MAN4521
10/06

Instruction Manual

HI 4521 & HI 4522
pH/mV/ISE/Temperature/
Conductivity/Resistivity/TDS/Salinity
Bench Meters

HANNA®
instruments

www.hannainst.com

OTHER ACCESSORIES

HI 710005/8	Voltage adapter from 115 VAC / 12 VDC 800 mA (USA plug)
HI 710006/8	Voltage adapter from 230 VAC / 12 VDC 800 mA (European plug)
ChecktempC	Pocket-size thermometer (range −50.0 to 150.0 ºC)
HI 76404N	Electrode holder
HI 8427	pH and ORP electrode simulator with 1 m (3.3') coaxial cable ending in female BNC connectors
HI 931001	pH and ORP electrode simulator with LCD and 1 m (3.3') coaxial cable ending in female BNC connectors
HI 76312	Platinum 4-ring conductivity/TDS probe with temperature sensor and 1 m (3.3') cable
HI 7662-T	Temperature probe with 1 m (3.3') cable
HI 92000	Windows® compatible software
HI 920010	9 to 9-pin RS232 cable

RECOMMENDATIONS FOR USERS

Before using these products, make sure they are entirely suitable for the environment in which they are used.

Operation of these instruments in residential areas could cause unacceptable interferences to radio and TV equipment, requiring the operator to follow all necessary steps to correct interferences.

The glass bulb at the end of the pH electrode is sensitive to electrostatic discharges. Avoid touching this glass bulb at all times.

During operation, ESD wrist straps should be worn to avoid possible damage to the electrode by electrostatic discharges.

Any variation introduced by the user to the supplied equipment may degrade the instruments' EMC performance.

To avoid electrical shock, do not use these instruments when voltages at the measurement surface exceed 24 VAC or 60 VDC.
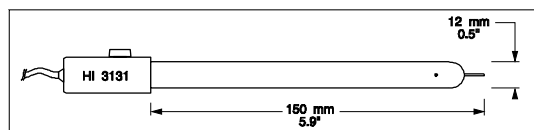
To avoid damage or burns, do not perform any measurement in microwave ovens.

ORP ELECTRODES

HI 3131B
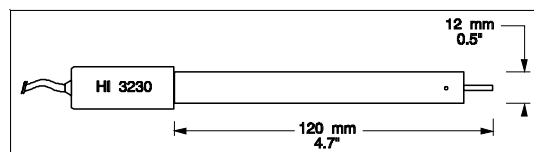Glass-body, refillable, combination platinum ORP electrode.

Use: titration.

HI 3230B
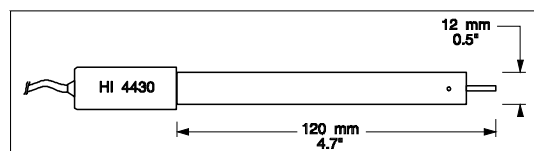Plastic-body, gel-filled, combination platinum ORP electrode.

Use: general purpose.

HI 4430B
Plastic-body, gel-filled, combination gold ORP electrode.
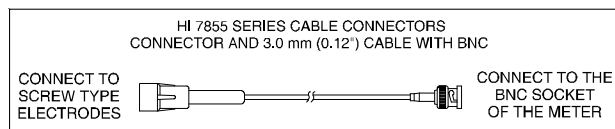
Use: general purpose.

Consult the Hanna General Catalog for more electrodes with screw-type or BNC connectors.

EXTENSION CABLE FOR SCREW-TYPE ELECTRODES
(SCREW TO BNC ADAPTER)

HI 7855/1   Extension cable 1 m (3.3') long
HI 7855/3   Extension cable 3 m (9.9') long

Dear Customer,

Thank you for choosing a Hanna Instruments product. This manual will provide you with the necessary information for correct use of the instrument.

Please read this instruction manual carefully before using the instrument.

If you need additional technical information, do not hesitate to e-mail us at tech@hannainst.com or see the back side of this manual for our worldwide sales and technical service contacts.

These instruments are in compliance with CE directives.

WARRANTY

HI 4521 and HI 4522 are warranted for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. Electrodes and probes are guaranteed for six months. This warranty is limited to repair or replacement free of charge.

Damage due to accidents, misuse, tampering or lack of prescribed maintenance is not covered.

If service is required, contact the dealer from whom you purchased the instrument. If under warranty, report the model number, date of purchase, serial number and the nature of the failure. If the repair is not covered by the warranty, you will be notified of the charges incurred. If the instrument is to be returned to Hanna Instruments, first obtain a Returned Goods Authorization number from the Technical Service Department and then send it with shipping costs prepaid. When shipping any instrument, make sure it is properly packed for complete protection.

To validate your warranty, fill out and return the enclosed warranty card within 14 days from the date of purchase.

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FC 200B

Plastic-body, open junction, conic, Viscolene, non-refillable, combination **pH** electrode.
Use: meat & cheese.
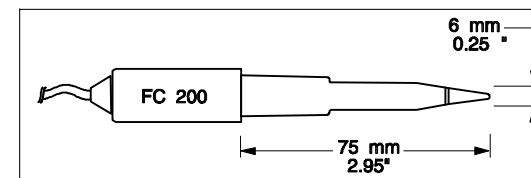
FC 210B

Glass-body, double junction, conic, Viscolene, non-refillable, combination **pH** electrode.
Use: milk, yogurt.

FC 220B

Glass-body, triple-ceramic, single junction, refillable, combination **pH** electrode.
Use: food processing.
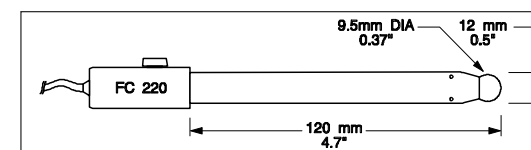
FC 911B

Plastic-body, double junction, refillable with built-in amplifier, combination **pH** electrode.
Use: very high humidity.
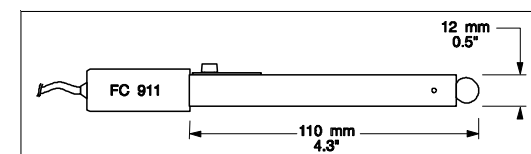
HI 2031B

Glass-body, semimicro, conic, refillable, combination **pH** electrode.

Use: semisolid products.
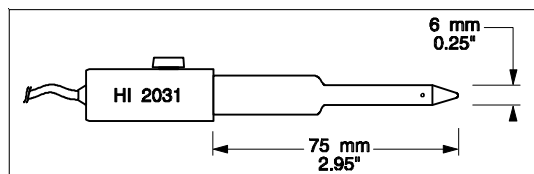
HI 1332B

Plastic-body, double junction, refillable, combination **pH** electrode.

Use: general purpose.
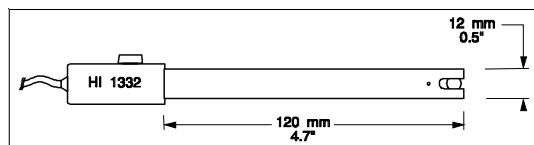
HI 1413B

Glass-body, single junction, flat tip, Viscolene, non-refillable, combination **pH** electrode.
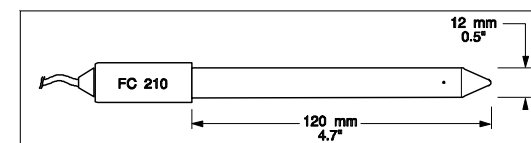
Use: surface measurement.

FC 100B

Plastic-body, double junction, refillable, combination **pH** electrode.

Use: general purpose for food industry.
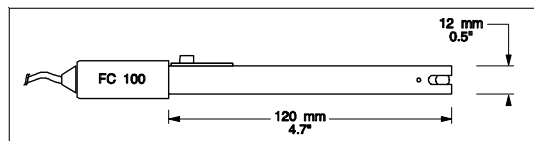
PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any damage, notify your dealer or the nearest Hanna Service Center.
The meters are supplied complete with:

- **HI 1131B** Glass-body Combination pH Electrode
- **HI 76312** Four-ring Conductivity Probe with built-in temperature sensor and ID
- **HI 7662-T** Temperature probe
- **pH 4.01 & 7.01** Buffer solutions, 20 mL each
- **HI 700661** Cleaning solution, 2 x 20 mL
- **HI 7071S** Electrolyte solution
- **HI 76404N** Electrode Holder
- 12 Vdc Power Adapter
- Instruction Manual

HI 4521 and **HI 4522** are supplied with 12 Vdc/230 Vac adapter.
HI 4521-01 and **HI 4522-01** are supplied with 12 Vdc/115 Vac adapter.

Note: Save all packing material until you are sure that the instrument works properly. Any defective item must be returned in the original packing with the supplied accessories.

GENERAL DESCRIPTION

HI 4521 and **HI 4522** are professional bench meters with color graphic LCD for pH, ORP (Oxidation Reduction Potential), ISE (**HI 4522** only), conductivity, resistivity, TDS, salinity and temperature measurements.

The display can be configured as a single channel or dual channel display in various modes: Basic information only, GLP information, Graph and Log History mode.

The main features of the instruments are:

- Two input channels;
- Eight measurement parameters: pH, mV, ISE (**HI 4522** only), conductivity, resistivity, TDS, salinity and temperature;
- Manual selection, automatic and semiautomatic pH calibration in up to five points, with standard (1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) and custom buffers (up to 5 custom buffers);
- Manual Selection and Custom Standard ISE calibration in up to five points, with standard (up to five standard solutions for each measurement unit) and custom solutions (up to 5 custom solutions), with or without temperature compensation (**HI 4522** only);
- Pure water checking using the USP <645> standard;
- Conductivity probe automatic recognition;
- Automatic or custom standard conductivity calibration in up to four points, probe offset calibration;
- One fixed point salinity calibration (Percent Scale only);
- AutoHold feature to freeze first stable reading on the LCD;
- Two selectable alarm limits (for pH, mV, ISE, conductivity, resistivity, TDS, salinity);
- Three selectable logging modes: Automatic, Manual, AutoHold logging;
- Up to 100 logging lots for automatic or manual modes and up to 200 USP reports, up to 100 ISE methods reports;
- Selectable area and sampling period feature for automatic logging;
- GLP feature;
- Online and offline graph;
- User-friendly interface on large color graphic LCD (240 x 320 pixels);
- Opto-isolated PC interface via RS232, respectively USB.

HI 1131B
Glass-body, single junction, refillable, combination **pH** electrode.
Use: general purpose.
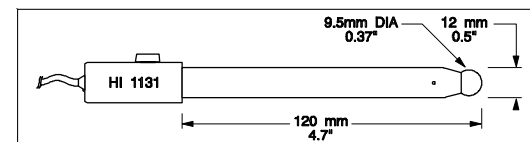
HI 1330B
Glass-body, semimicro, single junction, refillable, combination **pH** electrode.
Use: laboratory, vials.
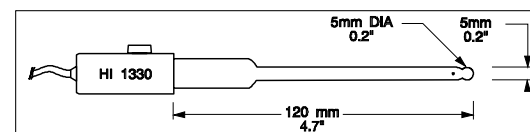
HI 1331B
Glass-body, semimicro, single junction, refillable, combination **pH** electrode.
Use: flasks.
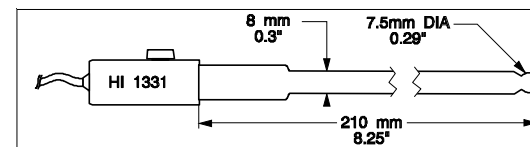
HI 1230B
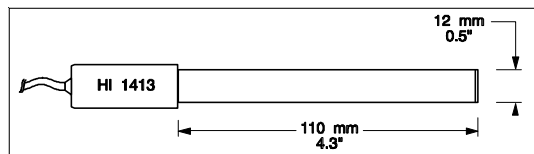Plastic-body, double junction, gel-filled, combination **pH** electrode.
Use: general, field.
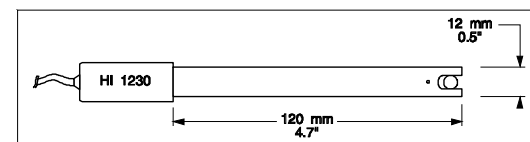
pH ELECTRODES

All electrodes part numbers ending in B are supplied with a BNC connector and 1 m (3.3') cable, as shown below:
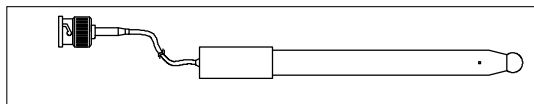
HI 1043B

Glass-body, double junction, refillable, combination **pH** electrode.
Use: strong acid/alkali.
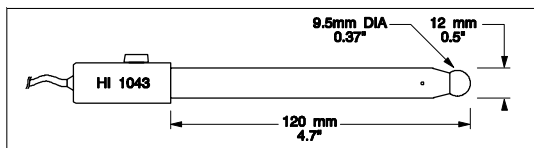
HI 1053B

Glass-body, triple ceramic, conic shape, refillable, combination **pH** electrode.
Use: emulsions.
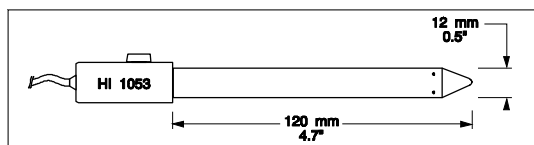
HI 1083B

Glass-body, micro, Viscolene, non-refillable, combination **pH** electrode.
Use: biotechnology, micro titration.
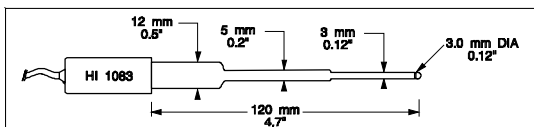
FUNCTIONAL DESCRIPTION

HI 4521/4522 DESCRIPTION

FRONT PANEL
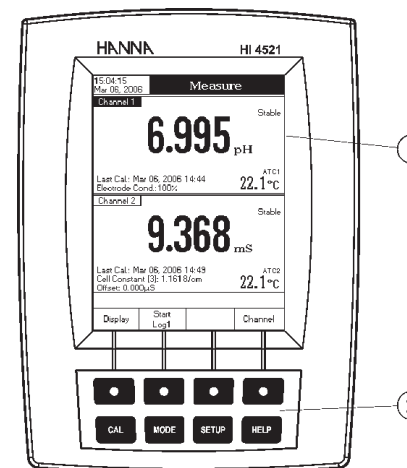
REAR PANEL
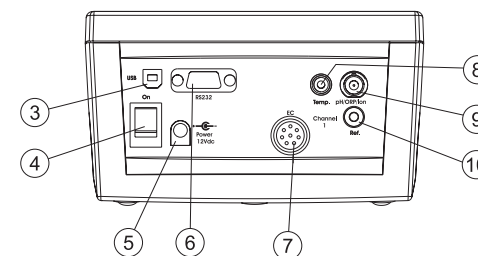
1) Liquid Crystal Display (LCD)
2) Main Keyboard
3) USB connector
4) ON/OFF switch
5) Power adapter socket
6) RS232 serial communication connector
7) Conductivity probe connector
8) Temperature probe socket
9) BNC electrode connector for pH/ORP/Ion measurements
10) Reference input socket

KEYBOARD DESCRIPTION

FUNCTION KEYS

CAL — To enter/exit calibration mode;

MODE — To select the desired measurement mode, pH, mV, Rel mV, ISE (**HI 4522** only), Conductivity, Resistivity, TDS, Salinity;

SETUP — To enter Setup (System Setup, pH Setup, mV Setup, ISE Setup (**HI 4522** only), Conductivity Setup, Resistivity Setup , TDS Setup or Salinity Setup) and to access Log Recall function;

HELP — To obtain general information about the selected option / operation.

VIRTUAL KEYS

The upper row keys are assigned to the **virtual keys** placed on the bottom of the LCD, which allow you to perform the displayed function, depending on the current menu (e.g. Display , Start Log1 and Channel in *Measure* mode).
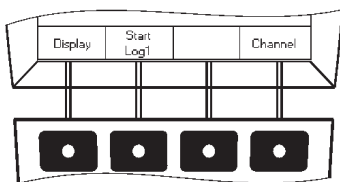
Note: All the virtual keys are assigned to the focused channel (with Channel key exception).

LCD GENERAL DESCRIPTION

Time & Date
Selected mode
Stability indicator
Measured value
Measurement unit
Short GLP information
Temperature compensation mode
Reminder messages area
Temperature value & unit
Virtual keys
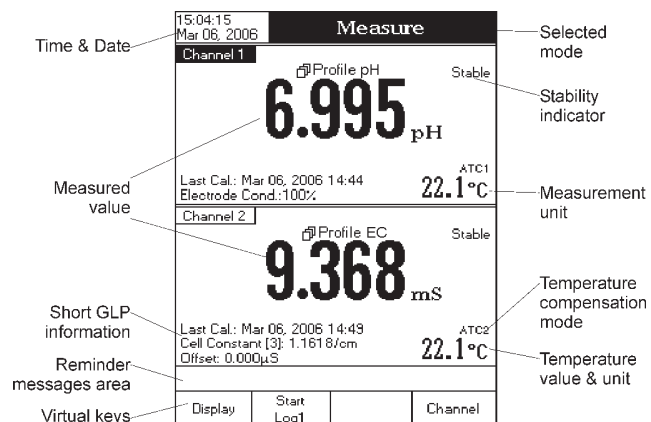
HI 7035M   111800 μS/cm (μmho/cm), 230 mL bottle
HI 7035L   111800 μS/cm (μmho/cm), 500 mL bottle
HI 8035L   111800 μS/cm (μmho/cm), 500 mL FDA approved bottle
HI 7037L   100% NaCl sea water standard solution, 500 mL

ELECTRODE STORAGE SOLUTIONS

HI 70300L   Storage Solution, 500 mL bottle
HI 80300L   Storage Solution in FDA approved bottle, 500 mL

ELECTRODE AND PROBE CLEANING SOLUTIONS

HI 70000P   Electrode Rinse Sachets, 20 mL, 25 pcs
HI 7061L   General Purpose Solution, 500 mL bottle
HI 7073L   Protein Cleaning Solution, 500 mL bottle
HI 7074L   Inorganic Cleaning Solution, 500 mL bottle
HI 7077L   Oil & Fat Cleaning Solution, 500 mL bottle
HI 8061L   General Purpose Solution in FDA approved bottle, 500 mL
HI 8073L   Protein Cleaning Solution in FDA approved bottle, 500 mL
HI 8077L   Oil & Fat Cleaning Solution in FDA approved bottle, 500 mL

ELECTRODE REFILL ELECTROLYTE SOLUTIONS

HI 7071   3.5M KCl $+$ AgCl Electrolyte, 4x30 mL, for single junction electrodes
HI 7072   1M KNO$_3$ Electrolyte, 4x30 mL
HI 7082   3.5M KCl Electrolyte, 4x30 mL, for double junction electrodes
HI 8071   3.5M KCl $+$ AgCl Electrolyte in FDA approved bottle, 4x30 mL, for single junction electrodes
HI 8072   1M KNO$_3$ Electrolyte in FDA approved bottle, 4x30 mL
HI 8082   3.5M KCl Electrolyte in FDA approved bottle, 4x30 mL, for double junction electrodes
HI 8093   1M KCl $+$ AgCl Electrolyte in FDA approved bottle, 4x30 mL

ORP PRETREATMENT SOLUTIONS

HI 7020L   Test Solution 200-275 mV, 500 mL bottle
HI 7021L   Test Solution 240 mV, 500 mL bottle
HI 7022L   Test Solution 470 mV, 500 mL bottle
HI 7091L   Reducing Pretreatment Solution, 500 mL
HI 7092L   Oxidizing Pretreatment Solution, 500 mL

pH BUFFER SOLUTIONS

HI 6001	pH 1.679 Buffer Solution, 500 mL bottle
HI 6003	pH 3.000 Buffer Solution, 500 mL bottle
HI 8004L	pH 4.01 Buffer Solution in FDA approved bottle, 500 mL
HI 6004	pH 4.010 Buffer Solution, 500 mL bottle
HI 8006L	pH 6.86 Buffer Solution in FDA approved bottle, 500 mL
HI 6068	pH 6.862 Buffer Solution, 500 mL bottle
HI 8007L	pH 7.01 Buffer Solution in FDA approved bottle, 500 mL
HI 6007	pH 7.010 Buffer Solution, 500 mL bottle
HI 6091	pH 9.177 Buffer Solution, 500 mL bottle
HI 8009L	pH 9.18 Buffer Solution in FDA approved bottle, 500 mL
HI 8010L	pH 10.01 Buffer Solution in FDA approved bottle, 500 mL
HI 6010	pH 10.010 Buffer Solution, 500 mL bottle
HI 6124	pH 12.450 Buffer Solution, 500 mL bottle

