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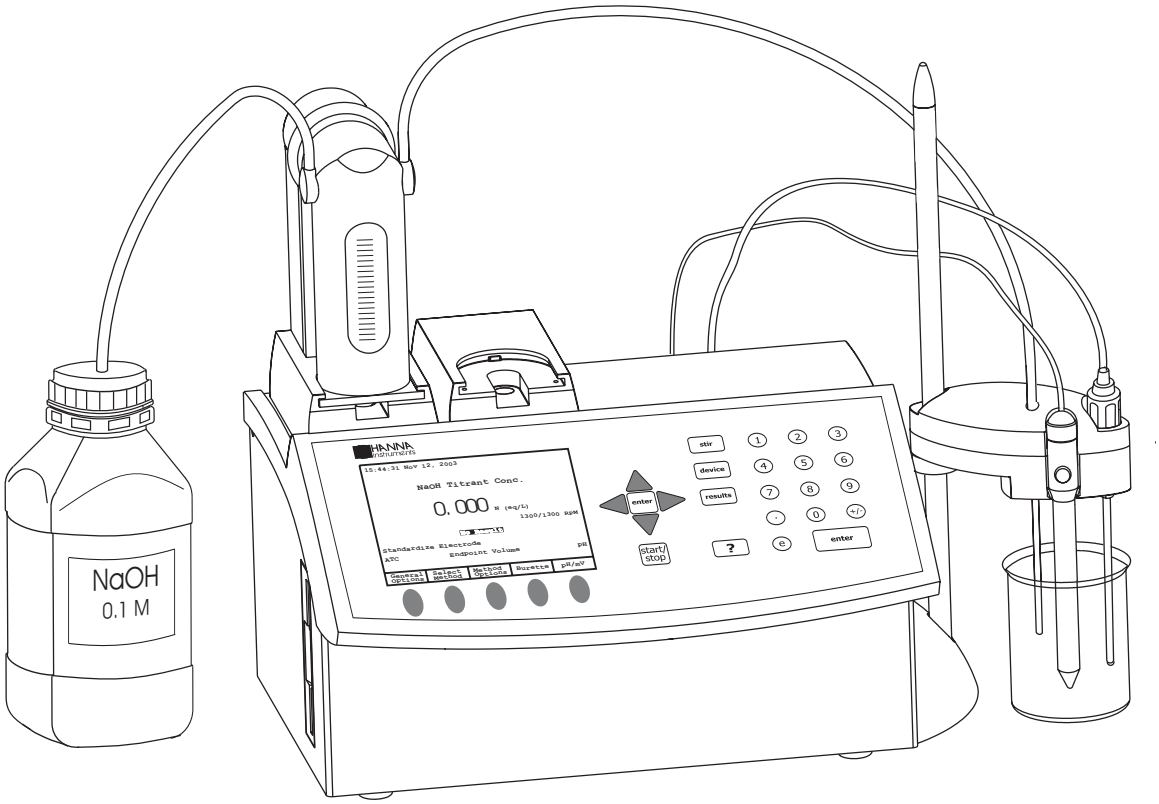
INSTRUCTION MANUAL

HI 901 / HI 902

AUTOMATIC TITRATOR



HANNA instruments
www.hannainst.com

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Dear customer,

Thank you for choosing a Hanna Instruments Product.
This instruction manual has been written for the HI 901 / HI 902 Titrator products.
Please read this instruction manual carefully before using the instrument. This manual will provide you with the necessary information for the correct use of the instrument.

1 INTRODUCTION

HI 901 and HI 902 are automatic titrators with high accuracy, great flexibility and repeatability.

The titrators are designed to perform a variety of potentiometric titrations, allowing the user to obtain both good results and high speed analysis.

The main attributes of these titrators are:

Flexibility	Support up to 100 titration methods (standard and user defined).
High accuracy	Precise dosing system (under 0.1% accuracy). Precise mV and pH measurements (± 0.1 mV and ± 0.001 pH accuracy). Interpolated end point volume.
Repeatability	Powerful built-in algorithms for equivalence point detection (first derivative and second derivative detection algorithms, filtered derivatives option, settable range for equivalence point detection). Fixed end point mV or pH.
Quick results	Standard titration methods. Pre-titration dosing feature. Dynamic / Linear dosing feature.
Complete report	The results are displayed directly in the selected units. Titration graph can be displayed on line and saved. User customized reports can be printed, saved on floppy disk or transferred to PC via RS232 interface. The sample information and data stamp are included in the report.
Direct measurements	The titrator can also be used for precise mV, pH and temperature measurements. Report of data logging is available for direct measurements.
GLP features	Up to 5 standardization points for the pH electrode. Reminders for titrant age and standardization expiration. Fields for specific annotations.
Large graphical display	7.5” B/W graphical display with backlight. Easy to view text and graphs. Lots of information on each screen.
Self diagnosis and integrated help	Integrated help is available. Self diagnosis features for peripheral devices including pump, valve, burette, stirrer. Error management with warning and error messages. Predefined troubleshooting titration methods.

This manual provides information regarding installation and functionality of the titrator, pointing out hints and refined operation suggestions.

Before beginning to work with the titrator it is recommended to become familiar with it’s various features.

Chapter 2. Contents

2 SETUP

2.1 Unpacking

The titrator and the accessories are shipped in a single box containing:

	ITEM	QUANTITY
1	Titrator	1
2	Pump Assembly	1
3	Burette Assembly • Burette (with 25 mL syringe) • Aspiration Tube with Fitting and Protection Tube • Dispensing Tube with Normal Dispensing Tip, Fitting, Protection Tube and Tube Guide • Tube Locks • Tool for Valve Fitting and Burette Cap Removal • Light Spectrum Protection Screen	1
4	Stirrer Support, Stand, Collar and Positioning Screw	1
5	Burette Blank Support	1
6	Pump and Burette Locking Screws with Plastic Head	2
9	Temperature Sensor	1
10	Shorting Cap	1
11	Power Cable	1
12	RS232 Cable	1
13	Instruction Manual Binder	1
14	Start-up Disk (FDD with Titrator Installation Kit)	1
15	HI 900 PC Application (FDD with Installation Kit)	1
16	Quality Certificate	1

See **Appendix 4** section **A 4.3 Titrator components** for pictures.

If any of the items is missing or damaged, please contact your sales representative.

Note: *Save all packing materials until you are sure that the instrument functions correctly. Any damaged or defective items must be returned in their original packing materials together with the supplied accessories.*

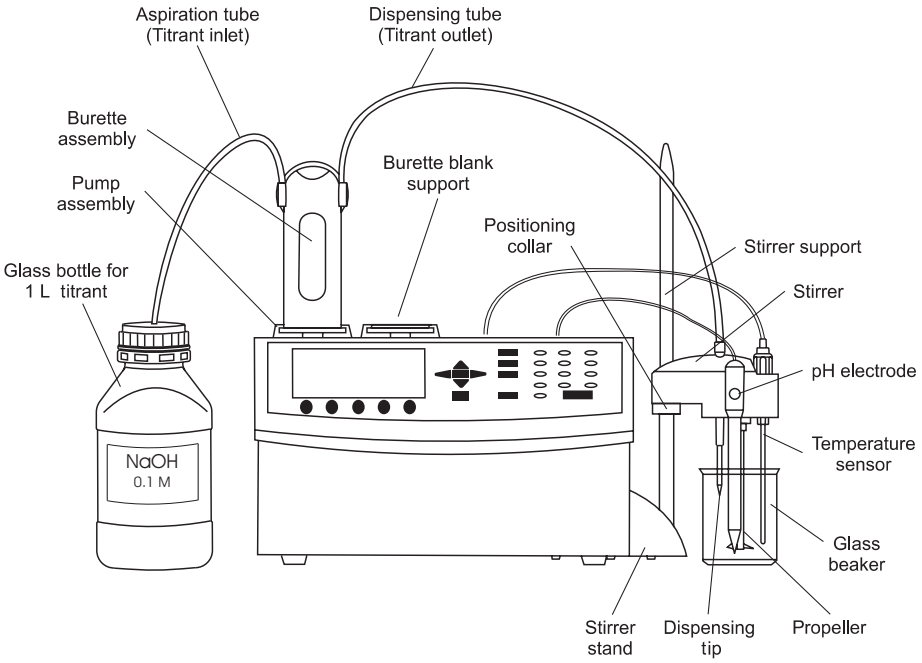
2.2 Safety Measures

The following safety measures must be followed:

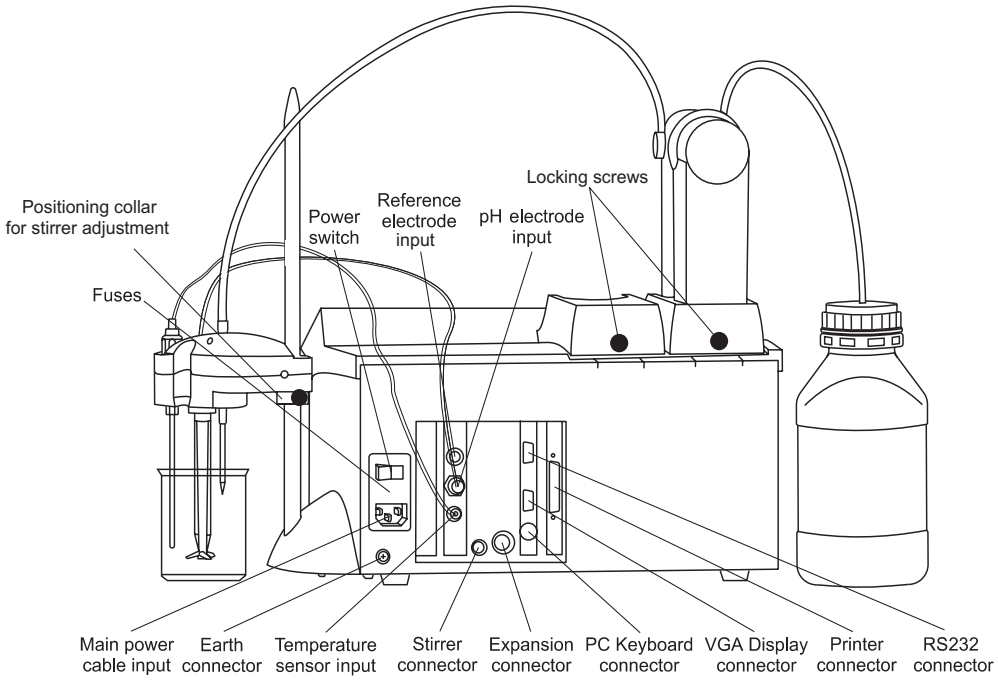
1. Always ensure that the power-supply cable is connected to a grounded main power plug.
2. Never connect or disconnect the pump assembly with the titrator turned on.
3. Verify that the burette and the attached tubing are as described in this manual (see *9.1 Burette Maintenance* section for more details).
4. Always check that the titrant bottle and the titration beaker are firmly sitting on a flat surface.
5. Always wipe up spills and splashes immediately.
6. Avoid the following environmental working conditions:
    - Severe vibrations
    - Direct sunlight
    - Atmospheric relative humidity above 95% non-condensing
    - Environment temperatures below 10°C and above 40°C and a normal humidity range
    - Explosion hazards
7. Have the titrator serviced only by qualified service personnel.

2.3 Installation

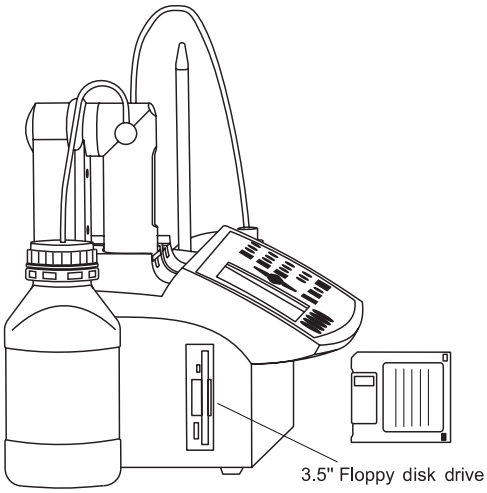
2.3.1 Titrator Front View



2.3.2 Titrator Rear View



2.3.3 Titrator Left-side View



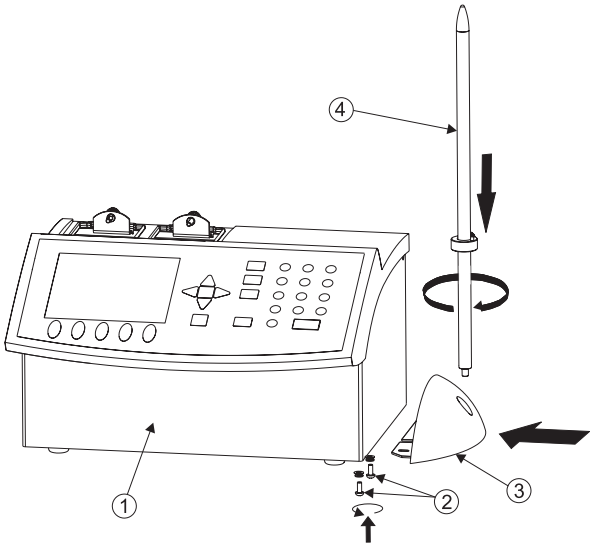
2.3.4 Titrator Assembly

Note: *Assembly operations must be completed before connecting the titrator to the power-supply voltage!*

2.3.4.1 Assembling Stirrer Stand and Support

Follow these steps to assemble the stirrer:

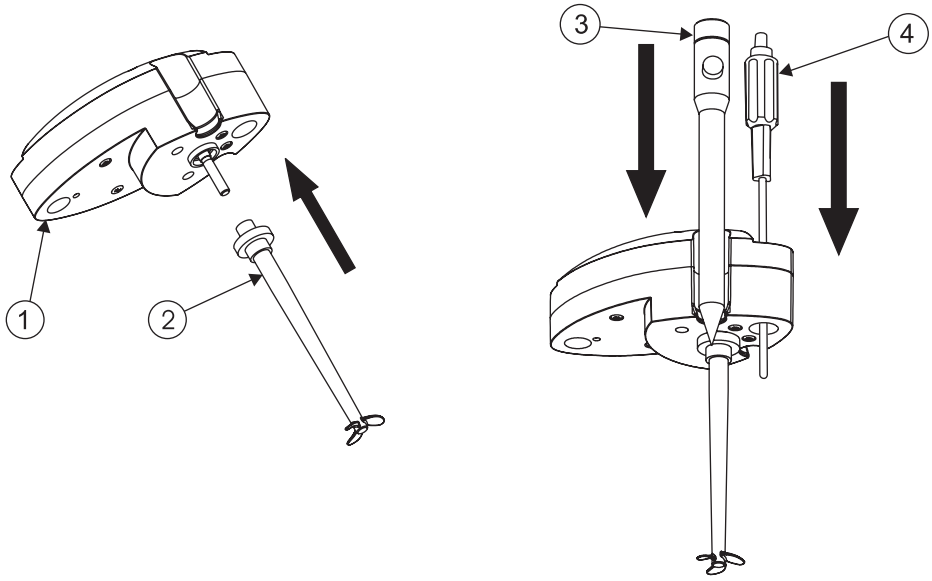
- Remove the screws (2) from the titrator chassis (1).
- Attach the stirrer stand (3) to the titrator chassis. Make sure to position the stirrer stand close to the wall of the chassis.
- Tighten the stirrer stand (3) using the previously removed screws (2).
- Screw the stirrer support (4) in the stirrer stand (3).



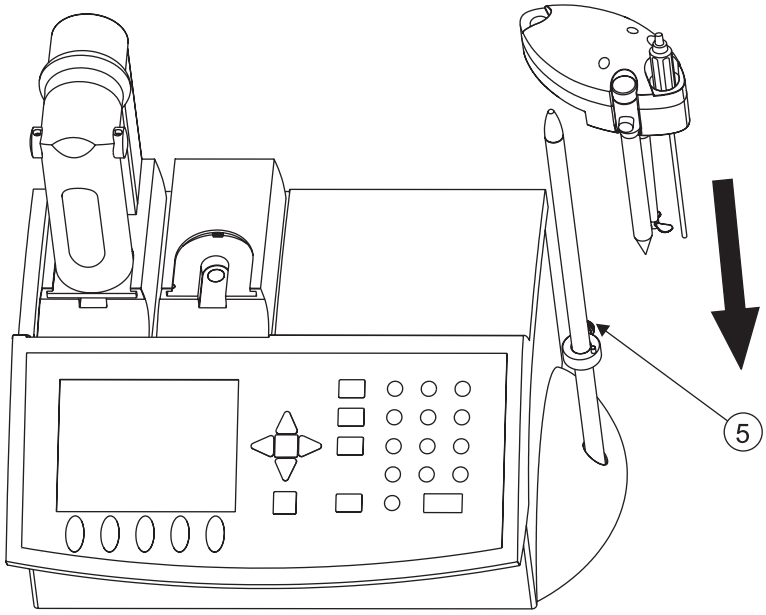
2.3.4.2 Attaching Stirrer

To attach the stirrer to titrator, follow these steps:

- Attach the propeller (2) to the stirrer (1) by pressing it onto the stirrer shaft.
- Insert the pH electrode (3) and temperature sensor (4) into the dedicated holes on the stirrer. Push them in until they are tightened in a stable position.



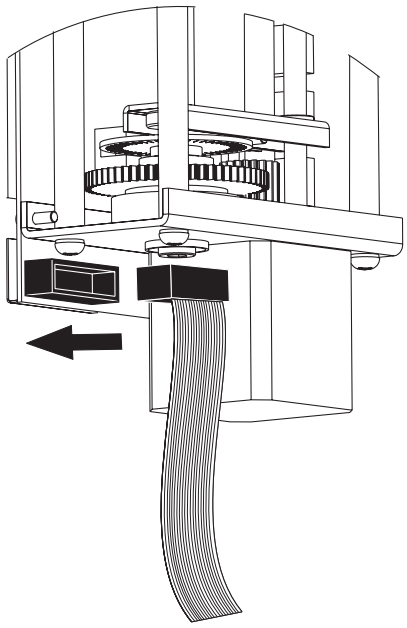
- Slide the stirrer on the stirrer support and set the height by tightening the screw located on the positioning collar (5).



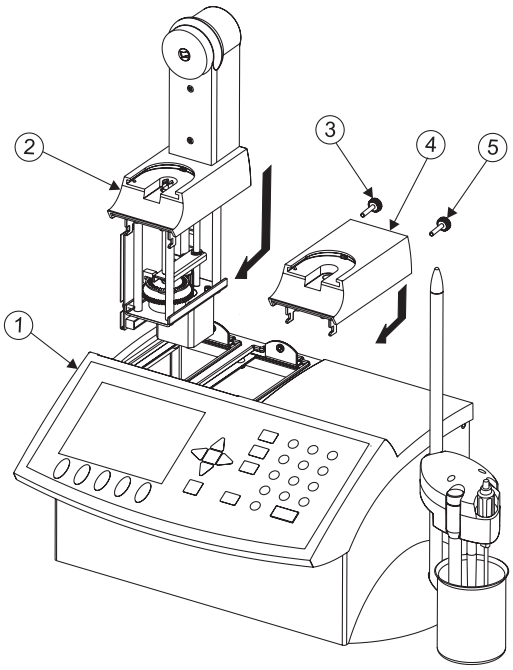
2.3.4.3 Connecting the Pump

To connect the pump, follow these steps:

- Retrieve the pump cable from inside the bay. The pump 1 connector is located in the left side bay.
- Connect the cable to the pump as shown in the figure below. The pump connector is located in the lower part of the pump, near the motor.



- Insert the pump (2) into the dedicated bay. Lower the pump until it reaches the lowest position, then slide it towards the front of the titrator chassis (1) until it is firmly latched.
- Secure the pump with the loking screw (3).



HI 902 only:
Follow the previous steps (2.3.4.3) to connect and attach the second pump.

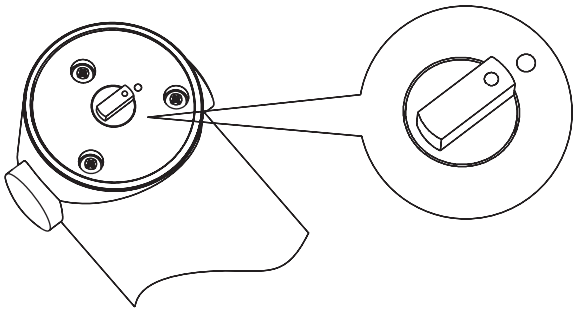
2.3.4.4 Attaching Burette Blank Support (**HI 901** only)

The burette blank support installation procedure is as follows:

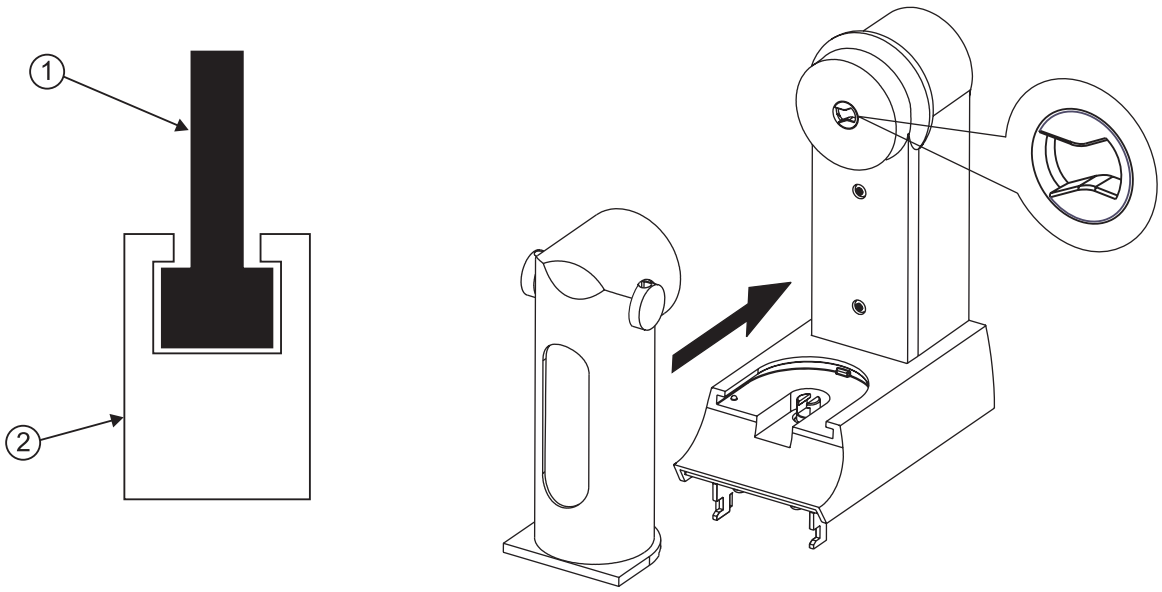
- Insert burette blank support (4) in the dedicated bay - on the right side (see the previous picture). Lower the burette blank support until it reaches the lowest position, then push it toward the front of the titrator chassis (1) until it is firmly latched.
- Secure the burette blank support with the locking screw (5).

2.3.4.5 Attaching Burette

Make sure that the mark from the valve actuating cap and from the burette body are aligned as shown in the figure below.

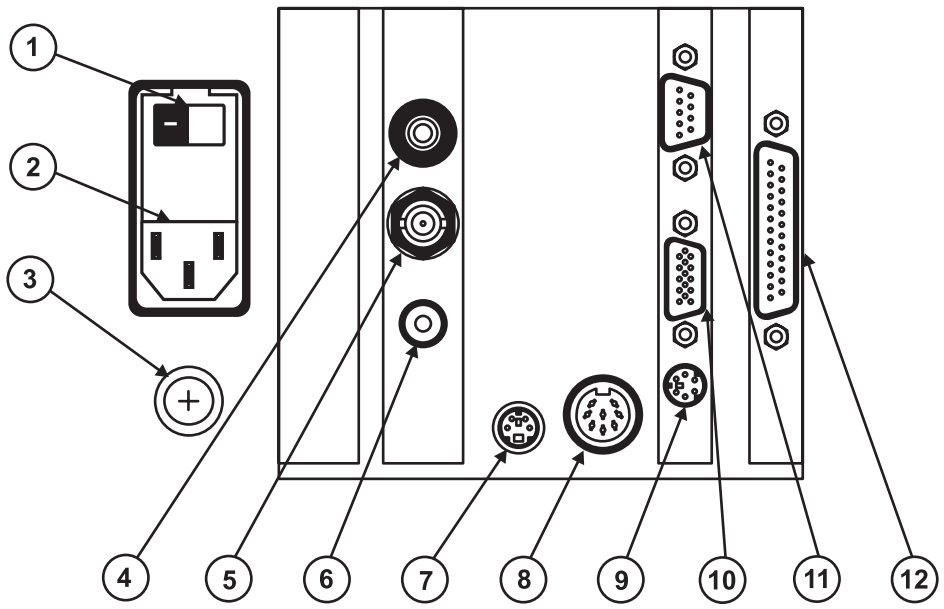


Take care to have a correct coupling between the pump plunger (2) and the syringe piston (1) and also when sliding the burette onto its support, consider the alignment between the valve actuating cap and the valve positioning wheel, as shown in the figure below.



2.3.4.6 Electrical Connections

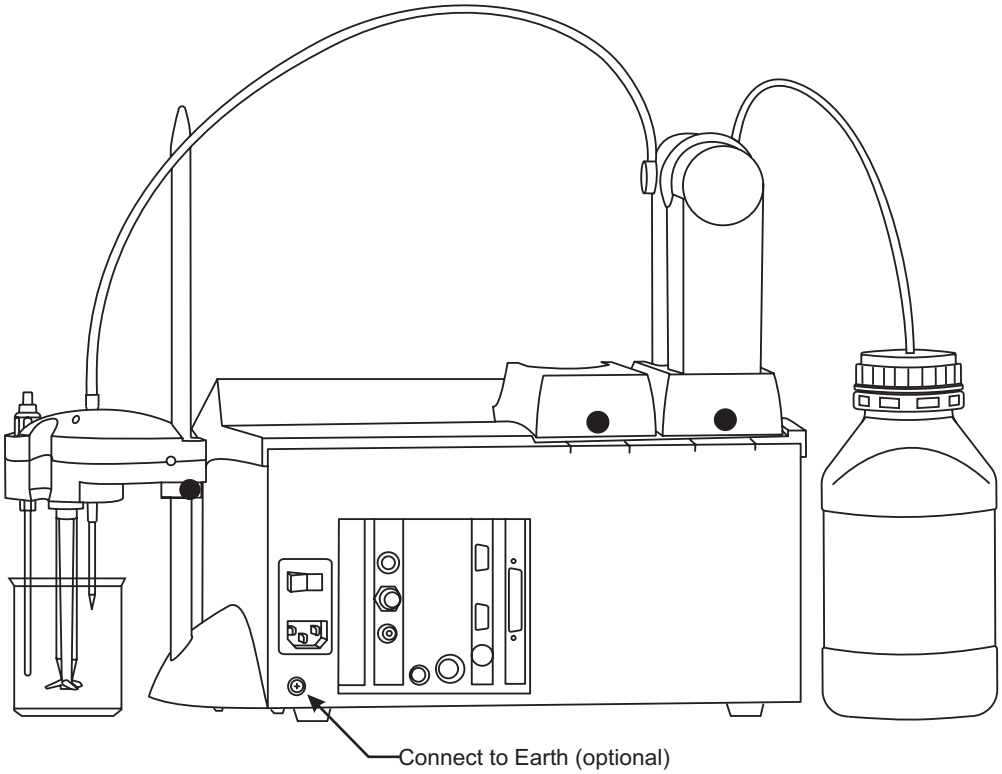
- Connect the pH electrode to the BNC connector (5).
- Connect the temperature sensor to the RCA connector (6).
- Connect the stirrer to the MINI-DIN connector (7).
- Connect the power-supply cable to the power supply connector (2).



Nr	Function	Type of Connector
1	Power switch	
2	Power supply (115, 230 VAC, 50-60 Hz)	IEC Power line connector
3	Earth connector	5 mm screw
4	Reference electrode	Ø 4 mm banana socket
5	Connection for pH or ORP indicating half-cell or combination electrodes (pH/mV)	BNC socket
6	Temperature sensor	RCA socket
7	Stirrer	4-pin mini DIN
8	Connector for expansion device	8-pin DIN socket
9	External PC keyboard	6-pin mini-DIN (Standard PS2)
10	External display	Standard VGA display 15-pin socket
11	RS232 interface	Standard DB 9 pin socket
12	Printer standard	DB 25–pin socket

2.3.5 Connection to Earth

It is important that the titrator has a good connection to Earth. The titrator is properly grounded through the power cord and for added confidence the unit can be connected to Earth using the optional 5 mm screw and the nut connection located on the rear panel of titrator.



2.3.6 Floppy Disk Drive

Report files, new created (user) methods, standard methods can be transferred to and from the titrator using a standard 3.5” floppy disk.

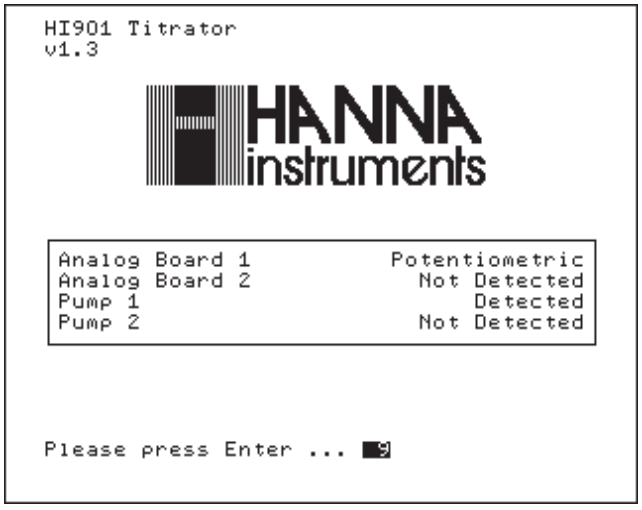
Chapter 3. Contents

3 USER INTERFACE

3.1 Start Up

Once the instrument is assembled and installed, please follow these steps to start up the titrator:

- Connect the instrument to a main power plug with ground wire. Make sure that the voltage of the main power and the one specified on the titrator are the same.
- Turn on the titrator from the power switch located on the back of the instrument.
- Wait until the titrator finishes the initialization process.
- Press enter when prompted or wait a few seconds for titrator to start.



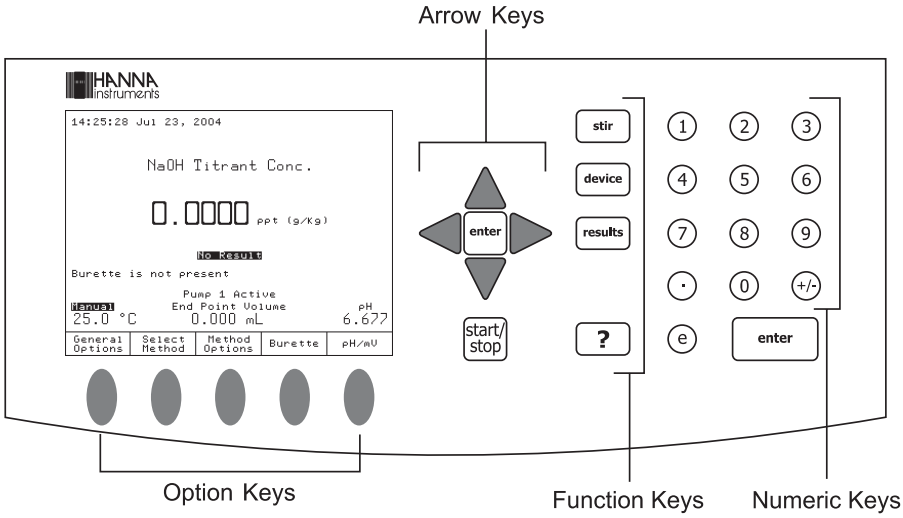
Note: *All the performed initialization processes must be successfully completed. If one of them is terminated by a* "Failed" *message, restart the titrator from the power switch. If the problem persists, contact your dealer.*

3.2 Description

This chapter describes the basic principles of navigating through the user interface, selecting fields and entering values from the keypad.

3.2.1 Keypad

The titrator's keypad is grouped into four categories, as follows:



3.2.1.1 Function Keys

If one of these keys is pressed, the associated function is immediately performed. The results and start/ stop keys are active only in specific screens:

?	Displays contextual Help
stir	Turns the stirrer ON and OFF
results	Gives access to results menu
device	Reserved
start/ stop	Starts or stops a titration or data logging (when the titrator is in pH or mV mode)

3.2.1.2 Option Keys

These keys are assigned to the virtual-keys on the display. The significance of each option key depends on the menu displayed on the screen.
The function related to an underlined virtual-key can also be activated by pressing enter.

3.2.1.3 Arrow Keys

These keys have the following functions:

- Move the on-screen cursor.
- Increase and decrease the stirrer speed and other settings.
- In the alphanumeric screen, to select a letter or to navigate through menu options.

3.2.1.4 Numeric Keys

Keys (0) to (9) - Used for numeric entries.

(+/-) - Toggles between positive and negative values.

(.) - Decimal point.

(e) - Initiates entry of exponent for scientific notation.

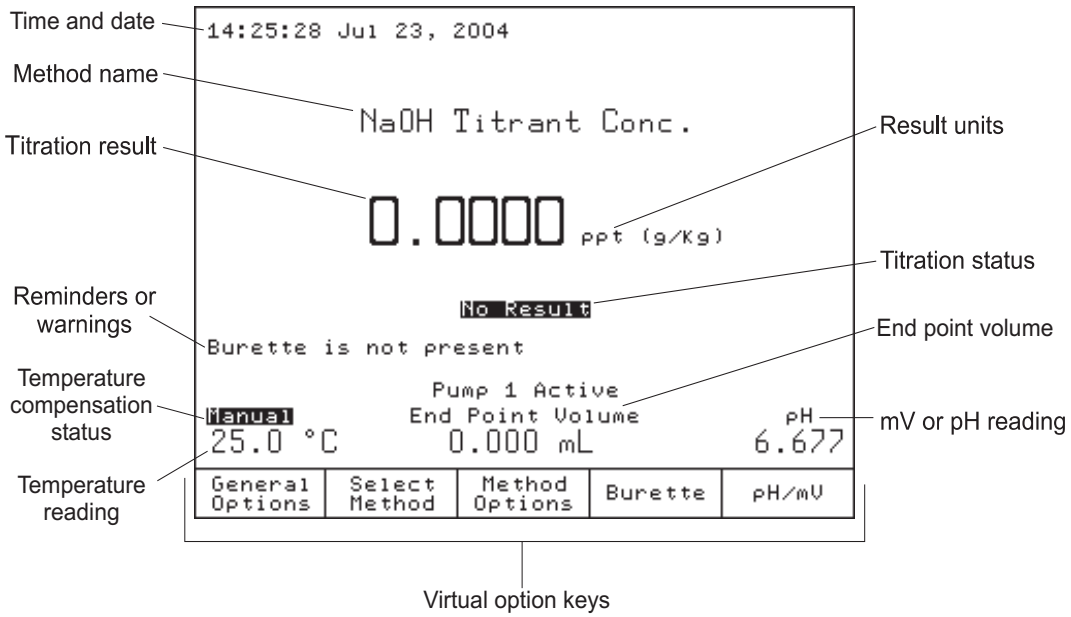
3.2.1.5 Enter Key

Both [enter], [enter] keys perform the same functions:

- Accepts alphanumeric data entry.
- Executes the default (underlined) virtual option key.

