Instruction Manual

HI 4321

Conductivity/Resistivity/TDS/Salinity/ Temperature Bench Meter

HANNA instruments®
www.hannainst.com

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 4321 is warranted for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. The probe is 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.

TABLE OF CONTENTS

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 meter is supplied complete with:

- **HI 76312** Four-ring Conductivity Probe with built-in temperature sensor and ID
- **HI 76404N** Electrode Holder
- 12Vdc Power Adapter
- Instruction Manual

HI 4321 is supplied with 12 Vdc/230 Vac adapter.
HI 4321-01 is 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

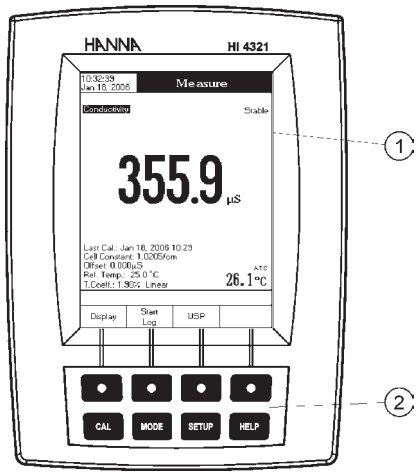
HI 4321 is a professional bench meter with color graphic LCD for conductivity, resistivity, TDS, salinity and temperature measurements.
The display viewing modes are: Basic information only, GLP information, Graph and Log History mode.
The main features of the instruments are:

- One input channel;
- Five measurement parameters: conductivity, resistivity, TDS, salinity and temperature;
- Pure water checking using the USP <645> standard;
- 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 the stable reading on the LCD;
- Two selectable alarm limits (for conductivity, resistivity, TDS, salinity);
- Three selectable logging modes: Automatic logging, Log on demand (manual logging) and AutoHold logging mode;
- Up to 100 logging lots for automatic or manual modes and up to 200 USP reports;
- Selectable area and settable sampling period feature for automatic logging;
- GLP feature;
- Online and offline graph;
- User-friendly interface on large color graphic LCD (240x320 pixels);
- Opto-isolated PC interface via RS232 respectively USB.

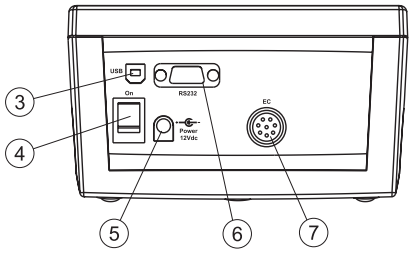
FUNCTIONAL DESCRIPTION

HI 4321 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 input

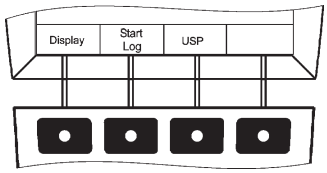
KEYBOARD DESCRIPTION

FUNCTION KEYS

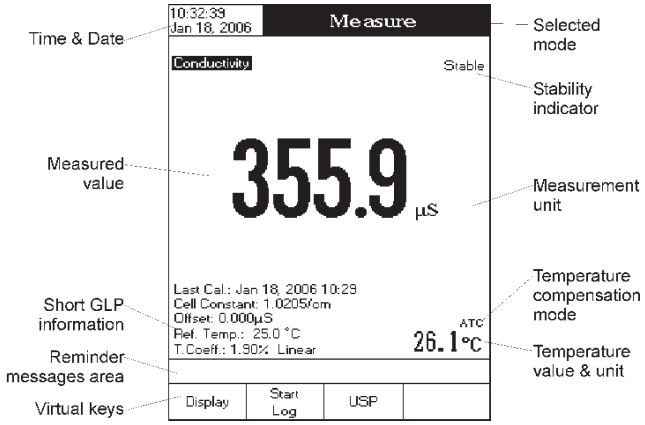
CAL	To enter / exit calibration mode.
MODE	To select the desired measurement mode: Conductivity, Resistivity, TDS, Salinity.
SETUP	To enter Setup (System Setup, Conductivity Setup, Resistivity Setup , TDS Setup or Salinity Setup) and to access Log Recall function.
HELP	To obtain general informations 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 Log and USP in *Measure* mode).



LCD GENERAL DESCRIPTION



SPECIFICATIONS

		HI 4321
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	±1% of reading (±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	Linear / Non linear (natural water) / Disabled
	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	±2 % of reading (±1 Ohm x cm)
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	±1% of reading (±0.01 ppm)

		HI 4321
Salinity	Range	Practical Salinity Scale 0.00 to 42.00 psu Natural Sea Water Scale 0.00 to 80.00 ppt Percent Scale 0.0 to 400.0 %
	Resolution	0.01 for Practical Salinity 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)
	User calibration	3 points calibration
Keyboard		8 keys (4 virtual keys)
PC application		Yes
GLP		Cell constant, ref. temp. / coefficient, calibration points, cal. time stamp, probe offset
Auto-Hold		Yes
Logging feature	Record samples	100 lots with 10000 records / lot
	Logging interval	Settable between 1s 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
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
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
Accessories		2 cell probe (0.1 cell const, 0 to 500 µS) 4 cell probe (1.0 cell constant wide range) USP kit (flow cell, resistor set for low range checking)

OPERATIONAL GUIDE

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.

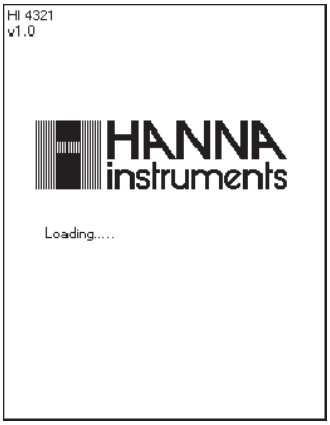
PROBE CONNECTION

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.