CONDUCTIVITY BUFFER SOLUTIONS

HI 70033P	84 μS/cm (μmho/cm), 20 mL sachets (25 pcs.)
HI 7033M	84 μS/cm (μmho/cm), 230 mL bottle
HI 7033L	84 μS/cm (μmho/cm), 500 mL bottle
HI 8033L	84 μS/cm (μmho/cm), 500 mL FDA approved bottle
HI 70031P	1413 μS/cm (μmho/cm), 20 mL sachets (25 pcs.)
HI 7031M	1413 μS/cm (μmho/cm), 230 mL bottle
HI 7031L	1413 μS/cm (μmho/cm), 500 mL bottle
HI 8031L	1413 μS/cm (μmho/cm), 500 mL FDA approved bottle
HI 70039P	5000 μS/cm (μmho/cm), 20 mL sachets (25 pcs.)
HI 7039M	5000 μS/cm (μmho/cm), 230 mL bottle
HI 7039L	5000 μS/cm (μmho/cm), 500 mL bottle
HI 8039L	5000 μS/cm (μmho/cm), 500 mL FDA approved bottle
HI 70030P	12880 μS/cm (μmho/cm), 20 mL sachets (25 pcs.)
HI 7030M	12880 μS/cm (μmho/cm), 230 mL bottle
HI 7030L	12880 μS/cm (μmho/cm), 500 mL bottle
HI 8030L	12880 μS/cm (μmho/cm), 500 mL FDA approved bottle
HI 7034M	80000 μS/cm (μmho/cm), 230 mL bottle
HI 7034L	80000 μS/cm (μmho/cm), 500 mL bottle
HI 8034L	80000 μS/cm (μmho/cm), 500 mL FDA approved bottle

		HI 4521	HI 4522
pH	Range	−2.000 to 20.000 pH	
	Resolution	0.1 pH / 0.01 pH / 0.001 pH	
	Accuracy	±0.1 pH ±0.01 pH ±0.002 pH ± 1LSD	
	Calibration	Up to five-point calibration, 8 standard buffers available (1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and 5 custom buffers	
mV	Range	±2000.0 mV	
	Resolution	0.1 mV	
	Accuracy	±0.2 mV ± 1LSD	
Relative mV offset range		±2000.0 mV	
ISE	Range	-	$1*10^{-6}$ to $9.99*10^{10}$ conc.
	Resolution	-	1 conc. / 0.1 conc. / 0.01 conc. / 0.001 conc.
	Accuracy	-	±0.5% (monovalent ions) ±1% (divalent ions)
	Calibration	-	Up to five-point calibration, 5 fixed standard solutions available for each measurement unit, and 5 custom solutions

		HI 4521	HI 4522
Conductivity	Range	0.000 to 9.999 μS/cm 10.00 to 99.99 μS/cm 100.0 to 999.9 μS/cm 1.000 to 9.999 mS/cm 10.00 to 99.99 mS/cm 100.0 to 1000.0 mS/cm	
	Resolution	0.001 μS/cm 0.01 μS/cm 0.1 μS/cm 0.001 mS/cm 0.01 mS/cm 0.1 mS/cm	
	Accuracy	$\pm$1% of reading ($\pm$0.01 μS/cm)	
	Cell constant	0.0500 to 200.00	
	Cell type	2, 4 cells	
	Calibration type/points	Auto standard recognition, User standard Single Point / Multi Point calibration	
	Calibration reminder	Yes	
	Temperature compensation	Disabled / Linear / Non linear (natural water)	
	Temperature coefficient	0.00 to 10.00 %/°C	
	Reference temperature	15.0 °C to 30.0 °C	
	Profiles	Up to 10	
	USP compliant	Yes	
Resistivity	Range	1.0 to 99.9 Ohms x cm 100 to 999 Ohms x cm 1.00 to 9.99 KOhms x cm 10.0 to 99.9 KOhms x cm 100 to 999 KOhms x cm 1.00 to 9.99 MOhms x cm 10.0 to 100.0 MOhms x cm	
	Resolution	0.1 Ohms x cm 1 Ohms x cm 0.01 KOhms x cm 0.1 KOhms x cm 1 KOhms x cm 0.01 MOhms x cm 0.1 MOhms x cm	
	Accuracy	$\pm$2 % of reading ($\pm$1 Ohm x cm)	
	Calibration	No	
TDS	Range	0.000 to 9.999 ppm 10.00 to 99.99 ppm 100.0 to 999.9 ppm 1.000 to 9.999 ppt 10.00 to 99.99 ppt 100.0 to 400.0 ppt actual TDS (with 1.00 factor)	
	Resolution	0.001 ppm 0.01 ppm 0.1 ppm 0.001 ppt 0.01 ppt 0.1 ppt	
	Accuracy	$\pm$1% of reading ($\pm$0.01 ppm)	

TEMPERATURE CORRELATION FOR pH SENSITIVE GLASS

The resistance of glass electrodes partially depends on the temperature. The lower the temperature, the higher the resistance. It takes more time for the reading to stabilize if the resistance is higher. In addition, the response time will suffer to a greater degree at temperatures below 25 °C (77 °F).
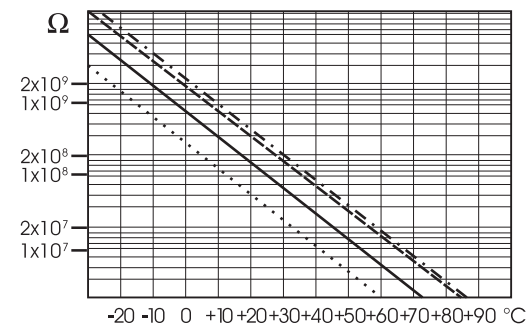
Since the resistance of the pH electrode is in the range of 50 − 200 Mohm, the current across the membrane is in the pico Ampere range. Large currents can disturb the calibration of the electrode for many hours.

For these reasons high humidity environments, short circuits and static discharges are detrimental to a stable pH reading.

The pH electrode's life also depends on the temperature. If constantly used at high temperatures, the electrode life is drastically reduced.

Typical Electrode Life

Ambient Temperature	1 − 3 years
90 °C (194 °F)	Less than 4 months
120 °C (248 °F)	Less than 1 month

Alkaline Error

High concentrations of sodium ions interfere with readings in alkaline solutions. The pH at which the interference starts to be significant depends upon the composition of the glass. This interference is called alkaline error and causes the pH to be underestimated. Hanna's glass formulations have the indicated characteristics.

Sodium Ion Correction for the Glass at 20-25 °C (68-77 °F)		
Concentration	pH	Error
0.1 Mol L^{-1} Na$^+$	13.00	0.10
	13.50	0.14
	14.00	0.20
1.0 Mol L^{-1} Na$^+$	12.50	0.10
	13.00	0.18
	13.50	0.29
	14.00	0.40

mV / pH / ISE CHANNEL

SYMPTOMS	PROBLEM	SOLUTION
Slow response/excessive drift.	Dirty pH electrode.	Soak the electrode tip in HI 7061 solution for 30 minutes and then clean the electrode.
Readings fluctuate up and down (noise).	Clogged/dirty junction. Low electrolyte level (refillable electrodes only).	Clean the electrode. Refill with fresh solution (for refillable electrodes only).
The LCD displays "-----" during measurements (pH, mV, mV Rel or ISE).	Out of range in the appropriate scale.	Make sure the sample is in the specified range. Recalibrate. Check the electrolyte level and the general state of the pH/ORP or ISE electrode.
Out of range in the mV scale.	Dry membrane/junction.	Soak in HI 70300 Storage solution for at least one hour.
The instrument does not work with the temperature probe.	Out of order temperature probe.	Replace the probe.
The meter fails to calibrate or gives faulty readings.	Broken or out of order electrode.	Replace the electrode.
Explicit warnings are displayed during calibration.	Dirty/broken electrode, contaminated buffers.	Follow displayed instructions.
The electrode condition is not displayed after calibration.	Only one-point calibration has been performed.	Perform at least a two-point calibration.
The instrument does not override the loading process.	Internal or software error.	Restart the instrument using the power switch. If the error persists, contact your vendor.

		HI 4521	HI 4522
Salinity	Range	Practical Scale 0.00 to 42.00 psu Water Scale 0.00 to 80.00 ppt Percent Scale 0.0 to 400.0 %	
	Resolution	0.01 for Practical Scale / Natural Sea Water 0.1 % for Percent Scale	
	Accuracy	±1% of reading	
	Calibration	Percent Scale - 1 point (with HI 7037 buffer)	
Temperature	Range	-20.0 to 120.0 °C -4.0 to 248.0 °F 253.15 to 393.15 K	
	Resolution	0.1 °C / 0.1 °F / 0.1 K	
	Accuracy	±0.2 °C / ±0.4 °F / ±0.2 K (without probe)	
Keyboard		8 keys	
Input channels		2	
PC interface		opto-isolated RS232 and USB	
GLP		Cell constant, ref temp / coefficient, calibration points, cal time stamp, probe offset for conductivity	
Auto-Hold		Yes	
Logging feature	Record samples	100 lots with 10000 records / lot	
	Logging interval	Settable between 1 and max log time	
	Type	Automatic, Log on demand, AutoHold	
Replatinization		Yes	
LCD		Color Graphic LCD 240 x 320 pixels	
Backlight		Yes (with settable backlight saver)	
Inputs		8 pin DIN, BNC	
Outputs		RS232, USB	
Power		12VDC adapter	
Dimensions		160 x 231 x 94 mm (6.3 x 9.1 x 3.7")	
Weight		1.2 Kg (2.6 lb)	
Implemented standards		USP stage 1, 2, 3	
Conductivity probe recognition		Yes	
EC calibration solution		84.0 μS/cm, 1413 μS/cm, 5.00 mS/cm, 12.88 mS/cm, 80.0 mS/cm, 111.8 mS/cm	
Accesories		2 cell probe (0.1 cell const, 0 to 400 μS) 4 cell probe (1.0 cell constant wide range) USP kit (flow cell, resistor set for low range checking)	

POWER CONNECTION

Plug the 12 VDC adapter into the power supply socket.

Note: These instruments use non volatile memory to retain the meter settings, even when unplugged.

ELECTRODE AND PROBE CONNECTIONS

For pH or ORP measurements connect a pH / ORP electrode with internal reference to the BNC connector located on the rear panel of the instrument.

For ISE measurements (**HI 4522**) connect, an ISE electrode with internal reference to the BNC connector located on the rear panel of the instrument.

For electrodes with a separate reference connect the electrode's BNC to the BNC connector and the electrode's reference to the reference input socket.

For temperature measurements and automatic temperature compensation connect the temperature probe to the appropriate socket (mV channel only).

For conductivity, resistivity, TDS or salinity measurements connect a conductivity probe to the DIN connector located on the rear panel of the instrument.

INSTRUMENT START UP

• Turn the instrument on from the power switch located on the rear panel of the instrument.

• Please wait until the instrument finishes the initialization process.

Note: It is normal for the loading process to take a few seconds. If the instrument doesn't display the next screen, restart the meter using the power switch. If the problem persists, contact your dealer.

CONDUCTIVITY / RESISTIVITY / TDS / SALINITY CHANNEL

SYMPTOMS	PROBLEM	SOLUTION
Reading fluctuates up and down (noise).	Conductivity probe not properly connected.	Insert the probe.
Display shows "-----" during measurements.	Reading out of range.	Recalibrate the meter; Check the sample is within the measurable range.
Meter fails to calibrate or gives faulty readings.	Broken Conductivity probe.	Replace the probe.
The instrument doesn't measure the temperature from the probe.	The probe temperature sensor is broken. / The temperature source is set as manual.	Replace the probe. / Set the temperature source as automatic.
The meter fails to calibrate or gives faulty readings.	The probe is damaged.	Replace the probe.
Explicit warnings are displayed during calibration.	Dirty / damaged probe, contaminated standards.	Follow displayed instructions.
The instrument does not override the loading process.	Initializing / software error.	Restart the instrument using the power switch. If the error persists contact your vendor.
"Error Detected" pop-up at start up.	Initialization error.	Visualize the error (by pressing "Yes" key). Contact your vendor if critical error occurs.

For AmpHel® electrodes:

If the electrode does not respond to pH changes, the battery run down and the electrode should be replaced.

MEASURE

Rinse the pH electrode tip with distilled water. Immerse the tip (bottom 4 cm /1½") in the sample and stir gently for a few seconds.

For a faster response and to avoid cross-contamination of the samples, rinse the electrode tip with a few drops of the solution to be tested, before taking measurements.

STORAGE PROCEDURE

To minimize clogging and assure a quick response time, the glass bulb and the junction of pH electrode should be kept moist and not allowed to dry out.

Replace the solution in the protective cap with a few drops of **HI 70300** or **HI 80300** Storage Solution or, in its absence, Filling Solution (**HI 7071** or **HI 8071** for single junction and **HI 7082** or **HI 8082** for double junction electrodes). Follow the Preparation Procedure on page 103 before taking measurements.

Note: NEVER STORE THE ELECTRODE IN DISTILLED OR DEIONIZED WATER.

PERIODIC MAINTENANCE

Inspect the electrode and the cable. The cable used for connection to the instrument must be intact and there must be no points of broken insulation on the cable or cracks on the electrode stem or bulb. Connectors must be perfectly clean and dry. If any scratches or cracks are present, replace the electrode. Rinse off any salt deposits with water.

pH Probe Maintenance

For refillable electrodes:

Refill the reference chamber with fresh electrolyte (**HI 7071** or **HI 8071** for single junction or **HI 7082** or **HI 8082** for double junction electrodes). Allow the electrode to stand upright for 1 hour. Follow the Storage Procedure above.

pH CLEANING PROCEDURE

- *General* Soak in Hanna **HI 7061** or **HI 8061** General Cleaning Solution for approximately ½ hour.
- *Protein* Soak in Hanna **HI 7073** or **HI 8073** Protein Cleaning Solution for 15 minutes.
- *Inorganic* Soak in Hanna **HI 7074** Inorganic Cleaning Solution for 15 minutes.
- *Oil/grease* Rinse with Hanna **HI 7077** or **HI 8077** Oil and Fat Cleaning Solution.

IMPORTANT: After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water, refill the reference chamber with fresh electrolyte (not necessary for gel-filled electrodes) and soak the electrode in **HI 70300** or **HI 80300** Storage Solution for at least 1 hour before taking measurements.

CHANNEL SELECTION

- Press `Channel` while in *Measure* mode to access channel selection menu. Four available options will be displayed: Channel 1, Channel 2, or multi-channel with the first or the second channel focused. The "Choose Channel Configuration" message is displayed in the Reminder messages area when `Channel` is pressed.
- Select the desired option by pressing the appropriate key: `Channel 1`, `Channel 2`, `Channel 1 / Channel 2` or `Channel 1 / Channel 2`. The instrument will enter in the selected option *Measure* mode.
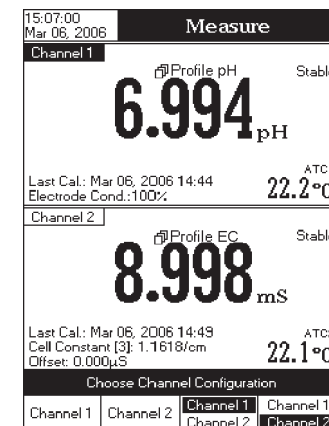
For each measurement mode (pH, mV, Rel mV, Ion, Conductivity, Resistivity, TDS or Salinity) the following display configurations are available: Basic, Good Laboratory Practice (GLP), Graph and Log History.

Basic

Accessing this option, the measured value and its units are displayed on the LCD, along with the temperature value, temperature compensation mode, and minimal GLP data.

To choose the Basic displaying mode:

- Press [Display] while in *Measure* mode. The "Choose Display Configuration" message will be displayed in the Reminder messages area.

- Press [Basic]. The instrument will display the basic information for the selected measurement mode.
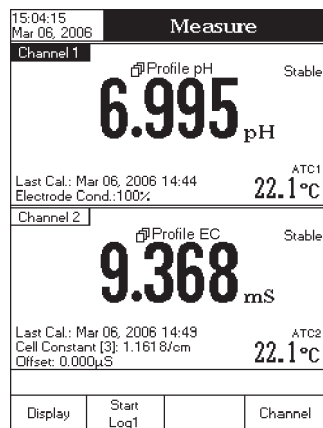
GLP

Accessing this option, a detailed GLP data will be displayed on the LCD for pH / ISE: Last Calibration Date and Time, Offset and Slope values, Calibration Buffers, Electrode Condition and for conductivity / salinity: Last Calibration Date and Time, Calibration Standards, Cell Constant, Probe Offset, Reference Temperature, Compensation Coefficient, Temperature Compensation.

Note: If only a one-point pH calibration is performed or the current calibration does not include at least two consecutive standard buffers of pH 4.01, 7.01 (6.86) and 10.01 (9.18) buffers, the Electrode Condition will be unknown.

To access the GLP displaying mode:

- Press [Display] while in *Measure* mode. The "Choose Display Configuration" message will be displayed in the Reminder messages area.

- Press [GLP]. The instrument will display the detailed GLP data.
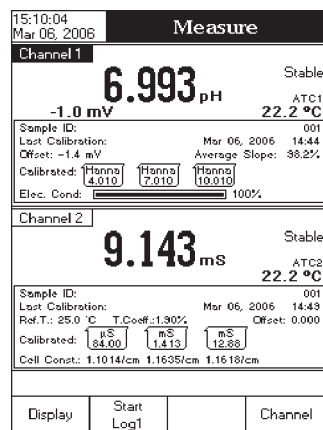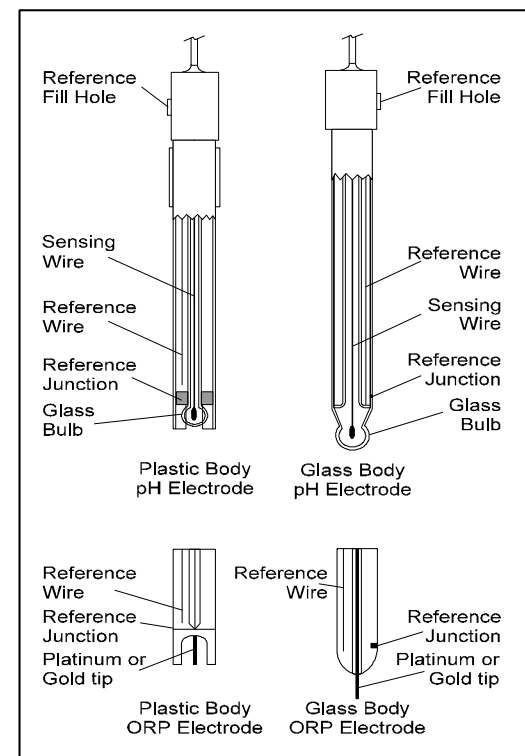
PREPARATION PROCEDURE

Remove the protective cap of the pH electrode.

DO NOT BE ALARMED IF SALT DEPOSITS ARE PRESENT. This is normal with electrodes. They will disappear when rinsed with water.

During transport, tiny bubbles of air may form inside the glass bulb affecting proper functioning of the electrode. These bubbles can be removed by "shaking down" the electrode as you would do with a glass thermometer.

If the bulb and/or junction is dry, soak the electrode in **HI 70300** or **HI 80300** Storage Solution for at least one hour.

For refillable electrodes:

If the filling solution (electrolyte) is more than 2½ cm (1") below the fill hole, add **HI 7082** or **HI 8082** 3.5M KCl Electrolyte Solution for double junction or **HI 7071** or **HI 8071** 3.5M KCl+AgCl Electrolyte Solution for single junction electrodes.

For faster response, unscrew the fill hole screw during measurements.

MEASURE

Rinse the conductivity probe with distilled water. Immerse the tip (bottom 4 cm /1½") in the sample and stir gently for a few seconds.

For a faster response and to avoid cross-contamination of the samples, rinse the probe with a few drops of the solution to be tested, before taking measurements.

PERIODIC MAINTENANCE

Inspect the probe and the cable. The cable used for connection to the instrument must be intact and there must be no points of broken insulation on the cable. Connectors must be perfectly clean and dry. Rinse off any salt deposits with water.

If more cleaning is required, remove the probe sleeve and clean the probe with a cloth or a nonabrasive detergent. Make sure to reinsert the sleeve onto the probe properly and in the right direction. After cleaning the probe, recalibrate the instrument.

The platinum rings are sustained with glass. Take great care while handling the probe.
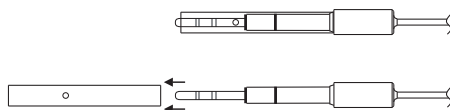
IMPORTANT: After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water.

Graph

Accessing this option, the online graph with the currently logged values (pH, mV, Rel mV, ISE respectively Conductivity, Resistivity, TDS, Salinity vs. Seconds) will be displayed.

If there is no active log, the previously logged data for the selected parameter will be plotted.

Notes: • If no data were logged, the graph displaying mode will not be accessible.

• If no automatic log is saved, the offline graph will not be available.

To access the offline / online graph:

• Press Display while in *Measure* mode. The "Choose Display Configuration" message will be displayed in the Reminder messages area.

• Press Graph .

When the **online graph** is displayed:

• Use ◁ and ▷ to move the graph along horizontal (*Time*) axis.

• Press SETUP to access the zoom menu for the vertical (*Parameter*) axis. Use Zoom IN or Zoom OUT for zooming vertical axis.

• Press Escape to return to the main menu.

When the **offline graph** is displayed:

• Use the arrow keys to move the graph along the horizontal and vertical axes.

