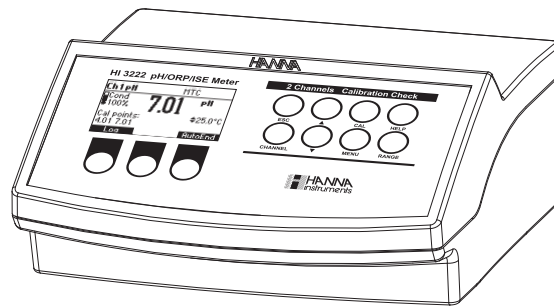


Instruction Manual

HI 3220 HI 3221 HI 3222

Calibration Check pH/mV/ISE/Temperature Bench Meters



WARRANTY

The HI 322x series are guaranteed 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 problem. 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.

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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 Customer Service Center.

Each instrument is supplied with:

- **HI 1131B** Glass body combination double-junction pH electrode
- **HI 7662-T** stainless steel Temperature Probe with 1 m (3.3') Cable
- **pH 4.01 & 7.01** Buffer Solutions (20 mL each)
- **HI 700661** Cleaning solution (2x20 mL each)
- **HI 7071S** Electrolyte Solution
- **HI 76404N** Electrode Holder
- 12 Vdc Power Adaptor
- Instruction Manual

HI 322x are supplied with 12 Vdc/230 Vac power adapter

HI 322x-01 are supplied with 12 Vdc/115 Vac power adapter

Note: Save all packing material until you are sure that the instrument functions correctly. All defective items must be returned in the original packing with the accessories supplied.

GENERAL DESCRIPTION

The **HI 322x** instruments are state-of-the-art, professional bench pH meters with graphical LCD, designed to provide laboratory results and accuracy. They are provided with a series of new diagnostic features which add an entirely new dimension to the measurement of pH, by allowing the user to dramatically improve the reliability of the measurement:

- Single (**HI 3220** and **HI 3221**) or dual (**HI 3222**) input channels
- 7 standard pH buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) for calibration.
- pH calibration up to five calibration points (see instrument specifications).
- Custom calibration with up to five custom buffers.
- Messages on the graphic LCD for an easy and accurate calibration.
- Diagnostic features to alert the user when the electrode needs cleaning.
- User selectable "**Outside Calibration Range**" warning.
- User-selectable "**Calibration Time Out**" to remind when a new calibration is necessary.

Hanna Instruments reserves the right to modify the design, construction and appearance of its products without advance notice.

Moreover, they offer an extended temperature range from -20 to 120 °C (-4 to 248 °F), using **HI 7662-T** interchangeable temperature probes.

These instruments can also measure with ORP electrodes, thanks to their capability to measure mV with a resolution up to 0.1 mV.

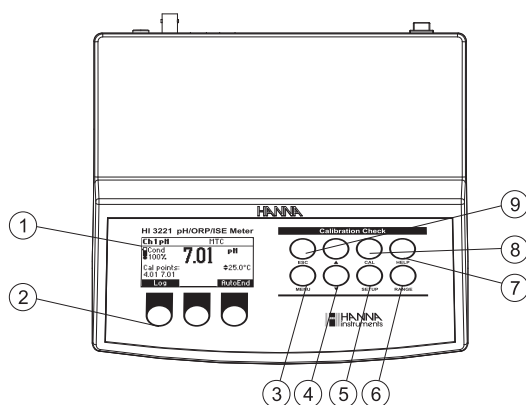
HI 3221 and **HI 3222** can also measure with ISE electrodes on ppm scale. The electrode type and unit selection capability (for **HI 3222**), the ion change selection capability (for **HI 3221**) and the ISE calibration in up to five calibration standard solutions make this instrument very useful for a large range of concentration solutions measurements.

Other features include:

- Relative mV measurements
- Log on demand up to 400 samples
- Log interval with log on stability feature up to 600 records
- Auto Hold feature, to freeze first stable reading on the LCD
- GLP feature, to view last calibration data for pH, Rel mV or ISE
- PC interface

HI 3220, HI 3221 FUNCTIONAL DESCRIPTION

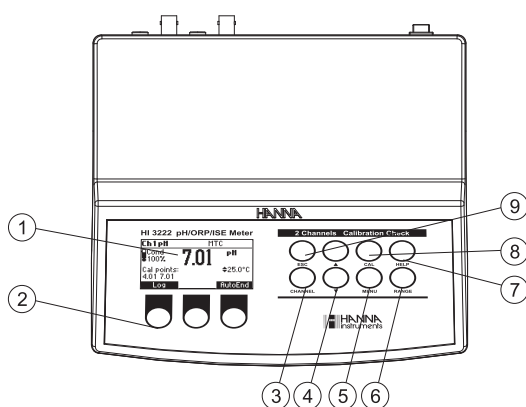
Front view



- 1) Liquid Crystal Display (LCD)
- 2) Function keys
- 3) **MENU** key, to change the function key at the bottom of the display
- 4) **▲/▼** keys to manually increase/decrease the parameters or to scroll between the parameter list
- 5) **SETUP** key, to enter SETUP mode
- 6) **RANGE** key, to switch between pH and mV range (HI 3220); pH, mV and ISE range (HI 3221)
- 7) **HELP** key to enter/exit contextual help
- 8) **CAL** key, to enter calibration mode
- 9) **ESC** to escape the current mode, exit calibration, setup, help, etc.

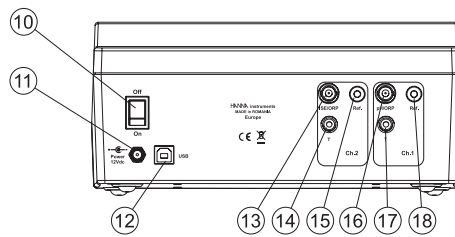
HI 3222 FUNCTIONAL DESCRIPTION

Front view



- 1) Liquid Crystal Display (LCD)
- 2) Function keys
- 3) **CHANNEL** keys to toggle between channels (Ch1 - pH, Ch2 - ISE)
- 4) **▲/▼** keys to manually increase/decrease the parameters or to scroll between the parameter list
- 5) **MENU** key, to change the function key at the bottom of the display
- 6) **RANGE** key, to switch between pH and mV range (Ch1); ISE and mV range (Ch2)
- 7) **HELP** key to enter/exit contextual help
- 8) **CAL** key, to enter calibration mode
- 9) **ESC** to escape the current mode, exit calibration, setup, help, etc.

Rear view



- 10) **ON/OFF** switch.
- 11) Power adaptor socket.
- 12) **USB** connector.
- 13) **BNC** electrode connector for channel two (**HI 3222** only).
- 14) Temperature socket for channel two (**HI 3222** only).
- 15) Reference electrode connector for channel two (**HI 3222** only).
- 16) **BNC** electrode connector for channel one.
- 17) Temperature socket for channel one.
- 18) Reference electrode connector for channel one.

HI 3220 SPECIFICATIONS

RANGE	-2.0 to 20.0 pH -2.00 to 20.00 pH -2.000 to 20.000 pH
	±2000.0 mV
	-20.0 to 120.0 °C (-4.0 to 248.0 °F)
RESOLUTION	0.1 pH 0.01 pH 0.001 pH
	0.1 mV
	0.1 °C (0.1 °F)
ACCURACY @ 20 °C / 68 °F	±0.01 pH ±0.002 pH
	±0.2 mV
	±0.2 °C (±0.4 °F) (excluding probe error)
Rel mV offset range	±2000 mV
pH Calibration	Up to 5 points. 7 standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45) and 5 custom buffers.
Slope Calibration	From 80 to 110%
Temperature compensation	Manual or Automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
pH Electrode	HI 1131B (included)
Temperature probe	HI 7662-T (included)
LOG on demand	200 samples
Lot logging	5, 10, 30 sec 1, 2, 5, 10, 15, 30, 60, 120, 180 min, AutoEnd (max 600 samples)
Input impedance	10 ¹² ohms
Power supply	12 Vdc power adaptor.
PC interface	opto-isolated USB
Dimensions	235 x 207 x 110 mm (9.2 x 8.14 x 4.33")
Weight (meter only)	1.8 Kg (4.1 lb)
Environment	0 – 50 °C (32 – 122 °F) max. RH 55% non-condensing

HI 3221 SPECIFICATIONS

RANGE	-2.0 to 20.0 pH -2.00 to 20.00 pH -2.000 to 20.000 pH
	±2000.0 mV
	1.00/E-3 to 1.00/E5 conc.
	-20.0 to 120.0 °C (-4.0 to 248.0 °F)
RESOLUTION	0.1 pH 0.01 pH 0.001 pH
	0.1 mV
	3 digits 0.01, 0.1, 1, 10 conc.
	0.1 °C (0.1 °F)
ACCURACY @ 20 °C / 68 °F	±0.1 pH ±0.002 pH
	±0.2 mV
	±0.5% of reading (monovalent ions) ±1% of reading (divalent ions)
	±0.2 °C (±0.4 °F) (excluding probe error)
Rel mV offset range	±2000 mV
pH Calibration	Up to five-point calibration, 7 standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and 5 custom buffers
Slope Calibration	From 80 to 110%
ISE Calibration	Up to two points. 6 standard solutions (0.1, 1, 10, 100, 1000, 10000 ppm).
Temperature compensation	Manual or Automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
pH Electrode	HI 1131B (included)
Temperature probe	HI 7662-T (included)
LOG on demand	300 samples
Lot logging	5, 10, 30 sec 1, 2, 5, 10, 15, 30, 60, 120, 180 min, AutoEnd (max 600 samples)
Input impedance	10 ¹² ohms
Power supply	12 Vdc Power Adaptor
PC interface	opto-isolated USB
Dimensions	235 x 207 x 110 mm (9.2 x 8.14 x 4.33")
Weight (meter only)	1.8 Kg (4.1 lb)
Environment	0 – 50 °C (32 – 122 °F) max. RH 55% non-condensing

HI 3222 SPECIFICATIONS

RANGE	-2.0 to 20.0 pH -2.00 to 2.00 pH -2.000 to 2.000 pH
	±2000.0 mV
	1.00/E-7 to 9.99/E10 conc.
	-20.0 to 120.0 °C (-4.0 to 248.0 °F)
RESOLUTION	0.1 pH 0.01 pH 0.001 pH
	0.1 mV
	3 digits 0.01, 0.1, 1, 10 conc.
	0.1 °C (0.1 °F)
ACCURACY @ 20 °C / 68 °F	±0.01 pH ±0.002 pH
	±0.2 mV
	±0.5% of reading (monovalent ions) ±1% of reading (divalent ions)
	±0.2 °C (±0.4 °F) (excluding probe error)
Rel mV offset range	±2000 mV
pH Calibration	Up to five-point calibration, 7 standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and 5 custom buffers
Slope Calibration	From 80 to 110%
ISE Calibration	Up to five-point calibration points. 6 standard solutions available (0.1, 1, 10, 100, 1000, 10000 ppm)
Temperature compensation	Manual or Automatic from -20.0 to 120.0 °C (-4.0 to 248.0 °F)
pH Electrode	HI 1131B (included)
Temperature probe	HI 7662-T (included)
LOG on demand	400 samples
Lot logging	5, 10, 30 sec 1, 2, 5, 10, 15, 30, 60, 120, 180 min, AutoEnd (max 600 samples)
Input impedance	10 ¹² ohms
Power supply	12 Vdc Power Adaptor
PC interface	opto-isolated USB
Dimensions	235 x 207 x 110 mm (9.2 x 8.14 x 4.33")
Weight (meter only)	1.8 Kg (4.1 lb)
Environment	0 - 50 °C (32 - 122 °F) max. RH 55% non-condensing

OPERATIONAL GUIDE

POWER CONNECTION

Plug the 12 Vdc adapter into the power supply socket.

