Instruction Manual

HI 98170 HI 98171 HI 98172

Calibration Check Waterproof pH/mV/ISE/Temperature Meters

HANNA
instruments
www.hannainst.com
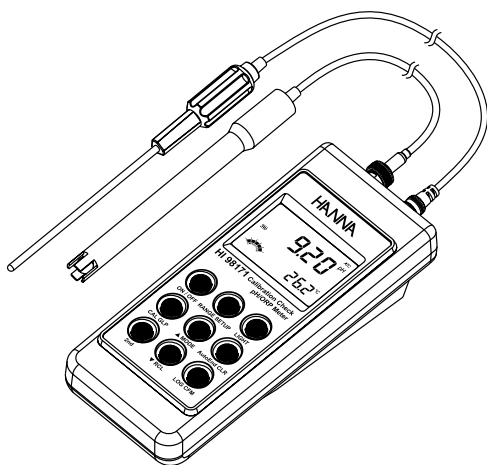
Dear Customer,

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 or turn to the back cover for our worldwide contact list.

These instruments are in compliance with $C\epsilon$ directives.

WARRANTY

HI 98170, **HI 98171** and **HI 98172** 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** Combination double-junction, gel pH Electrode
- **HI 7662** stainless steel Temperature Probe with 1 m (3.3') Cable
- **pH 4.01 & 7.01** Buffer Solutions (20 mL each)
- 100 mL Plastic Beaker
- 4 x 1.2V AA, 1300 mAh Rechargeable Batteries
- **HI 710041** Inductive Recharger
- 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 98170, **HI 98171** and **HI 98172** are state-of-the-art, heavy-duty 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 memorized 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
- Custom calibration by entering up to five custom buffers
- Messages on the LCD to make the calibration easy and accurate
- Diagnostic features to alert the user when the electrode needs cleaning
- Outside Calibration Range warning
- Monitoring of the electrode aging
- User-selectable "calibration time out" to remind when a new calibration is necessary

Moreover, they offer an extended temperature range from −20 ºC to 120 ºC (-4 ºF to 248 ºF), using **HI 7662** interchangeable 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 98172 can also measure with ISE electrodes on ppm scale. The ion charge selection capability 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 (50 samples on each range - pH, mV, ISE)
• 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
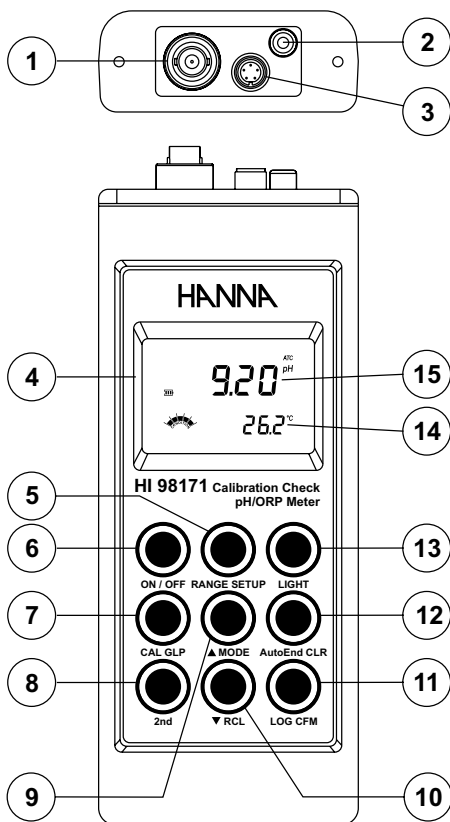
1) BNC electrode connector.
2) Temperature probe socket.
3) RS232 serial communication connector.
4) Liquid Crystal Display (LCD).
5) **RANGE** key, to select pH or mV (**HI 98171**, **HI 98172**), or ISE (**HI 98172**).
   SETUP key, to enter/exit SETUP mode.
6) **ON/OFF** key, to turn the instrument ON and OFF.
7) **CAL** key, to enter/exit calibration mode.
   GLP key, to display Good Laboratory Practice information.
8) **2nd** key, to select second key function.
9) ▲ key, to manually increase temperature or other parameters.
   MODE key, to select measurement resolution, 0.1 pH / 0.01 pH (**HI 98170**), or to toggle between mV and Rel mV (**HI 98171**, **HI 98172**).

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10) ▼ key, to manually decrease temperature or other parameters.
    RCL key, to enter/exit view logged data mode.
11) **LOG** key, to store measured data.
    CFM key, to confirm different values.
12) **AutoEnd** key, to freeze first stable reading on the LCD.
    CLR key, to clear calibration or logged data.
13) **LIGHT** key, to toggle display backlighting.
14) Secondary LCD.
15) Primary LCD.

RANGE	−2.0 to 16.0 pH
	−2.00 to 16.00 pH
	± 699.9 mV (HI 98171 only)
	± 2000 mV (HI 98171 only)
	−20.0 to 120.0 °C (−4.0 to 248.0 °F)
RESOLUTION	0.1 pH
	0.01 pH
	0.1 mV (HI 98171 only)
	1 mV (HI 98171 only)
	0.1 °C (0.1 °F)
ACCURACY @ 20 °C / 68 °F	± 0.1 pH
	± 0.01 pH
	± 0.2 mV (± 699.9 mV)
	± 1 mV (± 2000 mV)
	± 0.4 °C (± 0.8 °F) (excluding probe error)
Rel mV offset range	± 2000 mV (HI 98171 only)
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
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)
Temperature probe	HI 7662 (included)
LOG	On demand, 50 samples on each range
Input impedance	10^{12} ohms
Battery Type & Life	4 x 1.2V AA rechargeable batteries approx. 200 hours of continuous use without backlight (50 hours with backlight)
Auto-off	User selectable: 1 to 30 minutes or disabled
PC interface	opto-isolated RS232
Dimensions	196 x 80 x 60 mm (7.7 x 3.1 x 2.4")
Weight (meter only)	425 g (15 oz)
Environment	0 – 50 °C (32 – 122 °F) max RH 100%
Warranty	2 years

