.	3.2.2.25
	up to 9 windows		
.FixEP	Fix end points		
.1	Fix EP1		
.Value	Measured value for fix EP1	depends on meas quant.	3.2.2.25
	up to 9 fix EP's		
.pK	pK or HNP evaluation	ON, OFF	3.2.2.25
.Presel	**Preselections**		
.IReq	Request of Id's after start	id1, id1&2, all, OFF	3.2.2.26
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.26
.ActPulse	Output of a pulse	ON, OFF	3.2.2.27

Object	Function	Input range	see...
***Parameter**	**Tree part "Parameters for SET"**		
.SET1	**Control parameters for EP1**		
.EP	End point 1	depends on meas quant.	3.2.2.28
.UnitEp	Unit of the end point EP1	read only	3.2.2.28
.Dyn	Dynamics	depends on meas quant.	3.2.2.29
.UnitDyn	Unit of dynamics	read only	3.2.2.29
.MaxRate	Maximum dispensing rate	0.01...150, max.	3.2.2.29
.MinRate	Minimum dispensing rate	0.01...999.9	3.2.2.29
.Stop	Titration stop		
.Type	Type of stop criterion	drift, time	3.2.2.30
.Drift	Stop drift	1...999	3.2.2.30
.Time	Switch-off delay time	0...999, inf	3.2.2.30
.StopT	Stop time	0...999 999, OFF	3.2.2.30
.SET2	**Control parameters for EP2**, identical to SET1		
.TitrPara	**Titration parameters**		
.Direction	Titration direction	+, –, auto	3.2.2.31
.StartV	Start volume		
.Type	Type of start volume	abs., rel., OFF	3.2.2.16
.V	Volume for the absolute start volume	0...999.99	3.2.2.16
.Factor	Factor for the relative start volume	0... ± 999 999	3.2.2.16
.Rate	Dispensing rate	0.01...150, max.	3.2.2.16
.Pause	Waiting time	0...999999	3.2.2.17
.MeasInput	Measuring input	1, 2, diff.	3.2.2.18
.Ipol	Polarisation current	0... ± 127	3.2.2.18
.Upol	Polarisation potential	0... ± 1270	3.2.2.18
.PolElectrTest	Test for polarized electrodes	ON, OFF	3.2.2.18
.Temp	Titration temperature	–170.0...500.0	3.2.2.19
.StopCond	**Stop conditions**		
.VStop	Stop volume		
.Type	Type of stop volume	abs., rel., OFF	3.2.2.20
.V	Volume for the absolute stop volume	0...9999.99	3.2.2.20
.Factor	Factor for the relative stop volume	0... ± 999 999	3.2.2.20
.FillRate	Filling rate after the titration	0.01...150.0, max.	3.2.2.23
.Presel	**Preselections**		
.Cond	Conditioning	ON, OFF	3.2.2.32
.DriftDisp	Display of the drift during conditioning	ON, OFF	3.2.2.32
.IReq	Request of Id's after start	id1, id2, all, OFF	3.2.2.26
.SReq	Request of sample size after start	value, unit, all, OFF	3.2.2.26
.ActPulse	Output of a pulse	first, all, cond., OFF	3.2.2.27

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

Object	Function	Input range	see...
*Parameter	**Tree part "Parameters for CAL"**		
.Calibration	**Calibration parameters**		
.MeasInput	Measuring input	1, 2, diff.	3.2.2.36
.CalTemp	Calibration temperature	–20.0...120.0	3.2.2.37
.Buffer	pH value of the buffers		
.1	Buffer 1		
.Value	pH value of buffer 1	0... ± 20.00	3.2.2.38
.2	Buffer 2		
.Value	pH value of buffer 2	0... ± 20.00, OFF	3.2.2.38
	up to 9 buffers		
.SignalDrift	Drift for measured value acquisition	0.5...999, OFF	3.2.2.39
.EquTime	Equilibr. time for meas. value acquisition	0...9999, OFF	3.2.2.39
.ElectrodeId	Electrode identification	up to 8 ASCII char	3.2.2.40
.SmplChanger	Calibration at sample changer	ON, OFF	3.2.2.41
.ActPulse	Output of a pulse	first, all, OFF	3.2.2.42

Object	Function	Input range	see...
&	**Root**		
Config	**Configuration**		
.PeriphUnit	**Selection of external devices**		
.CharSet	Selection of the character set	Epson,Seiko,Citizen,IBM, HP	3.2.2.43
.Balance	Selection of the balance	Sartorius,Mettler,Mettler AT, AND, Precisa	3.2.2.44
.Plot	Sel. of the curve at the analog output	U, dU/dt, V, dV/dt, U(rel), T	3.2.2.44
.Aux	**Setting of various auxiliary functions**		
.Language	Selection of the dialog language	english,deutsch,francais, espanol, portuguese, italiano, svenska	3.2.2.45
.Set	Setting of date and time	$G	3.2.2.46
.Date	Date	XXXX-XX-XX	3.2.2.46
.Time	Time	XX:XX	3.2.2.46
.RunNo	Current sample number	0...9999	3.2.2.47
.AutoStart	Internal automatic start	1...9999, OFF	3.2.2.48
.StartDelay	Start delay	0...999999	3.2.2.49
.DevName	Device name	up to 8 ASCII char	3.2.2.50
.Prog	Program version	read only	3.2.2.51
.RSSet	**Settings for RS232**	$G	3.2.2.52
.Baud	Baud Rate	special (300...9600)	3.2.2.53
.DataBit	Data Bit	7,8	3.2.2.53
.StopBit	Stop Bit	1,2	3.2.2.53
.Parity	Parity	even,odd,none	3.2.2.53
.Handsh	Handshake	HWs,HWf,SWchar, SWline,none	3.2.2.53
.ComVar	**Values of the common variables**		
.C30	Value of C30 up to C39	0... ±999 999	3.2.2.54
SmplData	**Sample data**		
.OFFSilo	Current sample data (Silo = OFF)		
.Id1	Sample identification 1	up to 8 ASCII char	3.2.2.56
.Id2	Sample identification 2	up to 8 ASCII char	3.2.2.56
.Id3	Sample identification 3	up to 8 ASCII char	3.2.2.56
.ValSmpl	Sample size	±X.XXXXX	3.2.2.56
.UnitSmpl	Unit of the sample size	up to 5 ASCII char	3.2.2.56

Object	Function	Input range	see...
&	**Root**		
Info	**Information**		
.Report	**Send formatted reports**	$G	3.2.2.62
.Select	Selection of the reports	configuration, parameters, smpl data, calib, C-fmla, def, user method, calc, full, short, ff, mplist, curve, derive, comb, all	3.2.2.62
.CalibrationData	pH calibration data	$G	3.2.2.63
.Inp1	For measuring input 1		
.pHas	Asymmetry pH	0... ±20.00	3.2.2.63
.Slope	Slope of the electrode	0... ±9.999	3.2.2.63
.Temp	Calibration temperature	-170...500	3.2.2.63
.Date	Date of the calibration	read only	3.2.2.63
.ElectrodeId	Id of the calibrated electrode	read only	3.2.2.63
.Inp2	For measuring input 2, identical to 1		
.Diff	For differential input, identical to 1		
.Checksums	**Checksums**	$G	3.2.2.64
.MPList	Checksum of the measured point list	read only/read + write	3.2.2.64
.ActualMethod	Checksum of the current method	read only/read + write	3.2.2.64
.DetermData	**Determination data**		
.Write	Read/write of meas.point list and C4X	ON, OFF	3.2.2.65
.ExV	Volume of exchange unit	read only/read + write	3.2.2.65
.MPList	Measuring point list		
.1	Measuring point 1		
.Attribute	Attribute	read only/read + write	3.2.2.65
.X	X coordinate, volume	read only/read + write	3.2.2.65
.Y	Y coordinate, measured value for every measuring point	read only/read + write	3.2.2.65
.TitrResults	**Results of the determination**		
.RS	Calculated results		
.1	Result 1		
.Value	Numeric value of result 1 up to 9 results	read only	3.2.2.66
.EP	End points		
.1	End point 1		
.V	Volume coordinate	read only	3.2.2.66
.Meas	Measured value coordinate	read only	3.2.2.66
.Mark	Mark if more than 1EP per window up to 9 endpoints	read only	3.2.2.66
.Var	Variables C4X		
.C40	Initial measured value	read only/read + write	3.2.2.66
.C41	Titration end volume	read only/read + write	3.2.2.66
.C42	Titration time	read only/read + write	3.2.2.66
.C43	Volume drift	read only/read + write	3.2.2.66
.C44	Titration temperature	read only/read + write	3.2.2.66
.C45	Start volume	read only/read + write	3.2.2.66
.C46	Asymmetry pH	read only	3.2.2.66
.C47	Slope of the electrode	read only	3.2.2.66
.DTime	Time for drift correction in SET	read only/read + write	3.2.2.66
.FixEP	Fix end points		
.51	Fix EP 1, up to C59, volume of fix EP 9		
.Value	Volume value	read only	3.2.2.67
.pK	pK or HNP values		
.61	pK1 or HNP1, up to C69		
.Value	Value	read only	3.2.2.67

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

Object	Function	Input range	see...
&	**Root**		
Assembly	**Basic elements of the assembly**		
.Bur	**Burette**		
.Rates	Rates		
.Forward	In direction "expel"		
.Select	Type of rate control	digital, analog	3.2.2.77
.Digital	Digital rate	0...150,max.	3.2.2.77
.Reverse	In direction "aspirate"		
.Select	Type of rate control	digital, analog	3.2.2.77
.Digital	Digital rate	0...150,max.	3.2.2.77
.Fill	Filling	$G, $H, $C	3.2.2.78
.ModeDis	Dispensing mode	$G, $S, $H, $C	3.2.2.79
.Select	Type of dispensing control	volume, time	3.2.2.79
.V	Volume to be dispensed	0.0001...9999	3.2.2.79
.Time	Time of dispensing	0.25...86400	3.2.2.79
.VStop	Limit volume	0.0001...9999,OFF	3.2.2.79
.AutoFill	Filling after every increment	ON, OFF	3.2.2.79
.Meas	**Measurement**		
.Status	On/off switching of measurement	ON, OFF	3.2.2.80
.MeasInput	Selection of the measuring input	1, 2, Diff., Ipol, Upol, Temp	3.2.2.80
.Ipol	Polarisation current	0... ± 127	3.2.2.80
.Upol	Polarisation potential	0... ± 1270	3.2.2.80
.Outputs	**I/O outputs**		
.AutoEOD	Output of pulse End Of Determination	ON, OFF	3.2.2.81
.SetLines	Set I/O lines	$G	3.2.2.81
.L1	Signal on line 1	active, inactive, pulse, OFF	3.2.2.81
	up to L3	as L1	3.2.2.81
.ResetLines	Reset I/O outputs	$G	3.2.2.81
Setup	**Setting the operation mode**		
.Keycode	Send key code of pressed key	ON,OFF	3.2.2.82
.Tree	Definition of response to $Q		
.Short	Only necessary characters	ON,OFF	3.2.2.83
.ChangedOnly	Only changed values	ON,OFF	3.2.2.83
.Trace	no meaning	ON,OFF	3.2.2.84
.Lock	**Disable key functions**		
.Keyboard	Disable all keys of the Titrino	ON,OFF	3.2.2.85
.Config	no meaning		
.Parameter	no meaning		
.SmplData	no meaning		
.UserMeth	no meaning		
.Recall	no meaning		
.Store	no meaning		
.Delete	no meaning		
.Display	Disable display service of the Titrino	ON,OFF	3.2.2.85
.Mode	**Mode sequence**		
.StartWait	Stops after Start	ON, OFF	3.2.2.86
.FinWait	Stops at the end	ON, OFF	3.2.2.86

Object	Function	Input range	see...
&	**Root**		
	Setting the operation mode, cont.		
.SendMeas	**Automatic transmission of meas. data**		
.SendStatus	On/off switching of transmission	ON,OFF	3.2.2.87
.Interval	Time interval for transmission	0.08...16200, MPList	3.2.2.87
.Select	Selection	Assembly, Titrator	3.2.2.87
.Assembly	Values from &Assembly		
.CyclNo	Cycle number	ON,OFF	3.2.2.88
.V	Volume	ON,OFF	3.2.2.88
.Meas	Associated measured value	ON,OFF	3.2.2.88
.Titrator	Values from titrator		
.CyclNo	Cycle number	ON,OFF	3.2.2.89
.V	Associated volume	ON,OFF	3.2.2.89
.Meas	Associated measured value	ON,OFF	3.2.2.89
.dVdt	Associated volume drift	ON,OFF	3.2.2.89
.dMeasdt	Associated measured value drift	ON,OFF	3.2.2.89
.dMeasdV	Associated 1st derivative titr. curve	ON,OFF	3.2.2.89
.ERC	Associated ERC in DET	ON,OFF	3.2.2.89
.AutoInfo	**Automatic message on status changes**		
.Status	Global switch for set AutoInfos	ON,OFF	3.2.2.90
.P	When power is switched on	ON,OFF	3.2.2.90
.T	From titrator		
.R	When instrument in "ready" status	ON,OFF	3.2.2.90
.G	When instrument is started.	ON,OFF	3.2.2.90
.GC	A GO command has been received.	ON,OFF	3.2.2.90
.S	When instrument in "stop" status	ON,OFF	3.2.2.90
.B	Begin of titration	ON,OFF	3.2.2.90
.F	End of titration	ON,OFF	3.2.2.90
.E	On error message	ON,OFF	3.2.2.90
.H	When instrument in "hold" status	ON,OFF	3.2.2.90
.C	Continue after hold	ON,OFF	3.2.2.90
.O	Conditioning OK.	ON,OFF	3.2.2.90
.N	Conditioning Not OK.	ON,OFF	3.2.2.90
.Re	When in request after titration start	ON,OFF	3.2.2.90
.M	Entry in measuring point list	ON,OFF	3.2.2.90
.EP	Entry in EP list	ON,OFF	3.2.2.90
.RC	Recalculation	ON,OFF	3.2.2.90
.I	On change of an I/O input	ON,OFF	3.2.2.90
.O	On change of an I/O output	ON,OFF	3.2.2.90
.Graphics	Change of the curve output		
.Grid	Grid over the curve	ON,OFF	3.2.2.91
.Frame	Frame surrounding curve	ON,OFF	3.2.2.91
.Scale	Type of curve scaling of meas.value axis	Full, Auto	3.2.2.91
.Recorder			
.Right	Length of the measured value axis	0.2...1.00	3.2.2.91
.Feed	Length of the volume axis	0.01...1.00	3.2.2.91
.PowerOn	Simulation "power on"	$G	3.2.2.92
.Initialise	Set values to default settings	$G	3.2.2.93
.Select	Selection	ActMeth,Calib,Setup Config, Assembly, All	3.2.2.93
.RamInit	Initialisation, see page 63	$G	3.2.2.94
.InstrNo	Set instrument identification	$G	3.2.2.95
.Value	Input of instrument identification	up to 8 ASCII char	3.2.2.95

3.2.2 Description of the remote control commands

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

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

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

Start and stop of a measurement in the basic mode with the parameters (measured quantity, measuring input) of the current method.
With an ongoing measurement, the current mode can be started. This stops the measurement automatically.

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

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

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

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

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

Example for the entry of formulas: "(EP2–EP1)*C01/C00"
In addition to the formula, a text for result output, the number of decimal places and a unit for the result output can be selected. "No unit" is selected with the blank string.
In place of "RSX", a result name may be entered (.TextRS). This name is outputted in the full and short result report. It is used for the result and the corresponding mean value.

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

Assignment of common variables. Results RSX, endpoints EPX or variables CXX can be assigned.
The values of the common variables are to be found in &Config.ComVar. They can be viewed and entered there, see 3.2.2.54.

3.2.2.7 **M**ode.**Def.R**eport.**A**ssign

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

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

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

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

3.2.2.10 **U**serMeth.**F**reeMem read only

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

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

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

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

List of the methods in the user method memory with the following characteristics:

.Name:	Name of the method
.Mode:	Mode
.Quantity:	Measured quantity
.Bytes:	Number of bytes of the user memory used by the method
.Checksum:	Checksum of the method, see 3.2.2.64.

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

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

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

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

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

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

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

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

Start volume in mL = smpl size* factor

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

3.2.2.17 **M**ode.**P**arameter.**T**itrPara.**P**ause **0**...999999

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

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

Parameter for DET, MET, and SET:
Selection of the measuring input; valid with measured quantities pH and U. "diff." means differential amplifier, see page 80.
With Ipol, the inquiries for the polarisation current in µA (Ipol) and .PolElectrTest are valid.
With Upol, the inquiry for the polarisation voltage in mV (Upol) is valid. Entry in steps of 10 mV.
Besides .PolElectrTest is valid.
If the test for polarized electrodes is switched on, it is performed on changeover from the inactive state to an active state (titration or conditioning).