- Notes:**
- These instruments use non volatile memory to retain the pH, mV, Ion calibrations and all other settings, when unplugged.
 - Make sure a fuse protects the main line.

ELECTRODE AND PROBE CONNECTIONS

For pH or ORP measurements connect a combination pH/ORP electrode to the BNC connector located on the rear panel of the instrument (16 – see page 7).

For ISE measurements (HI 3221 & HI 3222 only) connect a combination ISE electrode to the BNC connector located on the rear panel of the instrument (16 for HI 3221 or 13 for HI 3222 – see page 7).

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

For temperature measurements and automatic temperature compensation connect the temperature probe to the appropriate socket. HI 3222, two channels instrument, use a proper temperature socket (14, 17 – see page 7) for each channel. As the channels are fully isolated use 2 temperature probes in order to view the independent temperature reading on each channel.

INSTRUMENT START UP

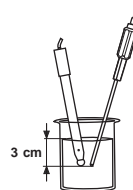
- Turn the instrument on from the power switch located on the rear panel of the instrument (10 – see page 7).
- Wait until the instrument finishes the initialization process. During this process the Hanna Instrument logo is displayed.

pH MEASUREMENTS

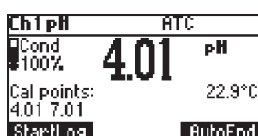
To take a pH measurement remove the electrode protective cap and simply submerge the electrode and the temperature probe 3 cm (1 1/4") into the sample to be tested.

If necessary, press **RANGE** until the display changes to the pH mode. Enter **SETUP** menu to select the pH resolution.

In the HI 3222, press **Channel** if the ISE measurements are displayed.



Allow for the electrode to adjust and reading to stabilize (hourglass symbol turns off).



On the pH screen are displayed:

- pH reading with the selected resolution.
- Temperature reading in the selected unit (°C or °F).
- Temperature compensation mode (MTC - manual, ATC - automatic).
While in MTC mode the \blacklozenge indicate that the temperature can be manually changed using **ARROW** keys.
- Electrode condition during the calibration day.
- The buffers used in last pH calibration (if feature is enabled in **SETUP**).
- Available function keys in accordance to the model.

In order to take more accurate pH measurements, make sure that the instrument is calibrated (see page 15 for details).

It is recommended that the electrode is always kept wet and rinsed thoroughly with the sample to be measured before use.

The pH reading is directly affected by temperature. For accurate pH measurements, temperature must be taken into consideration. If the sample temperature is different from the temperature at which the pH electrode was kept, allow a few minutes to reach thermal equilibrium.

To use the instrument's Automatic Temperature Compensation feature, submerge the temperature probe into the sample as close to the electrode as possible and wait for a few seconds.

If manual temperature compensation (MTC) is desired, the temperature probe must be disconnected from the instrument.

The display will show the default temperature of 25 °C, the last measured temperature reading, or the last set temperature, with the "MTC" indication.

The "MTC" indication and the \blacklozenge symbol light up on the LCD to indicate that the instrument is in MTC mode and the **ARROW** keys can be used to enter the desired temperature value.

Note: When in MTC mode the user can press and hold an **ARROW** key, and the instrument will start incrementing /decrementing the temperature value. The instrument keeps measuring and the display is updated periodically.

ORP MEASUREMENTS

To perform ORP measurements, connect an ORP electrode (see “Accessories” section) to the instrument and turn it ON.

If necessary, enter the mV mode by pressing **RANGE** until the display changes to mV.

Submerge the ORP electrode 3 cm (1¼”) into the sample to be tested and wait a few seconds for the reading to stabilize.



Measurements are displayed with 0.1 mV resolution.

The “ATC” (or “MTC”) message is turned off because mV readings are not temperature compensated.

For accurate ORP measurements, the surface of the electrode must be clean and smooth. Pretreatment solutions are available to condition the electrode and improve its response time (see “Accessories” section, page 61).

RELATIVE mV MEASUREMENTS

To enter Relative mV mode, press **Rel mV** function key while in mV measurement mode. The relative mV reading will be displayed along with the Absolute mV value and the current temperature readings.



The relative mV reading is equal to the difference between the absolute mV input value and relative mV offset established in the relative mV calibration.

Note: If using the pH or ISE electrode while in mV mode, the instrument will measure the mV generated by the electrode.

ISE MEASUREMENTS (HI 3221, HI 3222 only)

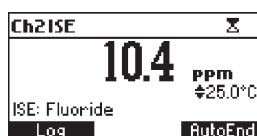
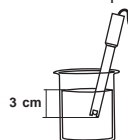
To perform ion concentration measurements, connect an ISE electrode (and the corresponding reference if necessary) to the corresponding instrument input and turn it ON.

On **HI 3222** the instrument input must be Channel 2. Press **Channel**, if necessary, to display ISE in top header.

On the HI 3221 enter the ISE mode by pressing **RANGE** until the display changes to ISE.

Submerge the ISE electrode tip 3 cm (1¼") into the sample to be tested and wait for the reading to stabilize.

The ISE reading will be displayed along with the current temperature reading.



The "ATC" (or "MTC") message is turned off because ppm readings are not temperature compensated.

In order to take accurate ISE measurements, make sure that the appropriate ISE electrode type and ISE unit were set in SETUP menu (HI 3222 only), or the proper ion charge and slope is set (HI 3221 only), and the instrument was calibrated (see ISE CALIBRATION for details, page 25).

- Notes:**
- When the reading is out of range, the display will flash the closest full-scale value.
 - The instrument will display "----" on the primary LCD if it is not calibrated. Perform at least a single-point calibration in order to take ISE measurements.
 - Changing the selection in the SETUP menu for the ISE electrode or the ion charge will require calibration.

TEMPERATURE MEASUREMENTS

Connect the HI 7662-T temperature probe to the appropriate socket. Immerse the temperature probe into the sample and allow the reading on the secondary LCD to stabilize.

Note: The temperature can be displayed in Celsius degrees (°C) or in Fahrenheit degrees (°F) (see SETUP for details, page 31).

BACKLIGHT FEATURE

The instrument is provided with a Backlight feature. The Backlight levels can be selected in the SETUP menu.

pH CALIBRATION

It is recommended to calibrate the instrument frequently, especially if high accuracy is required.

The pH range should be recalibrated:

- Whenever the pH electrode is replaced.
- At least once a week.
- After testing aggressive chemicals.
- When calibration alarm time out is expired - "CAL DUE" blinks (if feature is enabled in SETUP).
- If "Outside Cal Range" message blinks during pH measurement (the measurement range is not covered by current calibration, if this feature is enabled in SETUP).

PROCEDURE

The HI 32xx family offers a choice of 7 standard buffers (1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45 pH) and up to 5 custom buffers. The standard pH buffers are temperature compensated during calibration. The custom, user entered buffers are not temperature compensated during calibration.

When a custom buffer is selected during calibration, the "Custom" function key is displayed on the LCD. Press **Custom** key in order to alter the value to the actual pH value at the temperature of measurement. Use **ARROW** keys to change the value within a ± 1.00 pH window and then press **Accept**. Press **ESC** to leave custom buffers value unchanged. Press **Confirm**.

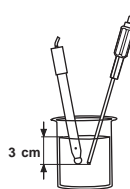
For accurate pH measurements, it is recommended to perform a multipoint calibration. At least a two-point calibration is required.

The instrument will automatically skip the buffers within ± 0.2 pH window, around one of the calibrated buffers.

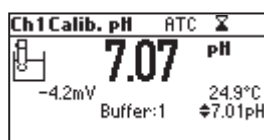
- Pour small quantities of selected buffer solutions into clean beakers. For accurate calibration use two beakers for each buffer solution, the first one for rinsing the electrode and the second one for calibration.
- Remove the protective cap, open the fill hole and rinse the electrode with some of the buffer solution to be used for the first calibration point.

FIVE-POINT CALIBRATION

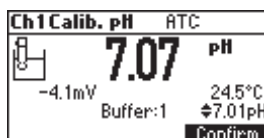
- Immerse the pH electrode and the temperature probe approximately 3 cm (1 1/4") into a buffer solution of your choice (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45 or a custom buffer) and stir the buffer gently. The temperature probe should be close to the pH electrode.



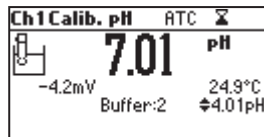
- Press **CAL**. The instrument will display the measured pH, the LCD first expected buffer and the temperature reading.



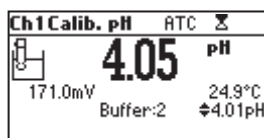
- If necessary, press the **ARROW** keys to select a different buffer value.
- The "Σ" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected buffer, **Confirm** function key is displayed.



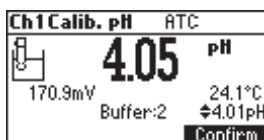
- Press **Confirm** to confirm first point.
- The calibrated value and the second expected buffer value is then displayed on the LCD.



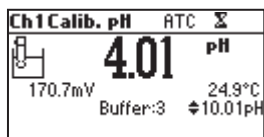
- After the first calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 3 cm (1 3/4") into the second buffer solution and stir gently. The temperature probe should be close to the pH electrode.
- If necessary, press the **ARROW** keys to select a different buffer value.
- The "Σ" tag will blink on the LCD until the reading is stable.