HI 98172
SPECIFICATIONS

RANGE	−2.00 to 16.00 pH
	± 699.9 mV ± 2000 mV
	0.001 to 19990 ppm
	−20.0 to 120.0 °C(−4.0 to 248.0 °F)
RESOLUTION	0.01 pH
	0.1 mV 1 mV
	0.001 ppm (from 0.001 to 1.999) 0.01 ppm (from 2.00 to 19.99) 0.1 ppm (from 20.0 to 199.9) 1 ppm (from 200 to 1999) 10 ppm (from 2000 to 19990)
	0.1 °C(0.1 °F)
ACCURACY @ 20 °C/ 68 °F	± 0.01 pH
	± 0.2 mV (± 699.9 mV) ± 1 mV (± 2000 mV)
	± 0.5% f.s
	± 0.4 °C(± 0.8 °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
Offset Calibration	± 1 pH
Slope Calibration	From 80 to 110%
ISE Calibration	Up to five-point calibration 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 1230B (included)
Temperature probe	HI 7662 (included)
LOG	On demand, 50 samples on each range
Input impedance	10^{12} ohms
Battery Type & Life	4 x 1.2V AA rechargeable batteries approx 200 hours of continuous use without backlight (50 hours with backlight)
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PC interface	opto-isolated RS232
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Weight (meter only)	425 g (15 oz)
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INITIAL PREPARATION

The instrument is supplied complete with rechargeable batteries. Remove the back cover, unwrap the batteries and install them, while paying attention to the correct polarity. Proceed with a complete charging process (see page 37).

To prepare the instrument for use, connect the pH electrode and the temperature probe to the BNC and temperature sockets on the top of the instrument. The temperature probe is used in conjunction with the pH electrode to utilize the instrument's ATC capability, 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 10 for details).

Turn the instrument ON by pressing ON/OFF.

At start-up the display will show all the used segments for a few seconds (or while the button is held), followed by the percentage indication of the remaining battery charge, then enters measurement mode.

After measurement switch the instrument off, clean the electrode and store it with a few drops of **HI 70300** storage solution in the protection cap. Place the instrument in the battery recharger case and start the recharging process (see page 37).

The auto-off feature turns the instrument off after a set period (default 20 min) with no button pressed to save battery life. To set another period or to disable this feature, see SETUP menu on page 25.

The auto-off backlight feature turns the backlight off after a set period (default 1 min) with no buttons pressed. To set another period or to disable this feature, see SETUP menu on page 25.

pH MEASUREMENTS

To take a pH measurement remove the electrode protective cap and simply submerge the tip of the electrode (4cm/1½") and the temperature probe into the sample to be tested.
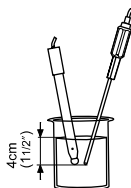
If necessary, press **RANGE** until the display changes to the pH mode.

Allow for the electrode to adjust and reading to stabilize (hourglass symbol turns 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 instrument is calibrated (see page 12 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. In order for the instrument to measure the pH accurately, 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.

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

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

The "MTC" tag and up & down arrows 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, and the instrument will start incrementing / decrementing the temperature value. The instrument keeps measuring and the display is updated periodically.

## ORP MEASUREMENTS (HI 98171 & HI 98172 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 (4cm/1½") into the sample to be tested and wait a few seconds for the reading to stabilize.
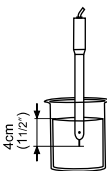
Measurements within the ± 699.9 mV range are displayed with 0.1 mV resolution, while outside this range the resolution automatically switches to 1 mV. The "ATC" (or "MTC") tag is turned off because mV readings are not temperature compensated.
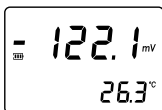
For accurate ORP measurements, the surface of the electrode must be clean and smooth. Pretreatment solutions are available to condition the electrode and improve its response time (see Accessories section, page 45).

RELATIVE mV MEASUREMENTS (HI 98171 & HI 98172 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.

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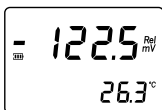
The relative mV reading is equal to the difference between the absolute mV input value and relative mV offset established in the relative mV calibration (see page 18).

## ISE MEASUREMENTS (HI 98172 only)

To perform ion concentration measurements, connect an optional ISE electrode to the instrument and turn it ON.

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

Submerge the ISE electrode tip (4cm/1½") into the sample to be tested and wait a few seconds for the reading to stabilize.
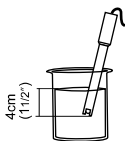
The ppm reading will be displayed on the primary LCD and the current temperature value on the secondary LCD. The "ATC" (or "MTC") tag is turned off because ppm readings are not temperature compensated.
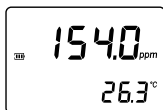
In order to take accurate ISE measurements, make sure that the appropriate ion charge was set in SETUP menu, according to the ion type that is to be measured and the instrument was calibrated (see ISE CALIBRATION for details, page 19).

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 one-point calibration if the ion charge is -1, 1, -2, 2 or a two-point calibration for the "undF" option selected in SETUP menu in order to take ISE measurements.

• If using the pH electrode while in mV mode, the instrument will measure the mV generated by the pH electrode.