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

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

3.2.2.20 **M**ode.**P**arameter.**S**topCond.**V**Stop.**T**ype **abs.**, rel., OFF
Mode.**P**arameter.**S**topCond.**V**Stop.**V** 0...**99.99**...9999.99
Mode.**P**arameter.**S**topCond.**V**Stop.**F**actor 0... ± **999 999**

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

Stop volume in mL = smpl size* factor

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

3.2.2.21 **M**ode.**P**arameter.**S**topCond.**M**easStop pH: 0... ± 20.00, **OFF**
U: 0... ± 2000, **OFF**
I: 0...200.0, **OFF**
Mode.**P**arameter.**S**topCond.**U**nitMStop read only

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

3.2.2.22 **M**ode.**P**arameter.**S**topCond.**E**PStop 1...**9**, OFF

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

3.2.2.23 **M**ode.**P**arameter.**S**topCond.**F**illRate 0.01...150, **max.**

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

3.2.2.25 **M**ode.**P**arameter.**E**valuation.**E**PC — DET 0...**5**...200; MET pH: 0.1...**0.50**...9.99; U, Ipol: 1...**30**...999; Upol: 0.1...**2**...99.9

Mode.**P**arameter.**E**valuation.**R**ecognition.**S**elected — **all**, greatest, last, window, OFF

Mode.**P**arameter.**E**valuation.**R**ecognition.**W**indow.**1**.**L**owLim — pH: 0... ±20.00, **OFF**; U, Ipol: 0... ±2000, **OFF**; Upol: 0... ±200.0, **OFF**

Mode.**P**arameter.**E**valuation.**R**ecognition.**W**indow.**1**.**U**pLim — Input range as LowLim

etc. up to 9 windows

Mode.**P**arameter.**E**valuation.**F**ixEP.**1**.**V**alue — pH: 0... ±20.00, **OFF**; U; Ipol: 0... ±2000, **OFF**; Upol: 0... ±200.0, **OFF**

etc. up to 9 fix EP's

Mode.**P**arameter.**E**valuation.**p**K — ON, **OFF**

Parameters for DET and MET: Evaluation of the EP's, see page 6ff.
.EPC: EP criterion in pH, in mV (with U and Ipol) or in µA (with Upol).
.Recognition.Selected: EP recognition.
all: All end points found are recognised.
great: Only the largest EP is recognised.
last: Only the last EP is recognised.
window: Only EP's that lie within set windows are recognised.
OFF: The EP evaluation is switched off.
.Recognition.Window.1.LowLim: Lower limit for window in pH, mV (with U and Ipol) or µA (with Upol).
.Recognition.Window.1.UpLim: Upper limit for window in pH, mV (with U and Ipol) or µA (with Upol).
Windows are opened until the lower limit is set to OFF.
For every expected EP, an individual window must be set, see page 8.
.FixEP.1.Val: Fix-EP's in pH, mV (bei U, Ipol) resp. µA (bei Upol). Fix EP's are evaluated until the setting OFF is found.
.pK: pK or HNP evaluation. Possible only in pH and U titrations.

3.2.2.26 **M**ode.**P**arameter.**P**resel.**I**Req — id1, id1&2, all, **OFF**

Mode.**P**arameter.**P**resel.**S**Req — value, unit, all, **OFF**

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

3.2.2.27 **M**ode.**P**arameter.**P**resel.**A**ctPulse — DET: ON, **OFF**; MET: ON, **OFF**; SET:first, all, cond.,**OFF**; MEAS: ON, **OFF**

Parameters for DET, MET, SET and MEAS: Output of a pulse on the I/O line "activate", see pages 89 and 90.

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

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

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

3.2.2.29	**M**ode.**P**arameter.**S**ET1.**D**yn	pH: 0.01...20.00, **OFF** U, Ipol: 1...2000, **OFF** Upol: 0.1...200.0, **OFF**
	Mode.**P**arameter.**S**ET1.**U**nit**D**yn	read only
	Mode.**P**arameter.**S**ET1.**M**axRate	0.01...**10**...150, max.
	Mode.**P**arameter.**S**ET1.**M**inRate	0.01...**25.0**...999.9

Parameters for SET: Control parameters, see page 11.

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

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

.MinRate: Minimum titration rate in µL/min.

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

Parameter für SET: Type and size of the stop criterion of the titration.

.Type: Type of stop criterion – after stop drift or switch-off delay time.

.Drift: Stop drift in µl/min. Applies when "drift" has been selected.

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

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

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

Parameter for SET: Titration direction.

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

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

Parameter für SET:

.Cond: On/off switching of conditioning.

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

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

Parameters for MEAS: Criteria for the measured value acquisition. Measured value drift in mV/min (with pH, U, Ipol, T) or µA/min (with Upol), equilibration time in s. OFF means that the corresponding criterion is switched off. If both criteria are OFF, the measurement continues indefinitely. For measuring point lists with measured value vs. time, see 3.2.2.13.

If the equilibration time has never been edited, it is automatically calculated by the instrument to match the drift. After it has been edited once, it remains in force with the set value.

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

Parameter for MEAS:
Selection of the measuring input; valid with measured quantities pH and U. "diff." means differential amplifier, see page 80.
With Ipol, the inquiries for the polarisation current in µA (Ipol) and .PolElectrTest are valid.
With Upol the inquiry for the polarisation voltage in mV (Upol) is valid. Entry in steps on 10 mV.
Besides .PolElectrTest is valid.
If the test for polarized electrodes is switched on, it is performed on changeover from the inactive state to the measurement.

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

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

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

Parameter for CAL: Selection of the measuring input. "diff." means differential amplifier, see page 80.

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

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

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

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

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

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

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

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

3.2.2.41 **M**ode.**P**arameter.**C**alibration.**S**mplChanger ON, **OFF**

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

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

Parameter for CAL: Output of a pulse on the I/O line "activate", see pages 89 and 90.

3.2.2.43 Config.PeriphUnit.CharSet — Epson, Seiko, Citizen, IBM, **HP**

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

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

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

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

Selection of the dialog language.

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

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

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

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

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

Number of automatic, internal starts.

3.2.2.49 **C**onfig.**A**ux.**S**tartDelay — **0**...999999

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

3.2.2.50 **C**onfig.**A**ux.**De**vName — bis 8 ASCII-Zeichen

Name of the instrument for connections with several units. It is advisable to use only the letters A...Z (ASCII Nos 65...90), a...z (ASCII Nos 97...122) and the numbers 0...9 (ASCII Nos 48...57) when the function Setup.AutoInfo (3.2.2.90) is used at the same time.

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

Output of the program version.
The Titrino sends "721.0010" on requests with $Q.

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

$G sets all RS settings. The changes are performed only if the instrument is inactive. After the setting of the interface parameters, wait at least 2 s to allow the components to equilibrate.

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

Settings of the values for the data transmission via the RS interface: baud rate, data bit, stop bit, parity and type of handshake, see also page 53 ff.
The setting of the values must be initiated with $G immediately after entry of the values, see 3.2.2.52.

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

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

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

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

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

$G sends the selected report:

configuration:	Configuration report. Is not accessible during a running determination.
parameters:	Parameter report of the current method. During a running determination only "live"-parameters are accessible.
smpl data:	Current sample data.
cal.data:	Calibration data of the measuring input in the current method.
C-fmla:	Contents of the tree part .CFmla.
def:	Contents of the tree part .Def.
user method:	Contents of the method memory.
calc:	Calculation report of the current method.
full:	Full result report of the last completed determination.
short:	Short result report of the last completed determination.
ff:	Form feed on printer.
mplist:	Measuring point list of the running determination (with DET and MET).
curve:	Titration curve of the last determination (with DET and MET).
derive:	1st derivative of titration curve (with DET).
comb:	Combined 1st derivative and titration curves (with DET).
all:	All reports.

Reports which are sent from the Titrino are marked with space (ASCII32) and ' at the beginning. Then an individual identifier for each report follows. Reports which are triggered by RS232 ($G) have the same introducer but without preceeding space, i.e. they start with '.

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

pH calibration data for measuring input 1. After the calibration, the data are entered automatically together with the date of the calibration and the electrode identification, see 3.2.2.40.
Calibration data can be entered. They are accepted with &Info.CalibrationData $G. If calibration data are entered, the calibration date is deleted.

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

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

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

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

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

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

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

.Attribute: Attribute

.MPList.X: X coordinate, volume

.MPList.Y: Y coordinate, measured value

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

.RS: Values of the calculated results.

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

- Volume coordinate in mL, e.g. "1.234"
- Measured value coordinate in pH "5.12", mV (with U and Ipol) "-241" or µA (with Upol) "43.7".
- Marking in the case of DET and MET with EP windows when more than 1 EP has been found per window: " + ". In regular operation or when no window has been set, a blank string "" is sent.

.Var: Various variables.

C40: Initial measured value in pH "5.12", mV (with U and Ipol) "-241", µA (with Upol) "43.7" or °C (withT) "25.0".

C41: Titration end volume with DET, MET, and SET in mL, "12.536".

C42: Titration time from start to end in s, "62".

C43: Volume drift on start of a SET titration from the conditioning in µL/min, "3.5".

C44: Titration temperature in °C, "23.2". Measured after the start and used for the temperature correction in pH measurements.

C45: Start volume with DET, MET, and SET in mL, "2.800".

C46: Asymmetry pH of CAL, "6.89".

C47: Relative electrode slope of CAL, "0.995".

DTime: Time for drift correction in SET with conditioning.

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

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

3.2.2.69 **I**nfo.**A**ctualInfo.**I**nputs.**S**tatus read only
Info.**A**ctualInfo.**I**nputs.**C**hange read only
Info.**A**ctualInfo.**I**nputs.**C**lear $G
Info.**A**ctualInfo.**O**utputs.**S**tatus read only
Info.**A**ctualInfo.**O**utputs.**C**hange read only
Info.**A**ctualInfo.**O**utputs.**C**lear $G

Status sends the current status of the I/O lines, Change sends the information regarding whether a change in status of a line has taken place since the last clearing, Clear clears the change byte. For the output, the byte is converted from binary to decimal, e.g.

	0	0	0	0	1	0	1	0
Line No.	7	6	5	4	3	2	1	0

Output: $2^1 + 2^3$ = "10"
1 means ON or change; 0 means OFF or no change.
The lines are assigned as follows (see also pages 87ff):

Inputs:		**Outputs**:	
0	Start (pin 21)	0	Ready (pin 5)
1	Stop (pin 9)	1	Cond. ok (pin 18)
2	Enter (pin 22)	2	Titration (pin 4)
3	Clear (pin 10)	3	EOD (pin 17)
4	Smpl Ready (pin 23)	4	Freely selectable (pin 3)
5	pin 11	5	Error (pin 16)
6	pin 24	6	Activate (pin 1)
7	pin 12	7	Pulse for recorder (pin 2)

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

$Q sends the current cycle number of the voltage measurement cycle, e.g. "127". From the cycle number and the cycle time (see 3.2.2.76), a time frame can be set up.
The cycle number is set to 0 on switching on the instrument and it is always incremented as long as the instrument remains switched on.

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

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

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

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

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

$Q sends the current values in the following formats:

		DET	MET	SET	MEAS	CAL
Cycle number		127	127	127	127	127
Volume (ml)		1.2345	1.2345	1.2345	NV	NV
Meas.value:	pH	3.456	3.456	-345.6 (mV)	3.456	3.456
	U, Ipol (mV)	-345.6	-345.6	-345.6	-345.6	–
	Upol (uA)	-12.5	-12.5	-12.5	-12.5	–
	T (°C)	–	–	–	25.0	–
Volume drift (ul/s)		NV	NV	2.5142	NV	NV
Meas.value-	pH, U, Ipol (mV/s)	0.7957	0.7957	0.7957	0.7957	0.7957
drift:	Upol (uA/s)	0.7957	0.7957	0.7957	0.7957	–
	T (°C/s)	–	–	–	0.7957	–
1st derivative (mV/ul)		NV	NV	10.6326	NV	NV
ERC		34	NV	NV	NV	NV

NV: Not valid. If the signal drift is OFF in modes DET, MET, MEAS, and CAL, the signal drift is NV.
OV will be sent for "overrange".
A time frame can be set up from the cycle number and the cycle time (see 3.2.2.76). The cycle number is set to 0 at the start of a method and it is incremented until the end of the method.

3.2.2.74	Info.**A**ctualInfo.**M**easPt.**I**ndex	read only
	Info.**A**ctualInfo.**M**easPt.**X**	read only
	Info.**A**ctualInfo.**M**easPt.**Y**	read only
	Info.**A**ctualInfo.**EP**.**I**ndex	read only
	Info.**A**ctualInfo.**EP**.**X**	read only
	Info.**A**ctualInfo.**EP**.**Y**	read only

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

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

3.2.2.75	Info.**A**ctualInfo.**D**isplay.**L**1	up to 24 ASCII characters
	Info.**A**ctualInfo.**D**isplay.**L2**	up to 24 ASCII characters

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

3.2.2.76	Info.**As**sembly.**C**ycleTime	read only
	Info.**As**sembly.**E**xV	read only

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

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

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

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

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

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

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

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

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

Measurement in assembly. The measuring function can only be started via RS Control. When the measuring function is switched on, no method can be started at the Titrino.
.Input: Selection of the potentiometric measuring input 1, 2, diff., polarized electrodes or temperature.
.Ipol: Polarisation current in µA.
.Upol: Polarisation potential in mV, entry in steps of 10 mV.

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

Setting the I/O output lines.
.AutoEOD: The automatic output of the EOD (End of Determination) at the end of the determination can be switched off. Thus, for example, in conjunction with a sample changer several determinations can be performed in the same beaker. Before AutoEOD is switched on, line 2 must be set to "OFF".
.SetLines: With $G, lines 1 and 2 are set.
.SetLines.LX: Set the freely forcible line X. "active" means setting of a static signal, "inactive" means resetting of the signal, "pulse" means output of a pulse of app. 150 ms, "OFF" means the line is not operated.
L2 is the line of EOD. Note that in combinations with AutoEOD "ON", a static active line 2 can be set to inactive by the EOD pulse.
L3 is the line of the activate pulse. Note that in combinations with AutoEOD "ON", a static active line 3 can be set to inactive by the EOD pulse.
.ResetLines: Lines 1 to 3 are set to the inactive status (= high).

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

ON means the key code of a key pressed on the Titrino is outputted. The key code comprises 2 ASCII characters; table of the keys with their code, see page 66. A keystroke of key 11 is sent as follows:

#11

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

3.2.2.83	**S**etup.**T**ree.**S**hort	ON, **OFF**
	Setup.**T**ree.**C**hangedOnly	ON, **OFF**

Definition of the type of answer to $Q. Enables rapid data transfer.
.Short: With "ON", each path is sent with only the necessary amount of characters in order to be unequivocal (printed in bold in this manual).
.ChangedOnly: Sends only the changed values, i.e. values which ave been edited. All paths are sent absolute, i.e. from the root &.

3.2.2.85 **Se**tup.**L**ock.**K**eyboard ON, **OFF**
Setup.**L**ock.**D**isplay ON, **OFF**

ON means disable the corresponding function:
.Keyboard: Disable all keys of the Titrino.
.Display: Disable the display, i.e. it will not be written to by the device program of the Titrino and can be operated from the computer.

3.2.2.86 **Se**tup.**M**ode.**S**tartWait ON, **OFF**
Setup.**M**ode.**F**inWait ON, **OFF**

The sequence stops if a wait is to "ON" until the wait is set to "OFF". Switching the Titrino OFF/ON sets both nodes to "OFF".
.StartWait: The sequence stops right after after the start of a method (stop after AutoInfo !".T.GC").
.FinWait: The sequence stops at the end of the method (stop after AutoInfo !".T.F").

3.2.2.87 **Se**tup.**S**endMeas.**S**endStatus ON, **OFF**
Setup.**S**endMeas.**I**nterval 0.08...**4**...16200, MPList
Setup.**S**endMeas.**Sel**ect Assembly, **Titrator**

.SendStatus: ON means the automatic transmission of measured values (see 3.2.2.88 and 3.2.2.89) in the inputted interval is active.
.Interval: Time interval (in s) for the automatic transmission of associated measured values defined under points 3.2.2.88 and 3.2.2.89. The inputted value is rounded off to a multiple of 0.08. The smallest possible time interval depends on the number of measured values which have to be sent, on the baud rate, on the load on the interface and on the type of device connection.
With "MPList" the measured values are sent at the time of their entry into the measured point list (in modes DET and MET; in the modes SET, MEAS, CAL nothing is being sent).
.Select: Selection of the unit of which the measured values should be sent (3.2.2.88 or 3.2.2.89).
The automatic transmission is switched on/off with 'SendStatus'.

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

Selection of the values from Assembly for the output in the set time interval (see 3.2.2.87):
.CyclNo: Cycle number of the potential measurement. Together with the cycle time (3.2.2.75), a time frame can be set up.
The cycle number is set to 0 on switching on the instrument and it is always incremented as long as the instrument remains switched on.
.V: Volume
.Meas: Measured value associated to the cycle number.
The unit "assembly" must be preset (see 3.2.2.87).

3.2.2.89	**S**etup.**S**endMeas.**T**itrator.**C**yclNo	ON, **OFF**
	Setup.**S**endMeas.**T**itrator.**V**	ON, **OFF**
	Setup.**S**endMeas.**T**itrator.**M**eas	ON, **OFF**
	Setup.**S**endMeas.**T**itrator.**d**Vdt	ON, **OFF**
	Setup.**S**endMeas.**T**itrator.**dM**easdt	ON, **OFF**
	Setup.**S**endMeas.**T**itrator.**dMeasdV**	ON, **OFF**
	Setup.**S**endMeas.**T**itrator.**E**RC	ON, **OFF**

Selection of the values from the titrator which are sent in the set time interval (see 3.2.2.87, formats see 3.2.2.73):

.CyclNo: Cycle number. Together with the cycle time (3.2.2.75), a time frame can be set up.The other data belong to the corresponding cycle number. The cycle number is set to 0 at the start of a method and it is incremented until the end of the method.
.V: associated volume.
.Meas: associated measured value.
.dVdt: associated volume drift.
.dMeasdt: associated measured value drift.
.dMeasdV: associated1st derivative of the titration curve.
.ERC: associated ERC in DET.

