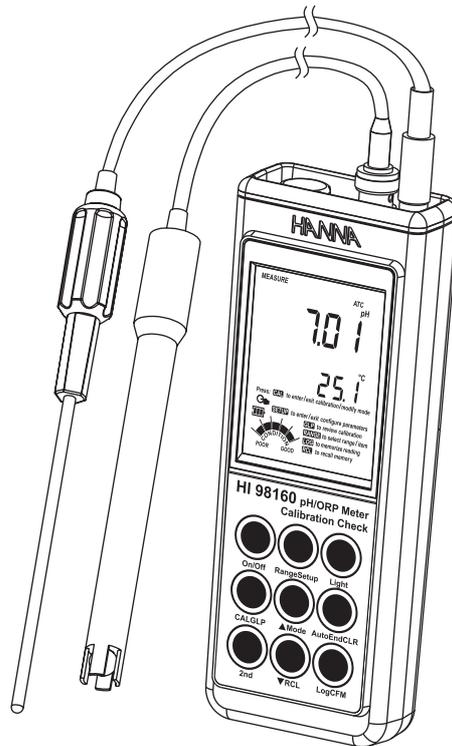


## Instruction Manual

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# HI 98140 HI 98150 HI 98160

## Calibration Check pH/mV/Temperature Meters



Dear Customer,

Thank you for choosing a Hanna Instruments product.

Please read this instruction manual carefully before using the instruments.

This manual will provide you with the necessary information for correct use of the instruments, as well as a precise idea of their versatility.

If you need additional technical information, do not hesitate to e-mail us at [tech@hannainst.com](mailto:tech@hannainst.com).

## WARRANTY

**HI 98140, HI 98150 and HI 98160** 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 1230B** Non refillable Combination double-junction, pH Electrode with gelled electrolyte (**HI 98160**)
- **HI 1618D** Amplified pH electrode with built-in temperature sensor and EEPROM and DIN connector. (**HI 98140 & HI 98150**)
- **HI 7662** stainless steel Temperature Probe with 1 m (3.3') Cable (**HI 98160**)
- **pH 4.01 & 7.01** Buffer Solutions (20 mL each)
- **HI 70000** electrode cleaning solution
- 3 x 1.5V AAA Batteries
- Instruction Manual
- Rugged Carrying Case

**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 supplied accessories.

## GENERAL DESCRIPTION

**HI 98140, HI 98150** and **HI 98160** are state-of-the-art, hand held pH meters, designed to provide laboratory results and accuracy under harsh industrial conditions.

These instruments 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:

- 7 automatically recognized pH buffers (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45) for calibration
- pH calibration up to three (**HI 98140**) and five (**HI 98150 & HI 98160**) calibration points
- Custom calibration by entering up to two custom buffers
- Messages on the LCD to guide the user through instrument operation
- Diagnostic features to alert the user when the electrode needs cleaning
- Outside Calibration Range warning
- Monitoring of the electrode's aging
- User-selectable "calibration time out" to remind the user when a new calibration is necessary.

**HI 98140** and **HI 98150** works with SMART amplified electrodes. These electrodes incorporate a chip, which stores the calibration data performed with a specific instrument.

When the SMART electrode is attached to the meter again, it is automatically recognized. This technology allows the operator to optimize time and efficiency with unsurpassed safety. It avoids erroneous measurements taken in the event the pH electrode is substituted after calibration. This series of electrodes also incorporates a temperature sensor, eliminating the need for an additional temperature probe. They also offer an extended temperature range from  $-20\text{ }^{\circ}\text{C}$  to  $120\text{ }^{\circ}\text{C}$  ( $-4\text{ }^{\circ}\text{F}$  to  $248\text{ }^{\circ}\text{F}$ ).

These instruments can also measure with ORP electrodes (**HI 98150 & HI 98160**), thanks to their capability to measure mV with a resolution up to 0.1 mV.

Other features include:

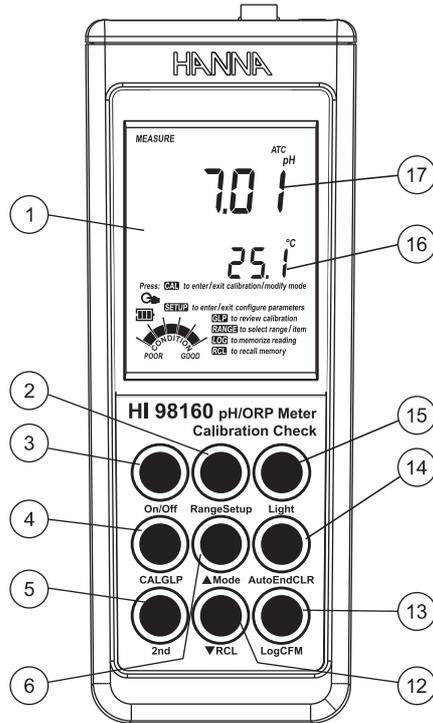
- Relative mV measurements (**HI98150 & HI 98160**)
- Log on demand (500 samples)
- Auto Hold feature, to freeze first stable reading on the LCD
- GLP feature, to view last calibration data for pH, Rel mV
- PC interface

The Battery Error Preventing System (BEPS) detects when the batteries become too weak to ensure reliable measurements.

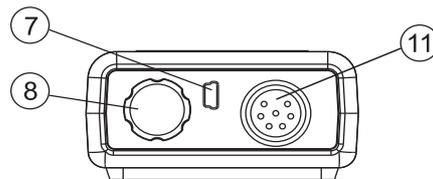
The backlight feature is automatically disabled when batteries are getting low and a clear indication is displayed to warn the user of this condition. However, the meter continues to measure correctly even when the low battery indication is displayed. The meter automatically switches itself off when the batteries are too weak to support proper function.

In addition, the meters allow the user to enter an ID code to uniquely identify the instrument.

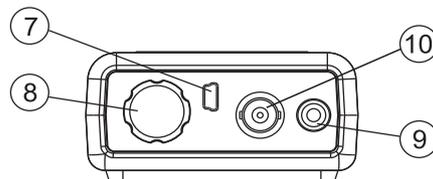
## FUNCTIONAL DESCRIPTION



### HI 98140 & HI 98150



### HI 98160



- 1) Liquid Crystal Display (LCD).
- 2) **Range** key, to select pH or mV range (**HI 98150 & HI 98160** only).  
**Setup** key, to enter/exit SETUP mode.
- 3) **On/Off** key, to turn the instrument ON and OFF.
- 4) **CAL** key, to enter/exit calibration mode.  
**GLP** key, to display Good Laboratory Practice information.
- 5) **2nd** key, to select second key function.
- 6) **▲** key, to manually increase temperature or other parameters.  
**Mode** key, to select measurement resolution, 0.1 pH / 0.01 pH, or to toggle between mV and Rel mV (**HI 98150 & HI 98160** only).
- 7) USB connector.
- 8) Battery compartment cap.
- 9) Temperature probe socket (**HI 98160**).
- 10) BNC electrode connector (**HI 98160**).
- 11) DIN connector for SMART electrode (**HI 98140 & HI 98150**).
- 12) **▼** key, to manually decrease temperature or other parameters.  
**RCL** key, to enter/exit view logged data mode.
- 13) **Log** key, to store measured data.  
**CFM** key, to confirm calibration point, confirm delete record or confirm different set values.
- 14) **AutoEnd** key, to freeze first stable reading on the LCD.  
**CLR** key, to clear calibration or enter delete logged data screen.
- 15) **Light** key, to toggle display backlighting.
- 16) Secondary LCD.
- 17) Primary LCD.