• Press SETUP to access the zoom menu for horizontal and vertical axes. Use Zoom Time or Zoom pH / Zoom mV / Zoom Rel mV / Zoom Ion respectively Zoom Cond. / Zoom Resistiv. / Zoom TDS / Zoom Salinity to switch between the active zooming axes. Press Zoom IN or Zoom OUT to zoom the selected axis.

Note: While in zoom graph menu the MODE key is not accessible.

• Press Escape to return to the main menu.
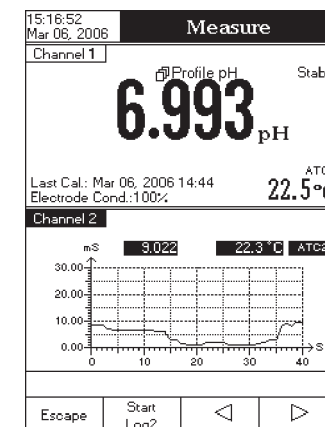
Log History

Accessing this option, last logged records will be displayed on the LCD. The log history list also contains the appropriate main parameter values, the logged temperature, the temperature compensation source / mode, as well as the records time stamp.

To access the Log History displaying mode:

- Press [Display] while in *Measure* mode. The "Choose Display Configuration" message will be displayed in the Reminder messages area.

- Press [Log History]. The instrument will display the log history regarding the selected measure mode.

Notes:
- When an alarm condition is active, all logged records will have an exclamation mark (!).
- When a meter is in auto-hold, the logged records will have an "H" symbol.
- If another measure mode is selected, the Log History will be cleared.
- If the temperature unit is changed, all logged temperature values will be automatically displayed in the new temperature unit.

pH BUFFER TEMPERATURE DEPENDENCE

Temperature has an effect on pH. The calibration buffer solutions are affected by temperature changes to a lower degree than normal solutions.

During calibration the instrument will automatically calibrate to the pH value corresponding to the measured or set temperature.

TEMP			pH BUFFERS							
°C	°K	°F	1.679	3.000	4.010	6.862	7.010	9.177	10.010	12.454
0	273	32	1.670	3.072	4.007	6.982	7.130	9.459	10.316	13.379
5	278	41	1.670	3.051	4.002	6.949	7.098	9.391	10.245	13.178
10	283	50	1.671	3.033	4.000	6.921	7.070	9.328	10.180	12.985
15	288	59	1.673	3.019	4.001	6.897	7.046	9.273	10.118	12.799
20	293	68	1.675	3.008	4.004	6.878	7.027	9.222	10.062	12.621
25	298	77	1.679	3.000	4.010	6.862	7.010	9.177	10.010	12.450
30	303	86	1.683	2.995	4.017	6.851	6.998	9.137	9.962	12.286
35	308	95	1.688	2.991	4.026	6.842	6.989	9.108	9.919	12.128
40	313	104	1.693	2.990	4.037	6.837	6.983	9.069	9.881	11.978
45	318	113	1.700	2.990	4.049	6.834	6.979	9.040	9.847	11.834
50	323	122	1.707	2.991	4.062	6.834	6.978	9.014	9.817	11.697
55	328	131	1.715	2.993	4.076	6.836	6.979	8.990	9.793	11.566
60	333	140	1.724	2.995	4.091	6.839	6.982	8.969	9.773	11.442
65	338	149	1.734	2.998	4.107	6.844	6.987	8.948	9.757	11.323
70	343	158	1.744	3.000	4.123	6.850	6.993	8.929	9.746	11.211
75	348	167	1.755	3.002	4.139	6.857	7.001	8.910	9.740	11.104
80	353	176	1.767	3.003	4.156	6.865	7.010	8.891	9.738	11.003
85	358	185	1.780	3.002	4.172	6.873	7.019	8.871	9.740	10.908
90	363	194	1.793	3.000	4.187	6.880	7.029	8.851	9.748	10.819
95	368	203	1.807	2.996	4.202	6.888	7.040	8.829	9.759	10.734

During calibration the instrument will display the pH buffer value at 25 °C.

Data transmission from the instrument to the PC can be done with the **HI 92000** Windows® compatible software (optional). **HI 92000** also offers graphing and on-line help feature.

Data can be exported to the most popular spreadsheet programs for further analysis.

HI 4521 and **HI 4522** instruments have two available serial interfaces: RS232 and USB. The desired serial interface can be selected from the settings window of the **HI 92000** software.

If choosing the **RS232** serial interface, use the optional Hanna **HI 920010** cable connector to connect your instrument to a PC. Make sure that your instrument is switched off and then plug one connector to the instrument RS232 socket and the other one to the serial port of your PC.

Note: Other cables than **HI 920010** may use a different configuration. In this case, communication between instrument and PC may not be possible.

If choosing the **USB** serial interface, use a standard USB cable to connect your instrument to the PC.

For both serial interfaces, make sure that the instrument and the **HI 92000** software have the same baud rate and the appropriate communication port.

The System Setup menu allows the user to customize the user interface, consult the meter information, set the external serial communication interface and to restore the manufacturer settings.
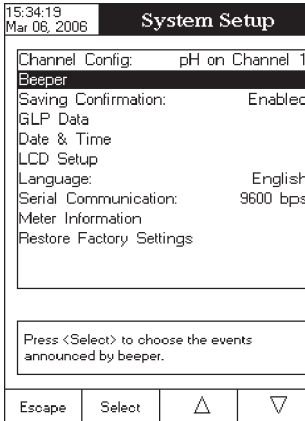
Accessing System Setup

- Press [SETUP] while in *Measure* mode.
- Press [System Setup]. The system setup options will be displayed on the LCD.

To access a System Setup option:

- Use [△] or [▽] to highlight the desired option.
- Press [Select] to access the selected option.

The following is a detailed description of the System Setup option screen.

Beeper

This option allows the user to enable or disable the beeper. When the beeper is enabled, a specific beep will be heard when the reading becomes stable, when an alarm condition is reached, when pressing a key or if a wrong key is pressed.

Stability Indicator

When the reading becomes stable, the instrument delivers a medium beep only if this option is ON, along with the "Stable" indicator on the LCD.

Alarm

If this option is ON, a continuous double beep will be heard each time the set limits in *Measure* mode are exceeded, along with the "Alarm" indicator on the LCD.

Key Pressed

If this option is ON, a short beep will be heard each time a valid key is pressed.

Wrong Key

If this option is ON, a long beep will be heard when an incorrect key is pressed.

To set the Beeper:

- Use ☐△ or ☐▽ to select the Beeper option.

- Press ☐Select and use ☐△ or ☐▽ to highlight the desired beeper associated parameter you want to modify.

- Press ☐Select and use ☐△ or ☐▽ to highlight the beeper status option.

- Press ☐Select to confirm your selection and return to the Beeper menu or press ☐Escape to return without changing.

Saving Confirmation

When enabling this option, a prompt will appear on the LCD alerting the user to save the modified values by pressing ☐Yes , exiting without saving by pressing ☐No or canceling the saving operation and return to the editing mode by pressing ☐Cancel . If disabled, the modified values will be saved automatically.

To enable / disable the saving confirmation:

- Use ☐△ or ☐▽ to select the *Saving Confirmation* option.

- Press ☐Select and use ☐△ or ☐▽ to choose enabled / disabled.

- Press ☐Select to confirm your selection or press ☐Escape to cancel operation.

GLP Data

This option allows the user to set general information which will appear in the log reports. The options can have a max of 10 characters.

Operator ID — this option allows you to edit the name of the operator.

Instrument ID — this option allows you to edit an identification name/number for the instrument.

Company Name — this option allows you to edit the company name.

Additional Info 1 & Additional Info 2 — for general purpose notations.

highlighted lot. The "Please wait..." message will be displayed on the LCD for a short period. The user customised report will be displayed on the LCD.

Note: For automatic logging only, it is possible to view the plotted graph.

- Press ☐View Graph to display the graph.

- By pressing ☐Shift Axes it is possible to move the graph along the horizontal or vertical axis with the arrow keys.

- If pressing ☐SETUP while the graph is displayed, the zoom menu for the horizontal and vertical axes will be accessed. Press ☐Zoom Time , or ☐Zoom pH / ☐Zoom mV / ☐Zoom Rel mV / ☐Zoom Ion / ☐Zoom Cond. / ☐Zoom Resistiv. / ☐Zoom TDS / ☐Zoom Salinity to switch between the active zooming axes and then zoom in or out on the selected axis by pressing the appropriate virtual key.

- Press ☐Escape to return to the previous menu at any time.

To delete lots:

- Press ☐SETUP while in *Log Recall* mode.

- Press ☐Delete or ☐Delete All to access delete or delete all mode. Otherwise, press ☐View to return to *Log Recall* view mode.

- After selecting one of the deleting modes, use ☐△ or ☐▽ to select one lot and then press ☐Delete or ☐Delete All to delete the selected lot or all lots. The "Please wait..." message will be displayed on the LCD until the selected lot or all lots are deleted.

- Press ☐SETUP and then press ☐View to exit deleting mode and return to *Log Recall* view mode.

- Press ☐Escape to exit *Log Recall* mode and return to *Measure* mode.

Note: Logged lots should also be deleted whenever "Please Delete Old Log Files" or "Low Data Logging Space" message appears on the LCD, in the Reminder messages area.

set as Direct/AutoHold in order to use this logging mode.

To log data using this mode:

• Press [Start Log] while in *Measure* mode to start the logging session. The logged values are only the ones frozen on the LCD, after [Auto Hold] was pressed and the stability criterion reached.

• To store another frozen value, press [Continuous Reading] to return to normal logging mode and then [Auto Hold] again.

• To stop the logging session, press [Stop Log] or [Stop Log1] / [Stop Log2].

Notes: • For the automatic logging, if the maximum logging time (24h) has been reached, a warning pop-up will be displayed on the LCD in order to stop the current log and start another one in a new lot.

• If 100 lots have been saved or maximum 10000 records have been manually stored, a warning pop-up will be displayed on the LCD in order to delete one lot or to select a new lot for the manual logging to log other records.

LOG RECALL

This feature allows the user to view all stored data. If no data were logged, the "No records were found" message will be displayed on the LCD in the Log Recall screen. Otherwise, the instrument will display all the memorized lots in accordance with the selected option: Automatic Log, Manual Log ISE Method Report (**HI 4522**), or USP Report.

To view the memorized data:

• Press [SETUP] while in *Measure* mode.

• Press [Log Recall]. The "Choose Log Report Type" message will be displayed in the Reminder messages area.

• Press [Automatic Log], [Manual Log], [ISE Method Report], or [USP Reports] to select the desired Log / ISE/ USP Report type. All logged lots for the selected Log Report type will be displayed on the LCD.

• To filter the displayed lots, press [MODE] and then the desired unit ([pH], [mV], [ISE] (**HI 4522**), [Cond.], [Resistiv.], [TDS] or [Salinity]). Only the selected measurement unit lots will be displayed on the LCD.

• Select the desired lot with [△] or [▽] and press [View] to display the logged / report data from the

To set the GLP Data:

• Use [△] or [▽] to select the *GLP Data* option.

• Press [Select] and use [△] or [▽] to highlight the desired option.

• Press [Select] to edit the desired information. The Text Editor menu will be displayed on the LCD.

• Enter the desired information by using [▷] and [▽] to highlight the desired character. It is also possible to delete the last character by positioning the cursor on the Backspace character (⌫) and pressing [Select].

• Press [Escape] to return to the *GLP Data* menu. If the *Saving Confirmation* is enabled, press [Yes] to accept the modified option, [No] to escape without saving or [Cancel] to return to the editing mode. Otherwise, the modified options are saved automatically.

Date & Time

This option allows the user to set the current date & time and the format in which they appear.

Set Date and Time

This option allows you to set the current date (year/month/day) and time (hour/minute/second).

Notes: • Only years starting with 2000 are accepted.

• The time is set using the selected time format. For 12 Hour time format only, the AM/PM can also be selected with [△] or [▽].

Set Time Format

This option allows you to choose between 12 Hour (AM/PM) time format and 24 Hour time format from the displayed pop-up menu.

Set Date Format

This option allows you to choose the desired date format from 6 available options: DD/MM/YYYY; MM/DD/YYYY; YYYY/MM/DD; Mon DD, YYYY; DD-MM-YYYY and YYYY-Mon-DD.

To set the Date & Time:

• Use [△] or [▽] to select the *Date& Time* option.

• Press [Select] and use [△] or [▽] to highlight the desired option you want to modify.

- Press [Select] to confirm your selection. Use [Next] and [Previous] and then use [Edit] to modify the value with [△] or [▽] (for *Set Date and Time* option). For the other two options press [Select] to confirm your selection and select one of the displayed formats with [△] or [▽].

- Press [Select] to confirm your selection and return to the *Date & Time* options.

- Press [Escape] to return to the previous mode.

Notes: • For the *Set Date and Time* option, if the *Saving Confirmation* is enabled, press [Yes] to accept the modified option, [No] to escape without saving or [Cancel] to return to the editing mode. Otherwise, the modified option is saved automatically.

• If the time is changed with more than one hour before last pH/ION calibration, a pop-up warning will appear on the LCD, notifying the user that a date/time conflict has occured and some time-dependent modes could work improperly (e.g. *Measure, GLP, Log*).

LCD Setup

This option allows the user to set the *Contrast*, the *Backlight* of the LCD and the *Backlight Saver*. The *Contrast* parameter can be adjusted within 7 steps, while the *Backlight* parameter within 4 steps. The *Backlight Saver* can be set from 1 to 60 minutes or it can be OFF (disabled). All the changes are visible on the LCD for each parameter.

Note: If the instrument backlight is turned off after the set period of time, press any key to turn it back on.

To set the LCD Setup:

- Use [△] or [▽] to select the *LCD Setup* option.

- Press [Select] and use [Next] key to highlight the desired parameter.

- Use [△] or [▽] to adjust the selected parameter.

- Press [Escape] to return to the *System Setup* menu with saving.

The "Logging", sampling period and "AutoHold" indicators will be displayed on the LCD.

- To store another frozen value, press [Auto Hold1]/[Auto Hold2] again.

- To stop the logging session, press [Stop Log1]/[Stop Log2].

LOGGING MODE 3

This logging mode can be used for any sample measurements. By choosing this logging mode, [Log1]/[Log2] will be available in *Measure* mode.

To log data using this mode:

- Press [Log] while in *Measure* mode to manually log a record. The "Logged" indicator will be displayed on the LCD.

- The records will be stored in one lot. In order to change the logging lot, see the measured parameter setup for details, Log option, New Lot generation.

LOGGING MODE 4

This logging mode can be used for multiple samples measurement. By choosing this logging mode, [Log1]/[Log2] and [Auto Hold1]/[Auto Hold2] will be available in *Measure* mode.

To log data using this mode:

- Press [Log1]/[Log2] while in *Measure* mode to manually log a record. Each value is logged at the time when the key was pressed. When the measured value is frozen on the LCD by pressing [Auto Hold1]/[Auto Hold2] and the stability criterion is reached, the logged value is the one that has been frozen on the LCD.

- To store another frozen value, press [Continuous Reading] to return to normal logging mode and then [Auto Hold] again.

- The records will be stored in one lot. In order to change the logging lot, see the measured unit *Setup* for details, Log option, New Lot generation.

LOGGING MODE 5

This logging mode can be used for multiple samples measurement. By choosing this logging mode, [Start Log] and [Auto Hold] will be available in *Measure* mode.

Notes: • The [Start Log1] or [Start Log2] and [Auto Hold1] or [Auto Hold2] will be available in multichannel *Measure* mode, depending on the focused channel.

• If the Reading Mode option is set as Direct and the Logging Mode 5 session is started, a warning pop-up will be displayed on the LCD, informing the user that the Reading Mode option must be

- To stop the logging session, press [Stop Log1] / [Stop Log2]. The Log Save screen will display thelog lot ID, the settable log interval / sampling:
  - Press [Set Interval] to adjust the log interval and/or the log sampling or press [Save] to save the current log in the displayed format.
  - Press [Edit] to enter log interval edit menu and use [△] or [▽] to adjust the logging start-stop time or the log sampling. Press [Accept] to save the current value and use [Next] or [Previous] to adjust next / previous parameter.
  - Press [Escape] to exit log interval edit menu and then press [Save] to save the current log.
  - While the instrument is saving the data, a "Please wait..." pop-up message will be displayed on the LCD.

LOGGING MODE 2

This logging mode can be used for multiple samples measurement. By choosing this logging mode, [Start Log1] / [Start Log2] and [Auto Hold1] / [Auto Hold2] will be available in *Measure* mode.

To log data using this mode:

- Press [Start Log1] / [Start Log2] while in *Measure* mode to start the logging session. When the measured value is frozen on the LCD by pressing [Auto Hold1] / [Auto Hold2] and the stability criterion is reached, the logged value is the one that has been frozen on the LCD until returning to normal logging mode by pressing [Continuous Reading].

Language

This option allows the user to choose the desired language in which all information will be displayed.

To select the Language:

- Use [△] or [▽] to select the Language option.
- Press [Select] and use [△] or [▽] to highlight the desired language.
- Press [Select] to confirm your selection and return to the *System Setup* menu or press [Escape] to return to the System Setup menu without changing.

Serial Communication

This option allows the user to set the desired speed for the serial communication (baud rate) between the instrument and PC from *1200, 2400, 4800* or *9600*.

To set the serial communication:

- Use [△] or [▽] to select the *Serial Communication* option.
- Press [Select] and use [△] or [▽] to highlight the desired baud rate.
- Press [Select] to confirm your selection and return to the *System Setup* menu or press [Escape] to return without changing.

Note: The meter and the PC program must have the same baud rate.

Meter Information

This option provides general information about the instrument serial number (each instrument has an unique identification serial number), the software version and the factory calibration date and time (for mV, conductivity and temperature).

Note: All the instruments are factory calibrated for mV, conductivity and temperature. After one year following factory calibration, the "**Factory Calibration Due**" message will appear on the LCD, in the Reminder messages area, notifying the user that the instrument should be taken to the nearest Hanna Customer Service for factory calibration.
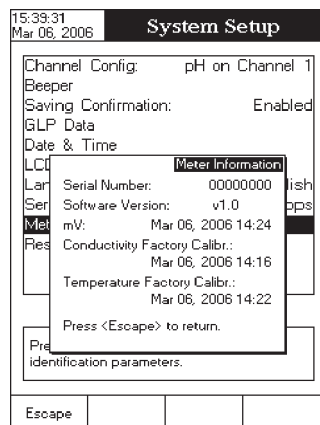
To view the meter information:

- Use [△] or [▽] to select the *Meter Information* option.
- Press [Select] to confirm and to view the meter information or press [Escape] to return to the *System Setup* menu.

Restore Factory Settings

This option allows the user to reset the instrument to the default factory settings.

To restore the factory settings:

- Use [△] or [▽] to select the *Restore Factory Settings* option.
- Press [Select] to confirm your selection. A pop-up box will be displayed, asking for confirmation.
- Press [Yes] to confirm your selection and return to the *System Setup* or press [No] to return without restoring defaults.
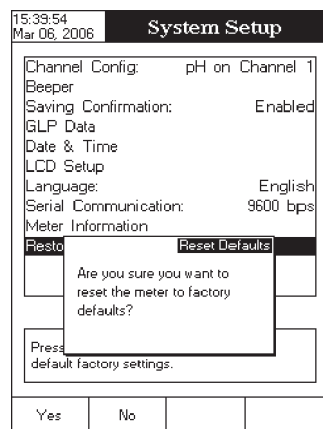
This feature allows the user to log pH, mV, ISE (**HI 4522**), conductivity, resistivity, TDS, salinity and temperature. The logging behaviour is dependent on the *Logging Type* and *Reading Mode* options from the parameter setup.

The *Logging Data Configuration* options from the appropriate unit setup must be set first in order to be saved into the log report.

The maximum number of logged records is 10.000/lot, the maximum logging time is 24h and up to 100 lots can be saved.

Regarding data logging, the available logging modes are shown in the table below:

Logging Mode	Logging Type	Reading Mode
1	Automatic	Direct
2	Automatic	Direct/AutoHold
3	Manual	Direct
4	Manual	Direct/AutoHold
5	AutoHold	Direct/AutoHold

LOGGING MODE 1

This logging mode can be used to monitor a chemical reaction. By choosing this logging mode, [Start Log] will be available in *Measure* mode.

To log data using this mode:

- Press [Start Log1] / [Start Log2] while in *Measure* mode to start the logging session. The "Logging" and the Sampling Period indicators will be displayed on the LCD and data will be stored at the set sampling period.
- **Note**: While automatic logging is running, the measured parameter setup is not available. A warning message will be displayed if the setup is accessed.
- If accessing Graph option while logging, the online graph can be visualized on the LCD (see *Display Mode* section).
- If accessing Log History option while logging, last logged data can be visualized on the LCD (see *Display Mode*).
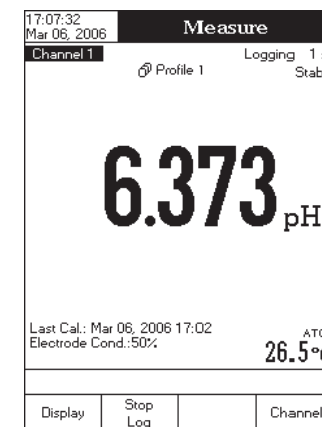
The temperature user calibration menu can be accessed at the meter startup by pressing simultaniously three keys as in the below drawing:

PUSH ALL THREE BUTTONS SAME TIME
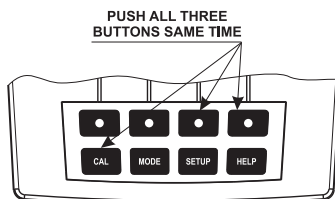
Note: The temperature user calibration is performed in three points: around 0°C, 50°C, 100°C.