The unit "titrator" must be preset (see 3.2.2.87).

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

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

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

Messages from node .T, Titrator:

.T.R Ready: Status 'Ready' has been reached.
.T.G Go: Instrument has been started.
.T.GC GoCommand: A start command has been received.
.T.S Stop: Status 'Stop' has been reached.
.T.B Begin of titration.
.T.F Final: End of determination, the final steps will be carried out.
.T.E Error. Message together with error number, see page 22.
.T.H Hold: Status 'Hold' has been reached.
.T.C Continue: Continue after hold.
.T.O Conditioning OK in SET with conditioning.
.T.N Conditioning Not OK in SET with conditioning.
.T.Re Request: In the inquiry of an identification or the sample size after start of titration.
.T.M MeasList: Entry in the measuring point list (with DET and MET).
.T.EP EPList: Entry into EP list (with DET, MET, and SET)
.T.RC Recalculation of results.

Messages for changements in the I/O lines. If the changements are made simultaneously, there is 1 message. Pulses receive 2 messages: one message each for line active and inactive.

.I Input: Change of an input line.

.O Output: Change of an output line (except 7, pin 2, for recorder pulses).

If a change occurs that requires a message, the Titrino sends space (ASCII 32) and ! as an introducer. This is followed by the name of the device (see 3.2.2.50). Special ASCII characters in the device name are ignored. If no device name has been entered, only ! is sent. Finally the Titrino sends the information which node has triggered the message.
Example: !John".T.G": The message was triggered from instrument "John", node .T.G

3.2.2.91 **Se**tup.**G**raphics.**G**rid **ON**, OFF
Setup.**G**raphics.**F**rame **ON**, OFF
Setup.**G**raphics.**S**cale **Full**, Auto
Setup.**G**raphics.**R**ecorder.**R**ight 0.2...**0.5**...1.00
Setup.**G**raphics.**R**ecorder.**F**eed 0.01...**0.05**...1.00

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

.Grid: On/off switching of grid over curve.

.Frame: On/off switching of frame surrounding the curve. If grid and frame are switched off, the curve is printed faster as the print head does not have to move to the end of the paper.

.Scale: Type of scaling of the measured value axis:
Full means that the scale runs from the smallest up to the greatest measured point.
With auto, the smallest measured value is taken and the next smaller tick defines the beginning of the scale; the next greater tick to the greatest measured value is the end of the scale.

.Right: Relative specification of the width of the output medium (e.g. paper width) for the length of the measured value axis. 1 means the measured value axis is plotted over the entire width of the paper (largest possible width). In extrme cases, the writing of the right tick may lie outside.

.Feed: Length of the volume axis referred to the burette cylinder volume, V(B) per cm (0.1 means, e.g. 1 mL/cm with a 10 mL Exchange Unit). Depending on the printer, the measure in cm may not always be correct.

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

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

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

Setting of default values for the following areas:

ActMeth: Current method. Parameters, calculations, and assignments for the data output, operands C01...C19.

Calib: pH calibration data for all measuring inputs.

Config: All values under &Config.

Assembly: All values under &Assembly.

Setup: All values under &Setup.

All: Values of the entire tree (except silo and method memory).

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

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

Initialises instrument as in the diagnosis, see page 63. All parameters are set to their default value and error messages are cleared.

3.2.2.93 **Se**tup.**Ins**trNo $G
Setup.**Ins**trNo.**V**alue **serial number**, up to 8 ASCII characters

Instrument identification for the output in reports. The value has to be set with &Setup.InstrNo $G.

3.3. Characteristics of the RS232 interface

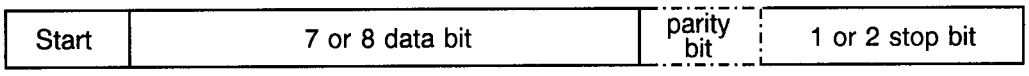
3.3.1 Data transfer protocol

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

The RS232 interface has the following technical specifications:

Data interface in accordance with the RS 232C standard. RS parameters can be selected.

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



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

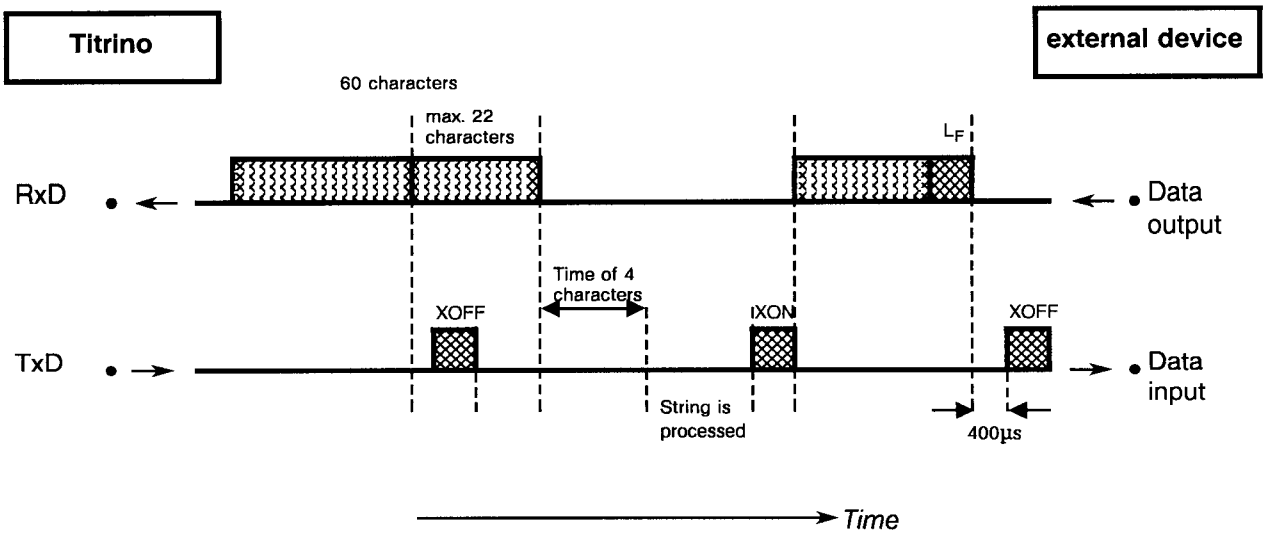
3.3.2 Handshake

3.3.2.1 Software handshake , SWChar

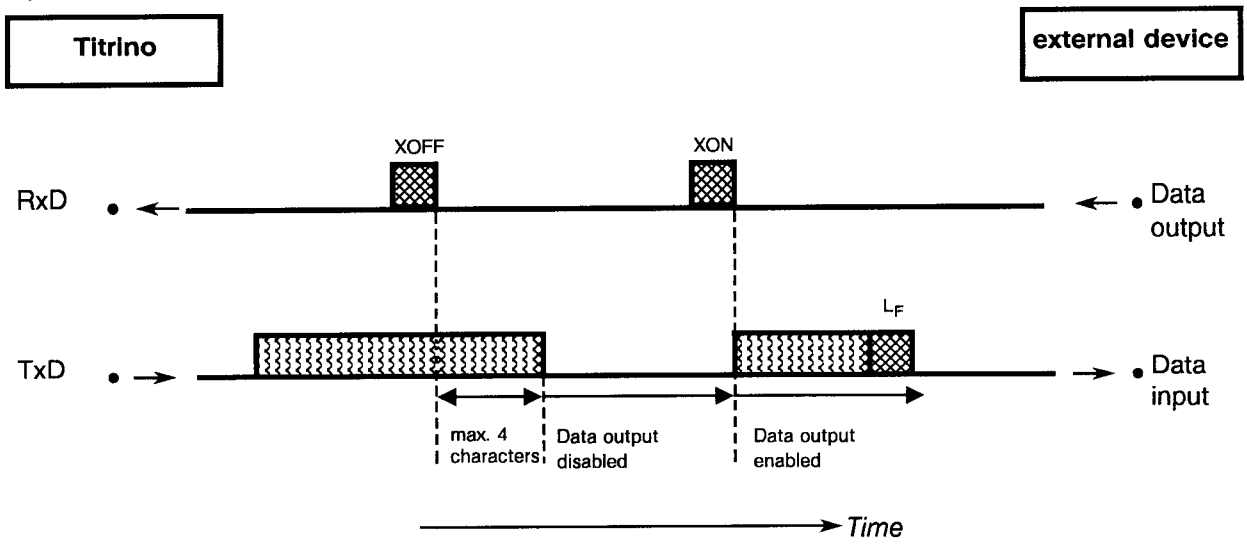
Handshake inputs at the Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the Titrino.

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

Titrino as **receiver**:



Titrino as **sender**:

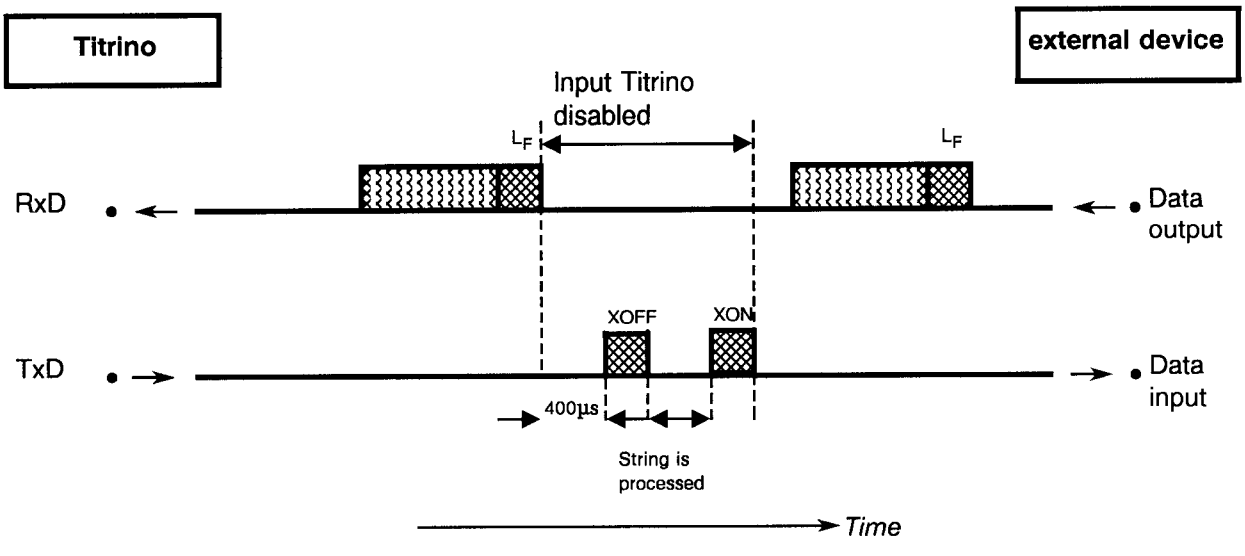


3.3.2.2 Software-Handshake , SWline

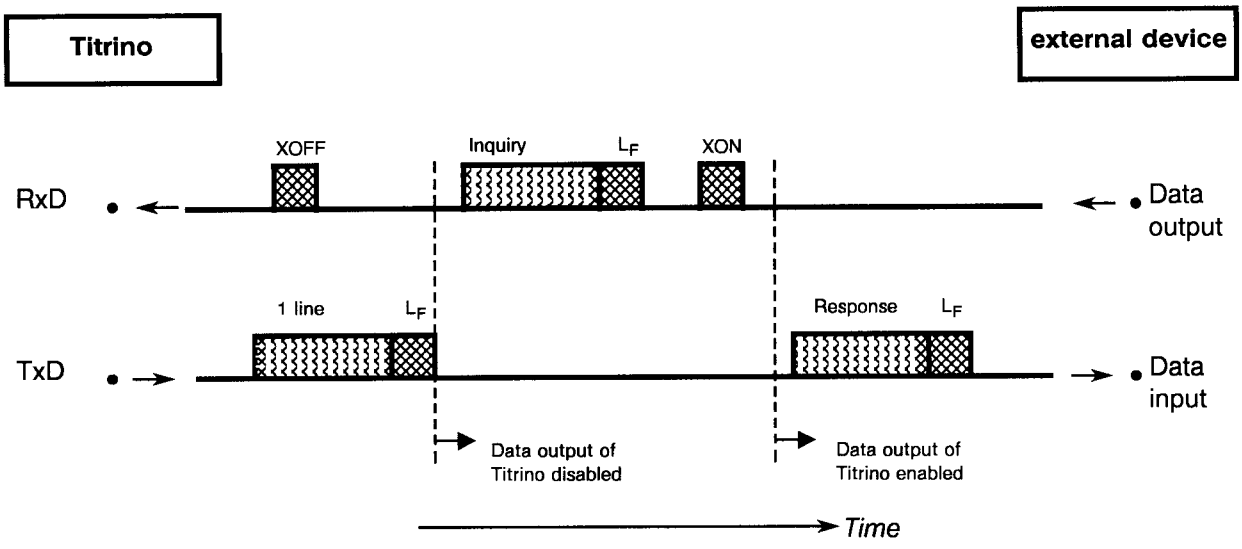
Handshake inputs at the Titrino (CTS, DSR, DCD) are not checked.
Handshake outputs (DTR, RTS) are set by the Titrino.

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

Titrino as **receiver**:



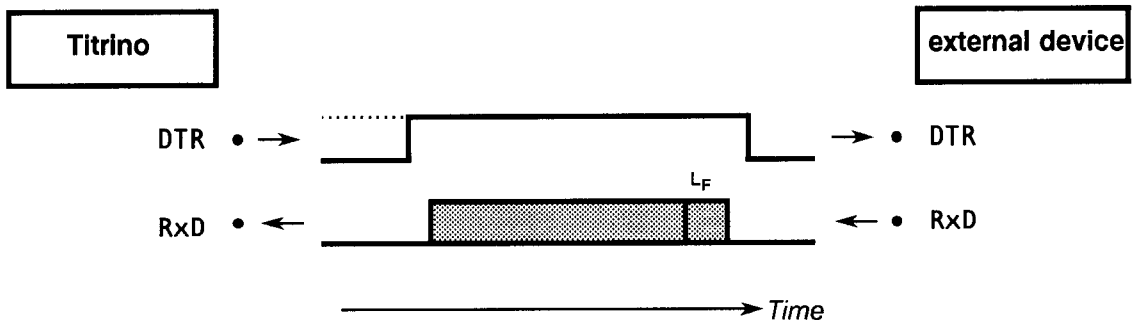
Titrino as **sender**:



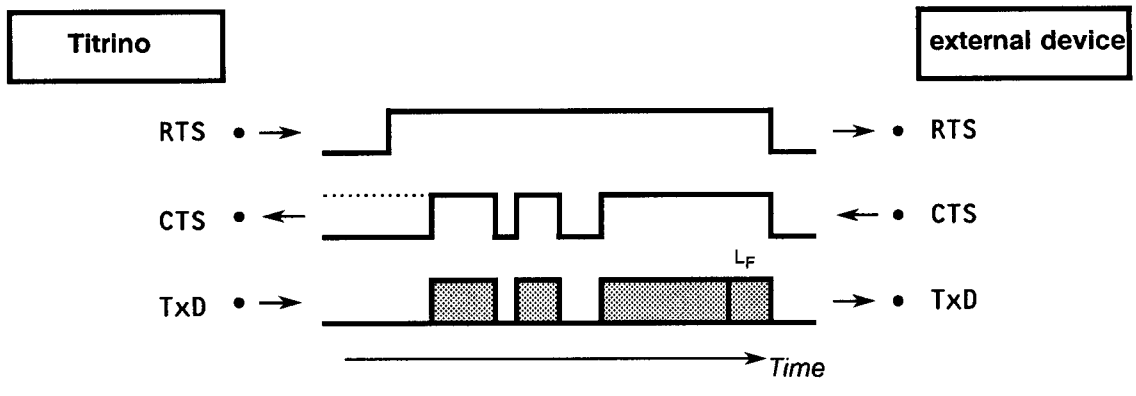
The transmission of the Titrino can be stopped by the external device with XOFF. After receipt of XOFF, the Titrino completes transmission of the line already started. If the data output is disabled for more than 3 s by XOFF, E43 appears in the display.

3.3.2.3 Hardware handshake, HWs

Titrino as **receiver**:



Titrino as **sender**:

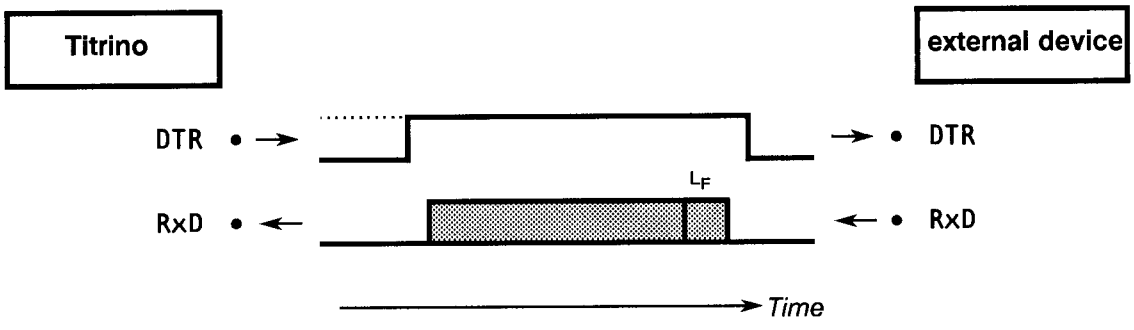


The data flow can be interrupted by deactivation of the CTS line.