## SPECIFICATIONS

RANGE	–4.0 to 20.0 pH –4.00 to 20.00 pH
	±699.9 mV; ±2000 mV (HI 98150 & HI 98160)
	–20.0 to 120.0 °C (–4.0 to 248.0 °F)
RESOLUTION	0.1 pH 0.01 pH
	0.1 mV (±699.9mV) (HI 98150 & HI 98160) 1 mV (±2000mV) (HI 98150 & HI 98160)
	0.1 °C (0.1 °F)
ACCURACY @ 20 °C / 68 °F	±0.1 pH ±0.01 pH
	±0.2 mV (±699.9 mV) (HI 98150 & HI 98160) ±1 mV (±2000 mV) (HI 98150 & HI 98160)
	±0.2 °C (±0.4 °F) excluding probe error
Rel mV offset range	±2000 mV (HI 98150 & HI 98160)
pH Calibration	Up to three-point calibration (HI 98140) Up to five-point calibration (HI 98150 & HI 98160), 7 (8 for HI 98160) standard buffers available (1.68, 3.00 - HI 98160, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and 2 custom buffers
mV Calibration	Automatic, 2 points at 0, 350mV or 3 points 0, 350, 1900mV
Offset Calibration	±1 pH
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 1230B (included for HI 98160) HI 1618D (included for HI 98140 & HI 98150)
Temperature Probe	HI 7662 (included for HI 98160)
LOG	On demand, 500 samples
Input Impedance	10 <sup>12</sup> ohms
Battery Type & Life	3 x 1.5V AAA batteries approx. 200 hours of continuous use without backlight (50 hours with backlight)
Auto-off	User selectable: 5, 10, 20, 60 minutes or disabled
PC Communication	Optoisolated USB
Dimensions	185 x 72 x 36 mm (7.3 x 2.8 x 1.4")
Weight	300 g (10.6 oz)
Environment	0 – 50 °C (32 – 122 °F) max. RH 100%
Warranty	2 years

## OPERATIONAL GUIDE

### INITIAL PREPARATION

The instrument is supplied complete with batteries. For placing the batteries inside the meter, see page 33.

To prepare the instrument for use, connect the pH electrode to the input socket on the top of the instrument. For **HI 98160** connect the temperature probe to the temperature socket too. The temperature probe is used in conjunction with the pH electrode for pH temperature compensation, but it can also be used independently to take temperature measurements. If the probe is disconnected, temperature can be set manually with the **ARROW** keys (see page 9 for details).

Turn the instrument ON by pressing On/Off.



On/Off

At start-up the display will show all the available segments for a few seconds (or while the button is held), followed by the percentage indication of the remaining battery life. The meter is now ready to operate.



After measurement switch the instrument off, remove the electrodes, clean the electrode and store it with a few drops of **HI 70300** storage solution in the protection cap.

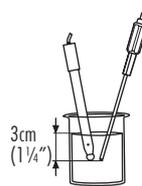
**Note:** In order to avoid error conditions when working with SMART electrodes, be sure the electrode is connected before the instrument is turned ON and is disconnected only after the instrument is turned OFF.

The auto-off feature turns the instrument off after a set period (default 20 min) to save battery life. To set another period or to disable this feature, see SETUP menu on page 21.

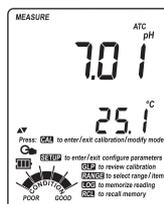
The auto-off backlight feature turns the backlight off after a set period (default 1 min). To set another period or to disable this feature, see SETUP menu on page 21.

### pH MEASUREMENTS

To take a pH measurement remove the electrode protective cap and simply submerge the tip of the electrode (3cm/1¼") and the temperature probe (**HI 98160** only) into the sample to be tested. If necessary, press **Range** until the display changes to the pH mode. Allow the electrode to equilibrate and reading to stabilize (hourglass symbol will turn off).



The LCD will show the pH measurement together with the temperature of the sample. In order to take more accurate pH measurements, make sure that the electrode and instrument is calibrated (see page 11 for details).



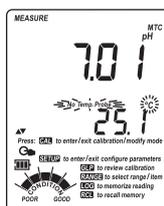
Hanna recommends to keep the pH electrode wet and to rinse thoroughly with the sample before measurements.

The pH reading is directly affected by temperature. In order for the instrument to measure the pH accurately, temperature must be taken into consideration. If the sample temperature is different from the ambient temperature, allow a few minutes for the pH electrode to reach thermal equilibrium.

The HI 1618D pH sensor contains an integral temperature sensor so the pH reading is automatically temperature compensated (ATC) on the HI 98140 and HI 98150. If the temperature is out of range (due to temperature sensor failure) these instruments will enter MTC mode and permit temperature values to be set manually using the **ARROW** keys. To use the instrument's Automatic Temperature Compensation feature for HI 98160, connect and 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 (HI 98160 only).**

The display will show the default temperature of 25 °C, the last measured temperature reading, or the last set temperature, with the "°C" (or "°F") tag blinking.

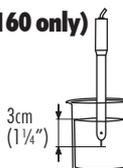


The "MTC" tag and ▲▼ arrow symbols light up on the LCD to indicate that the instrument is in MTC mode and the arrow keys can be used to enter the desired temperature value.

**Note:** When in MTC the user can press and hold the **ARROW** keys to set the measurement temperature. The instrument will start incrementing/decrementing the temperature value. The instrument keeps measuring using the MTC value for temperature compensated pH and the display is updated.

### **ORP MEASUREMENTS (HI 98150 & HI 98160 only)**

To perform ORP measurements, connect an optional 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 tip (3cm/1¼") into the sample to be tested and wait a few seconds for the reading to stabilize.

Measurements within the  $\pm 699.9$  mV range are displayed with 0.1 mV resolution, while outside this range the resolution automatically switches to 1 mV.

The "ATC" (or "MTC") tag is turned off because ORP measurements are not temperature compensated.

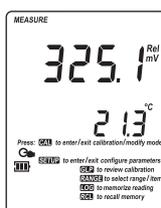
For accurate ORP measurements, the surface of the electrode must be clean and smooth. Pretreatment solutions are available to condition the electrode and improve its response time (see Accessories section, page 41).



### RELATIVE mV MEASUREMENTS (HI 98150 & HI 98160 only)

To enter Relative mV mode, press 2nd then Mode while in mV measurement mode. The relative mV reading will be displayed on the primary LCD and the current temperature value on the secondary LCD.

Relative mV is an operation mode in which the displayed electrode potential (mV) can be changed by means of a calibration control offset. See page 17.



### TEMPERATURE MEASUREMENTS

The pH electrodes used for HI 98140 and HI 98150 also include an integral temperature measuring element.

For HI 98160 connect the HI 7662 temperature probe to the appropriate socket, submerge the temperature probe into the sample and permit it to equilibrate by watching the reading on the secondary LCD.



If the temperature is out of range, or the temperature probe is not connected (HI 98160 only) the instruments will display the last in range temperature reading and enter MTC mode (see page 9).

**Note:** The temperature can be displayed in Celsius degrees (°C) or in Fahrenheit degrees (°F) (see SETUP for details, page 21).

### BACKLIGHT FEATURE

The instrument is provided with a Backlight feature to enhance display readability in low light conditions. It can be easily toggled on and off through the keypad by pressing Light.



**Note:** The backlight automatically shuts off after a set time period to save battery life (see SETUP for details, page 21).