3.2.2 Display

The titrator has a large graphical display with built-in backlight. The main screen with short explanations is presented below.



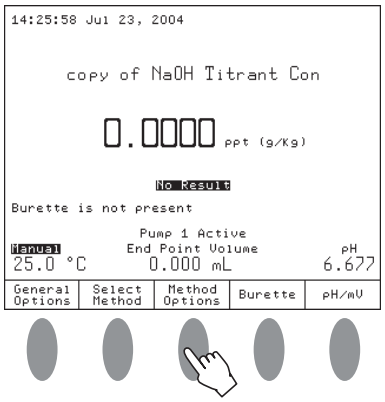
The user interface contains several screens. For each titrator function, one or more screens are used.
Warnings and other critical information are displayed in **reversed** font.

3.2.3 The Main Screen

After start up and initialization, the first screen displayed is the main screen.
The main screen fields describe:

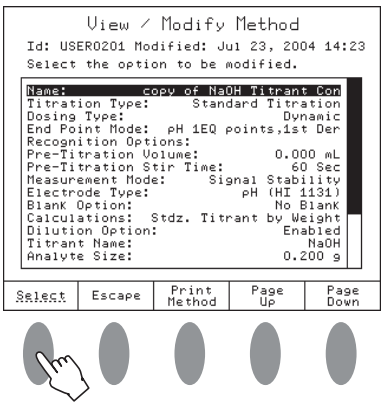
Method name:	Displays the name of the selected method
Time and date:	Displays the current date and time
Temperature reading:	Displays the measured temperature
ATC:	Indicates automatic temperature compensation
Manual:	Indicates manual temperature compensation
Manual:	Indicates manual temperature compensation as the temperature probe is not connected
Stirrer information:	Actual / Set stirrer speed is displayed in RPM. When stirrer is off, the stirrer information is not displayed
End point volume:	Displays the volume delivered to reach the titration end point. When no titration has been performed, the displayed volume is "0.000 mL"
Titration result:	Displays the titration result
mV or pH reading:	Displays the current readings. The sample reading will be: mV or pH respectively
mV:	Indicates actual potential reading
rel mV:	Indicates relative potential reading
pH:	Indicates actual pH value
Titration status:	Displays the status of the selected titration. When no titration was performed, **No results** is displayed
Reminders:	Indicates when a task needs to be performed and displays error or warning messages
Pump 1 Active:	Displays the current active pump

3.3 Menu navigation



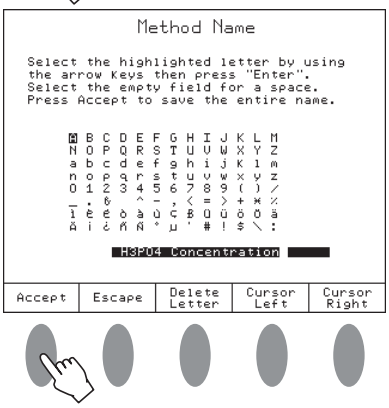
3.3.1 Selecting an Option

To select an option, simply press the option key below the virtual option key. For example, to access the ***Method Options*** screen press [Method Options].



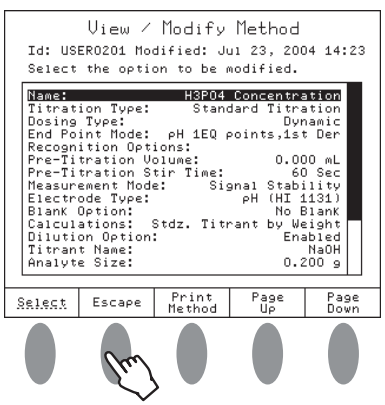
3.3.2 Selecting a Menu Item

To select an item from the menu screen use the arrow keys △ and ▽ to move the cursor.
When the menu is larger than the display, a scroll bar is active on the right side. The [Page Up] and [Page Down] keys can be used to scroll through the pages.
To activate the selected menu item, press [enter] or [Select].

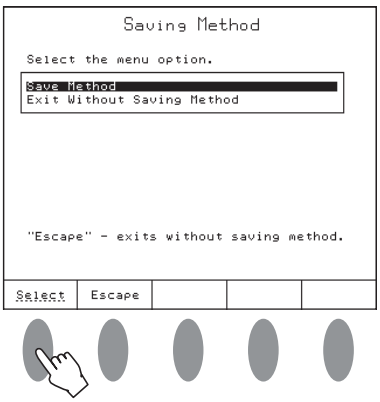


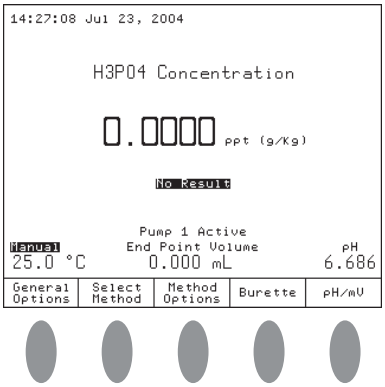
3.3.3 Entering Text

To enter text in an alphanumeric input box, first erase the previous text by using [Delete Letter].
To enter a letter, highlight it using the arrow keys then press [enter]. Use the same procedure to enter the whole name.
For editing, use the [Cursor Left] and [Cursor Right] keys.
When editing is complete, press [Accept].



The method name will be updated and displayed in the name field of the ***View/Modify Method*** screen.
When all the desired parameters have been set, press [Escape].





3.3.4 Saving Modifications

The ***Saving Method*** screen allows the user to save the modifications. To exit from ***Saving Method*** screen without saving, press Escape or highlight the *Exit Without Saving Method* option and then press Select. To save the modifications highlight the *Save Method* option and then press Select.

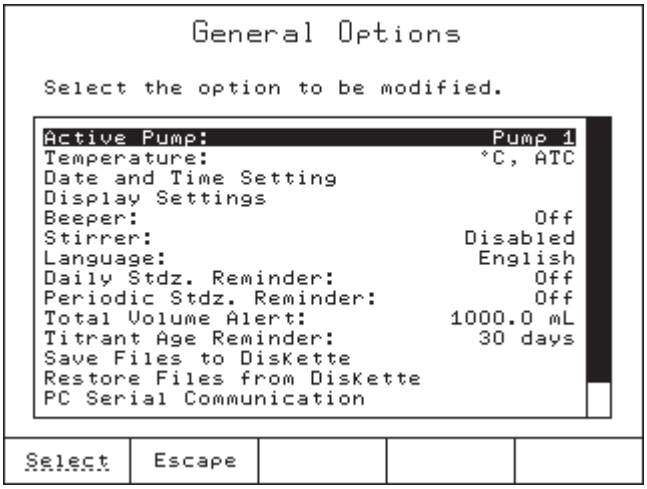
After the method name is changed, it appears in the method name field.

Note: *To access the contextual help menu, press ? at any time. Help is related to the displayed screen. Press Escape or press ? again to return to the previous screen.*

Chapter 4. Contents

4 GENERAL OPTIONS

The ***General Options*** screen gives access to options that are not directly related to the titration process or pH / mV measurement. To access this screen, press [General Options] from the main screen. The available menus are described below:

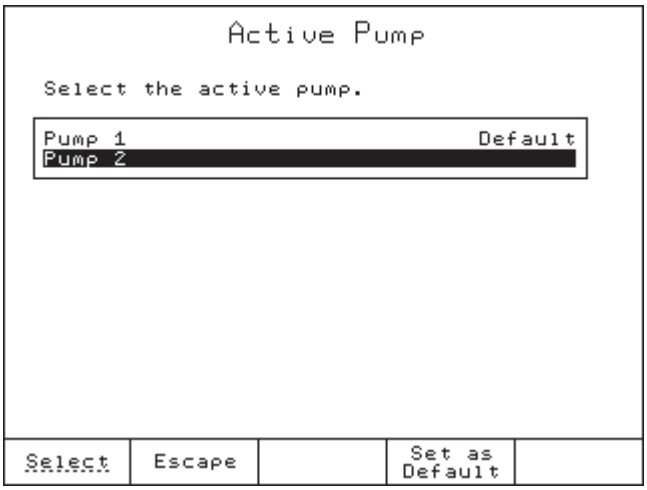


4.1 Active Pump

The HI 901 and HI 902 titrators can be equipped with one or two dosing systems (pump & burette). Only one pump can be active at a time. This option allows the user to set active either pump 1 or pump 2. Any further operations that involve the pump are referring to the active one.

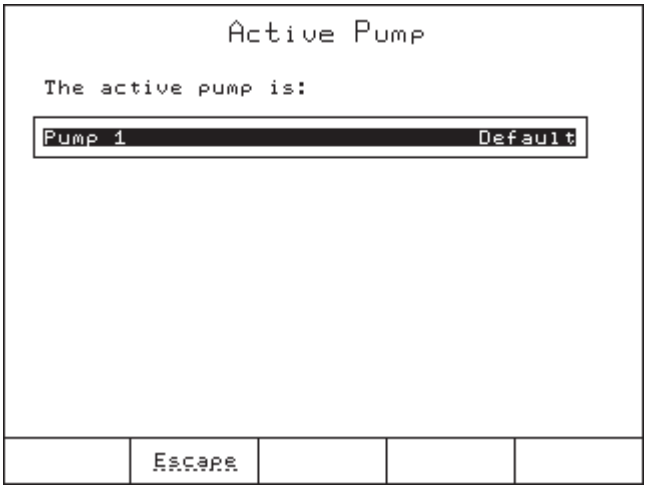
Highlight the *Active Pump* option and then press [Select]. The ***Active Pump*** screen is displayed.

If there are two pumps connected to the titrator: use the arrow keys to select the active pump as follows:



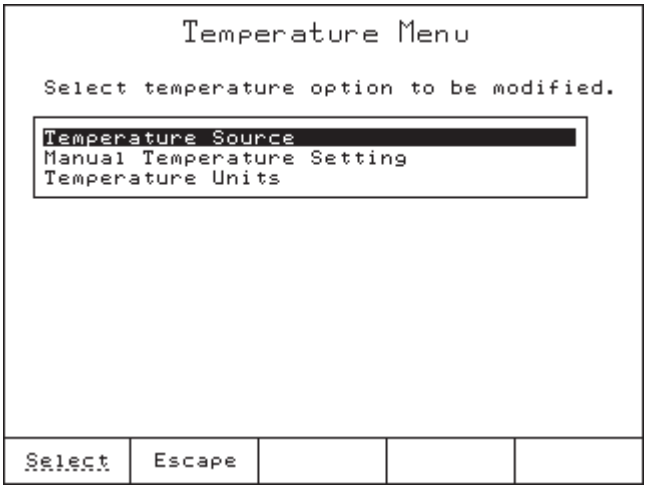
- Highlight the pump to be activated.
- Press Select and the highlighted pump is set as temporarily active (for the duration of the current running session). After the titrator is restarted, the active pump will be reset to the one set as default.
- Press Set as Default and the highlighted pump is set as active immediately in the current session and all following running sessions.

If only one pump is connected to titrator, the ***Active Pump*** screen will be as follows:



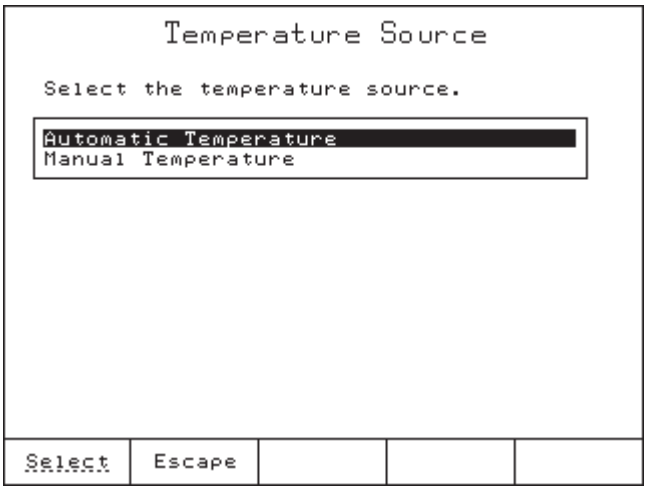
4.2 Temperature

The ***Temperature Menu*** screen allows selection of temperature source and other options related to temperature.



4.2.1 Temperature Source

The ***Temperature Source*** screen allows the user to select the temperature source, used for pH temperature compensation.

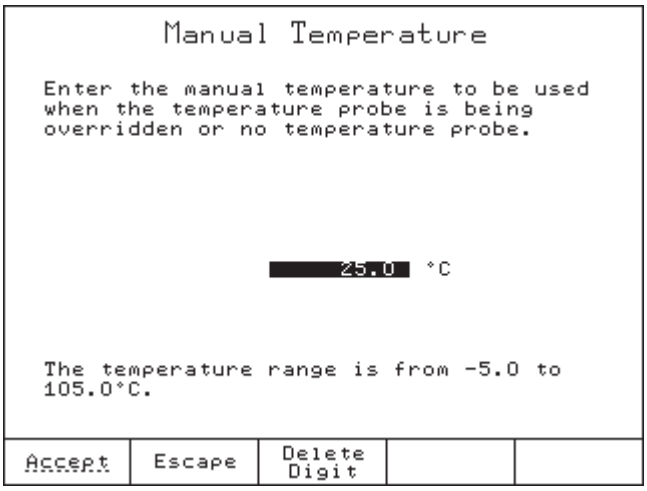


When the *Automatic Temperature Compensation* option is selected, the temperature displayed on the main screen is read by the temperature probe. Also the "ATC" icon is displayed.

When the *Manual Temperature* option is selected, a preset value of the temperature is used for temperature compensation and the "Manual" icon is displayed on the main screen.

4.2.2 Manual Temperature Setting

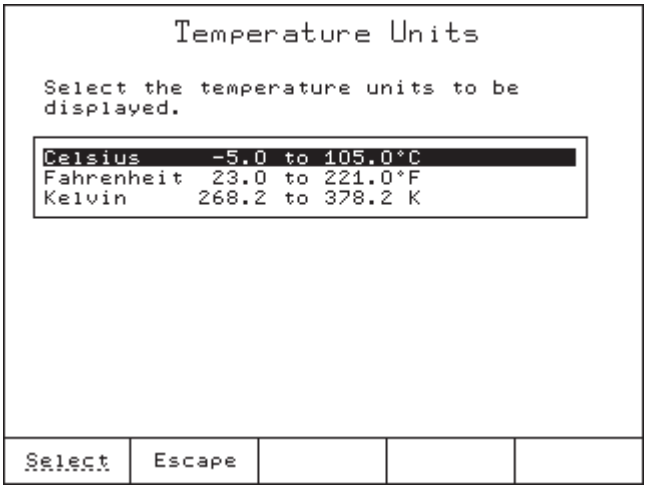
If the temperature probe is not connected the user can manually set the temperature used by the titrator for compensation. This can be done when the *Manual Temperature* option is selected (see *4.2.1 Temperature Source* section).



The temperature value can be set between –5 and 105 ºC.

4.2.3 Temperature Units

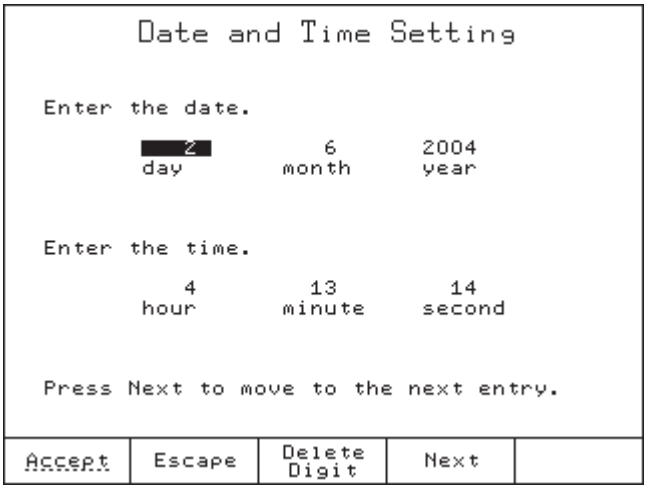
The following temperature units can be selected.



The temperature ranges are as displayed in the ***Temperature Units*** screen.
The titrator will automatically convert the measured temperature to the new unit.

4.3 Date and Time Setting

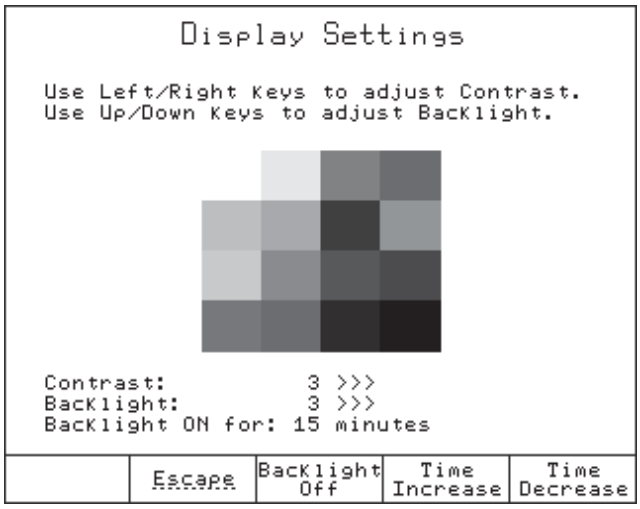
This screen allows the user to set the date and time.



By pressing Next the cursor will cycle to the next field.

4.4 Display Settings

This screen allows the user to customize the viewing features of the display.



Option Keys:

BackLight Off	Turns the backlight off
BackLight On	Turns the backlight on
Time Increase	Increases the backlight saver time interval
Time Decrease	Decreases the backlight saver time interval

The contrast can be adjusted using ◁ and ▷ keys.

The backlight intensity can be adjusted using △ and ▽ keys.

There are 8 gradual steps both for contrast and backlight intensity, ranging from 0 to 7.

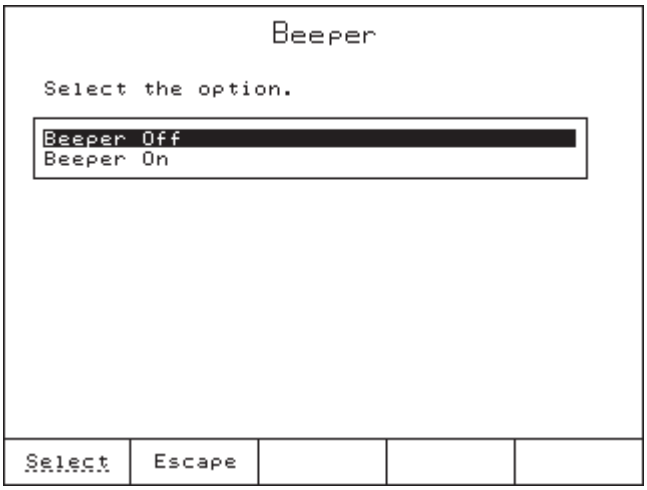
A gray-scale grid ranging from black to white, is displayed in the center of the display, allowing an easy selection of the appropriate display lighting.

The backlight saver option protects the display during stand-by periods, when no keys have been pressed for a set amount of time.
If the display backlight is in Save mode, any keystroke will activate the display backlight without performing any action.

The range for backlight saver interval is between 1 and 60 minutes. To disable the backlight saver set it to 0 minute.

4.5 Beeper

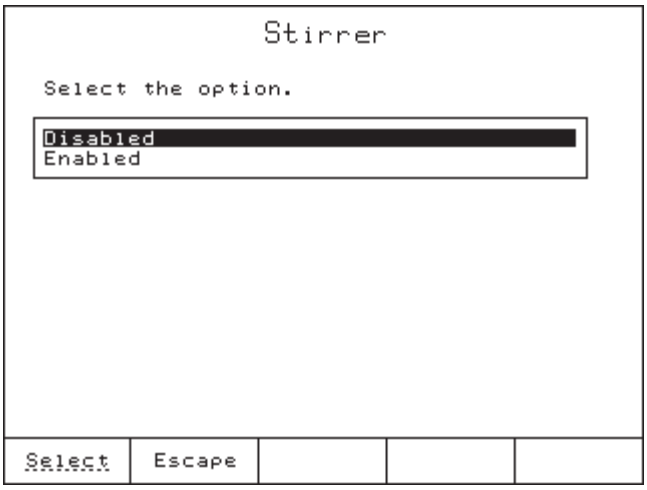
This screen allows the beeper to be enabled (*Beeper On*) or disabled (*Beeper Off*).



The beeper will sound after a titration is completed, when an invalid key is pressed or when a critical error occurs during titration.

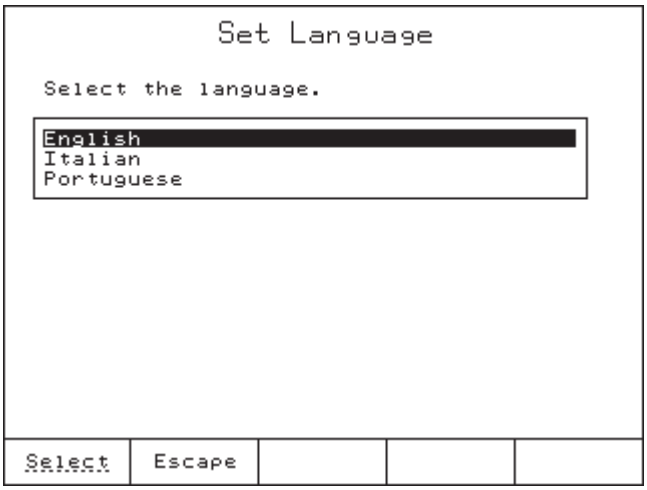
4.6 Stirrer

This screen allows the stirrer to be enabled or disabled.



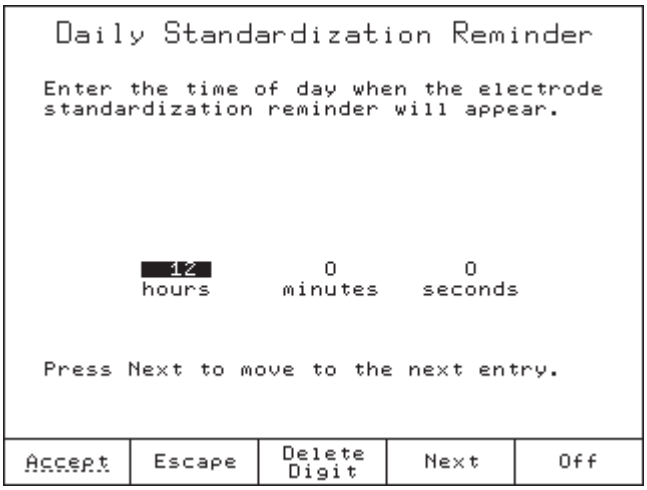
4.7 Language

Select the language from the available languages listed in this screen.



4.8 Daily Standardization Reminder

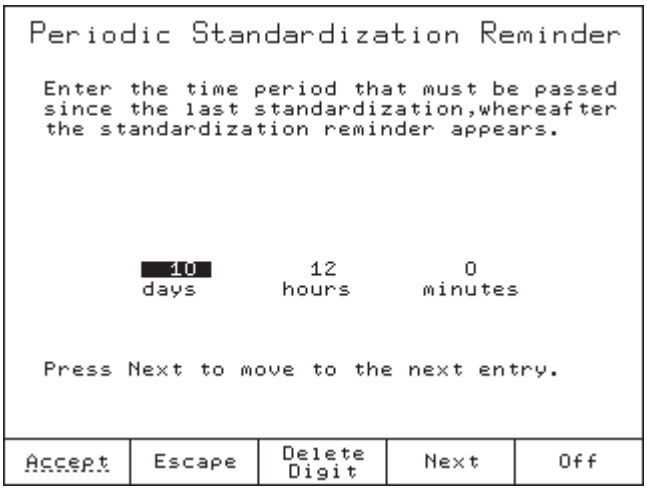
This screen allows a programmable reminder to appear when it is time to standardize the pH electrode. The "Standardize Electrode" reminder message will appear each day at the programmed time. Once standardization has been performed, the reminder will disappear until the next day.



The reminder can be disabled by pressing Off.

4.9 Periodic Standardization Reminder

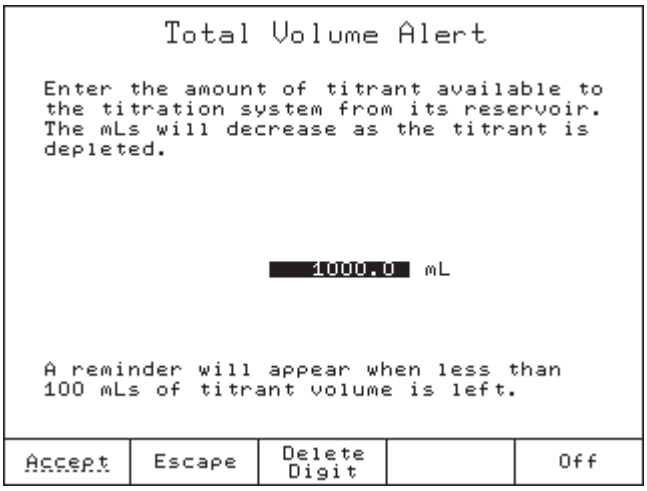
This screen allows a programmable reminder to appear when it is time to standardize the pH electrode. The "Standardize Electrode" reminder message will appear when it is time for the electrode to be re-standardized.
Once the new standardization has been performed, the reminder will disappear and the timer will reset.



The reminder can be disabled by pressing Off.

4.10 Total Volume Alert

The ***Total Volume Alert*** screen allows a programmable reminder to appear when it is time to add supplementary titrant to the glass titrant bottle. The current titrant volume data will decrease as the titrant is used.

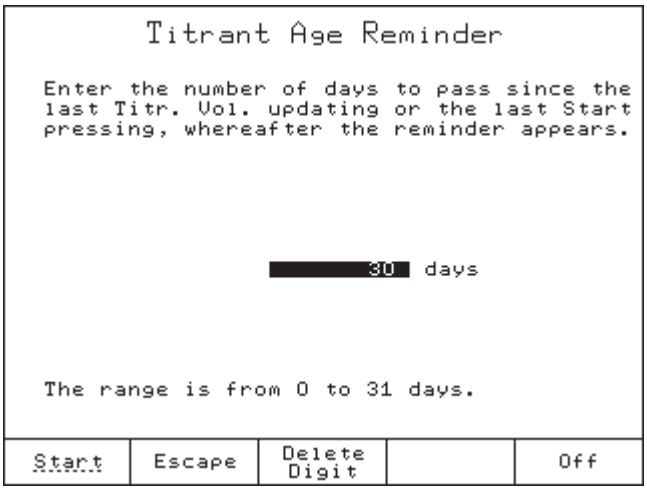


The "Low Titrant Volume" reminder message will appear when the available titrant volume has decreased under 100 mL.

After the new titrant volume has been set on titrator (in the ***Total Volume Alert*** screen), a warning message appears reminding the user to perform titrant re-standardization.
The reminder can be disabled by pressing Off.
The range is from 0 to 10,000 mL.

4.11 Titrant Age Reminder

This screen allows a programmable reminder to appear when it is time to verify the titrant concentration or to change the titrant due to concentration confidence loss.



The "Check Titrant Concentration" reminder will appear when a number of days have passed since the total volume alert was set or since the timer was restarted by pressing Start. The reminder can be disabled by pressing Off.
The range is from 0 to 31 days.

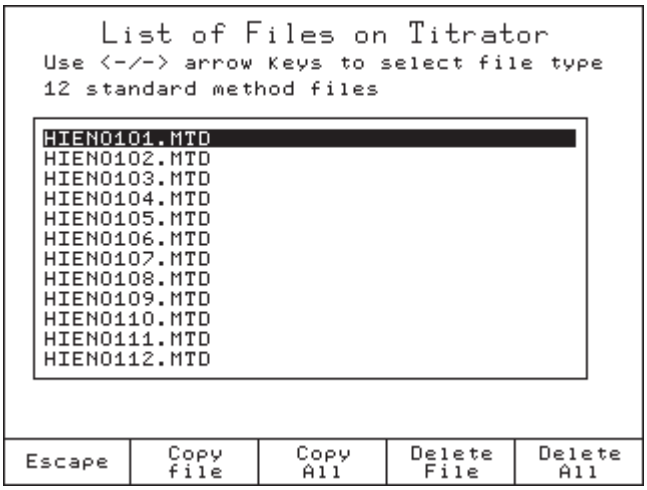
4.12 Save Files to Diskette

This menu allows the user to save files from the titrator to a floppy disk.
On the titrator, the available file types are:

Standard Method Files	**- HI*.MTD**
User Method Files	**- USER*.MTD**
Report Files	**- *.RPT**

If there is no diskette inserted in the floppy disk drive, the file manager menu is not available.
The selection of the file types can be performed with ◁ and ▷ keys. The number of files and each file name on the titrator will be displayed.

For example, if no report file was found on the titrator the message "0 report files" is displayed. Corresponding messages are displayed for the other file types.



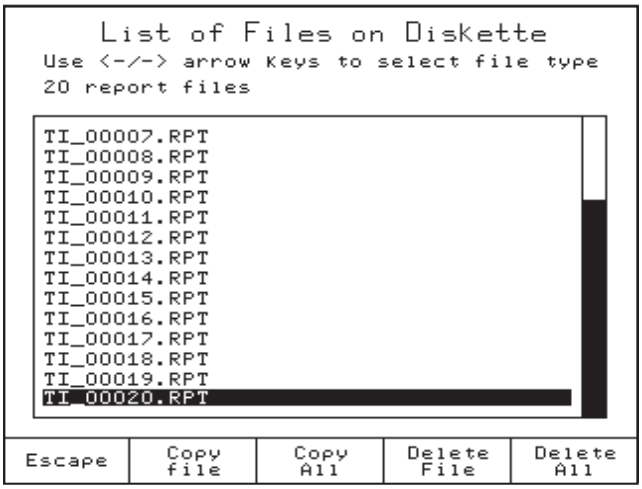
The option keys allow the following operations:

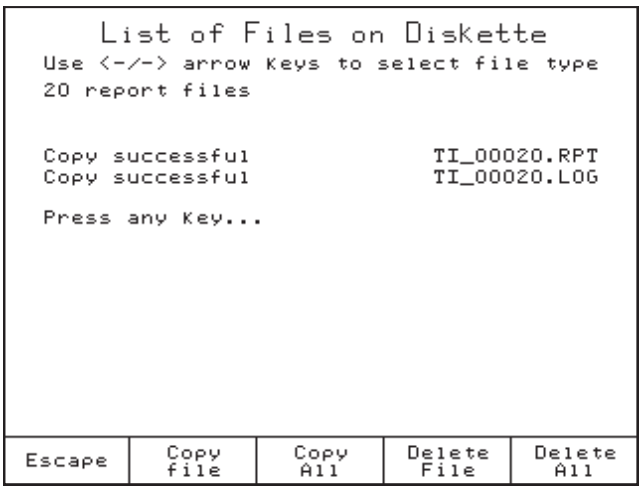
Delete File	Deletes the highlighted file
Delete All	Deletes all currently displayed files
Copy File	Copies the highlighted file from titrator to floppy disk
Copy All	Copies all currently displayed files from titrator to floppy disk
Escape	Returns to the ***General Options*** screen

The status of the transfer ("successful" / "unsuccessful") and the file name of the currently processed file are displayed during copying or deleting.
When copying or deleting files is over, "Press any key…" message appears and the instrument returns to the list of files.

4.13 Restore Files from Diskette

This screen allows transfer of files from the floppy disk to the titrator.





The file types that can be transferred are:

Standard Method Files	**- HI*.MTD**
User Method Files	**- USER*.MTD**
Report Files	**- *.RPT**

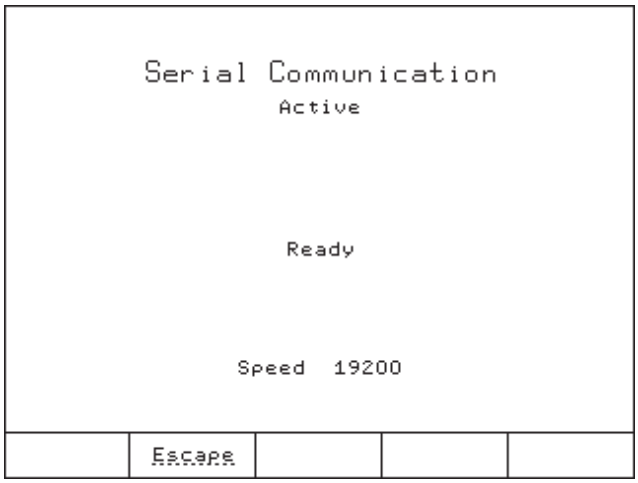
Selection of the file types can be performed with the ◁ and ▷ keys.
The number of files and the name of each file found on the floppy disk is displayed on the screen.
The option keys allow the following operations:

Delete File	Deletes the highlighted file from diskette.
Delete All	Deletes all currently displayed files from diskette.
Copy File	Copies the highlighted file from diskette to titrator.
Copy All	Copies all currently displayed files from diskette to titrator.
Escape	Returns to the ***General Options*** screen.

All the allowable operations are the same with the ones presented in *4.11 Save Files to Diskette* section.

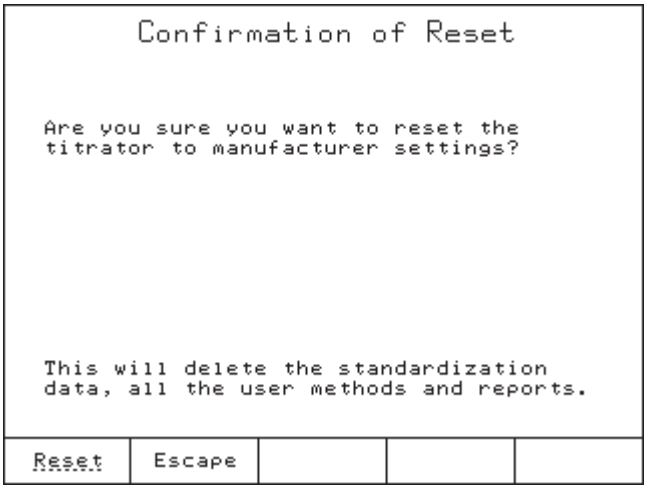
4.14 Serial Link with PC

In order to use this feature, the serial RS232 cable is needed to be connected between the titrator and the PC. Make sure that HI 900 PC application is running on the PC.
In the ***Serial Communication*** screen:
"Active / Inactive": shows the status of the serial link with the PC.
"Active" means that the titrator is using the RS232 serial communication with a PC and not with other device.
"Ready" shows that the titrator is able to communicate with the PC.
During transfer of any information between the PC and the titrator, "Transmit" and information about the percentage already transferred of current file are displayed.