TEMPERATURE MEASUREMENTS

Connect the **HI 7662** 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 (ºC) or in Fahrenheit degrees (ºF) (see SETUP for details, page 25).

BACKLIGHT FEATURE

The instrument is provided with a Backlight feature, which can be easily toggled on and off through the keyboard by pressing **LIGHT**.

Note: The backlight automatically shuts off after a set period (see SETUP for details, page 25) with no buttons pressed.

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" tags blink (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 memorized buffers (1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45 pH) and also allows the user to enter five more pH values for calibration, "Custom 1" to "Custom 5". The set custom buffers are the buffer values at 25 ºC.

When a custom buffer is selected during calibration, the "Custom" tag is displayed on the LCD and its value can be changed in a ± 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 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 ± 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

• Immerse the pH electrode and the temperature probe approximately 4 cm (1½") 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.
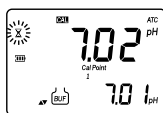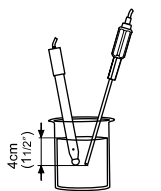
- The "⧗" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected buffer, "CFM" tag blinks.
- Press **CFM** to confirm calibration.

- 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.
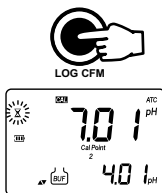
- After the first calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 4 cm (1½") into the second buffer solution and stir gently. The temperature probe should be close to the pH electrode.
- If necessary, press the **ARROW** keys to select a different buffer value.
- The "⧗" 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, immerse the pH electrode and the temperature probe approximately 4 cm (1½") 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 "⧗" 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, immerse the pH electrode and the temperature probe approximately 4 cm (1½") 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 "⧗" 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, immerse the pH electrode and the temperature probe approximately 4 cm (1½") 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 "ᵷ" 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.

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".

If the "Pnt" option is selected, the adjacent slopes will be reevaluated.

If the "OFFS" option is selected, an electrode offset correction is performed keeping unchanged the existing slopes.

- 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 **2nd** then **MODE** 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 used, or regenerate the electrode by following the Cleaning Procedure (see page 43). 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 on the secondary LCD are displayed blinking, an inconsistency between new and previous (old) calibration is detected. Clear old calibration parameters and proceed with calibration from the current calibration point. The instrument will keep all confirmed values during current calibration.

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- 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), and after confirming the 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 leave replace mode. In this case, the buffer will not be memorized.

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" tag will be displayed blinking on the LCD.

Press **2nd** then **SETUP** if you want to adjust the buffer value in accordance with current temperature. The buffer value, displayed on the secondary LCD, will start blinking.
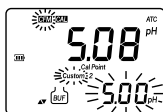
Use the **ARROW** keys to change the buffer value.

After about 5 seconds you performed the last change, the buffer value is updated. Press **2nd** then **SETUP** if you want to change it again.

Notes: • Custom buffer value can be adjusted in a ± 1.00 pH window, around the set value.

  • If you want to return to the set custom buffer value, simply press the **ARROW** keys (UP then DOWN) to select again the custom buffer.

CLEAR CALIBRATION

Press **2nd** then **CLR** in any moment during calibration.
The "CLr ALL" message will be displayed on the LCD along with "OLD" tag.

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.

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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.

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 41).

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

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						
ºC	ºF	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 ºC.

RELATIVE mV CALIBRATION
(HI 98171 & HI 98172)

- 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 if you want 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 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. Change the input value or the Relative mV value on the primary LCD to complete the calibration process.

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

The ppm range should be recalibrated:

• Whenever the ISE electrode is replaced.

• When the ion charge is changed in SETUP menu.

• At least once a week.

• After testing agressive chemicals.

• When calibration alarm time out is expired - "CAL DUE" tags blink (if feature is enabled).

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

PROCEDURE

Select the proper ion charge in SETUP menu (see SETUP for details, page 25).

Note: If "undF" option is selected in SETUP menu, calibration must be performed in at least two points, otherwise "----" message will be displayed on the LCD if exiting calibration after confirming the first used standard.

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

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

The instrument offers a choice of six memorized standard solutions: 0.1, 1, 10, 100, 1000, 10000 ppm and calibration up to five points.

Remove the protective cap from the ISE electrode.

FIVE-POINT CALIBRATION

• Immerse the ISE electrode approximately 4 cm (1½") into the less concentrated standard solution and stir gently.

• Press CAL. The primary LCD will display the ppm value using the current offset and slope. The "CAL" and "Cal Point 1" tags will appear and "0.100" ppm standard will be displayed on the secondary LCD.

• If necessary, press the ARROW keys to select a different standard value.

• The "⧖" tag will blink on the LCD until the reading is stable.

• When the reading is stable and close to the selected standard, the "CFM" tag blinks.

• Press CFM to confirm calibration.
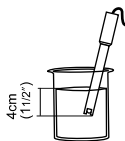
- The calibrated value will be displayed on the primary LCD and the second expected standard value on the secondary LCD, together with "CAL" and "Cal Point 2" tags.

Note: The instrument will automatically skip the standard solution used for the first point.