If battery percentage is less than 20% the backlight can not be ON.

## pH CALIBRATION

Hanna recommends frequent calibrations, especially if high accuracy is required.

The pH range should be recalibrated:

- Whenever the pH electrode is replaced.
- At least once a week, but daily is recommended.
- After testing aggressive chemicals.
- After electrode is cleaned.
- When calibration alarm time out is expired - "Cal Due" tag blinks (if feature is enabled).
- If "Outside Cal Range" message blinks during pH measurement (the measurement range is not covered by current calibration).

### PROCEDURE

The instrument offers a choice of 7 buffers that are automatically recognized (1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45 pH) and also allows the user to enter two more pH values for calibration, "Custom 1" and "Custom 2". The set custom buffers are the buffer values at 25 °C.

HI 98160 offers also 3.00 pH buffer choice for wine measurement.

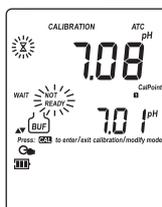
When a custom buffer is selected during calibration, the "Custom" tag is displayed on the LCD and its value can be changed in a  $\pm 1.0$  pH window, around the set value, in accordance with current temperature. For accurate pH measurements, it is recommended to perform a five-point (HI 98150 & HI 98160) calibration respectively a three-point (HI 98140) calibration. However, at least a two-point calibration is suggested.

The instrument will automatically skip the buffers used during calibration and the buffers which are in a  $\pm 0.2$  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 and rinse the electrode with some of the buffer solution to be used for the first calibration point.

### FIVE-POINT CALIBRATION (HI 98150 & HI 98160)

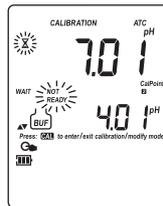
- Submerge the pH electrode and the temperature probe approximately 3 cm (1¼") into a buffer solution of your choice (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45 or a custom buffer) and stir gently. The temperature probe should be close to the pH electrode.
- Press **CAL**. The instrument will display the measured pH on the primary LCD and "7.01" buffer on the secondary LCD, together with "CAL" and "Cal Point 1" tags.



- 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, “**CFM**” tag blinks.



- Press **CFM** to confirm calibration.
- The calibrated value is then displayed on the primary LCD and the secondary LCD will display the second expected buffer value, together with “**CAL**” and “**Cal Point 2**” tags.



- After the first calibration point is confirmed, submerge the pH electrode and the temperature probe (if required) approximately 3 cm (1 ¼”) 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 the appropriate 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, “**CFM**” tag blinks.



- Press **CFM** to confirm calibration.
- The calibrated value is then displayed on the primary LCD and the secondary LCD will display the third expected buffer value.
- After the second calibration point is confirmed, submerge the pH electrode and the temperature probe approximately 3 cm (1 ¼”) into the 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, “**CFM**” tag blinks.



- Press **CFM** to confirm calibration.
- The calibrated value is then displayed on the primary LCD and the secondary LCD will display the fourth expected buffer value.
- After the third calibration point is confirmed, submerge the pH electrode and the temperature probe approximately 3 cm (1 ¼”) into the fourth 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, “**CFM**” tag blinks.



- Press **CFM** to confirm calibration.

- The calibrated value is then displayed on the primary LCD and the secondary LCD will display the fifth expected buffer value.
- After the fourth calibration point is confirmed, submerge the pH electrode and the temperature probe approximately 3 cm (1 1/4") into the fifth 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, "CFM" tag blinks.
- Press **CFM** to confirm calibration.
- The instrument stores the calibration values and returns to normal measurement mode.



**Note:** For HI 98140 calibration proceed as in the FIVE-POINT CALIBRATION above. After the third point is confirmed the instrument stores the calibration value and returns to measurement mode.

#### **FOUR, THREE or TWO-POINT CALIBRATION**

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



#### **ONE-POINT CALIBRATION**

Two SETUP selectable options are available for one-point calibration: "Pnt" and "OFFS". See page 22 for Setup information using "1Pnt" parameter.

If the "Pnt" option is selected, the adjacent slopes will be recalculated using the new calibration value.

If the "OFFS" option is selected, an electrode offset correction is performed keeping the existing slopes unchanged, but offsetting all by same value.

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



- Notes:**
- Press **Range** to toggle between pH buffer and temperature reading during calibration.
  - If the value measured by the instrument is not close to the selected buffer, "WRONG" "⚠" and "WRONG" "⚠" tags will blink alternately. In this case check if the correct buffer has been selected or used, or regenerate the electrode by following the Cleaning Procedure (see page 39). If necessary, change the buffer or the electrode.
  - If the buffer temperature or the manual temperature exceeds the temperature limits of the buffer, "WRONG" "⚠" tags and temperature reading will blink.

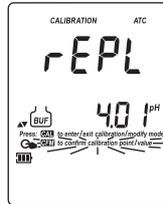
- If “**WRONG**” tag and “**OLD**” message are displayed on the secondary LCD, an inconsistency exists between new and previous (old) calibration data. Clear old calibration parameters and proceed with calibration from the current calibration point. The instrument will keep all confirmed values during current calibration.
- With one-point calibration there is no “**Condition**” and only the frame is shown. Calibration time out is active.
- Each time a buffer is confirmed, the new calibration parameters replace the old calibration parameters of the corresponding buffer.

If current confirmed buffer has no correspondence in the existing stored calibration and this is not full, the current buffer is added to the existing stored calibration.

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

Press the **ARROW** keys to select another buffer to be replaced. Press **CFM** to confirm the buffer that will be replaced.

Press **CAL** to exit this function. In this case, the buffer calibration will not be stored.



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

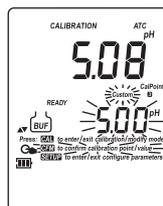
### WORKING WITH CUSTOM BUFFERS

If a custom buffer was configured in **SETUP** menu, it can be selected for calibration by pressing the **ARROW** keys. The “**CUSTOM**” tag will be displayed blinking on the LCD.

Press **2nd** then **Setup** if you want to adjust the buffer value to it’s value at the current temperature. The buffer value, displayed on the secondary LCD, will start blinking.

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

After about 5 seconds, the last buffer change will be updated. Press **2nd** then **Setup** if you want to change it again.



**Notes:** • Custom buffer value can be adjusted in a  $\pm 1.00$  pH window, around the set value.

- If you want to return to the set custom buffer value, simply press the **ARROW** keys (**▲** then **▼**) to select again the custom buffer.

### CLEAR CALIBRATION

To clear calibration press **2nd** then **CLR** or **CLR** alone after entering CAL mode. The “CLR ALL” message will be displayed on the LCD along with “Cal Due” CLR message blinking.



All old calibrations, starting with current selected buffer are cleared and the instrument continues calibration.

**Note:** If **CLR** is pressed during the first calibration point, the instrument returns to measurement mode.

### CONDITION

The display is provided with a 5-dot bargraph (unless the feature is disabled) which gives an indication of the electrode status after calibration as follows:

Bargraph indication		Condition value
All 5 dots steady		81 to 100% of life
4 dots steady		61 to 80%
3 dots steady		41 to 60%
2 dots steady		21 to 40%
1 dot steady		1 to 20%
1 dot blinking		0%
Only frame is ON		No info available

The “condition” bargraph 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

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” “!” tags blink on the LCD to advise the user that the pH electrode may need to be cleaned (see ELECTRODE CONDITIONING & MAINTENANCE section for details, page 37).

After cleaning, perform a new calibration.