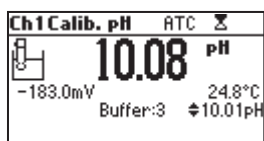
- When the reading is stable and close to the selected buffer, the **Confirm** function key is displayed.



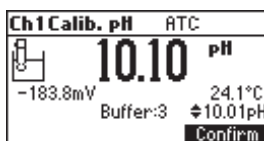
- Press **Confirm** to confirm calibration.
- The calibrated value and the third expected buffer value will be displayed.



- After the second calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 3 cm (1³/₄") into a third buffer solution and stir gently. The temperature probe should be close to the pH electrode.



- If necessary, press the **ARROW** keys to select a different buffer value.
- The "Σ" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected buffer, the **Confirm** function key is displayed.



- Press **Confirm** to confirm calibration.

Repeat this procedure with two additional pH buffers to encompass the entire sample pH range.

FOUR, THREE or TWO-POINT CALIBRATION

- Proceed as described in "FIVE-POINT CALIBRATION" section.
- Press **CAL** or **ESC** after the appropriate accepted calibration point. The instruments will return to measurement mode and will memorize the calibration data.

SINGLE-POINT CALIBRATION

There are two selectable options for a single-point calibration:

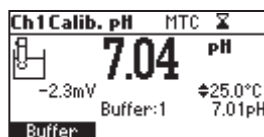
Replace and **Offset**.

This option is configured in **SETUP** mode under the parameter **First Point Mode**. In both cases the meter will alter the present calibration data in the instrument. If "**Replace**" is selected a new calibration point will be added to the existing data, and the slope is calculated. The slopes between current buffer and nearest lower and higher buffers will be reevaluated.

If the "**Offset**" option is selected, an electrode offset correction is performed to all buffer data keeping the existing slopes unchanged.

- Proceed as described in "FIVE-POINT CALIBRATION" section.
- Press **CAL** or **ESC** after the first calibration point was confirmed. The instruments will memorize the single-point calibration data and will return to measurement mode.

Notes: • Press **MTC** key to toggle between pH buffer selection and the temperature reading during calibration while temperature probe is disconnected (**MTC** mode).

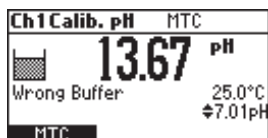


- The displayed arrow is moving to the temperature value. Use **ARROW** keys in order to change the temperature.

ERROR SCREENS

Wrong buffer

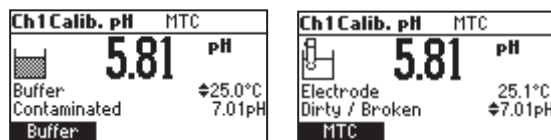
The calibration cannot be confirmed.



The pH reading is not close to the selected buffer. Select another buffer using the **ARROW** keys or change the buffer.

Electrode Dirty/Broken alternatively with Buffer Contaminated

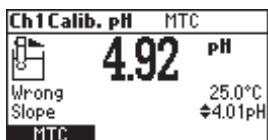
The calibration cannot be confirmed.



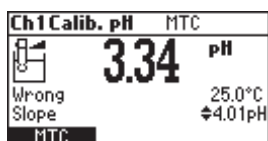
The offset of the electrode is not in the accepted range. Check if the electrode is broken or clean it following the Cleaning Procedure (see page 59). Check the quality of the buffer. If necessary, change the buffer.

Wrong slope

The calibration cannot be confirmed.



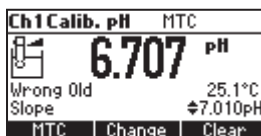
The evaluated slope is less than the lowest accepted value (80% of default slope).



The evaluated slope is more than the highest accepted value (110 % of default slope).

Wrong old slope

An inconsistency between new and previous (old) calibration is detected. Clear old calibration parameters and initiate calibration from the current point. The instrument will keep all confirmed values during current calibration.

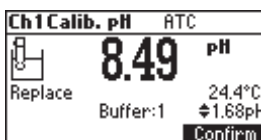


Note: For single-point calibration the electrode condition is not displayed in the measurement screen.

Each time a buffer is confirmed, the new calibration parameters replace the older calibration parameters of the corresponding buffer.

If an additional single buffer calibration is added at a latter time, the new buffer point will be added to the stored calibration.

If the existing stored calibration is full (five calibration points), after confirming the calibration point, the instrument will ask which buffer will be replaced by current buffer. On the Buffer line will be displayed the proposed buffer.



Press **ARROW** keys to select another buffer to be replaced.

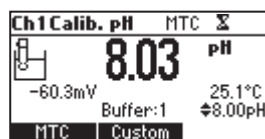
Press **Confirm** to confirm the buffer that will be replaced.

Press **CAL** or **ESC** to exit mode. In this case, the buffer will not be entered.

Note: The replaced buffer is not removed from calibration list and it can be selected for the next calibration points.

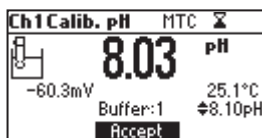
WORKING WITH CUSTOM BUFFERS

If at least one custom buffer was set in **SETUP** menu, it can be selected for calibration by pressing the **ARROW** keys. The **Custom** function key will be displayed.



Press **Custom** if you want to adjust the buffer to its value at the current temperature.

Use the **ARROW** keys to change the buffer value.



Press **Accept** to accept new value or **ESC** to exit mode.

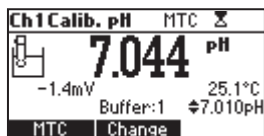
Note: Custom buffer value can be adjusted within a ± 1.00 pH window, around the set value.

WORKING WITH MILI pH BUFFERS

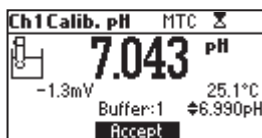
HANNA millesimal pH buffers are $\pm .002$ pH buffers formulated to correspond to nominal pH values. (1.000, 2.000, 3.000, 4.010, 5.000, 6.000, 7.010, 8.000, 9.000, 10.010, 11.000, 12.000, 13.000 and 9 that fall between). These buffers require the user to use the closest standard buffer and adjust it, or to use custom buffers. With these buffers it is possible to closely bracket the measurement range of interest and insure an accurate measurement.

The resolution of the meter must be set to 0.001 pH (see SETUP on page 31). Eight buffers are stored in instrument for calibration.

If calibration is invoked using millesimal buffers, the calibration buffer can be modified within a ± 0.020 pH range in accordance with the label on the calibration buffer.



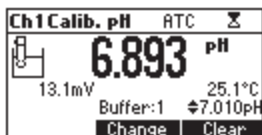
Press **Change** to enter buffer adjust mode.



Use **ARROW** keys to change the buffer value.

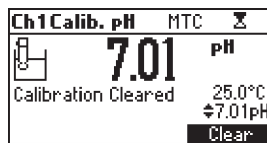
Press **Accept** to accept new value or **ESC** to exit adjusting mode.

CLEAR CALIBRATION



Press **Clear** function key when displayed to clear previous calibrations.

The instrument will display “Calibration Cleared”.



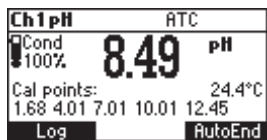
All previous calibrations, are cleared and the instrument continues in calibration mode. When new calibration points are confirmed, they are kept.

Note: If **Clear** calibration is invoked during the first calibration point, the instrument returns to measurement mode with CAL DUE message flashing.

ELECTRODE CONDITION

The display is provided with an icon, and a numeric value (unless the feature is disabled) which gives an indication of the electrode status after calibration.

The “cond” remains active until the end of the calibration day.

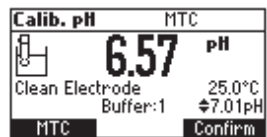


Note: The electrode condition is evaluated only if current calibration includes at least two standard buffers.

CLEAN ELECTRODE WARNING

Each time pH calibration is performed, the instrument internally compares the new calibration with the one previously stored.

When this comparison indicates a significant difference, the “Clean electrode” warning message is displayed to advise the user that the pH electrode may need to be cleaned (see ELECTRODE CONDITIONING & MAINTENANCE section for details, page 57).



After cleaning, perform a new calibration.

Note: If the calibration data are cleared, the comparison is done with the default values.

pH BUFFER TEMPERATURE DEPENDENCE

Temperature has an effect on pH buffers. During calibration the instrument will automatically calibrate to the pH value corresponding to the measured or set temperature.

TEMP		pH BUFFERS						
°C	°F	1.68	4.01	6.86	7.01	9.18	10.01	12.45
0	32	1.67	4.01	6.98	7.13	9.46	10.32	13.38
5	41	1.67	4.00	6.95	7.10	9.39	10.24	13.18
10	50	1.67	4.00	6.92	7.07	9.33	10.18	12.99
15	59	1.67	4.00	6.90	7.05	9.27	10.12	12.80
20	68	1.68	4.00	6.88	7.03	9.22	10.06	12.62
25	77	1.68	4.01	6.86	7.01	9.18	10.01	12.45
30	86	1.68	4.02	6.85	7.00	9.14	9.96	12.29
35	95	1.69	4.03	6.84	6.99	9.11	9.92	12.13
40	104	1.69	4.04	6.84	6.98	9.07	9.88	11.98
45	113	1.70	4.05	6.83	6.98	9.04	9.85	11.83
50	122	1.71	4.06	6.83	6.98	9.01	9.82	11.70
55	131	1.72	4.08	6.84	6.98	8.99	9.79	11.57
60	140	1.72	4.09	6.84	6.98	8.97	9.77	11.44
65	149	1.73	4.11	6.84	6.99	8.95	9.76	11.32
70	158	1.74	4.12	6.85	6.99	8.93	9.75	11.21
75	167	1.76	4.14	6.86	7.00	8.91	9.74	11.10
80	176	1.77	4.16	6.87	7.01	8.89	9.74	11.00
85	185	1.78	4.17	6.87	7.02	8.87	9.74	10.91
90	194	1.79	4.19	6.88	7.03	8.85	9.75	10.82
95	203	1.81	4.20	6.89	7.04	8.83	9.76	10.73

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

RELATIVE mV CALIBRATION

The relative mV value calibration may be used to perform a single point calibration with an ORP standard or remove the contribution of the reference electrode to display mV equivalent to a SHE.

- Press **CAL** when the instrument is in **RELATIVE mV** measurement mode. The relative mV value and the temperature values are displayed.
- Use the **ARROW** keys if you want to change the displayed relative mV value.



- Press **ZERO** function key if you want Rel mV reading to be zero (Relative mV offset equals the mV reading).
- When the reading is stable in mV range and the Relative mV offset is inside the offset window (± 2000 mV), the **Confirm** function key is displayed.



