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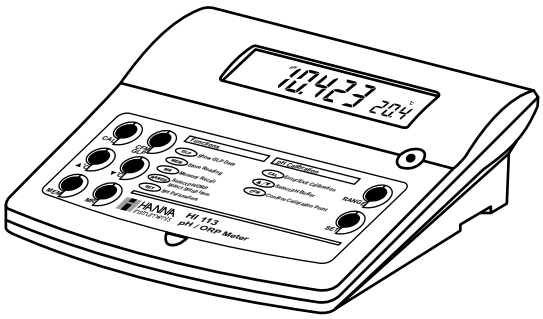
Instruction Manual

HI 110 HI 111
HI 112 HI 113

pH/mV/°C
Bench Meters
with Custom Buffers



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 CE directives.

WARRANTY

HI 110, **HI 111**, **HI 112** and **HI 113** are guaranteed for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. Electrodes and probes are guaranteed for six months. This warranty is limited to repair or replacement free of charge.

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

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

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PRELIMINARY EXAMINATION

Remove the instrument from the packing material and examine it carefully to make sure that no damage has occurred during shipping. If there is any damage, notify your Dealer or the nearest Hanna Customer Service Center.

Each instrument is supplied with:

- **HI 1131B** Glass-body Combination pH Electrode with 1 m (3.3') Cable
- **HI 7669/2W** Temperature Probe
- **HI 76404** Electrode Holder
- **pH 4.01 & 7.01** Buffer Solutions (20 mL each)
- **HI 7071S** Electrolyte Solution
- 12VDC Power Adapter
- Instruction Manual

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

The HANNA **HI 110**, **HI 111**, **HI 112** and **HI 113** are microprocessor-based pH and Temperature bench meters.

HI 111 and **HI 113** can also measure Oxidation Reduction Potential (ORP) in mV range. **Relative mV** feature is also provided.

pH measurements are compensated for temperature effect manually or automatically with the **HI 7669/2W** temperature probe.

Up to three-point (**HI 110**, **HI 111**) or up to five-point (**HI 112**, **HI 113**) calibration is possible. In addition, two custom buffers can be set and used during calibration.

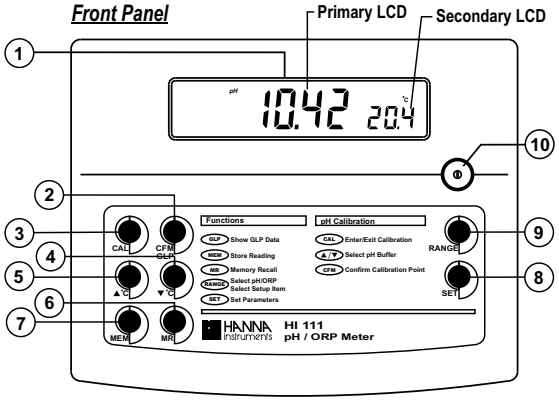
The **GLP** feature provides a guarantee of data consistency.

An alarm time-out is available to alert the user that too much time elapsed since the last pH calibration.

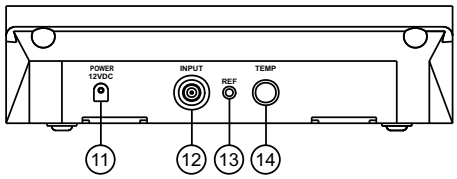
Through the RS232 serial port data can be transferred to a PC (**HI 112**, **HI 113**).

FUNCTIONAL DESCRIPTION
HI 110 AND HI 111

Front Panel



Rear Panel



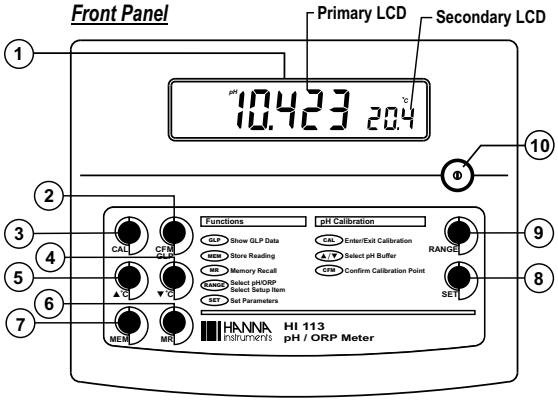
1) Liquid Crystal Display (LCD).
2) **CFM/GLP** key, to confirm different values or to display Good Laboratory Practice information.
3) **CAL** key, to enter and exit/escape calibration mode.
4) ▼/ºC key, to manually decrease temperature value or other parameters.
5) ▲/ºC key, to manually increase temperature value or other parameters.
6) **MR** key, to recall the stored value.
7) **MEM** key, to store a value into memory.
8) **SET** key, to enter/exit SETUP mode.
9) **RANGE** key, to select measurement range or switch to focused data in SETUP (**HI 111** only).
   SEL key, to switch to focused data in SETUP menu (**HI 110** only).
10) **ON/OFF** switch.
11) Power supply socket.
12) BNC electrode connector.
13) Electrode reference socket.
14) Temperature probe socket.