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

## pH BUFFER TEMPERATURE DEPENDENCE

The temperature has an effect on pH. The calibration buffer solutions are affected by temperature changes to a lesser degree than normal solutions. During calibration the instrument will automatically calibrate to the pH value corresponding to the measured or set temperature.

TEMP		pH BUFFERS						
°C	°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.

However, temperature correction during pH measurements provides values at the temperature of measurement. Actual pH values may differ if measured at two different temperatures.

## RELATIVE mV CALIBRATION (HI 98150 & HI 98160)

To enter Rel mV operation press **2nd** and **Mode** from mV measurement.

- Place the ORP electrode into solution or standard.
- Wait for a stable mV to be displayed.
- Press **CAL** when the instrument is in RELATIVE mV measurement mode. The relative mV value is displayed on the primary LCD and the absolute mV value on the secondary LCD.



- Use the **ARROW** keys to change the displayed relative mV value.



- When the reading is stable, in mV range and the Relative mV offset is inside the offset window ( $\pm 2000$  mV), "CFM" tag blinks.
- Press **CFM** to confirm the 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" tag will blink. Verify sensor tip is fully submersed in solution and electrode is fully plugged in.

## 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 or Rel mV calibration is stored for the user to review when necessary.

**HI 98140** and **HI 98150** use electrodes with built-in EEPROM in which calibration data is read at start up and stored after calibration. The meter can automatically analyze the data and advise the user during measurements if a problem is found with a clear message.

If the calibration offset is outside  $\pm 30$  mV window, “**OLD Probe**” tag is displayed blinking to warn user to perform a cleaning procedure.

If the calibration offset is outside  $\pm 60$  mV window “**DEAD Probe**” tag is displayed blinking to warn the user that readings are not reliable.

### EXPIRED CALIBRATION

The instrument is provided with a real time clock (RTC), 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**” tag 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 21) from OFF (function disabled) to 7 days.

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**” tag blinking.
  - When an abnormal condition in the RTC 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 **2nd** then **GLP** when the instrument is in pH measurement mode.

The instrument will display the date (mm.dd) and the time (hh:mm) of the last calibration.

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



Press the **ARROW** keys to view the next calibration parameter (pressing the **▲** key):

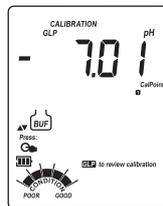
- The pH calibration slope and offset.



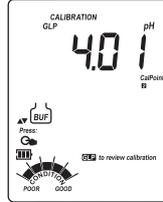
The GLP slope is the average of the calibration slopes; the percentage is referred to the ideal slope value. For example 59.16 mV/pH at 25 °C.

- The calibration buffers in calibrating order, for the last calibration.

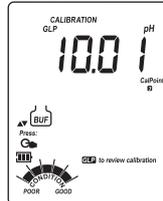
The first pH calibration buffer:



The second pH calibration buffer (if exist):



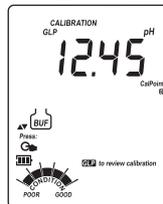
The third pH calibration buffer (if exist):



The fourth pH calibration buffer (if exist):



The fifth pH calibration buffer (if exist):



- Notes:**
- The “**OLD**” message displayed beside the pH value means that this buffer was not used during last calibration. Press **2nd** then **Setup** if you want to see calibration date (or time, if old calibration was performed in the same day with current calibration). In this case, the calibration buffer number is not displayed on the LCD.
  - If “**not CAL**” message appears on the LCD, the instrument informs you that calibration was performed in less than five points.
  - The Calibration Alarm Time Out status. If disabled, or the number of days until the calibration alarm will be displayed (e.g. 5 days), or from the time calibration expired (e.g. -3 days).
  - The instrument ID.



### 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 **2nd** then **GLP** while in Relative mV measurement mode.

The instrument will display the Relative mV GLP information.

- The date (mm.dd) and the time (hh:mm:ss) of the last Rel mV calibration as in pH GLP mode.

Press the **ARROW** keys to view the next calibration parameter (pressing the **▲** key):

- The Relative mV calibration offset as in pH GLP mode. For the slope position “----” is displayed.
- The instrument ID as in pH GLP mode.

- Notes:**
- Press **2nd** then **GLP** or only **GLP** at any moment and the instrument will return to measurement mode.
  - If calibration has not been performed, the instrument displays “**no CAL**” message blinking.
  - Press **2nd** and **Setup** while date and time are displayed in order to view the year in the first LCD line.

## SETUP

Setup mode allows viewing and configuring the following parameters:

- Calibration Alarm Time Out (pH range only)(dAY)
- Custom buffers (1 or 2) (pH range only) (Custom)
- One-point calibration behavior (pH range only) (1Pnt)
- Current Time (hour & minute)
- Current Date (month, day & year)
- Beep Status (bBEEP)
- Instrument ID (InSId)
- Auto-off backlight timer (LIGH)
- Auto power off timer (AOFF)
- Temperature Unit

To enter SETUP mode, press **Setup** button directly on the **HI 98140** and **2nd** then **Setup** on the **HI 98150 & HI 98160** while the instrument is in measurement mode.

Select the desired setup parameter using the **ARROW** keys.

Press **CAL** if you want to change the item value. “CFM” tag and the selected item (e.g. hour, in setting up the correct time) will start blinking.



Press the **ARROW** keys to change the displayed value.

If there is another item to be set (e.g. minutes), press **Range** (**HI 98150 & HI 98160**), **2nd** then **Mode** (**HI 98140**). The other item will start blinking.

Press the **ARROW** keys to change the displayed value.

Press **CFM** to confirm or **CAL** to escape without changing.



Press the **ARROW** keys to select the next/previous parameter.

Press **Setup** to exit SETUP menu at any time.

The following table (see page 22) lists the SETUP parameters, their valid values range and the factory settings (default). Use ▲ to move through parameters in this order.

SETUP PARAMETERS			
Abbreviation	What it does	Valid Values	Default
dAY	Use this parameter to set interval between calibrations before a calibration due message is displayed.	OFF or 1 to 7 days	OFF
Custom	Enter the up to 2 custom buffer values in this parameter. Permits two "user solutions" to be selectable for buffer calibration.	no or -4.00 to 20.00 pH	no
1Pnt	A one-point calibration can be used after a 2-5 buffer calibration. The one-point will adjust the previous calibration one of 2 ways. "Pnt" will add or replace a calibration point between two previously calibrated buffers. New slope values will be evaluated based upon this value. "OFFS" will bias all calibrations and measurements by a constant value.	Pnt or OFFS	Pnt
Time	This value is used to reference calibrations and logging using a 24 hour clock. (hh:mm)	00:00 to 23:59	0:00
Date	This value is used to reference calibrations and logging. (mm.dd.yyyy)	01.01.2000 to 12.31.2099	01.01.2009
bEEP	Beep tone used to signal errors and confirming change.	On/Off	OFF
InSId	Instrument ID: Give this instrument a discreet #. When downloading logs this instrument will be identified.	0000 to 9999	0
LIGH	Backlight timer. If backlight is turned on display, permits it to be automatically turned off to save battery power.	Off, 1, 5 or 10 minutes	1 minute
AOFF	Auto off timer: Permits unit to turn off after preset time to save battery power.	Off, 5, 10, 20 or 60 minutes	20 minutes
	Temperature unit displayed.	°C or °F	°C

**Note:** The custom buffers can be set only with 0.01 pH resolution, at 25 °C. Press **Range (HI 98150 & HI 98160)** or **2nd and Mode (HI 98140)** repeatedly while in custom buffer setting mode until the closest buffer value to the desired custom buffer to be set is displayed on the LCD. If selecting “no” option, the selected custom buffer is removed. After removing one custom buffer, the custom buffer list is reordered.