- Press **Confirm** to confirm relative mV calibration. The instrument will return to measurement mode.
- If the absolute mV reading is out of range or the Relative mV offset is out of the offset window, "Wrong relative offset" message is displayed.



Change the input value or the Relative mV value to complete the calibration process.

Note: If a **Rel mV** offset calibration exists, **CLR** function key is displayed. Press **CLR** if you want **Rel mV** offset to be 0.0 mV.

ISE CALIBRATION (HI 3221 & HI 3222)

It is recommended to calibrate the instrument frequently, especially if high accuracy is required.

The ISE range should be recalibrated:

- Whenever the ISE probe or ion charge is changed.
- At least once a day.
- After testing aggressive chemicals.
- When calibration alarm time out is expired- "CAL DUE" warning blinks (if feature is enabled).

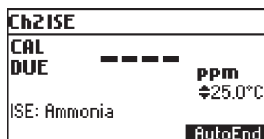
Follow instructions for the individual electrode.

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 LCD. This will make the calibration a simple and error-free procedure.

PROCEDURE

Select the proper ISE probe in SETUP menu (only for HI 3222) or select the proper Ion Charge slope (see SETUP for details, page 31).

Note: If the ISE probe has not been previously calibrated (at least one point), the "----" will be displayed.



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 standard solution. One for rinsing the electrode and one for calibration.

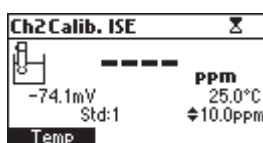
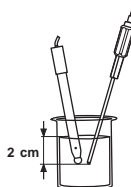
The HI 3221 instrument offers a choice of six standard solutions: 0.1, 1, 10, 100, 1000, 10000 ppm and calibration up to 2 points. The HI 3222 offers additional ranges for other concentration units. These cover 5 decades of concentration. The HI 3222 permits a 5 point calibration. It is advised to bracket expected ion concentration with your standards. For fluoride electrode the 2 ppm standard is also available (HI 3222 only).

Remove the protective cap from the ISE electrode.

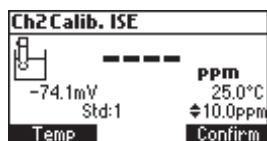
FIVE-POINT CALIBRATION (HI 3222 only)

Use part of this procedure for 2, 3 or 4 point calibration.
Press ESC.

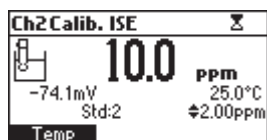
- Immerse the ISE electrode approximately 2 cm (3/4") into the less concentrated standard solution and stir gently.
- Press **CAL**. The primary LCD will display the ion concentration in the selected unit or "---" if not calibrated and first standard value.



- If necessary, press the **ARROW** keys to select a different standard value.
- The "Σ" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the **Confirm** function key is displayed.



- Press **Confirm** to confirm calibration.
- The calibrated value and the second expected standard value will be displayed.



- After the first calibration point is confirmed, immerse the ISE electrode approximately 2 cm (3/4") into the second calibration solution.
- If necessary, press the **ARROW** keys to select a different standard value.
- The "Σ" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the **Confirm** function key is displayed.
- Press **Confirm** to confirm calibration.
- The calibrated value and the third expected standard value will be displayed.

- After the second calibration point is confirmed, immerse the ISE electrode approximately 2 cm ($\frac{3}{4}$ ") into the third calibration solution.
- If necessary, press the **ARROW** keys to select a different standard value.
- The "Σ" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the **Confirm** function key is displayed.
- Press **Confirm** to confirm calibration.
- The calibrated value and the fourth expected standard value will be displayed.
- After the third calibration point is confirmed, immerse the ISE electrode approximately 2 cm ($\frac{3}{4}$ ") into the fourth calibration solution.
- If necessary, press the **ARROW** keys to select a different standard value.
- The "Σ" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the **Confirm** function key is displayed.
- Press **Confirm** to confirm calibration.
- The calibrated value and the fifth expected standard value will be displayed.
- After the fourth calibration point is confirmed, immerse the ISE electrode approximately 2 cm ($\frac{3}{4}$ ") into the fifth calibration solution.
- If necessary, press the **ARROW** keys to select a different standard value.
- The "Σ" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the **Confirm** function key is displayed.
- Press **Confirm** to confirm calibration. The instrument stores the calibration value and returns to normal measurement mode.

Note: The instrument will automatically skip the standard solutions used during calibration.

ERROR SCREENS

Wrong standard

The calibration cannot be confirmed. Verify that the correct standard is selected.



The message appears if mV input is out of ± 2000 mV range.

Wrong slope

The calibration cannot be confirmed.

This message is displayed if slope is out of the accepted range.

Slope under accepted value (30 % default slope). Verify that the correct standard is selected.



Slope over accepted value (130 % default slope).



Wrong old slope

An inconsistency between present and previous (old) calibration is detected. Clear old calibration parameters and proceed calibration from the current point. The instrument will keep all confirmed values during current calibration. The instrument will display "----" on the primary LCD if is not calibrated or after all calibrations are cleared.

If "Clear" is pressed during the first calibration point, the instrument returns to measurement mode.

- Notes:**
- Press **Temp** function key to select temperature value to be changed if the temperature probe is not connected;
 - ISE range is not temperature compensated on this meter;
 - Standards and samples should be at the same temperature.

GOOD LABORATORY PRACTICE (GLP)

GLP is a set of functions that allows storage and retrieval of data regarding the maintenance and status of the electrode.

All data regarding pH, Rel mV or ISE calibration is stored for the user to review when necessary.

EXPIRED CALIBRATION

The instrument is provided with a real time clock (RTC), in order to monitor the time elapsed since the last pH calibration.

The real time clock is reset every time the instrument is calibrated and the "expired calibration" status is triggered when the instrument detects a calibration time out. The "CAL" "DUE" warning will start blinking to warn the user that the instrument should be recalibrated.

The calibration time out can be set (see SETUP for details, page 31) from 1 to 7 days or can be disabled.

For example, if a 4 days time out has been selected, the instrument will issue the alarm exactly 4 days after the last calibration.

However, if at any moment the expiration value is changed (e.g. to 5 days), then the alarm will be immediately recalculated and appear 5 days after the last calibration.

- Notes:**
- When the instrument is not calibrated or calibration is cleared (default values loaded) there is no "expired calibration", and the display always shows the "CAL" "DUE" warning blinking.
 - When an abnormal condition in the RTC (Real Time Clock) is detected, the instrument forces the "expired calibration" status.

LAST pH CALIBRATION DATA

The last pH calibration data is stored automatically after a successful calibration.

To view the pH calibration data, press **GLP function key** when the instrument is in the pH measurement mode. If GLP function key is not displayed press MENU key.

Ch1 Last pH cal	Buffer[pH]
Date: 2007/01/01	7.010
Time: 01:42:29	4.010
Cal Expire: Disabled	8.000*
Offset: 0.6mV	1.68
Aver. Slope: 100.4%	12.45
Electrode condition: 100%	

The instrument will display a lot of data including calibration buffer, offset, slope, electrode condition.

Note: Buffers displayed in video inverse mode are from previous calibrations. The custom buffers are marked with an "*" on the right side of the buffer value. "No user calibration" message is displayed if all calibration are cleared or the instrument was not calibrated in the pH range.

LAST RELATIVE mV CALIBRATION DATA

Last Relative mV calibration data is stored automatically after a successful calibration.

To view the Relative mV calibration data, press **GLP** key while in Relative mV measurement mode.

The instrument will display the Relative mV GLP information: calibration date, time and offset.

Ch1 Last Rel mV cal
Date: 2007/01/01
Time: 01:44:12
Offset: 20.8mV

LAST ISE CALIBRATION DATA

Last ISE calibration data is stored automatically after a successful calibration.

To view the ISE calibration data, press **GLP** function key while in ISE measurement mode. If **GLP** function key is not displayed press **MENU** key.

The instrument will display the ISE calibration information: calibration date, time, slope, calibration status and electrode type.

Ch2 Last ISE cal	Std(ppm)
Date: 2007/01/01	10.0
Time: 02:24:55	
Cal Expire: Disabled	
Slope: 100.0%	
ISE: Fluoride	

- Notes:**
- Press **ESC** at any moment and the instrument will return to measurement mode.
 - If calibration has not been performed, the instrument displays **"No user calibration"** message.
 - The calibration standards from previous calibration are displayed in video inverse mode.

SETUP

Setup mode allows viewing and modifying the measurement parameters.

These are general SETUP parameters for all the ranges and range specific parameters.

The following table lists the general SETUP parameters, their valid range and the factory default settings.

New	Description	Valid value	Default
Backlight	Backlight level	0 to 8	4
Contrast	Contrast level	0 to 20	10
Date/Time		01.01.2006 to 12.31.2099 00:00 to 23:59	current date/time
Time Format		AM/PM or 24 hours	24 hours
Date Format		DD/MM/YYYY MM/DD/YYYY YYYY/MM/DD YYYY-MM-DD Mon DD, YYYY DD-Mon-YYYY YYYY-Mon-DD	YYYY/MM/DD
Language	Message display language	Up to four languages	English
Temperature unit		°C or °F	°C
AutoEnd Stability	Select AutoEnd Stability Criteria	Fast, Medium, Accurate	Medium
Log interval	Select log interval	Manual, AutoEnd, 5, 10, 30 s 1, 2, 5, 10, 15, 30, 60, 120, 180 min. (Log on demand)	Manual
Beep ON	Beeper Status	Enabled or Disabled	Disabled
Instrument ID	Instrument identification	0000 to 9999	0000
Baud Rate	Serial Communication	600, 1200, 1800, 9600	9600
Meter information	Displays general information		

The following table lists the specific range parameters.

Item	Description	Valid value	Default
Calibr. Timeout (pH & ISE)	Number of days after Calibration warning is displayed	Disable, 1 to 7 days	Disable
First point mode (pH)	Management of 1 point calibration	Replace or offset	Replace
Custom buffer (pH)	Custom buffer setting	Max. 5 buffers	No
pH Resolution	Set pH resolution display	0.1, 0.01, 0.001	0.01
View calibr. points (pH)	Display calibration points	Enable or disabled	Enable
Display out of calibr. range warning		Enable or disable	Enable
ISE probe (HI 3222 only)	Type of ISE probe	Custom or Standard (18)	Fluoride
ISE unit (HI 3222 only)		User, ppt, g/L, ppm, mg/L, ppb, M, mol/L, mmol/L, % W/V	ppm
Ion Charge (HI 3221 only)	± 1 , ± 2 , none		+1

To enter SETUP menu, press SETUP function key while in measuring mode.