HI 110 AND HI 111 SPECIFICATIONS

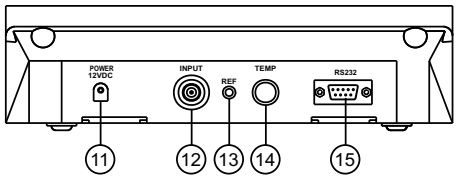
RANGE	–2.00 to 16.00 pH
	±699.9 mV (ISE & ORP, HI 111 only) ±2000 mV (ISE & ORP, HI 111 only)
	–9.9 to 120.0 °C
RESOLUTION	0.01 pH
	0.1 mV (ISE & ORP, HI 111 only) 1 mV (ISE & ORP, HI 111 only)
	0.1 °C
ACCURACY @ 20°C / 68°F	±0.01 pH
	±0.2 mV (±699.9 mV) ±1 mV (±2000 mV)
	±0.4 °C (excluding probe error)
Rel mV offset range	±2000 mV (HI 111 only)
pH Calibration	1, 2 or 3 point calibration, 5 standard buffers available (4.01, 6.86, 7.01, 9.18, 10.01), and 2 custom buffers
Temperature compensation	Manual or Automatic from: –9.9 to 120.0 °C (14.2 to 248.0 °F)
pH Electrode	HI 1131B
Temperature probe	HI 7669/2W
Input impedance	10^{12} ohms
Power supply	12 VDC adapter
Dimensions	240x182x74 mm (9.4x7.1x2.9")
Weight	1.1 Kg (2.5 lb); kit with holder 2.5 Kg (5.5 lb)
Environment	0 – 50 °C (32 – 122 °F) max. 95% RH non-condensing
Warranty	2 years

FUNCTIONAL DESCRIPTION
HI 112 AND HI 113

Front Panel



Rear Panel



1) Liquid Crystal Display (LCD).
2) **CFM/GLP** key, to confirm different values or to display Good Laboratory Practice information.
3) **CAL** key, to enter and exit/escape calibration mode.
4) ▼/ºC key, to manually decrease temperature value or other parameters.
5) ▲/ºC key, to manually increase temperature value or other parameters.
6) **MR** key, to recall the stored value.
7) **MEM** key, to store a value into memory.
8) **SET** key, to enter/exit SETUP mode.
9) **RANGE** key, to select measurement range or switch to focused data in SETUP.
10) **ON/OFF** switch.
11) Power supply socket.
12) BNC electrode connector.
13) Electrode reference socket.
14) Temperature probe socket.
15) RS232 serial communication connector.

HI 112 AND HI 113 SPECIFICATIONS

RANGE	–2.00 to 16.00 pH –2.000 to 16.000 pH
	±999.9 mV (ISE & ORP, HI 113 only) ±2000 mV (ISE & ORP, HI 113 only)
	–9.9 to 120.0 °C
RESOLUTION	0.01 pH 0.001 pH
	0.1 mV (ISE & ORP, HI 113 only) 1 mV (ISE & ORP, HI 113 only)
	0.1 °C
ACCURACY @ 20°C / 68°F	±0.01 pH ±0.002 pH
	±0.5 mV (±999.9 mV) ±1 mV (±2000 mV)
	±0.4 °C (excluding probe error)
Rel mV offset range	±2000 mV (HI 113 only)
Computer interface	opto-isolated RS232
pH Calibration	Up to 5 calibration points, 7 standard buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45), and 2 custom buffers
Temperature compensation	Manual or Automatic from: –9.9 to 120.0 °C (14.2 to 248.0 °F)
pH Electrode	HI 1131B
Temperature probe	HI 7669/2W
Input impedance	10^{12} ohms
Power supply	12 VDC adapter
Dimensions	240x182x74 mm (9.4x7.1x2.9")
Weight	1.1 Kg (2.5 lb); kit with holder 2.5 Kg (5.5 lb)
Environment	0 – 50 °C (32 – 122 °F) max. 95% RH non-condensing
Warranty	2 years

OPERATIONAL GUIDE

POWER CONNECTION

Plug the 12 VDC adapter into the power supply socket.