4.15 Reset to Default Settings

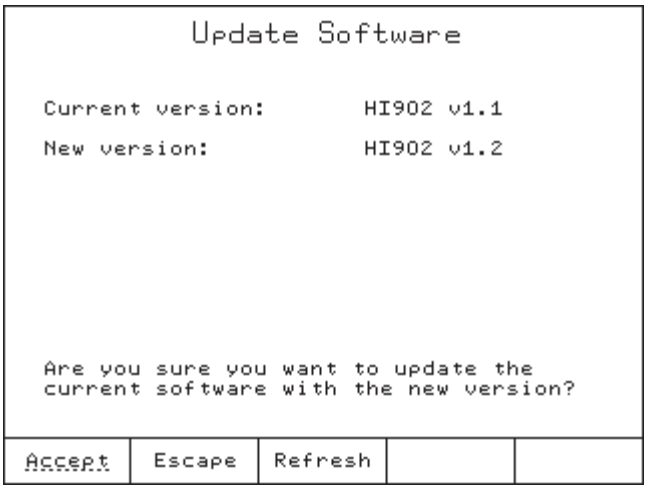
This option restores the manufacturer settings.



Note: *Please be careful !!! This will also delete all the user created methods and restore all manufacturer settings such as titrator configuration, standard method parameters, etc.*

4.16 Update Software

This screen allows the user to update the titrator software from a floppy disk.



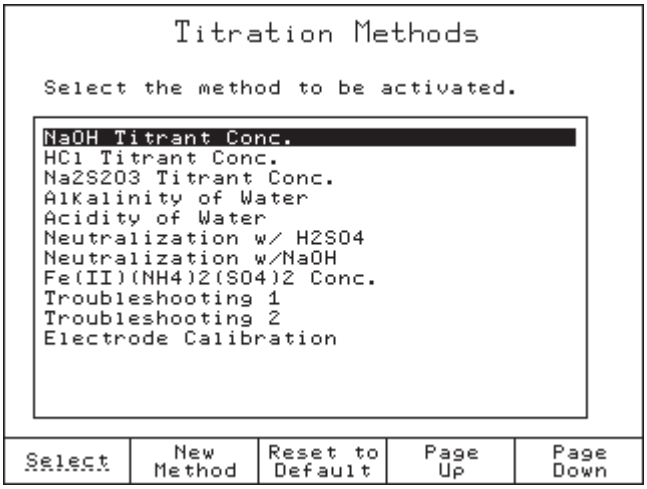
Chapter 5. Contents

5 METHODS

The titrator automatically performs a complete analysis.
A complete analysis comprises sample preparation, dispensing of titrant solution, stirring, measuring and waiting times, recognition of the end point and storing titration results.
All the parameters that a titration requires are grouped into a method.
The titrator is supplied with a pack of standard methods.
Using a floppy disk or connect the titrator to a PC using the HI 900 PC application, the methods (standard and user methods) can be upgraded, stored or deleted.

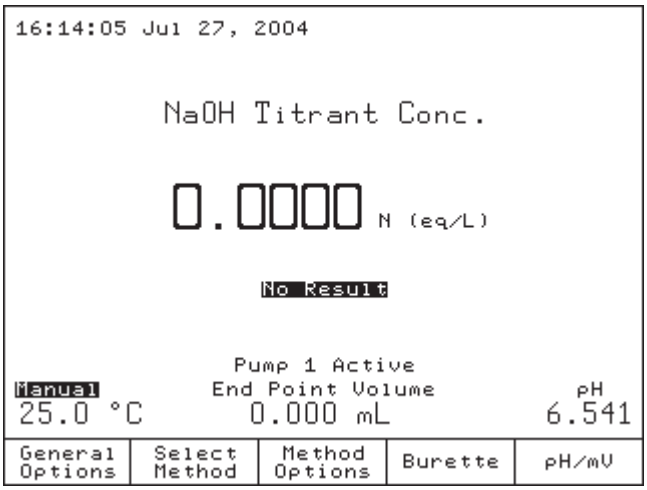
5.1 Selecting Methods

To select a method, press Select Method from the main screen. A list of available methods will be displayed.



In the ***Titration Methods*** screen, you can view the list of all available methods (standard and user methods).
If no user method has been defined, only standard methods are displayed.

To select a method, highlight the method and press Select. The name of the selected method will be displayed on the main screen.



5.2 Standard Methods

The standard methods are developed by the manufacturer for the most common types of analysis. Also, each standard method can be used as a model to create a new user method. Only specific method parameters can be modified by the user (see *5.5 Method Options* section).

5.2.1 Upgrading Standard Methods

The titrator will accept up to 50 standard methods.
To upgrade the titrator from Floppy Disk or PC with new standard methods, folow the steps below:

Floppy Disk:

- Insert the methods installation diskette into the floppy disk unit.
- Press General Options from the main screen.
- Using △ and ▽ keys, highlight the *Restore Files from Diskette* option and choose Select.
- Using ◁ and ▷ keys, navigate through file types menu to find "standard method files". The list with available standard methods on the diskette will be displayed.
- Press the Copy File or Copy All key to upgrade the titrator with the standard methods.
- Press Escape to return to ***General Options*** screen.

PC:

You can upgrade the titrator with standard methods from a PC, using HI 900 PC application (see *4.14 Serial Link with PC* section).

5.2.2 Deleting Standard Methods

You can remove unnecessary standard methods from titrator following the next steps:

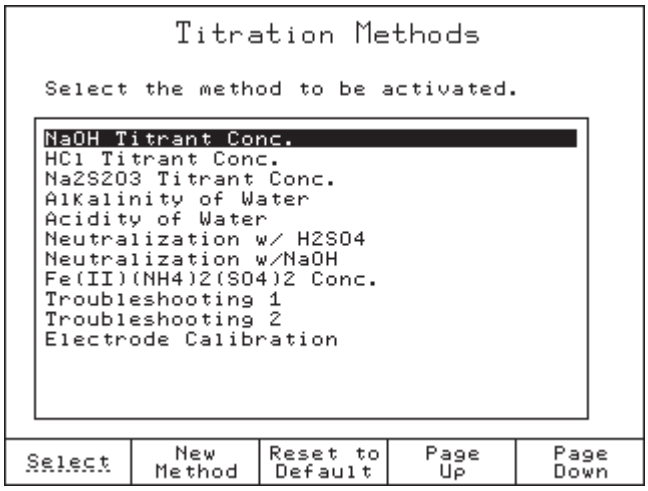
- Insert any diskette into the titrator.
- From the main screen press [General Options].
- Using the △ and ▽ keys, highlight the *Save Files to Diskette* option and press [Select];
- Using the ◁ and ▷ keys, navigate through the file types menu to find "standard method files". The available standard methods will be displayed.
- Press the [Delete] or [Delete All] keys to remove unnecessary standard methods.
- Press [Escape] to return to ***General Options*** screen.

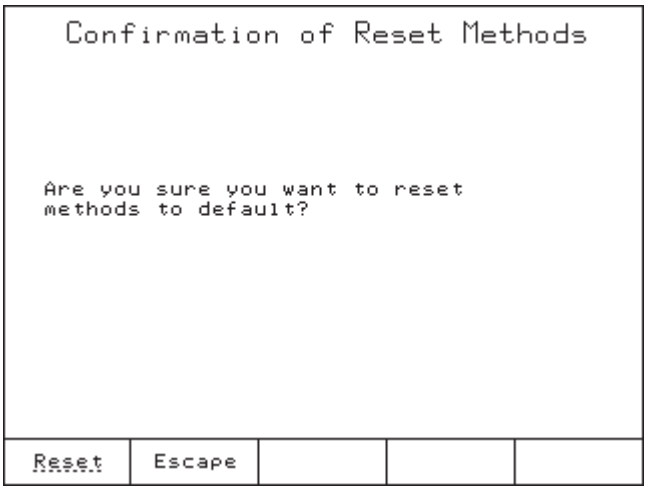
Also, you can remove standard methods from the titrator, using the HI 900 PC application (see *4.14 Serial Link with PC* section)

5.2.3 Restore the Standard Methods to the Manufacturer Settings

You can restore the standard methods to the manufacturer setting by highlighting a standard method and pressing [Reset to Default].

Warning: *Be careful, by pressing* [Reset to Default] *you will also delete all the user methods.*





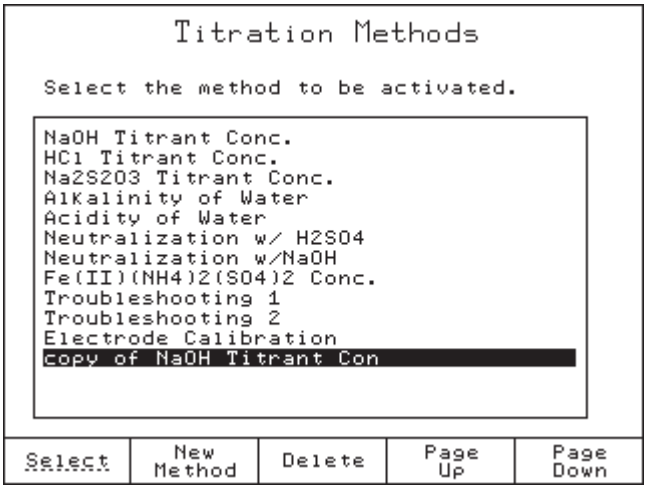
5.3 User Methods

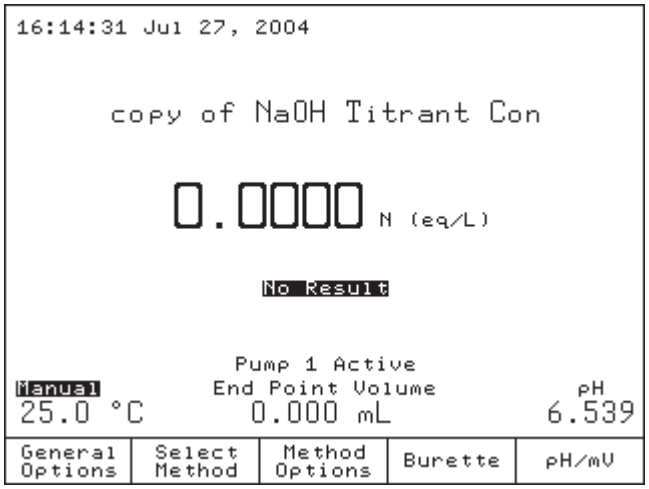
User methods are defined by the user (usually by modifying a standard method).
The user methods can be developed in accordance with the requirements of the user. All method parameters can be modified by the user.

5.3.1 Creating User Methods

To create a new user method start from a standard or user method and follow these steps:

- Press [Select Method] from the main screen.
- Using the △ and ▽ keys, highlight an existing method from the methods list.
- Press [New Method]. A new user method will be generated.
- Press [Select] to activate the new created user method.

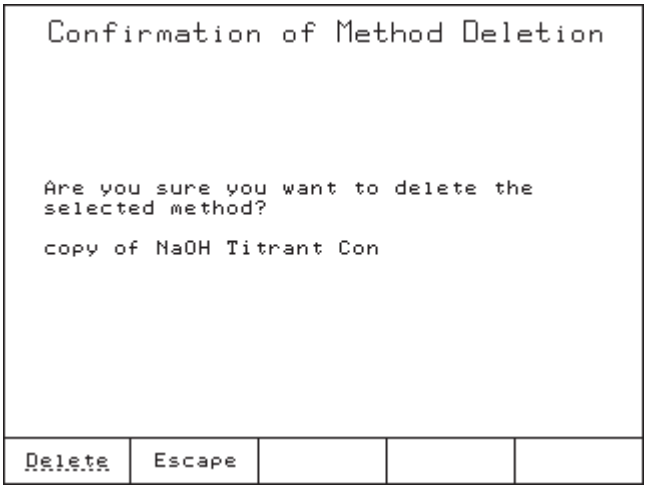




Note: *Only a limited number of user methods can be generated. If the limit of standard and user methods (100 methods) is reached, a warning message will be displayed.*

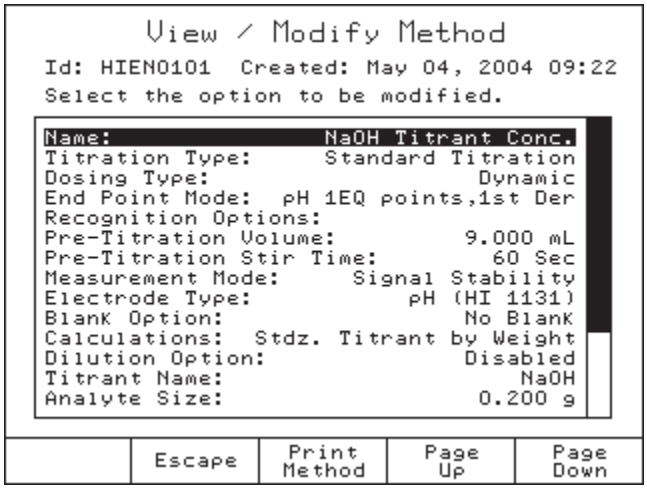
5.3.2 Deleting User Methods

To remove a user method, press [Select Method] from the main screen. Highlight the user method that you want to delete and press [Delete]. A screen will appear in order to confirm the deletion. Press [Delete] again to confirm, or press [Escape] to cancel the operation.



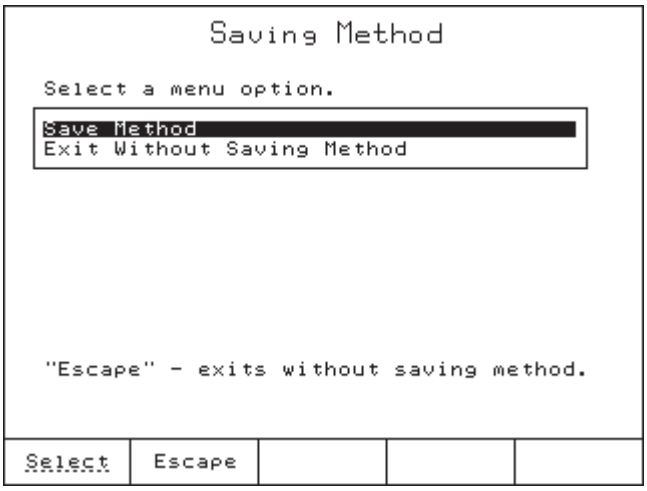
5.4 View / Modify Method

To modify the method's parameters, press Method Options from the main screen. A list of all the parameters for the selected method will be displayed. Using the △ and ▽ keys, highlight the option that you want to modify and choose Select.



Save method:

From the ***View / Modify Method*** screen, press Escape.

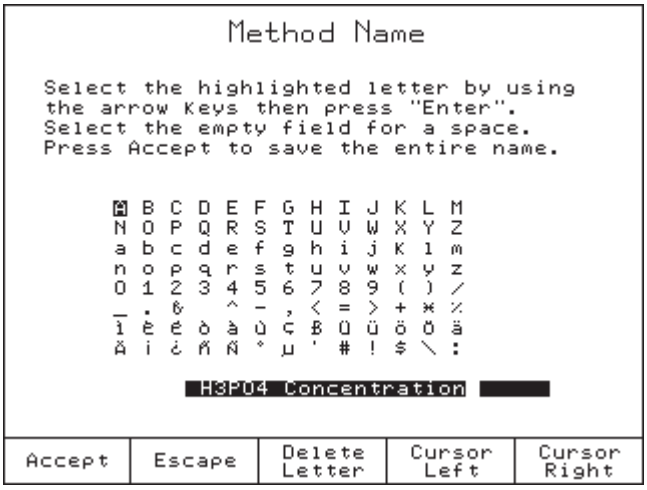


You can choose to save the modifications of the method parameters or to discard them.

5.4 Method Options

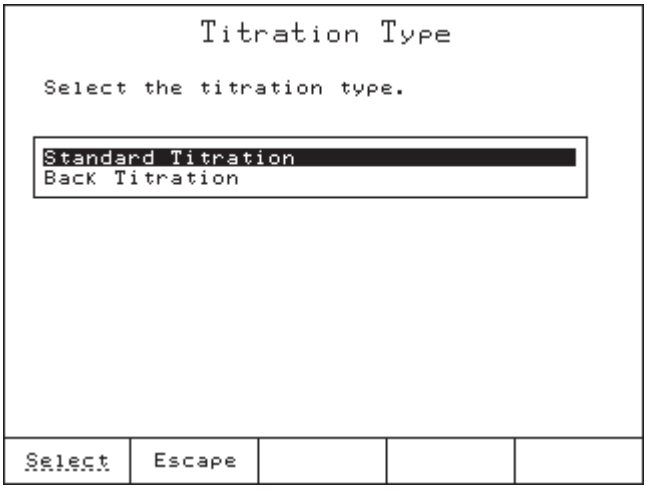
5.5.1 Naming the User Method

This option allows you to enter a name for the new method (up to 24 characters). Use the arrow keys to navigate through the character table. Press [enter] to add the highlighted character to the method name.



5.5.2 Titration Type (HI 902 only)

In order to make an analysis you have to choose the type of titration:



Standard Titration

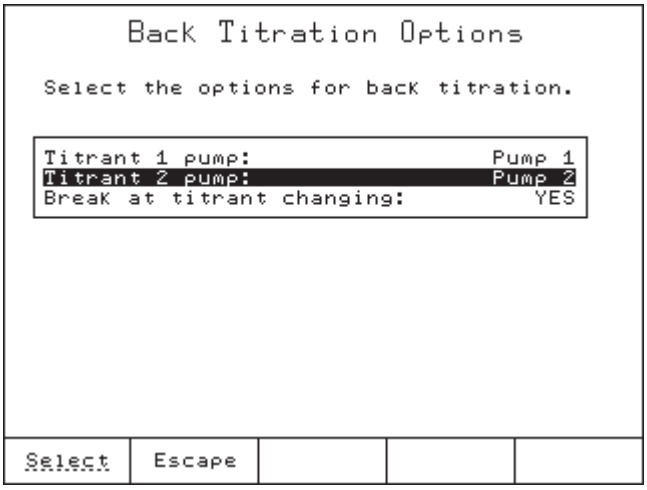
- A titration with a pH or mV equivalence point detection.
- A titration with fixed pH or mV end point.

Back Titration

A titration with a pH or mV equivalence point detection, consisting of two titration phases:

- Phase 1 – the sample is consumed by a known volume and concentration of titrant 1. A sufficient amount of titrant 1 is dispensed to surpass the equivalence point in order to react quickly with the sample.
- Phase 2 – the excess of titrant 1 is titrated with the titrant 2 to the equivalence point. Finally, the concentration of the sample will be determined.

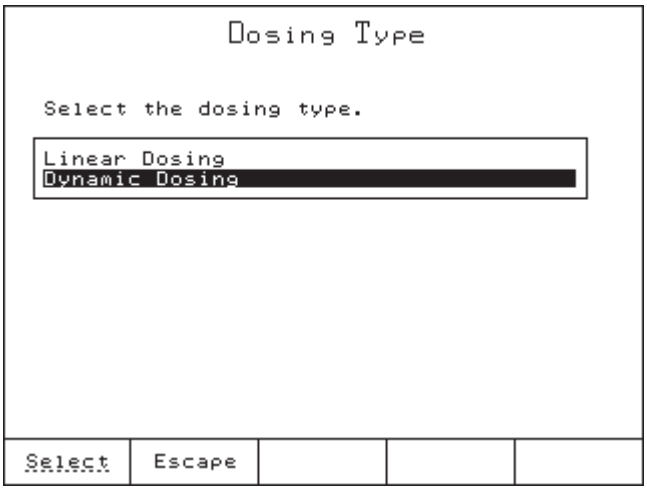
Also, if the *Back Titration* option is chosen, the following settings must be selected:



- *Titrant 1 pump*: select the pump used in phase 1 of the titration *(Pump 1)*.
- *Titrant 2 pump*: select the pump used in phase 2 of the titration *(Pump 2)*.
- *Break at titrant changing:* select "YES" to stop titration temporarily, between the first and the second phase of the back titration (you can do some tasks in order to perform the analysis: eg. boiling the sample in order to evaporate the carbon dioxide).

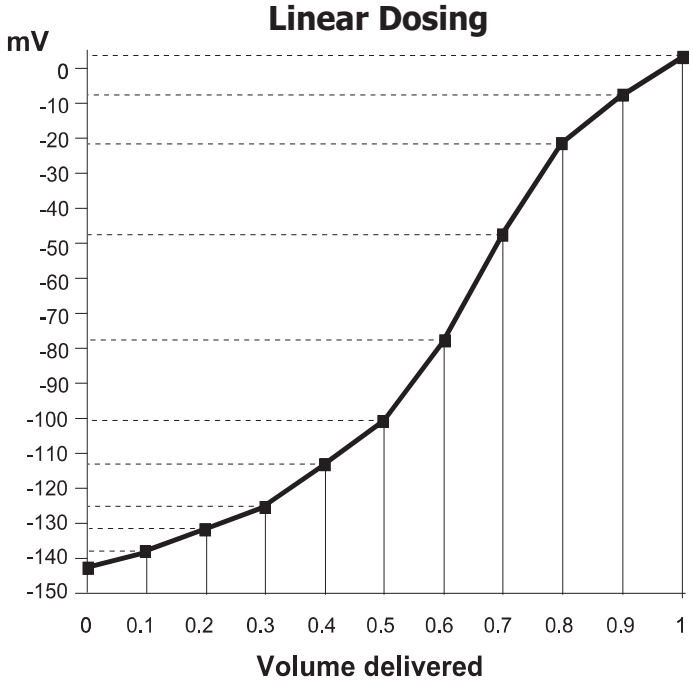
5.5.3 Dosing Type

The Titrator allows two dosing types: *Linear Dosing* and *Dynamic Dosing*.



5.5.3.1 Linear Dosing

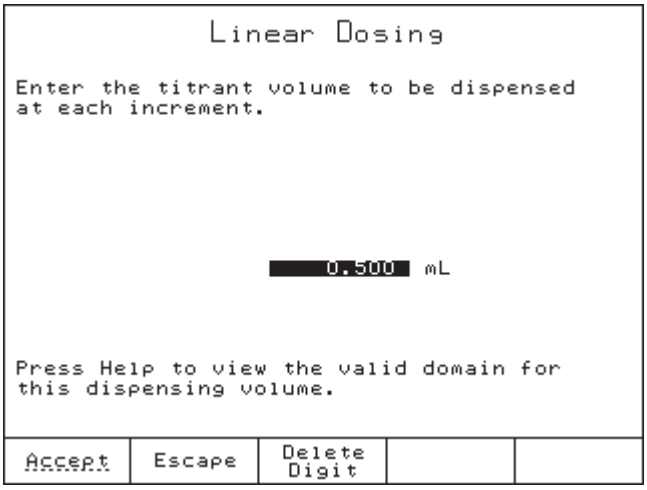
This type of dosing uses equal volume doses of titrant as shown in the graph below.



The *Linear Dosing* option is recommended for slower, difficult nonaqueous titrations or certain specific analysis.

Note: *For steep and normal titration curves, smaller volume increments are recommended, to obtain many measured points around the equivalence point.*
For flat titration curves, larger volume increments are recommended for equivalence point detection.

To set the dosing volume, select *Linear Dosing* option and type the optimum dose.

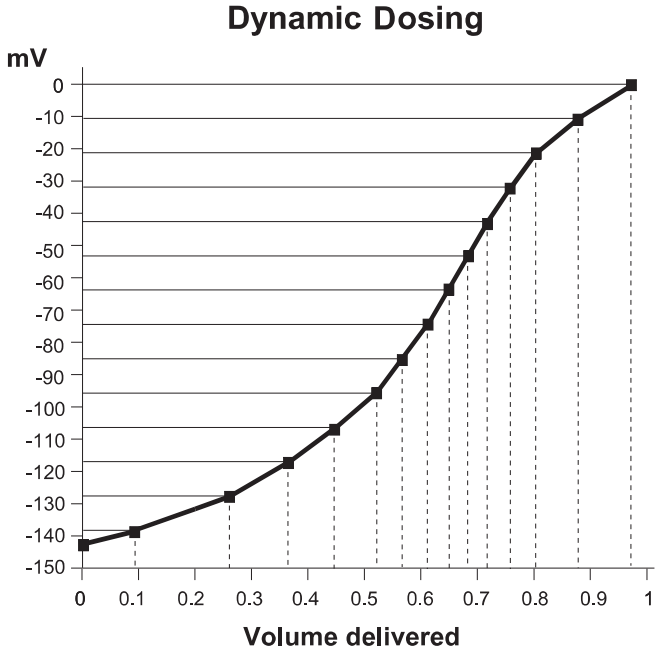


The allowed ranges for dosing volume are:

0.001	to	4.500	mL	for a	5 mL burette
0.001	to	9.000	mL	for a	10 mL burette
0.005	to	22.500	mL	for a	25 mL burette
0.005	to	45.000	mL	for a	50 mL burette

5.5.3.2 Dynamic Dosing

The titrant is added in volumes that depends on the proximity of the end point as shown in the graph below.

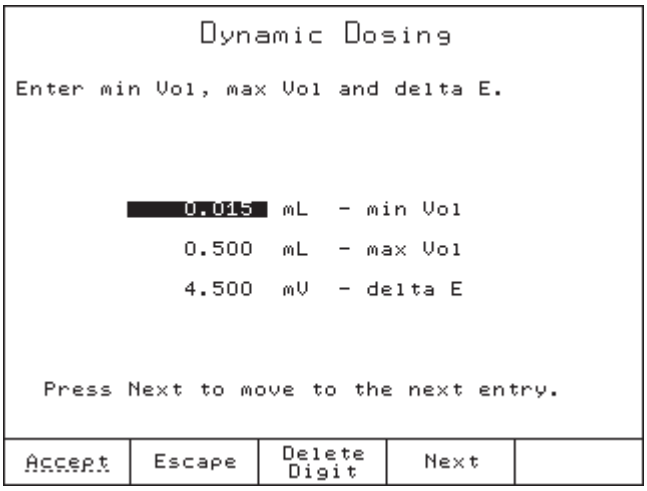


The titrator determines the titrant dose by trying to maintain a certain potential change *(delta E)* with each addition.

If the potential jump, after the titrant dose, is lower than the set *delta E*, the next dose volume is progressively increased until *max Vol* is attained. If the potential jump is still lower, the titration will continue with the *max Vol* doses.

If the potential jump, after the titrant dose, is higher than the set *delta E*, the next dose volume is progressively decreased until *min Vol* is attained. If the potential jump is still higher, the titration will continue with the *min Vol* doses.

As a result, far from the end point, larger doses are made, reducing the total titration time. Closer to the end point, smaller doses are made, providing more data and higher accuracy in the critical end point region.



The following parameters must be set:

min Vol: Sets the smallest dose volume to be dispensed during titration.
The *min Vol* must be greater or equal than:
0.001 mL for a 5 mL burette
0.001 mL for a 10 mL burette
0.005 mL for a 25 mL burette
0.005 mL for a 50 mL burette

max Vol: Sets the largest dose volume to be dispensed during titration.
The *max Vol* must be lower or equal to 4.000 mL.

delta E: Sets the fixed potential jump that has to be achieved after each titrant dose.
The allowed range is between 0.1 and 99.9 mV.

Recommendations for dosing parameters:

For titrations with stepper titration curves the recommended settings are:

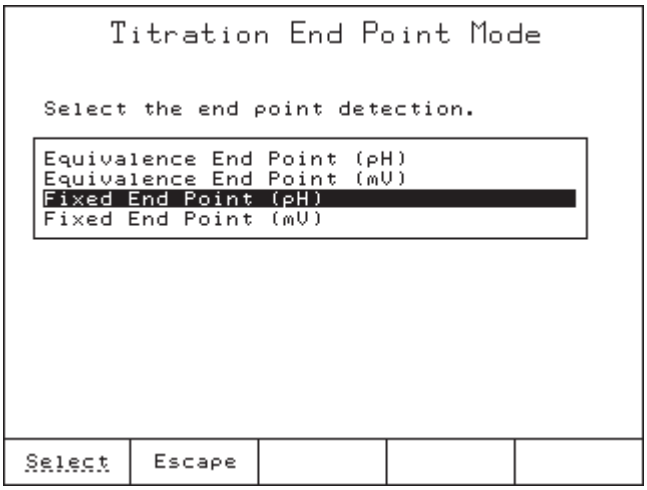
delta E = 3.5 to 9 mV
min Vol = 0.010 to 0.025 mL (for a 25 mL burette)
max Vol = 0.075 to 0.250 mL (for a 25 mL burette)

For titrations with flat titration curves the recommended settings are:

delta E = 10 to 15 mV
min Vol = 0.050 to 0.150 mL (for a 25 mL burette)
max Vol = 0.400 to 0.600 mL (for a 25 mL burette)

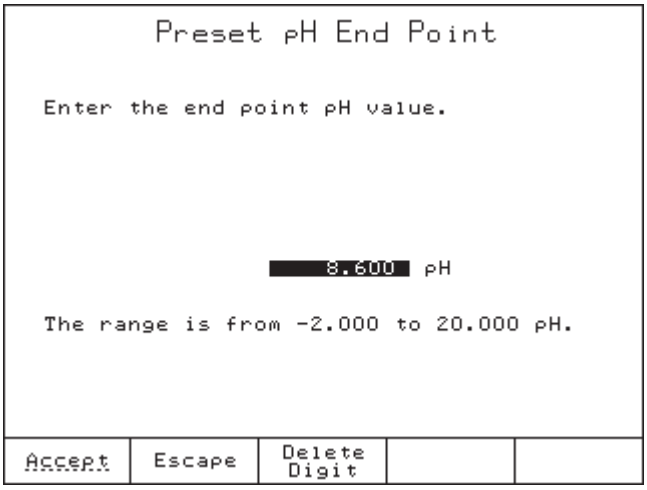
In order to achieve maximum accuracy and reproducibility, it is recommended that 20% to 80% of the nominal volume of the burette is consumed. If lower or higher volumes of titrant are required, it is recommended to use the optimum burette volume as follows: 5, 10, 25 or 50mL.

5.5.4 End Point Mode



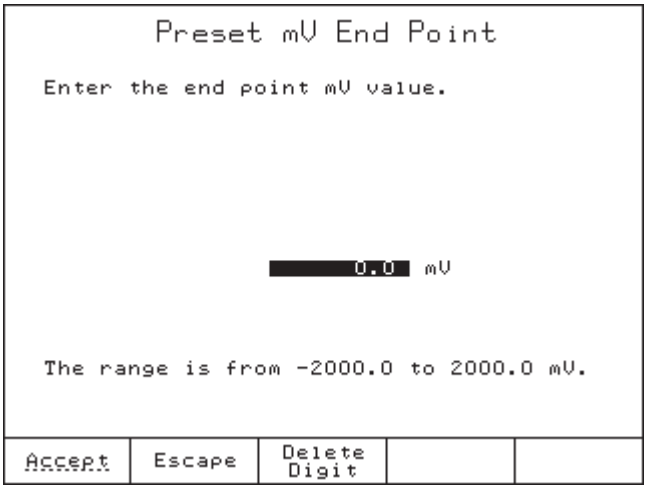
5.5.4.1 Fixed End Point (pH or mv)

Fixed End Point (pH):
The titration is normally terminated when the preset pH value has been exceeded. The reported end point volume is interpolated between the dispensed volume when pH is under the preset pH value and the dispensed volume when pH exceeded the preset pH value.

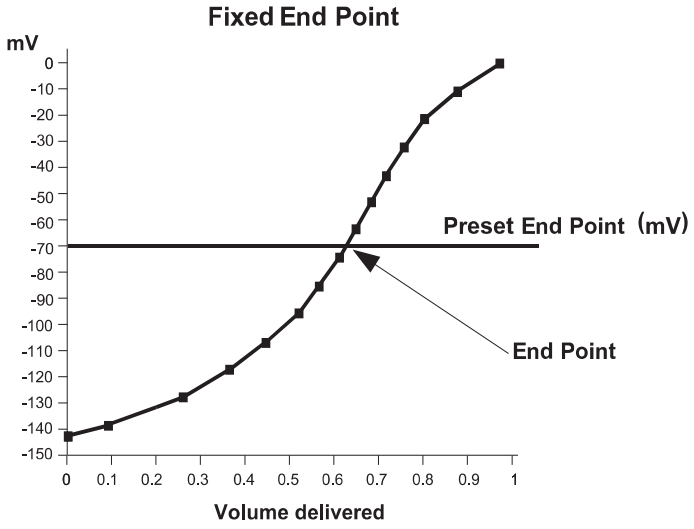


The range is from - 2.000 to 20.000 pH.

Fixed End Point (mV):
The end point detection algorithm is the same as for pH, but the threshold value is expressed in mV.



The range is from - 2000.0 to 2000.0 mV.

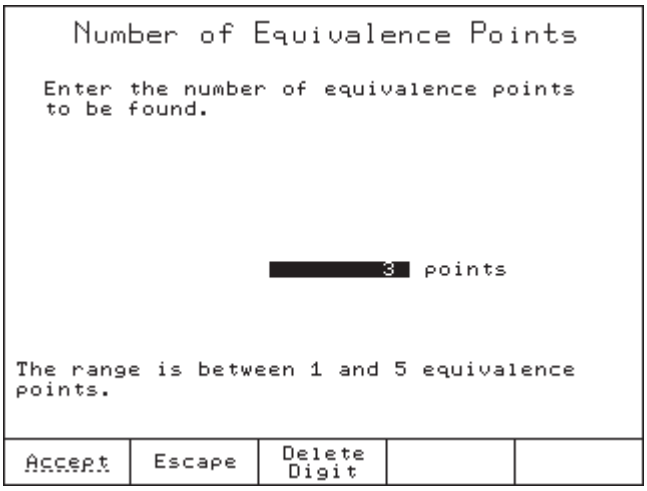


5.5.4.2 Equivalence End Point (pH or mv)

The titration is normally terminated when the equivalence point is detected (the point where the added quantity of titrant equals the quantity of analyte present in the sample, according to the chemical combination ratio).

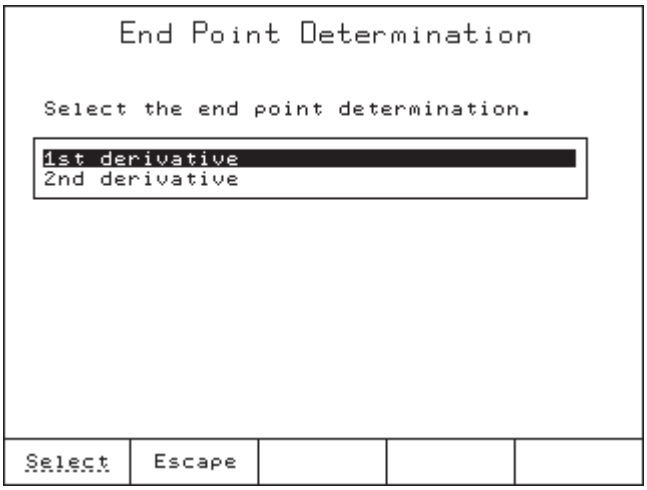
Number of Equivalence Points (HI 902 only)

The titrator can perform a titration with more than one equivalence point.
Up to 5 equivalence points can be detected.