- After the first calibration point is confirmed, immerse the ISE electrode approximately 4 cm (1½") into the second calibration solution.
- If necessary, press the **ARROW** keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the "CFM" tag blinks.
- Press **CFM** to confirm calibration.
- The calibrated value will be displayed on the primary LCD and the third expected standard value on the secondary LCD.
- After the second calibration point is confirmed, immerse the ISE electrode approximately 4 cm (1½") into the third calibration solution.
- If necessary, press the **ARROW** keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the "CFM" tag blinks.
- Press **CFM** to confirm calibration.
- The calibrated value will be displayed on the primary LCD and the fourth expected standard value on the secondary LCD.
- After the third calibration point is confirmed, immerse the ISE electrode approximately 4 cm (1½") into the fourth calibration solution.
- If necessary, press the **ARROW** keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.
- When the reading is stable and close to the selected standard, the "CFM" tag blinks.
- Press **CFM** to confirm calibration.
- The calibrated value will be displayed on the primary LCD and the fifth expected standard value on the secondary LCD.
- After the fourth calibration point is confirmed, immerse the ISE electrode approximately 4 cm (1½") into the fifth calibration solution.
- If necessary, press the **ARROW** keys to select a different standard value.
- The "⧖" tag will blink on the LCD until the reading is stable.

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- When the reading is stable and close to the selected standard, the "CFM" tag blinks.
- Press **CFM** to confirm calibration. The instrument stores the calibration value and returns to normal measurement mode.

LOG CFM

Notes: • If the new slope is out of slope window or the mV value is out of mV range (± 2000), "WRONG" tag will blink. In this case check if the correct standard has been used, or refresh the electrode by following the Cleaning Procedure (see page 43). If necessary, change the standard or the electrode.

- Slope window is between ± 20 mV and ± 120 mV if ion charge is not specified (undF selected in SETUP menu) or between 50% and 120% of default slope for the corresponding ion charge.

   Default slope value (mV/decade):
   -59.16 (monovalent anion) - ion charge is -1
      59.16 (monovalent cation) - ion charge is 1
   -29.58 (divalent anion) - ion charge is -2
      29.58 (divalent cation) - ion charge is 2
      100 - ion charge is "undF"

- Press **2nd** then **CLR** in any moment during calibration. The "CLr ALL" message will be displayed on the LCD along with "OLD" tag.

AutoEnd CLR

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

- The instrument will display "----" on the primary LCD if it is not calibrated or after all calibrations are cleared.

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

- Press **2nd** then **MODE** to display the temperature reading on the LCD during calibration.

▲ MODE

FOUR, THREE, TWO or ONE-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.

CAL GLP

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" tags 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 25) 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" tags 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 time (hh:mm) of the last calibration.

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

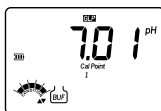• The date (mm.dd.yyyy) of the last calibration.
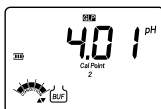
• The pH calibration offset.

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- The pH calibration slope (the GLP slope is the average of the calibration slopes; the percentage is referred to the ideal value of 59.16 mV/pH).

%	99.8
	SLOP

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

The first pH calibration buffer:

	7.01 pH
	Cal Point 1
	BUF

The second pH calibration buffer:

	4.01 pH
	Cal Point 2
	BUF

The third pH calibration buffer:

	5.00 pH
	Cal Point Custom 3
	BUF

The fourth pH calibration buffer:

	9.18 pH
	Cal Point 4
	BUF

The fifth pH calibration buffer:

	12.45 pH
	Cal Point 5
	BUF

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 "no bUF" 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,

	OFF
	dAY

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.

	0001
	InS Id

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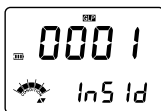
LAST RELATIVE mV CALIBRATION DATA

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 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 date as in pH GLP mode.
• The Relative mV calibration offset as in pH GLP mode.
• The instrument ID as in pH GLP mode.

Notes: • Press **2nd** then **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.

LAST ISE CALIBRATION DATA

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

To view the ISE calibration data, press **2nd** then **GLP** while in ISE measurement mode.

The instrument will display the time (hh:mm:ss) of the last calibration as in pH GLP mode.

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

• The ISE calibration date as in pH GLP mode.

• The ISE calibration slope (mV/decade).

• The calibration standards in calibrating order, for the last calibration.
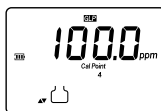
The first calibration standard:

The second calibration standard:

The third calibration standard:

The fourth calibration standard:

The fifth calibration standard:

Notes: • The "OLd" message displayed beside the ppm value means that this standard 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 standard number is not displayed on the LCD.

• If "no bUF" message appears on the LCD, the instrument informs you that calibration was performed in less than five points.

• The Calibration Alarm Time Out status and the Instrument ID as in pH GLP mode.

SETUP

Setup mode allows viewing and modifying the following parameters:

• Calibration Alarm Time Out (pH and ISE range only)
• One-point calibration behaviour (pH range only)
• Custom buffers (1 to 5) (pH range only)
• Ion charge (ISE range only)
• Current Date (mm.dd.yyyy)
• Current Time (hh:mm)
• Beep Status
• Baud Rate (serial communication)
• Command prefix (serial communication)
• Instrument ID
• Auto power off
• Auto-off backlight
• Temperature Unit

To enter SETUP mode, press **2nd** then **SETUP** 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. The selected item (e.g. hour, in setting up the correct time) will start blinking.
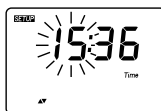
Press the **ARROW** keys to change the displayed value.

If there is another item to be set (e.g. minutes), press
2nd then **MODE**. The other item will start blinking.

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

Press **CFM** to confirm or **CAL** to escape.

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

Press **2nd** then **SETUP** to exit SETUP menu at any time.