Note: These instruments use non volatile memory to retain the pH, mV, temperature calibrations and all other settings, even when unplugged.

Note: Make sure a fuse protects the main line.

ELECTRODE AND PROBE CONNECTIONS

For pH or ORP measurements connect an electrode with internal reference to the BNC connector on the back of the instrument.

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

For temperature measurements and automatic temperature compensation connect the temperature probe to the appropriate socket.

INSTRUMENT START-UP

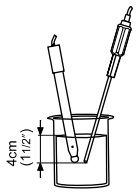
- Turn the instrument on by pressing the **ON/OFF** switch.
- All LCD tags are displayed and a beep is sounded while the instruments perform a self test.

HI 110 and **HI 111**

HI 112 and **HI 113**

pH MEASUREMENTS

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



- Submerge the electrode tip and the temperature probe approximately 4 cm (1½") into the sample to be tested and stir gently. Allow time for the electrode to stabilize.
- The pH is displayed on the primary LCD and the temperature on the secondary LCD.

- If the reading is out of range, the closest full-scale value will be displayed blinking on the primary LCD.

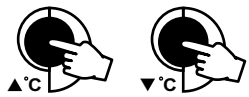
If measurements are taken successively in different samples, it is recommended to rinse the electrode thoroughly with deionized water or tap water and then with some of the next sample to prevent cross-contamination.

The pH reading is affected by temperature. In order to measure the pH accurately, the temperature effect must be compensated for. To use the Automatic Temperature Compensation feature, connect and submerge the **HI 7669/2W** temperature probe into the sample as close as possible to the electrode and wait for a few seconds.

If the temperature of the sample is known, simple manual compensation can be performed by disconnecting the temperature probe.

The display will then show the default temperature of 25 ºC or the last temperature reading with the "ºC" tag blinking.

The temperature can now be adjusted with the **ARROW** keys (from –9.9 ºC to 120.0 ºC).

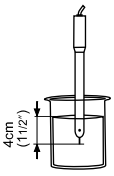


mV/ORP MEASUREMENTS (HI 111 and HI 113)

An optional ORP electrode must be used to perform ORP measurements (see Accessories).

Oxidation-Reduction Potential (REDOX) measurements provide the quantification of the oxidizing or reducing power of the tested sample.

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



- Press **RANGE** to enter mV range.
- Submerge the tip of the ORP electrode 4 cm (1½") into the sample to be tested and allow a few seconds for the reading to stabilize.
- The instrument displays the mV reading on the primary LCD and the temperature on the secondary LCD.

- If the reading is out of range, the closest full-scale value will be displayed blinking on the primary LCD.

RELATIVE mV MEASUREMENTS (HI 111 and HI 113)

- Press **RANGE** until "rEL" message will be displayed on the secondary LCD line for about one second and "mV" tag will blink. After one second the temperature will be displayed on the secondary LCD.

The reading displayed by the instrument is equal to the difference between the current mV input value and relative mV offset established in the relative mV calibration.

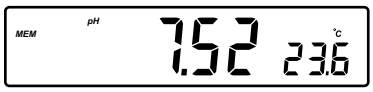
TEMPERATURE MEASUREMENTS

Connect the **HI 7669/2W** temperature probe to the appropriate socket and turn the instrument on.

Immerse the temperature probe into the sample and allow the reading on the secondary LCD to stabilize.

MEMORY FUNCTION

Press and hold down **MEM**. The last reading will appear on the LCD along with "MEM" tag until **MEM** is released.



Press **MR** and the previously memorized reading will be displayed on the LCD with "MEM" tag.

pH CALIBRATION

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

The instrument should be recalibrated:

- Whenever the pH electrode is replaced.
- At least once a week.
- After testing aggressive chemicals.
- If "CAL" "INTV" tags are blinking during measurement.

Every time you calibrate the instrument use fresh buffers and perform an electrode Cleaning Procedure (see page 30).

PREPARATION

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

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

If you are measuring in the acidic range, use pH 7.01 or 6.86 as first buffer and pH 4.01 or 1.68 (**HI 112**, **HI 113**) as second buffer. If you are measuring in the alkaline range, use pH 7.01 or 6.86 as first buffer and pH 10.01, 9.18 or 12.45 (**HI 112**, **HI 113**) as second buffer.

PROCEDURE

Calibration can be performed in three (**HI 110**, **HI 111**) or five (**HI 112**, **HI 113**) calibration points.

For accurate measurements, it is recommended to perform a three (**HI 110**, **HI 111**) or five-point calibration (**HI 112**, **HI 113**). However, at least a two-point calibration is suggested.