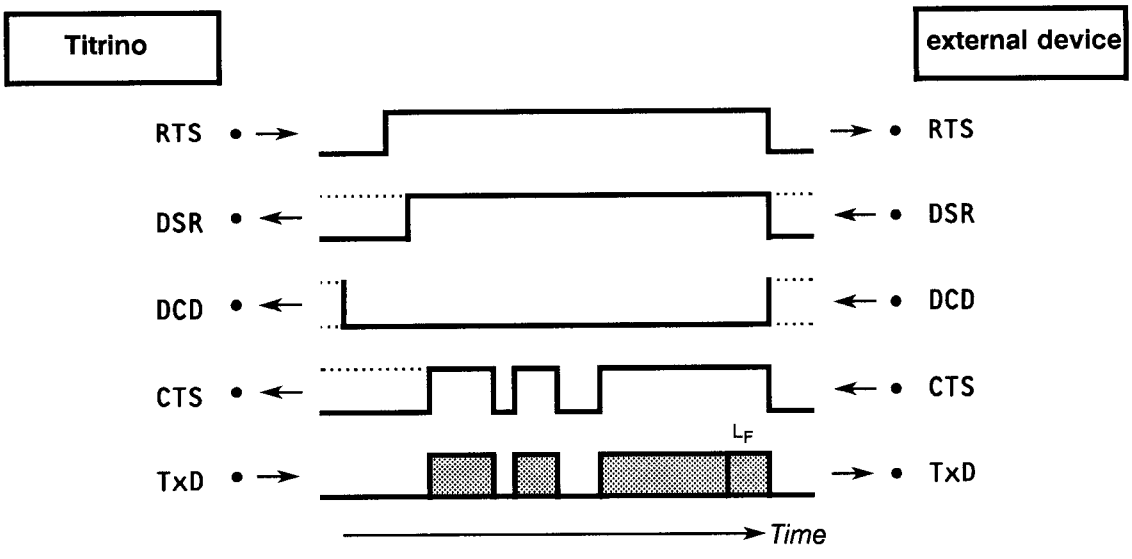
Hardware handshake, HWf

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

Titrino as **receiver**:



Titrino as **sender**:



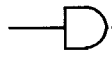
The data flow can be interrupted by deactivation of the CTS line.

3.3.3 Pin assignment

external

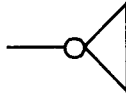
RS 232C Interface

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



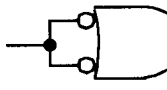
E 2
Transmitted Data

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



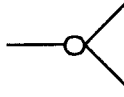
E 3
Received Data

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



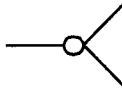
E 4
Request to Send

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



E 5
Clear to Send

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

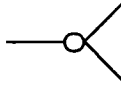


E 6
Data Set Ready

Signal Ground (GND)

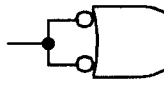
E 7
Signal Ground

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

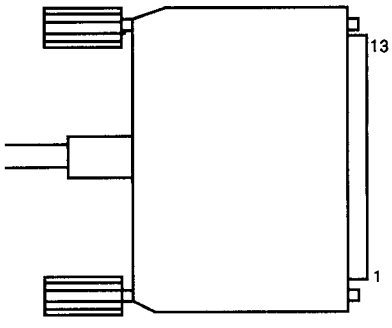
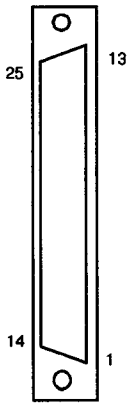


E 8
Data Carrier Detect

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



E 20
Data Terminal Ready

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

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

3.4 What can you do if the data transfer does not work?

Problem	Questions for remedial action
No data transmission occurs and the display of the Titrino shows an error message	– **E40-42**: Transmission error. Is the cable used properly wired and connected? Is the printer switched on and set to "on-line"? – **E43**: Data output of the Titrino disabled for longer than 3 s by XOFF. – **E36-39**: Receive error. Are the settings of the RS232 data transmission parameters the same for both devices?
The received characters are garbled	– Are the data bit and the parity settings the same for both devices? – Is the baud rate setting the same for both devices? – Has the correct character set been selected?

4. Error messages, Troubleshooting

"Clicking" of the Exchange Unit	Cause: Stopcock switch mechanism bouncing. Press the stopcock switch lever manually into the end position. Do not rotate the stopcock when the Titrino is switched on!
Data transfer inoperative	See measures on page 59.

4.1 Error and special messages

XXX bytes missing	XXX more bytes are needed to store a method or a silo line. Exit: Delete methods no longer needed.
check electrode	With polarized electrodes. There is a break or short circuit. Possible causes and rectification of the fault: – the electrode is not plugged in → plug it in – the electrode is not immersed in the solution → immerse it – the electrode is defective → use new electrode. The electrode test can be switched off. Exit: Rectify fault or <STOP>.
check exchange unit	The Exchange Unit is not mounted (properly). Exit: Mount Exchange Unit (properly) so that the coupling engages.
check T-sensor	In MEAS T, no temperature sensor has been connected. Exit: Connect Pt100 or Pt1000 or <STOP>.
data set reevaluation	Message if Titrino is reevaluating downloaded measuring point lists.
division by zero	The result could not be calculated as a divisor in the formula was equal to zero. Exit: Enter appropriate value.
EP overflow	In DET or MET titrations, more than 9 EP's have been found. The first 9 EP's are listed. Corrective measure: Recalculate data with higher EP crit.
manual stop	The determination has been terminated manually.
meas.pt list overflow	In DET or MET titrations, maximum 500 measured points can be stored. Corrective measure: Use start V or add larger volume increments.
missing EP	An EP needed in a formula for calculation purposes is missing.
missing fix EP	In a formula, a fix EP is required which has not been defined.
No.EP not corresponding	In DET or MET titrations, the number of EP's actually found does not match the set windows: Exactly 1 EP per window has not been found.
no EP set	In a SET titration, no EP has been set. Exit: <STOP> and set EP.
no new com.var.	The common variable could not be assigned as the result or the mean value could not be calculated. The old value is retained.
not valid	Value not existing.
outside	In DET or MET titrations, the set fix EP is outside the measurement range.
overrange	The measurement range of ±2 V has been exceeded. Exit: Rectify error, <STOP>.
same buffer	In the calibration routine, the potential difference between the first and the second buffer is < 6 mV. Exit: <STOP> (stop calibration).

stop EP reached	A DET or MET titration has been terminated as the stop criterion "stop EP" has been reached.
stop meas.val.reached	A DET or MET titration has been terminated as the stop measured value pH, U or I has been reached.
stop time reached	A SET titration, (pH) stat, has been terminated as the stop time has been reached.
stop V reached	The titration has been terminated as the stop volume has been reached.
system error 3	Instrument adjustment data have been overwritten. Exit: <STOP>. Standard adjustment data are set. The error message appears after every switching on of the instrument until it is re-adjusted (Metrohm service).
wrong sample	In a SET titration with preset titration direction (or with 2 set EP's), the first measured value is already past the end point.

Error messages in connection with the data transfer

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

Receive errors:

E36	Parity	Exit: Switch Titrino OFF/ON and ensure settings of appropriate parameter are the same at both devices.
E37	Stop bit	

E38	Overrun error. At least 1 character could not be read. Exit: Switch Titrino OFF/ON.
E39	The receive buffer of the Titrino is full (>82 characters). Exit: Switch Titrino OFF/ON.

Send errors:

E40	DSR = OFF	No proper handshake for 1 s or longer. Exit: Switch Titrino OFF/ON. Is the receiver switched on and ready to receive?
E41	DCD = ON	
E42	CTS = OFF	

E43	The transmission of the Titrino has been interrupted with XOFF for at least 3 s. Exit: Switch Titrino OFF/ON.
E44	The RS interface parameters are no longer the same for both devices. Reset.
E45	The receive buffer of the Titrino contains an incomplete character string (L_F missing). Transmission of the Titrino is thus blocked. Exit: Send L_F or switch Titrino OFF/ON.

4.2 Diagnosis

4.2.1 Using a PC

The 721 NET Titrino is a very precise and reliable instrument. Thanks to its rugged construction it is virtually impossible for external mechanical or electrical influences to have an adverse effect on its functions.

Although the occasional fault in the instrument can not be excluded completely, it is certainly much more likely that malfunctions are caused by wrong operation or handling or through improper connections and operation with non-Metrohm instruments.

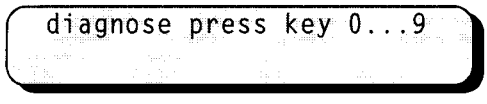
It is advisable in each case to isolate the fault with the rapid and easy to perform diagnostic tests. The customer thus need not call METROHM service until there is a true fault in the instrument. In addition, with the aid of the numbering in the diagnostic program he can provide the service engineer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

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

Please mind: The following diagnosis instructions can be executed with the aid of a PC and a suitable terminal program (and further auxiliary devices) only. Continue on this page if these ones are available.
But with the aid of a short test on page 74 the major functions can nevertheless be checked in case that the mentioned tools should not be available.

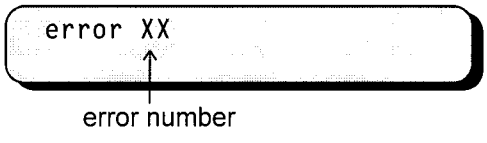
Procedure

- The diagnostic steps must be performed in sequence and compared with the reactions of the 721 NET Titrino (indented). In the "yes" case, continue with the next instruction.
- If the instrument does not show the expected reaction ("no" case), the appropriate diagnostic step must be repeated to exclude an operating error. With repeated wrong reactions, however, there is a strong possibility that a malfunction exists.
- The diagnostic steps allow re-entry into the test routine for repetition if the following display appears:

  If the instrument is in a subprogram of the diagnostic routine: Send <C>.

  If need be, send diagnosis command <&DIAGNOSE $G> for re-entry into the test routine.
- If <C> has been sent during the display of 'diagnose press key 0...9', the instrument returns to the user program.
- Error display: An error is shown in the display as follows:

- If a fault causes the burette drive to stick at the top or bottom end of the cylinder, see point 13, page 72.

Equipment required:

- voltage calibrator, e.g. Metrohm pH Simulator 642[1]
- highly insulated interconnection cable 6.2108.060
- resistor switch-box, class 0.1 % (or resistor 14.3 k, 0.1 %)
- cable 3.496.5070[2]
- exchange units, if possible with different cylinder volumes (or 3.496.0070 dummy exchange unit)
- stop watch or watch with second hand
- digital or analogue voltmeter (if need be, connect a calibrated recorder)
- Interconnecting cable 721 ÷ IBM-PC 6.2125.060 (for 9 pin interface ⇒ use adapter 9 to 25 pins 6.2125.010)
- PC with serial interface and terminal program (e.g. terminal program of MS-Windows)
- connecting cables with 4 mm banana plugs

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

1 Prepare instruments for diagnostic test

PC: With cable 6.2125.060 interconnect 721 with the serial interface (e.g. COM 2).

Start terminal program (e.g. Terminal program of Windows in the program group Accessory)

Set RS 232 parameters:

Baud rate	9600 baud	(in Windows Terminal under 'Communications')
Data Bits:	8	
Stop Bits:	1	
Parity:	no	
Flow control:	characters at a time	(in Windows Terminal under 'Text Transfer')
Connector:	COM2	(COM1 is normally used for the mouse.)
Local Echo:	on	(in Wind. Term. under 'Terminal Preferences'
<CR> ⇒ <CR/LF>:	on	(Each command to the Titrino is terminated with <CR> + <LF>)

Titrino: Power off

Disconnect all external connections (cables at rear, except mains cable and cable for serial interface)

Remove exchange unit

Power on

PC: key-in diagnosis command: <&DIAGNOSE $G>

After the powerup test pattern the display shows:

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

2 Perform display test

Send <2>

```
display test
```

Send <Z>

---

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

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

Characters for a visual check of the display are generated on both lines.

Test sequence:

- Display is cleared and overwritten from the left with a dot pattern.
- Display is cleared and both lines are written into with the letters A, B, C,...,Z.
- The complete character set (see Fig. 4.1) is shown as a moving display.

The test sequence can be held and then continued at any time by sending <5>.

Block 2 is quit by sending <C>.

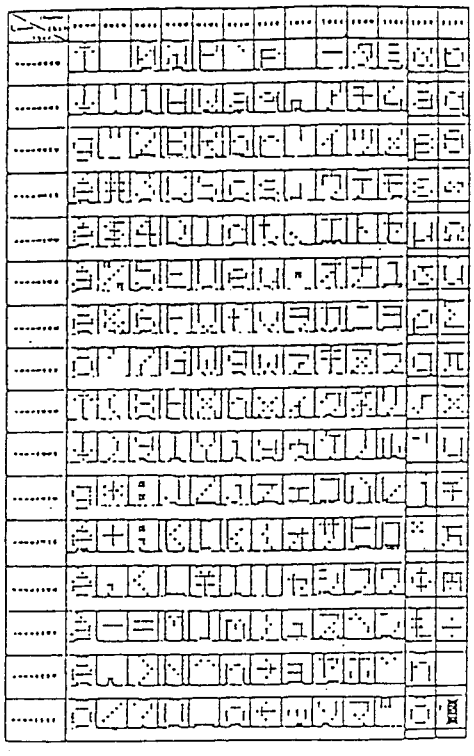


Fig. 4.1

3 Keypad test

Send <1>

```
keys test
```

Send <Z>

```
display test
matrix code
```

Press keys on the front panel of the Titrino.
The appropriate matrix code appears in the display:

<START>	22
<STOP/FILL>	6
<DOS>	15

Block 2 is quit by sending <C> twice.

4 Cylinder code, date, time

Send <0>

```
date/time
cylinder code
```

Send <Z>

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

Check date and time. If deviations are found, enter new date and/or time, see page 41.

Insert exchange unit (or dummy). (Put the burette tip into a collecting receptacle)

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

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

If desired, the exchange unit can be removed again.

Send <C>

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

5 Check analogue output

A voltage can be set at the analogue output (sockets at D) using the serial interface. But this should not exceed ±2000 mV. This voltage can also be used for the calibration of a connected recorder..

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

Send <3>

```
analog output-1 test
```

Send <Z>

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

Enter a voltage value in the range (±)2000 mV using the serial interface.
The figures have to be sent separately, terminated by <Z> (→ Enter).
e.g.. 1250 mV ⇒ <1> send, <2> send, <5> send, <0> send, <Z> send
After sending <Z>, this value appears as a voltage at the analogue output.

Read off value on the connected voltmeter and compare with the mV value on the display. (Tolerance ± 2 mV)

For exit send <Q>

Disconnect voltmeter.

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

---

[1] current date

[2] current time

[3] Check that mL code of exchange unit used is displayed.

[4] This value is incidental, but can be accepted by sending <Z>.

6 Motor timer test

Send <6>

```
motor-timer test
```

Send <Z>

```
pot.meter dV/dt → 10?
```

Turn knob 'dV/dt' to the right stop

Send <Z>

```
motor-timer test
```

Test sequence

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

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

Send <C>

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

7 Analogue input test

Send <7>

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

7.1 Examination of highly insulated measuring inputs

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

Send <1>

```
Input 1          0.0 mV
```

Tolerance: ± 0.5 mV

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

Tolerance (with ± 1500 ÷ 2000 mV) ± 1 mV
(Be aware of the calibrator's tolerance)

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

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

Send <C>

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

Disconnect simulator from 'Ind I' input and connect to 'Ind II' input.

Send <2>

```
Input 2              XX mV
```

Carry out the same measurements as with Input 1 and compare the displayed value.

Send <C>

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

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

Send <3>

```
Input 1-2            XX mV
```

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

Send <C>

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

7.2 To check Pt 100 / 1000 connection

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

Send <4>

```
Pt 100*              XX °C
```

(* or Pt 1000)

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

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

Send <C>

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

Remove resistor switch-box.

7.3 Polarizer test

Send <5>

```
polarizer test
```

Send <Z>

```
dummy resistor 14.3kΩ ?
```

Connect resistor switch-box (or suitable resistor 14.3 kΩ 0.1%) using 3.496.5070 cable [1] to 'Pol' socket. Switch-box to 14.3 kΩ.

Send <Z>

```
polarizer test    *
```

An asterisk flashes during the test.

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

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

Send <C>

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

Send <C>

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

Remove cable and resistor switch-box.

8 External inputs and outputs

This test is meaningful only if the 721 NET-Titrino is used interconnected with other instruments via the 'Remote' connection. In addition, a 3.496.8510 test plug normally used in the repair service is required for this test. However, this plug can also be purchased by customers under the above number.
For the sake of completeness, the procedure is described here.
(If a diagnostic test of the external inputs and outputs is not required, continue with point 9.)