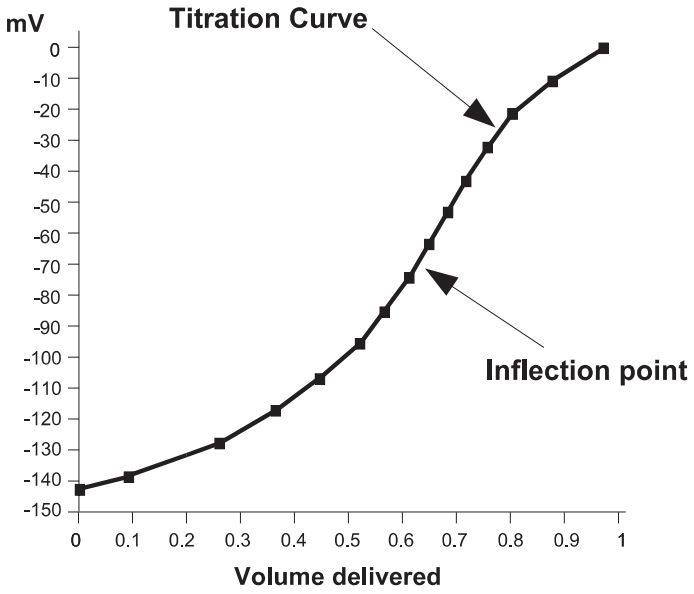
End Point Determination

The first and the second derivative of the S-shaped titration curve can be used to detect the equivalence point.



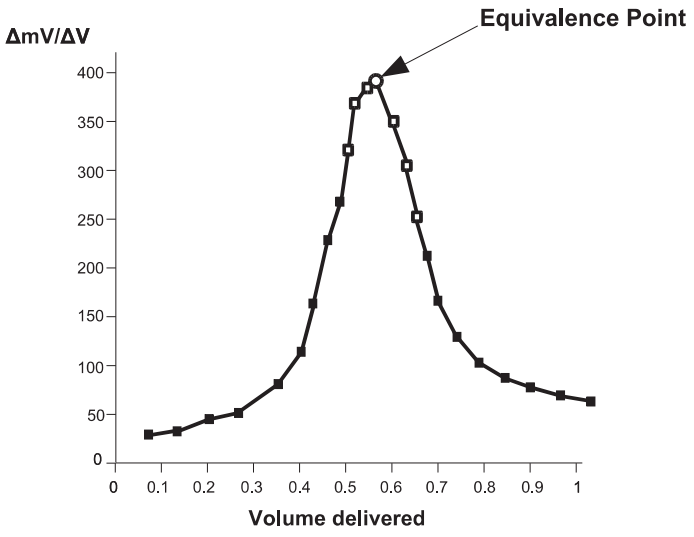
The equivalence point detection algorithm requires three more doses to be dispensed in the analyte after the equivalence point is reached.
The reported end point volume is a calculated value based on a number of points around the equivalence point.
The potentiometric S-shaped titration curve is the response in potential (mV) or pH between the indication of the electrode versus cumulated addition of titrant. The graph takes the shape of the S-character and can be expressed as mV or pH versus titrant volume.
The inflection point of the S-shaped titration curve is assumed to be the equivalence point of the chemical reaction.

This is rigorously exact only for symmetric S-shaped titration curves. For non-symmetric curves, the effect of this theoretical error can be minimized by smaller doses (more measurement points) around the equivalence point.



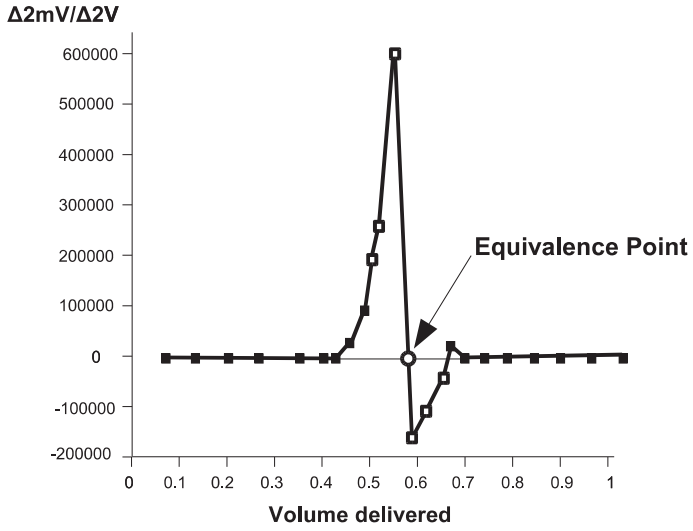
1st Derivative:

When first derivative is used to recognize the equivalence point, the point where the first derivative reaches the maximum value corresponds to the titration curve inflection point (EQP).



The detection algorithm searches for the maximum value of the first derivative. Also, the first derivative must be greater than the threshold value at the maximum point (see *Recognition Options* on page 5-17).

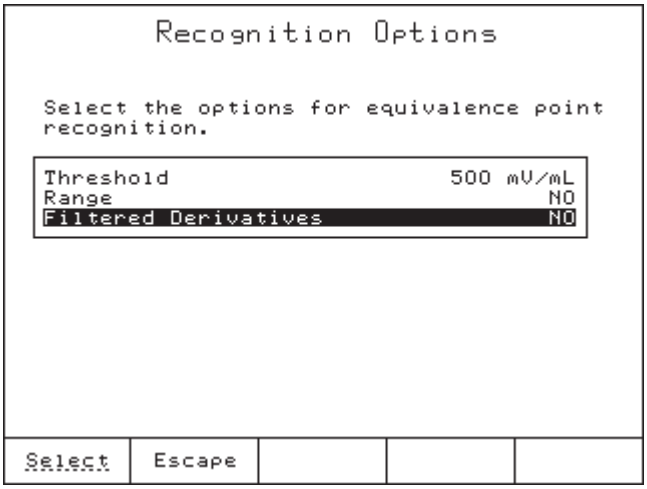
2nd Derivative:
When second derivative is used to recognize the equivalence point, the zero crossing point of the second derivative corresponds to the titration curve inflection point (EQP).



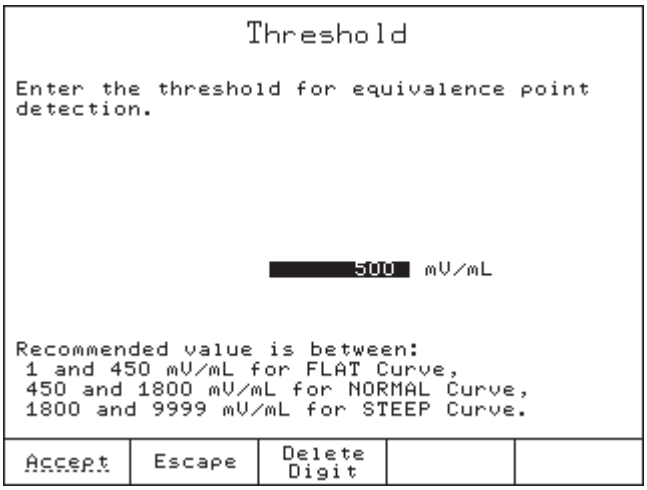
The detection algorithm searches for the point where the second derivative changes the sign. Also, the first derivative, corresponding to the checked point must be greater than the threshold value (see *Recognition Options* on page 5-17).

Recognition Options

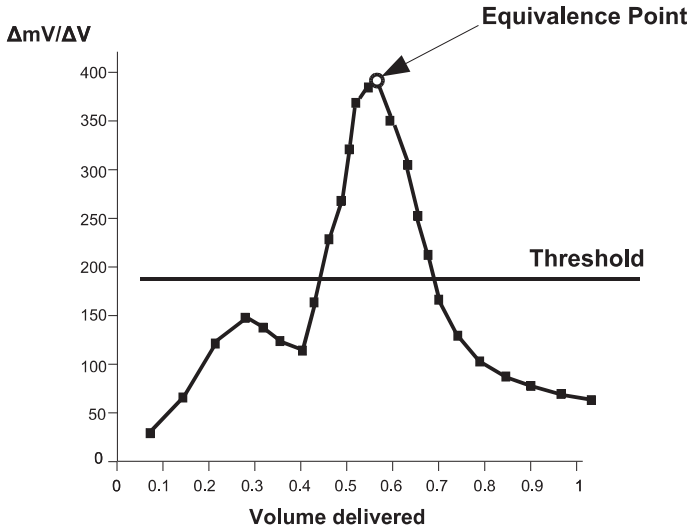
The ***Recognition Options*** screen represents a set of parameters used to avoid false detection of the equivalence point. This could appear mainly due to the chemical system (involved titrant / sample chemical species and concentrations) and / or to the electrode response.
The ***Recognition Options*** screen is available only when *Equivalence End Point (pH or mV)* option is selected.



Threshold:
This parameter must be set by the user in according with the analysis.
The threshold represents the absolute value of the first derivative, expressed in |mV/mL| (absolute value), below which the detection algorithm does not search for the equivalence point.



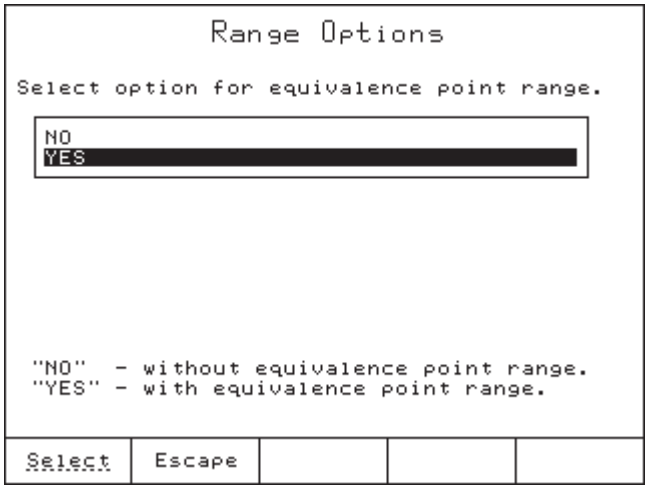
Range is between 1 and 9999 mV/mL.
The recommended value for the threshold is around 40% of the estimated maximum absolute value of the first derivative.

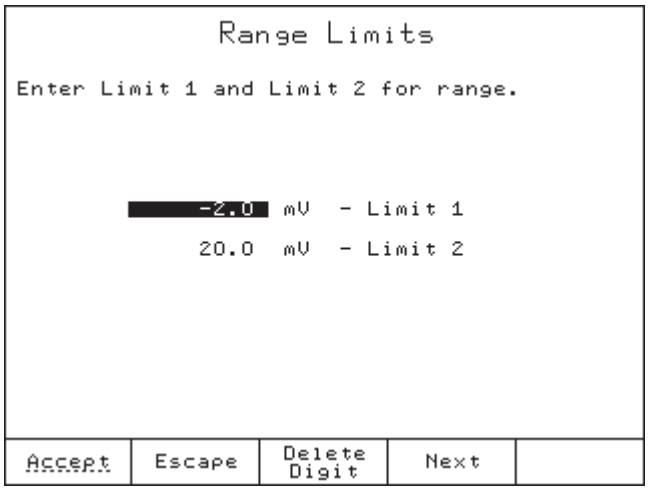


Depending on the titration curve profile, the following guiding ranges might be used:

TITRATION CURVE PROFILE	THRESHOLD |mV/mL|
FLAT	1 to 450
NORMAL	450 to 1800
STEEP	1800 to 9999

Range:
Range is an optional feature for equivalence point recognition. It represents a set mV or pH range for equivalence point detection.
The *Range* option can be enabled by selecting *YES* in the ***Range Options*** screen.

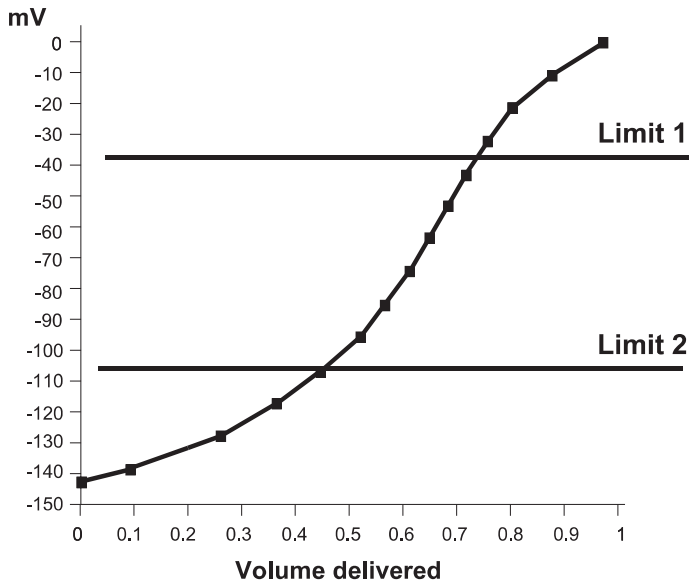




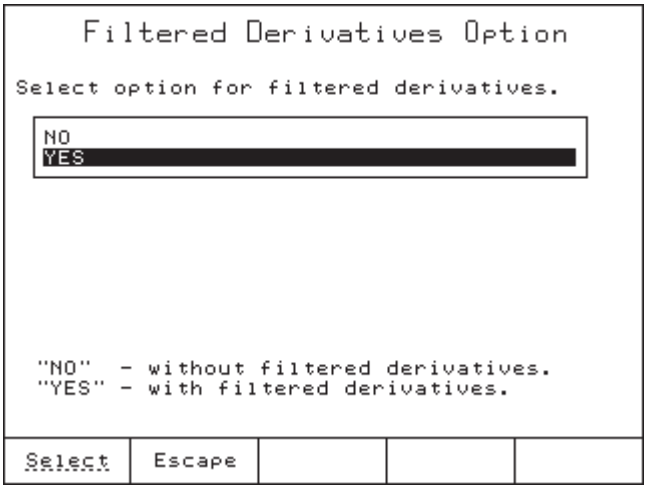
Limit 1 - The first limit of the range attained during the titration:
This range can be from -2.000 pH to 20.000 pH (for *pH equivalence point)*.
This range can be from -2000.0 mV to 2000.0 mV (for *mV equivalence point)*.

Limit 2 - The second limit of the range attained during titration:
This range can be from -2.000 pH to 20.000 pH (for *pH equivalence point)*.
This range can be from -2000.0 mV to 2000.0 mV (for *mV equivalence point)*.

The Limit 2 value must not be equal to the Limit 1 value.



Filtered Derivatives:
Filtered Derivatives is an optional feature for equivalence point recognition.
This option adds a filtering procedure in the 1st and 2nd derivative computation algorithm that reduces the influence of pH or mV noise.
The *Filtered Derivatives* option can be enabled by selecting *YES* in the ***Filtered Derivatives Option*** screen.



Noise can appear due to:

- Chemical system properties (sample, titrant, solvent), such as slow chemical reactions or unbuffered samples such as wastewater, tap water, wine.
- Electrode response.
- Incorrect method parameters settings such as *Signal Stability, Stirring Speed*, etc.
- Too small titrant doses.

***Note**: Even if false equivalence point detection has been highly diminished, a shift of the end point volume might sometimes occur due to filtering. The shift is often at the level of 1 or 2 doses from the real equivalence point volume. For fast titrations and small doses this is a useful option.*

5.5.5 Pre-Titration Volume

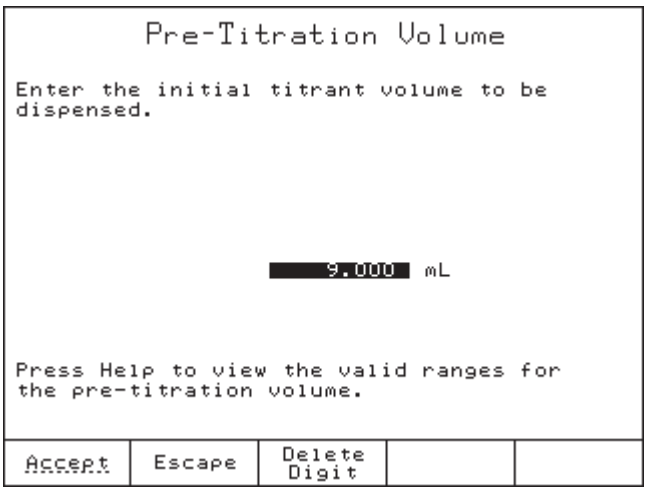
During a regular titration, the equivalence point is reached after many doses are dispensed. Most of these doses simply take up extra time while having no relevance for equivalence point detection.

Pre-titration volume adds a large initial dose to jump directly to the proximity of the equivalence point.

This first dose occurs after the pre-titration stir time is completed.

The valid pre-titration volume is between the ranges shown below:

0.001 to 4.500 mL for a 5 mL burette
0.001 to 9.000 mL for a 10 mL burette
0.005 to 22.500 mL for a 25 mL burette
0.005 to 45.000 mL for a 50 mL burette

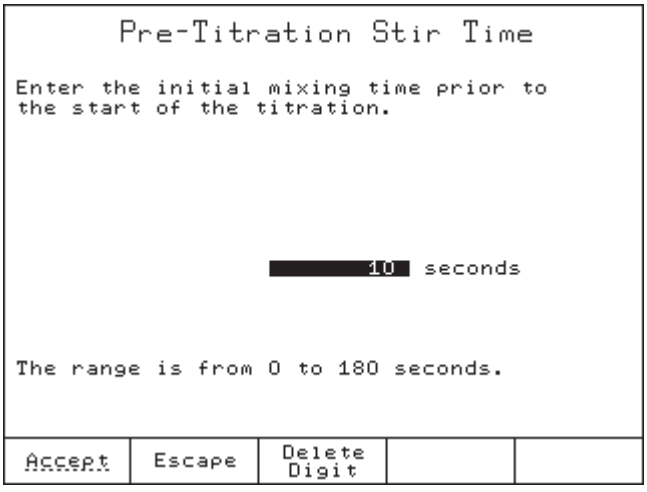


If no pre-titration volume is used, 0.000 mL should be entered.

Note: *A pre-titration volume is highly recommended whenever possible. When fewer linear doses are used the overall titration duration considerably shortens.*

5.5.6 Pre-Titration Stir Time

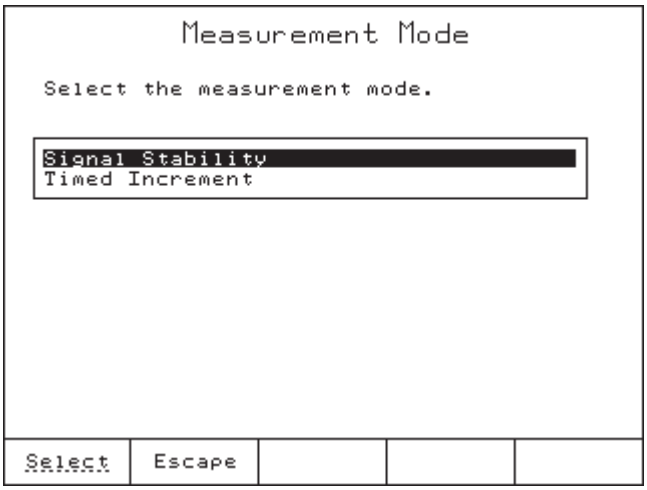
When this option is enabled, the sample is mixed for a period of time before the titration begins. This allows the sample to become homogeneous.
The range is from 0 to 180 seconds.



If 0 seconds is entered, the *Pre-Titration Stir Time* option is disabled.

5.5.7 Measurement Mode

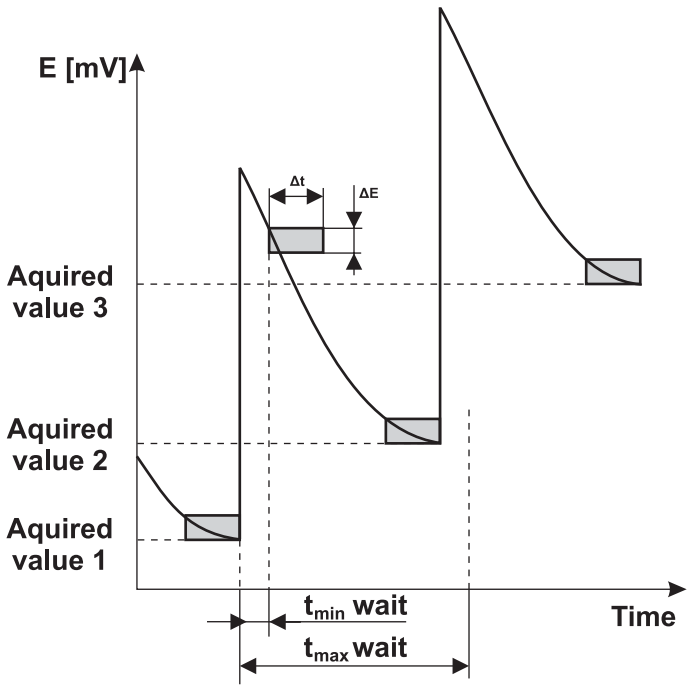
During titration, the acquisition of the potential (mV) value of the solution, can be performed in two ways, by using either *Signal Stability* or *Timed Increment* option.



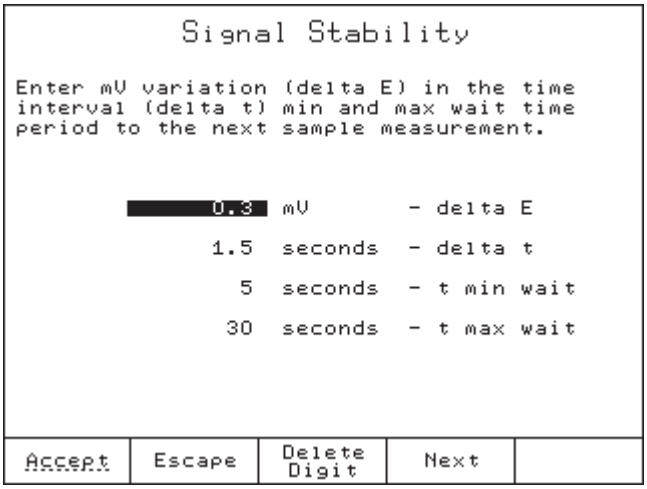
Addition of the next dose is performed immediately after the potential is measured.

5.5.7.1 Signal Stability

When *Signal Stability* option is selected, the titrator acquires the potential (from solution) only when the stability condition is reached.
The response of the electrode for each added dose and the principles of the stability window are plotted below and described on the following page.



The signal stability window (condition) represents the time interval Δt during which the potential measured in solution (mV) is confined inside the potential interval ΔE (see the boxes on the chart).
The new signal value is acquired if the stability condition is reached but not before the minimum waiting time (*t min wait*) has elapsed.
If the *t max wait* time has elapsed and the stability condition is not reached, the potential is acquired (and a new dose is added).



delta E - is the height of the signal stability window.

The range is from 0.1 to 99.9 mV.

delta t - is the width of the signal stability window.

The range is from 0.5 to 10.0 seconds.

t min wait - is the minimum elapsed time before stability check. This is also the minimum elapsed time between two doses.

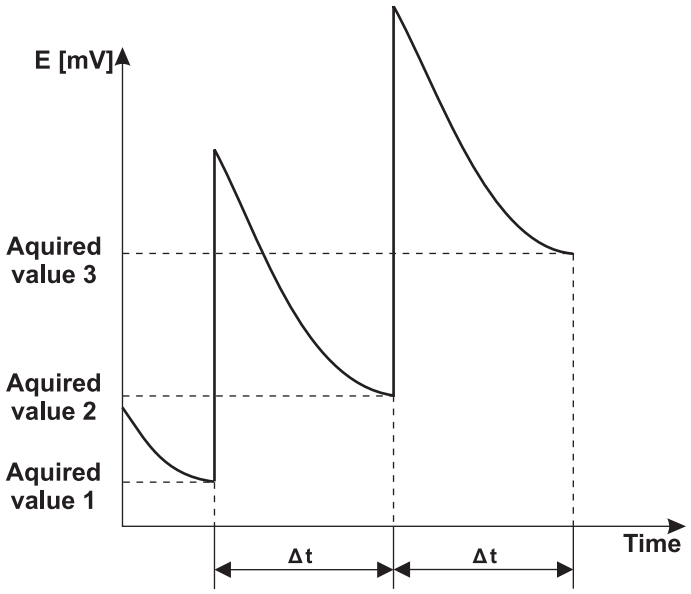
The range is from 2 seconds to *t max wait* time.

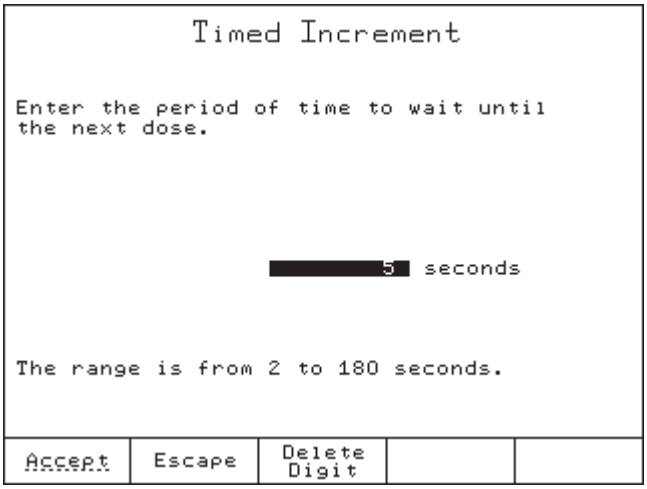
t max wait - is the maximum elapsed time between two successive doses. If the *t max wait* has elapsed, a new dose is added even if the condition of signal stability is not reached.

The range is from *t min wait* time to 180 seconds.

5.5.7.2 Timed Increment

When *Timed Increment* option is selected, the acquiring of the potential (mV) value from the solution is made at a fixed time interval (no signal stability check).
The time period between two acquisitions must be set according with the used reaction and the time response of the electrode.

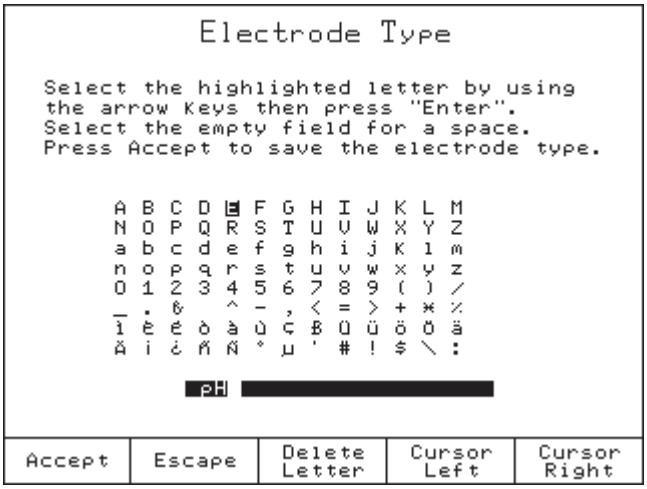




The range is from 2 to 180 seconds.

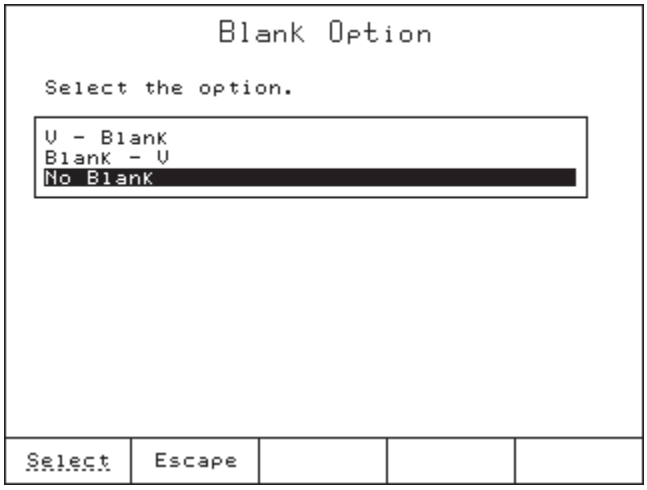
5.5.8 Electrode Type

Enter the type of the electrode, up to 24 characters. The electrode type will appear in the titration report.

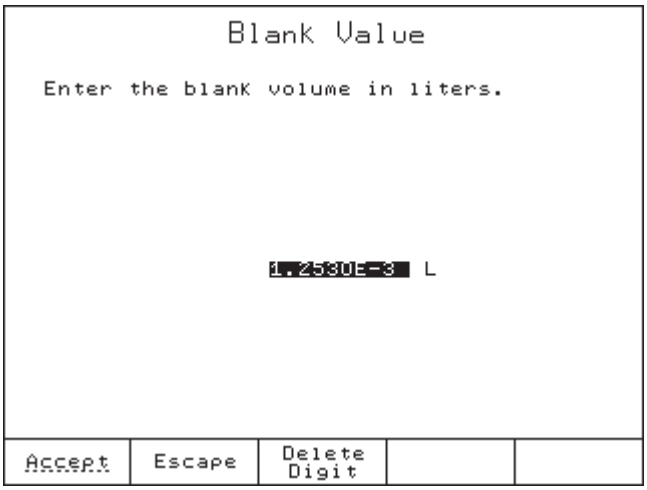


5.5.9 Blank Option

This feature allows the user to select the procedure for the blank calculations (where *V* is the volume of titrant dispensed during the titration and *Blank* is the volume of titrant consumed by the blank sample).

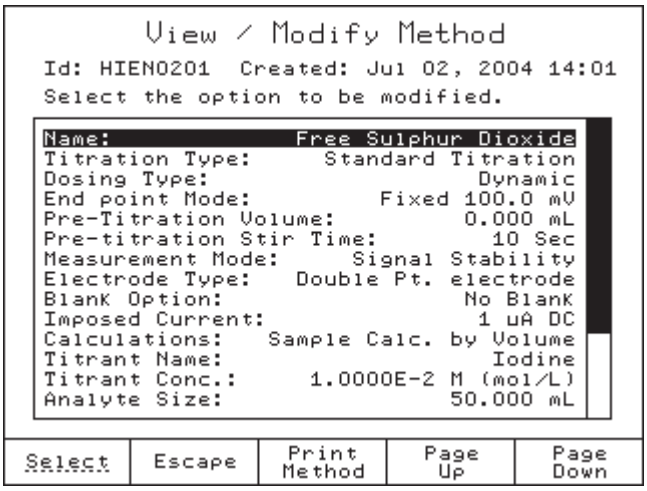


If one of the options (*V-Blank* or *Blank-V*) is selected in the ***View / Modify Method*** screen the *Blank Value* option will became active and the value of blank can be set (in liters).



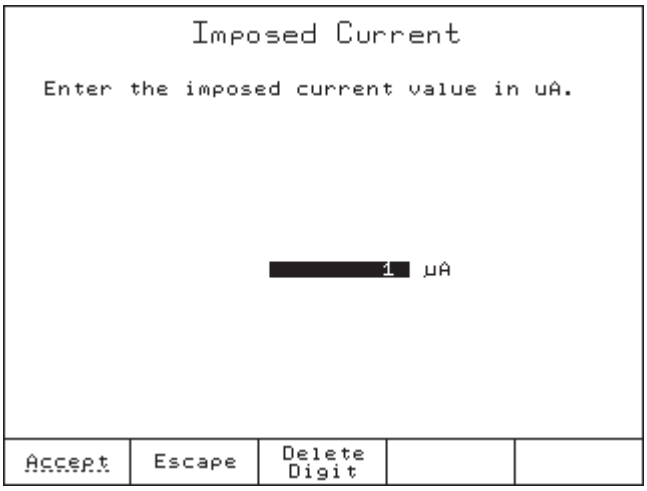
5.5.10 Imposed Current (HI 902 only)

When ***Fixed End Point (mV)*** (see *5.5.4 End Point Mode*) is set, the *Imposed Current* option will become available.



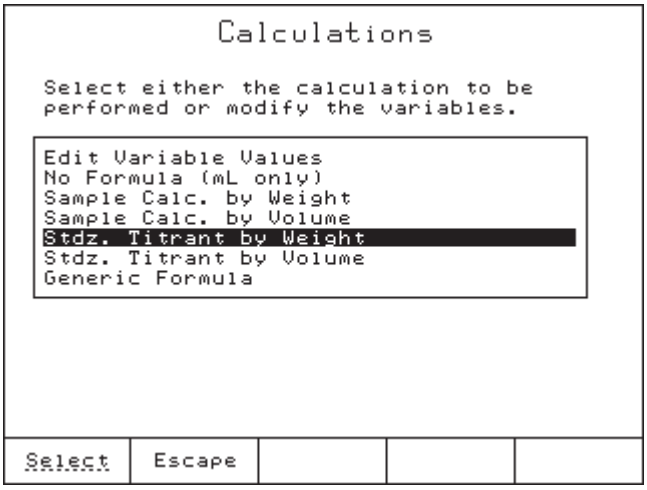
Using the imposed current feature in end point redox titrations has a great advantage on the speed of the redox reactions. The speed is increased significantly when the double Pt electrode used for the titration is polarized with a small imposed current (we obtain a stepper jump, perfect adapted for end point titrations).
In order to use this feature you must install the HI 900401 imposed current analog board.

The imposed current can be set from -100 µA to 100 µA with 1 µA resolution.



5.5.11 Calculations

The titrator will make certain calculations in order to obtain the result of the analysis. The result is computed starting from the end point volume (titrant volume at the equivalence point), using a formula set by the user.



5.5.11.1 Standard Titrations

Edit Variable Values

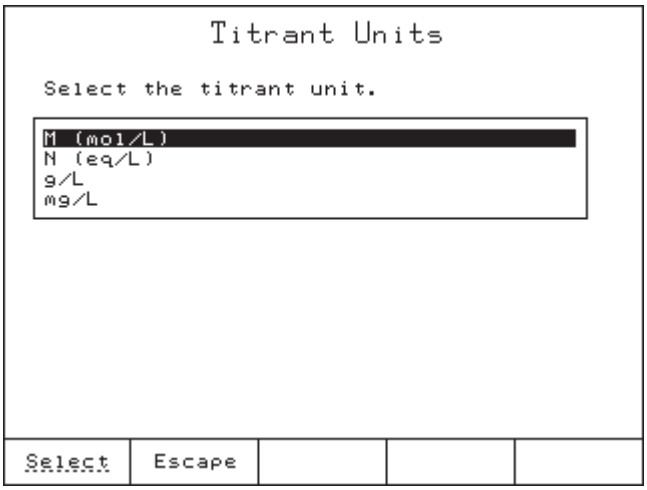
This option allows the user to change the values of the variables used in a previously selected calculation.
For each formula, selected variables can be changed.