The calibration buffer can be selected from the calibration buffer list that includes the defined custom buffers in SETUP menu and the memorized standard buffers:

- pH 4.01, 6.86, 7.01, 9.18, 10.01 (**HI 110**, **HI 111**)
- pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45 (**HI 112**, **HI 113**)

The custom buffers are a special option that allows the user to calibrate in a buffer solution different from a standard one. Up to two custom buffers can be set in SETUP menu (see page 17). Each custom buffer value can be changed in a $\pm$1.0 pH window around the set value, during calibration, when it is selected; the "BUFFER pH" tag will blink.

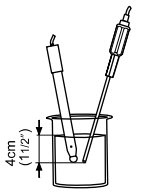
The instruments will automatically skip the buffer used during calibration and the buffers which are in a $\pm$0.2 pH window, around one of the calibrated buffers.

All new calibrations will override existing stored calibration data in a $\pm$0.2 pH window. The slopes adjacent to the new points will be reevaluated.

If the new calibration point has no correspondence in the existing stored calibration data, it is added to it if this is not full (3 or 5 points), or the instrument will ask which buffer will be replaced by the current buffer.

If at least a two-point calibration has been performed and an offset correction of the electrode is wanted, keeping unchanged the existing slopes, perform a one-point calibration with "OFFS" option selected in SETUP menu. If "Pnt" option is selected, the slopes adjacent to the calibration points will be reevaluated.

THREE- (HI 110, HI 111) / FIVE-POINT (HI 112, HI 113) CALIBRATION



- Immerse the pH electrode and the temperature probe approximately 4 cm (1½") into a buffer solution and stir gently. The temperature probe should be close to the pH electrode.
- Press **CAL**. The "CAL" and "BUF" tags will appear and the "7.01" buffer will be displayed on the secondary LCD.

- 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, the "READY" tag will be displayed and the "CFM" tag will blink.
- Press **CFM** to confirm calibration.
- The calibrated value will be displayed on the primary LCD and the second expected buffer value on the secondary LCD.

- 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, the "READY" tag will be displayed and the "CFM" tag will blink.
- Press **CFM** to confirm calibration.
- The calibrated value is then displayed on the primary LCD and and the third expected buffer value on the secondary LCD.

- After the second calibration point is confirmed, immerse the pH electrode and the temperature probe approximately 4 cm (1½") into the next 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, the "READY" tag will be displayed and the "CFM" tag will blink.
- Press **CFM** to confirm calibration.
- If the fifth calibration point is reached, the instrument stores the calibration value and returns to normal measurement mode, or else it goes to the next calibration point.

TWO-POINT CALIBRATION

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

ONE-POINT CALIBRATION

Two SETUP selectable options are available: "Pnt" and "OFFS".

If the "Pnt" option is selected, the new calibration point overrides an existing one. 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 "THREE-/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.

Note:
- If the value measured by the instrument is not close to the selected buffer, "WRONG" "BUF" 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 30). If necessary, change the buffer or the electrode.
- When a custom buffer is displayed, the "BUFFER pH" tag blinks. To change the custom buffer value in according with the buffer temperature proceed as described in "WORKING WITH CUSTOM BUFFERS" paragraph (see page 14).
- If the buffer temperature or the manual temperature exceeds the temperature limits of the buffer, "WRONG" tag and temperature reading will blink.
- If "WRONG", "BUFFER pH" tags and "OLD" message are displayed blinking on the secondary LCD line, an inconsistency between new and previous (old) calibration is detected. Clear calibration parameters and proceed with calibration from the current calibration point. The instrument will keep all confirmed values during current calibration.

- To clear calibration parameters for all uncalibrated buffers starting with current buffer, press and hold down **CFM**, then press **CAL**. If this procedure is performed while calibrating in the first calibration point, the instrument returns to measurement mode, else calibration can be continued from the current point.
- Press **RANGE** (**SEL** for **HI 110**) to toggle between pH buffer and temperature reading (**HI 110**, **HI 111**).

  Press **RANGE** to toggle between pH buffer, buffer number and temperature reading during calibration (**HI 112**, **HI 113** only).
- Each time a buffer is confirmed, the new calibration parameters replace the old calibration parameters of the coresponding buffer. If current confirmed buffer has no correspondence in the existing stored calibration and this is not full, (three buffers for **HI 110**, **HI 111**; five buffers for **HI 112**, **HI 113**), the current buffer is added to the existing stored calibration. If the existing stored calibration is full, the instrument asks 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 calibration without replacing.

Note: If the replaced buffer is outside the ±0.2 pH window, around each of the calibrated buffers, it is possible to select this buffer for next calibration during current calibration.