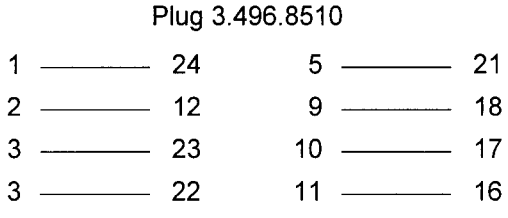


Fig. 4.3 Connections in the 3.496.8510 test plug

Send <4>

```
extern input/output test
```

Send <Z>

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

Insert the 3.496.8510 test plug in port B 'Remote'. (Do not switch off instrument, pay attention to alignment of the plug!).

Send <Z>

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

Remove test plug.

[1] If cable not available see page 64.

Send <C>

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

9 RS 232 test

A 3.496.8480 test plug normally used in the repair service is required for this test. However, this plug can also be purchased by customers under the above number.

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

(If a diagnostic test of the RS 232 interface is not required, continue with point 10.)

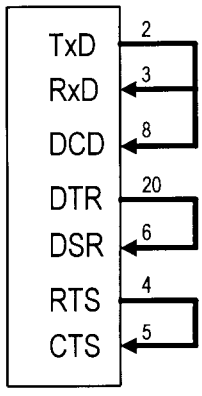


Fig. 4.4 Connections in the 3.496.8480 plug

Send <5>

```
RS232 test
```

Send <Z>

```
RS232 test-connector?
```

Remove cable between Titrino and PC

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

Press <START> key at Titrino

The test runs automatically. If no error is found, 'RS232 test o.k.' appears after about 3 s. Otherwise, an error message is shown. If no test plug is connected, 'error 68' appears.

Remove test plug and insert connecting cable Titrino - PC again.

Send <C>

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

10 Spindle drive and stopcock changeover

Send <C>

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

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

X = according to the selected method

Remove exchange unit (if still inserted).

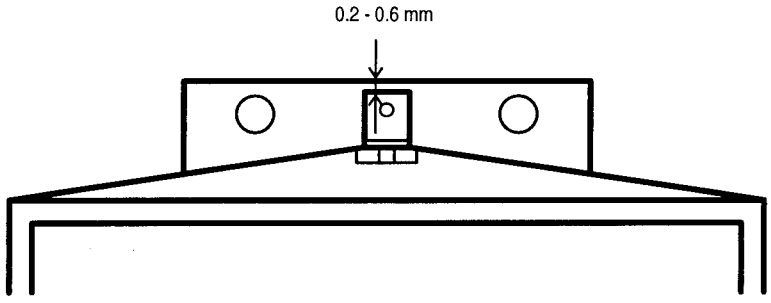


Fig. 4.5

The spindle must be 0.2 -0.6 mm below the edge of the sliding plate.

The bar of the stopcock coupling must be exactly parallel to the lateral edges of the NET Titrino.

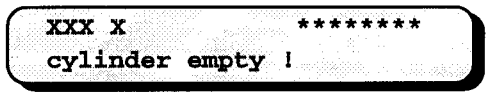
Re-insert exchange unit.

Titrino fills.

The display of before reappears.

(Knob 'dV/dt' to right stop)

Press the <DOS> key (on instrument) until the piston rod reaches the top and at the same time measure the time from start to end.



Spindle remains at maximum position.
The transit time of the spindle is 20 s.

Measure spindle height (can be performed only if the 3.496.0070 dummy exchange unit is inserted or the locking switch (in right hole) is carefully operated with a screwdriver after removal of the exchange unit).

From the start point, the spindle travels 80 mm.

Instead of the spindle height, the expelled volume can be measured (corresponds to max. vol. of exchange unit used).

Press <FILL> and simultaneously measure the time until the Titrino is again in the 'ready' position.

Times for filling:	per stop cock cycle	1 s	
	for filling	20 s	(tolerance: 10 %)

The following generally holds:
Spindle and stopcock must move at a constant speed (noise!).
In the filling setting, the stopcock coupling must position the lever of the exchange unit correctly at the left stop (with virtually no play and without sticking).

Set potentiometer 'dV/dt' to left stop.

Press <DOS> at same time and use a stopwatch to measure the time for 1/10 of the cylinder volume to be expelled. The time should be about 76...126 s.

Set potentiometer 'dV/dt' to right stop.

Press <FILL>

End of test.

11 Setting up original arrangement

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

12 Initialise RAM

On the odd occasion large disturbing signals (e.g. mains spikes, lightning, etc.) can have an adverse effect on the processor functions and hence lead to a system crash. After such a crash the RAM area must be initialised. Although the basic instrument data remain stored, the RAM initialisation should be performed only when necessary since the stored user data (configuration, parameters, calculation variables, etc.) are cleared as a result.

Power off

Power on and press <DOS> and <STOP/FILL> key simultaneously.

```
RAM Init.
```

Press <START> key

```
confirm RAM Init.
```

Press <START> key

```
RAM Init. activ
```

RAM is tested and initialised. Subsequently a 'warm' start is executed.

The lost data of the user memory must now be re-entered.

Perform point 11.

If 'system error 3' appears in the display, sending <C> (clear) can be used to exit to the instrument program. The initialisation values are loaded automatically. The instrument thus remains capable of measurement. However, possibly a small loss in accuracy must be anticipated. A new optimum adjustment can be performed by Metrohm service. The error message 'system error 3' always appears after the instrument is switched on until the adjustment has been performed.

13 Releasing a locked spindle with inserted exchange unit

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

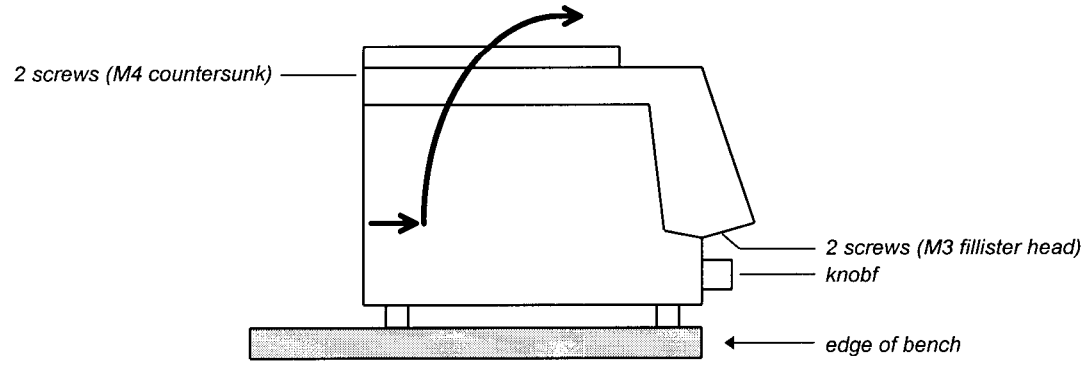
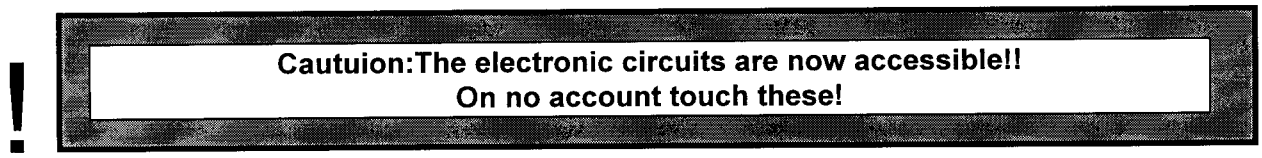


Fig. 4.6

- Disconnect instrument from power supply!
- Remove control knob.
- Place instrument over edge of bench to allow the M3 screws to be removed (Fig. 4-6)
- Remove M4 screws

– Lift off top part of instrument together with exchange unit in the manner shown by the arrow.



– Remove spindle from mechanical stop by turning the large gear wheel. (In case that the motor is inoperative, position spindle by hand to zero position.)

Overview of the key assignment in the diagnostic test

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

<&Diagnose $G >	Entry to the diagnosis
<$S>	Quit of diagnosis
<QDISP1>	send display line 1
<QDISP2>	send display line 2
<&Diagnose.Report$G>	Send adjusting parameters

Since the NET Titrino 721 is not having an external keyboard, the keys can be emulated during the diagnosis by sending the following characters

<S>	START
<F>	STOP
<Q>	QUIT
<D>	DOS
<C>	clear
<Z>	enter

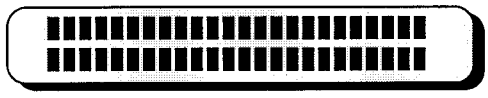
All commands must be sent as strings terminated by 'CR +LF' (<Code>CRLF).

4.2.2 Short check

This short check can be executed with the 721 Titrino as a stand alone instrument, without the aid of a PC. For a complete diagnosis via RS 232 with a PC please refer to page 63.

001 Check system start

1. Remove all external connections except the mains cable.
2. Mains on.



⇒ The power-up test pattern appears for about 5 s.

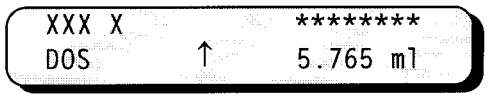
002 Check automatic cock changeover

1. Remove exchange unit (in case that it is still inserted).
2. Re-insert exchange unit. (Put the burette tip into a collecting receptacle)

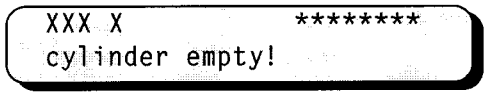
⇒ The automatic cock changes to 'fill' and then to 'dose'.

003 Check the DOS functions (Dosing)

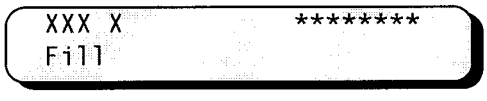
1. Depress <DOS> key.



⇒ The Titrino is dosing as long as the DOS key is depressed. The volume fed out is indicated at the right side of the display. The dosing speed can be varied with the aid of the potentiometer 'dV/dt' (with uninterrupted dosing at full speed the run-through time is 20 s ± 10%). The following display appears as soon as the maximum volume of the corresponding exchange unit is reached:



2. Set the potentiometer 'dV/dt' to the right stop. Depress <STOP/FILL> .

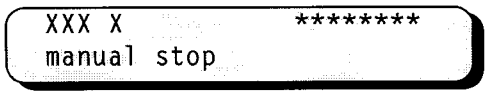


⇒ The cock turns to filling position and the spindle moves downwards.(The run-through time of the spindle is 20 s, ± 10 %). Subsequently the cock turns to dosing position.

3. Depress <START>

⇒ The Titrino starts the titration according to the selected settings and works in a pulsewise operation. The volume fed is indicated in the display.

4. Depress <STOP/FILL> .



⇒ The titration is stopped and the Titrino releases 'fill'.

5. Preparations

Ensure that the set operating voltage corresponds to the mains voltage before switching on the instrument.
The mains cables supplied with the instrument are three-core and equipped with a plug with an earthing pin. If a different plug has to be fitted, the yellow/green lead must be connected to the protective earth. If no socket with earthing is available, the instrument must be connected to a perfect earthing conductor via its earthing socket. Each break in the earthing inside or outside the instrument can make it a hazard.
When the instrument is opened or if parts of it are removed, certain components may be live if the instrument is connected to the mains. The mains cable must therefore always be unplugged when certain adjustments are made or parts replaced.

5.1 Setting up and connecting the instruments

5.1.1 Titrino with Stirrer

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

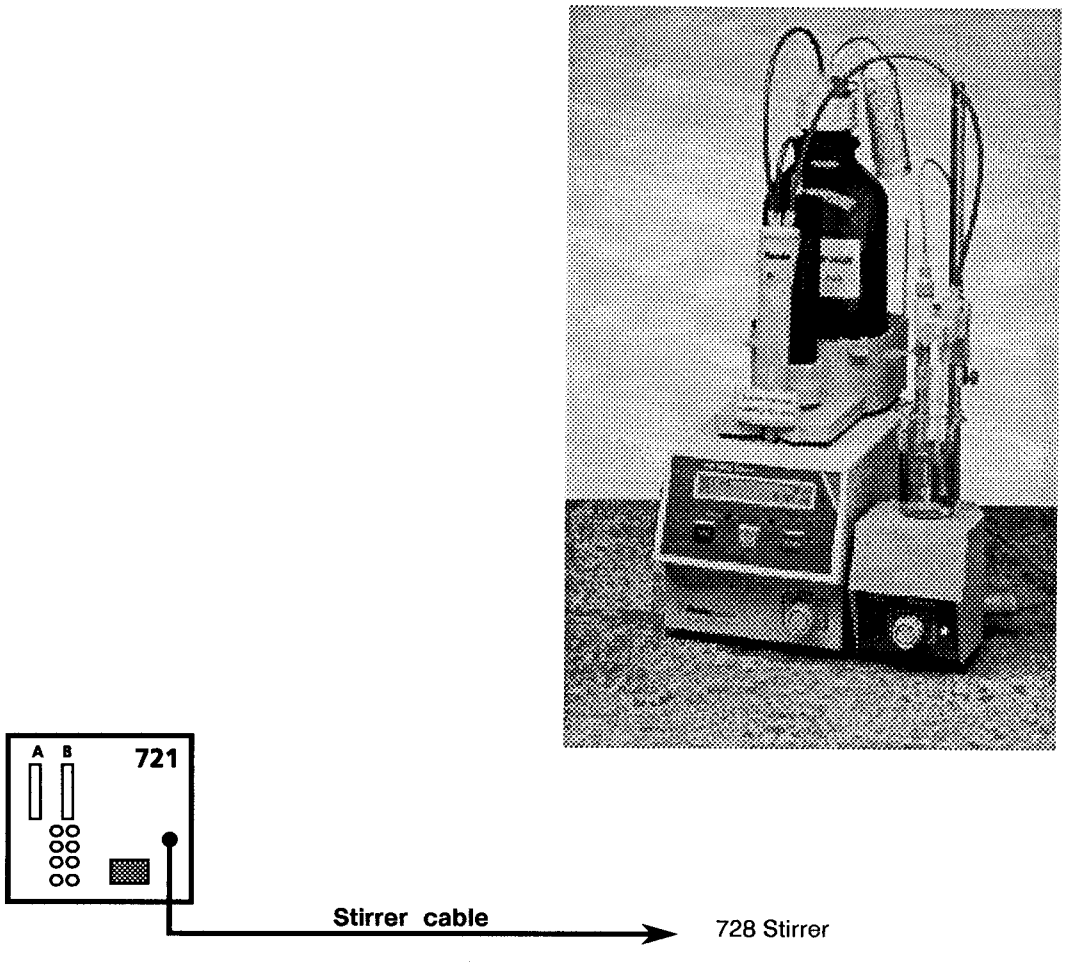


Fig. 5-1: Setting up the Titrino and connection of the stirrer

The 722 Rod Stirrer, the 727, or the 703 Ti Stand can also be connected instead of the 728 Magnetic Stirrer.

5.1.2 Connection of a sample changer

The sample changer is connected as follows:

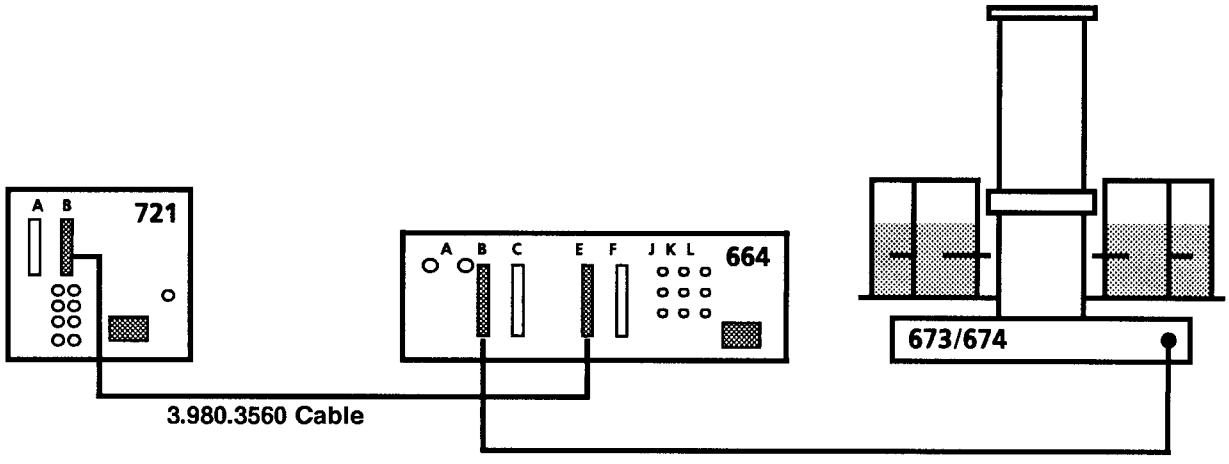


Fig. 5-2: Connection of a sample changer

- The "remote" socket allows not only connection of a sample changer but also additional control functions. Pin assignment of the "remote" socket and control possibilities, see page 87.
- If a calibration has to be performed with the sample changer, the calibration parameter "sample changer:" must be set to "ON".
- In connections with the sample changer, "auto start" should be set to "OFF" in the "configuration". The start command is given by the 664 Control Unit when the sample beaker is at the processing station.