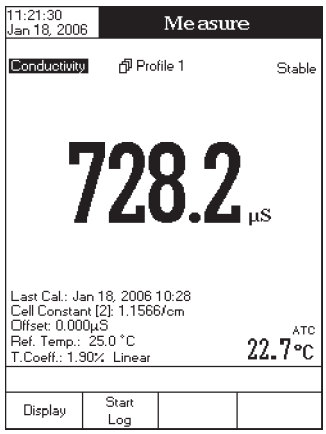
Note: It is normal for the loading process to take a few seconds. If the instrument doesn't display the next screen, restart the meter using the power switch. If the problem persists, contact your dealer.



DISPLAYING MODES

For each measurement mode (Conductivity, Resistivity, TDS or Salinity) the following display configurations are available: Basic, Good Laboratory Practice (GLP), Graph and Log History.

Basic

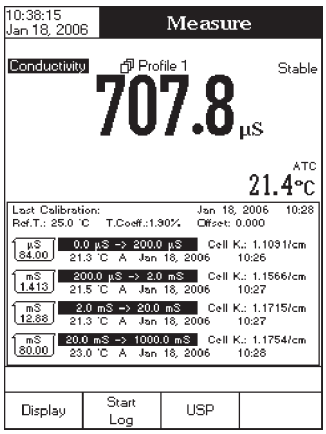


Accessing this option, the measured value and its units are displayed on the LCD, along with the temperature value, temperature compensation mode, and minimal GLP data.

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

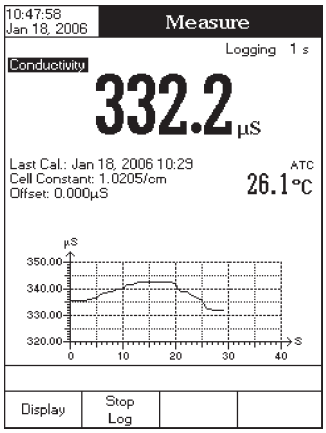


Accessing this option, a detailed GLP data will be displayed on the LCD for conductivity and salinity (Percent Scale only) measure modes: Last Calibration Date and Time, Cell Constant, Probe Offset, Reference Temperature, Compensation Coefficient, Temperature Compensation.

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.

Graph



Accessing this option, the online graph with currently logged values (Conductivity, Resistivity, TDS or Salinity vs. Seconds) could 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 the horizontal (*Time*) axis.
- Press [SETUP] to access the zoom menu for the vertical (*Parameter*) axis. Use [Zoom IN] or [Zoom OUT] for vertical axis zooming.
- 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 the horizontal and vertical axes. Use [Zoom Time] or [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.

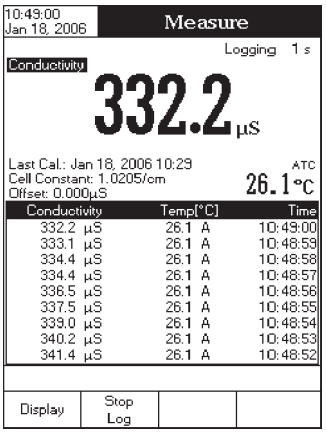
- Press [Escape] to return to the main menu.

Log History

Accessing this option, last logged records will be displayed on the LCD. The log history list also contains the appropriate conductivity / resistivity / TDS / salinity values, the logged temperature, the temperature source, 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, the 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.

SYSTEM SETUP

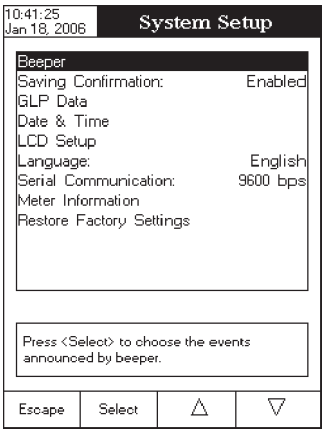
The System Setup menu allows the user to customize the user interface, consult the meter information, set the external serial communication interface and to restore the manufacturer settings.

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 activated, along with the "Stable" indicator on the LCD.

Alarm

If this option is activated, 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

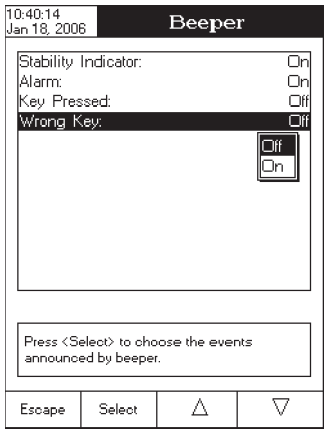
If this option is activated, a short beep will be heard each time a valid key is pressed.

Wrong Key

If this option is activated, 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 event 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 enabled /disabled 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 edited text can have max 10 characters.

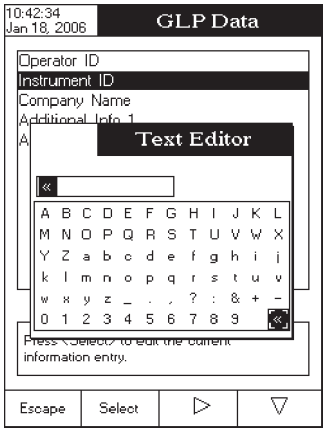
Operator ID – edit the operator's name.

Instrument ID – edit an identification name / number for the instrument.

Company Name – edit the company name.

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

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. These parameters will be displayed on the *Measure* screens and also when storing measured data.

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

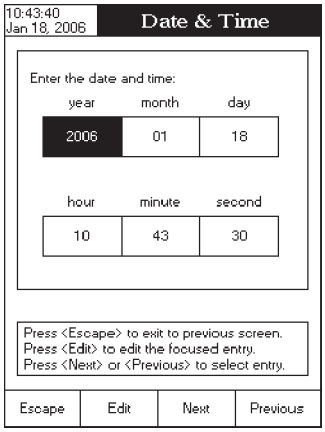
This option allows you to choose between 12 Hour (AM / PM) time format and 24 Hour time format from the displayed pop-up box.

Set Date Format

This option allows you to choose the desired date format from the available formats: 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.