To perform temperature user calibration:

- Select the desired temperature channel by pressing [Channel] (the temperature channel is switched between temperature EC channel and temperature pH channel).

- Press [Start User Calib] to start the temperature calibration. Adjust the temperature preset value using [△] or [▽] when necessary.

- Insert the probe in the beaker with water at 0°C.

- Wait to stabilize and then press [Accept] to confirm the calibration point.

- Repeat the previous three steps for 50°C and 100°C.

- Save the calibration.

- Press [Escape] to return to measure mode.
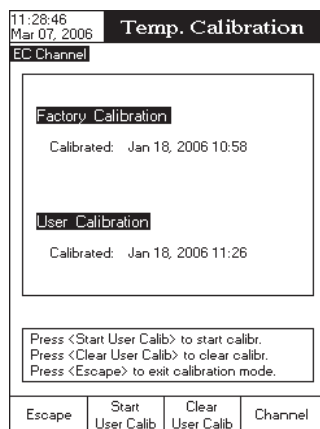
Note: Press [Clear User Calib] if you want to clear the temperature user calibration.


```
11:28:46        Temp. Calibration
Mar 07, 2006
EC Channel

    Factory Calibration

        Calibrated:   Jan 18, 2006 10:58


    User Calibration

        Calibrated:   Jan 18, 2006 11:26



Press <Start User Calib> to start calibr.
Press <Clear User Calib> to clear calibr.
Press <Escape> to exit calibration mode.

Escape   Start      Clear     Channel
         User Calib User Calib
```

The pH Setup menu allows the user to set the parameters associated with pH measurement and calibration.

Accessing pH Setup

- Press [MODE] while in *Measure* mode and then [pH] to select pH range for the desired channel.

- Press [SETUP] and then [pH Setup] to access pH Setup menu.

To access a pH Setup option:

- Use [△] or [▽] to highlight the desired option.

- Press [Select] to access the selected option.


```
15:40:18          pH Setup
Mar 06, 2006
Channel 1

Profile:                    Profile 1
Temperature
Calibration
Sample ID
Stability Criteria:           Medium
Reading Mode:                 Direct
Log
Alarm
Isopotential Point:        7.000 pH
pH Resolution:                X.XXX


Press <Select> to access the profiles
manager.

Escape    Select     △        ▽
```
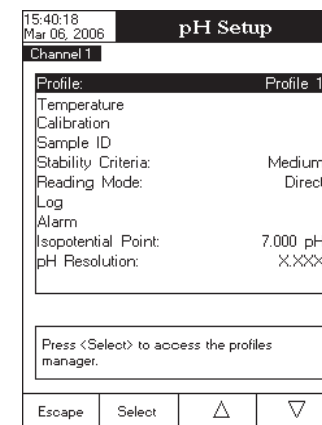
The following is a detailed description of the pH Setup option screens.

Profile

Choosing this option the measuring and the calibration mode can be customized. Up to 10 profiles can be defined by the user.

The available options are:

Save Current Profile: save the current profile.

Load Profile: load from available profiles.

Delete Profile: delete a profile.

Save Current Profile

To save the current profile:

- Use [△] or [▽] to select the *Profile* option.

- Press [Select] and then select *Save Current Profile* option. The *Text Editor* box will be displayed on the LCD.

- Enter the desired profile name by using [▷] and [▽] to highlight the desired character and then press [Select] to add it to the text bar. It is also possible to delete the last character by positioning the cursor on the Backspace character (⌫) and pressing [Select].

- Press [Escape] to return to the Profile options.


```
14:17:49          pH Setup
Mar 06, 2006
Channel 2

Save Current Profile
Load Profile
Delete Profile




Press <Select> to save the current profile
and give it the name for future use.

Escape    Select     △        ▽
```

Note: The saved profile will automatically become the current profile.

Load Profile

To load one profile:

- Use [△] or [▽] to select the *Profile* option.
- Press [Select] and use [△] or [▽] to highlight the *Load Profile* option.
- Press [Select]. A list with all customised profiles will be displayed on the screen.
- Use [△] or [▽] to select the desired profile and press [Select] to confirm or [Escape] to exit without selecting.

Delete Profile

To delete one of the existing profiles:

- Use [△] or [▽] to select the *Profile* option.
- Press [Select] and use [△] or [▽] to highlight the *Delete Profile* option.
- Press [Select]. A list with all customised profiles will appear on the screen.
- Use [△] or [▽] to select the desired profile and press [Delete].
- Press [Escape] to return to the previous menu.

PRACTICAL SALINITY SCALE (UNESCO 1978)

According to the definition, salinity of a sample in psu (practical salinity units) is calculated using the following formula:

$$R_T = \frac{C_T(\text{sample})}{C(35;15) \cdot r_T}$$

$$r_T = 1.0031 \cdot 10^{-9} T^4 - 6.9698 \cdot 10^{-7} T^3 + 1.104259 \cdot 10^{-4} T^2 + 2.00564 \cdot 10^{-2} T + 6.766097 \cdot 10^{-1}$$

$$\text{Sal} = \sum_{k=0}^{5} a_k \cdot R_T^{\frac{k}{2}} + f(t) \cdot \sum_{k=0}^{5} b_k R_T^{\frac{k}{2}} - \frac{c_0}{1 + 1.5X + X^2} - \frac{c_1 f(t)}{1 + Y^{\frac{1}{2}} + Y^{\frac{3}{2}}}$$

$$f(t) = \frac{T - 15}{1 + 0.0162 \cdot (T - 15)}$$

where:

R_T - coefficient;

$C_T(\text{sample})$ - uncompensated conductivity at T °C;

$C(35,15) = 42914$ μS/cm - the corresponding conductivity of KCl solution containing a mass of 32.4356 g KCl / 1 Kg solution;

r_T - temperature compensation polynom

$a_0 = 0.008$	$b_0 = 0.0005$
$a_1 = -0.1692$	$b_1 = -0.0056$
$a_2 = 25.3851$	$b_2 = -0.0066$
$a_3 = 14.0941$	$b_3 = -0.0375$
$a_4 = -7.0261$	$b_4 = 0.0636$
$a_5 = 2.7081$	$b_5 = -0.0144$

$c_0 = 0.008$
$c_1 = 0.0005$
$X = 400R_T$
$Y = 100R_T$

$$f(T) = (T-15)/[1 + 0.0162(T-15)]$$

Note: The formula can be applied for salinity values between 0 and 42 psu.
The formula can be applied for temperatures between -2 °C and 35 °C.

Salinity calibration is a one-point calibration procedure at 100.0% NaCl. Use the **HI 7037L** calibration solution (sea water solution) as a 100% NaCl standard solution.

To enter salinity calibration:
- Set the meter for salinity range;
- Select the *Percent Scale* (see *Salinity Setup* section);
- Rinse the probe with some of the calibration solution or deionized water;
- Immerse the probe into **HI 7037L** solution. The sleeve holes must be completely submerged. Tap the probe repeatedly to remove any air bubbles that may be trapped inside the sleeve.
- Enter in calibration mode by pressing [CAL];
- Wait to stabilize;
- Press [Accept] to finish salinity calibration or press [Escape] to cancel calibration.

Three measurement scales are available for salinity (Natural Sea Water Scale, Practical Salinity Scale and Percent Scale).

NATURAL SEA WATER SCALE (UNESCO 1966)

According to the definition, salinity of a sample in ppt is calculated using the following formula:

$$R_T = \frac{C_T(\text{sample})}{C(35;15) \cdot r_T}$$
$$r_T = 1.0031 \cdot 10^{-9} T^4 - 6.9698 \cdot 10^{-7} T^3 + 1.104259 \cdot 10^{-4} T^2 + 2.00564 \cdot 10^{-2} T + 6.766097 \cdot 10^{-1}$$
$$R = R_T + 10^{-5} R_T (R_T - 1.0)(T - 15.0)[96.7 - 72.0 R_T + 37.3 R_T^2 - (0.63 + 0.21 R_T^2)(T - 15.0)]$$
$$S = -0.08996 + 28.2929729 R + 12.80832 R^2 - 10.67869 R^3 + 5.98624 R^4 - 1.32311 R^5$$

where:

R_T - coefficient;

C_T(sample) - uncompensated conductivity at T °C;

$C(35,15) = 42914 \ \mu S$/cm - the corresponding conductivity of KCl solution containing a mass of 32.4356 g KCl / 1 Kg solution;

r_T - temperature compensation polynom.

Note: The formula can be applied for temperatures between 10 °C and 31 °C.

Temperature

The temperature has a direct influence on pH. This option allows the user to choose the temperature source and units, as well as the desired manual temperature for manual temperature compensation mode.

Temperature Source

If using a temperature probe, Automatic Temperature Compensation will be performed relative to the displayed temperature, with the "ATC 1 / 2" indicator displayed on the LCD. The ATC option can be selected for Channel 1 or Channel 2, in accordance with the configured channel utilizing a temperature probe. If no temperature probe is detected, Manual Temperature Compensation will be performed, with the "MTC" indicator on the LCD.

Temperature Unit

Accessing this option, the desired temperature unit can be chosen (Celsius, Fahrenheit or Kelvin degrees) and the meter will automatically make the conversion for the selected unit.

Manual Temperature

If no temperature probe is connected or the *Temperature Source* is set as *Manual*, the desired temperature can be set manually.

To set one of the temperature options:
- Use [△] or [▽] to select the *Temperature* option.
- Press [Select] and use [△] or [▽] to highlight the desired temperature option you wish to modify.
- Press [Select] and use [△] or [▽] to highlight the desired option (for *Temperature Source* & *Unit options*) or use [△] or [▽] to adjust the temperature value between the displayed limits (for *Manual Temperature* option).
- Press [Select] to confirm your selection (for *Temperature Source* & *Unit* options) or press [Accept] to save the current value (for *Manual Temperature* option). Otherwise, press [Escape] to cancel operation.
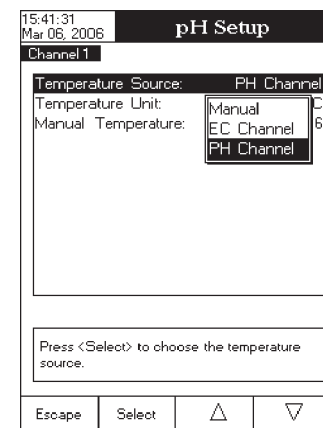
Calibration

This option allows the user to set all the data regarding the pH calibration process.

Buffer Entry Type

Three entry modes for the pH buffers used for calibration are available:

Automatic — the instrument automatically selects the closest buffer to the measured pH value from the edited buffer group.

Semiautomatic — the instrument automatically selects the closest buffers to the measured pH value from all

available buffers and you can choose the one used.

Manual Selection — the desired pH buffer is manually selected from all available buffers, regardless of measured value.

To select the Buffer Entry Type:

- Use [△] or [▽] to select the Calibration option.

- Press [Select] and use [△] or [▽] to highlight the *Buffer Entry Type* option.

- Press [Select] and use [△] or [▽] to highlight the desired option.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.

1st Cal. Point

Two options are available for the 1st Cal.: Point and Offset.

If Point option is selected, the slope values adjacent to the calibration points will be reevaluated (normal calibration).

If at least a two-point calibration has been performed and an offset correction of the electrode is wanted (maintaining the existing slope values), perform a one-point calibration using the Offset option.

To set the 1st Cal. Point:

- Use [△] or [▽] to select the *Calibration* option.

- Press [Select] and use [△] or [▽] to highlight the *1st Cal. Point* option.

- Press [Select] and use [△] or [▽] to highlight the desired option.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Edit Custom Buffers

If you want to use other buffers than the ones already memorized (standard buffers), the Edit Custom Buffers option is available, allowing you to set the desired pH buffers. Up to five pH custom buffers can be set.

Make sure the TDS factor has been set before taking TDS measurements (see *TDS Setup* section).

DIRECT MEASUREMENT

To measure the TDS of a sample using the *Direct* reading mode:

- Press [MODE] and then [TDS] to select TDS measure mode.
- Select the *Direct* reading mode (see *TDS Setup* section).
- Proceed as for the conductivity measurement (see *Conductivity Measurement* section).

DIRECT/AUTOHOLD MEASUREMENT

To measure TDS of a sample using the *Direct / AutoHold* reading mode:

- Select the *Direct / AutoHold* reading mode (see *TDS Setup* section).
- Proceed as for the conductivity measurement. (see *Conductivity Measurement* section)

RESISTIVITY MEASUREMENT

Make sure the instrument has been calibrated before taking resistivity measurements.

DIRECT MEASUREMENT

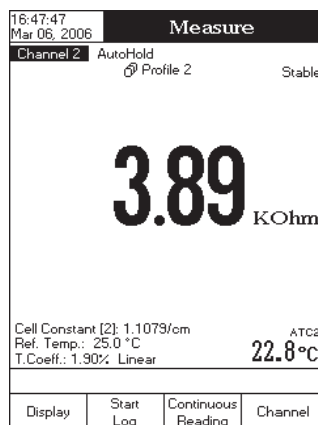To measure the resistivity of a sample using the *Direct* reading mode:

- Press [MODE] and then [Resistiv.] to select resistivity measure mode.
- Select the *Direct* reading mode (see *Resistivity Setup* section).
- Proceed as for the conductivity measurement (see *Conductivity Measurement* section).

```
16:45:30            Measure
Mar 06, 2006
Channel 2
              Profile 2         Stable



    3.90 KOhm



Cell Constant [2]: 1.1079/cm
Ref. Temp.: 25.0 °C              ATC2
T.Coeff.: 1.90% Linear       22.8°C

Display    Start              Channel
           Log
```
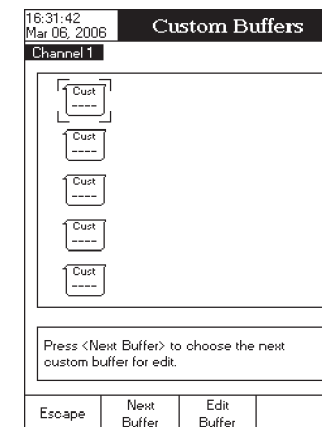
DIRECT/AUTOHOLD MEASUREMENT

To measure resistivity of a sample using the *Direct / AutoHold* reading mode:

- Select the *Direct / AutoHold* reading mode (see *Resistivity Setup* section).
- Proceed as for the conductivity measurement. (see *Conductivity Measurement* section)

```
16:47:47            Measure
Mar 06, 2006
Channel 2  AutoHold
              Profile 2         Stable



    3.89 KOhm



Cell Constant [2]: 1.1079/cm
Ref. Temp.: 25.0 °C              ATC2
T.Coeff.: 1.90% Linear       22.8°C

Display    Start   Continuous  Channel
           Log     Reading
```

To edit the Custom Buffers:

- Use [△] or [▽] to select the *Calibration* option.
- Press [Select] and use [△] or [▽] to highlight the *Edit Custom Buffers* option.
- For a previous set value, press [Invalidate Buffer] to set the custom buffer value to "----" if desired and confirm the setting by pressing [Yes], otherwise press [Edit Buffer] to edit the selected custom buffer.
- While in edit custom buffer menu press [Reset Buffer] to set the custom buffer value to 7.000 pH and then use [△] or [▽] to set the desired custom buffer value.
- Press [Escape] to exit custom buffer edit menu. If the Saving Confirmation is enabled, press [Yes] to accept the modified option, [No] to escape without saving or [Cancel] to return to the editing mode. Otherwise, the modified option is saved automatically.
- Use [Next Buffer] key to select the next custom buffer to be set or press [Escape] to return to Calibration options.

```
16:31:42          Custom Buffers
Mar 06, 2006
Channel 1
            Cust
            ----
            Cust
            ----
            Cust
            ----
            Cust
            ----
            Cust
            ----

Press <Next Buffer> to choose the next
custom buffer for edit.

Escape    Next     Edit
          Buffer   Buffer
```

Edit Buffer Group

Accessing this option the user can edit the desired group of five pH buffers for automatic buffer recognition (Automatic Buffer Entry Type). If the Buffer Group already contains five pH buffers, at least one pH buffer has to be removed in order to add another buffer.

To set the Buffer Group:

- Use [△] or [▽] to select the *Calibration* option.
- Press [Select] and use [△] or [▽] to highlight the *Edit Buffer Group* option.
- Press [Select] and use [▷] and [▽] to choose the pH buffer to be included in the buffer group.
- Press [Add] or [Remove] to add / remove the selected pH buffer to / from the buffer group.
- Press [Escape] to return to Calibration options and to save the changes.

```
16:32:54          Buffer Group
Mar 06, 2006
Channel 1
       Available Buffers
    Hanna Hanna Hanna Hanna Hanna
    1.679 3.000 4.010 6.862 7.010
    Hanna Hanna Hanna
    9.177 10.010 12.450

       Buffer Group
    Hanna Hanna Hanna Hanna
    1.679 4.010 7.010 10.010 ----

Press <Add/Remove> to add/remove the
current buffer to/from buffer group.

Escape   Remove    ▷       ▽
```
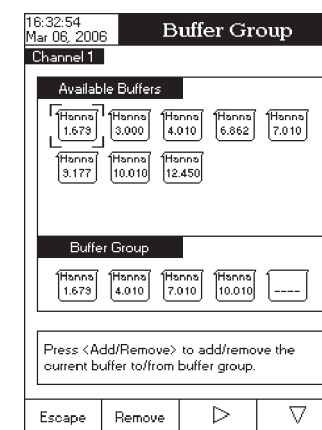
Calibration Reminder

In order to have accurate readings, the instrument must be calibrated frecquently. Three options are available for the calibration reminder: Daily, Periodic or Disabled.

To set the Calibration Reminder:

- Use [△] or [▽] to select the Calibration option.

- Press [Select] and use [△] or [▽] to highlight the *Calibration Reminder* option.

- Press [Select] and use [△] or [▽] to highlight the desired option.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Set Reminder Period

If choosing Daily or Periodic options for the Calibration Reminder, the Set Remind Period must be accessed in order to set the time interval until next calibration. The time interval between two calibrations can be set up to 1 day / 1 year for Daily / Periodic options.

Note: If Set Reminder Period parameter is accessed and the Calibration Reminder is disabled, a warning message appears on the LCD informing the user that the reminder period can be set only if the Calibration Reminder is set as Daily or Periodic.

To set the Reminder Period:

- Use [△] or [▽] to select the *Calibration* option.

- Press [Select] and use [△] or [▽] to highlight the *Set Reminder Period* option.

- Press [Select] and use [Next] / [Previous] to select next / previous entry to be edit.

- Press [Edit] and use [△] or [▽] to set the desired value, then press [Accept] to save the modified value.

- Press [Escape] to return to the Calibration options. If the Saving Confirmation is enabled, press [Yes] to accept the modified option, [No] to escape without saving or [Cancel] to return to the editing mode. Otherwise, the modified option is saved automatically.

Stage 3 - this is an off-line test.

To perform this test:

- Take the water sample from the previous test and increase its ionic strength for a pH measurement at 25 °C;
- Record the pH and round it to the nearest 0.1 pH;
- Look up the corresponding conducivity value measured in Stage 2 above;
- If the conductivity is lower than the conductivity from the below table, then the sample has met the USP requirements. Otherwise, the water didn't meet the USP requirements.

pH	Conductivity (μS/cm)	pH	Conductivity (μS/cm)
5.0	4.7	6.1	2.4
5.1	4.1	6.2	2.5
5.2	3.6	6.3	2.4
5.3	3.3	6.4	2.3
5.4	3.0	6.5	2.2
5.5	2.8	6.6	2.1
5.6	2.6	6.7	2.6
5.7	2.5	6.8	3.1
5.8	2.4	6.9	3.8
5.9	2.4	7.0	4.6
6.0	2.4		

To access the USP menu:

- Select the *Direct / USP* reading mode (see *Conductivity Setup*);
- Return to measure mode;
- Press (USP) and then select the desired USP stage.

DIRECT/USP MEASUREMENT

In this measure mode the user can check for ultra pure water using the United States Pharmacopeia standard (USP <645>).

This USP standard consists of three stages (one in-line and two off-line tests) as following:

Stage 1 - this is an in-line test.

To perform this test:

• Measure the temperature of the water and the uncompensated conductivity readings. The measurement may be performed in a suitable container or as in-line measurement.

• The temperature will be round down to the nearest 5 °C and look up the corresponding conductivity value in the below table.

• If the measured conductivity is lower than the conductivity in the table, then the water meets the USP requirements.

• Otherwise, proceed to Stage 2 testing.