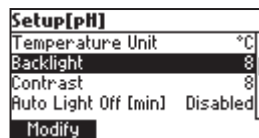
Ch 1 pH	ATC
Cond 100%	4.01 pH
Cal points: 4.01 7.01	23.3°C
Recall	GLP Setup

If SETUP is not displayed press MENU key.

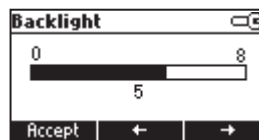
GENERAL PARAMETER SCREENS

Backlight

Focus on the *Backlight* item.



Press **Modify**.

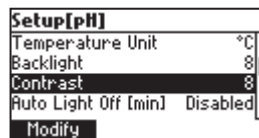


Use ←/→ keys to change the intensity then press **Accept** to confirm.

Press **ESC** to leave without changing.

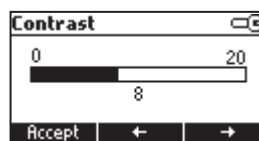
Contrast

Focus on the *Contrast* item.



Press **Modify**.

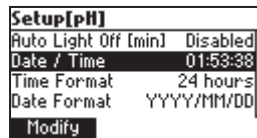
Use ←/→ keys to change contrast then press **Accept** to confirm.



Press **ESC** to leave without changing.

Date/Time

Focus on the *Date/Time* item.



Press **Modify**.



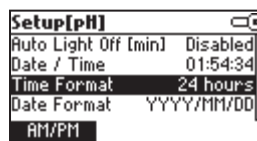
Use ←/→ keys to select item.

Use **ARROW** keys to change focused values.

Press **Accept** to confirm new setting, or **ESC** to leave without changing.

Time Format

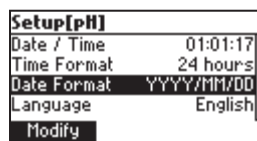
Focus on the *Time Format* item.



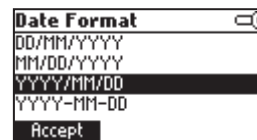
Press function key to change the option.

Date Format

Focus on the *Date Format* item.



Press **Modify**.

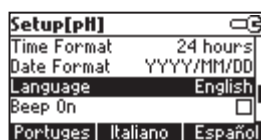


Use **ARROW** keys to select date format then press **Accept**.

Press **ESC** to leave without changing.

Language

Focus on the *Language* item.

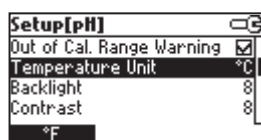


Use the desired function key to change the option. Wait until new language is loaded. If language load fails the instrument will try to reload current language.

If any language can't be loaded, the instrument will work in safe mode. In this mode all messages are displayed in English and **Help** is not available.

Temperature unit

Focus on the *Temperature* unit item.



Press the displayed function key in order to change the temperature unit.

Beep On

Focus on *Beep On* item.



Press the displayed function key to enable/disable beep.

When enabled, beep sounds as a short beep every time a key is pressed or when the calibration can be confirmed.

A long beep alert that the pressed key is not active or a wrong condition is detected while in calibration.

AutoEnd stability

Focus on *AutoEnd* item.



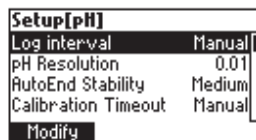
Press one of the displayed function keys to select the AutoEnd stability criteria.

Three options are available: *Fast*, *Medium*, *Accurate*.

For the pH range the stability criteria are different for different pH resolution selected (Medium in 0.01 pH range is different than Medium in 0.001 range).

Log interval

Focus on *Log interval* item.



Press *Modify* in order to change the option.



Use the arrow keys in order to select an option.

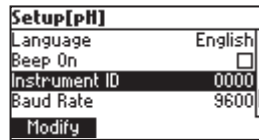
If the selected option is *Manual* the Log on demand is selected.

If *AutoEnd* is selected the reading will be memorized only when is stable.

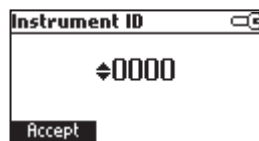
If a specific interval is selected, the reading is memorized at the start of the specific interval.

Instrument ID

Focus on the *Instrument ID* item.



Press **Modify**.

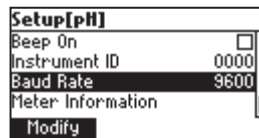


Use **ARROW** keys to change the instrument ID.

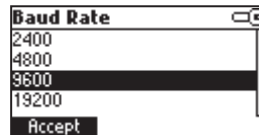
Press **Accept** to confirm or **ESC** to exit without saving.

Baud Rate

Focus on the *Baud Rate* item.



Press **Modify**.

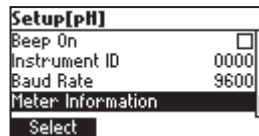


Use **ARROW** keys to select the desired communication baud.

Press **Accept** to confirm or **ESC** to exit.

Meter information

Focus on the *Meter Information* item.



Press **Select**.

The meter informations are displayed:

- firmware version
- language version
- mV and temperature factory calibration time/date

HI3202 Meter Info	
Firmware	V0.1
Language	1.2
mV	2007/01/01 01:01:04
T	2007/01/01 01:03:44

RANGE SPECIFIC PARAMETERS SCREENS

Calibration Timeout

Focus on the *Calibration Timeout* item.

Setup[pH]	
Calibration Timeout	Disabled
First Point Mode	Replace
Custom Buffers	
View Calibration Points	<input checked="" type="checkbox"/>
Modify	

Press **Modify**.

Calibration Timeout
↕ Disabled
Accept

Calibration Timeout
↕ 2 days
Accept

Use **ARROW** keys to set desired value.

Press **Accept** to confirm or **ESC** to return without saving.

Note: If enabled "CAL DUE" warning will be displayed, the set number of days after calibration is over passed.

First point mode

Focus on the *First Point* item.

Setup[pH]	
Calibration Timeout	2 days
First Point Mode	Replace
Custom Buffers	
View Calibration Points	<input checked="" type="checkbox"/>
Offset	

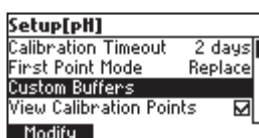
Press the displayed function key in order to change the option.

First point mode refers to the behaviour of the instrument regarding "One point calibration".

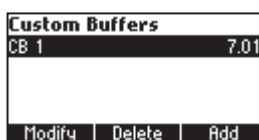
If **Offset** is set, after one point calibration the instrument evaluate the offset and keep unchanged the slopes.

Custom Buffers

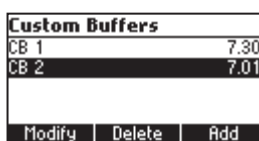
Focus on the *Custom Buffers* item.



Press **Modify**.

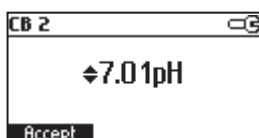


Press **Delete** to delete focused buffer.



Press **Add** to add a new buffer to the list (max 5).

Press **Modify** to set custom buffer value.



Use **ARROW** keys to change the value.

Press **Accept** to confirm custom buffer value or **ESC** to exit without saving.

pH Resolution

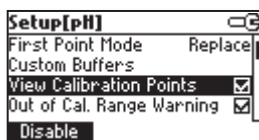
Focus on the *pH resolution* item.



Press the displayed function key to change option

View Calibration Points

Focus on the *Calibration Point* item.

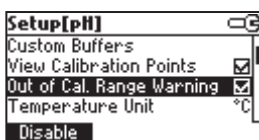


Press the displayed function key to change option.

If option is enabled the calibration buffers corresponding to the last calibration are displayed in the pH measurement screen.

Out of Cal-Range Warning

Focus on the *Out of Cal-Range Warning* item.



Press the displayed function key in order to change option.

If enabled, the "Out Cal Range" message will be displayed if the pH reading is not within the calibration range.

ISE probe

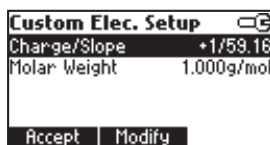
Focus on the *ISE probe* item.



Press **Custom** in order to set the parameters for a custom probe.

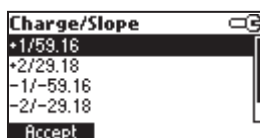
Press **Standard** in order to select one probe from the standard probes list.

If **Custom** is pressed:



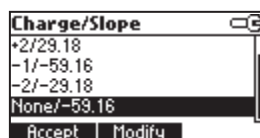
Use **ARROW** keys to focus on the parameter to be changed ("**Change Slope**" or "**Molar Weight**").

Focus on *Change Slope* item.

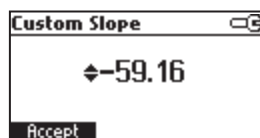


Use **ARROW** keys in order to select the desired combination.

If **None/-59.16** is selected the slope of the probe can be changed by pressing **Modify** key.



Press **Modify**.



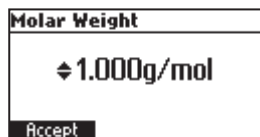
Use **ARROW** keys to change the slope.

Press **Accept** to confirm or **ESC** to exit.

Focus on *Molar Weight*.

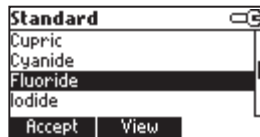


Press **Modify** in order to change molar weight.



Use **ARROW** keys to change the value. Press **Accept** to confirm or **ESC** to exit.

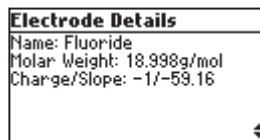
If **Standard** was pressed.



Use **ARROW** keys to focus on the desired electrode.

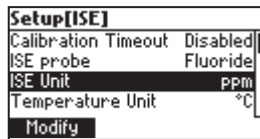
Press **Accept** to confirm setting or **ESC** to exit.

Press **View** to see probe parameters.

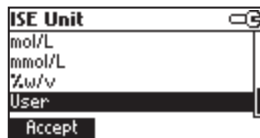


ISE unit

Focus on the *ISE unit* item.



Press **Modify**.



Use **ARROW** key to select unit.

Press **Accept** to confirm selection or **ESC** to exit.

- Note:**
- If the unit is changed or "User" is selected a warning message will be displayed to alert that the ISE range must be calibrated.
 - If a new probe was selected or custom probe parameter are changed, the ISE range must be calibrated.

LOGGING

This feature allows the user to log pH, Rel mV or ISE measurements. All logged data can be transferred to a PC through the USB port.