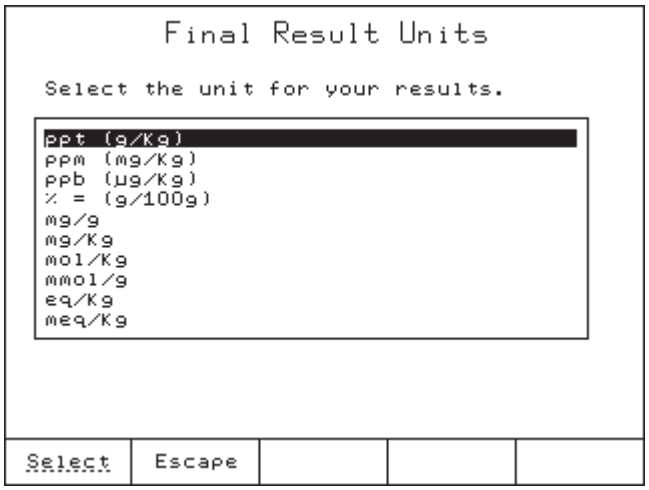
No Formula (mL only)

If this option is selected, only delivered milliliters (mL) are displayed.

Sample Calculations by Weight

This calculation should be used when the concentration of an analyte is determined in a solid sample. The results are based on the initial sample weight (in grams). When you choose this formula, select the *Titrant Unit* first and then the *Final Result Unit*.





The titrator will provide the results based on the titrant and sample units selected.

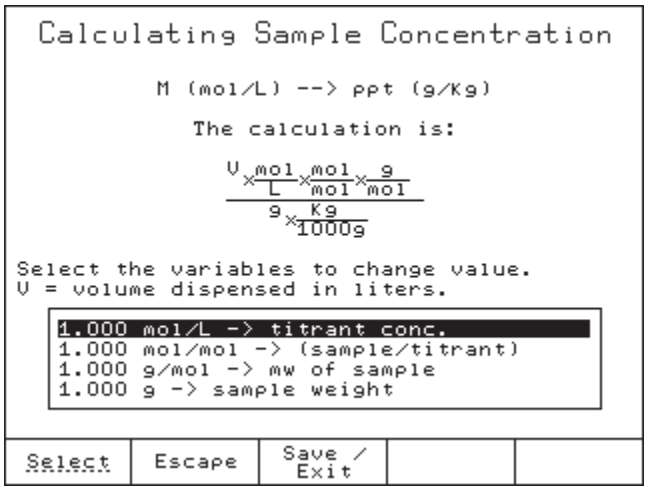
Titrant Units:

M (mol/L)	(moles/liter)
N (eq/L)	(equivalences/liter)
g/L	(grams/liter)
mg/L	(milligrams/liter)

Final Result Units:

ppt (g/Kg)	(parts per thousand; grams/kilogram)
ppm (mg/Kg)	(parts per million; milligrams/kilogram)
ppb (µg/Kg)	(parts per billion; micrograms/kilogram)
% = g/100 g	(percentage in weight; grams/100 grams)
mg/g	(milligrams/gram)
mg/Kg	(milligrams/kilogram)
mol/Kg	(moles/kilogram)
mmol/g	(millimoles/gram)
eq/Kg	(equivalences/kilogram)
meq/Kg	(milliequivalences/kilogram)

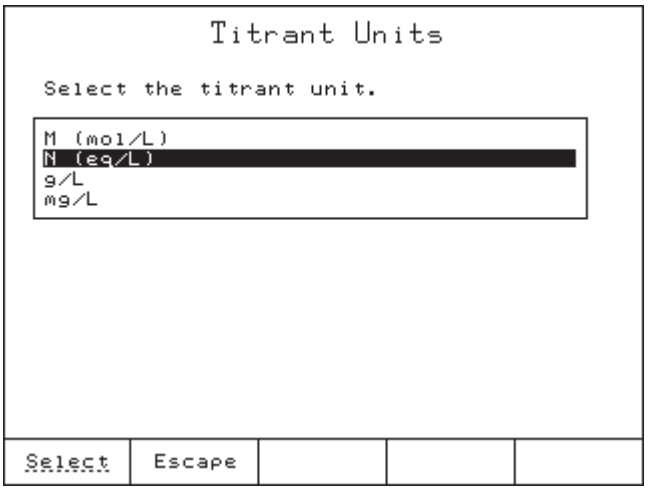
If the titrant unit is selected as M (mol/L) and the final sample unit as g/Kg (grams/kilogram) the formula used to generate the result is displayed below:

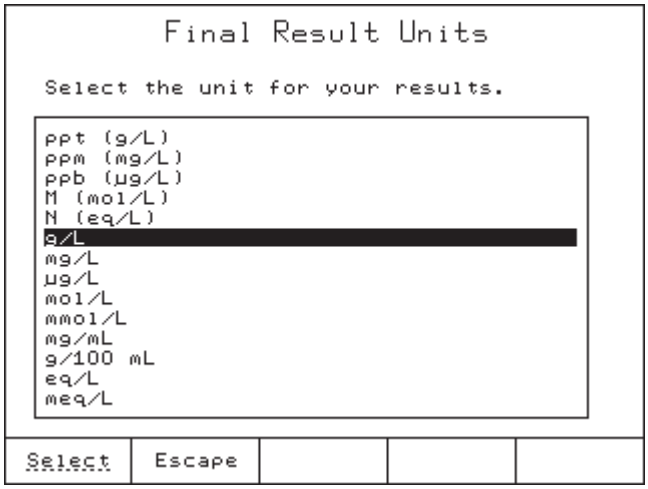


Some variables can be set according to the amount of sample and titrant used.

Sample Calculations by Volume

This calculation should be used when the concentration of an analyte is determined in a liquid sample. The results are based on the initial sample volume (in milliliters). When choosing the formula, select the *Titrant Unit* first and then the *Final Sample Unit*.
The titrator will perform the calculation based on the titrant and the sample units selected.





Titrant Units:

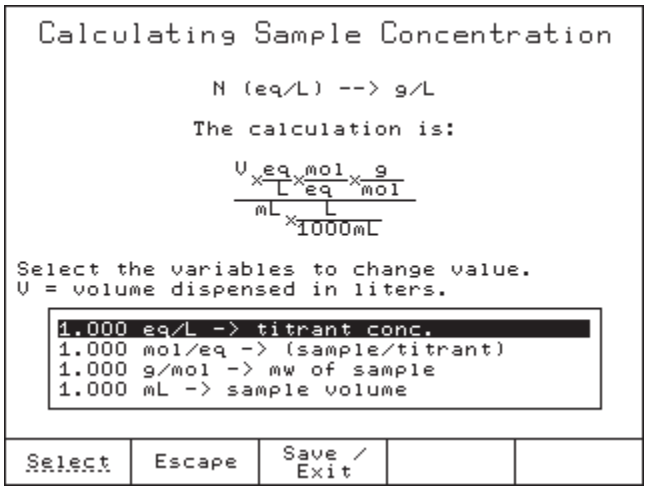
M (mol/L)	(moles/liter)
N (eq/L)	(equivalences/liter)
g/L	(grams/liter)
mg/L	(milligrams/liter)

Final Sample Units:

ppt (g/L)	(parts per thousand; grams/liter)
ppm (mg/L)	(parts per million; milligrams/liter)
ppb (µg/L)	(parts per billion; micrograms/liter)

M (mol/L)	(Molarity; moles/liter)
N (eq/L)	(Normality; equivalences/liter)
mg/L	(milligrams/liter)
µg/L	(micrograms/liter)
mmol/L	(millimoles/liter)
mg/mL	(milligrams/milliliter)
g/100 mL	(grams/100 milliliters)
eq/L	(equivalences/liter)
meq/L	(milliequivalences/liter)

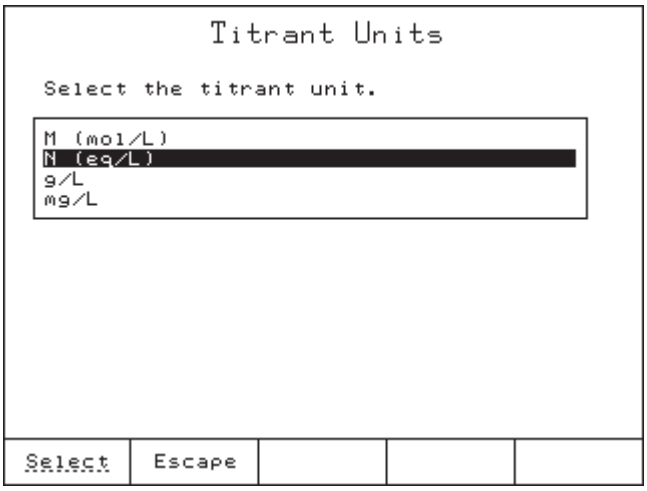
If the titrant unit is selected as N (eq/L) and the final sample unit as g/L (grams/liter), the formula used to generate the result is displayed below.



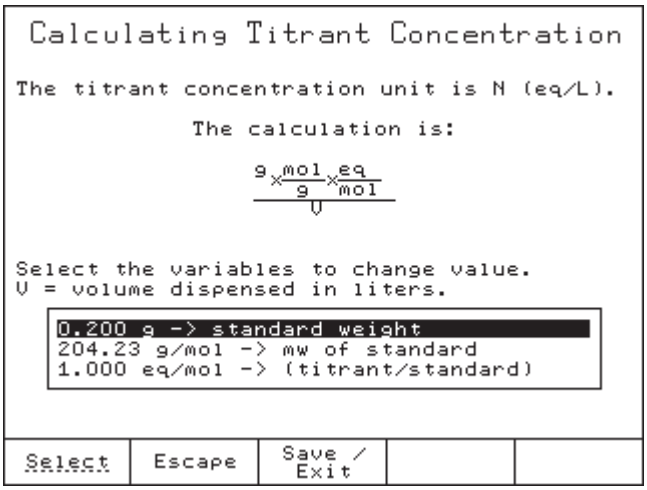
Some variables can be set according to the amount of sample and titrant used.

Standardize Titrant by Weight

This calculation should be used when the titrant is standardized (concentration determination) using a solid standard. Determination of the titrant concentration is based on the primary standard weight (in grams).



The titrator will provide the calculation based on the titrant unit selected.



Standardize Titrant by Volume

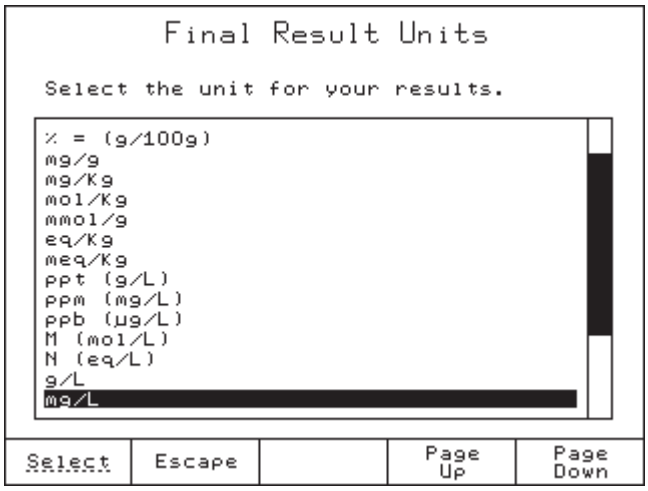
This calculation should be used when the titrant is standardized (concentration determination) using a standard solution. Determination of the titrant concentration is based on the primary standard volume (in milliliters).
The titrator will perform the calculation based on the titrant unit selected.

Generic Formula

This option allows the user to define their own calculation formula of the final analyte concentration in a solid or liquid sample. The variables can be set to reach any final result from the list below:

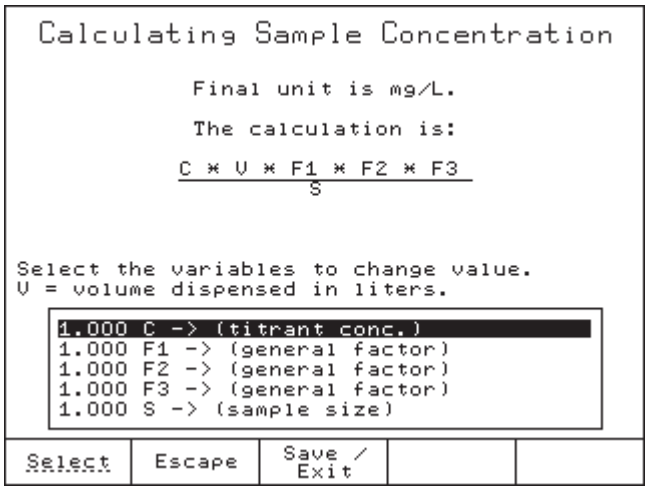
ppt (g/Kg)	(parts per thousand; grams/kilogram)
ppt (g/L)	(parts per thousand; grams/liter)
ppm	(parts per million; milligrams/kilogram)
ppm (mg/L)	(parts per million; milligrams/liter)
ppb	(parts per billion; micrograms/kilogram)
ppb (µg/L)	(parts per billion; micrograms/liter)
% = g/100 g	(percentage in weight; grams/100 grams)
M (mol/L)	(Molarity; moles/liter)
mg/g	(milligrams/gram)
N (eq/L)	(Normality; equivalences/liter)
mg/Kg	(milligrams/kilogram)
mg/L	(milligrams/liter)
mol/Kg	(moles/kilogram)
µg/L	(micrograms/liter)
mmol/g	(millimoles/gram)
eq/Kg	(equivalences/kilogram)
mmol/L	(millimoles/liter)
meq/Kg	(milliequivalences/kilogram)
mg/mL	(milligrams/milliliter)
g/100 mL	(grams/100 milliliters)

eq/L	(equivalences/liter)
meq/L	(milliequivalences/liter)



The formula can be used either for titrant standardization or for sample analysis.

$$\frac{C*V*F1*F2*F3}{S}$$



Where:

- C = the concentration of the titrant
- F1 = general factor
- F2 = general factor
- F3 = general factor
- S = sample size, in grams or milliliters
- V = the volume delivered, in liters, to reach the preset or equivalence end point (determined by the titrator)

Titrant Concentration:

The units for titrant concentration can be:

mol/L	(concentration unit of titrant)
eq/L	(concentration unit of titrant)
g/L	(concentration unit of titrant)
mg/L	(concentration unit of titrant)

One of the general factors should be used as a stoichiometric factor, the other as unit conversion factor and the third as weight conversion factor.

Chemical combination factor:

The chemical combination factor is the chemical combination ratio between the analyte and titrant or standard and titrant.
In the particular case that the combination ratio is expressed in moles, this factor is called the stoichiometric factor.
This factor can be one of the following:

mol/mol	(moles of sample/moles of titrant)
mol/eq	(moles of sample/equivalence of titrant)
eq/mol	(equivalences of sample/moles of titrant)
mol/mol	(moles of titrant/moles of standard)
eq/mol	(equivalences of titrant/moles of standard)

Examples: 2 moles of NaOH react with 1 mole of H_2SO_4

Unit Conversion factor:

Used to convert between various measurement units.

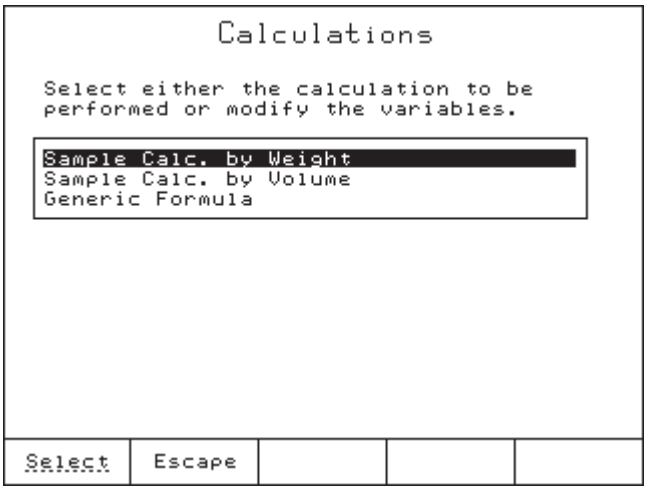
Examples: L/1000 —> mL
g/1000 —> mg

Weight Conversion factor:

Used to convert between weight measurement bases (Kg, g, mg, µg or mole, mmole).

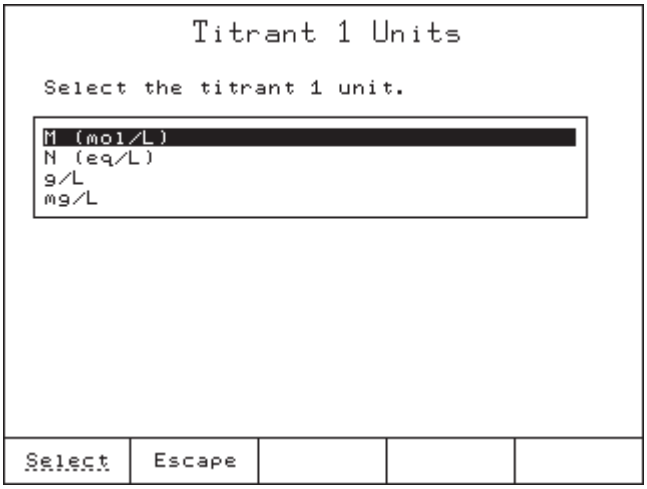
Example: g —> mol

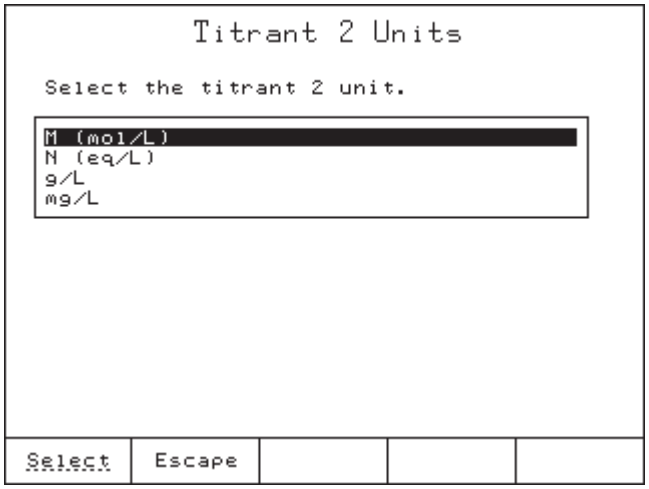
5.5.11.2 Back Titrations (HI 902 only)

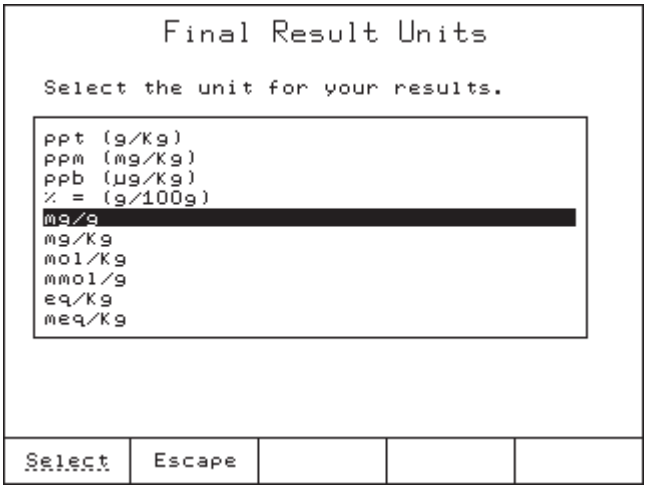


Sample Calculations by Weight

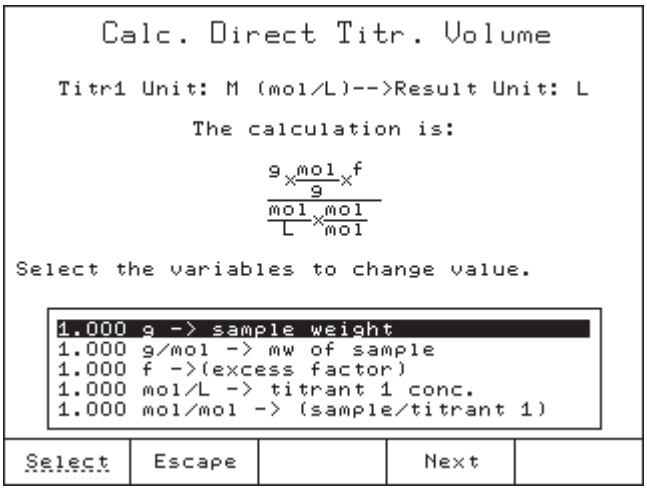
When choosing this formula, select the titrant 1 unit, the titrant 2 unit and then the final result unit.







If the titrant 1 unit is selected as M (mol/L), titrant 2 unit is selected as M (mol/L) and the final result unit as mg/g (milligrams/gram) the following formula is used to calculate the amount of titrant 1 (used in the first stage of back titration or direct titration) and will be as follows:

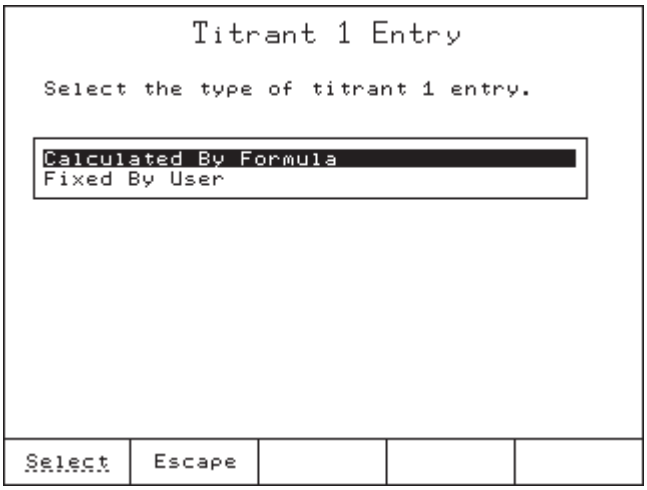


The formula is based on an approximation: the sample concentration is 100% w/w.
With this approximation, the titrator will calculate the volume of titrant 1 needed to consume the sample and multiply it with an excess factor in order to raise or to lower the amount of titrant 1 dispensed.
Some variables can be set according to the amount of sample and titrant 1 used.

When the parameters from the formula are set, press Next to proceed with the next formula used in the back titration algorithm.
If you do not want to use the "Calc. Direct Titr. Volume" formula, then from the ***View / Modify Method*** screen:

- highlight the *Titrant 1 Entry* option, press Select.
- highlight *Fixed Weight or Volume* option and press Select, you will be prompted to type the volume of titrant 1 to be dispensed in the first stage of back titration.

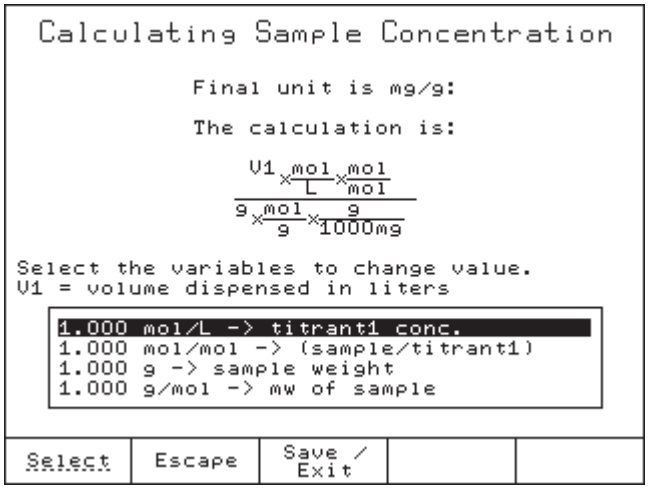
This formula is used to calculate the remaining volume of titrant 1 after the reaction with the sample.



In order to calculate this volume, the remaining titrant 1 volume is titrated (pH/mV equivalence point titration) with titrant 2.
After the excess volume of titrant 1 is calculated, the following formula is used to calculate the exact volume of titrant 1 that was consumed by the sample:

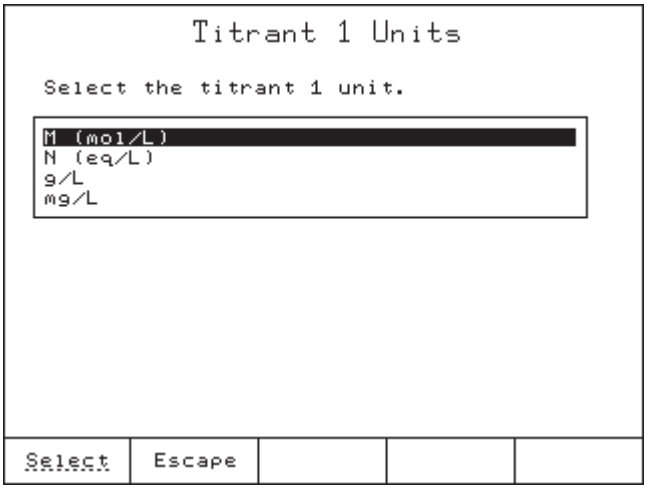
$$V1 = V1tot - V1excess$$

When all the parameters are set, press Next to proceed with the "Calculating Sample Concentration" formula:

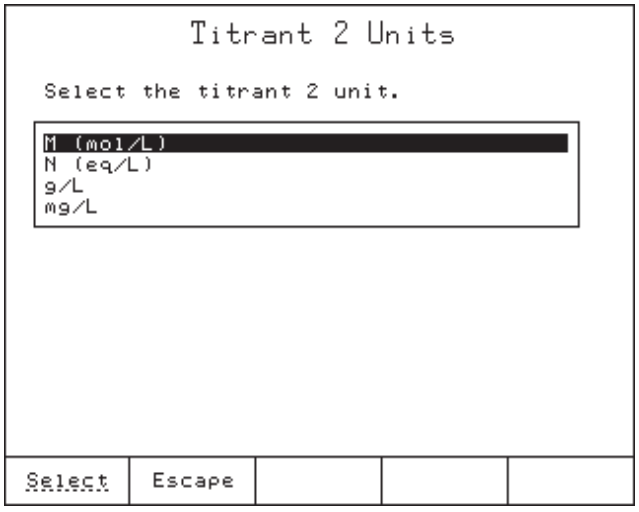


Sample Calculations by Volume

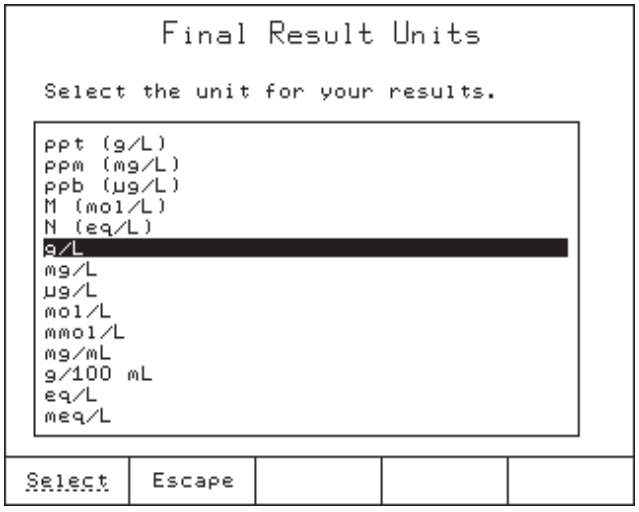
When choosing formula, follow these steps:



⇐ First select the titrant 1 unit

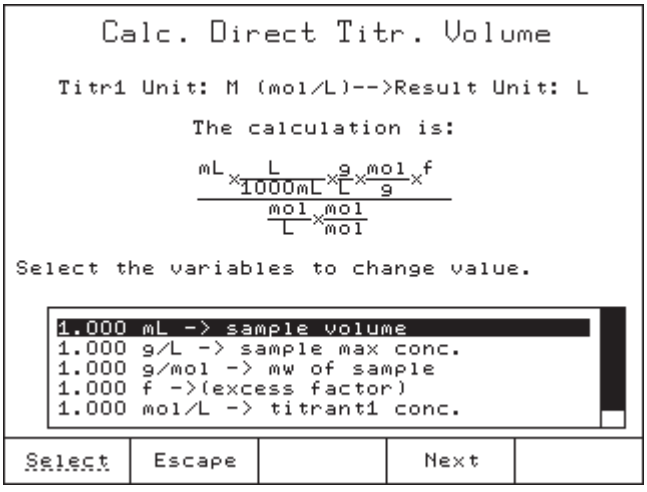


⇐ Select the titrant 2 unit



⇐ Select the final result unit

The titrator will provide the calculation based on the titrants and sample units selected. After you have selected the titrant 1, titrant 2 and the final result units the titrator will display a screen with a formula used to calculate the amount of titrant 1 (used in the first stage of back titration).

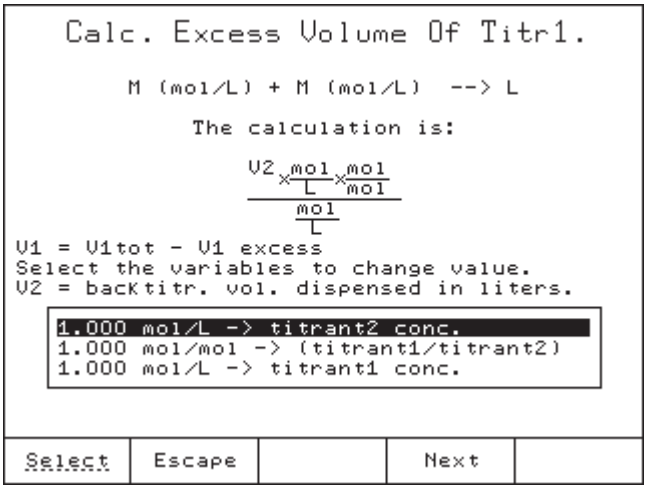


This calculation formula is used as an approximation of the sample concentration (sample max conc.). This formula can be used when we have an expected sample concentration (eg. we know that the sample concentration must be around 1 M (mol/L)).
If we don't have an expected sample concentration, then from the ***View/Modify Method*** screen:

- highlight the *Titrant 1 Entry* option, by pressing Select.
- highlight *Fixed By User* option and press Select, you will be prompted to type the volume of titrant 1 to be dispensed in the first stage of the back titration.

With this approximation, the titrator will calculate the volume of titrant 1 needed to consume the sample and multiply it by an excess factor in order to raise or to lower the amount of titrant 1 dispensed.

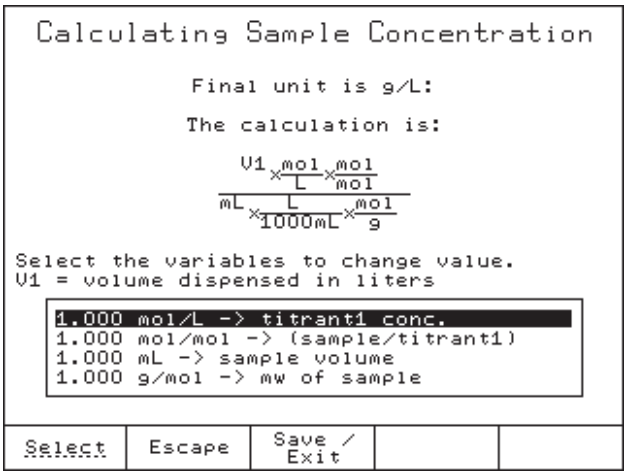
When the parameters from the formula are set, press Next to proceed to the next formula used in the back titration algorithm.
This formula is used to calculate the remaining volume of titrant 1 after the reaction with the sample.



In order to calculate this volume, the remaining volume of titrant 1 is titrated (pH/mV equivalence point titration) with the titrant 2.
After the excess (remaining) volume of titrant 1 is calculated, the following formula is used to calculate the exact volume of titrant 1 that was consumed by the sample:

$$V1 = V1tot - V1excess$$

When all the parameters are set, press Next to proceed with the "Calculating Sample Concentration" formula:

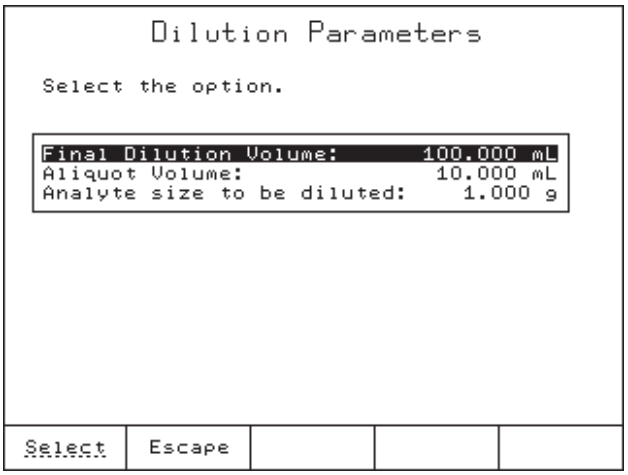


Generic Formula

This option allows the user to define their calculation formula for the "Direct Titration Volume", "Calculating Excess Volume of Titrant 1" and "Final Sample Concentration" in a solid or liquid sample.

5.5.12 Dilution Option

This option enables the dilution calculations to be made (when the initial sample is diluted, the titration is made with an aliquot of the diluted sample).
The calculations are made for the sample weight (volume) in order to express the results for the initial sample.



Final Dilution Volume: The volume of the sample after the dilution process.

Aliquot Volume: The volume of the aliquot (sample volume used for the titration)

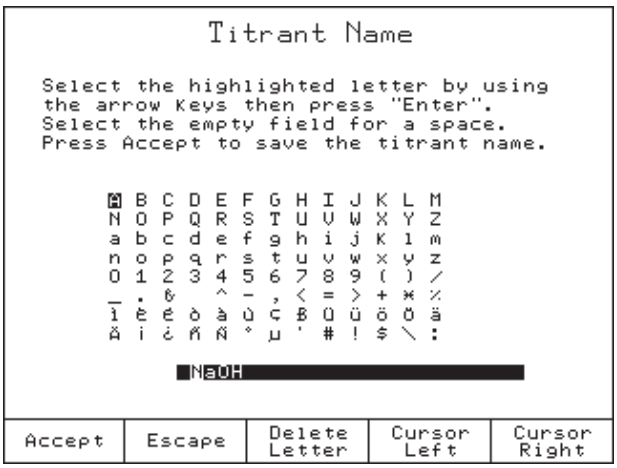
Analyte size to be diluted: The initial sample weight (volume)

The sample size used in the calculations will be:

$$\frac{\text{Analyte size to be diluted * Aliquot Volume}}{\text{Final Dilution Volume}}$$

5.5.13 Titrant Name

Enter the name of the titrant (up to 24 characters). This name will appear in the titration report.