Temperature (°C)	Conductivity (μS/cm)	Temperature (°C)	Conductivity (μS/cm)
0	0.6	55	2.1
5	0.8	60	2.2
10	0.9	65	2.4
15	1.0	70	2.5
20	1.1	75	2.7
25	1.3	80	2.7
30	1.4	85	2.7
35	1.5	90	2.7
40	1.7	95	2.9
45	1.8	100	3.1
50	1.9		

Stage 2 - this is an off-line test.

To perform this test:

• Store the water sample in an enclosed clean container that has been rinsed previously with water of the same quality.

• Adjust the sample's temperature to 25 °C and agitate the sample to ensure that it has equilibrated with ambient CO_2.

• If the measured conductivity is less than 2.1 μS/cm, then the sample has met the USP requirements.

• Otherwise, proceed to Stage 3 testing.

Clear Calibration

Accessing this option, the existent pH calibration can be cleared. If the calibration is cleared, another calibration has to be performed.

To clear Calibration:

• Use [△] or [▽] to select the Calibration option.

• Press [Select] and use [△] or [▽] to highlight the *Clear Calibration* option.

• Press [Select] to clear calibration. A pop-up menu will be displayed asking for confirmation.

• Press [Yes] to confirm or press [No] to escape without saving and return to the Calibration options.

Sample ID

This option allows the user to give to the measured samples an identification number/name. Two Sample ID options are available: *ID Increment Mode* and *Edit Sample ID*.

ID Increment Mode

Two increment modes for the sample ID can be selected:

None — the sample ID will be fixed and it can be set alphanumerically.

Automatic — the sample ID will be increased with 1 for each new log lot.

To set the ID Increment Mode:

• Use [△] or [▽] to select the *Sample ID* option.

• Press [Select] and use [△] or [▽] to highlight the *ID Increment Mode* option.

• Press [Select] and use [△] or [▽] to highlight the desired option.

• Press [Select] to confirm your selection or press [Escape] to cancel operation.

Edit Sample ID

This option allows the user to edit the sample ID.

Note: If the ID Increment Mode is set to None, the sample ID can be set alphanumerically, otherwise it can be set only numerically.

To edit the Sample ID:

- Use [△] or [▽] to select the Sample ID option.

- Press [Select] and use [△] or [▽] to highlight the *Edit Sample ID* option.

- Press [Select] to confirm your selection.

- If the selected increment mode is None, the Text Editor menu will be displayed on the LCD, allowing you to enter the desired sample number/name by accepting the highlighted character which is added in the text bar, using [Select]. The [▷] and [▽] keys help the user to select the desired character. It is also possible to delete the last character by positioning the cursor on the Backspace character and pressing [Select].

- Press [Escape] to return to Sample ID options. If the Saving Confirmation is enabled, press [Yes] to accept the modified option, [No] to escape without saving or [Cancel] to return to the editing mode. Otherwise, the modified options are saved automatically.

- If the selected increment mode is Automatic, the desired sample ID value can be set using [△] or [▽].

- Press [Accept] to save the current value or press [Escape] to cancel operation.

Stability Criteria

This option allows the user to select the signal stability criterion for the measured parameter (pH, mV, ISE):

Fast — this criterion will give faster results with less accuracy.

Medium — this criterion will give medium speed results with medium accuracy.

Accurate — this criterion will give slower results with high accuracy.

Make sure the instrument has been calibrated before taking conductivity measurements.

DIRECT MEASUREMENT

To measure the conductivity of a sample using the Direct reading mode:

- Press [MODE] and then [Cond.] to select conductivity measure mode.

- Select the *Direct* reading mode (see *Conductivity Setup*).

- Submerge the conductivity probe and tap it repeatedly to remove any air bubbles that may be trapped inside the sleeve. Allow time for the reading to stabilize.

- The measured conductivity value will be displayed.

Note: If the reading is out of range, "-----" will be displayed.

DIRECT/AUTOHOLD MEASUREMENT

To measure conductivity of a sample using the Direct / AutoHold reading mode:

- Select the Direct / AutoHold reading mode (see *Conductivity Setup*).

- If pressing [Auto Hold], the "AutoHold" indicator will start blinking on the display until the stability criterion is reached. The conductivity value will be frozen on the display, along with "AutoHold" indicator.

- To return to normal measure mode press [Continuous Reading].

- Insert and rinse the probe in the first beaker in order to decontaminate it;

- Insert the probe in the second beaker;

- Tap the probe repeatedly to remove any air bubbles that may be trapped inside the sleeve.

- Enter in calibration mode by pressing [CAL];

- Wait to stabilize;

- When the automatic standard recognition is selected, the calibration point will be automatically selected from the Hanna standard list (84 μS, 1413 μS, 5.0 mS,12.88 mS, 80.0 mS, 111.8 mS). The user can also select the desired standard value by using [△] and [▽];

- Otherwise (user standard), the pop-up will prompt for the custom standard value.

- Press [Accept] to finish the calibration or [Escape] to abort calibration.

Note: The calculated cell constant will be used for the whole range.

Multi Point Calibration

- Up to 4 calibration points can be performed in order to increase the measurement accuracy on the wide range;

- Select the multi point calibration (see *Conductivity Setup -> Calibration*);

- Repeat the steps from the single point calibration for each calibration point. The meter will calculate a cell constant corresponding to each calibration point;

- Press [Escape] to exit calibration mode.

Note: For each range the corresponding cell constant will be displayed.

CELL CONSTANT CALIBRATION (edited by the user)

- A known value of the probe cell constant can be set by the user for the whole range (see *Conductivity Setup -> Cell Constant* section)

Note: When the user cell constant is used the old calibration (in solution) will be cleared.

To set the Stability Criteria:
- Use [△] or [▽] to select the *Stability Criteria* option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Reading Mode
This option allows the user to select between *Direct* and *Direct/AutoHold* pH reading mode. If choosing the second option, the current reading can be frozen on the LCD when [Auto Hold] is pressed and if the stability criterion is reached.

To set the Reading Mode:
- Use [△] or [▽] to select the *Reading Mode* option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Log
This option allows the user to edit the logging settings: *Logging Type, Logging Data Configuration, Sampling Period* and *New Lot*.

Logging Type
Three logging types are available: *Automatic, Manual* and *AutoHold*. With the Automatic type the values are logged automatically at constant time intervals while with the Manual type the user has the capability to log a measured value by pressing [Log]. With the AutoHold type the stored values are only the ones frozen on the LCD

after the logging session was started.

To set the Logging Type:

- Use [△] or [▽] to select the *Log* option.

- Press [Select] and use [△] or [▽] to highlight the *Logging Type* option.

- Press [Select] and use [△] or [▽] to highlight the desired option.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Logging Data Configuration
This option allows the user to select the parameters that accompany a logged value: *Date / Time, Calibration Data, Sample ID, Instrument ID, Operator ID, Company Name, Aditional Info 1* and *Aditional Info 2.*

To set the Logging Data Configuration:

- Use [△] or [▽] to select the Log option.

- Press [Select] and use [△] or [▽] to highlight the *Logging Data Configuration* option.

- Press [Select] and use [△] or [▽] to highlight the desired parameter to be logged in file.

- Press [Select] to confirm your selection and use [△] or [▽] to enable the parameter by selecting Yes or to disable it by selecting No.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.

CONDUCTIVITY CALIBRATION

It is recommended to calibrate the instrument frequently, especially if high accuracy is required.
The conductivity range should be recalibrated:
- Whenever the conductivity probe is replaced.
- At least once a week.
- Before USP measurements.
- After testing aggressive chemicals.
- When calibration reminder is activated ("Conductivity Cal Expired").
- If the readings are far from the calibration point.

Note: TDS and Resistivity readings are automatically derived from the conductivity readings and no specific calibration is needed.

OFFSET CALIBRATION
The meter allows the user to calibrate the probe for the offset.
- Set the meter for conductivity range;
- Select the automatic standard recognition (see *Conductivity Setup -> Calibration*);
- Leave the dry probe in the air;
- Enter in calibration mode by pressing [CAL];
- Wait to stabilize. The 0.000 μS calibration point will appear on the screen;
- Press [Accept] to finish the probe offset calibration.
- Press [Escape] to exit calibration mode or continue calibration in the other standard solutions.

Note: The offset calibration can be performed only if it is perfomed first (no other calibration points present). Clear the old calibration if it is present.

CELL CONSTANT CALIBRATION (in solution)

Single Point Calibration

- Select the single point calibration (see *Conductivity Setup -> Calibration*);
- Pour a small quantity of the standard solution into a clean beaker. If possible, use plastic beakers to minimize any EMC interferences.
- For accurate calibration and to minimize cross-contamination, use two beakers for each standard solution.

One for rinsing the probe and one for calibration.

Clear Calibration

Accessing this option, the existent salinity calibration (*Percent Scale*) can be cleared.

To clear calibration:

- Use △ or ▽ to highlight the *Clear Calibration* option.
- Press Select to clear calibration. A pop-up menu will be displayed to ask for confirmation.
- Press Yes to confirm or press No to cancel operation.

Salinity Scale

The meter uses three salinity scales: Natural Sea Water 1966, Practical Scale 1978, Percent Scale [%].

To select the salinity measurement scale:

- Press SETUP while in salinity measure mode.
- Press Salinity Setup .
- Use △ or ▽ to select the *Salinity Scale* option.
- Press Select and use △ or ▽ to highlight the desired option.
- Press Select to confirm your selection or press Escape to cancel operation.

Sample ID - see *Conductivity Setup* section.

Log - see *Conductivity Setup* section.

Alarm - see *Conductivity Setup* section.

Sampling Period

This option allows the user to select the desired sampling period for automatic logging type.

To set the Sampling Period:

- Use △ or ▽ to select the *Log* option.
- Press Select and use △ or ▽ to highlight the *Sampling Period* option.
- Press Select and use △ or ▽ to select the desired logging time interval.
- Press Select to confirm your selection or press Escape to cancel operation.

New Lot

Accessing this option, a new manual lot can be generated next time you want to manually log a measured value.

Note: If New Lot option is accessed and the Logging Type is Automatic, a warning message appears on the LCD informing the user that a new lot can be created only if the Logging Type is set as Manual.

To generate a New Lot:

- Use △ or ▽ to select the *Log* option.
- Press Select and use △ or ▽ to highlight the *New Lot* option.
- Press Select to generate a new manual lot. A pop-up menu will be displayed asking for confirmation.
- Press Yes to confirm or press No to escape without saving and return to the Log options.

Alarm

This option allows the user to edit the alarm settings: *Alarm State* and *Alarm Limits*. If the *Alarm* option is enabled, a continuous double beep will be heard, along with the "Alarm" indicator blinking on the LCD, each time the set limits in *Measure* mode are exceeded.

Alarm State

Three modes are available for the *Alarm State* option:

Disabled – the alarm will be disabled.
Inside Limts – the alarm will notify the user when the measured value is inside the set limits.
Outside Limits – the alarm will notify the user when the measured value is outside the set limits.

To set the Alarm State:

- Use [△] or [▽] to select the *Alarm* option.
- Press [Select] and use [△] or [▽] to highlight the *Alarm State* option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Alarm Limits

This option allows the user to set the alarm limits for the measured value.
Note: The Alarm High value can not be lower than the Alarm Low value.

To set the Alarm Limits:

- Use [△] or [▽] to select the *Alarm* option.
- Press [Select] and use [△] or [▽] to highlight the *Alarm Limits* option.
- Press [Select] and use [Next] / [Previous] to select next / previous entry to be edit.
- Press [Edit] and use [△] or [▽] to set the desired value, then press [Accept] to save the modified value.
- Press [Escape] to return to the Alarm options. If the Saving

The Salinity Setup menu allows the user to set the parameters related to Salinity measurement and calibration.

Accessing Salinity Setup

- Press [MODE] while in *Measure* mode and then [Salinity] to select *Salinity* range.
- Press [SETUP] and then [Salinity Setup] to access *Salinity Setup* menu.

To access an *Salinity Setup* option:

- Use [△] or [▽] to highlight the desired option.
- Press [Select] to access the selected option.

The following is a description of the *Salinity Setup* option screens.

Profile - see *Conductivity Setup* section.

Reading Mode - see *Resistivity Setup* section.

Temperature

This option allows the user to choose the temperature source and units.

To access a Temperature options:

- Use [△] or [▽] to highlight the Temperature option.
- Press [Select] to access Temperature option.
- Press [Select] to confirm your selection and use [△] or [▽] to enable the parameter by selecting Yes or to disable it by selecting No.

Temperature Source, Temperature Unit - see *Conductivity Setup* section.

TDS factor

With this option the user can set the TDS factor.

- Use [△] or [▽] to highlight the TDS options.

- Press [Select] to confirm your selection and use [△] or [▽] to increase / decrease the value.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Sample ID - see *Conductivity Setup* section.

Log = see *Conductivity Setup* section.

Alarm - see *Conductivity Setup* section.

Confirmation is enabled, press [Yes] to accept the modified option, [No] to escape without saving or [Cancel] to return to the editing mode. Otherwise, the modified option is saved automatically.

Isopotential Point

This option allows the user to edit the isopotential point of the electrode used for pH measurements. The isopotential point is the mV reading for an electrode at which temperature has no effect on the measurement. The ideal electrode has an isopotential point of 0.0 mV and 7.00 pH, while an actual electrode tipically deviates slightly from the ideal values.

If the actual isopotential pH for an electrode is known, it can be set by accessing this option. The isopotential pH limits (low and high) will be displayed on the LCD.

Note: If the isopotential point has been modified, recalibration must be performed for the pH channel.

To set the Isopotential Point:

- Use [△] or [▽] to select the *Isopotential Point* option.

- Press [Select] and set the desired isopotential pH value using [△] or [▽].

- Press [Accept] to save the current value or press [Escape] to cancel operation.

pH Resolution

Accessing this option, the desired pH resolution can be set, with one (x.x), two (x.xx) or three (x.xxx) decimals.

To set the pH Resolution:

- Use [△] or [▽] to select the *pH Resolution* option.

- Press [Select] and use [△] or [▽] to highlight the desired option.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.

The mV Setup menu allows the user to set the parameters associated with mV and Relative mV measurements.

Accessing mV Setup

- Press [MODE] while in *Measure* mode and then [mV] or [Rel mV] to select mV / mV Rel range.
- Press [SETUP] and then [mV Setup] to access mV Setup menu.

To access a mV Setup option:

- Use [△] or [▽] to highlight the desired option.
- Press [Select] to access the selected option.

The following is a detailed description of the mV Setup option screens.

Profile — See *pH Setup* section.

Temperature — See *pH Setup* section.

Sample ID — See *pH Setup* section.

Stability Criteria — See *pH Setup* section.

Reading Mode — See *pH Setup* section.

Log — See *pH Setup* section.

Alarm — See *pH Setup* section.

Note: The Alarm Limits (Low and High) are set in mV units.

The TDS Setup menu allows the user to set the parameters related to the TDS measurement.

Accessing TDS Setup

- Press [MODE] while in *Measure* mode and then [TDS] to select TDS range.
- Press [SETUP] and then [TDS Setup] to access TDS Setup menu.

To access a TDS Setup option:

- Use [△] or [▽] to highlight the desired option.
- Press [Select] to access the selected option.

The following is a description of the TDS Setup option screens.

Profile - see *Conductivity Setup* section.

Reading Mode - see *Resistivity Setup* section.

Temperature - see *Conductivity Setup* section.

Units

This option allows the user to set the TDS measuring range ppm(mg/L), ppt(g/L), AutoRanging

To select the suitable unit:

- Use [△] or [▽] to highlight the *TDS Units*.
- Press [Select] to confirm and then use [△] or [▽] to highlight the convenient measuring range option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Temperature - see *Conductivity Setup* section.

Units
The user can choose between Ohm, KOhm, MOhm, AutoRanging measuring modes.
To select the units:
- Use [△] or [▽] to highlight the *Units* option.
- Press [Select] to confirm and then use [△] or [▽] to highlight the desired unit.
- Press [Select] to confirm or press [Escape] to cancel operation.

```
16:52:37
Mar 06, 2006      Resistivity Setup
Channel 2

Profile:                        Profile 2
Reading Mode:                    Direct
Temperature
Units:                       AutoRanging
Sample ID          ┌─────────────┐
Log                │ Ohm         │
Alarm              │ KOhm        │
                   │ MOhm        │
                   │ AutoRanging │
                   └─────────────┘

Press <Select> to set the resistivity
measurement units.

Escape   Select    △    ▽
```

Sample ID - see *Conductivity Setup* section.

Log - see *Conductivity Setup* section.

Alarm - see *Conductivity Setup* section.

ISE SETUP (HI 4522 only)

The ISE Setup menu allows the user to set the parameters regarding ISE measurement and calibration. These parameters can be set specifically for each channel. The settings will be applied only to the focused channel.

Accessing ISE Setup
- Press [MODE] while in *Measure* mode and then [ISE] to select ISE range for the desired channel.
- Press [SETUP] and then [ISE Setup] to access *ISE Setup* menu.

To access an *ISE Setup* option:
- Use [△] or [▽] to highlight the desired option.
- Press [Select] to access the selected option.

The following is a detailed description of the ISE Setup option screens.

```
13:43:59
Mar 06, 2006        ISE Setup
Channel 1

Profile:                        Profile 1
Reading Mode:                    Direct
Temperature
Calibration
Electrode Type:                 Fluoride
Concentration Unit:                  ppm
Sample ID
Stability Criteria:               Medium
Log
Alarm
ISE Significant Digits:              XXX

Press <Select> to access the profiles
manager.

Escape   Select    △    ▽
```

Reading Mode
This option allows the user to select the desired reading mode: *Direct, Direct / AutoHold, Known Addition, Known Subtraction, Analyte Addition* and *Analyte Subtraction*. Except Direct and Direct / AutoHold, all the other methods are incremental (see ISE Theory section for details).

Direct
If using Direct reading mode, the ion concentration can be read directly from the instrument. Make sure the instrument was calibrated before taking measurements.

Direct / AutoHold
If using Direct/AutoHold reading mode, the ion concentration can be frozen on the LCD after starting the AutoHold mode.

Known Addition
In the Known Addition method a standard with a known concentration of the measured ion is added to the sample. The difference in mV potential is then used to calculate the concentration of the ion in the sample.

Known Subtraction
In the Known Subtraction method a standard with a known concentration is added to the sample, reacting with the ion to be measured. The stoichiometric ratio between standard and sample must be known. The ion concentration is then calculated using the difference in mV potential.
The method is especially usefull when there is no available ISE for the measured ion.

Left Column

Analyte Addition

This method is similar to the Known Addition method, with the difference that an aliquot of sample is added to a standard of known concentration. The sample and standard contain the same ion to be measured. The ion concentration is then calculated using the difference in mV potential.

Analyte Subtraction

In the Analyte Subtraction method an aliquot of sample is added to a standard of known concentration, reacting with the ion to be measured. The stoichiometric ratio between standard and sample must be known. The ion concentration is then calculated using the difference in mV potential. The method is especially usefull when there is no available ISE for the measured ion.

To set the Reading Mode:

- Use [△] or [▽] to select the *Reading Mode* option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Temperature – See *pH Setup* section.

Note: The Temperature Compensation option is also included in the Temperature parameter.

Temperature Compensation

This option allows the user to enable / disable the temperature compensation for the measurement of Ion concentration.

To set the Temperature Compensation:

- Use [△] or [▽] to select the *Temperature* option.
- Press [Select] and use [△] or [▽] to highlight the *Temperature Compensation* option.
- Press [Select] and use [△] or [▽] to enable / disable the Temperature Compensation.

Right Column

The Resistivity Setup menu allows the user to set the parameters related with the resistivity measurements.

Accessing Resistivity Setup

- Press [MODE] while in *Measure* mode and then [Resistiv.] to select resistivity range.
- Press [SETUP] and then [Resistiv. Setup] to access *Resistivity Setup* menu.

To access a *Resistivity Setup* option:

- Use [△] or [▽] to select the desired option.
- Press [Select] to confirm your selection.

The following is a description of the Resistivity Setup option screens.

Profile - see *Conductivity Setup* section.

Reading Mode

This option allows the user to select between *Direct* and *Direct/AutoHold* resistivity reading modes.

To set the *Reading Mode:*

- Use [△] or [▽] to select the *Reading Mode* option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Alarm

This option allows the user to define two alarm limits.

Alarm State

The following options are available:

Disabled – the alarm will be disabled.

Inside Limits – the alarm will notify the user when the measured value is inside the preset limits.

Outside Limits – the alarm will notify the user when the measured value is outside the preset limits.

To set the alarm state:

- Use [△] or [▽] to highlight the *Alarm State* option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.
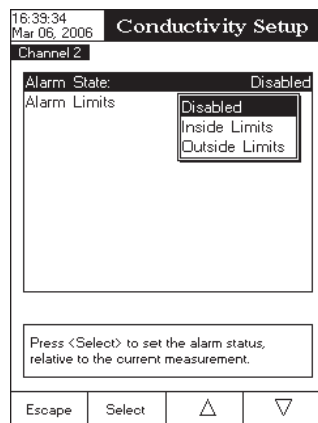
Alarm Limits

This option allows the user to set the alarm limits for the measured value.