5.1.3 Connection of a recorder

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

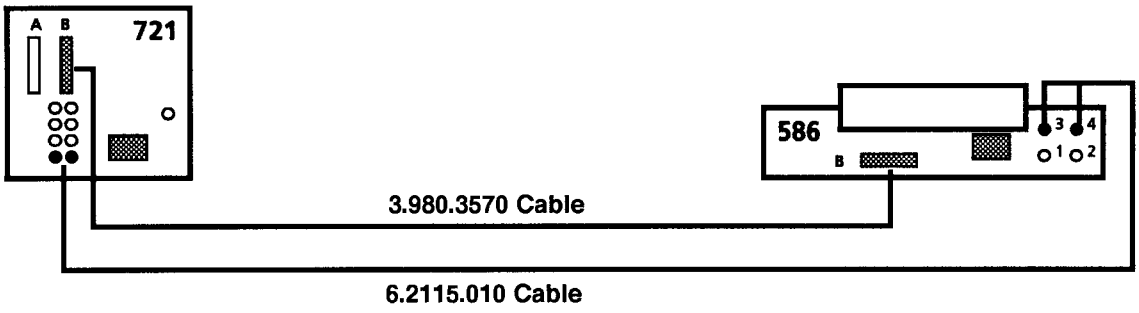


Fig. 5-3: Connection of a recorder

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

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

The signal at the analog output can be preselected on the Titrino ("Config.PeriphUnit.Plot"). The following are available:

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

5.1.4 Connection of a computer

The computer is connected as follows:

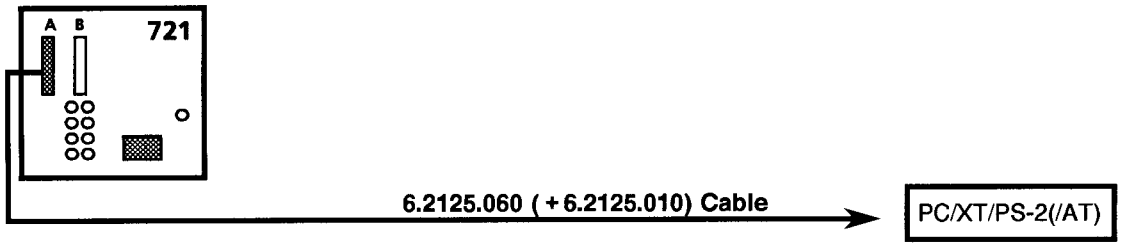


Fig. 5-4: Connection of a computer

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

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

TiNet 2, Programmpaket
german 6.6012.101
english 6.6012.103

5.2 Installation of the titration vessel, connection of electrodes

5.2.1 Setting up the titration vessel

The titration vessel is set up as shown in Fig. 5-5. During a titration, it is important to ensure that the solution in contact with the electrode is thoroughly mixed. This is achieved by

- efficient stirring. But it should not be too fast, otherwise the stirrer vortex will suck in air bubbles and CO_2 or O_2 can disturb the titration.
- positioning the burette tip as centrally as possible, above the stirring bar.

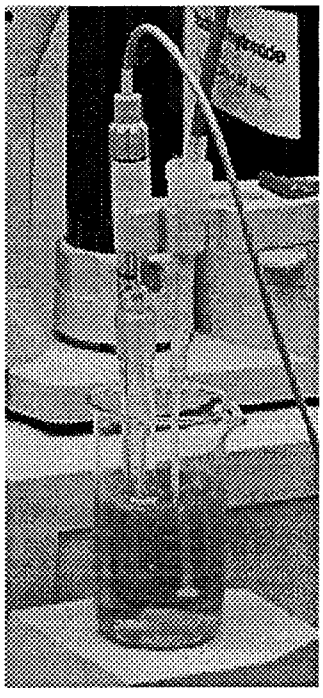
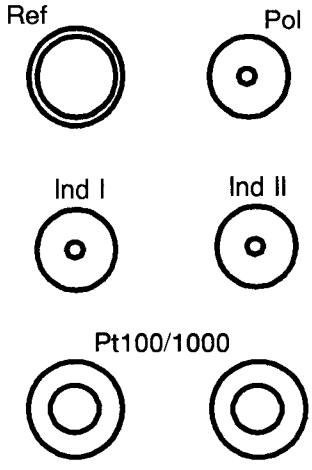


Fig. 5-5: Setting up the titration vessel

5.2.2 Connection of the sensors



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

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

Ind I: Indicator electrode I. (pH, redox, ISE electrodes). Combined or separate electrode. If measuring input 1 is selected, this measuring input is active.

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

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

Fig. 5-6: Connection of electrodes

Differential potentiometry

In potentiometric measurements in media of low conductivity, e.g. in organic solvents, high-impedance electrode assemblies such as pH electrodes record noise voltages which arise from stray electrostatic and electromagnetic fields. Particularly high field strengths occur through friction at insulators such as plastic floors, synthetic clothing, etc; conditions which can appear in every normal laboratory environment. These disturbing voltages are superimposed on the measurement signal and when titration curves are recorded can lead to "ghost end points", which make an automatic evaluation virtually impossible.
Problems of this type can be solved by measurement using a differential amplifier. Here, the indicator and reference electrode are each connected to a high-impedance measuring input. It is important to ensure that both electrodes have identical shielding and are thus symmetrical with regard to the recording of noise signals. An auxiliary electrode provides the electrical connection between the reference point of the amplifier circuit and the measurement solution.

Recommended electrodes:

Measuring input	Manual determinations	Determinations at sample changer
Ind I	6.0102.102 pH glass electrode	6.0104.100 pH glass electrode
Ind II	6.0729.100 double-shielded Ag/AgCl reference elecrode	6.0729.110 double-shielded Ag/AgCl reference electrode
Ref	6.0301.100 auxiliary elecrode	6.0302.110 auxiliary electrode

Practical tips
- Glass electrodes should be preconditioned in the solvent used for ca. 1 hour.
- If the potential jump after the first dispensing step is too large, a small start volume may help.
- As an "auxiliary electrode", the 6.1808.030 burette tip with earthing may be used in some cases. Use burette tips without anti-diffusion valve!

5.3 Preparing the Exchange Unit

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

Accuracy data:

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

Note:
In gravimetric checks of the dispensed volume, the air buoyancy (ca. 0.1%) must be taken into account in the weighing. Consideration should also be given to evaporation.

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

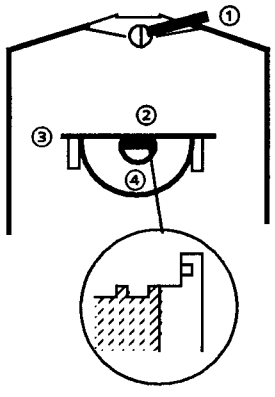


Fig. 5-7: Bottom of Exchange Unit

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

- Remove packing plate below the reagent bottle.
- Mount retaining clips for reagent bottle, see Fig. 6-1, page 105.

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

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

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

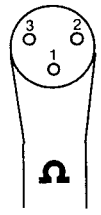
The holder on the right serves to hold the burette tip; in the holder on the left you can store, for instance the electrode associated with the reagent.

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

See also Fig. 6-2, page 106.

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

Flat stopcock



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

Fig. 5-8: Stopcock tubing connections

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

5.3.3 First-time filling

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

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

5.3.4 Changing the Exchange Unit

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

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

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

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

5.3.5 Maintenance

It is best to store the burette tip in the same solvent as the reagent to prevent crystallisation of reagent: Fill glass holder with solvent, pass burette tip through the bulb stopper and place in the glass holder. In the case of KF reagent, use methanol as storage solution. Warning: Before dispensing check that the burette tip is not blocked!

Emptying and cleaning:
- Discharge as much titrant as possible.
- Burette in the zero position, disconnect connections to bottle and burette tip.
- With 6.3011.XXX and 6.3012.XXX Exchange Units, remove light protection.
- Undo attachment of the glass cylinder and let spindle run out until the piston can be disengaged.
- Completely empty cylinder with the aid of the 6.2739.010 Key or 6.1546.010 piston rod and carefully pull out piston.
- Rinse and clean individual parts properly. (Especially ensure that no reagent remains in the threaded hole of the PTFE tubing connections.)

PTFE piston

The PTFE piston must be handled with care to avoid damaging the lip seals. Residual grease should be wiped off with a soft, lint-free cloth. Carefully apply fresh grease with your finger to the lip seals and in the spaces. Wipe off leading edge to ensure that the reagent does not come into contact with the grease. When inserting the piston in the glass cylinder, ensure that it is introduced straight and not at an angle.

SISCO 3000 (Swedish Iron & Steel Corp.) grease - this is not silicon grease (!), the name refers to the manufacturer - has well proved its worth since our tests have shown that it is not only inert to all titrants in normal use, but also has a favourable viscosity.

A worn piston must be replaced immediately to prevent titrant leaking out and corroding the drive spindle.

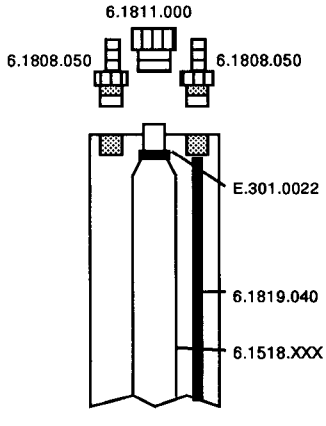
Stopcock

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

Removing the stopcock:
- Switch lever to "↑" ≙ dispensing.
- Unscrew nipples of the tubing connections.
- Pull out 6.1542.0X0 stopcock upwards (pull hard!).

Refitting:
- Switch lever to "↑" ≙ dispensing.
- For PTFE stopcock: Align marking on shaft and housing of stopcock.
- Insert stopcock from above in the holder and press down until the quick-release coupling engages.
- Screw in screw nipples.

5.3.6 Mounting the thermostat jacket of the 6.3011.XXX/6.3012.XXX Exchange Units



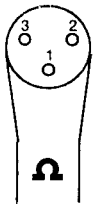
1. Undo tubing connection of 6.1518.XXX glass cylinder.
2. Remove light protection.
3. Unscrew 6.1811.000 screw fitting at glass fitting.
4. Roll O-ring upwards out of groove on glass fitting. Do not use any hard objects to remove the O-ring, otherwise the edge of the glass fitting can splinter! If all else fails, cut O-ring. Ordering number for new O-ring: E.301.0022.
5. Lightly grease inside of 6.1536.010 thermostat jacket at the bottom and mount.
6. Lightly grease O-ring and attach to glass fitting.
7. Attach upper part of 6.1811.000 screw fitting to glass fitting.
8. Make connection to stopcock.
9. Insert 6.1819.040 PTFE tubing in thermostat jacket and attach thermostat tubing using 6.1808.050 coupling.

Fig 5-9: Thermostat jacket

5.3.7 6.3006.113 Micromodel - 1 mL

Assembly:
See also Fig. 6-3, page 107.
- Dosimat without Exchange Unit is in the zero position.
- Mount Exchange Unit (without glass cylinder) from the front on the sliding plate and push right back.
- Allow piston spindle of Dosimat to run out by ca. 2 cm
- Mount 6.3022.113 Exchange Set and screw tightly.
- Join coupling of the piston spindle to that of the exchange set and move piston spindle of the Dosimat into the zero position.
- Fasten fitting with 6.2035.000 metal flange and V.911.0040 knurled nuts using 6.2035.000 metal flange.
- Turn glass piston until curve is aligned towards the handle.
- Attach remaining components of the Exchange Unit.
  . Tubing connections:

Flat stopcock



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

Fig. 5-10: Stopcock tubing connections

  . Tighten tubing connections firmly by hand. Use 6.2739.000 key at all inaccessible positions and tighten using a moderate amount of force (tubing must not be pinched).
  Warning: Solids block the capillary tubing! Never pull on the tubing!
- Move piston to zero position.

Filling:

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

Repeat filling process in both directions until the glass cylinder together with the connections up to the burette tip is filled. Drive any air bubbles to the top by lightly tapping the glass cylinder. If the air bubbles do not move, the Exchange Unit must be disassembled and the glass piston carefully degreased and dried.

Cleaning:
- Undo tubing connection to reagent bottle, repeat "dispensing" and "filling" until the piston is as empty as possible.
- Undo tubing connection to glass piston.
- Remove Exchange Unit from Dosimat.
- Unscrew knurled nuts and remove piston and fitting.
- Unscrew exchange set from fitting and disassemble Exchange Unit into its parts.
- Clean all parts thoroughly and dry (ensure that no reagent remains in the threaded holes of the tubing connections).
- If need be, replace 6.2712.000 Seal (round part pointing upwards).

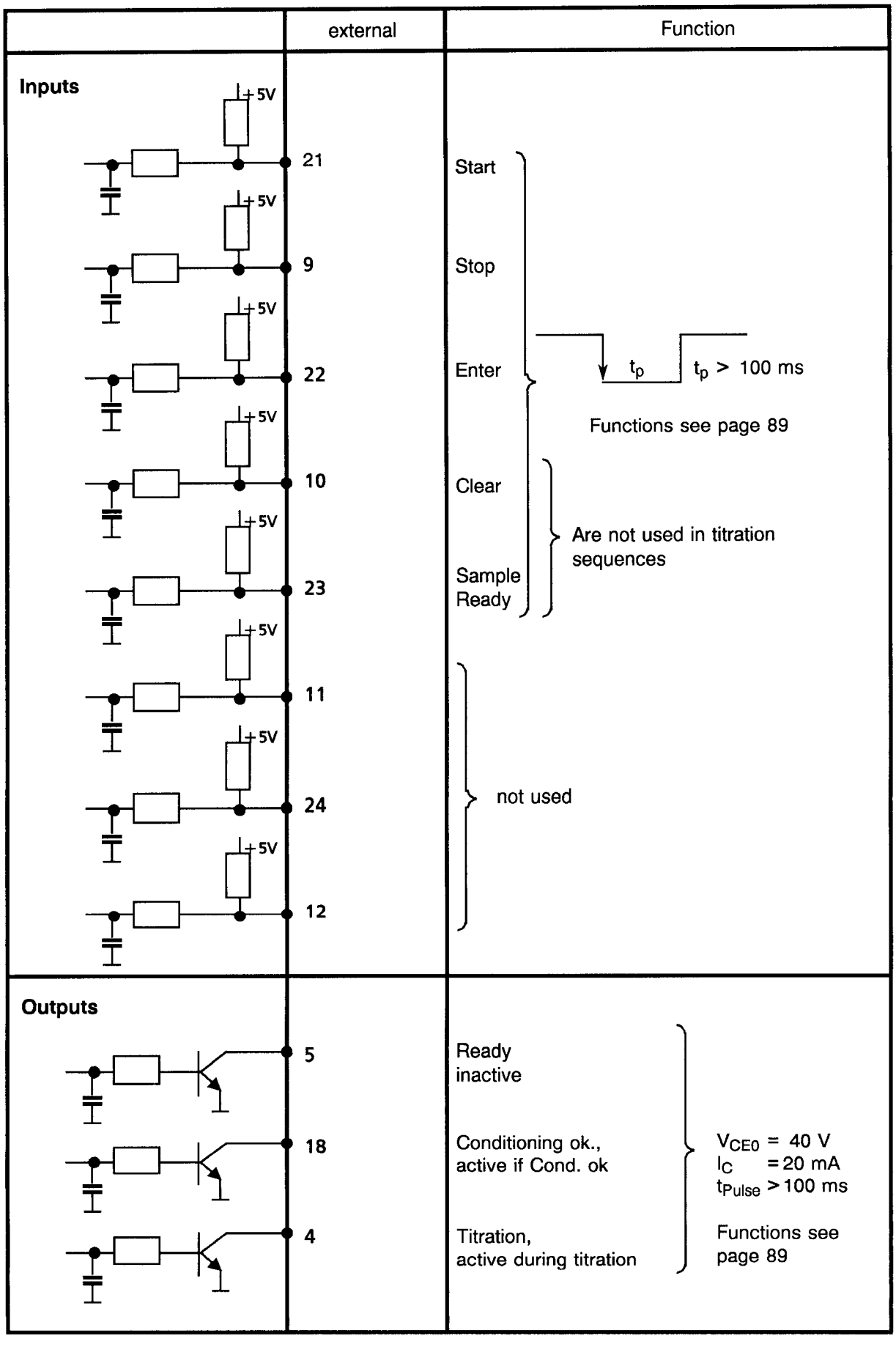
6. Appendix

6.1 Technical specifications

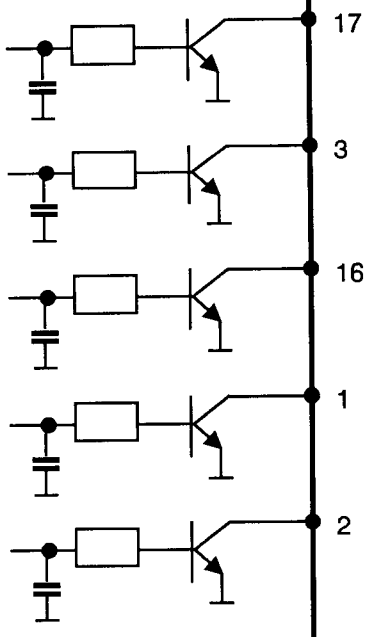
Modes	DET: **D**ynamic **E**quivalence point **T**itration MET: **M**onotonic **E**quivalence point **T**itration SET: **S**et **E**nd point **T**itration MEAS: **MEAS**urement CAL: pH **CAL**ibration
Measuring input	2 high-impedance measuring inputs for pH, redox and ISE electrodes 1 reference input for a separate reference electrode May also be used as a differential amplifier. 1 measuring input for polarized electrodes 1 measuring input for temperature sensor Pt100 or Pt1000
Measuring range	
pH value (pX)	0... ± 20.00
Voltage	0... ± 2000 mV
Current	0... ± 200.0 µA
Temperature	−150.0... + 450.0 °C
Error of measurement of instrument (without snesors)	
at 25 °C and with a warmed-up Titrino	
pH value	± 0.02
Voltage	± 2 mV
Temperature	≤ 0.2 °C in the range of 0... + 100 °C
as a function of the ambient temperature	
pH value, voltage	typical 40 µV/K
Temperature	0.04 °C/K
Measuring amplifier	
Input resistence	$> 10^{13}\Omega$
Offset current	$< 3 \cdot 10^{-13}$ A
Deviation of offset voltage as a function of the ambient temperature	15 µV/K
Polarizer	Ipol: 0... ± 127 µA Upol: 0... ± 1270 mV, in 10 mV steps
Dosification	
Volume of a burette cylinder	1, 5, 10, 20 or 50 ml
Resolution	10 000 steps per burette cylinder
Materials	
Housing	polybutyleneterephthalate (PBTP)
Keypad covers	polycarbonate (PC)
Display	LCD, 2 lines of 24 characters each
Height of characters	5 mm
RS232 interface	for computer connection: completely remote controllable from external