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

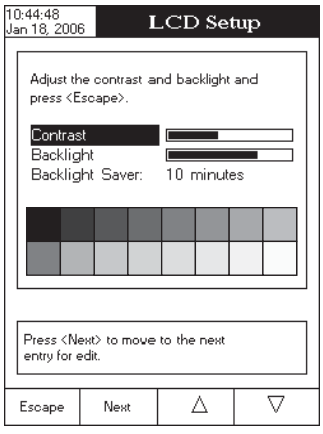
LCD Setup

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 disabled (OFF). 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:

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



Language

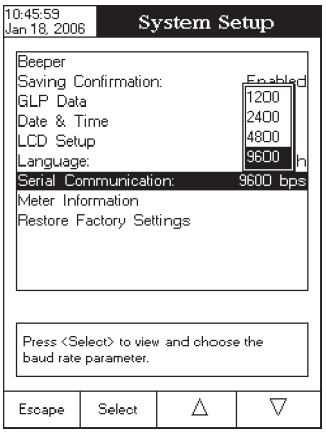
This option allows the user to choose the desired language for the user interface.

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*.



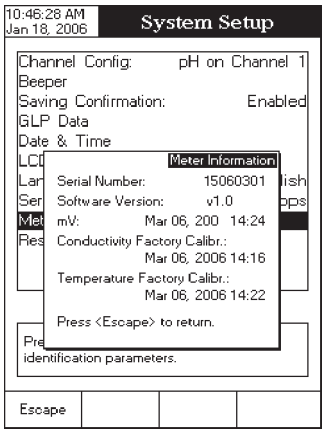
To set the serial communication:

- 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 application 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 conductivity and temperature).



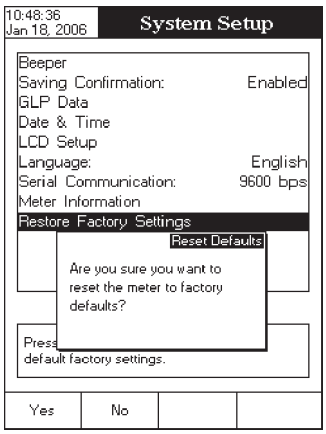
Note: All the instruments are factory calibrated for conductivity and temperature. After one year from last factory calibration, the warning will appear at meter startup to inform the user that a new factory calibration is required.

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 and return to the *System Setup* or press [No] to return without restoring defaults.

Conductivity SETUP

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

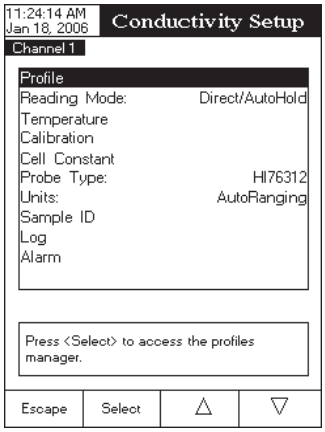
Accessing Conductivity Setup

- 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:

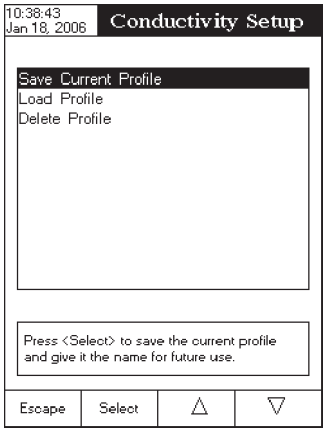
Save Current Profile: save the current profile.

Load Profile: load from available profiles.

Delete Profile: delete a profile.

Save Current Profile

To save the current profile:

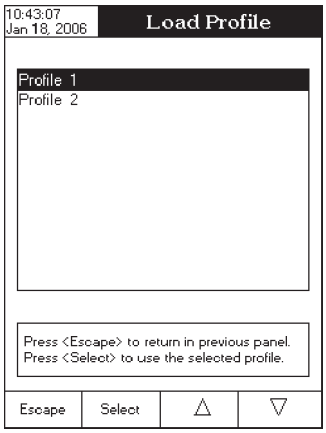


- Use [△] or [▽] to select the *Profile* option.
- Press [Select] and then select *Save Current Profile* option. The text editor box will be displayed on the LCD.
- Enter the desired profile name by using [▷] and [▽] to highlight the desired character and then press [Select] to add it to the text bar. 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.

Load Profile

To load the user customized profile:

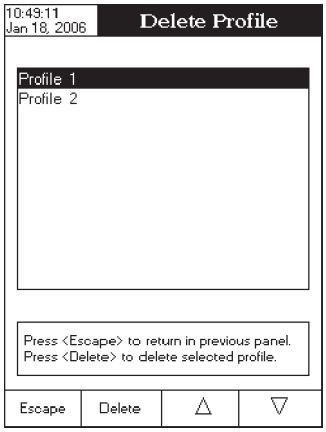


- Use [△] or [▽] to select the *Profile* option.
- Press [Select] and use [△] or [▽] to highlight the *Load Profile* option.
- Press [Select]. A list with all customised profiles will be displayed on the screen.
- Use [△] or [▽] to select the desired profile and press [Select] to confirm or [Escape] 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.

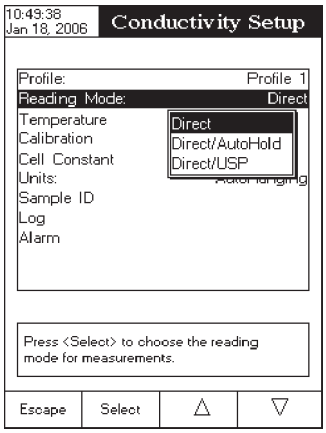


Reading Mode

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.