## LOGGING

This feature allows the user to log pH or Rel mV measurements, together with corresponding mV and temperature automatically. All logged data can be transferred to a PC through the USB port. The maximum logging space is 500 record locations.

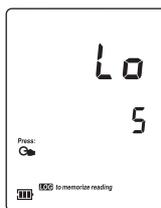
### LOGGING THE CURRENT DATA

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

The instrument will display the current date (mm.dd) on the primary LCD, the record number on the secondary LCD and then the available number of logs remaining.



If there are less than 6 memory locations remaining, the “Lo” message will be displayed for a few seconds to alert the user, and then the available number of remaining logs is displayed on the LCD.



If the LOG space is full, “FULL LOG” message will be displayed on the LCD for a few seconds and then “FrEE 0” message. The instrument returns to normal measurement mode.



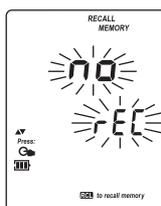
## VIEW LOGGED DATA

Press **2nd** then **RCL** to retrieve the information stored while in measurement mode for the specific range. "RECALL MEMORY" will be displayed on LCD.

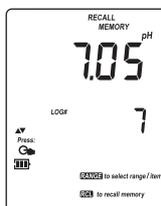


If no records were logged, the instrument will display "no REC" message blinking.

Otherwise, the instrument will display the logged data, in according with the selected range:



- If RCL mode was entered while the instrument was in pH range: the last pH memorized reading appears on the primary LCD and the record number on the secondary LCD.



- If RCL mode was entered while the instrument was in mV or Rel mV range: the last Rel mV memorized reading appears on the primary LCD and the record number on the secondary LCD.



Press **Range** (HI 98150 & HI 98160) or **2nd** then **Mode** (HI 98140) and the instrument will display the next logged parameter as shown in the table below:

Parameter	Primary LCD	Secondary LCD
mV	mV reading	Temperature
DATE/TIME	Month & day	Hour & minutes
SLOPE	Slope value in %	Offset value in mV

**Note:** If in Rel mV RECALL mode regarding the slope, the instrument will display "----" message on the primary LCD.

Press **2nd** and **CLR** or simply **CLR** to delete records.

The "dEL" message is displayed on the primary LCD, the record number on the secondary LCD and "CFM" tags will blink.

- Press the **ARROW** keys to change the record number.
- Press **CAL** or **Range** or **CLR** to escape from DEL screen and enter view record items mode.

**Note:** Pressing **2nd** then **Setup** the instrument toggles between record number and all records.

- Press **2nd** then **CFM** or **CFM** to confirm delete. The “nuLL” message will be displayed on the primary LCD for the selected record. While “nuLL” message is displayed the **2nd**, **CAL**, **Range** and **CLR** keys are inactive. Press the **ARROW** keys to select an undeleted record.
- If “dEL ALL” option was selected, all logged data are deleted and the instrument returns to measurement mode

Press **2nd** then **RCL** at any time to return to measurement mode.

The “**Σ**” and “**WAIT**” tags blinks during memory is reorganized.

## AutoEnd

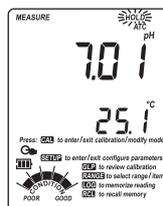
To freeze the first stable reading on the LCD press **AutoEnd** while the instrument is in measurement mode.



AutoEndCLR

The “**HOLD**” tag will be displayed blinking on the LCD until the reading will stabilize.

When the reading is stable, the “**HOLD**” tag stops blinking and the reading is frozen on the LCD.



Press **AutoEnd** again to return to normal measurement mode.

- Note:**
- Pressing **Range** (**HI 98150** & **HI 98160** only) the instrument will display alternate measurement range, without leaving AutoEnd mode. The **Log** key also holds AutoEnd mode.
  - Pressing **2nd** then **Setup**, **GLP** or **RCL**, the instrument leaves AutoEnd mode and performs the selected function.

## TEMPERATURE CALIBRATION (for technical personnel only)

All the instruments are factory calibrated for temperature.

Hanna's temperature probes are interchangeable and no temperature calibration is needed when they are replaced.

If the temperature measurements are inaccurate, temperature recalibration should be performed.

For an accurate recalibration, contact your dealer or the nearest Hanna Customer Service Center, or follow the instructions below.

- 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 **HI 7662** temperature probe to the appropriate socket (**HI 98160**) or the pH probe (**HI 98140 & HI 98150**).
- With the instrument off, press and hold down the **Range & ▼** keys, then power on the instrument. The "**CAL**" tag will appear and the secondary LCD will show "**0.0 °C**". The primary LCD will display the measured temperature or the "----" message, if the measured temperature is out of range.
- Submerge the temperature probe 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 reading on the secondary LCD to that of ice and water, measured by the reference thermometer. When the reading is stable and close to the selected calibration point, "**CFM**" tag will blink.



- Press **CFM** to confirm. The secondary LCD will display "**50.0 °C**".
- Submerge 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 reading on the secondary LCD to that of the hot water.
- When the reading is stable and close to the selected calibration point, "**CFM**" tag will blink.

- Press **CFM** to confirm. The instrument returns to measurement mode.



**Note:** If the reading is not close to the selected calibration point, “**WRONG**” tag will blink. Change the temperature probe and restart calibration.

### **mV CALIBRATION (HI 98160 only) (for technical personnel only)**

All the instruments are factory calibrated for mV.

Hanna’s ORP electrodes are interchangeable and no mV calibration is needed when they are replaced.

If the mV measurements are inaccurate, mV recalibration should be performed.

For an accurate recalibration, contact your dealer or the nearest Hanna Customer Service Center, or follow the instructions below.

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  $\pm 0.1$  mV.
- With the instrument off, press and hold down the **Light & Log** keys, then power on the instrument. The “**CAL**” tag will appear and the secondary LCD will show “**0.0 mV**”.

- Set 0.0 mV on the simulator.

When the reading is stable and close to the selected calibration point, “**CFM**” tag will blink.

- Press **CFM** to confirm. The secondary LCD will display “**1800 mV**”.
- Set 1800.0 mV on the simulator.

When the reading is stable and close to the selected calibration point, “**CFM**” tag will blink.

- Press **CFM** to confirm. The instrument returns 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 can not calibrate.

- Press **CAL** in any moment of the calibration process. The instrument will return to 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 an 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 a standard USB cable. Make sure that your instrument is switched off and plug one connector to the instrument's USB socket and the other to the USB port of your PC.

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

In order to avoid data errors the serial communication interface is not available if the battery percentage is less than 30%. The instrument will answer with "Err9" message.

### SENDING COMMANDS FROM PC

It is also possible to remotely control the instrument with any terminal program. Use a standard 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, baud rate 9600.

### COMMAND TYPES

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

<command prefix> <command> <CR>

where: <command prefix> is 16 ASCII character.

<command> is the command code.