The following table lists the SETUP parameters, their valid values range and
the factory settings (default):

Item	Description	Valid values	Default
CAL DUE	Alarm Time Out	OFF or 1 to 7 days	OFF
Custom 1-5	Custom Buffer 1 to 5	no or -2.00 to 16.00 pH	no
1 Pnt	One-point cal. behaviour	Pnt or OFFS	Pnt
IonCG	Ion Charge	undF or -2; -1; 1; 2	undF
Time (hh:mm)		00:00 to 23:59	00:00
Date	Date (mm.dd.yyyy)	01.01.2000 to 12.31.2099	01.01.2005
bEEP	Beep Status	ON/OFF	OFF
bAUd	Baud Rate	600; 1200; 2400; 4800; 9600	2400
PrEF	Command Prefix	0 to 47	16
In Id	Instrument ID	0000 to 9999	0000
LIGH	Auto-off backlight	OFF or 1, 5, 10 min	1
A.OFF	Auto power off	OFF or 5, 10, 20, 60 min	20
tEMP	Temperature Unit	°C or °F	°C

Notes: • The custom buffers can be set only with 0.01 pH resolution, at 25 °C.
Press **2nd** then **MODE** 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.

• To select the right ion charge, different ion types and their charge
are presented in the table below:

ION CHARGE	ION types
−2 (divalent anions)	S, CO_3
−1 (monovalent anions)	$F, Cl, Br, I, CN, SCN, ClO_4, NO_3$
1 (monovalent cations)	H, Na, K, Ag, NH_4
2 (divalent cations)	Mg, Ca, Ba, Cd, Cu, Pb
undF	undefined ion

LOGGING

This feature allows the user to log pH, Rel mV or ISE measurements, together with corresponding mV and temperature automatically. All logged data can be transferred to a PC through the RS232 port.

The maximum logging space is 150 record locations (50 records on each range).

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, together with "LOG" tag and then the free locations number.

If there are less than 6 memory locations remaining, the "Lo" message will blink for a few seconds to alert the user, and then the free locations number is displayed on the LCD.
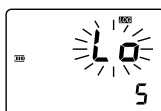
If the LOG space is full, "FULL LOC" message will be displayed on the LCD for a few seconds with "LOG" tag blinking, and then "FrEE 0" message.
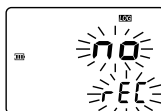
The instrument returns to normal measurement mode.

VIEW LOGGED DATA

Press **2nd** then **RCL** to retrieve the information stored while in measurement mode for the specific range.

If no data were logged, the instrument will display "no rEC" message blinking.

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

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

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

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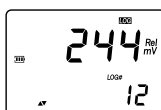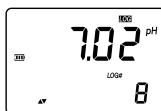
- If RCL mode was invoked while the instrument was in ISE range: the last **ppm** memorized reading on the primary LCD and the record number on the secondary LCD.

```
   1.284ppm
        LOG#
        46
```

Press **2nd** then **SETUP** while in RECALL mode and the instrument will toggle between the record number on the secondary LCD and the current displayed information. Use the **ARROW** keys to select another record.

Press **2nd** then **MODE** 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	Month & day	Year
TIME	Hour & minutes	Seconds
OFFSET	Offset value	OFFS
SLOPE	Slope value	SLP

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

Last displayed parameter is "dEL" message on the primary LCD and the record number on the secondary LCD.

```
     dEL
        LOG#
        8
```

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

- Press **2nd** then **CLR** to delete the selected or all records. The "nuLL" message will be displayed on the primary LCD for the selected 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.

AutoEnd

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

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 **2nd** then **MODE** the instrument will skip to the displayed 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 ºC or 122 ºF). Place insulation material around the vessels to minimize temperature changes.

• Use a calibrated thermometer with a resolution of 0.1 ºC as a reference thermometer. Connect the **HI 7662** temperature probe to the appropriate socket.

• With the instrument off, press and hold down the **SETUP** & ▼ keys, then power on the instrument. The "CAL" tag will appear and the secondary LCD will show 0.0 ºC. The primary LCD will display the measured temperature or the "**----**" message, if the measured temperature is out of range.

• Immerse 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 ºC.

• 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 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.

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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
(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 ± 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 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 the optional Hanna **HI 920011** (5 to 9 pin) cable connector. Make sure that your instrument is switched off and plug one connector to the instrument RS232C socket and the other to the serial port of your PC.

Notes: • Other cables than **HI 920011** may use a different configuration. In this case, communication between instrument and PC may not be possible.

• 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 **HI 920011** 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 a selectable ASCII character between 0 and 47 (default 16).

$<command>$ 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 (**HI 98170**, **HI 98171**)
- xx=03 mV range
- xx=04 Relative mV range
- xx=05 ISE range (**HI 98172**)

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 98170**), and mV reading (**HI 98171**) on pH range.
- Rel mV, absolute mV and temperature reading on Rel mV range (**HI 98171**, **HI 98172**).
- ppm, mV and temperature reading on ppm range (**HI 98172**).

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
  - 05 - ISE range
- Meter status (2 chars of status byte): represents a 8 bit hexadecimal encoding.

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- • 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 ºC.

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 ion charge, with sign (2 chars)
  - • 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)

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- the calibration time, **yymmddhhmmss** (12 chars).
- ISE calibration data (if available), which contains:
  - the number of calibrated standards (1 char)
  - the ion charge, with sign (2 chars)
  - 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;
      O (old) - from an old calibration.
    - warnings during calibration (2 chars): 00 - no warning.
    - standard value, with sign and decimal point (7 chars).
    - 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)
- The ion charge (2 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
- I - request for ISE range

LODPxxx   Requests the xxx[th] pH record logged data.

LODMxxx   Requests the xxx[th] mV/Rel mV record logged data.

LODIxxx   Requests the xxx[th] ISE record logged data (**HI 98172**).

LODPALL   Requests all pH Log on demand.

LODMALL   Requests all mV/Rel mV Log on demand.

LODIALL   Requests all ISE Log on demand (**HI 98172**).