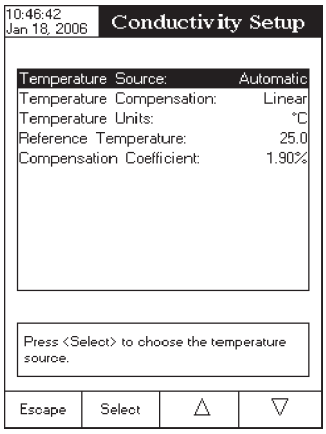


Temperature

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:

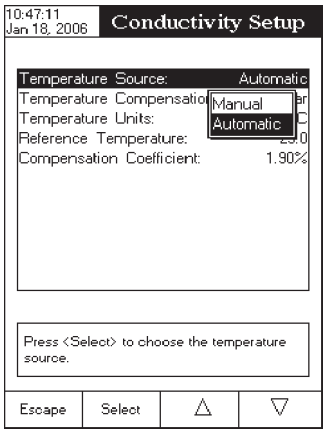
- Use [△] or [▽] to highlight the *Temperature* option from the *Conductivity Setup* menu.
- Press [Select] to access the *Temperature* option.



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.



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

C_i - measured conductivity (uncompensated)

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.

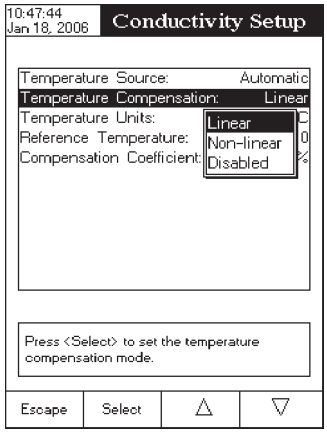


Table for non-linear temperature compensation:

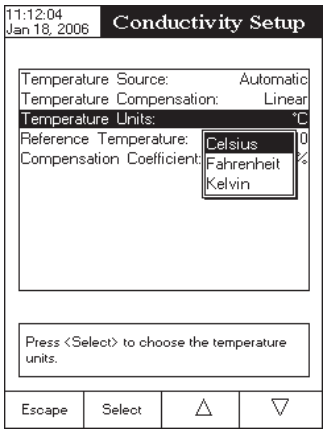
	0	1	2	3	4	5	6	7	8	9
0	1.918	1.912	1.905	1.899	1.893	1.887	1.881	1.875	1.869	1.863
1	1.857	1.851	1.845	1.840	1.834	1.829	1.822	1.817	1.811	1.805
2	1.800	1.794	1.788	1.783	1.777	1.772	1.766	1.761	1.756	1.750
3	1.745	1.740	1.734	1.729	1.724	1.719	1.713	1.708	1.703	1.698
4	1.693	1.688	1.683	1.678	1.673	1.668	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 Unit

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

To set the temperature unit:

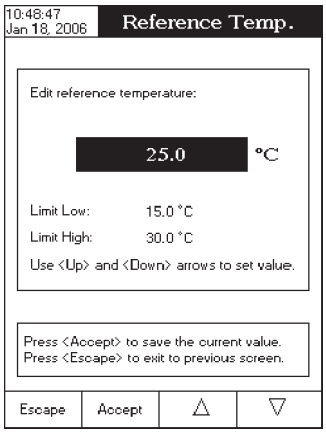
- Use [△] or [▽] to highlight the *Temperature Units* option.
- Press [Select] and then use [△] or [▽] to select *Celsius, Fahrenheit* or *Kelvin* degrees unit.
- Press [Select] to confirm your selection or press [Escape] to cancel operation.



Reference Temperature (only for linear or non-linear temperature compensation)

To set the reference temperature:

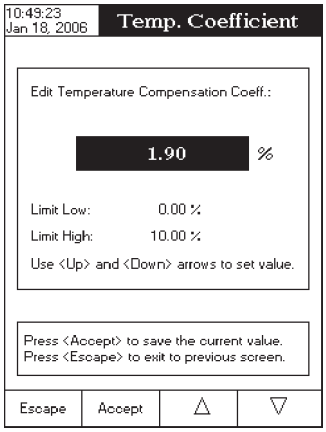
- Use [△] or [▽] to highlight the *Reference Temperature* option.
- Press [Select] and then use [△] or [▽] to increase / decrease the value.
- Press [Accept] to save or press [Escape] to cancel operation.



Compensation Coefficient (only for linear temperature compensation)

To set the compensation coefficient:

- Use △ or ▽ to highlight the *Compensation Coefficient* option.
- Press Select and set the desired compensation coefficient using △ or ▽ 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

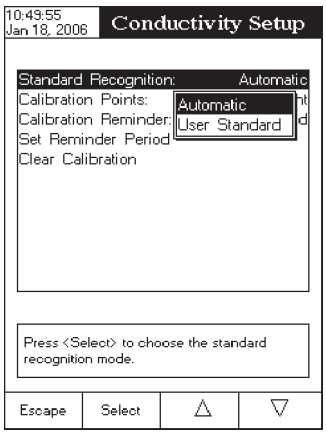
The meter can be calibrated in a single or multi-points (up to four points), using 6 Hanna standards (84 µS, 1413 µS, 5.0 mS,12.88 mS, 80.0 mS, 111.8 mS) or using the custom standards.

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).

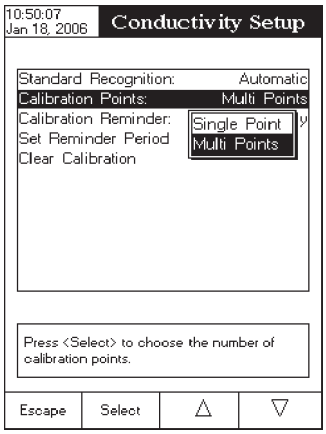
- Use △ or ▽ to highlight the *Standard Recognition* option.
- Use △ or ▽ to choose from *Automatic* or *User Standard* option.
- Press Select to confirm your selection or press Escape to cancel operation.



Calibration Points

The user can choose between *Single Point* and *Multi Points* calibration.
To select the calibration points type:

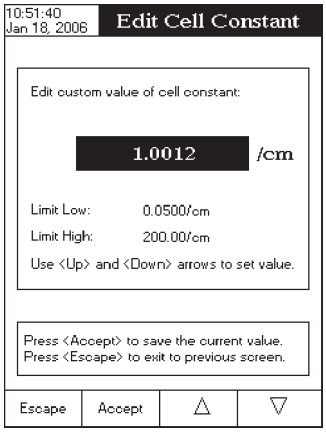
- Use △ or ▽ to highlight the *Calibration Points* option.
- Press Select to confirm your selection and then use △ or ▽ to choose the desired option.
- Press Select to confirm your selection or press Escape to cancel operation.