Conventional input/output lines	for connection of sample changer or robot
Input lines	Start, Stop, Enter, Clear, Sample Ready
Output lines	Ready, Conditioning ok, Titration, End of titration, Error, Activate, lines to be set via RS232 Control
Analog output	
Output signal	–2000 ... 2000 mV
Signal at analog output	depending on preselection: U (measuring value) dU/dt (measured value drift) V (volume) dV/dt (volume drift) U(rel) (control deviation at SET) T (Temperature)
Resolution	1 mV (12 bit), see also page 77
Ambient temperature	
Nominal operational range	5 ... 40 °C
Storage, transport	– 20 ... 70 °C
Safety specifications	Designed and tested in accordance to IEC publication 1010, safety class I. This manual contains some information and warnings which have to be followed by the user to ensure safe operation and to retain the apparatus in safe condition.
Mains connection	
Voltage	100, 117, 220, 240 V ± 10% (switchable)
Frequency	50 ... 60 Hz
Power consumption	15 VA
Fuse	Thermal fuse
Dimensions with Exchange Unit	
Width	150 mm
Height	450 mm
Depth	275 mm
Weight	app. 3.4 kg

6.2 Pin assignment of the "Remote" socket



Outputs



End of determination
EOD

To be set via RS232 control

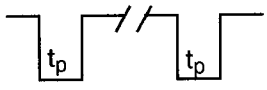
Error: active with errors

Activate, as set in method (see also page 90)

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

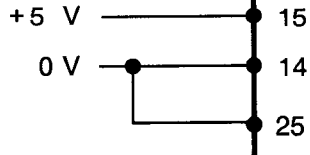
Functions see page 89

Pulses for recorder



t_p = 150 µs

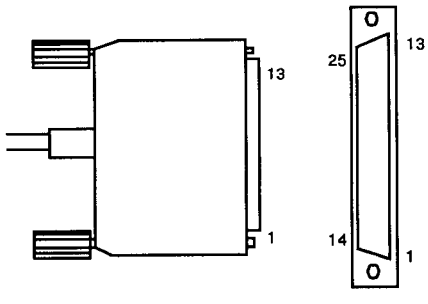
Voltage



I ≤ 75 mA

0 V: active
5 V: inactive

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

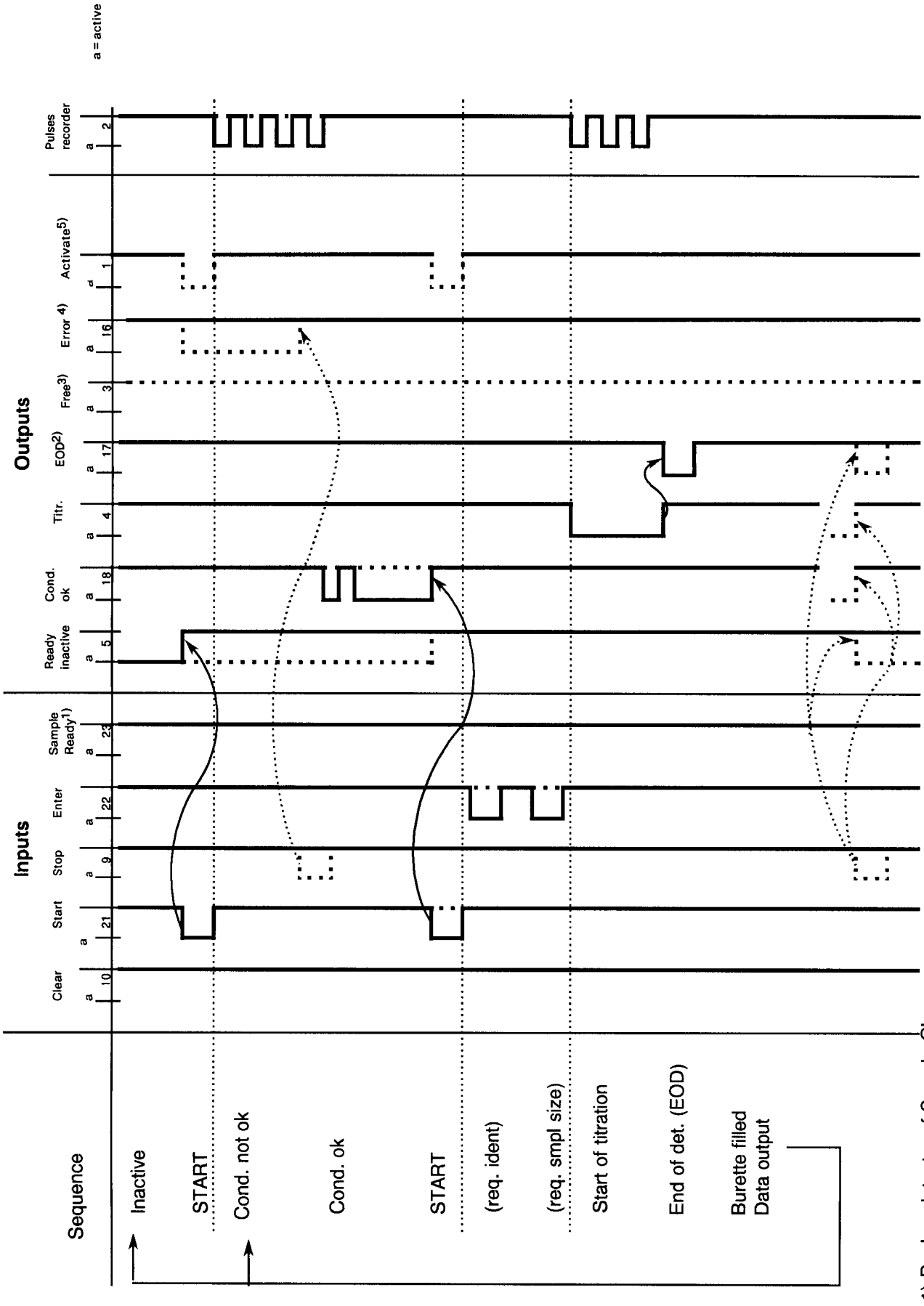


View from solder side of connector

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

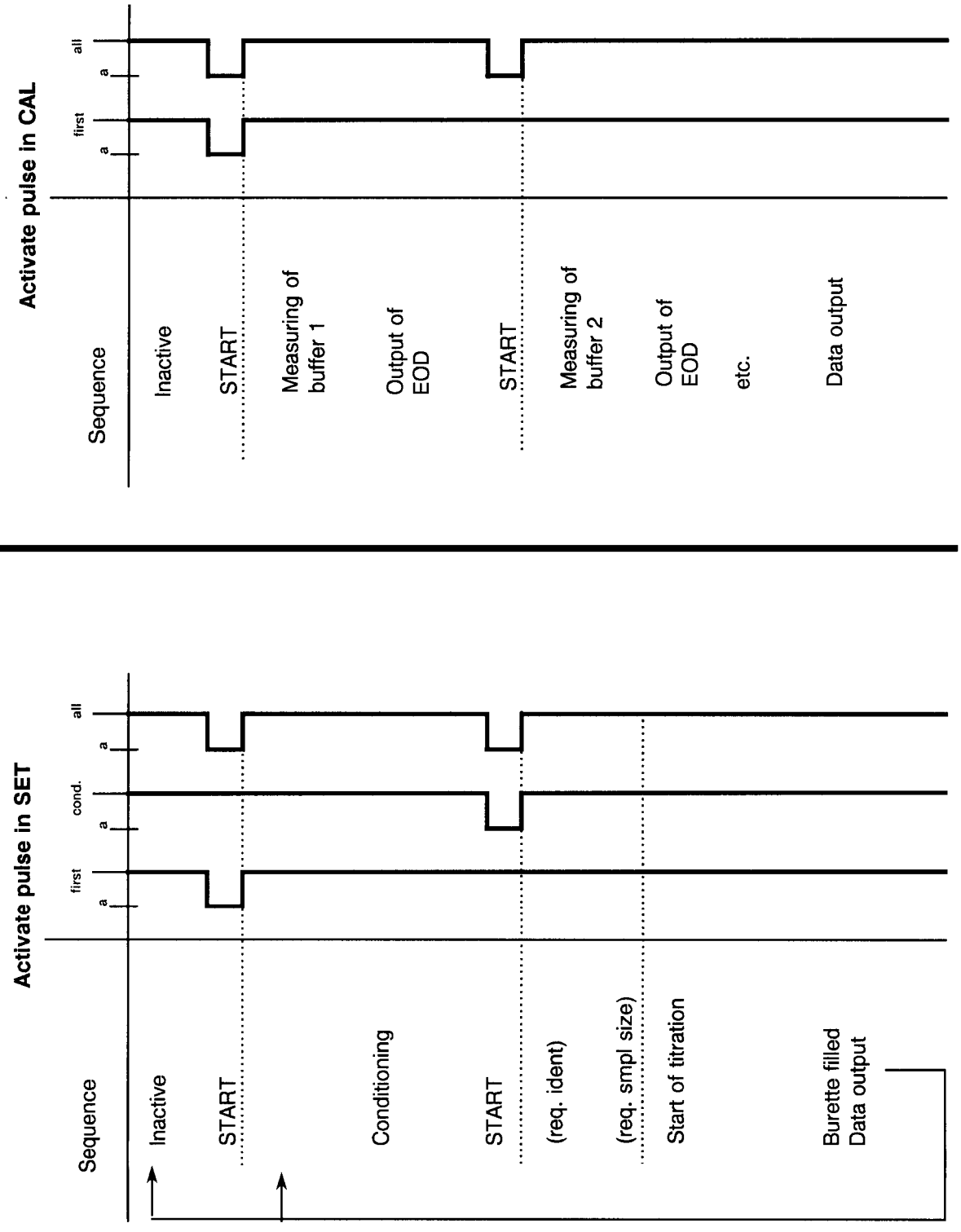
No liability whatsoever will be accepted for damage caused by improper interconnection of instruments.

6.2.1 Lines of the "Remote" socket during the titration



1) Beaker detector of Sample Changer.
2) In CAL, EOD is sent after every buffer. Automatic output of EOD can be switched off via RS232, see page 48.
3) Line can be set via RS232, see page 48.
4) The error line is reset when the error is rectified.
5) According to method configuration, see pages 38 and 41.

Possible configurations of the activate pulse in SET and CAL



6.3 User methods

6.3.1 General

The methods are stored ready for use in the user memory. They can be loaded, modified and overwritten. Depending on sample and instrument configuration, the methods should be completed with the following settings:
- For some methods the molar mass, blank value etc. should be entered.
- Stop volumes or other stop conditions should be entered depending on sample.

6.3.2 "Titer_pH"

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

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

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

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

Reference: Metrohm Application Bulletin No. 206

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


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

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

6.3.3 "Blank"

Treat the "blank sample" in the same way as you treat your real samples. Can be used e.g. for the methods Sapon.No. and Perox.No, see pages 97 and 101.

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

Reference: Metrohm Application Bulletin No. 210

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


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

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

6.3.4 "Chloride"

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

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

Sample: Dissolve sample and add HNO_3.

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

Reference: Metrohm Application Bulletin No. 130

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


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

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

6.3.5 "TAN-TBN"

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

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

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

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

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

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

Reference: Metrohm Application Bulletin No. 80

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


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

Differential potentiometry, see page 80

Makes sure that the sum value is evaluated

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

6.3.6 "Diazo"

Diazotation of sulfonamides and primary amines.

Electrode: 6.0413.100 combined gold cap electrode

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

Solvent: 30% HBr

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

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

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

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

6.3.7 "Br-Index"

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

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

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

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

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

Remarks: The bromine index can be determined easily by endpoint titration (SET).

Reference: Metrohm Application Bulletin No. 177

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


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

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

6.3.8 "Sapon.No"

Electrode:	6.0203.100 combined pH glass electrode, at measuring input 1.
Titrant:	HCl, c = 0.5 mol/L
Sample:	Weigh out app. 2 g of sample. Add 25 mL of KOH, c = 0.5 mol/L in ethanol and allow to boil lightly for at least 30 minutes. Rinse the content into a beaker and titrate the excess KOH with HCl. Determine a blank sample in the same way.
Remarks:	Change the result unit to e.g. mg KOH
Reference:	Metrohm Application Bulletin No. 141

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


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

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

6.3.9 "Ca-Mg"

Electrode:	6.0504.100 Ca electrode and 6.0726.100 Ag/AgCl reference electrode (outer electrolyte KNO_3 sat.), at measuring input 1.
Titrant:	Na_2EDTA, c = 0.05 mol/L in KOH, c = 0.1 mol/L
Aux. reagent:	Acetyl acetone, c = 0.1 mol/L + TRIS, c = 0.2 mol/L (TRIS = Trishydroxymethyl amino-methane)
Sample:	Add auxiliary complexing agent to sample.
Remarks:	The volume of added auxiliary reagent can be optimized: As a rule of thumb, the ratio Mg/acetyl acetone should be app. 0.05.
Reference:	Metrohm Application Bulletin No. 125

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


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

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

6.3.10 "EDTA-NTA"

EDTA and NTA in detergents.

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

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

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

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

Reference: Metrohm Application Bulletin No. 143

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


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

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

6.3.11 "Metals"

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

Titrant: EDTA, c = 0.1 mol/L

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

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

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

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

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

Reference: Metrohm Application Bulletin No. 101

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


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

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

6.3.12 "Perox.No"

Determination of the peroxide number in edible oils and fats.

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

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

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

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

Reference: Metrohm Application Bulletin No. 141

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


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

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

6.4 Warranty

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

For day and night operation, the warranty is valid for 6 months.

Glass breakage in the case of electrodes or other glass parts is not covered by the warranty. Checks which are not a result of material or manufacturing faults are also charged during the warranty period. For parts of outside manufacture insofar as these constitute an appreciable part of our instrument, the warranty stipulations of the manufacturer in question apply.

With regard to the guarantee of accuracy, the technical specifications in the Instructions for Use are authoritative.

Concerning defects in material, construction or design as well as the absence of guaranteed features, the orderer has no rights or claims except those mentioned above.

If damage of the packaging is evident on receipt of a consignment or if the goods show signs of transport damage after unpacking, the carrier must be informed immediately and a written damage report demanded. Lack of an official damage report releases METROHM from any liability to pay compensation.

If any instruments and parts have to be returned, the original packaging should be used if at all possible. This applies above all to instruments, electrodes, burette cylinders and PTFE pistons. Before embedment in wood shavings or similar material, the parts must be packed in a dustproof package (for instruments, use of a plastic bag is imperative). If open assemblies are enclosed in the scope of delivery that are sensitive to electromagnetic voltages (e.g. data interfaces etc.) these must be returned in the associated original protective packaging (e.g. conductive protective bag). (Exception: assemblies with built-in voltage source belong in a non-conductive protective packaging). For damage which arises as a result of non-compliance with these instructions, no warranty responsibility whatsoever will be accepted by METROHM.