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
  - 05 - ISE range
- Reading status (1 char): R, O, U
- Calculated reading, with sign and decimal point (7 chars) - for pH, Rel mV and ISE range
- Temperature reading, with sign and two decimal points (7 chars)
- mV reading status (1 char): R, O, U - only for **HI 98171** and **HI 98172**
- The mV reading, with sign and decimal point (7 chars) - only for **HI 98171** and **HI 98172**
- 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 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
RECHARGING/REPLACEMENT

It is recommended to recharge the rechargeable batteries as soon as you finish your work with the instrument or as soon as the battery indicator does not show full scale.

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 recharge the batteries soon.

To replace the rechargeable batteries, follow the next steps:

• Turn OFF the instrument.

• Unscrew the two screws from the rear cover of the instrument.

• Insert four new 1.2V AA rechargeable batteries in the battery compartment while paying attention to the correct polarity.

• Put the switch on the back of the instrument in the "Recharge" position.
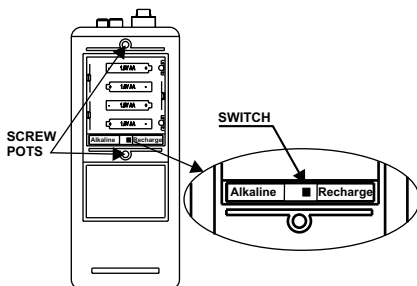
• Reattach the cover and tighten the two screws.

To recharge the rechargeable batteries, follow the next steps:

• Make sure that the switch on the back of the instrument is in the "Recharge" position (see above).

• Connect the 12Vdc power adapter to the main line and to the battery recharger. The front LED will turn on (green).

• Place the instrument in the battery recharger case. The LED will become red (recharging in progress).
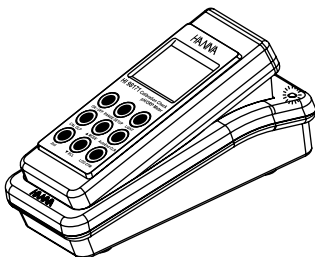
- The complete charging process takes about 30 hours.

Notes: • As the charging process is performed at low current, the instrument can be left on the recharger more than 30 hours, without damaging the rechargeable batteries.

- It is recommended to turn off the instrument while recharging the batteries. The measurements can be affected by the recharging process. The capacity of the battery displayed after power on is also affected.

- Batteries recharging must only take place in a non hazardous area, using the **HI 710041** inductive recharger.

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.

This instrument can also be powered on with 4 x 1.5V AA alkaline batteries.

To replace rundown batteries, remove the rear cover of the instrument and substitute all four 1.5V AA alkaline batteries with new ones, while paying attention to the correct polarity. Make sure that the switch on the back of the instrument is in the "Alkaline" position (see below).

Reattach the cover and tighten the two screws.

Note: Don't forget to change the switch position if you are using 1.5V AA alkaline batteries. This will avoid the damages which can be produced if trying to recharge the alkaline batteries.

LCD MESSAGE GUIDE

TAGS & SYMBOLS
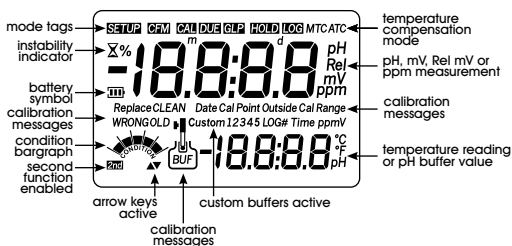
- **Mode tags** light up for indicating the corresponding active mode, and blink for warning the user.

  SETUP on: SETUP menu mode has been entered.

  CFM blinking: ask confirmation of calibration or set value.

  CAL on: calibration mode has been entered.

  CAL DUE blinking: instrument is not calibrated or calibration is expired.

  GLP on: GLP mode has been entered.

  HOLD on: reading frozen in AutoEnd mode.

  HOLD blinking: reading unstable in AutoEnd mode.

  LOG on: measurement stored in the internal memory.

  X̄ blinking (while in calibration): reading unstable.

- Indication of **temperature compensation mode**:
  MTC for manual, **ATC** for automatic compensation.

- **Battery symbol blinking**: low battery condition. Rechargeable batteries shoud be recharged soon or batteries replaced.

- **Calibration messages**.

  Outside Cal Range blinking: reading out of calibration range.

  WRONG 🜂 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.

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 ºC (77 ºF).
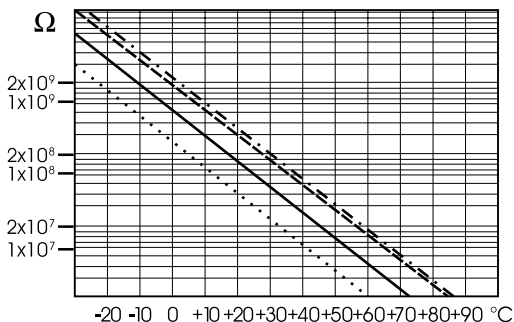
Since the resistance of the pH electrode is in the range of 50 − 200 Mohm, the current across the membrane is in the pico Ampere range. Large currents can disturb the calibration of the electrode for many hours.