The logging space includes 200, 300 or 400 records of Log on demand, according to the model, and 600 records of Log interval (lot logging). The log interval is organized in lots. A maximum of 100 lots are accepted. One lot can occupy all the memory space available.

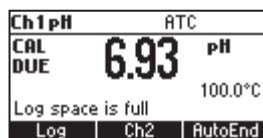
LOGGING THE CURRENT DATA

To store the current reading into memory, press LOG while in measurement mode.



The instrument will display for few seconds the record number and the amount of the free log space.

If the LOG space is full, the "Log space is full" message will be displayed for few seconds when Log key is pressed. Enter View Logged Data Mode and delete records in order to free log space.



LOT LOGGING

Select the desired interval in SETUP as a timed interval or AutoEnd waits for a stable value before logging.



Press the StartLog function key in order to start Log interval.



Press the StopLog function key in order to stop logging and close current lot.

- Notes:**
- At Power Off the current lot is automatically closed.
 - If the 600 records space or 100 lots are reached, the “Log space is full” message will be displayed.
 - Enter View Log Data mode and delete lots in order to free space.

VIEW LOGGED DATA

Press the **Recall** function key to retrieve the information stored while in measurement mode for the specific range. If the **Recall** function key is not displayed press **MENU** key.

The Recall selection screen is displayed.



Press the corresponding function key to view the records.

If **Man.Log** is pressed, the list of records is displayed.

Log	pH	Date
1	7.02	2007/01/01
2	6.77	2007/01/01
3	4.41	2007/01/01
4	1.80	2007/01/01

At the bottom of the table are three buttons: 'Delete All', 'Delete', and 'More'.

If no data were logged, the instrument will display “No Records” message.

Use **ARROW** keys to scroll between the records from the list.

Press **Delete All** to enter *Delete All* screen.

Press **Delete** to enter *Delete records* screen.

Press **More** to view more information of the focused record.

If **More** is pressed.

Record number: 1	
2007/01/01	01:14:46
7.02pH	100.0°C
-1.6mV	
Offset: 0mV	
Slope: 0%	

Use **ARROW** keys to scroll between complete log information.

If **Delete** is pressed.

Delete Record?		
1	I-2.00	2008/01/01
2	I-2.00	2008/01/01
3	4.10	2008/01/01

Confirm

Use **ARROW** key to focus the record to be deleted and then press **Confirm**.

Press **ESC** to exit.

If **Delete All** is pressed the instrument asks for confirmation.

Press **Confirm** to confirm or **ESC** to exit without deleting.

If **AutoLog** is pressed.

The lot information of the specific range are displayed.

Lot	Interval	Date
1	AutoEnd	2008/01/01
2	5 s	2008/01/01
3	5 s	2008/01/01
4	AutoEnd	2008/01/01

Delete All | Delete | More

Use the **ARROW** keys to scroll the lots.

Press the **Delete All** function key to enter the Delete All lots screen.

Press the **Delete** function key to enter the Delete lot screen.

Press the **More** function key to view the records information of the focused lot.

Rec	pH	Time
1	4.02	22:47:17
2	4.02	22:47:22
3	4.02	22:47:27
4	4.02	22:47:32

More

If **More** is pressed.

Record number: 1	
2008/01/08	22:47:17
4.02 pH	23.6°C
176.8mV	
Offset: -0.1mV	
Slope: 100.6 %	

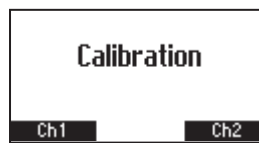
⇓

mV and TEMPERATURE CALIBRATION (for technical personnel only)

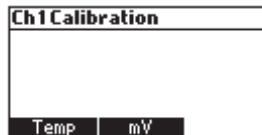
All the instruments are factory calibrated for mV and temperature. Hanna's temperature probes are interchangeable and no temperature calibration is needed when they are replaced. If the temperature or ORP measurements are inaccurate, calibration should be performed. For an accurate recalibration, contact your dealer or the nearest Hanna Customer Service Center, or follow the instructions below.

ENTER CALIBRATION MODE

With the instrument off, press and hold down the ▲/▼ then power on the instrument. Press either "Ch 1" or "Ch 2" function key to enter the corresponding calibration screen.

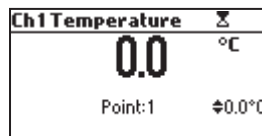


The calibration screen is displayed. Press "T" function key to enter the temperature calibration mode.

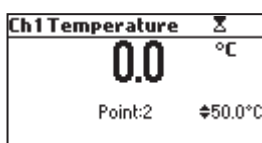


TEMPERATURE CALIBRATION

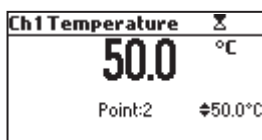
- Prepare a vessel containing ice and water and another one containing hot water (at approximately 50 °C or 122 °F). Place insulation material around the vessels to minimize temperature changes.
- Use a calibrated thermometer with a resolution of 0.1 °C as a reference thermometer. Connect the temperature probe to the appropriate socket.



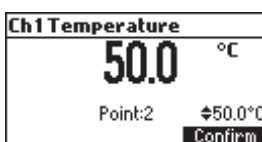
- Immerse the temperature probe or the pH probe including temperature sensor into the vessel with ice and water as close as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.
- Use the **ARROW** keys to set the calibration point value to that of ice and water mixture, measured by the reference thermometer. When the reading is stable and close to the selected calibration point, the **Confirm** function key is displayed.
- Press **Confirm** to confirm.
- The second expected calibrated point is displayed.



- Immerse the temperature probe into the second vessel as close as possible to the reference thermometer. Allow a few seconds for the probe to stabilize.



- Use the **ARROW** keys to set the calibration point value to that of the hot water.
- When the reading is stable and close to the selected calibration point, **Confirm** function key is displayed.



- Press **Confirm** to confirm. The instrument returns to measurement mode.
- Note:** Use **ARROW** keys to change calibration point if necessary (± 10.0 °C) around the point.

If the reading is not close to the selected calibration point, **“Wrong”** message will blink. Change the temperature probe and restart calibration.

mV CALIBRATION

A two point calibration can be performed at 0 mV and 1800 mV.

- Attach to the BNC connector a mV simulator with an accuracy of ± 0.1 mV.
- Enter the calibration screen. Press **mV** function key.
- Set **0.0 mV** on the simulator.
- When the reading is stable and close to the selected calibration point, the **Confirm** function key is displayed.
- Press **Confirm** to confirm. The second calibration point of 1800 mV will be displayed.
- Set **1800.0 mV** on the simulator.
- When the reading is stable and close to the selected calibration point, the **Confirm** function key is displayed.
- Press **Confirm** to confirm. The instrument returns to calibration screen.
- Press **ESC** to return to measurement mode.

Notes: • If the reading is not close to the selected calibration point, “**WRONG**” tag will blink. Verify calibration condition or contact your vendor if you cannot calibrate.

- Press **CAL** or **ESC** in any moment of the calibration process. The instrument will return in the measurement mode.

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. To connect your instrument to a PC, use an **USB** cable connector. Make sure that your instrument is switched off and plug one connector to the instrument **USB** socket and the other to the serial or USB port of your PC.

Note: • If you are not using Hanna Instruments **HI 92000** software, please see the following instructions.

SENDING COMMANDS FROM PC

It is also possible to remotely control the instrument with any terminal program. Use an **USB** cable to connect the instrument to a PC, start the terminal program and set the communication options as follows: 8, N, 1, no flow control.

COMMAND TYPES

To send a command to the instrument follow the next scheme:

< command prefix > < command > < CR >

where: < command prefix > is the 16 ASCII character
< command > is the command code.

Note: Either small or capital letters can be used.

SIMPLE COMMANDS

KF1	Is equivalent to pressing function key 1
KF2	Is equivalent to pressing function key 2
KF3	Is equivalent to pressing function key 3
RNG	Is equivalent to pressing RANGE key
CAL	Is equivalent to pressing CAL key
UPC	Is equivalent to pressing the UP arrow key
DWC	Is equivalent to pressing the DOWN arrow key
SET	Is equivalent to pressing SETUP key (HI3220, HI3221)
MNU	Is equivalent to pressing MENU key
ESC	Is equivalent to pressing ESC key
CLR	Is equivalent to pressing CLR key

CHRxx Change the instrument range according with the parameter value (xx):

- xx=10 pH range/0.001 resolution on channel 1
- xx=11 pH range/0.01 resolution on channel 1
- xx=12 pH range/0.1 resolution on channel 1
- xx=13 mV range on channel 1
- xx=14 Relative mV range on channel 1
- xx=15 ISE range on channel 1 (**HI 3221**)
- xx=20 ISE range on channel 2 (**HI 3222**)
- xx=21 mV range on channel 2 (**HI 3222**)
- xx=22 Relative mV range on channel 2 (**HI 3222**)

The instrument will answer for these commands with:

<STX> <answer> <ETX>

where: <STX> is 02 ASCII code character (start of text)

<ETX> is 03 ASCII code character (end of text)

<answer>:

<ACK> is 06 ASCII code character (recognized command)

<NAK> is 21 ASCII code character (unrecognized command)

<CAN> is 24 ASCII code character (corrupted command)

COMMANDS REQUIRING AN ANSWER

The instrument will answer for these commands with:

<STX> <answer> <checksum> <ETX>

where the checksum is the bytes sum of the answer string sent as 2 ASCII characters.

All the answer messages are with ASCII characters.

RAS Causes the instrument to send a complete set of readings in according with the current range:

- pH, temperature and mV reading on pH range.
- Rel mV, absolute mV and temperature reading on Rel mV range.
- concentration, mV and temperature reading on ppm range (**HI 3221, HI 3222**).

The answer string contains:

- Meter mode (2 chars):
 - 10 pH range/0.001 resolution on channel 1
 - 11 pH range/0.01 resolution on channel 1
 - 12 pH range/0.1 resolution on channel 1

- 13 mV range on channel 1
- 14 Relative mV range on channel 1
- 15 ISE range on channel 1 (**HI 3221**)
- 20 ISE range on channel 2 (**HI 3222**)
- 21 mV range on channel 2 (**HI 3222**)
- 22 Relative mV range on channel 2 (**HI 3222**)
- Meter status (2 chars of status byte): represents a 8 bit hexadecimal encoding.
 - 0x10 - temperature probe is connected
 - 0x01 - new GLP data available
 - 0x02 - new SETUP parameter
 - 0x04 - out of calibration range
 - 0x08 - the meter is in autoend point mode
- Reading status (2 chars): R - in range, O - over range, U - under range. First character corresponds to the primary reading. Second character corresponds to mV reading.
- Primary reading (corresponding to the selected range) - 11 ASCII chars, including sign and decimal point and exponent.
- Secondary reading (only when primary reading is not mV) - 7 ASCII chars, including sign and decimal point.
- Temperature reading - 8 ASCII chars, with sign and two decimal points, always in °C.