6.5 Scope of delivery and ordering designations

6.5.1 721 NETTitrino

721 NETTitrino	**2.721.0010**
including the following accessories:	
1 Key for exchange units	6.2739.010
1 Mains cable with cable socket, type CEE(22),V	
Cable plug to customer's specifications:	
type SEV 12 (Switzerland...)	6.2122.020
type CEE(7),VII (Germany...)	6.2122.040
type NEMA/ASA (USA...)	6.2122.070
1 Instructions for Use for 721 NETTitrino	8.721.1003

Options

Accessories to separate order and on payment of extra charge:

728 Magnetic Stirrer	
Magnetic Stirrer 728	2.728.0040
727 Ti Stand	
For rinsing and addition of fresh solvent	2.727.0010
Rod stirrer	2.722.0010
or	
727 Ti Stand with built-in magnetic stirrer and rinsing and addition of fresh solvent	2.727.0100
703 Ti Stand	2.703.0010
Magnetic stirrer, stand, siphoning device for waste solvent, addition of fresh solvent.	
Titration equipment	
Titration vessel, volumes	
1... 50 mL	6.1415.110
5... 70 mL	6.1415.150
10... 90 mL	6.1415.210
20... 90 mL	6.1415.220
50... 150 mL	6.1415.250
70... 200 mL	6.1415.310
Thermostatable titration vessel, volumes	
1... 50 mL	6.1418.110
5... 70 mL	6.1418.150
20... 90 mL	6.1418.220
50... 150 mL	6.1418.250
Titration vessel upper half for electrodes and burette tips (5 openings)	6.1414.010
Magnetic stirring bars, length	
12 mm	6.1903.010
16 mm	6.1903.020
25 mm	6.1903.030
Electrode holder	6.2021.020
Equipment for KF titrations	6.5609.000

PC connection, control via RS232 C interface

Cable 721 NETTitrino – IBM® PC/XT/PS-2 or compatible	6.2125.060
Cable 721 NETTitrino – IBM® AT	6.2125.060 + 6.2125.010
RS232 C extension cable	6.2125.020
TiNet 2, program package for the control of the 721 NETTitrino	
german	6.6012.101
english	6.6012.103

Analog recorder

Labograph 586, 50 Hz	2.586.0012
Labograph 586, 60 Hz	2.586.0013
Cable 721 NET Titrino – Labograph 586	3.980.3570 + 6.2115.010

Sample Changer

With 10 sample beakers, 1 work station	2.673.0020
With 10 sample beakers, 2 work stations	2.673.0010
With 32 sample beakers, 1 work station	2.674.0010
With 32 sample beakers, 2 work stations	2.674.0020
Control Unit for all Sample Changers	2.664.0010
Cable 721 NETTitrino – 664 Control Unit	3.980.3560
Cable 721 NETTitrino – 664 Control Unit and 665 or 725 Dosimat	3.980.3610

6.6.2 Exchange Units

Burette cylinder volume 5 mL	
Light protection, burette tip with microvalve	6.3012.153
Amber glass, burette tip with microvalve	6.3007.153
Amber glass, burette tip without microvalve	6.3006.153
Burette cylinder volume 10 mL	
Light protection, burette tip with microvalve	6.3012.213
Amber glass, burette tip with microvalve	6.3007.213
Amber glass, burette tip without microvalve	6.3006.213
Burette cylinder volume 20 mL	
Light protection, burette tip with microvalve	6.3012.223
Amber glass, burette tip with microvalve	6.3007.223
Amber glass, burette tip without microvalve	6.3006.223
Burette cylinder volume 50 mL	
Light protection, burette tip without microvalve	6.3011.253
Amber glass, burette tip without microvalve	6.3006.253

Accessories, see Fig. 6-1 and 6-2.

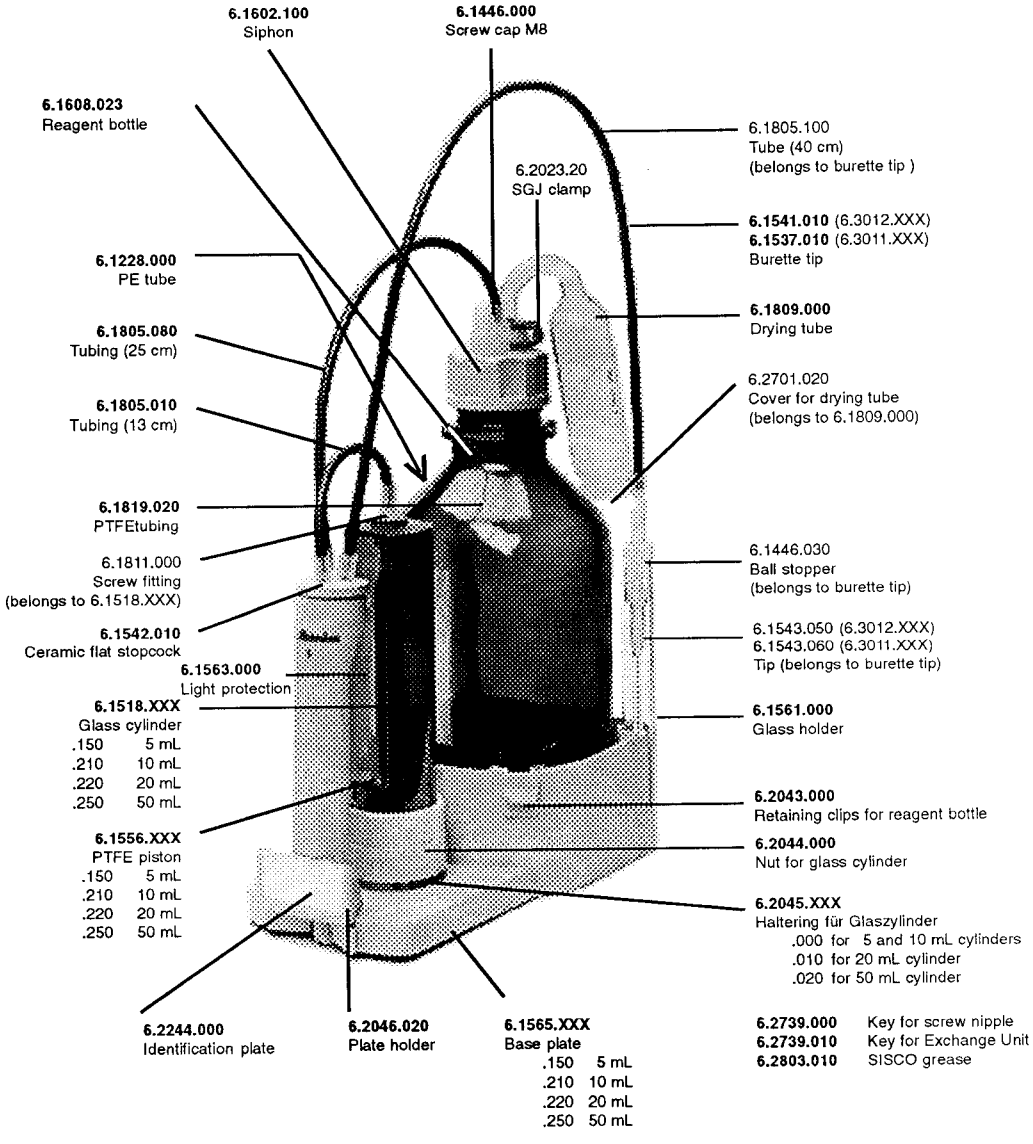


Fig. 6-1: Standard accessories and ordering designations for the 6.3011.253 and 6.3012.XXX Exchange Units

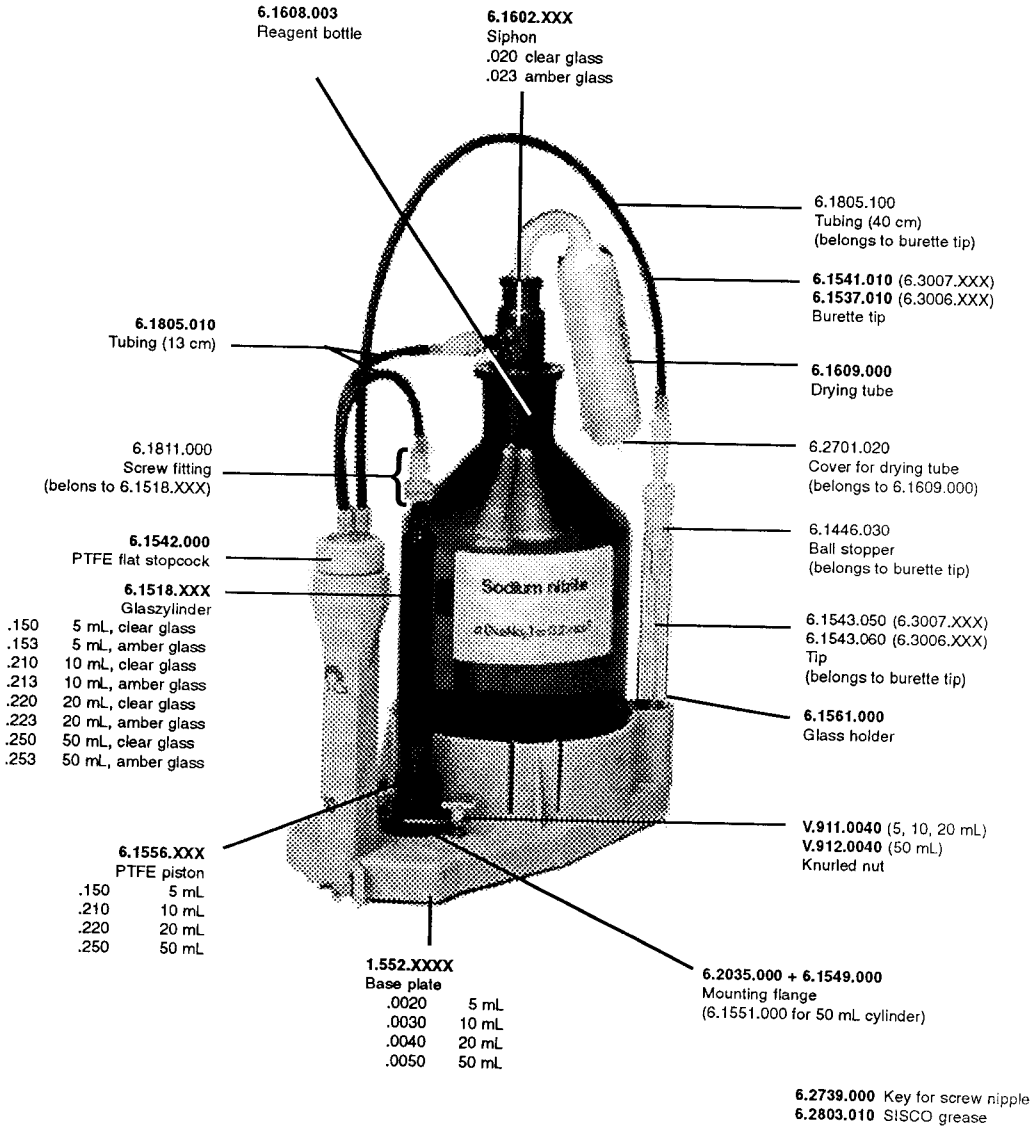


Fig. 6-2: Standard accessories and ordering designations for the 6.3006.XXX and 6.3007.XXX Exchange Units

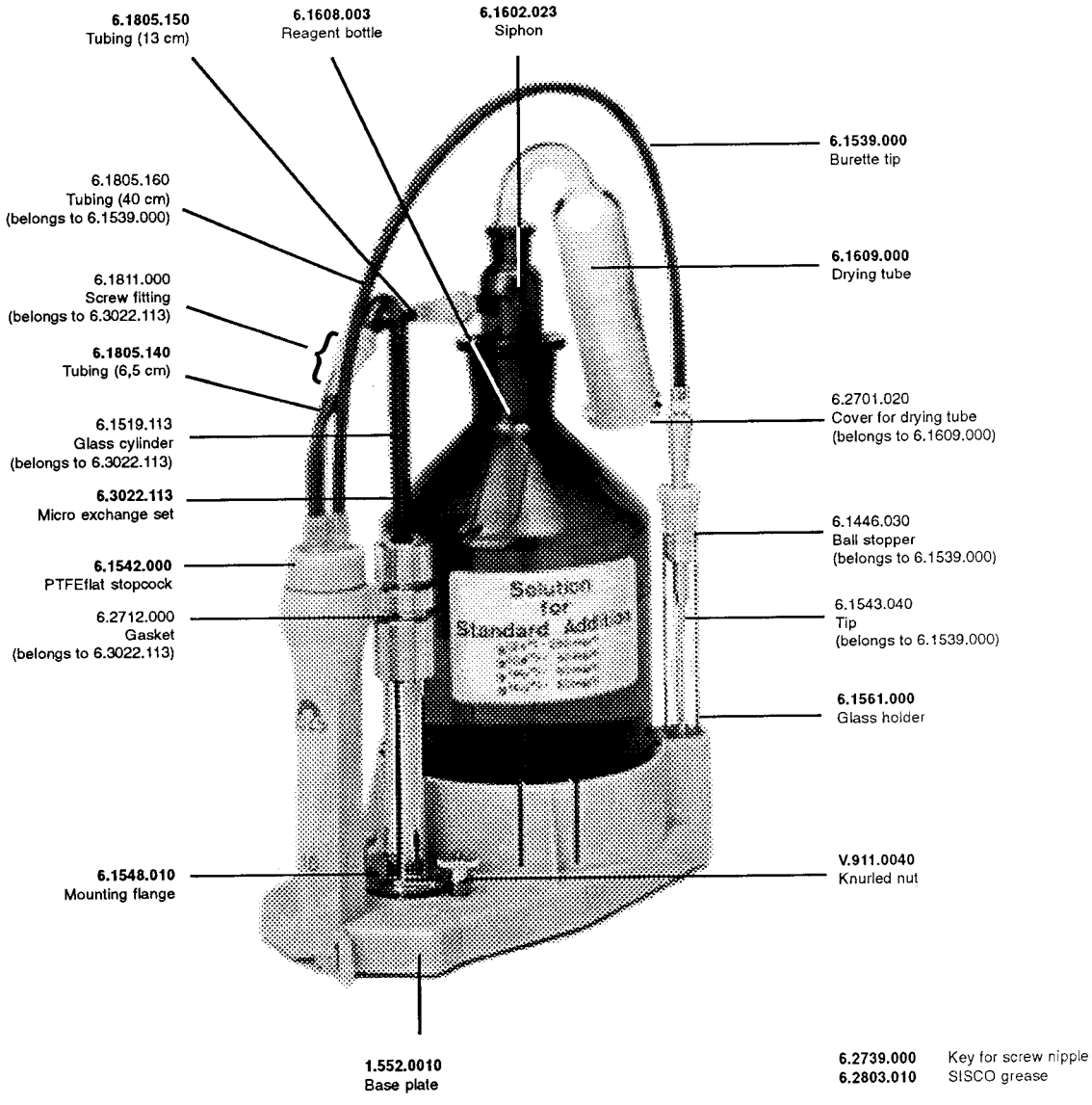


Fig. 6-3: Standard accessories and ordering designations for the 6.3006.113 1 mL Exchange Unit

Options for Exchange Units
Accessories to separate order and on payment of extra charge:

Bottles and accessories:

Siphon with GL 45 thread (bottles from Riedel de Haën, ...)	6.1602.120
Siphon with S40 thread (bottles from Merck ...)	6.1602.130
Amber glass bottle with GL 45 thread	6.1608.023
Bottle made of PE with thread GL45	6.1608.040
Bottle made of PP with ground-glass joint SGJ 29	6.1608.004
Siphon for bottles with SGJ 29	6.1602.023
Thread adapter 32 mm/GL 45	6.1618.000
Thread adapter 28 mm/GL 45	6.1618.010

Tubing and accessories:
The standard screw fitting of the Exchange Units has M6 thread size. On change to M8 thread, the 6.1808.040 Thread Adapter is needed.

Extension tubing with screw nipples, M6 thread	
Length 80 cm	6.1805.110
Length 150 cm	6.1805.030
additional lengths, see Accessories catalogue	
Extension tubing with screw nipples, M8 thread	
Length 50 cm	6.1805.200
Length 25 cm	6.1805.210
Connecting sleeve for tubing extensions (tubing with M6 thread)	6.1808.000
T-connection for tubing with M6 thread	6.1808.060
T-connection for tubing with M8 thread	6.1808.070
Coupling with M6 thread and stub for tubing with internal diameter app. 3 mm	6.1808.020
Coupling with M8 thread and stub for tubing with internal diameter app. 3 mm	6.1808.050
Screw cap, seals tubing with M6 thread together with 6.1808.000 Connecting Sleeve	6.1446.040
Screw fitting for glass cylinder and tubing with M6 thread	6.1811.000
Screw fitting for glass cylinder and tubing with M8 thread	6.1811.010

Tubing connections with larger internal diameter and M8 thread at Exchange Unit:

For the connection bottle-stopcock:	
Stopper, M6 thread	6.1446.040
PTFE tubing	6.1819.030
Tubing with screw nipples, 25 cm, M8 thread	6.1805.210
Thread adapter with M6 outer thread, M8 inner thread	6.1808.040
For the connection stopcock-tip:	
Thread adapter with M6 outer thread, M8 inner thread	6.1808.040
Tubing with screw nipples, 50 cm, M8 thread	6.1805.200
Tip, M8 thread	6.1543.120

Burette tips:

Earthing for burette tip	6.1808.030
Tip without anti-diffusion valve	6.1543.060
Tip with anti-diffusion valve	6.1543.050

Miscellaneous:

Thermostat jacket for 6.3011.XXX and 6.3012.XXX Exchange Units with M8 thread	6.1563.010
PTFE tubing for thermostat jacket, 105 mm	6.1819.040
Coupling for thermostat jacket tubing	6.1808.050
Coupling for 6.1542.010 Ceramic Flat Stopcock in 6.3006.XXX and 6.3007.XXX Exchange Units	6.1564.000
SISCO 300 grease, 1 oz. (28.35 g)	6.2803.000

Index

Pages concerning the operation via RS232 interface (green leaves) are *printed in italic*.

S

T

U

V

W

Ionenanalytik • Analyse des ions • Ion analysis • Análisis iónico

721 NET Titrino

CE

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EC Declaration of Conformity

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

721 NET Titrino

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

Source of the specifications:

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

Description of the instrument:

Remote control titrator for dynamic and monotonic titrations with automatic equivalent-point determination, as well as potentiometric end-point titrations and pK value determinations. Only for use within laboratory automation systems.

Herisau, December 5, 1995

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