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 ºC (194 ºF)	Less than 4 months
120 ºC (248 ºF)	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 ºC (68-77 ºF)		
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
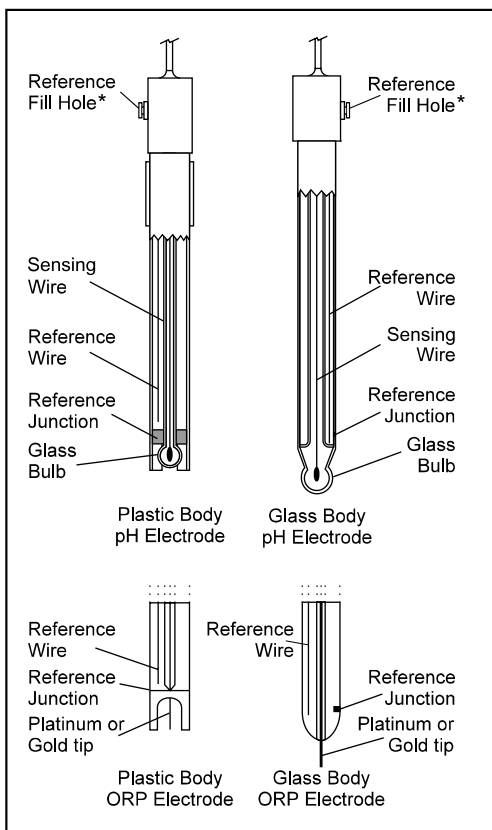
* Not present in gel electrodes.

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.

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 run down and the electrode should be replaced.

MEASUREMENT

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

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

See that the sleeve holes of the ORP probe are completly 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, 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 41 before taking measurements.

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

PERIODIC MAINTENANCE

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

pH Probe Maintenance

For refillable electrodes:

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

Follow the Storage Procedure above.

pH CLEANING PROCEDURE

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

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

TROUBLESHOOTING GUIDE

SYMPTOMS	PROBLEM	SOLUTION
Slow response/excessive drift.	Dirty pH electrode.	Soak the electrode tip in HI 7061 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).
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.	Dry membrane or dry junction.	Soak electrode in HI 70300 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.
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.
Display shows blinking battery symbol.	Low accumulator level.	Recharge accumulators or replace batteries.
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.
Meter shuts off.	Dead accumulators; Auto-off feature is enabled: in this case, meter shuts off after selected period of non-use.	Recharge accumulators or replace batteries; Press ON/OFF.
"Errxx" message at start up.	Internal error.	Contact your dealer or any Hanna Service Center.
The instrument does not start when pressing ON/OFF.	Initialization error.	Press and hold down ON/OFF for about 10 sec. or disconnect and then connect one accumulator.

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 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:
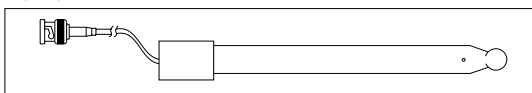
HI 1043B

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

Use: strong acid/alkali.
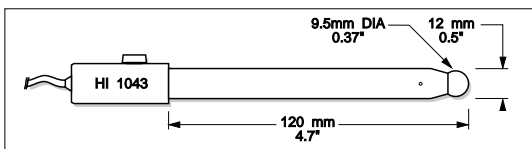
HI 1053B

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

Use: emulsions.
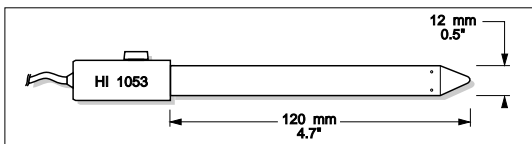
HI 1083B

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

Use: biotechnology, micro titration.
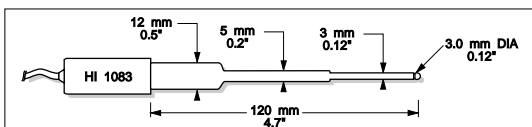
HI 1131B

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

Use: general purpose.
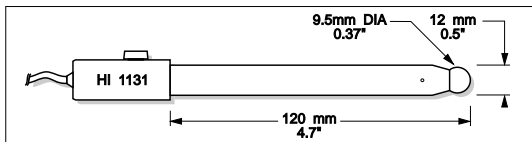
HI 1330B

Glass-body, semimicro, single junction, refillable, combination **pH** electrode.
Use: laboratory, vials.
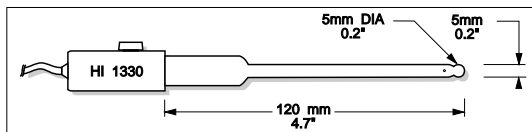
HI 1331B

Glass-body, semimicro, single junction, refillable, combination **pH** electrode.
Use: flasks.
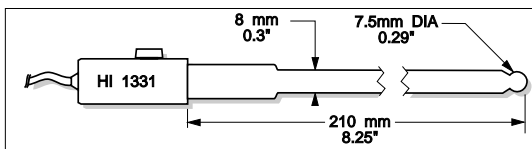
HI 1230B

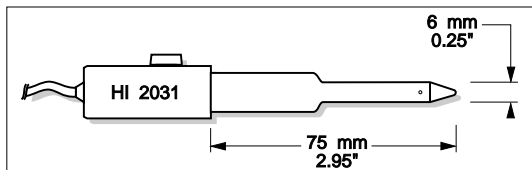Plastic-body (PEI®), double junction, gel-filled, combination **pH** electrode.
Use: general, field.
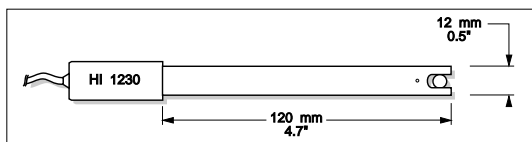
HI 2031B