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.
- Press Reset Cell K. to preset the cell constant value to the probe auto-recognizable default cell constant.
- Use △ or ▽ to increase / decrease the value.
- Press Accept to confirm the new value or press Escape to exit without modifying.

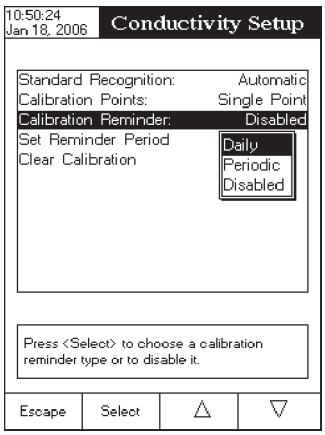


Calibration Reminder

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.



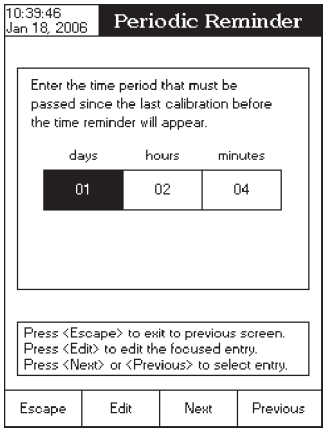
Set Reminder Period

Daily reminder - the user can set the time from the 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.



Clear Calibration

Accessing this option, the existent conductivity calibration can be cleared (the probe cell constant will be reset to default). If the calibration is cleared, another calibration has to be performed.

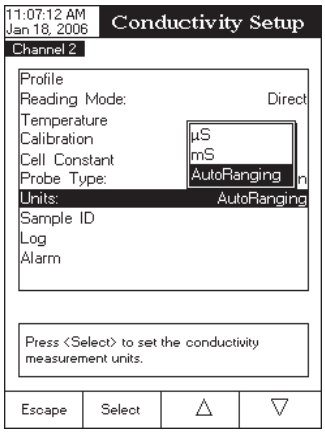
To clear calibration:

- 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.

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.



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*.

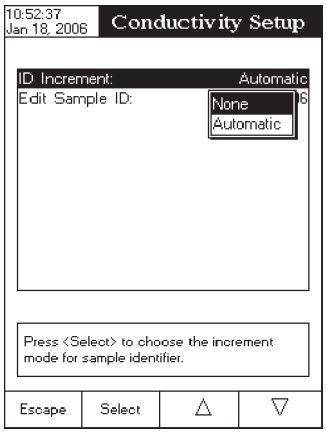
ID Increment

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 - auto-increment 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.

Log

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

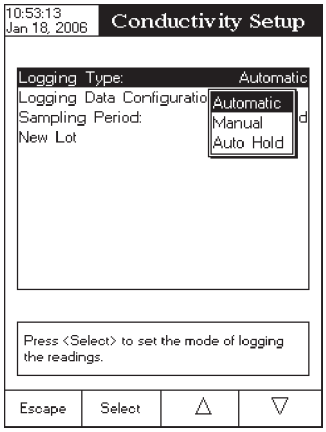
Logging Type

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.

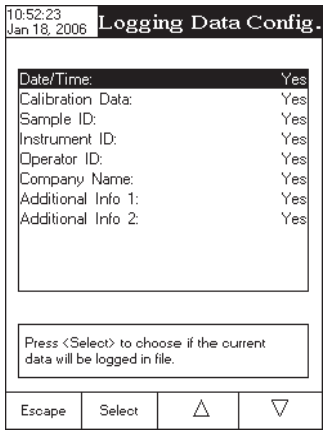


To set the sample logging type:

- 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 customise the logging data configuration:

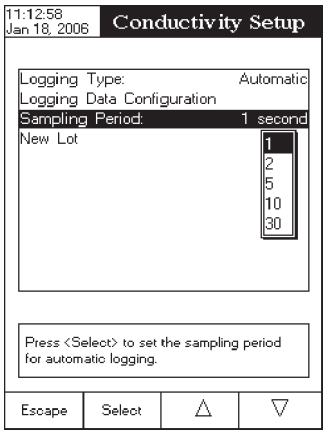
- Use [△] or [▽] to highlight the *Logging Data Configuration* option.
- Press [Select] and then use [△] or [▽] to enable the parameter by selecting *Yes* or to disable it by selecting *No* for each option.
- Press [Escape] to return to the previous menu.

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: The *New Lot* option is available only for manual logging.

Alarm

This option allows the user to define two alarm limits for the measurements.

Alarm State

The following options are available:

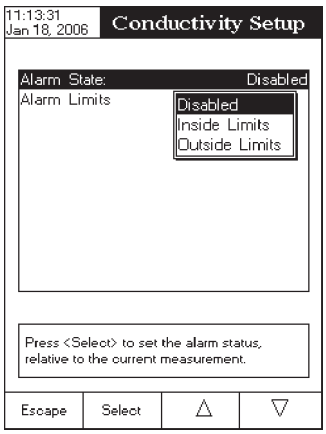
Disabled – the alarm will be disabled.

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.



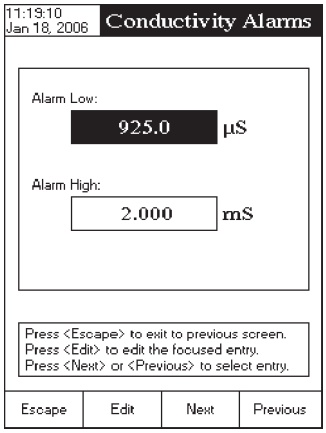
Alarm Limits

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:

- Highlight 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.