5.5.14 Titrant Concentration

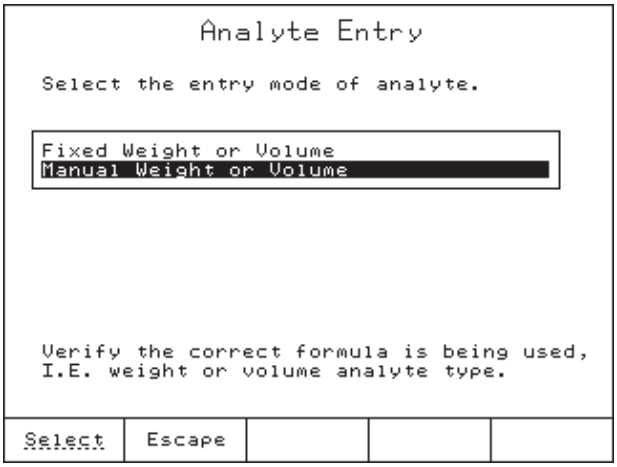
Enter the concentration of the titrant to be used. When determining the titrant concentration only the unit is displayed and the titrant concentration can not be set.

5.5.15 Analyte Size

Enter the size of the sample (for sample concentration determinations) or standard (for titrant concentration determination).

5.5.16 Analyte Entry

With this option select the entry type mode of the analyte.



5.5.16.1 Fixed Weight or Volume

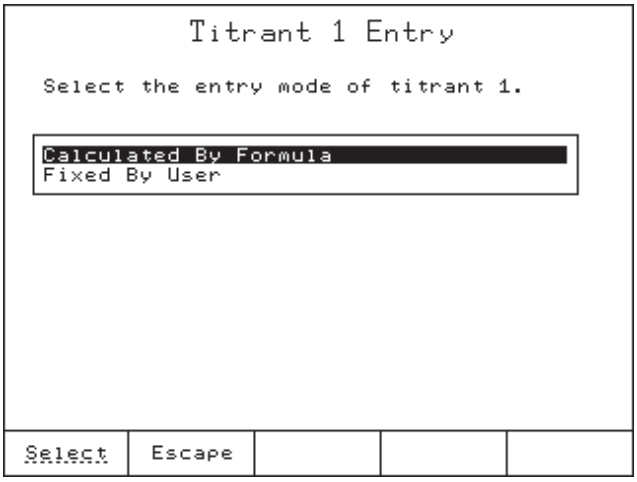
Each titration will use the same analyte weight or volume as preset in the calculations.

5.5.16.2 Manual Weight or Volume

Each titration will use a different analyte weight or volume. The titrator will prompt for the analyte volume at the beginning of each titration.

5.5.17 Titrant 1 Entry (HI 902 only)

Select the mode for evaluating the necessary quantity of titrant 1 used in the back titration process (phase 1).

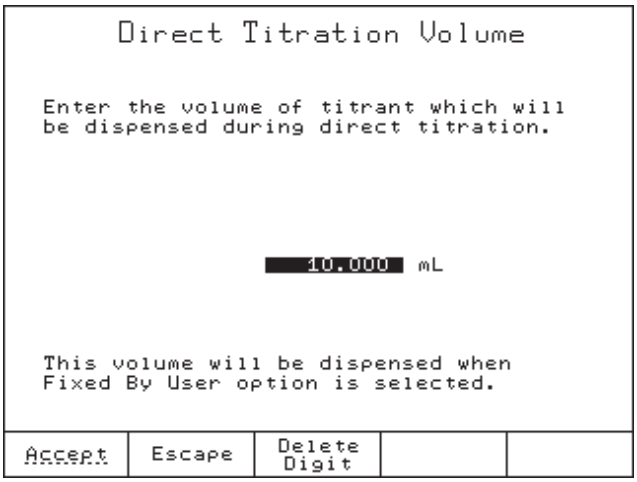


5.5.17.1 Calculated by Formula

The volume of titrant 1 to be dispensed in the phase 1 of back titration will be calculated by formula (see ***Calc. Direct Titr. Volume*** screen on page 5-35).

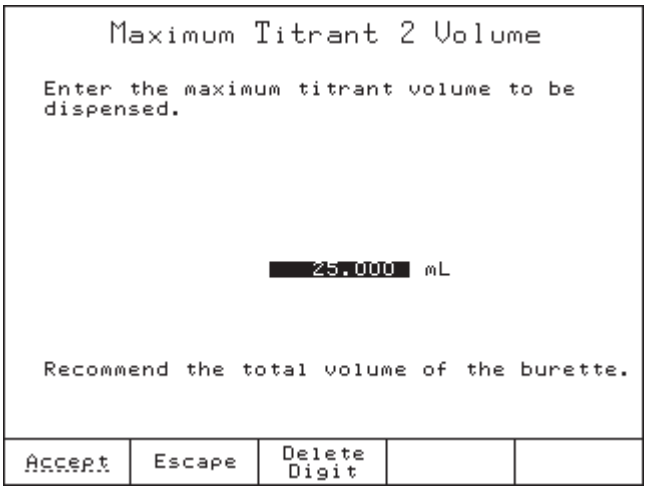
5.5.17.2 Fixed by User

Fixed volume of titrant 1 will be used during the first phase of back titration process (direct titration).



5.5.18 Maximum Titrant Volume

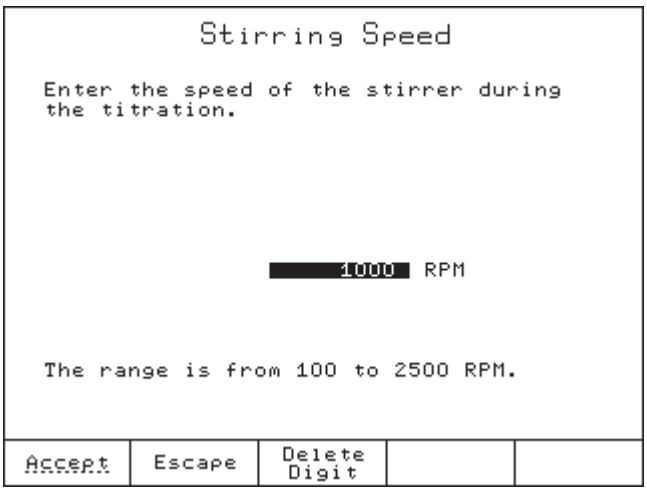
The maximum titrant volume used in the titration must be set according to the analysis. If the titration end point (fixed or equivalence End Point) is not reached, the titration will be abnormally terminated after the maximum titrant volume has been dispensed. The error message ("Limits Exceeded") will appear on the display.



Range is from 0.100 to 100.000 mL.

5.5.19 Stirring Speed

The stirring speed can be set between 100 and 2500 RPM with 100 RPM resolution.

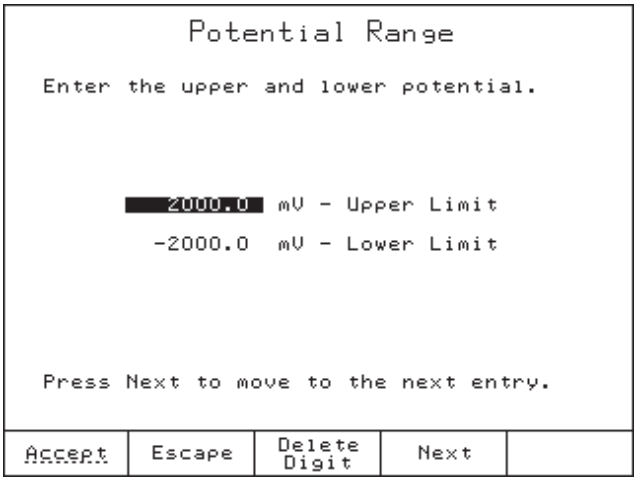


The preset value of stirrer speed from the current method is used during the entire process, as long as the method is set as active.

Also, the speed can be adjusted using the △ and ▽ keys when the stirrer is on.

5.5.20 Potential Range

The allowable input potential range can be set by the user. Outside of these limits, if the titration is in progress, the titration will be abnormally terminated and an error message will appear.
These limits provide protection against a titration that does not generate an end point due to potential over-range.

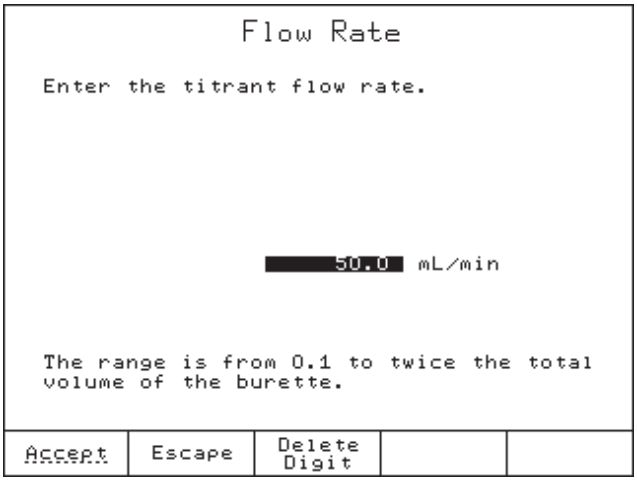


The ranges must be set within -2000.0 to 2000.0 mV.

5.5.21 Volume/Flow Rate

The flow rate for the dosing system can be set by the user in an interval of 0.1 to twice the total burette volume, as follows:

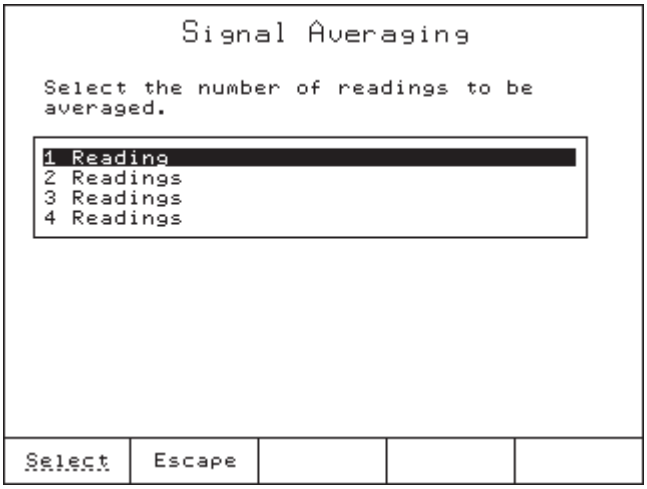
0.1 to	10 mL/min	for a 5 mL burette
0.1 to	20 mL/min	for a 10 mL burette
0.1 to	50 mL/min	for a 25 mL burette
0.1 to	100 mL/min	for a 50 mL burette



Note: *The titrator automatically detects and displays the burette size.*
The flow rate is set for all burette operations.

5.5.22 Signal Averaging

This option enables or disables a filtering on the mV/pH reading.
If *1 Reading* is selected, the filtering is disabled. Otherwise, the titrator will take the last reading and place it into a "moving window" along with the last 2, 3 or 4 readings (depending on the selected option). The average of those readings is displayed and used for calculations.



Averaging more readings is helpful when a noisy signal is received from the electrode.

5.6 Printing

To print method parameters, press Method Options from the main screen.

Press Print Method and wait a few seconds until the printer completes the job.
If no printer is connected to the dedicated socket, or if the printer is offline, an error message will appear on the display (see *9.3.3 Connecting a Printer* section, for information about connecting a printer to the titrator).

Chapter 6. Contents

6 TITRATION MODE

6.1 Titration Start

Before beginning to perform a titration make sure that the following conditions are met:

- A pump is properly installed and selected as active.
- A burette is inserted in the pump and filled with titrant.
- The aspiration tube is inserted in the titrant bottle and the dispensing tube is over the analyte beaker.
- The electrode and the temperature probe is inserted in the analyte beaker.
- The desired method is selected as active and the parameters are set at optimum values.

6.1.1 In Progress Titration

To start a new titration, press start/stop from the main screen.
When a titration begins:

- The stirrer will turn on (if detected and enabled).
- If the pre-stirring time option is enabled, the sample will be stirred until the prescribed time elapses (see *5.5.6 Pre-Titration Stir Time).*
- If the pre-titration volume option is enabled, the prescribed volume will be dispensed (see *5.5.5 Pre-Titration Volume).*
- According to the *Measurement Mode* and the *Dosing Type* option, the titrator will start to deliver doses until the titration end point are detected or a titration stop condition occurs.

6.1.2 Suspend Titration

While titration is in progress, you can temporarily stop it by pressing Suspend. All the titration parameters will be frozen.

You can continue the titration by pressing Resume.

6.1.3 On-line Graph

During a titration, both the potentiometric S-shaped curve and the selected derivative curve (titration with equivalence point only) can be displayed on the ***Titration Graph*** screen, by pressing View Curve. The titration ID report is also displayed inside the graph window.

The S-shaped curve and the derivative curve are scaled to fit simultaneously inside the display. Also, when the titration is normally terminated (end point detected successfully), the end point volume value marked with a cross is displayed on the graph.

The contents of the graph as related to an end point type, is as follows:

Equivalence End Point (pH) - the pH curve and the selected derivative vs volume is displayed. (see Figure 1)

Equivalence End Point (mV) - the mV curve and the selected derivative vs volume is displayed. (see Figure 2)

Fixed End Point (pH) - only the pH vs volume curve is displayed. (see Figure 3)

Fixed End Point (mV) - only the mV vs volume curve is displayed. (see Figure 4)

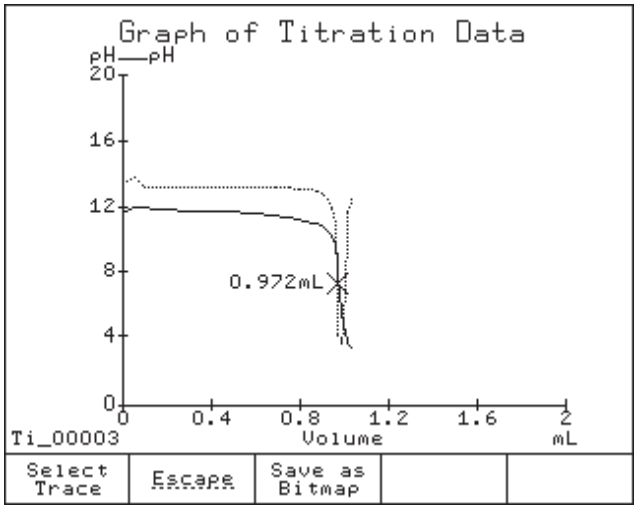


Figure 1

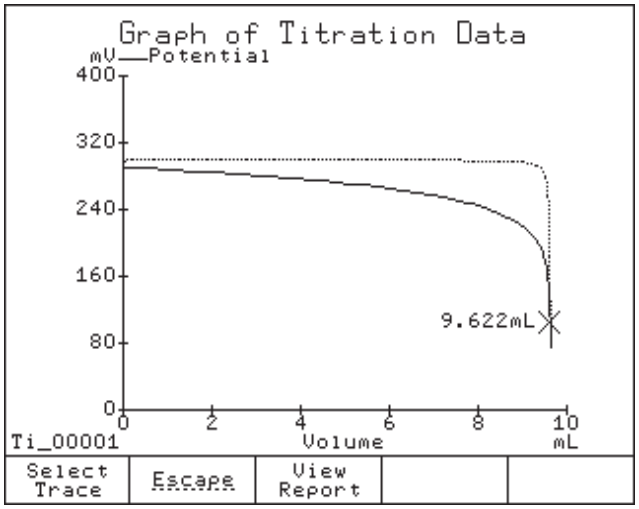


Figure 2

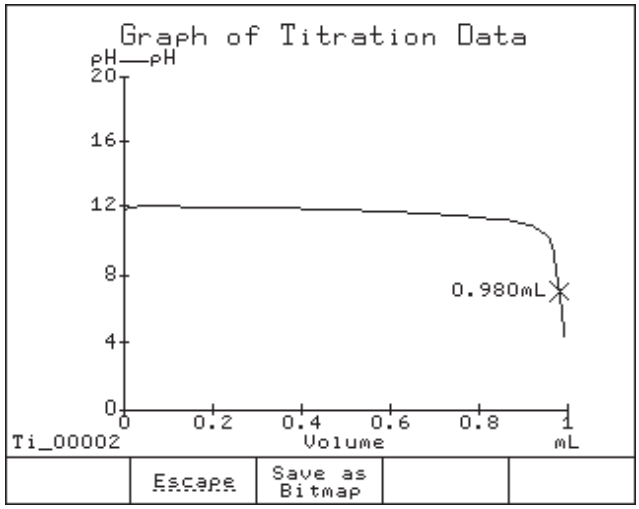


Figure 3

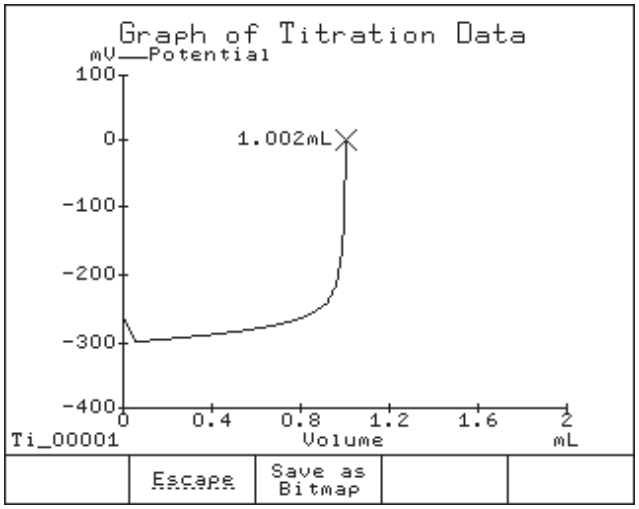


Figure 4

Select Trace - allows you to view on the ordinate axis a plot of either the mV (or pH) values or the selected derivatives values (of mV or pH). Available only for titrations with equivalence end points.

Save as Bitmap - allows you to save the graph as a bitmap file. Available only when the titration is finished (after end point detection).

6.2 Titration Stop

The titration can be finished in one of the modes described below:

- **Titration Completed.** The titration was successfully terminated (with end point successfully detected). This is the only mode with valid final result values.
- **Manually Terminated.** The current titration was manually terminated before end point detection was achieved.
- **Limits Exceeded.** The preset maximum titrant volume was delivered without reaching the end point. The titration is stopped with an error message.
- **Critical Error.** A critical error occurred and the titration was stopped. These errors are normally related to the dosing system. The titration is stopped with a specific error message.
- **Potential Out of Range.** The measured values from the input sensor are outside the preset range (potential range). The titration is stopped with an error message.

Chapter 7. Contents

7 pH & mV MODE

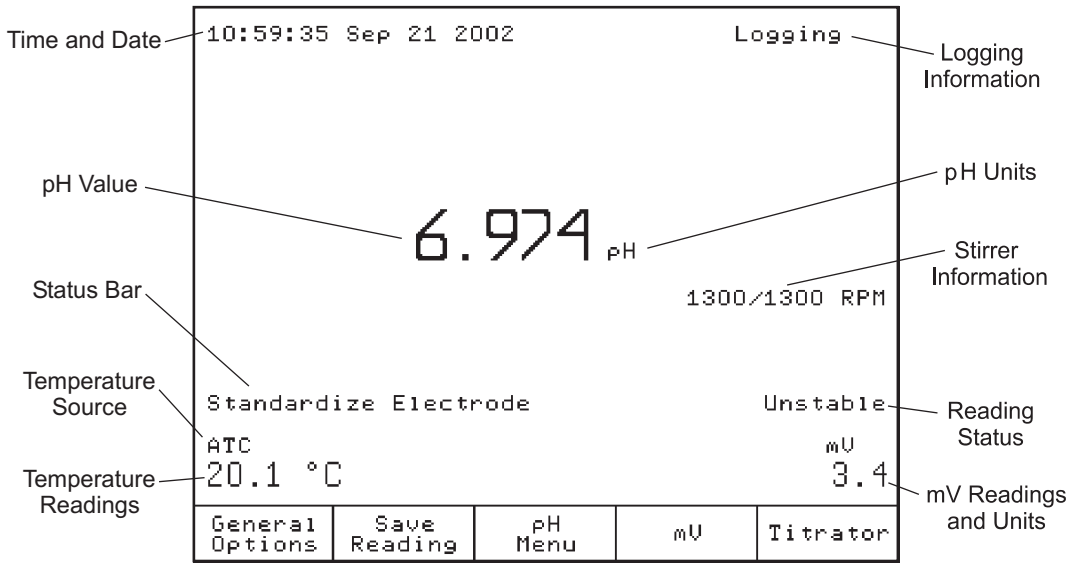
The HI 901 / HI 902 titrators can be used to log precise pH or mV measurements.
By pressing pH/mV from the main screen, the titrator will switch to the ***pH*** or ***mV*** screen (depending on the *End Point Mode* option selected from ***View / Modify Method*** screen).

7.1 pH Mode

7.1.1 Display

The ***pH*** screen shown below will help you understand the following explanations.

pH Mode Option keys:



General Options — Brings you to the ***General Options*** screen (for more details, see Chapter *4 General Options*).

Save Reading — Stores the current pH reading (see section *7.3.2 Manual* logging).

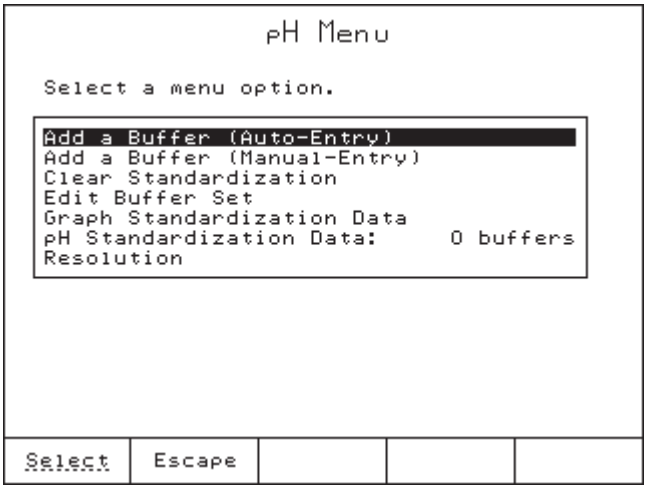
pH Menu — Displays the setup options for pH (see section *7.1.2 pH Menu*).

mV — Switches to the ***mV*** screen.

Titrator — Return to the main screen.

7.1.2 pH Menu

Options from this screen (except the *Resolution* option) refer to the pH electrode calibration functions.

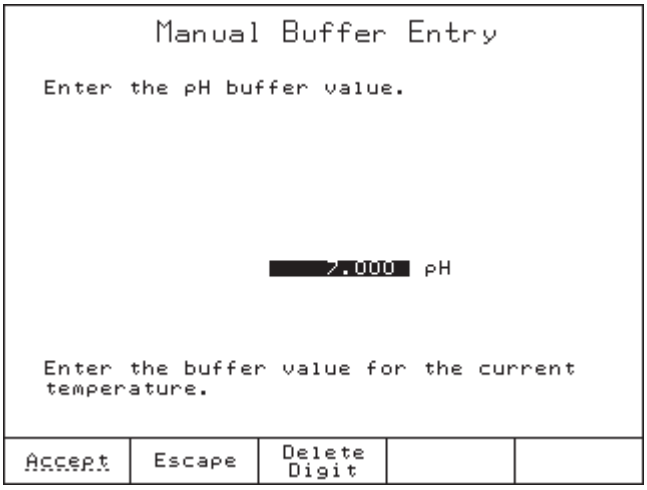


7.1.2.1 Add a Buffer (Auto-Entry)

Add a new buffer (up to 5 buffers can be added) or replace an existing one from the electrode standardization table. The buffer is now automatically recognized and temperature compensated from the created buffer list (see section *7.1.2.4 Edit Buffer Set*).
The titrator accepts electrode's slope between 80 to 105%.

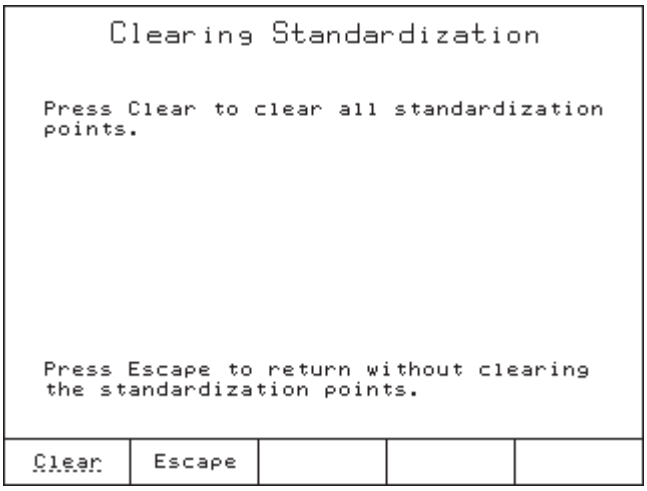
7.1.2.2 Add a Buffer (Manual-Entry)

The user can add a custom buffer to the calibration list. The titrator will prompt for the custom buffer value. The buffer value entered should be correlated with the expected temperature value. The range is from –2.000 to 20.000 pH.
The titrator accepts electrode's slope between 80 to 105%.



7.1.2.3 Clear Standardization

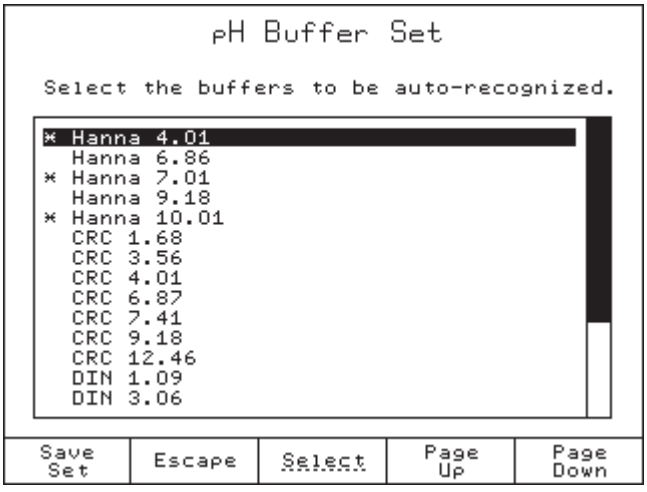
Deletes electrode standardization. The titrator will prompt for confirmation.



7.1.2.4 Edit Buffer Set

Creates a unique, auto-recognized buffer set. The new calibration standard buffer will be checked from the set described below.
Available buffers include:

Hanna: 4.01, 6.86, 7.01, 9.18, 10.01
CRC: 1.68, 3.56, 4.01, 6.87, 7.41, 9.18, 12.46
DIN: 1.09, 3.06, 4.65, 6.79, 9.23, 12.75
NIST: 4.01, 6.86, 7.42



To select a buffer from the list, highlight the desired buffer and press Select to add it to the buffer set. The selected buffers are marked with an asterisk.

Note: *Although any combination of buffers may be selected, their values should be at least 1.5 pH units apart.*

7.1.2.5 Graph Standardization Data

Graphs the electrode standardization data (pH vs mV).

7.1.2.6 pH Standardization Data

Displays the electrode standardization data in a tabular form.

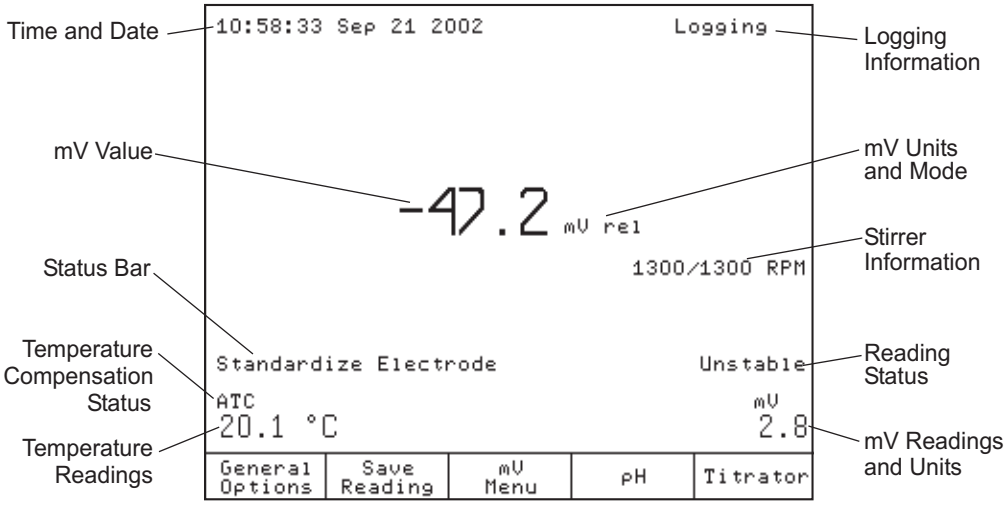
7.1.2.7 Resolution

You can choose between 0.1, 0.01 and 0.001 resolution for the displaying pH values.

7.2 mV Mode

7.2.1 Display

The ***mV*** screen shown below will help you understand the following discussion.



mV Mode Option Keys:

General Options — Brings you to the ***General Options*** screen (for more details, see Chapter *4 General Options*).

Save Reading — Stores the current mV reading (see section *7.3.2 Manual* logging).

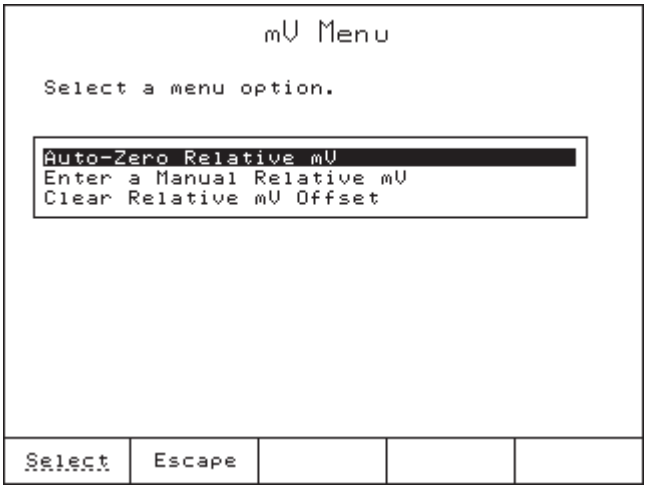
mV Menu — Displays the setup options for mV (see section *7.2.2 mV Menu*).

pH — Switches to the ***pH*** screen.

Titrator — Return to the main screen.

7.2.2 mV Menu

By pressing mV Menu, the following screen will be displayed:



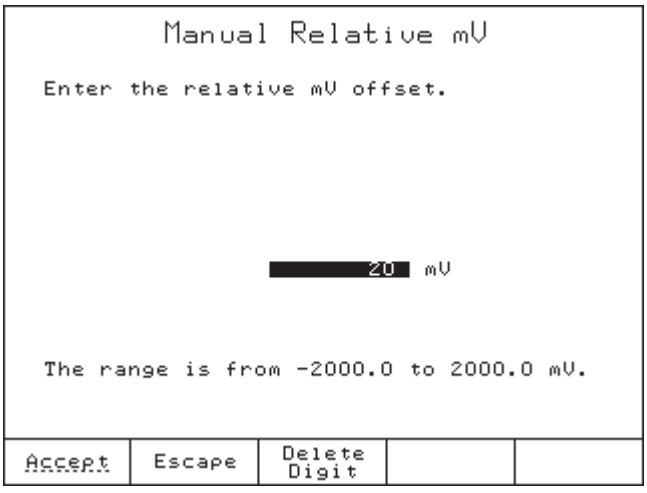
7.2.2.1 Auto-Zero Relative mV

This sets the relative potential to zero by saving the current potential and subtracting it from subsequent readings.
If an absolute zero is needed, replace the electrode with a shorting cap before performing this action.

Note: *The auto-zero will affect the mV reading and therefore the pH value (new displayed relative mV reading will be used to calculate the new pH value).*

7.2.2.2 Enter a Manual Relative mV

Allows to enter the mV offset . The range is from –2000.0 to 2000.0 mV.
The set value is subtracted from the actual readings from electrode.
In this case, the actual readings are displayed in the mV readings field and "rel" icon is displayed near the mV units.



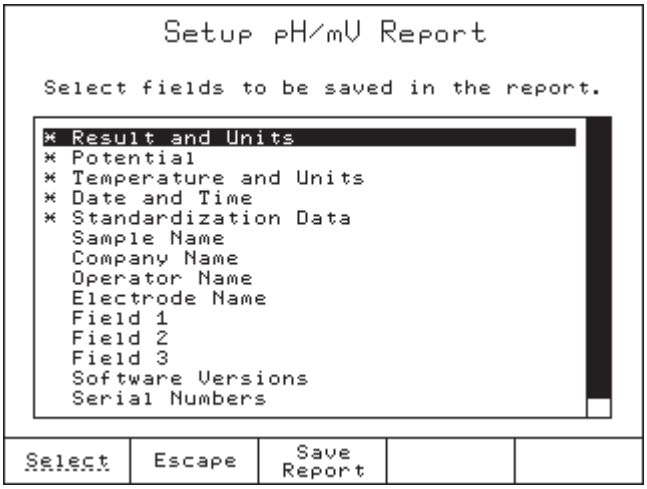
7.2.2.3 Clear Relative mV Offset

Sets the mV offset to zero. With this option, the previous relative value or auto zero is cleared.

7.3 Logging

When in pH or mV mode, logging can be either manual or automatic.
Before starting an automatic or manual logging operation, please customize a unique report for the saved pH and mV measurements, as follows:

- From the ***pH*** or ***mV*** screen, press [results] to display the ***Data Parameters*** screen.
- Highlight the *Setup pH/mV Report* option and press [Select] to display the ***Setup pH/mV Report*** screen.

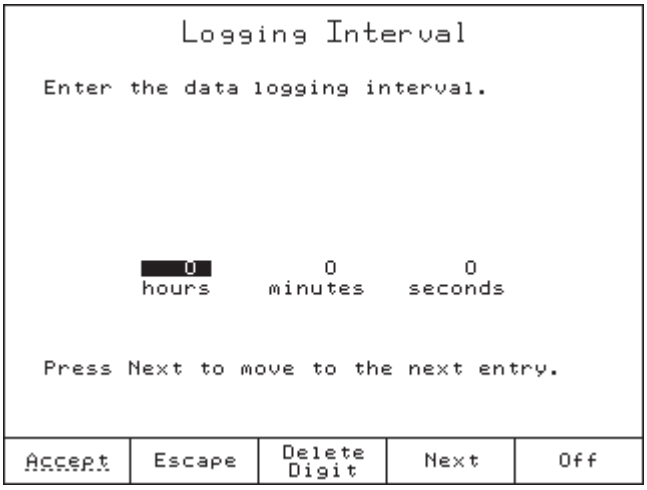


- Use the △ and ▽ keys to highlight the data field that you want to show/hide in the pH/mV report and then press [Select] to activate/deactivate it.
- Each field marked by "*" is an active field selected for the report.
- Press [Save Report] to save the customized report.

7.3.1 Automatic Logging

To start automatic logging pH or mV readings, follow these steps:

- From the ***pH*** or ***mV*** screen, press [results] to display the ***Data Parameters*** screen.
- Highlight the *Logging Interval – pH/mV* option and press [Select] to display the ***Logging Interval*** screen.



- Enter the time interval between each consecutive record.