MDR Requests the instrument model name and firmware code (16 ASCII chars).

GLPx Requests the calibration data record.

- x=1 calibration data from channel 1
- x=2 calibration data from channel 2 (**HI 3222**)

The answer string contains:

- GLP status (1 char): represents a 4 bit hexadecimal encoding.
 - 0x01 - pH calibration available
 - 0x02 - Rel mV calibration available
 - 0x04 - ISE calibration available
- pH calibration data if x=1 (if available), which contains:
 - the number of calibrated buffers (1 char)
 - the ion charge, with sign (2 chars) (**HI 3221**)
 - the offset, with sign and decimal point (7 chars)

- the average of slopes, with sign and decimal point (7 chars)
- the calibration time, **yymmddhhmmss** (12 chars)
- buffers information (for each buffer)
 - type (1 char): 0 - standard, 1 - custom
 - status (1 char): N (new) - calibrated in last calibration; 0 (old) - from an old calibration.
 - warnings during calibration (2 chars): 00 - no warning, 04 - Clean Electrode warning.
- buffer value, with sign and decimal point and exponent (11 chars).
- calibration time, **yymmddhhmmss** (12 chars).
- electrode condition, with sign (3 chars). The “-01” code means not calculated.
- Rel mV calibration data (if available), which contains:
 - the calibration offset, with sign (7 chars)
 - the calibration time, **yymmddhhmmss** (12 chars).
- ISE calibration data (if available) when $x=1$ (**HI 3221**) or when $x=2$ (**HI 3222**), which contains:
 - the number of calibrated standards (1 char)
 - the ion charge, with sign (2 chars) (**HI 3221**)
 - the calibration slope, with sign and decimal point (7 chars)
 - the calibration time, **yymmddhhmmss** (12 chars)
 - standards information (for each standard)
 - type (1 char): 0 - always standard solution.
 - status (1 char): N (new) - calibrated in last calibration; 0 (old) - from an old calibration.
 - warnings during calibration (2 chars): 00 - no warning.
 - standard value, with sign and decimal point and exponent (11 chars).
 - calibration time, **yymmddhhmmss** (12 chars).

PARx Requests the setup parameters setting.

- $x=1$ setup parameters for channel 1
- $x=2$ setup parameters for channel 2 (**HI 3222**)

The answer string contains:

- Backlight Value (1 ASCII char)
- Contrast Value (2 ASCII char)
- Instrument ID (4 chars)
- Calibration Alarm time out for pH (2 chars) when $x=1$

- Calibration Alarm timeout for ISE (2 chars) - if ISE available when x=1 (HI 3221) or when x=2 (HI 3222)
- SETUP information (2 chars): 8 bit hexadecimal encoding.
 - 0x01 - beep ON (else OFF)
 - 0x04 - degrees Celsius (else degrees Fahrenheit)
 - 0x08 - Offset calibration (else Point calibration)
- The number of custom buffers (1 char) when x=1
- The custom buffer values, with sign and decimal point, for each defined custom buffer (7 chars) when x=1
- The ID of the ISE electrode (2 chars) - if ISE available when x=1 (HI 3221) or when x=2 (HI 3222)
- The molar weight of the selected ION, with sign and decimal point (9 ASCII characters) when x=1 (HI 3221) or when x=2 (HI 3222)
- The electrode slope (6 ASCII chars)
- The ion charge (2 chars)
- The ISE unit (2 chars)
- The short name of the selected language (3 chars)

NSLxy Requests the number of logged samples (4 chars).

The command parameter (2 chars):

- x=1 request for channel 1
- x=2 request for channel 2
- y=P request for pH range when x=1
- y=M request for mV and Rel mV ranges
- y=I request for ISE range when x=1 (HI 3221) or when x=2 (HI 3222)

LLSxy Requests the number of lots (information about lots) on the specified channel and range (x - channel number; y - range number)

- xy = 11 - channel 1; range pH;
- xy = 13 - channel 1; range mV;
- xy = 22 - channel 2; range ISE;
- xy = 23 - channel 2; range mV;

The answer string contains:

- number of lots (3 chars)
- ID lot (3 chars)
- date (6 chars)
- time (6 chars)

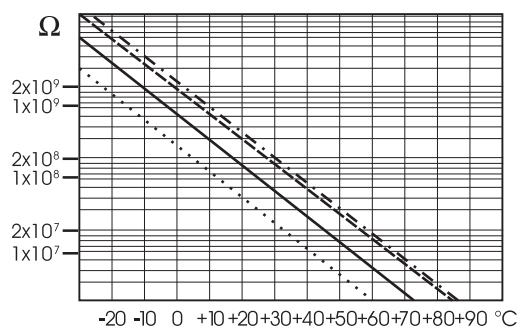
- log type (2 chars)
- GLDxxx** Requests all records for the lot with ID=xxx
- The answer string contains:
- Lot header data:
 - logging interval (5 char)
 - log type (1 char)
 - temperature mode (1 char)
 - offset (3 char)
 - slope (4 char)
 - unit (1 char)
 - Lot record data:
 - temperature (3 char)
 - value (6 char)
 - second value (6 char)
- LODxPyyy** Requests the yyth pH record logged data when x=1.
- LODxMyyy** Requests the yyth mV/Rel mV record logged data.
- LODxlyyy** Requests the yyth ISE record logged data when x=1 (**HI 3221**) or when x=2 (**HI 3222**).
- LODxPALL** Requests all pH Log on demand when x=1.
- LODxMALL** Requests all mV/Rel mV Log on demand.
- LODxIALL** Requests all ISE Log on demand when x=1 (**HI 3221**) or when x=2 (**HI 3222**).
- The answer string for each record contains:
- The logged mode (2 chars):
 - xx=10 pH range/0.001 resolution on channel 1
 - xx=11 pH range/0.01 resolution on channel 1
 - xx=12 pH range/0.1 resolution on channel 1
 - xx=13 mV range on channel 1
 - xx=14 Relative mV range on channel 1
 - xx=15 ISE range on channel 1 (**HI 3221**)
 - xx=20 ISE range on channel 2 (**HI 3222**)
 - xx=21 mV range on channel 2 (**HI 3222**)
 - xx=22 Relative mV range on channel 2 (**HI 3222**)
 - Reading status (1 char): R, O, U
 - Calculated reading, with sign and decimal point and exponent (13 chars) - for pH, Rel mV and ISE range
 - Temperature reading, with sign and two decimal points (8 chars)
 - mV reading status (1 char): R, O, U

- The mV reading, with sign and decimal point (7 chars)
- The logged time, **yymmddhhmmss** (12 chars)
- The calibration slope, with sign and decimal point (7 chars) - not available for Rel mV range
- The calibration offset, with sign and decimal point (7 chars) - not available for ISE
- Temperature probe presence (1 char)

- Notes:**
- "Err8" is sent if the instrument is not in measurement mode.
 - "Err6" is sent if the requested range is not available.
 - "Err4" is sent if the requested parameter is not available.
 - "Err3" is sent if the Log on demand is empty.
 - "Err9" is sent if the battery power is less than 30%.
 - Invalid commands will be ignored.

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

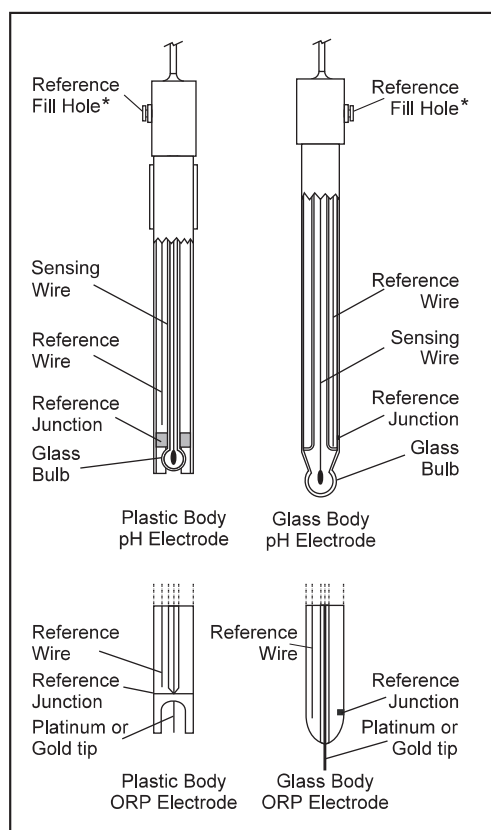
Ambient Temperature	1 – 3 years
90 °C (194 °F)	Less than 4 months
120 °C (248 °F)	Less than 1 month

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

ELECTRODE CONDITIONING & MAINTENANCE



* Not present in gel electrodes.

PREPARATION PROCEDURE

Remove the electrode protective cap.

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

During transport tiny bubbles of air may have formed inside the glass bulb. The electrode cannot function properly under these conditions. These bubbles can be removed by "shaking down" the electrode as you would do with a glass thermometer.

If the bulb and/or junction are dry, soak the electrode in **HI 70300** Storage Solution for at least one hour. Open the fill hole if refillable.

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.

For AmpHel® electrodes:

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

MEASUREMENT

Rinse the pH electrode tip with distilled or deionized water. Immerse the tip 3 cm (1¼") 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.

See that the sleeve holes of the ORP probe are completely submersed.

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 61 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 calibrating.

TROUBLESHOOTING GUIDE

SYMPTOMS	PROBLEM	SOLUTION
Slow response/excessive drift.	Dirty pH electrode.	Soak the electrode tip in HI 7061 cleaning solution for 30 minutes. Refill with fill solution.
Reading fluctuates up and down (noise).	Clogged/dirty junction. Low electrolyte level (refillable electrodes only).	Clean the electrode (see above). Refill with fresh electrolyte (refillable electrodes only).
Display shows blinking \blacklozenge full scale value.	Reading out of range.	Check that sample is within measurable range; Check electrolyte level and general electrode status.
mV scale out of range.	Dry membrane or dry junction.	Soak electrode in HI 70300 storage solution for at least 30 minutes.
Display shows symbol in front of temperature reading.	Out of order or missing temperature probe.	Replace temperature probe or check the connection.
Display shows "Clean electrode" blinking.	Difference between new and previous calibration has been detected.	Clean electrode and recalibrate. If the problem remains, check the buffer solutions.
Meter does not work with temperature probe.	Broken temperature probe.	Replace temperature probe.
Meter fails to calibrate or gives faulty readings.	Broken pH electrode.	Replace electrode.
Error messages are displayed during pH calibration procedure.	Wrong or contaminated buffer, electrode dirty or broken.	Check that buffer solution is correct and fresh, and the meter is set for the correct buffer.
"Errx" message at start up.	Internal error.	Contact your dealer or any Hanna Service Center.