Resistivity SETUP

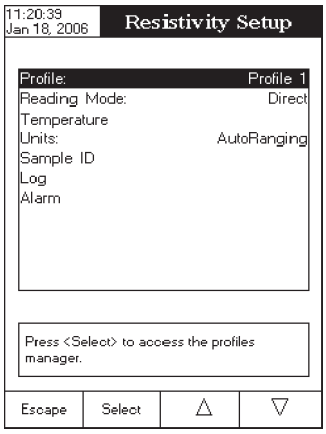
The Resistivity Setup menu allows the user to set the parameters related to the resistivity measurements.

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.

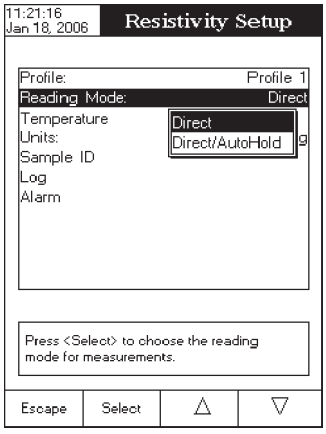
Profile - see *Conductivity Setup* section.

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.



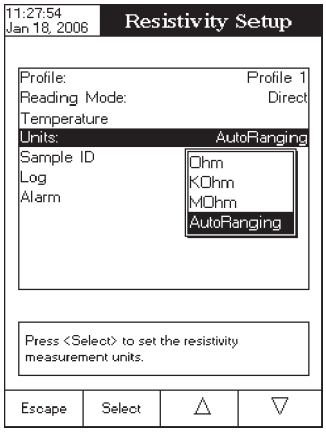
Temperature - see *Conductivity Setup* section.

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.



Sample ID - see *Conductivity Setup* section.

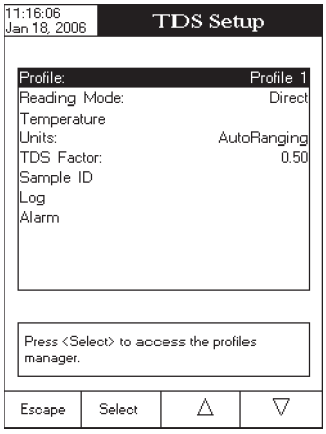
Log - see *Conductivity Setup* section.

Alarm - see *Conductivity Setup* section.

TDS SETUP

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.

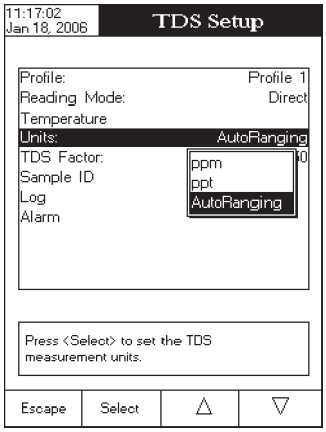
Profile - see *Conductivity Setup* section.

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



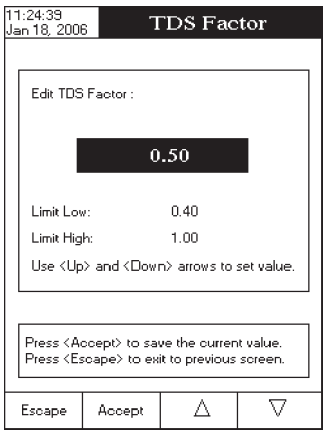
To select the suitable unit:

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

TDS factor

Using this option the user can set the TDS factor.

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

Salinity SETUP

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

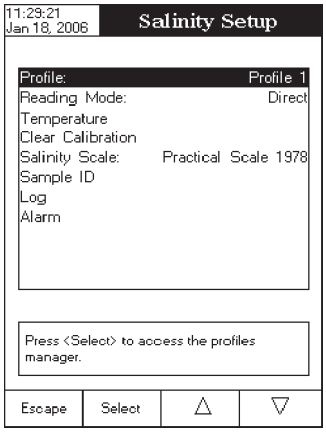
Accessing Salinity Setup

- 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* options.



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 temperature options:

- Use [△] or [▽] to highlight the *Temperature* option.
- Press [Select] to access *Temperature* menu.
- Use [△] or [▽] to select the desired option and then press [Select] to access it.
- Press [Escape] to return.

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

Clear Calibration

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

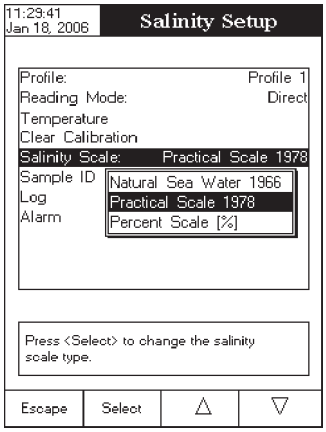
- Use [△] or [▽] to highlight the *Clear Calibration* option.
- Press [Select] to clear calibration. A pop-up menu will be displayed to ask for confirmation.
- Press [Yes] to confirm or press [No] to cancel operation.

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.

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 to calibrate for the offset.

CELL CONSTANT CALIBRATION (in solution)

Single Point Calibration

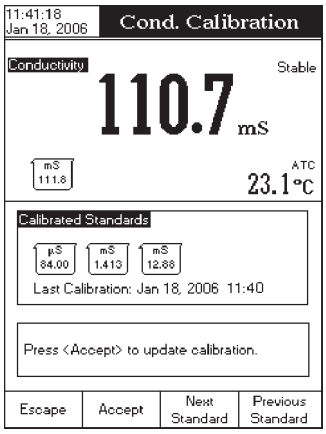
- Select the single point calibration (see *Conductivity Setup -> Calibration*);
- Pour a small quantity of the standard solution into a clean beaker. If possible, use plastic beakers to minimize any EMC interferences.
- For accurate calibration and to minimize cross-contamination, use two beakers for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

- 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 entering the custom standard value.
- Press [Accept] to finish the calibration or [Escape] to exit calibration.