  The time between records can be set in the following range:

Hours	0 to 8
Minutes	0 to 59
Seconds	0 to 59

- Press [Accept] and then [Escape] to save the setting and return to the ***pH*** or ***mV*** screen.
- Press [start/stop] to start auto-logging.

The logging interval and name of logging file will be also displayed on the ***pH*** or ***mV*** screen. To stop the automatic logging, press [start/stop] again.

7.3.2 Manual Logging

To manually log pH or mV readings, press [Save Reading] from the ***pH*** or ***mV*** screen.
A new record will be added to the logging file every time [Save Reading] is pressed.

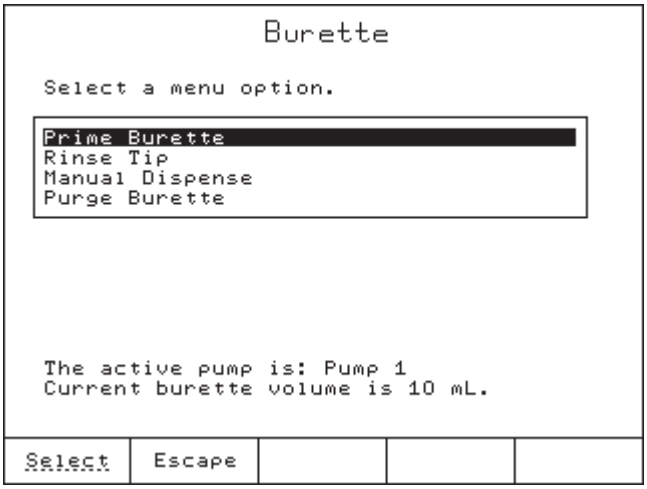
Chapter 8. Contents

8 AUXILIARY FUNCTIONS

8.1 Burette

To access the ***Burette*** screen, press [Burette] from the main screen.

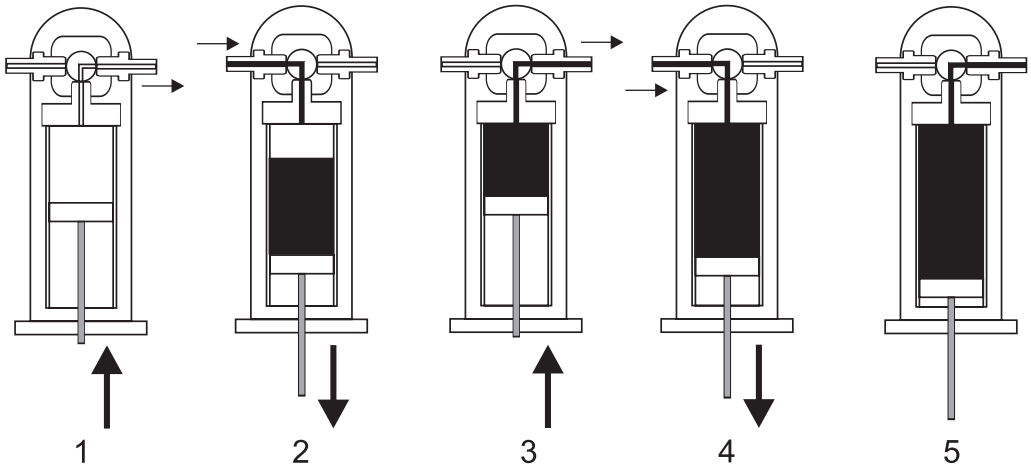
Highlight the desired option and then press [Select].



8.1.1 Prime Burette

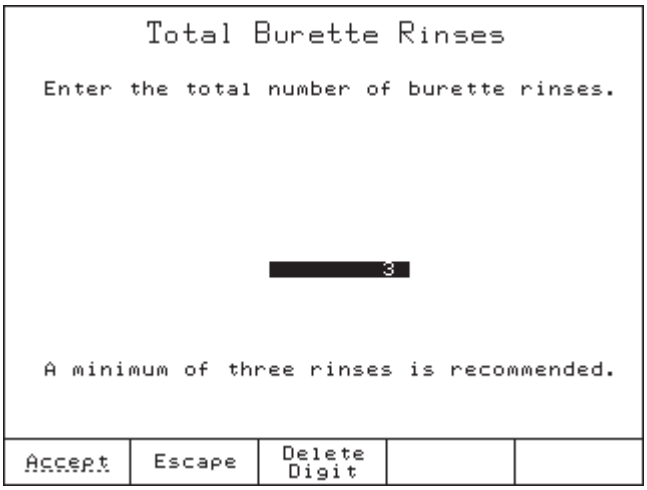
The *Prime Burette* option is used to mechanically fill the burette before starting a set of analysis.

Two rinses cycles of burette are shown in the figure below. The dispensing tube is connected on the right side and the aspiration tube on the left side.



Note: *Before starting this operation, the aspiration tube must be inserted in the titrant bottle.*

To prime the burette, select *Prime Burette* from the ***Burette*** screen. Enter the number of rinses and press Accept.



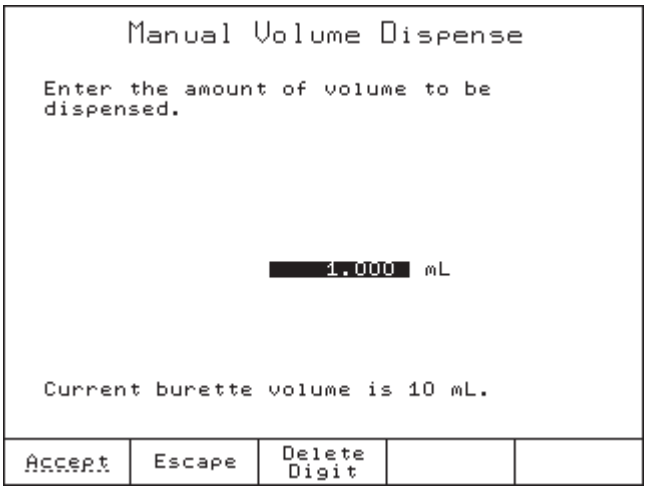
The number of burette rinses can be set between 1 and 5 (we recommend at least three rinses to assurre that the air bubbles are completely removed).

8.1.2 Rinse Tip

A 2 mL dose of titrant will be dispensed from the burette when this operation is started. This operation will eliminate the air from the dispensing tip.

8.1.3 Manual Dispense

Using the *Manual Dispense* option, a defined titrant volume can be dosed. Select the *Manual Dispense* option and press Select. The ***Manual Volume Dispense*** screen will become active and the display will prompt you to enter the desired volume to be dispensed.



The manual dispense volume must be between the limits shown bellow:

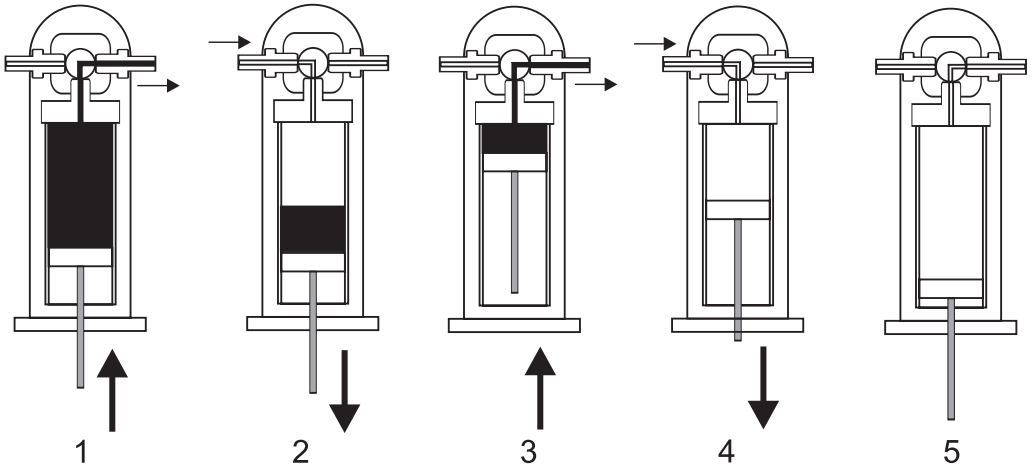
0.001 to 4.500 mL for a 5 mL burette
0.001 to 9.000 mL for a 10 mL burette
0.005 to 22.500 mL for a 25 mL burette
0.005 to 45.000 mL for a 50 mL burette

8.1.4 Purge Burette

This option allows titrant evacuation before cleaning and/or storing the burette. The burette is flushed twice.

Note: *Before starting this operation, remove the aspiration tube from the titrant bottle.*

The figures below show the steps in a purge burette operation.

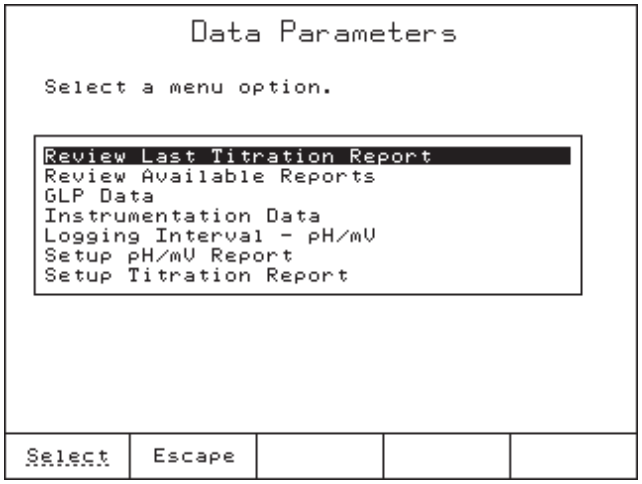


8.2 Stirrer

The stirrer can be started and stopped by pressing [stir].
The stirring speed is set within the active methods (see section *5.5.17 Stirring Speed*).
During the process, the stirring speed can also be manually adjusted by using the △ and ▽ keys.

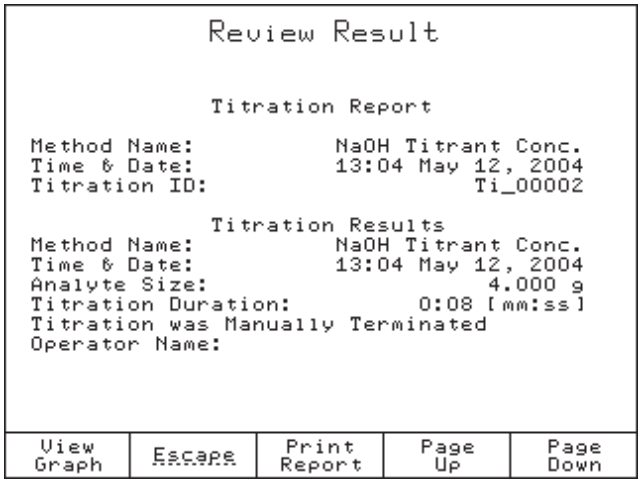
8.3 Results

The ***Data Parameters*** screen contains options regarding data parameters from the titrator, as follows:



8.3.1 Review Last Titration Report

Selecting this option, the last titration data can be reviewed.
The last titration report file can be displayed or printed. Also, the titration graph can be reviewed by selecting View Graph.



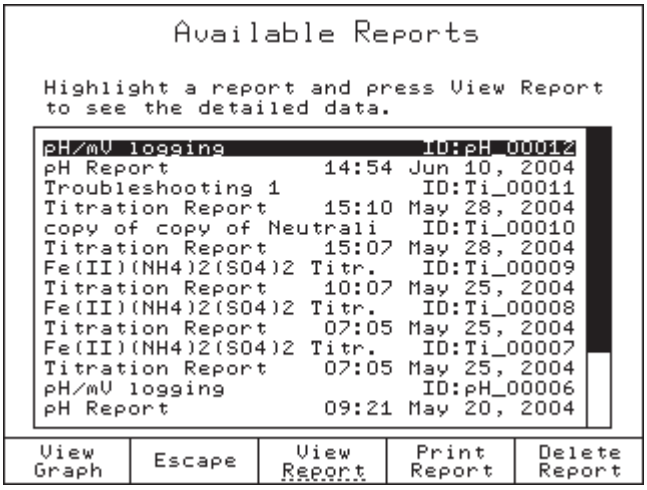
The information that can be reviewed in the report is based on the selections made in the ***Setup Titration Report*** screen.
The following option keys are available:

View Graph — Allows review of the last performed titration graph. The pH (or mV) versus titrant volume curve can also be displayed. Also, if the *Equivalence End Point* option was selected, the pH (or mV) curve and selected derivative curve *(*1st derivative, 2nd derivative) versus titrant volume are simultaneously displayed. Pressing Select Trace will change the vertical axes scale units.

Print Report — Allows printing the report to the printer.

8.3.2 Review Available Reports

Up to 100 reports can be recorded on the titrator. To view one of the recorded reports highlight a report and then press View Report.

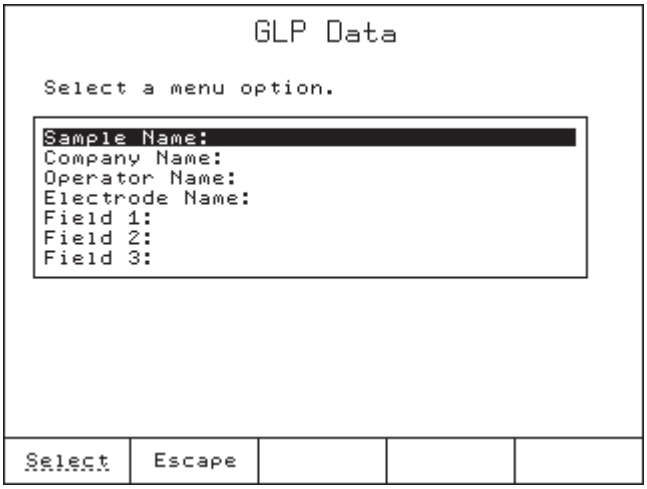


All the reports stored in the titrator (titration and pH/mV reports) can be reviewed and printed. The report contains only the information selected in the ***Setup Titration Report*** and ***Setup pH/mV Report*** screens during report configuration.
The keys are the same as in the previous section *(8.3.1 Review Last Titration Report)*.

Delete Report Allows you to delete the selected report.

8.3.3 GLP Data

Enter up to 20 alphanumeric characters for each option from ***GLP Data*** screen.



Sample Name - Allows the sample name to be recorded in each report. The sample name will increase by one, with each new titration or logging report, if the last character is a number.

Company Name: - Allows the company name to be recorded in each report.

Operator Name - Allows the operator name to be recorded in each report.

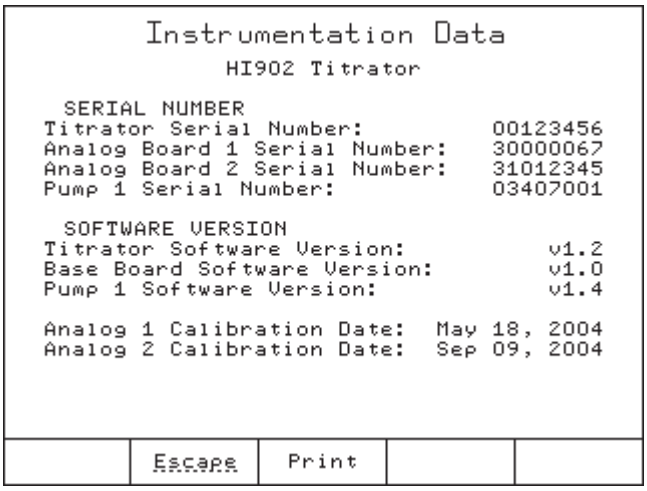
Electrode Name - Allows the electrode name to be recorded in each report.

Fields 1, 2, 3 - Allows any additional information to be recorded in each report.

The fields that must be present in the Titration Report must be selected from the ***Setup Titration Report*** screen (see *8.3.7 Setup Titration Report* section).

8.3.4 Instrumentation Data

Displays titrator configuration data.



Titrator Serial Number: Indicates the serial number of the titrator base board.

Analog Board 1 Serial Number: Indicates the serial number of the titrator analog board 1.

Analog Board 2 Serial Number: Indicates the serial number of the titrator analog board 2.

Pump 1 (and/or 2) Serial Number: Indicates the serial number of each connected pump.

Titrator Software Version: Indicates the current software version installed on the titrator.

Base Board Software Version: Indicates the current software version present on the base board of the titrator.

Pump 1 (and/or 2) Software Version: Indicates the current software version of the pumps.

Analog 1 Calibration Date: Indicates manufacturer calibration date of analog board 1.

Analog 2 Calibration Date: Indicates manufacturer calibration date of analog board 2.

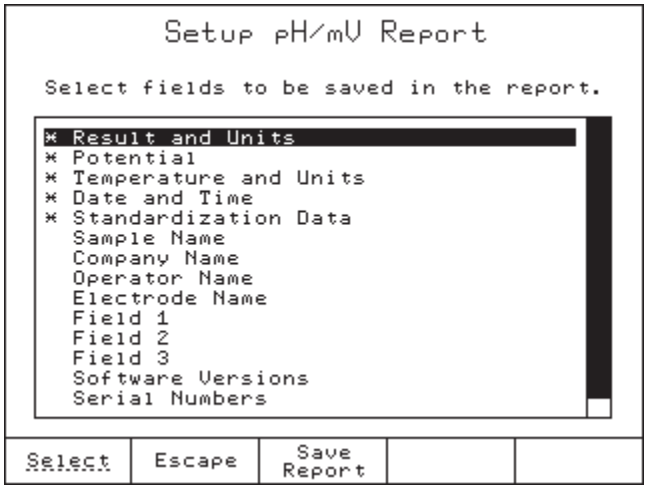
Note: *If more than 1 year elapsed from the calibration date of the analog board 1 or 2, the message* **Analog 1 Calibration Due** *or* **Analog 2 Calibration Due** *will appear on the main screen and analog board recalibration must be performed.*

8.3.5 Logging Interval – pH/mV

Allows the user to setup a time interval for auto-logging while in pH or mV mode (see *7.3 Logging* section).

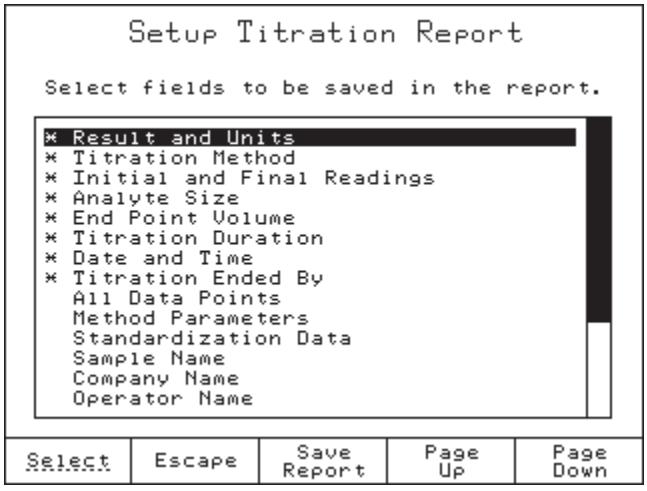
8.3.6 Setup pH/mV Report

Customize a unique report to record the pH and mV measurements.



8.3.7 Setup Titration Report

Customize a unique report to record the titration results. An asterisk means that it will be included in the titration report.



Chapter 9. Contents

9 MAINTENANCE, PERIPHERALS

9.1 Burette Maintenance

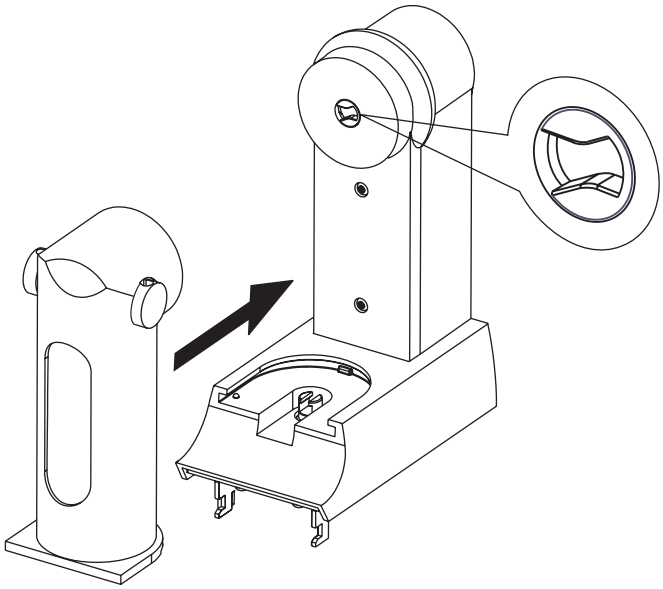
9.1.1 Burette Assembly

The included burette is delivered with a 25 mL syringe inside and with all the accessories mounted (see *2.1 Unpacking* section for burette assembly details).

Note: *The dispensing tube has one flat-shaped end and the other one is equipped with a dispensing tip. (See 2.1 Unpacking section for the accessories list.)*

9.1.2 Changing Burette

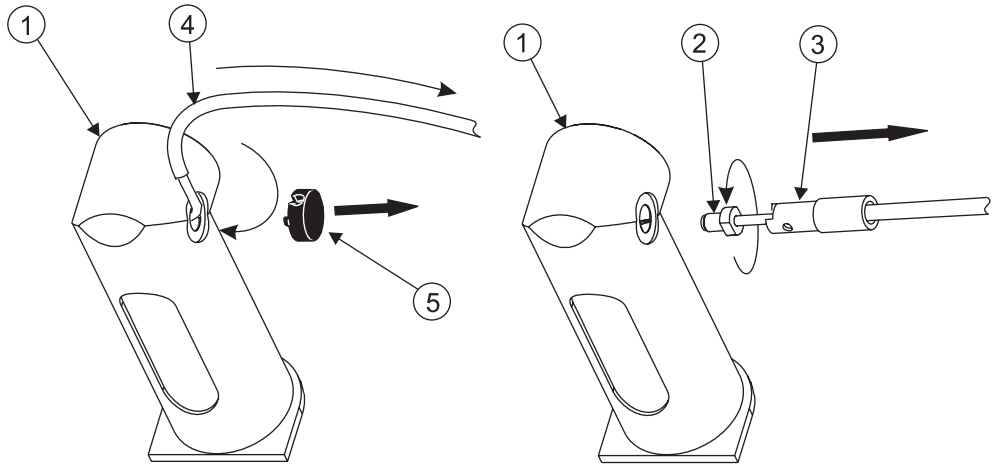
Remove the burette from the pump assembly by sliding it back and then slide the new burette into place (see the picture below).



9.1.3 Disassembling Burette

To dismount the dispensing tube and the aspiration tube follow these steps:

- Slide up the protection tube (4).
- Remove the tube lock (5) from the burette holder.
- Slide the mounting tool (3) over the dispensing tube.
- Unscrew the fitting (2).
- Remove the mounting tool (3) from the tube.
- Remove the tube.
- Repeat these steps for the aspiration tube.



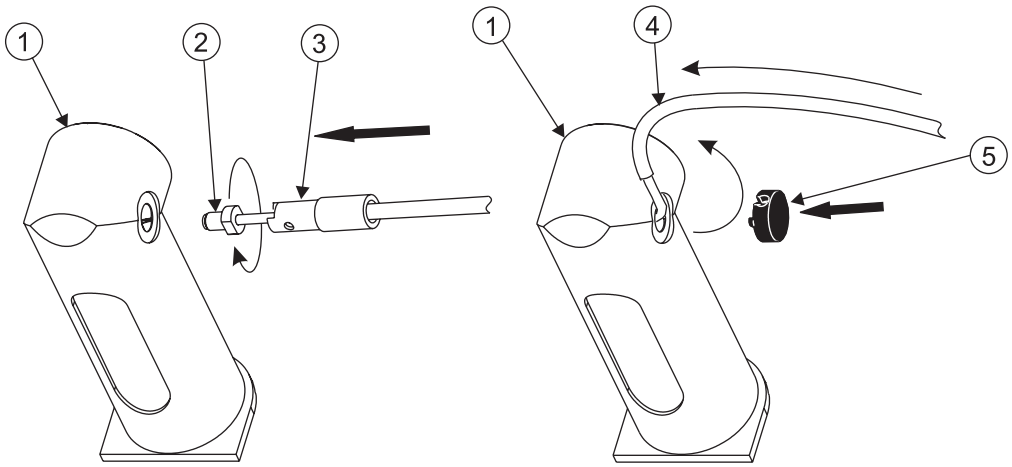
9.1.4 Assembling Burette

Both, the aspiration and the dispensing tube have a fitting and a protection tube. The aspiration tube will be mounted in the left side and the dispensing tube will be mounted in the right side of the burette (see diagram on the next page).

To attach the dispensing tube and the aspiration tube follow these steps:

- Slide the mounting tool (3) over the dispensing tube.
- Insert the flat-shaped end of the dispensing tube into the valve outlet.
- Screw in the fitting (2) with the mounting tool.
- Remove the mounting tool (3) from the tube.
- Bend the tube up into a vertical position.
- Press the tube lock (5) into the burette hole.
- Slide down tightly the protection tube (4) into the dedicated gap of the tube lock.
- Repeat these steps for the aspiration tube.

To attach the burette to the pump simply slide the burette into the pump support as shown in the figure presented in *9.1.2 Burette Changing* section.



9.1.5 Cleaning Burette

To clean the burette, follow these steps:

- If the burette is filled with liquid, remove the aspiration tube from the titrant bottle and execute purge burette operation (see *8.1.4 Purge Burette* section).
- Insert the aspiration tube into cleaning solution and/or into deionized water or titrant solvent, depending on the chemical nature of titrant and the intended use of the burette. If a titration will follow, use titrant solvent to clean the tube.
- Execute prime burette operation to fill the burette (use 2 rinses) (see *8.1.1 Prime Burette* section).
- During second refilling of the burette remove the aspiration tube out of the solvent beaker and allow the air to replace the liquid in the burette. This will clean the aspiration tube.

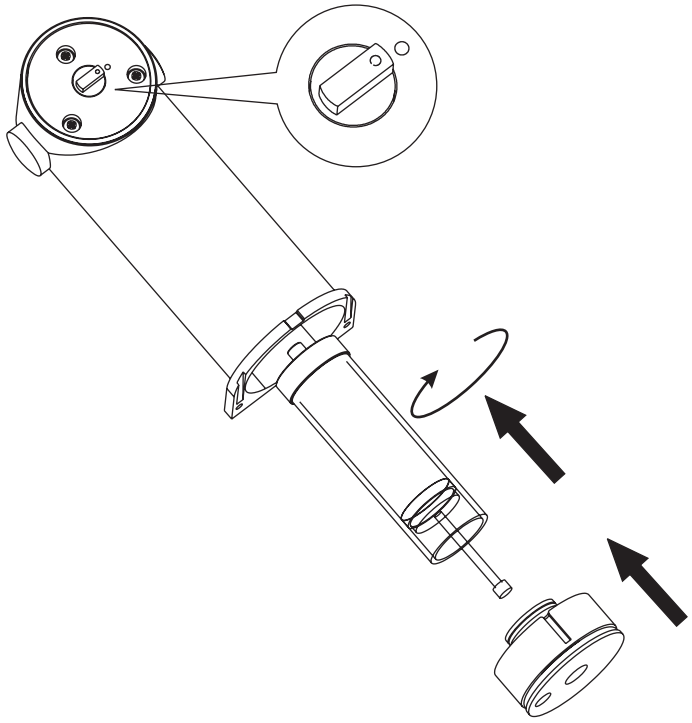
If this simple cleaning procedure is not adequate for the desired purpose, continue with these steps:

- Slide the burette out from the pump assembly.
- Remove the tubes with the special mounting tool (tool for valve fitting and burette cap removal).
- Clean them separately or insert new ones.
- Remove the protective cap from the bottom by using the special tool.
- Remove the protective plastic shield.
- Remove the syringe from the burette assembly by unscrewing it with your fingers.
- Extract the piston from the syringe.

- Clean both the piston and the syringe with appropriate solvents, then with ethylic alcohol and then rinse them several times with deionized water, titrant solvent or just titrant.
- Remove the excess liquid.

Warning: *Avoid contact with the titrant with bare hands.*
Avoid spilling titrant in the working place.
Clean the external side of the syringe and piston to remove aggressive chemicals.
Do not touch the Teflon part of the piston and internal walls of the burette with bare hands or greasy materials.

- Reinsert the piston into the syringe.
- Reinsert the syringe by screwing it in the valve with your fingers.
- Reinsert the protective cap to the bottom of the burette assembly. Carefully position the cap into the burette.
- Slide the burette into the burette stand. Notice the position of the piston shaft to the pump couple.
- A final rinse with titrant is recommended if the cleaning is followed by a titration.



9.1.6 Burette Preparation (Titrant Filling)

Before starting a titration, the burette must be properly filled with titrant in order to obtain a good and repeatable result. To fill the burette, follow the next steps and recommendations:

- If necessary, clean the burette and make sure it is empty.
- From the main screen press Burette.
- Highlight *Prime Burette* option and press Select.
- Enter the number of times the burette needs to be rinsed (minimum three rinses are recommend allowing air bubbles to be evacuated).
- Press Accept.
- Insert the aspiration tube into the titrant bottle only when the piston is going down and has reached about ¼ from the upper end.

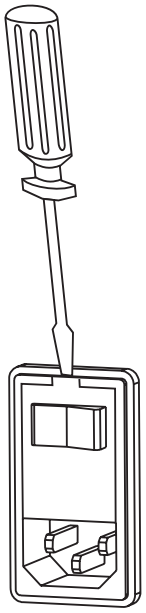
To avoid the presence of the air bubbles inside the burette, make sure to have a continuous liquid flow inside the burette and a little air zone just above the liquid level at the first filling movement. The next upward movement will evacuate the entire air. This way no air will be left in the valve.
Sometimes during the Prime Burette process, slight finger tapping on the tubes is helpful to evacuate captive air bubbles.
If air bubbles are still present:

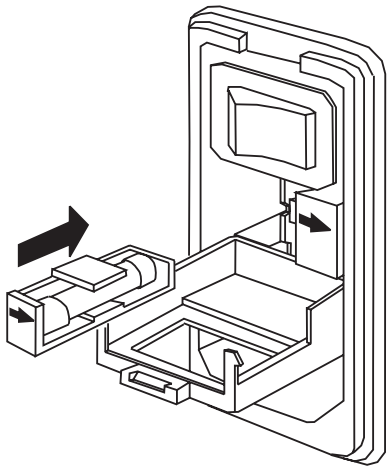
- Remove the aspiration tube from the titrant bottle.
- Repeat burette preparation procedure.
- If no success, clean the burette again.

9.2 Fuses Replacement

To replace the fuses, follow these steps:

- Turn off the titrator.
- Remove the power cord from the power connector located on the rear side of the titrator case.
- With a screw driver open the fuse holder lid.





- Extract the fuse holder.
- Replace the fuses (for recommended fuses replacement please see the label located above the main power switch).
- Close the fuse holder lid.
- Connect the power cord.

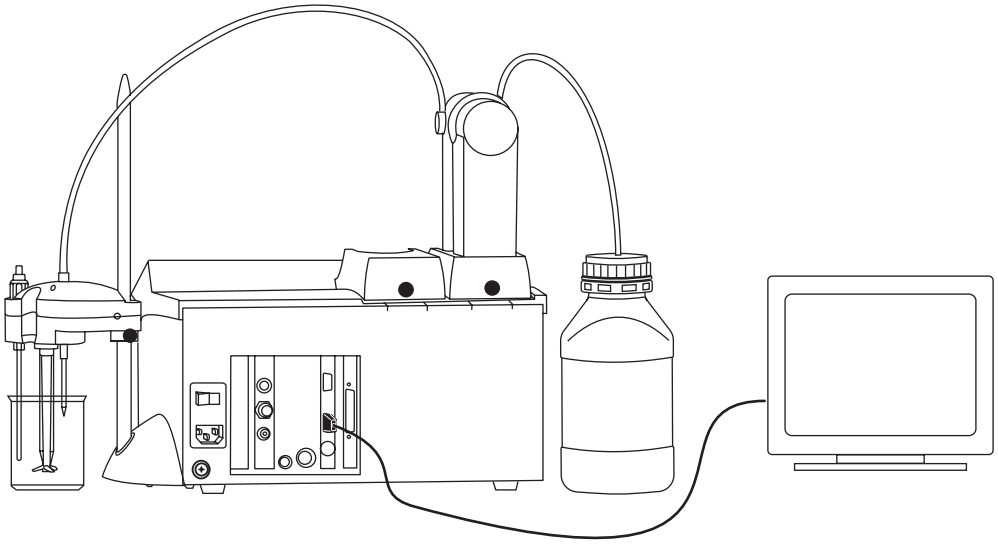
Note: *For other maintenance operations please contact your dealer or the nearest Hanna Customer Service Center.*

9.3 Peripherals

Warning! *Connection/disconnection of POWER CORD, PUMP ASSEMBLY, EXTERNAL PC DISPLAY, PRINTER, RS232 INTERFACE, EXPANSION DEVICE must be done only when titrator and external devices are turned off.*

9.3.1 Connecting an External Display

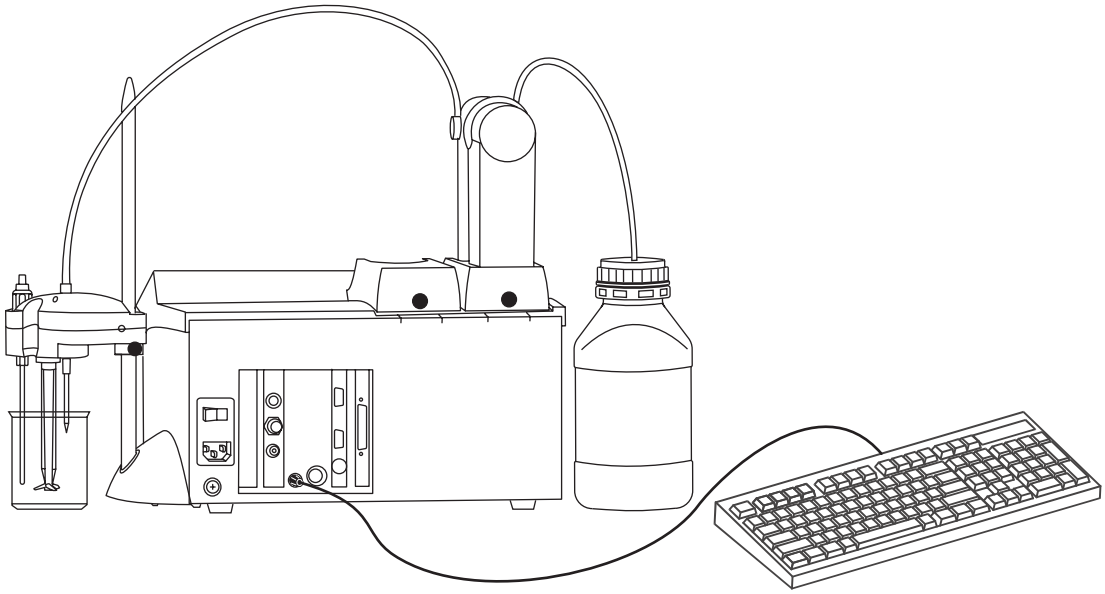
The information shown on the titrator display can be viewed also on a Standard VGA display connected with a 15-pin cable, as presented below.