Note: The alarm high value cannot be lower than the alarm low value.

To set the alarm limits:

- Hightlight the *Alarm Limits* option and then press [Select].
- Use [Next] or [Previous] to select the low /high alarm limit and then press (Edit) .
- Use [△] or [▽] to increase / decrease the selected alarm value.
- Press [Escape] to return to the Alarm options.
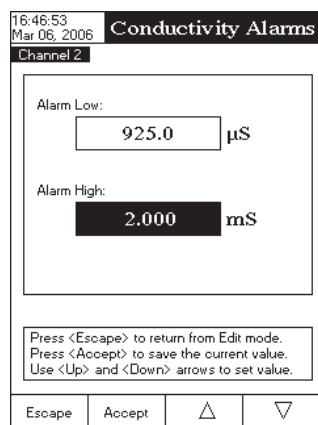
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Note: If an ISE calibration was performed and the Temperature Compensation option is changed, a warning message appears on the LCD informing the user to perform a new calibration or to set the previous option in order to perform accurate measurements.

Calibration

This option allows the user to set all the data regarding the Ion calibration process.

Standard Entry Type

Two entry modes for the standard solutions used for calibration are available:

Manual Selection – when the calibration is started, the desired standard solution can be manually selected from a standard solutions list (0.1 ppm, 1 ppm, 10 ppm, 100 ppm and 1000 ppm).

Custom Standard – when the calibration is started, each standard solution can be manually set (in ppm units) in a displayed pop-up menu.

To set the Standard Entry Type:

- Use [△] or [▽] to select the Calibration option.
- Press [Select] and use [△] or [▽] to highlight the *Standard Entry Type* option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.
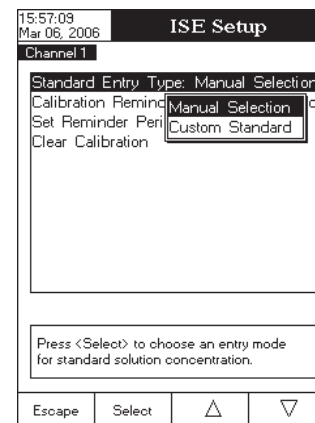
Calibration Reminder – See *pH Setup* section.

Set Reminder Period – See *pH Setup* section.

Clear Calibration – See *pH Setup* section.

Electrode Type

This option allows the user to select the desired Ion Selective Electrode used for measurements from a list: Ammonia, Bromide, Cadmium, Calcium, Carbon Dioxide, Chloride, Chlorine, Cupric, Cyanide, Fluoride, Iodide, Lead, Nitrate, Potassium, Silver, Sodium, Sulfate, Sulfide and five custom ISE. For the standard ISE it is possible to view the Ion constants (Name, Molar Weight and Electric Charge/Slope), while for the custom ISE all these constants can be manually set.

To set the Electrode Type:

- Use △ or ▽ to select the Electrode Type option.
- Press Select and use △ or ▽ to select the desired standard ISE or a custom one from the list.
  For standard ISE:
  - Press View to visualize the Ion constants and then press Escape at any time to exit Ion Constants view mode.
  - Press Select to confirm your selection and return to *ISE Setup* options.
  For custom ISE:
  - Press View to edit the Ion constants for the selected custom ISE. Use △ or ▽ to select the desired Ion constant and press Select to enter Ion constant edit mode or Escape to cancel operation.
  - For the Ion name the Text Editor menu will be displayed on the LCD. Enter the desired information by accepting the highlighted character which is added in the text bar, using Select . The ▷ and ▽ keys help the user to select the desired character. It is also possible to delete the last character by positioning the cursor on the Backspace character and pressing Select . Press Escape to return to the Ion Constants menu. If the Saving Confirmation is enabled, press Yes to accept the modified option, No to escape without saving or Cancel to return to the editing mode. Otherwise, the modified option is saved automatically.
  - To set the appropriate Ion molar weight (in g/mol units) use △ or ▽ and then press Accept to save the current value or press Escape to cancel operation.
  - To select the appropriate Electric Charge/Slope use △ or ▽ and then press Select . If the Ion electric charge is None, its slope can be manually set
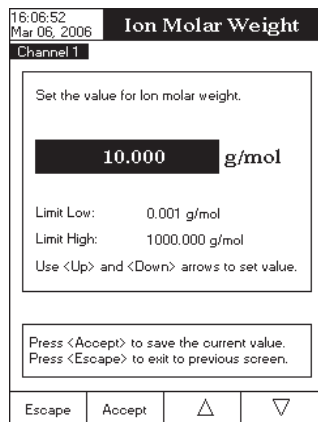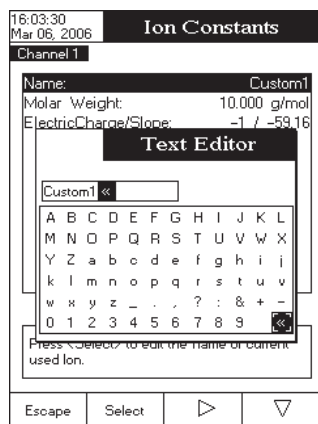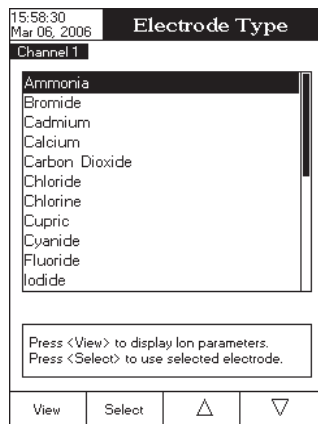
Sampling Period

This option allows the user to select the desired sampling period for automatic logging.

To set the sampling period:

- Use △ or ▽ to highlight the *Sampling Period* option.
- Press Select and use △ or ▽ to select the desired option from *1, 2, 5, 10, 30* seconds.
- Press Select to confirm your selection or press Escape to cancel operation.
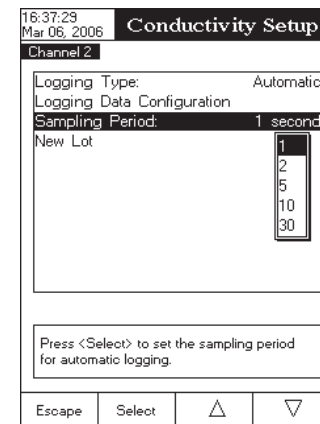
New Lot

Accessing this option, the new manually logged readings will be put in a new log lot.

To generate a new lot:

- Use △ or ▽ to highlight the *New Lot* option.
- Press Select to generate a new manual lot. A pop-up menu will be displayed to ask for confirmation.
- Press Yes to confirm or press No to escape without saving and return to the Log options.

Note: If *New Lot* option is accessed and the *Logging Type* is *Automatic*, a warning message appears on the LCD informing the user that a new lot can be created only if the Logging Type is set on *Manual*.

Log

This option allows the user to edit the settings related to the logging feature, as following:

Logging Type

Three logging types are available: *Automatic, Manual* and *AutoHold*.
Automatic logging - the readings are logged automatically at   constant time intervals (see *Sampling Period* option).
Manual logging (log on demand)- the readings are logged each time [Log] is pressed.
AutoHold logging - the readings are logged automatically at each auto-hold event occured.

To set the sample logging type:

- Use [△] or [▽] to highlight the *Logging Type* option.
- Press [Select] and use [△] or [▽] to choose from *Automatic, Manual* or *Auto Hold.*
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Logging Data Configuration

This option allows the user to select the parameters that accompany a logged value: *Date/Time, Calibration Data, Sample ID, Instrument ID, Operator ID, Company Name, Aditional Info 1* and *Aditional Info 2.*

To set the logging data configuration:

- Use [△] or [▽] to highlight the *Logging Data Configuration* option.
- Press [Select] and then use [△] or [▽] to enable the parameter by selecting *Yes* or to disable it by selecting *No* for each option.
- Press [Escape] to return to the previous menu.

by pressing [Edit]. A pop-up menu will be displayed on the LCD, in which the slope value can be set using [△] or [▽]. Press [Accept] to save the modified value or press [Escape] to return to the Ion Constants menu.

Note: If an ISE calibration was performed and a different Ion Selective Electrode is selected (standard or custom), a warning message appears on the LCD informing the user to perform a new calibration or to select the previous ISE in order to perform accurate measurements.

Concentration Unit

Accessing this option, the user can select the desired concentration unit for the measured ion or chemical compound. The available concentration units are: ppt (g/L), ppm (mg/L), ppb (μg/L), mg/mL, M (mol/L), mmol/L and %w/v.

To set the Concentration Unit:

- Use [△] or [▽] to select the Concentration Unit option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Sample ID — See *pH Setup* section.

Stability Criteria — See *pH Setup* section.

Log — See *pH Setup* section.

Note: The Logging Data Configuration option includes also the Ion Constants parameter. If you want it to appear in the log reports, it must be enabled.

Alarm — See *pH Setup* section.

Note: The Alarm Limits (Low and High) are set in the selected concentration unit of the measured ion or chemical compound and are displayed in a scientific format (value and value exponent).

Isopotential Point

This option allows the user to edit the isopotential point of the electrode used for ion measurements. The ion selective electrodes have different isopotential points. If temperature compensation is desired for the ion measurements, the isopotential point value is absolutely necessary.

The isopotential point is always edited in ppm (mg/L) units.

To set the Isopotential Point:

- Use [△] or [▽] to select the Isopotential Point option.
- Press [Select] and use [△] or [▽] to increase / decrease the isopotential point value.
- Press [Accept] key to save the modified value.
- Press [Escape] to return to the Ion Setup options. If the Saving Confirmation is enabled, press [Yes] to accept the modified option, [No] to escape without saving or [Cancel] to return to the editing mode. Otherwise, the modified option is saved automatically.

Note: If an ISE calibration was performed and the Isopotential Point option is changed, a warning message appears on the LCD informing the user to perform a new calibration or to set the previous option in order to perform accurate measurements.

ISE Significant Digits

Accessing this option, the number of ISE significant digits can be set, with one (x), two (xx) or three (xxx) significant digits.

To set the ISE Significant Digits:

- Use [△] or [▽] to select the *ISE Significant Digits* option.
- Press [Select] and use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Sample ID

This option allows the user to give to the measured samples an identification number/name. Two *Sample ID* options are available: *ID Increment* and *Edit Sample ID*.

ID Increment

None – the sample ID will be edited alphanumerically by the user.

Automatic – the sample ID will be automatically incremented at every new log lot notification.

To select the ID increment mode:

- Use [△] or [▽] to highlight the *ID Increment* option.
- Press [Select] and then use [△] or [▽] to highlight the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Edit Sample ID

This option allows the user to edit the sample ID (numeric - autoincrement mode, alphanumeric - user editable).

To edit the Sample ID:

- Use [△] or [▽] to select the Sample ID option.
- Press [Select] and use [△] or [▽] to highlight the *Edit Sample ID* option and then press [Select].
- Edit numerically / alphanumerically the sample ID.
- Press [Accept] to save the current sample ID or press [Escape] to cancel operation.

Clear Calibration

Accessing this option, the existent conductivity calibration can be cleared. If the calibration is cleared, another calibration has to be performed.

To clear calibration:

- Use [△] or [▽] to highlight the *Clear Calibration* option.

- Press [Select] to clear calibration. A pop-up menu will be displayed asking for confirmation.

- Press [Yes] to confirm or press [No] to escape without saving and return to the Calibration options.

Probe Type

This option allows the user to obtain some information about the connected conductivity probe: name, default cell constant, range and rings number.

Units

The user can select the desired measurement unit. The available options are: *μS, mS* or *AutoRanging*.

- Use [△] or [▽] to highlight the *Units* option.

- Press [Select] to confirm your selection.

- Use [△] or [▽] to select *μS, mS* or *AutoRanging*.
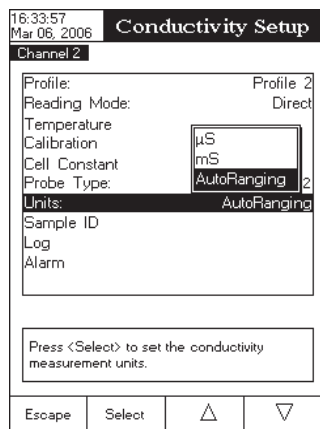
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Calibrate the instrument often, especially if high accuracy is required.

The instrument should be recalibrated:

- Whenever the pH electrode is replaced.
- At least once a week.
- After testing aggressive chemicals.
- When "No pH Calibration" or "pH Calibration Expired" message appears on the LCD, in the Reminder messages area.

PREPARATION

Pour small quantities of the buffer solutions into clean beakers. If possible, use plastic beakers to minimize any EMC interferences.

For accurate calibration and to minimize cross-contamination, use two beakers for each buffer solution. One for rinsing the electrode and one for calibration.

If you are measuring in the acidic range, use pH 7.01 or 6.86 as first buffer and pH 4.01/3.00 or 1.68 as second buffer. If you are measuring in the alkaline range, use pH 7.01 or 6.86 as first buffer and pH 10.01/9.18 or 12.45 as second buffer.

For extended range measurements (acidic and alkaline), perform a five-point calibration by selecting five of the available buffers.

CALIBRATION PROCEDURE

Calibration has a choice of 8 memorized buffers: pH 1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45 and up to 5 custom buffers.

For accurate measurements it is recommended to perform a five-point calibration. However, at least a two-point calibration is suggested.

pH Calibration screen description
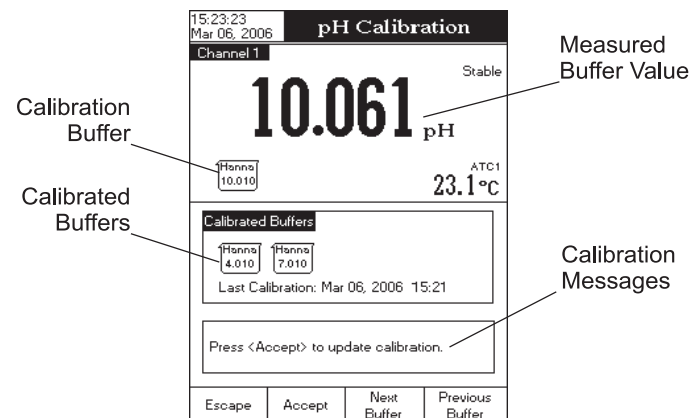
Three buffer entry types are available: Automatic, Semiautomatic and Manual Selection. The default option is Manual Selection.

To calibrate the instrument using Manual Selection buffer entry type:

- Press [CAL]. If the instrument was calibrated before and calibration was not cleared, the old calibration can be cleared by pressing [Clear Call]. After 10 seconds, [Clear Call] will no longer be available from calibration screen.

  Note: It is very important to clear calibration history when a new electrode is used because most errors and warning messages that appear during calibration depend on calibration history.

- Immerse the pH electrode and the temperature probe approximately 4 cm (1½") into a buffer solution of your choice (pH 1.68, 3.00, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45 or a custom buffer) and stir gently. The temperature probe should be close to the pH electrode.

- Select the used pH calibration buffer using [Next Buffer] or [Previous Buffer]. The "Please wait..." message will appear on the LCD until the reading is stable or the buffer is validated.

- If the pH buffer is validated, [Accept] will appear on the LCD. Press [Accept] to update calibration. The calibration buffer will be added to the Calibrated Buffers list.

- Immerse the pH electrode and the temperature probe into the next buffer solution and follow the above procedure or press [Escape] to exit calibration.
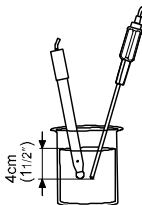
Notes: • The new added calibration point will replace an old one if the difference between them is ±0.2 pH.

- If the existing stored calibration is full (five calibration points), a pop-up menu will be displayed on the LCD in which you can select with [◁] or [▷] keys the buffer you want to replace with the current buffer. Press [Remove] to delete the selected buffer and then press [Accept] to update calibration with the new buffer.

- When in MTC mode, if pressing [SETUP] after entering pH calibration and while a HANNA pH calibration buffer with a x.xxx resolution is selected, a pop-up menu will be displayed on the LCD in which the temperature value can be adjusted using [△] or [▽]. Press [Accept] to save the new temperature value.

Calibration Reminder
This option allows the user to set the calibration reminder as *Daily*, *Periodic* or *Disabled*.
To set the calibration reminder:

- Use [△] or [▽] to highlight the *Calibration reminder* option.
- Press [Select] to confirm your selection and then use [△] or [▽] to choose the desired option.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Set Reminder Period
Daily reminder - the user can set the time of day when the reminder is to appear.
Periodic reminder - the user can set the time from the last calibration (days, hours and minutes) after which the reminder appears.

To set the reminder period:

- Use [△] or [▽] to highlight the *Set Reminder Period* option.
- Press [Select] and use [Next] / [Previous] to select next / previous entry to be edited.
- Press [Edit] and use [△] or [▽] to set the desired value, then press [Accept] to save the modified value.
- Press [Escape] to return to the previous menu.

Calibration Points

The user can choose between *Single Point* and *Multi Points* calibration.

To set the calibration points:

- Use △ or ▽ to highlight the *Calibration Points* option.

- Press [Select] to confirm your selection and then use △ or ▽ to choose the desired option.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.


```
16:26:58
Mar 06, 2006     Conductivity Setup
Channel 2
Standard Recognition:        Automatic
Calibration Points:         Multi Points
Calibration Reminder:    Single Point  d
Set Reminder Period      Multi Points
Clear Calibration

Press <Select> to choose the number of
calibration points.

Escape    Select    △    ▽
```

Cell constant manual editing:

The conductivity probe can also be calibrated by entering the cell constant value.

To edit the cell constant value:

- Use △ or ▽ to highlight the *Cell Constant* option.

- Press [Select] and then use △ or ▽ to increase / decrease the value.

- Press [Reset Cell K.] to preset the cell constant value to the probe auto-recognizable default cell constant.

- Press [Accept] to confirm the new value or press [Escape] to exit without modifying.


```
16:28:01
Mar 06, 2006     Edit Cell Constant
Channel 2
Edit custom value of cell constant:

          1.0012       /cm

Limit Low:        0.0500/cm
Limit High:       200.00/cm
Use <Up> and <Down> arrows to set value.

Press <Accept> to save the current value.
Press <Escape> to exit to previous screen.

Escape    Accept    △    ▽
```

- When in MTC mode, if pressing [SETUP] after entering calibration and while a custom pH calibration buffer is selected, a pop-up menu will be displayed on the LCD in which the custom buffer and the temperature value can be ajusted by pressing [Edit] and then △ or ▽ keys. Press [Accept] to save the modified value and then [Next] / [Previous] to select next / previous value to be adjusted.

- When in ATC mode, if pressing [SETUP] after entering calibration and while a standard pH buffer (with a x.xxx resolution) or a custom pH buffer is selected, a pop-up menu will be displayed on the LCD in which the buffer value can be adjusted using △ or ▽. Press [Accept] to save the new buffer value.


```
11:30:56
Mar 06, 2006        pH Calibration
Channel 1
                                    Stable
    6.938 pH
Hanna                              MTC1
7.010                              23.1 °C
                            Manual Edit
Std. Buffer      7.010  pH @ 25.0 °C

Temperature      23.1   °C

Press <Accept> to update calibration.

Escape    Edit    Next    Previous
```

- If the Automatic buffer entry type has been selected for the calibration procedure, the instrument will automatically select the closest buffer to the measured pH value from the edit buffer group (see *pH Setup* for details).

- If the Semiautomatic buffer entry type has been selected for the calibration procedure, the instrument will automatically select the closest buffers to the measured pH value from all the available buffers and the used buffer value can be selected with [Next Buffer] or [Previous Buffer].

CALIBRATION MESSAGES

- **Wrong buffer. Please check the buffer**: this message appears when the difference between the pH reading and the value of the selected calibration buffer is significant. If this message is displayed, check if you have selected the appropriate calibration buffer.

- **Wrong buffer temperature**: this message appears if the buffer temperature is out of the defined buffer temperature range.

- **Clean the electrode or check the buffer. Press <Accept> to update calibration**: this message alerts the user that some dirt or deposits could be on the electrode. Refer to the electrode Cleaning Procedure (see page 65).

- **Slope too low. Please check the buffer / Slope too high. Please check the buffer**: these messages appear if the current slope is under 80% or over 110% of default slope. Recalibrate the instrument using fresh buffers.

- **Slope too low. Press <Clear Cal> to clear old calibration / Slope too high. Press <Clear Cal> to clear old calibration**: these messages appear as a result of an erroneous slope condition. Follow displayed instructions.

- **Unrecognized buffer. Please check the buffer or the buffer list** (for Semiautomatic and Automatic buffer entry type): this message appears if the current buffer value is not close to any of the buffers from the buffer list/group. Check if the current buffer is present in the buffer list or the appropriate buffer group was selected.

- **The current buffer was already calibrated. Press <Accept> to recalibrate in this point, or change the buffer**: this message appears when calibration is performed in one of the previous calibrated buffers. Follow displayed instructions.

Compensation Coefficient (only for *Linear* temperature compensation)

To set the compensation coefficient:

- Use $\triangle$ or $\triangledown$ to highlight the *Compensation Coefficient* option.