**Note:** Either small or capital letters can be used.

### SIMPLE COMMANDS

RNG	Is equivalent to pressing RANGE
MOD	Is equivalent to pressing MODE
CAL	Is equivalent to pressing CAL
CFM	Is equivalent to pressing CFM
UPC	Is equivalent to pressing the UP arrow key
DWC	Is equivalent to pressing the DOWN arrow key
LOG	Is equivalent to pressing LOG
RCL	Is equivalent to pressing RCL
SET	Is equivalent to pressing SETUP
CLR	Is equivalent to pressing CLR
OFF	Is equivalent to pressing OFF
AED	Is equivalent to pressing AutoEnd

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

- xx=01 pH range/0.01 resolution
- xx=02 pH range/0.1 resolution
- xx=03 mV range
- xx=04 Relative mV range

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 and temperature reading (**HI 98140**), and mV reading (**HI 98150 & HI 98160**) on pH range.
- Rel mV, absolute mV and temperature reading on Rel mV range (**HI 98150 & HI 98160**).

The answer string contains:

- Meter mode (2 chars):
  - 01 - pH range (0.01 resolution)
  - 02 - pH range (0.1 resolution)
  - 03 - mV range
  - 04 - Rel mV range
- 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

- Reading status (2 chars): R - in range, O - over range, U - under range. First character corresponds to the appropriate range reading. Second character corresponds to mV reading.
- Primary reading (corresponding to the selected range) - 7 ASCII chars, including sign and decimal point.
- Secondary reading (only when primary reading is not mV) - 7 ASCII chars, including sign and decimal point.
- Temperature reading - 7 ASCII chars, with sign and two decimal points, always in °C.

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

**GLP** Requests the calibration data record.

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 available), which contains:
  - the number of calibrated buffers (1 char)
  - 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; O (old) - from an old calibration.
    - warnings during calibration (2 chars): 00 - no warning, 04 - Clean Electrode warning.
    - buffer value, with sign and decimal point (7 chars).
    - calibration time, **yymmddhhmmss** (12 chars).
  - electrode condition, with sign (3 chars). The "-01" code means not calculated.

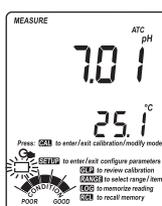
- Rel mV calibration data (if available), which contains:
    - the calibration offset, with sign (7 chars)
    - the calibration time, **yymmddhhmmss** (12 chars).
- PAR** Requests the setup parameters setting.  
The answer string contains:
- Instrument ID (4 chars)
  - Calibration alarm time out (2 chars)
  - 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)
  - Auto-off/Light time (3 chars)
  - Auto power off time (3 chars)
  - The number of custom buffers (1 char)
  - The custom buffer values, with sign and decimal point, for each defined custom buffer (7 chars)
- NSLx** Requests the number of logged samples (4 chars).  
The command parameter (1 char):
- P - request for pH range
  - M - request for mV and Rel mV ranges
- LODPxxx** Requests the xxx<sup>th</sup> pH record logged data.  
**LODMxxx** Requests the xxx<sup>th</sup> mV/Rel mV record logged data.  
**LODPALL** Requests all pH Log on demand.  
**LODMALL** Requests all mV/Rel mV Log on demand.
- The answer string for each record contains:
- The logged mode (2 chars):
    - 01 - pH range (0.01 resolution)
    - 02 - pH range (0.1 resolution)
    - 03 - mV range
    - 04 - Rel mV range
  - Reading status (1 char): R, O, U
  - Calculated reading, with sign and decimal point (7 chars) - for pH and Rel mV range
  - Temperature reading, with sign and two decimal points (8 chars)
  - mV reading status (1 char): R, O, U - only for **HI 98150** and **HI 98160**

- The mV reading, with sign and decimal point (7 chars) - only for **HI 98150** and **HI 98160**
- The logged time, **yymmddhhmmss** (12 chars)
- The calibration offset, with sign and decimal point (7 chars) - not available for ISE
- The calibration slope, with sign and decimal point (7 chars) - not available for Rel mV range
- 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 set 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.

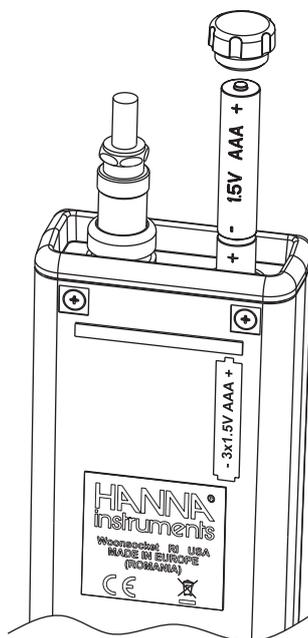
## BATTERIES REPLACEMENT

If the batteries become weak, the display will flash the battery symbol to advise the user that approx. 1 hour of working time is left. It is recommended to replace the batteries soon.



To replace the batteries, follow the next steps:

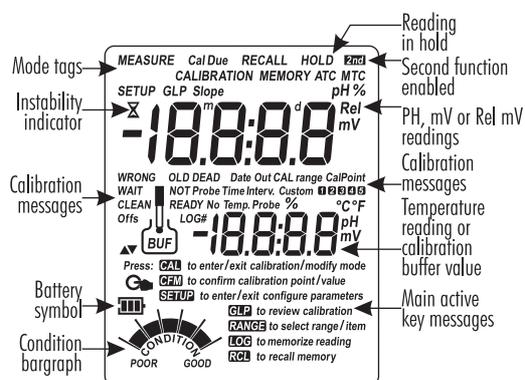
- Turn the instrument OFF.
- Open the battery compartment cap (located on the top of the instrument).
- Remove old batteries.
- Insert three new 1.5V AAA batteries in the battery compartment, following the instructions on the rear of the instrument.
- Reattach the battery compartment cap.



The instrument is provided with the BEPS (Battery Error Prevention System) feature, which automatically turns the instrument off when the batteries level is too low to ensure reliable readings. At start up the display will show “0 bAtt” message for a few seconds, then the instrument automatically turns off.

## LCD MESSAGE GUIDE

### TAGS & SYMBOLS



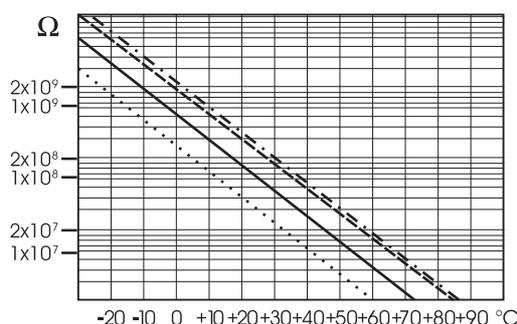
- **Mode tags** light up for indicating the corresponding active mode, and blink for warning the user.
  - MEASURE on:** Instrument in measurement mode.
  - SETUP on:** SETUP menu mode has been entered.
  - Cal Due blinking:** instrument is not calibrated or calibration is expired.
  - CALIBRATION on:** calibration mode has been entered.
  - GLP on:** GLP mode has been entered.
  - RECALL MEMORY on:** RECALL MEMORY mode has been entered.
  - HOLD on:** reading frozen in AutoEnd mode.
  - HOLD blinking:** reading unstable in AutoEnd mode.
- Indication of **temperature compensation mode:**
  - MTC for manual, ATC for automatic compensation.
- **X blinking (while in calibration):** reading unstable.

- **Main active key messages** light up for indicating the corresponding active key.
  - CAL on:** CAL key available.
  - CFM blinking:** ask confirmation of calibration or set value.
  - SETUP on:** SETUP key available.
  - GLP on:** GLP key available.
  - RANGE on:** RANGE key available.
  - LOG on:** LOG key available.
  - RCL on:** RLC key available.
- **Battery symbol blinking:** low battery condition. The batteries should be replaced.
- **Calibration messages:**
  - Out CAL range blinking:** reading out of calibration range.
  - WRONG <sup>(Buf)</sup> and WRONG  blinking** alternatively: wrong buffer, value not recognized.
  - CLEAN  blinking:** an abnormal difference between new and previous calibration has been detected. Electrode cleaning is suggested. Follow the Cleaning Procedure described in the "Electrode conditioning & maintenance" section. If the problem persists, check the buffer solutions.