Connect the external display to the display socket.
Turn on the titrator and then the external display.

9.3.2 Connecting an External PC Keyboard

This connection allows you to use an external PC Keyboard in addition to titrator's keypad.



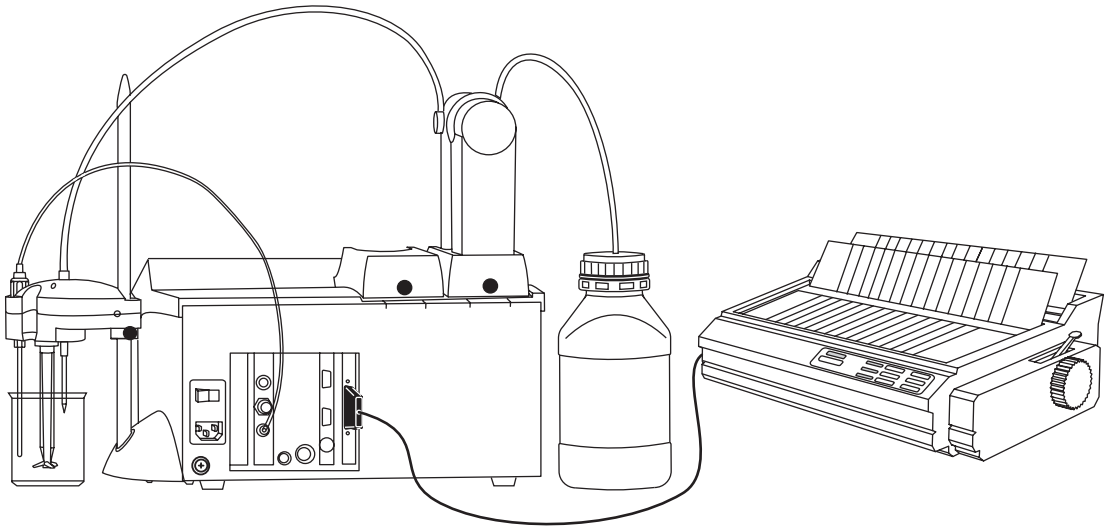
Connect an external PC Keyboard having a 6-pin Mini DIN connector.

The correspondence between the Titrator's Keypad and the United States 101-type external keyboard are:

External PC Keyboard (United States 101)	**Titrator Keypad**
Function Key **F-1**	?
Function Key **F-2**	stir
Function Key **F-3**	results
Function Key **F-4**	device
Function Key **F-5**	Option Key **1** (from left to right)
Function Key **F-6**	Option Key **2** (from left to right)
Function Key **F-7**	Option Key **3** (from left to right)
Function Key **F-8**	Option Key **4** (from left to right)
Function Key **F-9**	Option Key **5** (from left to right)
Function Key **F-10**	start/ stop
Arrow Key: **Up**	△
Arrow Key: **Down**	▽
Arrow Key**: Left**	◁
Arrow Key**: Right**	▷
Page Up	Page Up
Page Down	Page Down
Numeric Keys**: 0 to 9**	0 **to** 9
Tab	Tab
Enter	enter, enter
Alphanumeric Keys	Allow alphanumeric entries.

9.3.3 Connecting a Printer

A variety of parallel printers can be connected to the parallel port of the titrator using a standard DB25–pin cable.

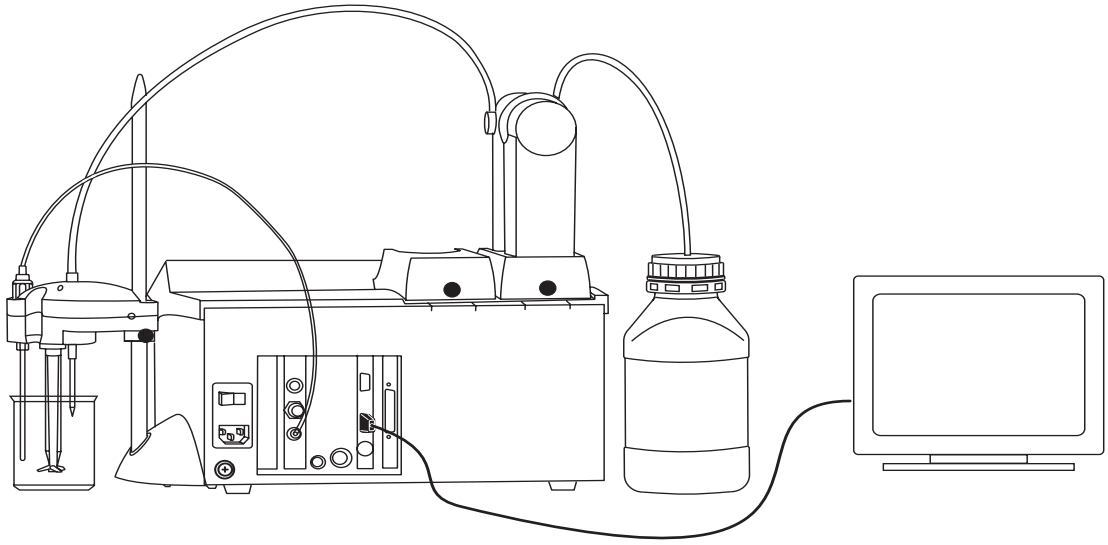


Warning: *The titrator and the external printer must be both turned OFF from the main switch before making the connection.*

Connect the external printer to the standard 25–pin Socket.
Turn on the titrator and then the printer.

9.3.4 Connecting to a Computer

The titrator can be connected to a computer using a standard serial cable with a standard DB9 pin connector. HI 900 PC application needs to be installed on the PC.



Warning: *The titrator and the external PC must be both turned OFF from the main switch before making the connection.*

Connect the cable to the standard DB9 pin Socket.

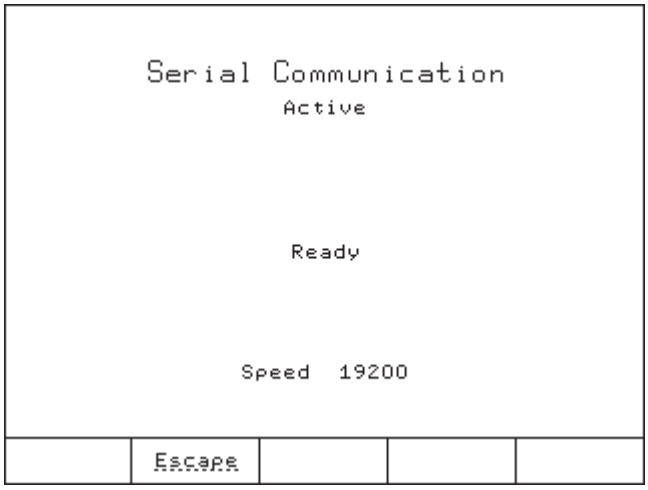
Connect the cable to the serial communication port on the PC.

Turn on the titrator and then the computer.

Select the ***Serial Communication*** screen on the titrator following the path:

General Options - Serial Link with PC - Serial Communication

Launch the HI 900 PC application and then select the appropriate serial port on the PC.



The HI 900 PC application allows the transfer of a variety of information between titrator and PC.

Appendix 1. Contents

A1 TECHNICAL SPECIFICATIONS

mV	Range	- 2000.0 to 2000.0 mV
	Accuracy	±0.1 mV
	Resolution	0.1 mV
pH	Range	- 2.000 to 20.000 pH
	Accuracy	±0.001 pH
	Resolution	0.1 / 0.01 / 0.001 pH
Temperature	Range	- 5.0 to 105.0 °C 23.0 to 221.0 °F 268.2 to 378.2 K
	Accuracy	±0.1 °C
	Resolution	0.1 °C
Dosing Accuracy		0.1 % of full nominal volume of the burette
Display Resolution		0.001 mL
Burette Sizes	5 mL	Accuracy: ± 5 µL
	10 mL	Accuracy: ± 10 µL
	25 mL	Accuracy: ± 25 µL
	50 mL	Accuracy: ± 50 µL
Graphic Display		7.5" B/W graphical display with backlight.
Languages		English, Italian, Portuguese.
Methods		up to 100 (standard and user methods)

Burette size auto-detection and interchangeable burettes. The titrator automatically detects the size of the burette when it is slid in the pump assembly.

Propeller Stirrer-Programmable Stirring Speed. 100-2500 RPM, automatically held with a 100 RPM accepted tolerance.

Flow Rate: user-selectable (see *5.5.21 Volume/Flow Rate* section for ranges).

Direct mV / pH Measurement.

Automatically Temperature Compensated pH Measurements.

pH Calibration with up to 5 buffers using *Auto-Entry* or *Manual-Entry* options; temperature compensated buffers are internally stored for *Auto-Entry* option.

Potentiometric Titrations: Acid-Base (pH or mV-Mode), Redox, Precipitation, Complexometric, Non-Aqueous, Ion-Selective, Argentometric, Voltametric (imposed current)

Titer Determination.

Fixed mV or pH End Point Detection.

Single Equivalence Point Detection, with the 1st or 2nd Derivatives of the titration curve.

Multiple Equivalence Point Detection (HI 902 only)

Flexible Concentration Calculations, with many concentration units.

Display of the Graphs during titration, graphs of the stored titration data (mV-Volume or pH-Volume titration curve, 1st derivative curve or 2nd derivative curve, in pH-mode or mV-mode) and pH/mV values versus time-data logging results.

Data Storage: up to 100 complete titration report and pH/mV logging complete reports.

Files Copied to and Restored from Floppy Disk: Standard Methods, User Methods, Titration and pH/mV Logging Reports, Graphic Bitmap Files can be transferred to and from floppy disk using the 3.5" Floppy Disk unit of the titrator.

Peripheral Units Attachment Possibilities:
- External VGA Display
- External PC Keyboard
- Printer
- RS232 interface

GLP Conformity: Good Laboratory Practice and Instrumentation Data storage and printing capabilities.

Mains: 110/220 Vac ; 50-60 Hz

Power Draw: 1.3 A

2 Exchangeable Fuses

Enclosure Material: Polycarbonate plastic and Steel

Keypad: Polycarbonate

Dimensions: Width x Depth x Height = 390 x 350 x 380 mm

Weight: approx. 10 Kg (with 1 pump, stirrer and sensors)

Operating Environment: 10 to 40 °C, up to 95% relative humidity

Storage Environment: -20 to 70 °C, up to 95% relative humidity

Appendix 2. Contents

A2 BACK TITRATION (HI 902 only)

A2.1 Applicability Domain

Back titrations are generally used for one of these reasons:

- Reaction kinetics are too slow for the direct titration of the analyte.
- The metal precipitates at the desired pH (complexometric titrations).
- The reaction between titrant and analyte produces some auxiliary compounds (e.g. CO_2) that can affect the mV signal and also the equivalence point detection.
- Heavily soluble analyte in the solvents used.
- Titrations with more flat first derivative curves.

A2.2 Method Principles

In a back titration, an excess of a reagent is added to the sample solution, helping to lead the reaction to its completion. The unreacted excess reagent is then titrated. The difference between the total reagent first added and that determined from the final titration is the quantity of reagent required to complete the reaction with the analyzed compound from the sample. With this reagent quantity will be calculated the sample concentration.
The back titration can be an acid – base, complexometric, redox etc.

A2.3 Back Titration Example

An example of back titration might be the determination of an antacid neutralizing capacity.

A2.3.1 Introduction

An excess of stomach acid (primarily HCl) causes heartburn and acid indigestion. Commercial antacids consist of a number of ingredients, such as binders and flavorings, but the active ingredient is simply a basic salt such as $Mg(OH)_2$ (milk of magnesia), $NaHCO_3$ (sodium bicarbonate), $CaCO_3$ (calcium carbonate) or $Al(OH)_3$ (aluminum hydroxide), to neutralize the acid. In this experiment we will analyze a typical antacid containing $CaCO_3$, which reacts with an acid to form a salt, water and a gas:

$$CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$$

A conventional acid/base titration is very difficult in this case as the active ingredient is less soluble in water, and the CO_2 gas formed has an important influence in pH measurements.
In order to overcome this limitation we will completely dissolve the tablets in excess acid:

$$CaCO_3 + 4HCl \longrightarrow CaCl_2 + H_2O + CO_2 + 2HCl_{excess}$$

and back titrate the remaining acid with NaOH to determine the amount of $CaCO_3$ present.

$$2HCl \text{ excess} + 2NaOH \text{ —> } 2NaCl + 2H_2O$$

In order to obtain an accurate value for the concentration of the titrated antacid, we need to know the exact concentration of NaOH and HCl used.
The final concentration is expressed as mg/g $CaCO_3$.

A1.3.2 Setting Up the Method Parameters

Use the following parameters to program the method (see *5.5 Method Options* section):

```
Name:                          Antacid Power
Titration Type:              Back-Titration
   Titrant 1 pump:                   Pump 1
   Titrant 2 pump:                   Pump 2
   Break at titrant change:             YES
Dosing Type:                       Dynamic
   min Vol:                      0.010 mL
   max Vol:                      0.500 mL
   delta E:                      4.500 mL
End Point Mode:       pH 1EQ points, 1st Der
Recognition Option:
   Threshold:                 500 mV / mL
   Range:                              NO
   Filtered Derivatives:               NO
Pre-Titration Volume:           0.000 mL
Pre-Titration Stir Time:           5 Sec
Measurement Mode:          Signal Stability
   delta E:                       0.3 mV
   delta t:                     1.5 Sec
   t min wait:                    5 Sec
   t max wait:                   15 Sec
Electrode Type:                       pH
Calculations:        Sample Calc. by Weight
   Titrant 1 Units             M (mol/L)
   Titrant 2 Units             M (mol/L)
   Final Result Units                g/g
Titrant 1 Name:                      HCl
Titrant 1 Conc.:             1 M(mol/L)
Titrant 2 Name:                     NaOH
Titrant 2 Conc.:             1 M(mol/L)
Analyte Size:                     0.5 g
Analyte Entry:                   Manual
Titrant 1 Entry:              Calculated
Maximum Titrant 2 Volume:     25.000 mL
Stirring Speed:                1500 RPM
Potential Range:      -2000.0 to 2000.0 mV
Flow Rate:                   30.0 mL/min
Signal Averaging:              1 Reading
```

In order to start the analysis, both burettes must be filled with needed reagents, as follows:

- Pump 1 must have attached a burette filled with HCl 1 M (mol/L).
- Pump 2 must have attached a burette filled with NaOH 1 M (mol/L).

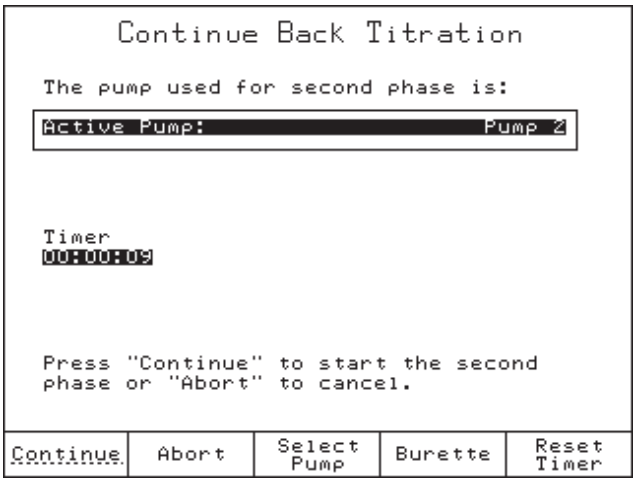
A2.3.3 Preparing the Sample

For this analysis can use commercial antacid pills.

- Crush a few pills in a mortar and separate a quantity weighting around 0.5 mg from the resulting powder.
- Pour about 20 mL distilled and deionized water into a 150 mL beaker and then add the sample powder.
- Raise the stirrer assembly.
- Place the beaker under the stirrer assembly.
- Lower the stirrer assembly until it rests on its positioning collar.
- Adjust the height of the stirrer by using the positioning screw of the positioning collar to have the propeller as close as possible to the bottom of the beaker.
- Adjust the level of the sample solution so that the pH electrode bulb is completely immersed in the sample and the reference junction of the electrode is 5-6 mm below the surface.

A2.3.4 Perform the Titration

- If the method is selected (the main screen displays "Antacid Power" at method name) press start/stop.
- The titrator will prompt for the sample weight. Enter the exact weight value (with 4 digits) and press Accept.
- The calculated volume of titrant 1 is displayed (this value can be modified by the user). The displayed volume will be dispensed during the first phase of back-titration.
- Press Continue to proceed with the next step.
- The titrator will start to dispense the titrant 1 (HCl).
- When this phase is completed, the titrator will stop and the ***Continue Back Titration*** screen is displayed.



- Slide the stirrer assembly up.
- Put the beaker on a hotplate.
- Heat gently until all the effervescence has ceased, then boil it for 1-2 minutes. Some of the inactive tablet material may not dissolve; however, this should not interfere with the titration.
- Cool the solution to the room temperature and put the beaker under the stirrer asembly.
- Lower the stirrer assembly until it rest on its positioning collar.
- Adjust the height of the stirrer by using the positioning screw of the positioning collar to have the propeller as close as possible to the bottom of the beaker.
- Press Continue to proceed to the second phase of the analysis.
- This phase is a normal equivalence point titration.

Appendix 3. Contents

A3 MULTIPLE EQUIVALENCE POINTS (HI 902 only)

A3.1 Applicability Domain

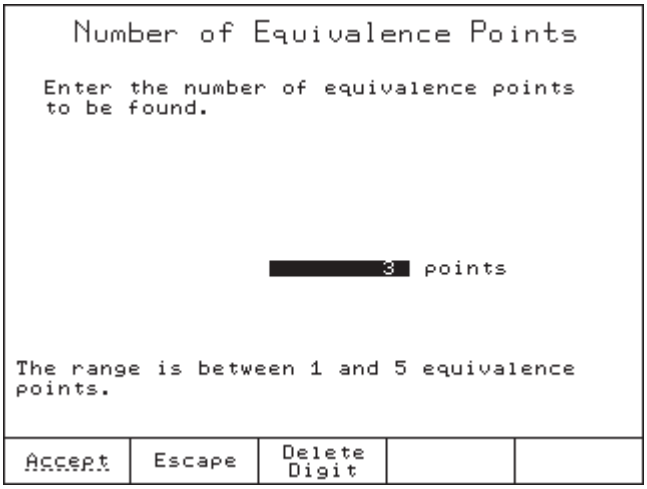
In case of:

- determining the components concentration from a synthetic mixture (e.g. Mixture of HCl, CH_3COOH, NH_4Cl).
- determining the concentration of a polyprotic acid in it's titrable ionization stages (e.g. H_3PO_4, two equivalence points in aquogenos medium).

A3.2 Perform a Multi-Equivalence Point Titration

With the information provided above, set up the method parameters as follows:

- Set the end point mode as equivalence end point (mV or pH).
- Set the number of equivalence points (up to 5 points) to be found.



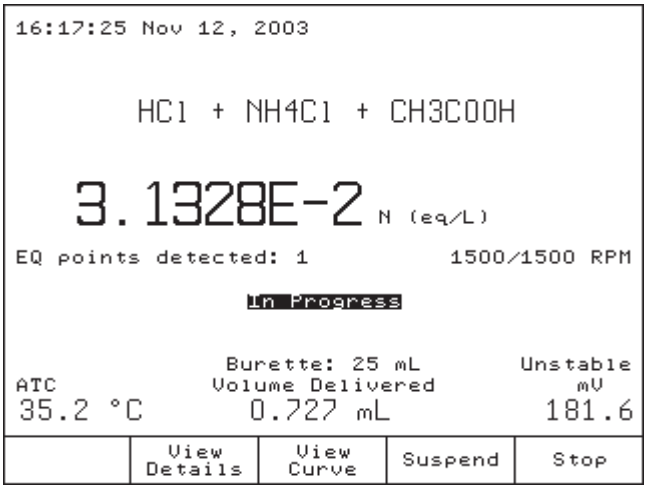
- Select the end point determination (like in standard titration).
- Set the rest of method parameters and save the modification.

A3.3 Titration Example

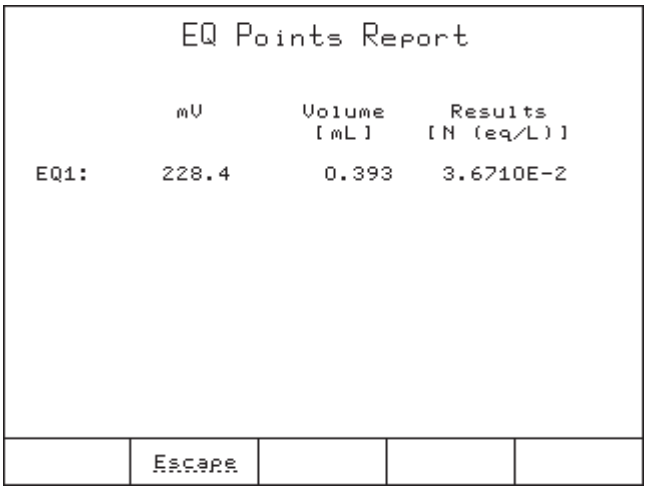
As an example of a multi-equivalence point titration we take the titration of a mixture containing HCl, CH_3COOH and NH_4CL with Sodium Hydroxide.

During this type of titration the user is able to view the following information:

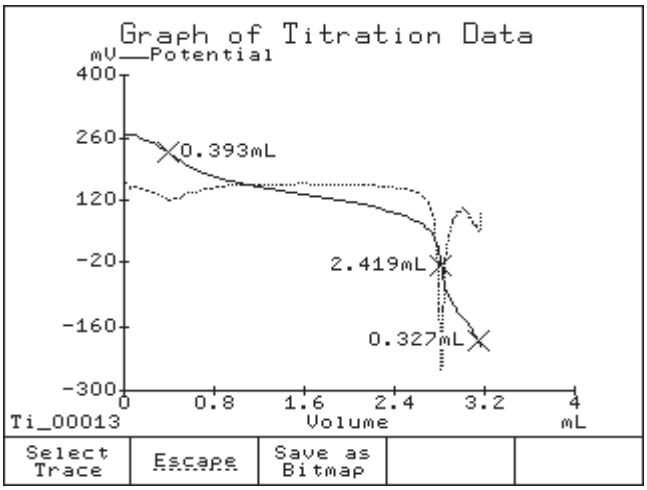
- After first equivalence point is detected, the titration screen will show [View Details] and the number of equivalence points detected.



By pressing [View Details] the titrator will display ***EQ Points Report***. This screen contains information about all the equivalence points detected.



- The graph displays the equivalence points with a cross. Near each cross the equivalence titrant volume is diplayed. The volume is calculated:
    - from titration beginning (for the first equivalence point marked with a cross).



    - the next volumes (marked with a cross) are calculated as the difference betwen the total volume dispensed until the current equivalence point is reached) and the sum of the already detected equivalence points.

The concentration is calculated with the formula selected in the *Calculations* option from the ***View / Modify Method*** screen.

Appendix 4. Contents

A4 ACCESSORIES

A4.1 Solutions

A4.1.1 pH Calibration Solutions

HI 70004C —> pH 4.01 Buffer Solution, 20 mL
HI 77400C —> pH 4.01 & 7.01 Buffer Solution, 20 mL each
HI 7004M —> pH 4.01 Buffer Solution, 230 mL
HI 7004L —> pH 4.01 Buffer Solution, 500 mL
HI 7006M —> pH 6.86 Buffer Solution, 230 mL
HI 7006L —> pH 6.86 Buffer Solution, 500 mL
HI 70007C —> pH 7.01 Buffer Solution, 20 mL
HI 7007M —> pH 7.01 Buffer Solution, 230 mL
HI 7007L —> pH 7.01 Buffer Solution, 500 mL
HI 7009M —> pH 9.18 Buffer Solution, 230 mL
HI 7009L —> pH 9.18 Buffer Solution, 500 mL
HI 770710C —> pH 10.01 & 7.01 Buffer Solution, 20 mL each
HI 7010M —> pH 10.01 Buffer Solution, 230 mL
HI 7010L —> pH 10.01 Buffer Solution, 500 mL
HI 7001M —> pH 1.68 Buffer Solution, 230 mL
HI 7001L —> pH 1.68 Buffer Solution, 500 mL

A4.1.2 pH Calibration Solutions in FDA Approved Bottle

HI 8004L —> pH 4.01 Buffer Solution, 500 mL
HI 8006L —> pH 6.86 Buffer Solution, 500 mL
HI 8007L —> pH 7.01 Buffer Solution, 500 mL
HI 8009L —> pH 9.18 Buffer Solution, 500 mL
HI 8010L —> pH 10.01 Buffer Solution, 500 mL

A4.1.3 Electrode Cleaning Solutions

HI 7061M —> General Purpose Solution, 230 mL
HI 7061L —> General Purpose Solution, 460 mL
HI 7073M —> Protein Cleaning Solution, 230 mL
HI 7073L —> Protein Cleaning Solution, 460 mL
HI 7074M —> Inorganic Cleaning Solution, 230 mL
HI 7074L —> Inorganic Cleaning Solution, 460 mL
HI 7077M —> Oil & Fat Cleaning Solution, 230 mL
HI 7077L —> Oil & Fat Cleaning Solution, 460 mL

APPENDIX 4

A4.1.4 Electrode Cleaning Solutions in FDA Approved Bottle

HI 8061M —> General Purpose Solution, 230 mL
HI 8061L —> General Purpose Solution, 460 mL
HI 8073M —> Protein Cleaning Solution, 230 mL
HI 8073L —> Protein Cleaning Solution, 460 mL
HI 8077M —> Oil & Fat Cleaning Solution, 230 mL
HI 8077L —> Oil & Fat Cleaning Solution, 460 mL

A4.1.5 Electrode Storage Solutions

HI 70300M —> Storage Solution, 230 mL
HI 70300L —> Storage Solution, 460 mL

A4.1.6 Electrode Storage Solutions in FDA Approved Bottle

HI 80300M —> Storage Solution, 230 mL
HI 80300L —> Storage Solution, 460 mL

A4.1.7 Refilling Electrolyte Solutions

HI 7071 —> 3.5M KCl + AgCl Electrolyte, 30 mL, for single junction electrodes
HI 7072 —> 1M KNO3 Electrolyte, 30 mL
HI 7082 —> 3.5M KCl Electrolyte, 30 mL, for double junction electrodes

A4.1.8 Refilling Electrolyte Solutions in FDA Approved Bottle

HI 8071 —> 3.5M KCl + AgCl Electrolyte, 30 mL, for single junction electrodes
HI 8072 —> 1M KNO3 Electrolyte, 30 mL
HI 8082 —> 3.5M KCl Electrolyte, 30 mL, for double junction electrodes

A4.1.9 ORP Pretreatment Solutions

HI 7091M —> Reducing Pretreatment Solution, 230 mL
HI 7091L —> Reducing Pretreatment Solution, 460 mL
HI 7092M —> Oxidizing Pretreatment Solution, 230 mL
HI 7092L —> Oxidizing Pretreatment Solution, 460 mL

A4.1.10 Titration Reagents

HI 70455 —> 0.01 N NaOH Titration Reagent, 1 L
HI 70456 —> 0.1 N NaOH Titration Reagent, 1 L
HI 70457 —> 1 N NaOH Titration Reagent, 1 L
HI 70458 —> 0.01 MH_2SO_4 Titration Reagent, 1 L
HI 70459 —> 0.05 MH_2SO_4 Titration Reagent, 1 L
HI 70462 —> 0.01 N HCl Titration Reagent, 1 L
HI 70463 —> 0.1 N HCl Titration Reagent, 1 L
HI 70464 —> 1 N HCl Titration Reagent, 1 L

A4.2 Sensors

A4.2.1 pH Electrodes

HI 1043B / HI 1040S
Glass-body, double junction, refillable, combination pH electrode.
Use: strong acid/alkali.

HI 1053B / HI 1050S
Glass-body, triple ceramic, conic shape, refillable, combination pH electrode.
Use: emulsions.

HI 1083B
Glass-body, micro, Viscolene, nonrefillable, combination pH electrode.
Use: biotechnology, micro titration.

HI 1131B / HI 1111S
Glass-body, single junction, refillable, combination pH electrode.
Use: general purpose.

HI 1330B / HI 1310S
Glass-body, semimicro, single junction, refillable, combination pH electrode.
Use: laboratory.

HI 1331B / HI 1311S
Glass-body, semimicro, single junction, refillable, combination pH electrode.
Use: flasks.

HI 1230B / HI 1210S
Plastic-body (Ultem®), double junction, gel-filled, combination pH electrode.
Use: general purpose.

HI 2031B / HI 2020S
Glass-body, semimicro, conic, refillable, combination pH electrode.
Use: semisolid products.

HI 1332B / HI 1312S
Plastic-body (Ultem®), double junction, refillable, combination pH electrode.
Use: general purpose.

FC 100B
Plastic-body (Kynar®), double junction, refillable, combination pH electrode.
Use: general purpose for food industry.

FC 200B / FC 200S
Plastic-body (Kynar®), single junction, conic, Viscolene, refillable, combination pH electrode.
Use: meat & cheese.

FC 210B
Glass-body, double junction, conic, Viscolene, combination pH electrode.
Use: milk, yogurt.

FC 220B
Glass-body, single junction, refillable, combination pH electrode.
Use: food & wine processing.

FC 911B
Plastic-body (Kynar®), double junction, refillable with built-in amplifier, combination pH electrode.
Use: very high humidity.

HI 1413B / HI 1410S
Glass-body, single junction, flat tip, Viscolene, combination pH electrode.
Use: surface measurement.

A4.2.2 ORP Electrodes

HI 3131B / HI 3111S
Glass-body, refillable, combination platinum ORP electrode.
Use: titration.

HI 3230B / HI 3210S
Plastic-body (Ultem®), gel-filled, combination platinum ORP electrode.
Use: general purpose.

HI 4430B / HI 4410S
Plastic-body (Ultem®), gel-filled, combination gold ORP electrode.
Use: general purpose.

A4.2.3 Half-cell Electrodes

HI 2110B
Glass-body, single half-cell pH electrode.
Use: general purpose.

HI 5311
Glass-body, Ag/AgCl reference half-cell electrode, double junction, refillable with 4mm banana plug with 1m (3.3') cable.
Use: general purpose with wide temperature range.

HI 5412
Glass-body, single Calomel reference half-cell electrode, refillable with 4mm plug with 1m (3.3') cable.
Use: general purpose with constant temperature range.

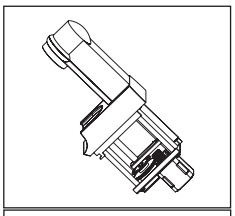
A4.2.4 Extension Cable for Screw-Type Electrodes only
(Screw to BNC Connector)

HI 7855/1
Extension cable 1m (3.3') long.

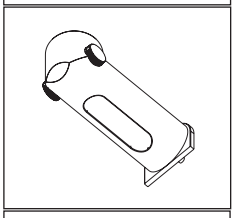
A4.2.5 Temperature Sensor

HI 7662-T
Temperature probe with 1 m (3.3') paneled cable.

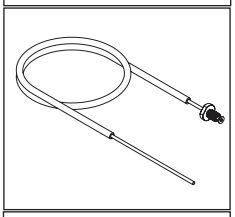
A4.3 Titrator components



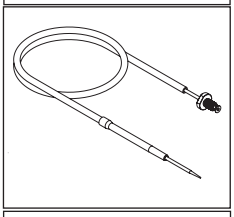
Pump assembly



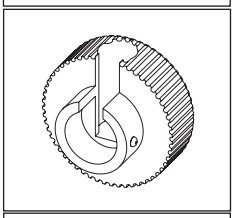
Burette (25 mL syringe)



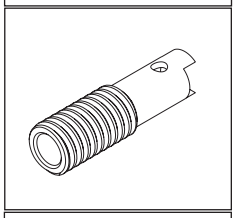
Aspiration tube with fitting and protection tube



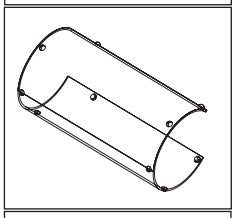
Dispensing tube with normal dispensing tip, fitting, protection tube and tube guide



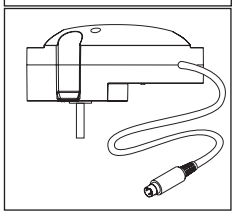
Tube locks



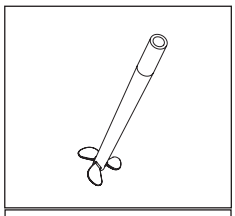
Tool for valve fitting and burette cap removal



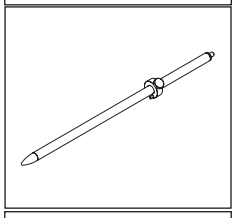
Light spectrum protection screen



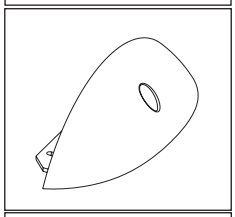
Overhead Stirrer



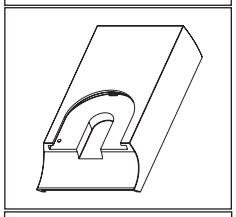
Propeller



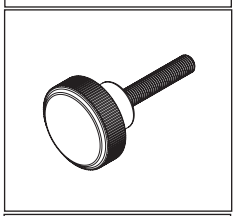
Stirrer support with positioning collar and positioning screw



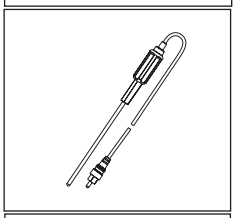
Stirrer stand



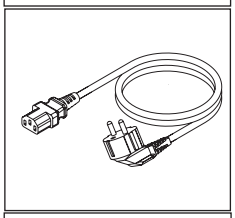
Burette blank support



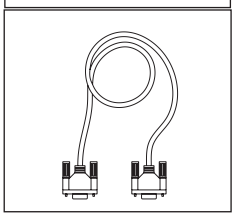
Pump and burette locking screw with plastic head



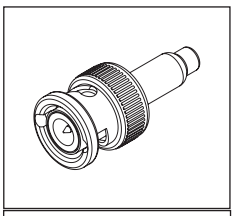
Temperature Probe



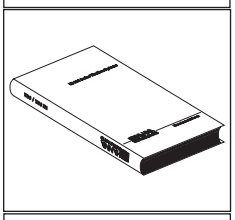
Power Cable



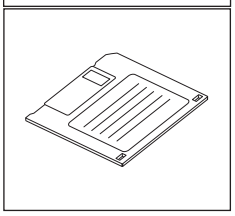
RS232 Cable



Shorting cap



Instruction Manual Binder



Start-up Disk (FDD with Titrator Installation Kit)

MAN901/902
09/04 R0