ACCESSORIES

pH CALIBRATION SOLUTIONS

HI 50004-01	pH 4.01 Buffer Solution, 20 mL sachet, 10 pcs
HI 50004-02	pH 4.01 Buffer Solution, 20 mL sachet, 25 pcs
HI 50007-01	pH 7.01 Buffer Solution, 20 mL sachet, 10 pcs
HI 50007-02	pH 7.01 Buffer Solution, 20 mL sachet, 25 pcs
HI 50010-01	pH 10.01 Buffer Solution, 20 mL sachet, 10 pcs
HI 50010-02	pH 10.01 Buffer Solution, 20 mL sachet, 25 pcs
HI 5016	pH 1.68 Buffer Solution, 500 mL bottle
HI 5004	pH 4.01 Buffer Solution, 500 mL bottle
HI 5068	pH 6.86 Buffer Solution, 500 mL bottle
HI 5007	pH 7.01 Buffer Solution, 500 mL bottle
HI 5091	pH 9.18 Buffer Solution, 500 mL bottle
HI 5010	pH 10.01 Buffer Solution, 500 mL bottle
HI 5124	pH 12.45 Buffer Solution, 500 mL bottle
HI 8004L	pH 4.01 Buffer Solution in FDA approved bottle, 500 mL
HI 8006L	pH 6.86 Buffer Solution in FDA approved bottle, 500 mL
HI 8007L	pH 7.01 Buffer Solution in FDA approved bottle, 500 mL
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

ELECTRODE STORAGE SOLUTION

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

ELECTRODE CLEANING SOLUTIONS

HI 70000P	Electrode Rinse Solution, 20 mL sachet, 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 for single junction electrodes
HI 7072	1M KNO ₃ Electrolyte
HI 7082	3.5M KCl Electrolyte 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 7091L Reducing Pretreatment Solution, 500 mL bottle

HI 7092L Oxidizing Pretreatment Solution, 500 mL bottle

ORP SOLUTIONS

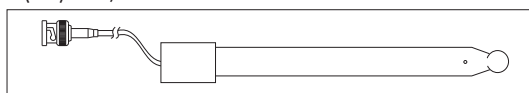
HI 7020L Test Solution 200-275 mV, 500 mL bottle

HI 7021L Test Solution 240 mV, 500 mL bottle

HI 7022L Test Solution 470 mV, 500 mL bottle

pH ELECTRODES

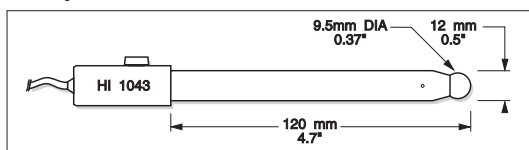
All electrodes part numbers ending in B are supplied with a BNC connector and 1 m (3.3') cable, as shown below:



HI 1043B

Glass-body, double junction, refillable, combination pH electrode.

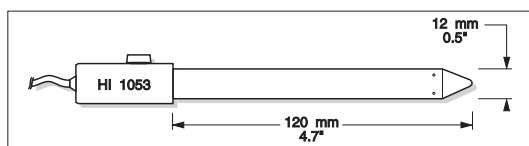
Use: strong acid/alkali.



HI 1053B

Glass-body, triple ceramic, conic shape, refillable, combination pH electrode.

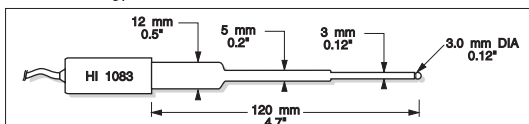
Use: emulsions.



HI 1083B

Glass-body, micro, Viscolene, non-refillable, combination pH electrode.

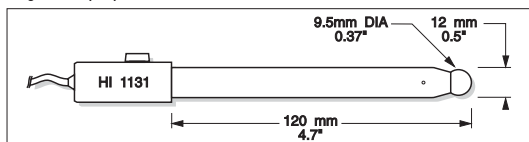
Use: biotechnology, micro titration.



HI 1131B

Glass-body, single junction, refillable, combination pH electrode.

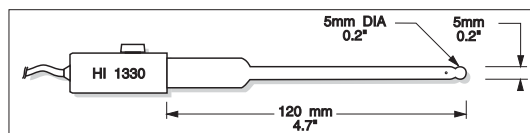
Use: general purpose.



HI 1330B

Glass-body, semimicro, single junction, refillable, combination pH electrode.

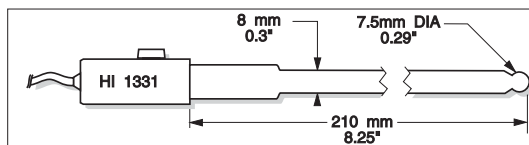
Use: laboratory, vials.



HI 1331B

Glass-body, semimicro, single junction, refillable, combination pH electrode.

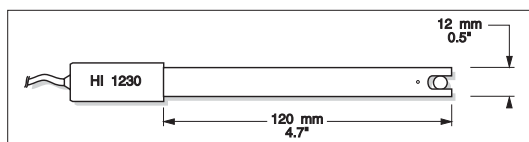
Use: flasks.



HI 1230B

Plastic-body (PEI), double junction, gel-filled, combination pH electrode.

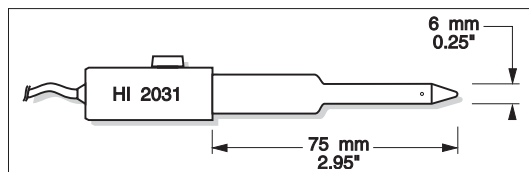
Use: general, field.



HI 2031B

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

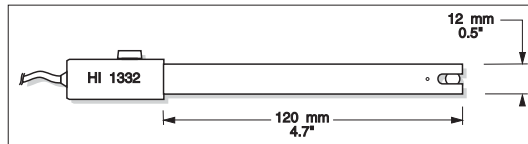
Use: semisolid products.



HI 1332B

Plastic-body (PEI), double junction, refillable, combination pH electrode.

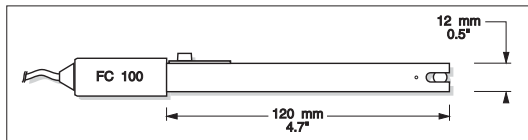
Use: general purpose.



FC 100B

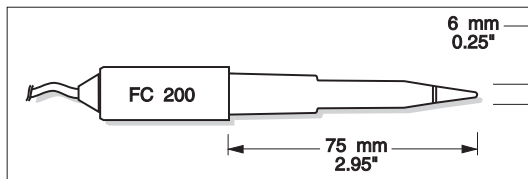
Plastic-body (PVDF), double junction, refillable, combination pH electrode.

Use: general purpose for food industry.



FC 200B

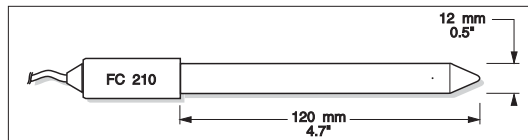
Plastic-body (PVDF), open junction, conic, Viscolene, non-refillable, combination pH electrode. Use: meat & cheese.



FC 210B

Glass-body, double junction, conic, Viscolene, non-refillable, combination pH electrode.

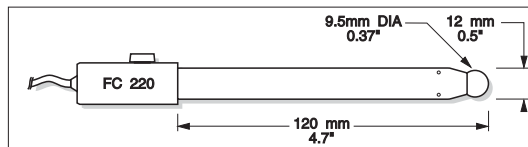
Use: milk, yogurt.



FC 220B

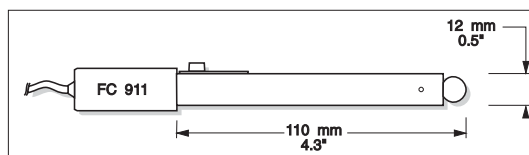
Glass-body, triple-ceramic, single junction, refillable, combination pH electrode.

Use: food processing.



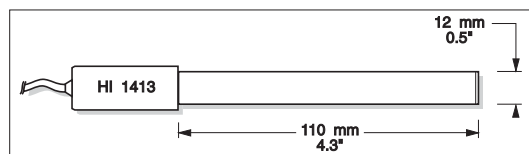
FC 911B

Plastic-body (PVDF), double junction, refillable with built-in amplifier, combination pH electrode. Use: very high humidity.



HI 1413B

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

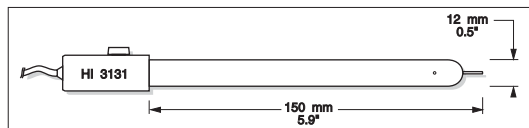


ORP ELECTRODES

HI 3131B

Glass-body, refillable, combination platinum ORP electrode.

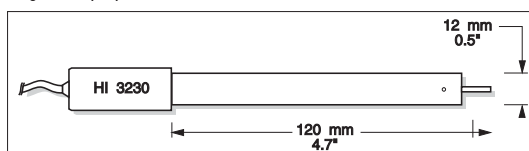
Use: titration.



HI 3230B

Plastic-body (PEI), gel-filled, combination platinum ORP electrode.

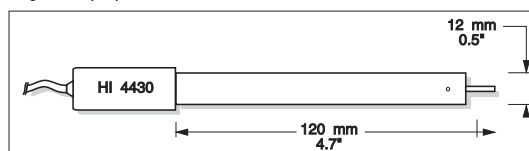
Use: general purpose.



HI 4430B

Plastic-body (PEI), gel-filled, combination gold ORP electrode.

Use: general purpose.

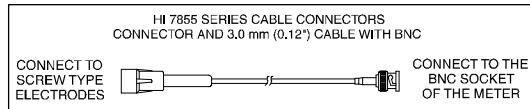


Consult the Hanna General Catalog for a complete and wide selection of electrodes.

**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



OTHER ACCESSORIES

HI 740157 Plastic electrode refilling pipet (20 pcs)

HI 76404N Electrode holder

HI 7662-T Stainless steel Temperature probe with 1 m (3.3') screened cable

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 76404N Electrode Holder

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.

Hanna Instruments reserves the right to modify the design, construction and appearance of its products without advance notice.
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Thank you for reading this data sheet.

For pricing or for further information, please contact us at our UK Office, using the details below.



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Please note - Product designs and specifications are subject to change without notice. The user is responsible for determining the suitability of this product.