- Press Select and set the desired compensation coefficient using $\triangle$ or $\triangledown$ to increase/decrease the value.

- Press Accept to save the current value or press Escape to cancel operation.

Calibration
Cell Constant

The conductivity probe can be calibrated using the conductivity standards or by entering the cell constant of the probe by the user.

Using standard solutions:

The meter can be calibrated in a single or multi-points (up to four points), using 6 Hanna standards (84 μS, 1413 μS, 5.0 mS,12.88 mS, 80.0 mS, 111.8 mS) or using the custom standards.

The following options are available for calibration:

Standard Recognition

The user can choose between *Automatic* recognition (from 6 Hanna standards available) or *User Standard* (when custom standards are used for calibration).

- Use $\triangle$ or $\triangledown$ to highlight the *Standard Recognition* option.

- Use $\triangle$ or $\triangledown$ to choose from *Automatic* or *User Standard* option.

- Press Select to confirm your selection or press Escape to cancel operation.

Temperature Unit

The user can choose from the *Celsius, Fahrenheit* or *Kelvin* temperature units.

To set the temperature unit:

- Use [△] or [▽] to highlight the *Temperature Unit* option.
- Press [Select] and then use [△] or [▽] to select *Celsius, Fahrenheit* or *Kelvin* degrees unit.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.

16:24:03
Mar 06, 2006
Conductivity Setup
Channel 2

Temperature Source: EC Channel
Temperature Compensation: Linear
Temperature Units: °C
Reference Temperature: Celsius   0
Compensation Coefficient: Fahrenheit %
Manual Temperature: Kelvin   8

Press <Select> to choose the temperature units.

| Escape | Select | △ | ▽ |

Reference Temperature (only for *Linear* or *Non-Linear* temperature compensation)

To set the reference temperature:

- Use [△] or [▽] to highlight the *Reference Temperature* option.
- Press [Select] and then use [△] or [▽] to increase / decrease the value.
- Press [Accept] to save or press [Escape] to cancel operation.

16:24:43
Mar 06, 2006
Reference Temp.
Channel 2

Edit reference temperature:

        25.0   °C

Limit Low: 15.0 °C
Limit High: 30.0 °C
Use <Up> and <Down> arrows to set value.

Press <Accept> to save the current value.
Press <Escape> to exit to previous screen.

| Escape | Accept | △ | ▽ |

Make sure the instrument has been calibrated before taking pH measurements.

DIRECT MEASUREMENT

To measure the pH of a sample using the Direct reading mode:

- Press [MODE] and then [pH] to select *pH Measure* mode.
- Select the Direct reading mode (see pH Setup for details).
- Submerge the electrode tip and the temperature probe approximately 4 cm (1½") into the sample to be tested. Allow time for the electrode to stabilize.
- The measured pH value will be displayed on the LCD, together with a short GLP information or "Default Calibration" message if no pH calibration was performed.

Note: If the reading is out of range, "-----" will be displayed on the LCD.

17:07:05
Mar 06, 2006
Measure
Channel 1

⟲ Profile 1   Stable

6.371 pH

Last Cal.: Mar 06, 2006 17:02
Electrode Cond.:50%   ATC1
                              26.4 °C

| Display | Start Log | | Channel |

DIRECT / AUTOHOLD MEASUREMENT

To measure pH of a sample using the Direct/AutoHold reading mode:

- Press [MODE] and then [pH] to select *pH Measure* mode.
- Select the Direct/AutoHold reading mode (see *pH Setup* for details).
- Submerge the electrode tip and the temperature probe approximately 4 cm (1½") into the sample to be tested. Allow time for the electrode to stabilize.
- The measured pH value will be displayed on the LCD. If pressing [Auto Hold], the "AutoHold" indicator will start blinking on the LCD until the stability criterion is reached. The pH value will be frozen on the LCD, along with "AutoHold" indicator.
- To return to normal *Measure* mode press [Continuous Reading].

Note: If the reading is out of range, "-----" will be displayed on the LCD.

14:57:30
Mar 06, 2006
Measure
Channel 1   AutoHold   Logging 1 s
        ⟲ Profile 1   Stable

6.726 pH

Last Cal.: Mar 06, 2006 14:55
Electrode Cond.:100%   ATC1
                              24.4 °C

| Display | Stop Log | Continuous Reading | Channel |

Outside Cal Range feature warns the user if the current reading is out of the calibrated area. The calibrated area is that part of the pH range in which the calibration point assures an accurate reading. If the reading is taken out of the calibration area, the "Outside Cal Range" message will start blinking on the LCD. The calibrated area is calculated in according with the pH resolution used during the reading. To avoid having this message, the calibration points have to be well distributed in the desired measurement range.

If measurements are taken successively in different samples, it is recommended to rinse the electrode thoroughly with deionized water or tap water and then with some of the next sample to prevent cross-contamination and to condition the electrode before immersing it into the sample solution.

The pH reading is affected by temperature. In order to measure the pH accurately, the temperature effect must be compensated. To use the **Automatic Temperature Compensation** (ATC) feature, connect and submerge the temperature probe into the sample as close as possible to the electrode and wait for a few seconds.

If the temperature of the sample is known, **Manual Temperature Compensation** (MTC) can be performed by disconnecting the temperature probe.

Notes: • When in MTC mode, the temperature can be modified by pressing [MTC] for *pH Measure* mode and [Manual Temp] for *mV/Rel mV Measure* mode. The temperature value can be ajusted with [△] or [▽] from −20.0 ºC to 120.0 ºC. Press [Accept] to save the new temperature value or press [Escape] to return to *Measure* mode.

• When in ATC mode for pH, respectively TEMP for mV/Rel mV, "-----" will be displayed on the LCD if the measured temperature is under or over temperature range (−20.0 ºC to 120.0 ºC).
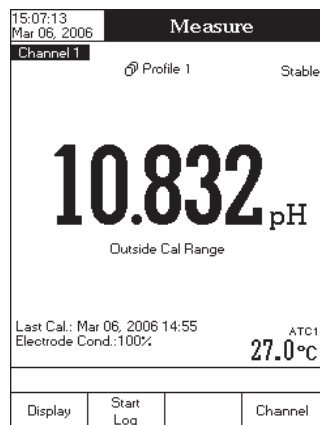
Table for non-linear temperature compensation:

	0	1	2	3	4	5	6	7	8	9
0	1.918	1.912	1.905	1.899	1.893	1.887	1.881	1.875	1.869	1.863
1	1.857	1.851	1.845	1.840	1.834	1.829	1.822	1.817	1.811	1.805
2	1.800	1.794	1.788	1.783	1.777	1.772	1.766	1.761	1.756	1.750
3	1.745	1.740	1.734	1.729	1.724	1.719	1.713	1.708	1.703	1.698
4	1.693	1.688	1.683	1.678	1.673	1.668	1.663	1.658	1.653	1.648
5	1.643	1.638	1.634	1.629	1.624	1.619	1.615	1.610	1.605	1.601
6	1.596	1.591	1.587	1.582	1.578	1.573	1.569	1.564	1.560	1.555
7	1.551	1.547	1.542	1.538	1.534	1.529	1.525	1.521	1.516	1.512
8	1.508	1.504	1.500	1.496	1.491	1.487	1.483	1.479	1.475	1.471
9	1.467	1.463	1.459	1.455	1.451	1.447	1.443	1.439	1.436	1.432
10	1.428	1.424	1.420	1.416	1.413	1.409	1.405	1.401	1.398	1.394
11	1.390	1.387	1.383	1.379	1.376	1.372	1.369	1.365	1.362	1.358
12	1.354	1.351	1.347	1.344	1.341	1.337	1.334	1.330	1.327	1.323
13	1.320	1.317	1.313	1.310	1.307	1.303	1.300	1.297	1.294	1.290
14	1.287	1.284	1.281	1.278	1.274	1.271	1.268	1.265	1.262	1.259
15	1.256	1.253	1.249	1.246	1.243	1.240	1.237	1.234	1.231	1.228
16	1.225	1.222	1.219	1.216	1.214	1.211	1.208	1.205	1.202	1.199
17	1.196	1.193	1.191	1.188	1.185	1.182	1.179	1.177	1.174	1.171
18	1.168	1.166	1.163	1.160	1.157	1.155	1.152	1.149	1.147	1.144
19	1.141	1.139	1.136	1.134	1.131	1.128	1.126	1.123	1.121	1.118
20	1.116	1.113	1.111	1.108	1.105	1.103	1.101	1.098	1.096	1.093
21	1.091	1.088	1.086	1.083	1.081	1.079	1.076	1.074	1.071	1.069
22	1.067	1.064	1.062	1.060	1.057	1.055	1.053	1.051	1.048	1.046
23	1.044	1.041	1.039	1.037	1.035	1.032	1.030	1.028	1.026	1.024
24	1.021	1.019	1.017	1.015	1.013	1.011	1.008	1.006	1.004	1.002
25	1.000	0.998	0.996	0.994	0.992	0.990	0.987	0.985	0.983	0.981
26	0.979	0.977	0.975	0.973	0.971	0.969	0.967	0.965	0.963	0.961
27	0.959	0.957	0.955	0.953	0.952	0.950	0.948	0.946	0.944	0.942
28	0.940	0.938	0.936	0.934	0.933	0.931	0.929	0.927	0.925	0.923
29	0.921	0.920	0.918	0.916	0.914	0.912	0.911	0.909	0.907	0.905
30	0.903	0.902	0.900	0.898	0.896	0.895	0.893	0.891	0.889	0.888
31	0.886	0.884	0.883	0.881	0.879	0.877	0.876	0.874	0.872	0.871
32	0.869	0.867	0.866	0.864	0.863	0.861	0.859	0.858	0.856	0.854
33	0.853	0.851	0.850	0.848	0.846	0.845	0.843	0.842	0.840	0.839
34	0.837	0.835	0.834	0.832	0.831	0.829	0.828	0.826	0.825	0.823
35	0.822	0.820	0.819	0.817	0.816	0.814	0.813	0.811	0.810	0.808

Temperature Compensation

The user can choose from the following options:

Linear - the meter will compensate automatically the conductivity using the following formula:

$$C_{ref} = \frac{Ci}{1 + \frac{\alpha}{100}\,(T - ref)}$$

where:

C_{ref} - conductivity at reference temperature

α - compensation coefficient

T - temperature

ref - reference temperature

Non-Linear - recommended for measuring the conductivity of the natural water in accordance with the compensation table on the next page.

Disabled - the meter will display the conductivity with no temperature compensation.

To set the temperature compensation mode:

- Use [△] or [▽] to highlight the *Temperature Compensation* option.

- Press [Select] and then use [△] or [▽] to select *Linear, Non-Linear* or *Disabled* option.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.
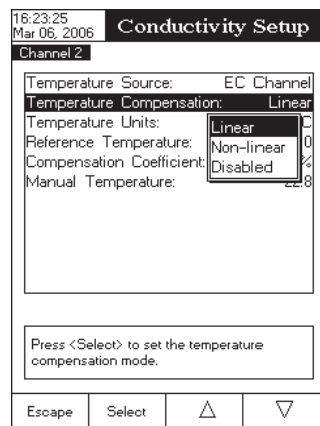
Whatever form of compensation is used, the reading will not be as accurate as taking a reading of the sample's conductivity at the reference temperature.

mV/ORP MEASUREMENTS

Oxidation-reduction potential (ORP) measurements provide the quantification of the oxidizing or reducing power of the tested sample.

To correctly perform a redox measurement, the surface of the ORP electrode must be clean and smooth.

DIRECT MEASUREMENT

To measure the mV of a sample using the Direct reading mode:

- Press [MODE] and then [mV] to enter *mV Measure* mode.

- Select the Direct reading mode (see *mV Setup* for details).

- Submerge the tip of the ORP electrode (4 cm/1½") into the sample to be tested and allow a few seconds for the reading to stabilize.

- The instrument will display the measured mV value on the LCD.

**Note**: If the reading is out of range, "-----" will be displayed on the LCD.
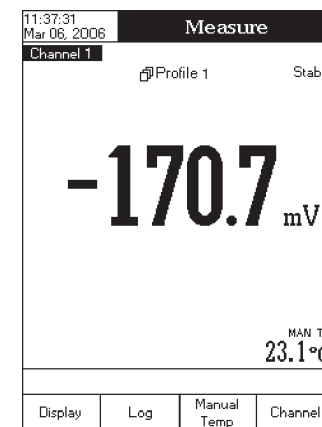
DIRECT/AUTOHOLD MEASUREMENT

To measure mV of a sample using the Direct/AutoHold reading mode:

- Press [MODE] and then [mV] to select *mV Measure* mode.

- Select the Direct/AutoHold reading mode (see *mV Setup* for details).

- Submerge the tip of the ORP electrode approximately 4 cm (1½") into the sample to be tested and allow a few seconds for the reading to stabilize.

- The measured mV value will be displayed on the LCD. If pressing [Auto Hold], the "AutoHold" indicator will start blinking on the LCD until the stability criterion is reached. The mV value will be frozen on the LCD, along with "AutoHold" indicator.

- To return to normal *Measure* mode press [Continuous Reading].

Note: If the reading is out of range, "-----" will be displayed on the LCD.
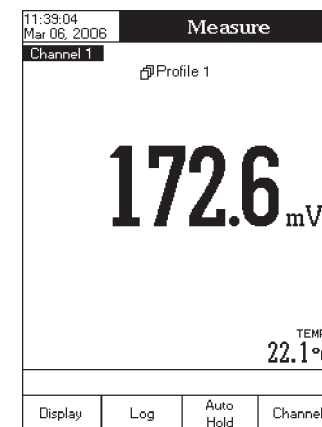
Relative mV MEASUREMENTS

To measure the Relative mV of a sample:

- Press [MODE] and then [Rel mV] to enter *Relative mV Measure* mode.

- The instrument will display the measured Relative mV value on the LCD, together with a short GLP information about the last calibration or "Not Calibrated" message if no Rel mV calibration was performed (no Rel mV offset set).

Notes:
- If the measured mV potential is out of range, "-----" will be displayed on the LCD.

  - If pressing [CAL] while in *Relative mV Measure* mode, the Relative mV offset screen will be displayed on the LCD. Press [Clear Ref mV Offset] to clear the existing Relative mV or use [△] or [▽] to adjust the Relative mV value and then press [Accept] to save the current Relative mV. Press [Escape] at any time to return to *Relative mV Measure* mode.

  - Before performing a Rel mV calibration, make sure that the electrode is immersed into the sample to be measured.

Temperature

From the *Temperature* menu the user can choose the temperature source and units, as well as the temperature compensation mode, reference temperature and compensation coefficient.

To access a *Temperature* option:

- Use [△] or [▽] to highlight the *Temperature* option from the *Conductivity Setup* menu.

- Press [Select] to access the *Temperature* option.

Temperature Source

To set the temperature source:

- Use [△] or [▽] to highlight the *Temperature Source* option.

- Press [Select] and then use [△] or [▽] to select *Automatic* or *Manual* temperature source.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.

Delete Profile

To delete one of the existing profiles:

- Use [△] or [▽] to select the *Profile* option.

- Press [Select] and use [△] or [▽] to highlight the *Delete Profile* option.

- Press [Select]. A list with all customised profiles will appear on the screen.

- Use [△] or [▽] to select the desired profile and press [Delete].

- Press [Escape] to return to the previous menu.
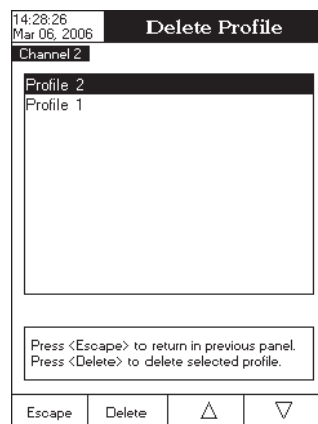
Reading Mode

This option allows the user to select between *Direct, Direct / AutoHold, Direct/USP* conductivity reading modes.

To set the reading mode:

- Use [△] or [▽] to select the *Reading Mode* option.

- Press [Select] and use [△] or [▽] to highlight the desired option.

- Press [Select] to confirm your selection or press [Escape] to cancel operation.
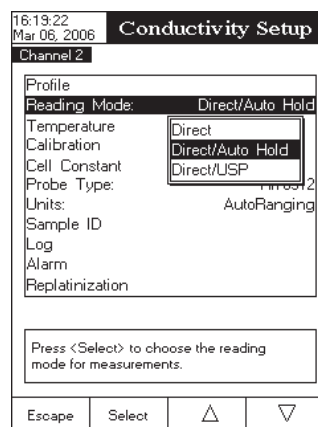
ISE CALIBRATION
(HI 4522 only)

For greatest accuracy, it is recommended to calibrate the instrument frequently. The instrument should also be recalibrated whenever "No ISE Calibration" or "ISE Calibration Expired" message appears on the LCD, in the Reminder messages area.

Due to electrode conditioning time, the electrode must be kept immersed a few seconds to stabilize. The user will be guided step by step during calibration with easy to follow messages on the display. This will make the calibration a simple and error-free procedure.

PREPARATION

Pour small quantities of the standard solutions into clean beakers. If possible, use plastic beakers to minimize any EMC interferences.

For accurate calibration and to minimize cross-contamination, use two beakers for each standard solution. One for rinsing the electrode and one for calibration.

Note: For accurate measurements, add the appropriate **ISAB** (Ionic Strength Adjustment Buffer) to the calibration standards.

CALIBRATION PROCEDURE

Up to five-point calibration is possible, using five memorized standard solutions: 0.1, 1, 10, 100, 1000 ppm and 5 custom solutions.

The ISE calibration and measurement can be performed with or without temperature compensation. If the temperature compensation option is enabled, the isopotential point of the electrode must be set in ISE Setup in order to perform correct concentration measurements.

Before calibrating, make sure that the appropriate Electrode Type has been selected in ISE Setup according to the measured Ion/compound.

ISE Calibration screen description
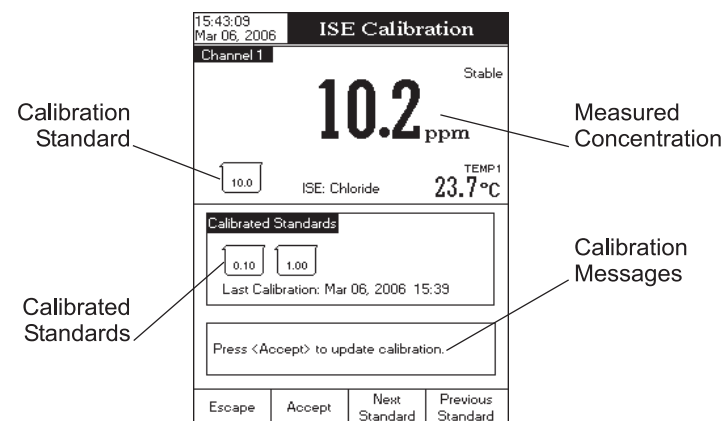
Two standard entry types are available: ManualSelection and Custom Standard. The default option is Manual Selection.

A. To calibrate the instrument using *Manual Selection* standard entry type:

- Press [CAL]. If the instrument was calibrated before and calibration was not cleared, the old calibration can be cleared by pressing [Clear Call]. After 10 seconds, [Clear Call] will no longer be available.

  Note: It is very important to clear calibration history when a new electrode is used because most errors and warning messages that appear during calibration depend on calibration history.

- Add ISAB to all standard solutions.
- Immerse the Ion Selective Electrode and the temperature probe approximately 4 cm (1½″) into the less concentrated standard solution and stir gently.

4cm (1½″)

- Select the used standard solution concentration with [Next Standard] or [Previous Standard]. The "Please wait..." message will appear on the LCD until the reading is stable or the concentration is validated.
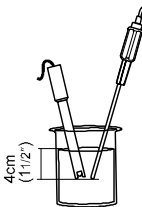
Note: When in ATC mode, if pressing [SETUP] a pop-up menu will be displayed on the LCD in which the concentration value can be adjusted using [△] or [▽]. Press [Accept] to save the new concentration value.

- If the standard solution concentration is validated, [Accept] will appear on the LCD. Press [Accept] to update calibration. The calibration point value will be added to the Calibrated Standards list.
- The "Please wait..." message will appear on the LCD for 10 seconds and until the reading is stable, time in which immerse the ion selective electrode and the temperature probe into the next standard solution and follow the above procedure or press [Escape] to exit calibration.

B. To calibrate the instrument using *Custom Standard* entry type:

- Press [CAL]. If the instrument was calibrated before and calibration was not cleared, the old calibration can be cleared by pressing [Clear Call]. After 10 seconds, [Clear Call] will no longer be available.

  Note: It is very important to clear calibration history when a new electrode is used because most errors and warning messages that appear during calibration depend on calibration history.

- Add ISAB to all standard solutions.
- Immerse the Ion Selective Electrode and the temperature probe approximately 4 cm (1½″) into the less concentrated standard solution and stir gently.