Note: The calculated cell constant will be used for the wide 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 introduced by the user for the wide range (see *Conductivity Setup -> Cell Constant* section)

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

CONDUCTIVITY MEASUREMENT

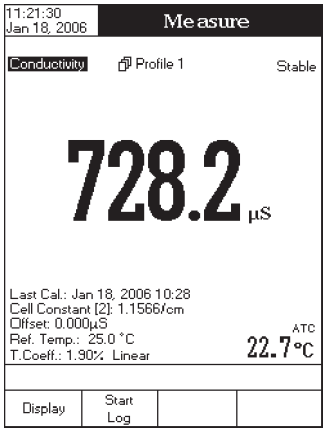
Make sure the instrument has been calibrated before taking conductivity measurements.

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.

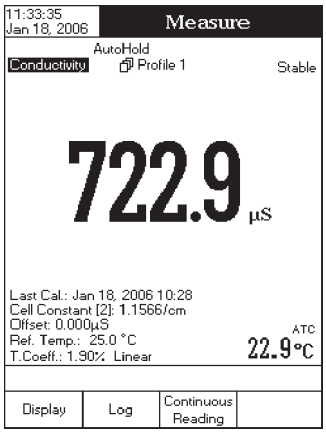
Note: If the reading is out of range, "-----" will be displayed.



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.



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.

Test steps:

- Measure the temperature of the water and the uncompensating 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.

Test steps:

- 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.

Stage 3 - this is an off-line test.

Test steps:

- Take the water sample from the previous stage 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 conductivity 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.

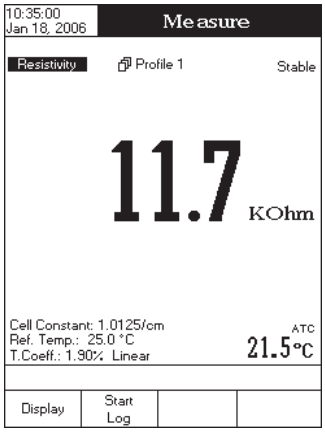
RESISTIVITY MEASUREMENT

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

DIRECT MEASUREMENT

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

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



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)

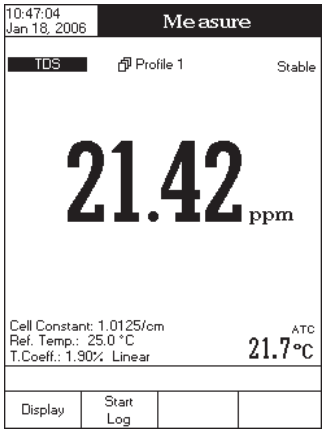
TDS MEASUREMENT

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:

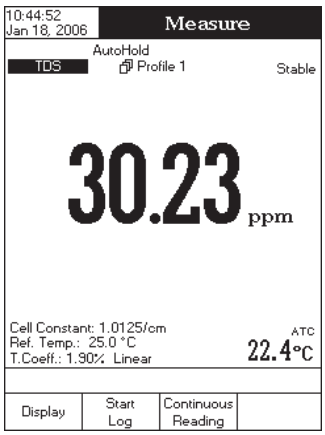
- Press MODE and then TDS to select TDS measure mode.
- Select the *Direct* reading mode (see *TDS Setup* section).
- Proceed as for the conductivity measurement (see *Conductivity Measurement* section).



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)



SALINITY CALIBRATION

Salinity calibration is a one-point 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.

SALINITY MEASUREMENT

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:

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

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

$$R = R_T + 10^{-5}R_T(R_T - 1.0)(T - 15.0)[96.7 - 72.0R_T + 37.3R_T^2 - (0.63 + 0.21R_T^2)(T - 15.0)]$$

$$S = -0.08996 + 28.2929729R + 12.80832R^2 - 10.67869R^3 + 5.98624R^4 - 1.32311R^5$$

where:

R_T - coefficient;

C_T(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.

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

PRACTICAL SALINITY SCALE (UNESCO 1978)

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

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

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

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

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

where:

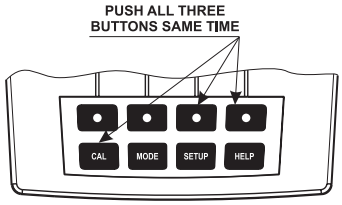
R_T - coefficient;
C_T(sample) - uncompensated conductivity at T °C;
C(35,15)= 42914 µS/cm - the corresponding conductivity of KCl solution containing a mass of 32.4356 g KCl / 1 Kg solution;
r_T - temperature compensation polynom

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.

TEMPERATURE CALIBRATION

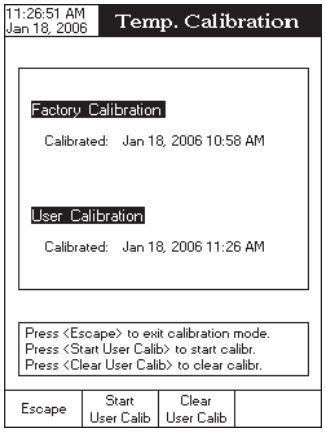
The temperature user calibration menu can be accessed at the meter startup by pressing simultaniously three keys as in the below drawing:



Note: The temperature user calibration is performed in three points: around 0°C, 50°C, 100°C.

To start temperature user calibration:

- Insert the probe in the beaker with water at 0°C.
- Press [Start User Calib] to start the temperature calibration. Adjust the temperature preset value using [△] or [▽] when necessary.
- Wait to stabilize and then press [Accept] to confirm the calibration point.
- Repeat the above 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.

LOGGING

This feature allows the user to log 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 parameter setup must be set first in order to be saved into the log report.