Condition bargraph gives an indication about the electrode status after calibration.

## TEMPERATURE CORRELATION FOR pH SENSITIVE GLASS

The temperature limit for the HI 1230B and HI 1618D is from 0 to 80 °C with optimum measurements between 20 and 40 °C. 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 to 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.

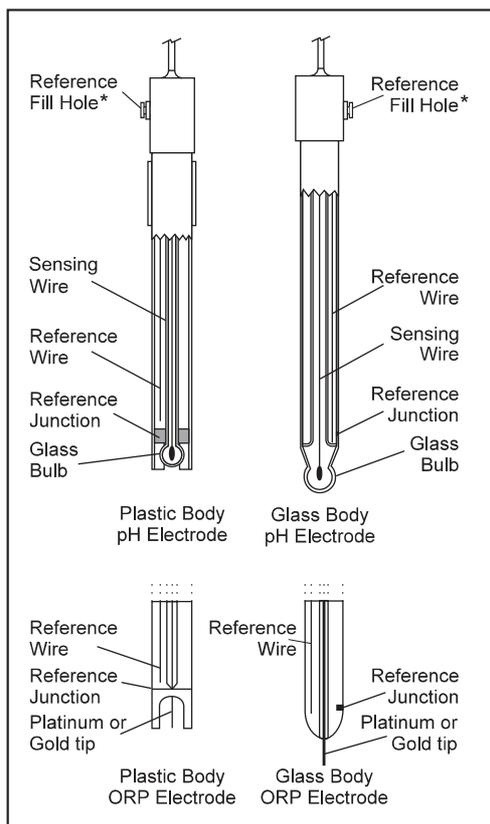
The HI 1618D and HI 1230B are specified for a pH range of 0 to 13 pH.

### 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 <sup>-1</sup> Na <sup>+</sup>	13.00	0.10
	13.50	0.14
	14.00	0.20
1.0 Mol L <sup>-1</sup> Na <sup>+</sup>	12.50	0.10
	13.00	0.18
	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. Do not be concerned if salt crystals are visible inside the electrode. This will not effect function.

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 or longer.

### **MEASUREMENT**

Verify if electrode is calibrated before making measurements. Rinse the pH electrode tip with distilled water. Submerge the tip (bottom 3 cm/1 1/4") 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 if the ORP probes tip is completely submerged.

### **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, with pH 4 buffer.

Follow the Preparation Procedure on page 37 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 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 and soak the electrode in **HI 70300** or **HI 80300** Storage Solution for at least 1 hour before taking measurements.

## TROUBLESHOOTING GUIDE

SYMPTOMS	PROBLEM	SOLUTION
Slow response/excessive drift.	Dirty pH electrode.	Soak the electrode tip in <b>HI 7061</b> solution for 30 minutes and then follow the Cleaning Procedure.
Reading fluctuates up and down (noise).	Clogged/dirty junction. Low electrolyte level (refillable electrodes only).	Clean the electrode. Refill with fresh electrolyte (refillable electrodes only). Check connector attachment.
Display shows blinking 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.	Coated ORP or dry junction.	Soak electrode in <b>HI 70300</b> storage solution for at least 30 minutes.
Display shows blinking "°C" or "°F".	Out of order or missing temperature probe.	Replace temperature probe or check the connection. Replace electrode or use MTC.
Display shows "CLEAN" blinking.	Difference between new and previous calibration has been detected.	Clean electrode and recalibrate. If the problem remains, check the buffer solutions and electrode.
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.
"WRONG buffer" "WRONG electrode" is displayed during pH calibration procedure.	Wrong or contaminated buffer.	Check that buffer solution is correct and fresh. Use the <b>ARROW</b> keys to select the appropriate buffer.
Meter shuts off.	Dead batteries or Auto-off feature is enabled: in this case, meter shuts off after selected period of non-use.	Replace the batteries; Press <b>ON/OFF</b> .
"Erxx" message at start up.	Internal error.	Contact your dealer or any Hanna Service Center.
"Ex10", then turn OFF (HI 98140, HI 98150)	Instrument can not read electrode's internal memory.	Replace the electrode. If the error remains contact your dealer or any Hanna Service Center.
The instrument does not start or not stop when pressing <b>ON/OFF</b> .	Initialization error.	Press and hold down <b>ON/OFF</b> for about 15 seconds for a hardware reset. If the error persist contact your dealer or any Hanna Service Center.
"Cal Due" "Prod" messages at startup.	Instrument not factory calibrated.	Contact Hanna Technical Support for factory calibration.

## ACCESSORIES

### pH CALIBRATION SOLUTIONS

HI 50004-01	pH 4.01 Buffer Solution, 20 mL sachet, 10 pcs
HI 50004-02	pH 7.01 Buffer Solution, 20 mL sachet, 25 pcs
HI 50007-01	pH 10.01 Buffer Solution, 20 mL sachet, 10 pcs
HI 50007-02	pH 4.01 Buffer Solution, 20 mL sachet, 25 pcs
HI 50010-01	pH 7.01 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 7000P	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 bottle, 4x30 mL
HI 7072	1M KNO <sub>3</sub> Electrolyte bottle, 4x30 mL
HI 7082	3.5M KCl Electrolyte for double junction electrodes bottle, 4x30 mL
HI 8071	3.5M KCl + AgCl Electrolyte in FDA approved bottle, 4x30 mL, for single junction electrodes
HI 8072	1M KNO <sub>3</sub> 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

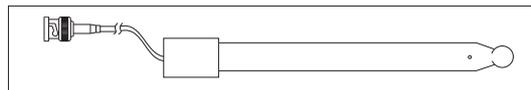
HI 7020L Test Solution 200-275 mV, 500 mL bottle

HI 7021L Test Solution 240 mV, 500 mL bottle

HI 7022L Test Solution 470 mV, 500 mL bottle

### pH ELECTRODES

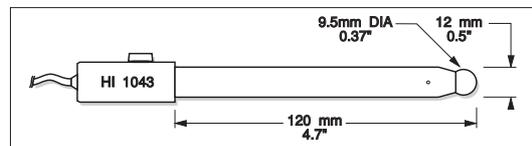
All electrodes part numbers ending in B are supplied with a BNC connector and 1 m (3.3') cable, as shown below:



#### HI 1043B

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

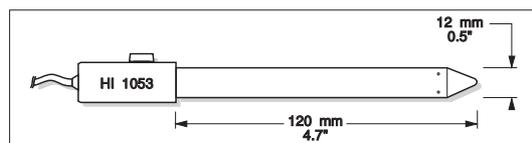
Use: strong acid/alkali.



#### HI 1053B

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

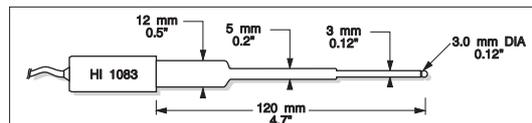
Use: emulsions.



#### HI 1083B

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

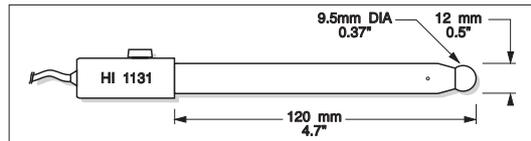
Use: biotechnology, micro titration.