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.
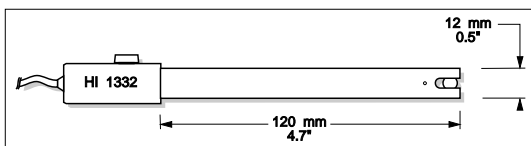
FC 100B
Plastic-body (PVDF®), double junction, refillable, combination **pH** electrode.
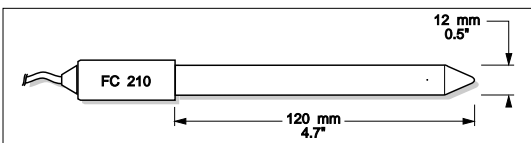Use: general purpose for food industry.
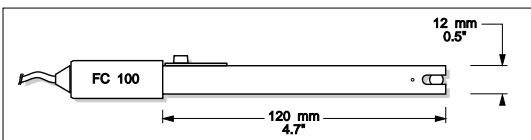
FC 200B
Plastic-body (PVDF®), open junction, conic, Viscolene, non-refillable, combination
pH electrode. Use: meat & cheese.
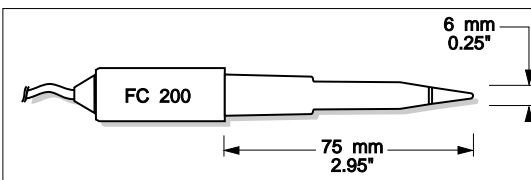
FC 210B
Glass-body, double junction, conic, Viscolene, non-refillable, combination **pH**
electrode.
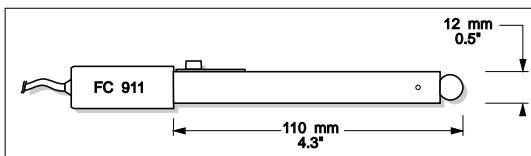Use: milk, yogurt.

FC 220B
Glass-body, triple-ceramic, single junction, refillable, combination **pH** electrode.
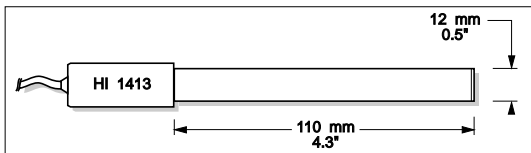Use: food processing.
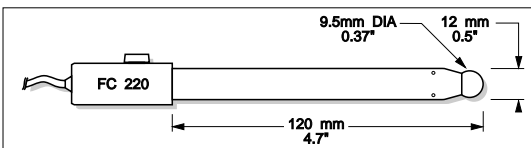
FC 911B

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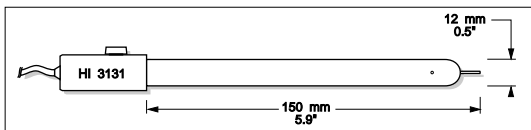

HI 1413B

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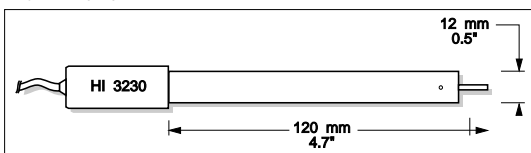

ORP ELECTRODES

HI 3131B

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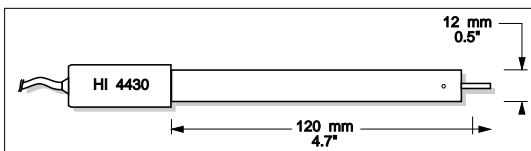Use: titration.

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.

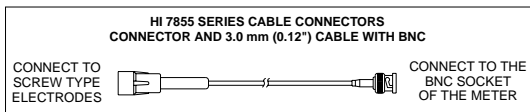Consult the Hanna General Catalog for a complete and wide selection of electrodes.

PEI® is registered Trademark of "General Electric Co."
PVDF® is registered Trademark of "Pennwalt Corp."

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

HI 7855 SERIES CABLE CONNECTORS
CONNECTOR AND 3.0 mm (0.12") CABLE WITH BNC

CONNECT TO
SCREW TYPE
ELECTRODES

CONNECT TO THE
BNC SOCKET
OF THE METER

OTHER ACCESSORIES

HI 710041 Inductive Recharger
HI 721317 Rugged carrying case
HI 740157 Plastic electrode refilling pipet (20 pcs)
HI 76405 Electrode holder
HI 7662 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

RECOMMENDATIONS FOR USERS

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

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

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

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

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

To avoid electrical shock, do not use these instruments when voltages at the measurement surface exceed 24 Vac or 60 Vdc.

To avoid damage or burns, do not perform any measurement in microwave ovens.

SALES AND TECHNICAL SERVICE CONTACTS

Australia:
Tel. (03) 9769.0666 • Fax (03) 9769.0699

China:
Tel. (10) 88570068 • Fax (10) 88570060

Egypt:
Tel. & Fax (02) 2758.683

Germany:
Tel. (07851) 9129-0 • Fax (07851) 9129-99

Greece:
Tel. (210) 823.5192 • Fax (210) 884.0210

Indonesia:
Tel. (210) 4584.2941 • Fax (210) 4584.2942

Japan:
Tel. (03) 3258.9565 • Fax (03) 3258.9567

Korea:
Tel. (02) 2278.5147 • Fax (02) 2264.1729

Malaysia:
Tel. (603) 5638.9940 • Fax (603) 5638.9829

Singapore:
Tel. 6296.7118 • Fax 6291.6906

South Africa:
Tel. (011) 615.6076 • Fax (011) 615.8582

Taiwan:
Tel. 886.2.2739.3014 • Fax 886.2.2739.2983

Thailand:
Tel. 66.2619.0708 • Fax 66.2619.0061

United Kingdom:
Tel. (01525) 850.855 • Fax (01525) 853.668

USA:
Tel. (401) 765.7500 • Fax (401) 765.7575

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