4cm (1½″)

- When the stability condition is reached and 10 seconds elapsed, a pop-up menu will appear on the LCD in which the standard concentration value can be set.
- Press [Next] / [Previous] to select next/previous entry to be edit. Press [Edit] and use [△] or [▽] to set the desired value. Press [Accept] to save the modified value and then press [Escape] to store the set concentration value.
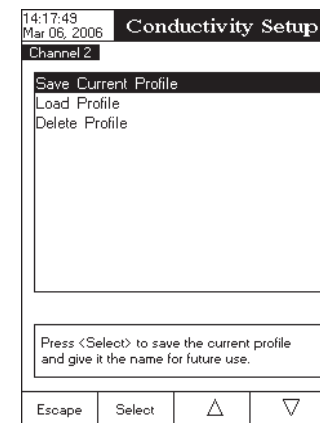
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Save Current Profile

To save the current profile:

- Use [△] or [▽] to select the *Profile* option.
- Press [Select] and then select *Save Current Profile* option. The *Text Editor* box will be displayed on the LCD.
- Enter the desired profile name by using [▷] and [▽] to highlight the desired character and then press [Select] to add it to the text bar. It is also possible to delete the last character by positioning the cursor on the Backspace character (⌫) and pressing [Select].
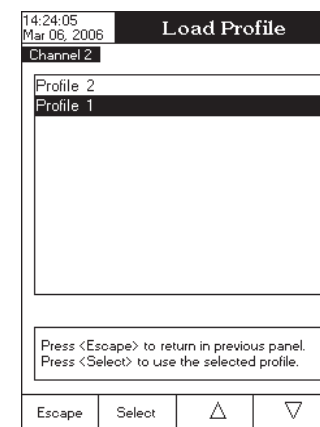- Press [Escape] to return to the Profile options.

Note: The saved profile will automatically become the current profile.

14:17:49
Mar 06, 2006
Channel 2
Conductivity Setup

Save Current Profile
Load Profile
Delete Profile

Press <Select> to save the current profile and give it the name for future use.

Escape | Select | △ | ▽

Load Profile

To load one profile:

- Use [△] or [▽] to select the *Profile* option.
- Press [Select] and use [△] or [▽] to highlight the *Load Profile* option.
- Press [Select]. A list with all customised profiles will be displayed on the screen.
- Use [△] or [▽] to select the desired profile and press [Select] to confirm or [Escape] to exit without selecting.

14:24:05
Mar 06, 2006
Channel 2
Load Profile

Profile 2
Profile 1

Press <Escape> to return in previous panel.
Press <Select> to use the selected profile.

Escape | Select | △ | ▽

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The Conductivity Setup menu allows the user to set the parameters related to the conductivity measurement.

Accessing Conductivity Setup

- Press [MODE] while in *Measure* mode and then [Cond.] to select the *Conductivity* measure mode.
- Press [SETUP] and then [Cond. Setup] to access *Conductivity Setup* menu.

To access a conductivity setup options:

- Use [△] or [▽] to highlight the desired option.
- Press [Select] to access the selected option or [Escape] to exit setup.

The following is a detailed description of the *Conductivity Setup* option screens.

Profile

Choosing this option the measuring and the calibration mode can be customized. Up to 10 profiles can be defined by the user.
The available options are:

Save Current Profile: save the current profile.

Load Profile: load from available profiles.

Delete Profile: delete a profile.

- If the standard solution concentration is validated, [Accept] will appear on the LCD. Press [Accept] to update calibration. The calibration point value will be added to the Calibrated Standards section.
- The "Please wait..." message will appear on the LCD until the reading is stable and 10 seconds elapsed, time in which immerse the Ion Selective Electrode and the temperature probe into the next standard solution and follow the above procedure or press [Escape] to exit calibration.

Notes:
- The new added calibration point will replace an old one if the difference between them is less than 20% of the standard solution.
    - If the existing stored calibration is full (five calibration points), a pop-up menu will be displayed on the LCD in which you can select with [◁] or [▷] the standard solution you want to replace with the current one. Press [Remove] to delete the selected calibrated point and then press [Accept] to update calibration with the new standard solution.
- If the isopotential point of the electrode is unknown, the ion calibration and measurements can be performed only without temperature compensation (see ISE Setup, Temperature option for details, page 33). When the temperature compensation option is disabled, at least a two-point calibration must be performed in order to perform ISE measurements. Otherwise, "-----" will appear on the LCD.
- When in MTC mode, if pressing [SETUP] after entering ISE calibration and while a standard solution is selected, a pop-up menu will be displayed on the LCD in which the concentration and the temperature value can be ajusted by pressing [Edit] and then [△] or [▽] keys. Press [Accept] to save the modified value and then [Next] / [Previous] to select next /previous value to be adjusted.

CALIBRATION MESSAGES

- **Wrong standard solution. Please check the standard solution**: this message appears when the difference between the ppm reading and the value of the selected standard solution concentration (ppm)

is significant. If this message is displayed, check if you have selected the appropriate calibration standard.to be tested. Allow time for the electrode to stabilize.

- **Wrong new slope. Please check the standard solution**: this message appears if the current slope exceeds slope window (50% to 120% of default slope for the corresponding ion charge - see ISE Theorysection for details). Recalibrate the instrument using fresh standards.

- **Wrong old slope. Press <Clear Cal> to clear old calibration**: this message appears as a result of an erroneous slope condition. Press Clear Cal to clear old calibration and restart calibration.

- **Difference between standards temperature is too high. Press <Accept> to update the calibration or clear old calibration**: this message appears when the difference between two standards temperature is greater than 5 °C. Recalibrate the instrument while paying attention to the standards temperature.

where: C_{SAMPLE} - the sample concentration;
C_{STD} - the standard concentration;
V_{SAMPLE} - the sample volume;
V_{STD} - the standard volume;
and $V_T = V_{SAMPLE} + V_{STD}$

ΔE - the difference of potential from the electrode;
S - the electrode slope, determined in a previous calibration;
f - the stoichiometric ratio between sample and standard;

$$C_{SAMPLE} = C_{STD} \frac{V_{STD}}{V_{SAMPLE} - V_T 10^{\Delta E/S}} f$$

where: C_{SAMPLE} - the sample concentration;
C_{STD} - the standard concentration;
V_{SAMPLE} - the sample volume;
V_{STD} - the standard volume;
and $V_T = V_{SAMPLE} + V_{STD}$

ΔE - the difference of potential from the electrode;
S - the electrode slope, determined in a previous calibration;
f - the stoichiometric ratio between sample and standard;

$$S^{2-} + 2Ag^+ \rightarrow Ag_2S$$
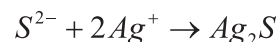
Example 1

You have sulfide samples and you are adding Ag^+. The reaction is:

One mole sulfide sample reacts with 2 moles silver standard ($f = \frac{1}{2}$).

$$S^{2-} + Pb^{2+} \rightarrow PbS$$
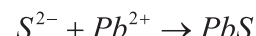
Example 2

You have sulfide samples and you are adding Pb^{2+}. The reaction is:

One mole sulfide sample reacts with 1 mole lead standard ($f = 1$).

Analyte Addition and Analyte Subtraction

Analyte Addition and Subtraction are variations of the previous two methods.

$$C_{SAMPLE} = C_{STD} \frac{V_T 10^{\Delta E/S} - V_{STD}}{V_{SAMPLE}}$$

With Analyte Addition, *sample (analyte) is added* to an ion standard being measured. The standard and sample contain the same ion. mV are taken before and after the sample addition. From the mV the analyte concentration is determined.

$$C_{SAMPLE} = C_{STD} \frac{V_{STD} - V_T 10^{\Delta E/S}}{V_{SAMPLE}} f$$

With Analyte Subtraction, *sample (analyte) is added to an ion standard* being measured. The analyte reacts with the measured ion in a known manner thus removing measured ions from the solution. From the change in mV the concentration of the analyte is determined.

Make sure the instrument has been calibrated before taking ISE measurements.

When using one of the incremental methods for measurement and no or only a one-point ISE calibration was performed, a warning message will be displayed on the LCD, notifying the user that at least a two-point ISE calibration must be performed.

For accurate measurements, add the appropriate **ISAB** (Ionic Strength Adjustment Buffer) to both samples and standards, if necessary. If ISAB is added to the calibration standards, it is important to add ISAB also to the samples to be measured.

DIRECT MEASUREMENT

To measure the concentration of a sample using the Direct reading mode:

- Press [MODE] and then [ISE] to select *ISE Measure* mode.
- Select the Direct reading mode (see *ISE Setup* for details).
- Add ISAB to the sample solution.
- Submerge the Ion Selective Electrode tip and the temperature probe approximately 4 cm (1½") into the sample to be tested. Allow time for the electrode to stabilize.
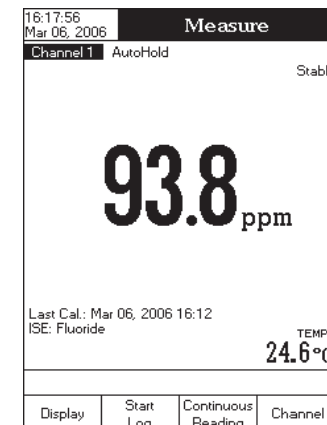- The measured concentration value will be displayed on the LCD in the selected units.

Note: If the reading is out of range, "-----" will be displayed on the LCD.
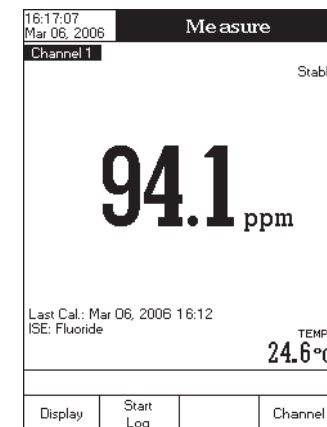
DIRECT/AUTOHOLD MEASUREMENT

To measure the concentration of a sample using the Direct / AutoHold reading mode:

- Press [MODE] and then [ISE] to select *ISE Measure* mode for the selected channel.
- Select the Direct/AutoHold reading mode (see *ISE Setup* for details).
- Add ISAB to the sample solution.
- Submerge the Ion Selective Electrode tip and the temperature probe approximately 4 cm (1½") into the sample to be tested. Allow time for the electrode to stabilize.

- The measured concentration value will be displayed on the LCD. If pressing [Auto Hold], the "AutoHold" indicator will start blinking on the LCD until the stability criterion is reached. The concentration value will be frozen on the LCD, along with "AutoHold" indicator.

- To return to normal *Measure* mode press [Continuous Reading].

Note: If the reading is out of range, "-----" will be displayed on the LCD.

Note: Press [Escape] at any time to stop the measurement and return to *ISE Measure* mode.

KNOWN ADDITION

To measure the concentration of a sample using the Known Addition incremental method:

- Press [MODE] and then [ISE] to select *ISE Measure* mode for the selected channel.

- Select the Known Addition method (see *ISE Setup* for details).

- Press [Start KA] to start the measurement. The first step of the method will be displayed on the LCD in which the user is notified to add the appropriate ISA Buffer Volume (if different from 0 mL) to the sample and to immerse the electrode into the Sample Volume. The method parameters are also displayed on the LCD.

- Press [Edit] to set the method parameters. Press [Next] / [Previous] to select next/previous parameter to be edit, then press [Edit] and use [△] or [▽] to set the desired parameter value. Press [Accept] to save the modified value and then press [Escape] to exit method parameters edit menu.

- Make sure that the set parameters values are the used ones and submerge the Ion Selective Electrode tip approximately 4 cm (1½") into the sample to be tested.

- Press [Continue] to take the first mV reading.

- When the reading is stable, press [Read] to store the first mV reading. The second step of the method will be displayed on the LCD in which the user is notified to add the Standard Volume of set concentration to the sample. The method parameters are also displayed on the LCD.

Actual samples that are more concentrated have much smaller activity coefficients ($\gamma < 1$). The addition of an inert background salt to standards and samples stabilizes the activity coefficient so that concentration measurements may be made directly. Hanna's Ionic Strength Adjustment Buffer (ISAB) formulations also may optimize pH, and complex interferences in addition to standardizing the ionic strength.

The Nernst equation can be rewritten:

$$E = E^o + S \log(C)$$

ION SELECTIVE ANALYSIS METHODS

Direct Analysis

This method is a simple procedure for measuring multiple samples. It should only be used in the linear working regions of the sensor. A direct reading instrument such as the **HI 4522** determines concentration of the unknown by a direct reading after calibrating the instrument with the standards. The instrument is calibrated as described in "ISE CALIBRATION" section, with two or more freshly made standards that are in the measurement range of the unknowns. Ionic strength adjustment is made to samples and standards. Unknowns are measured directly by the instrument.

At lower concentrations, in non-linear regions of the electrode response, multiple calibration points will extend measurements to a practical detection limit. Calibrations must be performed more frequently in these cases.

Incremental Methods

Incremental methods are useful for the measurement of samples whose constituents are variable or concentrated. Incremental techniques can reduce errors from such variables as temperature, viscosity, or pH extremes and will provide indirect analysis of ions for which there is no ISE sensor for a direct measurement. There are four different incremental methods for sample measurement. They are Known Addition, Known Subtraction, Analyte Addition and Analyte Subtraction. **HI 4522** allows the analyst to use these techniques as a simple routine procedure thus eliminating calculations or tables. The method once set up can be used for repetitive measurements on multiple samples.

Known Addition and Known Subtraction

With <u>Known addition</u>, *standard is added* to a sample being measured. The standard and sample contain the same ion. mV are taken before and after the standard addition. From the mV the sample concentration is determined.

$$C_{SAMPLE} = C_{STD} \frac{V_{STD}}{V_T 10^{\Delta E/S} - V_{SAMPLE}}$$

With <u>Known subtraction</u>, *a known standard is added to an ionic sample* being measured. The standard reacts with the measured ion in the sample in a known manner thus removing measured ions from the solution. From the change in mV the concentration of the sample is determined.

ISE THEORY

An Ion Selective Electrode (ISE) is an electrochemical sensor that changes voltage with the activity or concentration of ions in solutions. The change in voltage is a logarithmic relationship with concentration and is expressed by the Nernst equation:

$$E = E^o + S \log(a)$$

where: E - the measured voltage;

E^o - standard voltage and other standard system voltages;

a - the activity of the ion being measured;

S - the Nernst slope factor and is derived from thermodynamic principles:

$$S = 2.303RT/nF$$

R - the universal gas constant (8.314 J*K^{-1}*mol^{-1});

T - the temperature in degrees Kelvin;

F - the Faraday's constant (96,485 C*mol^{-1});

n - the ion charge.

The slope may be positive or negative depending upon the ion charge (n).

SPECIES	SLOPE (mV/decade)
Monovalent cation	+59.16
Monovalent anion	−59.16
Divalent cation	+29.58
Divalent anion	−29.58

Activity and concentration are related by an "activity coefficient", expressed as:

$$a = \gamma C$$

where: a - the activity of the ion being measured;

γ - the activity coefficient;

C - the concentration of the ion being measured.

In very dilute solutions γ approaches 1 so activity and concentration are the same.

- Press [Edit] to change the desired method parameters as indicated in the first step of the method.
- Press [Continue] to take the second mV reading.
- When the reading is stable, press [Read] to store the second mV reading. The ISE measurement results will be displayed on the LCD.
- Press [Save] to log the current results into a ISE Method Report or press [Direct Measure] to return to *ISE Measure* mode.
- If pressing [Edit], the method parameters can be changed and the sample concentration will be recalculated.
- Press [Start KA] to start another measurement.

Note: Press [Escape] at any time to stop the measurement and return to *ISE Measure* mode.

KNOWN SUBTRACTION

To measure the concentration of a sample using the Known Subtraction incremental method:

- Press [MODE] and then [ISE] to select *ISE Measure* mode for the selected channel.
- Select the Known Subtraction method (see *ISE Setup* for details).
- Press [Start KS] to start the measurement. The first step of the method will be displayed on the LCD in which the user is notified to add the appropriate ISA Buffer Volume (if different from 0 mL) to the sample and to immerse the electrode into the Sample Volume. The method parameters are also displayed on the LCD.
- Press [Edit] to set the method parameters. Press [Next] / [Previous] to select next / previous parameter to be edit, then press [Edit] and use [△] or [▽] to set the desired parameter value. Press [Accept] to save the modified value and then press [Escape] to exit method parameters edit menu.

Note: For the Known Subtraction method, the stoichiometric ratio (factor) between standard and sample must also be set in order to take accurate measurements.

- Make sure that the set parameters values are the used ones and submerge the Ion Selective Electrode tip approximately 4 cm (1½") into the sample to be tested.
- Press [Continue] to take the first mV reading.
- When the reading is stable, press [Read] to store the first mV reading. The second step of the method will be displayed on the LCD in which the user is notified to add the Standard Volume of set concentration to the sample. The method parameters are also displayed on the LCD.
- Press [Edit] to change the desired method parameters as indicated in the first step of the method.
- Press [Continue] to take the second mV reading.
- When the reading is stable, press [Read] to store the second mV reading. The ISE measurement

results will be displayed on the LCD.

- Press [Save] to log the current results into a ISE Method Report or press [Direct Measure] to return to *ISE Measure* mode.
- If pressing [Edit], the method parameters can be changed and the sample concentration will be recalculated.
- Press [Start KS] to start another measurement.

Note: Press [Escape] at any time to stop the measurement and return to *ISE Measure* mode.

ANALYTE ADDITION

To measure the concentration of a sample using the Analyte Addition incremental method:

- Press [MODE] and then [ISE] to select *ISE Measure* mode.
- Select the Analyte Addition method (see *ISE Setup* for details).
- Press [Start AA] to start the measurement. The first step of the method will be displayed on the LCD in which the user is notified to add the appropriate ISA Buffer Volume (if different from 0 mL) to the standard and to immerse the electrode into the Standard Volume of set concentration. The method parameters are also displayed on the LCD.
- Press [Edit] to set the method parameters. Press [Next] / [Previous] to select next / previous parameter to be edit, then press [Edit] and use [△] or [▽] to set the desired parameter value. Press [Accept] to save the modified value and then press [Escape] to exit method parameters edit menu.
- Make sure that the set parameters values are the used ones and submerge the Ion Selective Electrode tip approximately 4 cm (1½") into the standard solution.
- Press [Continue] to take the first mV reading.
- When the reading is stable, press [Read] to store the first mV reading. The second step of the method will be displayed on the LCD in which the user is notified to add the Sample Volume to the standard solution. The method parameters are also displayed on the LCD.
- Press [Edit] to change the desired method parameters as indicated in the first step of the method.
- Press [Continue] to take the second mV reading.
- When the reading is stable, press [Read] to store the second mV reading. The ISE measurement results will be displayed on the LCD.
- Press [Save] to log the current results into a ISE Method Report or press [Direct Measure] to return to *ISE Measure* mode.

```
14:15:47
Mar 06, 2006       ISE Results
Channel 1

        0.19 ppm

Sample ID:              Tap water1
Calculated Slope:           94.3 %
Reading 1:               287.2 mV
Reading 2:               192.9 mV
Sample Volume:       100.000 mL
Standard Volume:       10.000 mL
ISA Volume:             2.000 mL
Standard Conc.:         100 ppm

Press <Direct Measure> to return in main
measurement panel.
Press <Save> to log the current results.

Direct      Save     Edit     Start
Measure                        KA
```

- If pressing [Edit], the method parameters can be changed and the sample concentration will be recalculated.
- Press [Start AA] to start another measurement.

Note: Press [Escape] at any time to stop the measurement and return to *ISE Measure* mode.

ANALYTE SUBTRACTION

To measure the concentration of a sample using the Analyte Subtraction incremental method:

- Press [MODE] and then [ISE] to select *ISE Measure* mode.
- Select the Analyte Subtraction method (see *ISE Setup* for details).
- Press [Start AS] to start the measurement. The first step of the method will be displayed on the LCD in which the user is notified to add the appropriate ISA Buffer Volume (if different from 0 mL) to the standard and to immerse the electrode into the Standard Volume of set concentration. The method parameters are also displayed on the LCD.
- Press [Edit] to set the method parameters. Press [Next] / [Previous] to select next/previous parameter to be edit, then press [Edit] and use [△] or [▽] to set the desired parameter value. Press [Accept] to save the modified value and then press [Escape] to exit method parameters edit menu.

Note: For the Analyte Subtraction method, the stoichiometric ratio (factor) between standard and sample must also be set in order to take accurate measurements.

- Make sure that the set parameters values are the used ones and submerge the Ion Selective Electrode tip approximately 4 cm (1½") into the standard solution.
- Press [Continue] to take the first mV reading.
- When the reading is stable, press [Read] to store the first mV reading. The second step of the method will be displayed on the LCD in which the user is notified to add the Sample Volume to the standard solution. The method parameters are also displayed on the LCD.
- Press [Edit] to change the desired method parameters as indicated in the first step of the method.
- Press [Continue] to take the second mV reading.
- When the reading is stable, press [Read] to store the second mV reading. The ISE measurement results will be displayed on the LCD.
- Press [Save] to log the current results into a ISE Method Report or press [Direct Measure] to return to *ISE Measure* mode.
- If pressing [Edit], the method parameters can be changed and the sample concentration will be recalculated.
- Press [Start AS] to start another measurement.

Note: Press [Escape] at any time to stop the measurement and return to *ISE Measure* mode.