### HI 1131B

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

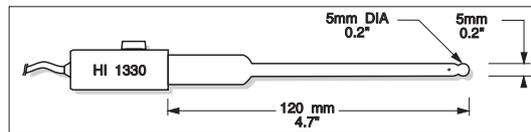
Use: general purpose.



### HI 1330B

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

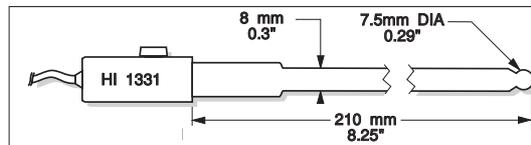
Use: laboratory, vials.



### HI 1331B

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

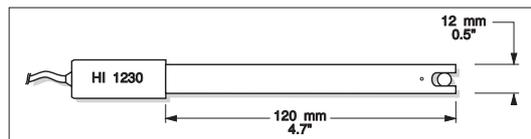
Use: flasks.



### HI 1230B

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

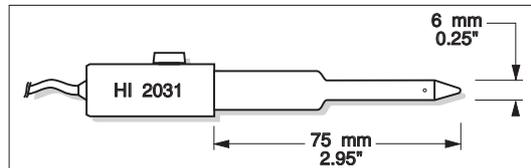
Use: general, field.



### HI 2031B

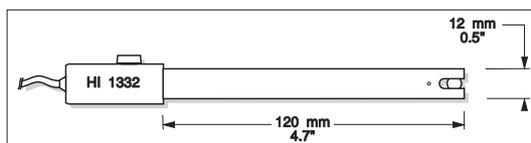
Glass-body, semimicro, conic, refillable, combination pH electrode.

Use: semisolid products.



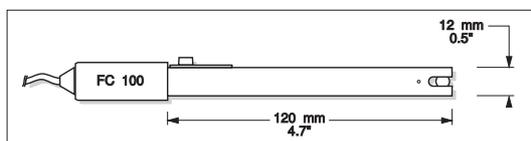
**HI 1332B**

Plastic-body (PES), double junction, refillable, combination pH electrode.  
Use: general purpose.



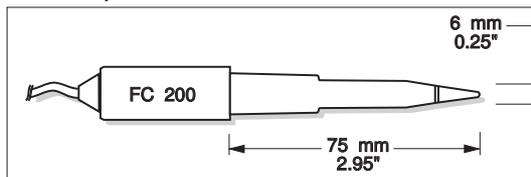
**FC 100B**

Plastic-body (PVDF), double junction, refillable, combination pH electrode.  
Use: general purpose for food industry.



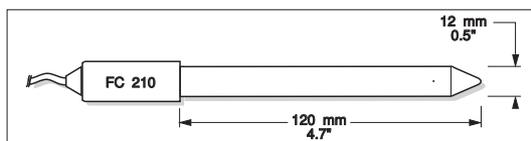
**FC 200B**

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



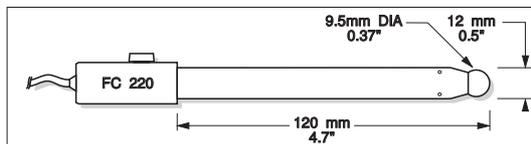
**FC 210B**

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



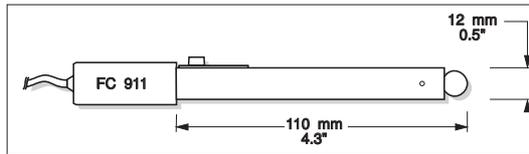
**FC 220B**

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



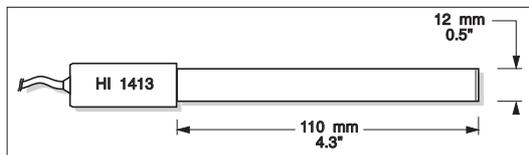
**FC 911B**

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



**HI 1413B**

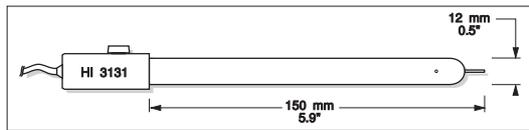
Glass-body, single junction, flat tip, Viscolene, non-refillable, combination pH electrode. Use: surface measurement.



**ORP ELECTRODES**

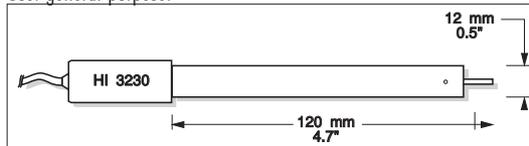
**HI 3131B**

Glass-body, refillable, combination platinum ORP electrode. Use: titration.



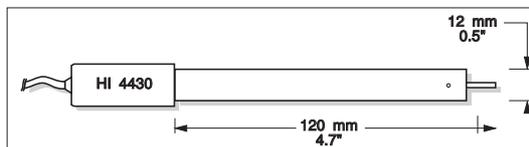
**HI 3230B**

Plastic-body (PES), gel-filled, combination platinum ORP electrode. Use: general purpose.



**HI 4430B**

Plastic-body (PES), gel-filled, combination gold ORP electrode. Use: general purpose.

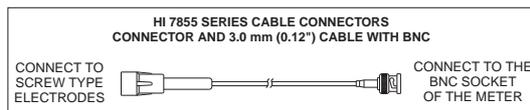


Consult the Hanna General Catalog for a complete and wide selection of electrodes.

### **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



### **SMART ELECTRODES**

HI 1615D combination pH electrode, glass-body, single junction, refillable with built-in temperature NTC sensor and EEPROM for GLP data storing.

HI 1616D combination pH electrode, glass-body, single junction, gel-filled with built-in temperature NTC sensor and EEPROM for GLP data storing.

HI 1617D combination pH electrode, glass-body, single junction, triple ceramic, refillable with built-in temperature NTC sensor and EEPROM for GLP data storing.

HI 1618D combination pH electrode, single junction, gel-filled with built-in temperature NTC sensor and EEPROM for GLP data storing.

HI 3619D combination ORP / Pt electrode, glass-body, single junction.

HI 3620D combination ORP / Pt electrode, single junction, gel-filled.

FC 201D combination pH electrode, single junction, with built-in temperature NTC sensor and EEPROM for GLP data storing.

FC 212D combination pH electrode, double junction, with built-in temperature NTC sensor and EEPROM for GLP data storing.

FC 231D combination pH electrode with knife (penetration 20mm/0.79"), single junction, with built-in temperature NTC sensor and EEPROM for GLP data storing.

FC 241D combination pH electrode with knife (penetration 35mm/1.38"), single junction, with built-in temperature NTC sensor and EEPROM for GLP data storing.

### **OTHER ACCESSORIES**

HI 7662 Stainless steel Temperature probe with 1 m (3.3') cable

HI 710031 Rugged carrying case

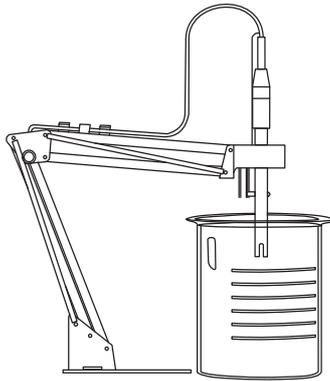
HI 740028 1.5V AAA batteries (4 pcs)

HI 8427 pH and mV simulator

HI 931001 pH and mV simulator with LCD display

HI 92000 Windows® compatible software.

HI 76405 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.

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