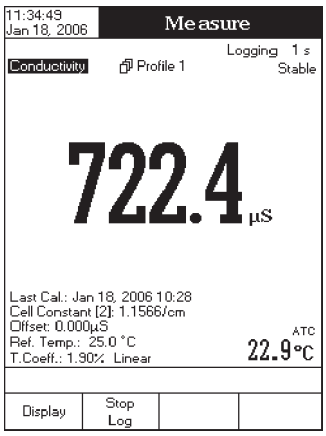
Regarding data logging, the available logging modes are shown in the table below:

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:

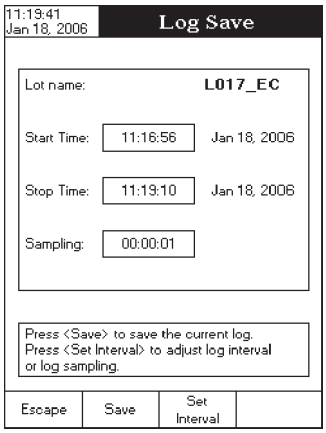


- Press [Start Log] while in *Measure* mode to start the logging session. The "Logging" and the Sampling Period indicators will be displayed on the LCD and data will be stored at the set sampling period.

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* section).
- To stop the logging session, press [Stop Log]. The Log Save screen will display the log 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.

- 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.

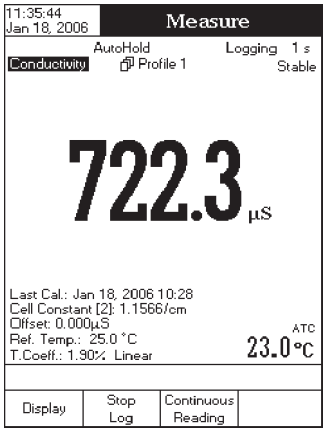


LOGGING MODE 2

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

To log data using this mode:

- Press [Start Log] while in *Measure* mode to start the logging session. When the measured value is frozen on the LCD by pressing [Auto Hold] 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].
  The "Logging" and "AutoHold" indicators will be displayed on the LCD.
- To store another frozen value, press [Auto Hold] again.
- To stop the logging session, press [Stop Log].

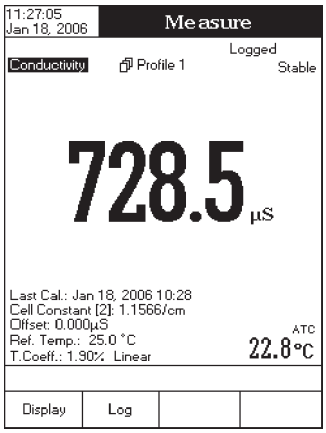


LOGGING MODE 3

This logging mode can be used for any sample measurements. By choosing this logging mode, [Log] 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, [Log] and [Auto Hold] will be available in *Measure* mode.

To log data using this mode:

- Press [Log] 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 Hold] 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.

Note: 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 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].

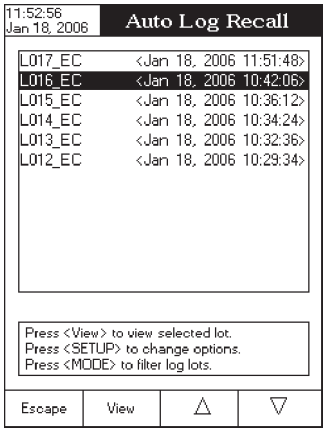
Notes: • For the automatic logging, if the maximum logging time (24h) has been reached, a warning pop-up will be displayed on the LCD in order to save the current log and start another one in a new lot.

• 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 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] or [USP Reports] to select the desired Log/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 [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 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.

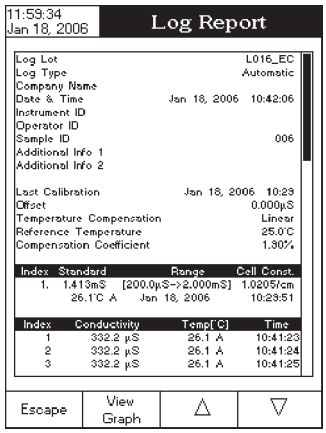
• If pressing [SETUP] while the graph is displayed, the zoom menu for the horizontal and vertical axes will be accessed. Press [Zoom Time] or [Zoom Cond.] / [Zoom Resistiv.] / [Zoom TDS] / [Zoom Salinity] to switch between the active zooming axes and then zoom in or out on the selected axis by pressing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

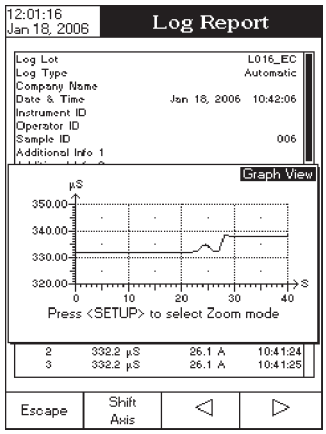
- Press [Escape] to return to the previous menu.

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.





PC INTERFACE

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 4321 instrument has 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.

PROBE CONDITIONING & MAINTENANCE

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.

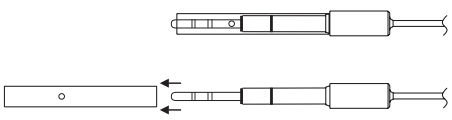
For a faster response and to avoid cross-contamination of the samples, rinse the probe with a few drops of the solution to be tested, before taking measurements.

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.

TROUBLESHOOTING GUIDE

SYMPTOMS	PROBLEM	SOLUTION
Reading fluctuates up and down (noise).	Conductivity probe not properly connected.	Insert the probe correctly into the connector.
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.

ACCESSORIES

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 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

PROBE CLEANING SOLUTIONS

HI 7061M General Cleaning Solution, 230 mL bottle
HI 8061M General Cleaning Solution, 230 mL FDA approved bottle
HI 7061L General Cleaning Solution, 500 mL bottle
HI 8061L General Cleaning Solution, 500 mL FDA approved bottle

OTHER ACCESSORIES

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 710005/8 12VDC voltage adapter from 115 Vac to 12 Vdc (US plug)
HI 710006/8 12VDC voltage adapter from 230 Vac to 12 Vdc (European plug)
HI 76404N Electrode holder
HI 920010 9 to 9-pin RS232 cable
HI 92000 Windows® compatible software

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.

SALES AND TECHNICAL SERVICE CONTACTS

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Greece:
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For e-mail contacts and a complete list of Sales and Technical offices, please see ***www.hannainst.com***.

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