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 "BUFFER pH" tag will blink.

Press **SET** if you want to adjust the buffer value. The buffer value will start blinking.

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

After about 5 seconds since you performed the last change, the buffer value is updated. Press **SET** if you want to change it again.

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

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 the last calibration (one, two, three, four or five-point) is stored for the user to review when necessary. This data includes the following: calibration time stamp, offset (mV), average of slope (%), calibration buffers and the time until a new calibration is required.

CALIBRATION ALARM TIME-OUT

These instruments allow the user to set the number of days before the next required calibration. This value can be set from 1 to 7 days. The default setting is OFF (disabled).

The instruments check if the time-out time has expired. If the time elapsed, the "CAL" "INTV" tags will blink as a reminder.

Note: If the instruments were not calibrated, the "CAL" "INTV" tags will be displayed even if the feature is disabled in SETUP menu.

LAST CALIBRATION DATA

Last calibration data are stored automatically after a successful calibration.

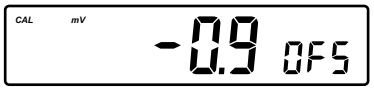
To view the pH calibration data, press **GLP** while in measurement mode.

The instruments will display the time (hh:mm) of the last calibration.

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

- The date (yyyy.mm.dd).

- The pH calibration offset.



- 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).

- The pH calibration buffers in calibrating order.
  The first pH calibration buffer:

  The second pH calibration buffer:

  The third pH calibration buffer:

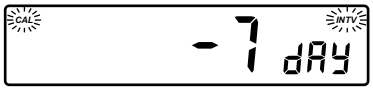
Note:
- For **HI 112** and **HI 113**, the fourth and the fifth calibration buffers are also displayed in GLP.
- The "OLd" message displayed beside the pH value means that this buffer was not used during last calibration. Press and hold down **SET** if you want to see calibration date (or time, if old calibration was made in the same day with current calibration).
- For each custom buffer used in calibration, the "BUFFER pH" tag will blink.
- If "no bUF" message appears on the LCD, the instrument informs you that calibration was performed in less than three (**HI 110**, **HI 111**) or five points (**HI 112**, **HI 113**).

- pH resolution during calibration.

- Calibration Alarm Time-Out status:
  if disabled.

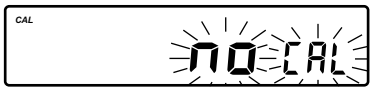
or the number of days until the calibration alarm will be displayed.

or if expired (7 days ago).



- The instrument ID.

Note:
- Press **GLP** at any moment and the instruments will return to measurement mode.
- If calibration has not been performed, the instruments display "no CAL" message blinking.



SETUP

Setup mode allows viewing and modifying the following parameters:

- Calibration Alarm Time-Out
- Custom buffer 1
- Custom buffer 2
- One-point calibration behaviour
- Instrument ID (**HI 112** & **HI 113**)
- Current Time
- Current Date
- Beep Status
- Baud Rate (serial communication, **HI 112** & **HI 113**)
- Command prefix (serial communication, **HI 112** & **HI 113**)

To enter SETUP mode press **SET** while the instrument is in measurement mode.
Select a parameter with the **ARROW** keys.
Press **CAL** if you want to change a parameter value. The selected parameter will start blinking.
Press **RANGE** (**SEL** for **HI 110**) to toggle between displayed parameters.
Press the **ARROW** keys to increase or decrease the displayed value.
Press **CFM** to save the modified value or **CAL** to escape.
Press the **ARROW** keys to select the next/previous parameter.

CALIBRATION ALARM TIME-OUT SET

Press **CAL** when the calibration time-out is displayed. Calibration time-out (OFF or 1 to 7 days) will start blinking.

Press the **ARROW** keys to change the calibration time-out value.

Press **CFM** to save the modified calibration time-out value.

Press **CAL** to escape without saving.

FIRST CUSTOM BUFFER SET

Press **CAL** when custom buffer 1 is displayed. The custom buffer (disabled – "no cb1" or 0 to 16 pH) will start blinking.

Press the **ARROW** keys to change the custom buffer value.

Press **CFM** to save the modified custom buffer value.

Press **CAL** to escape without saving.

SECOND CUSTOM BUFFER SET

Press **CAL** when custom buffer 2 is displayed. The custom buffer (disabled – "no cb2" or 0 to 16 pH) will start blinking.

Press the **ARROW** keys to change the custom buffer value.

Press **CFM** to save the modified custom buffer value.

Press **CAL** to escape without saving.

ONE-POINT CALIBRATION BEHAVIOUR

Press **CAL** when "1 Pnt" message is displayed on the secondary LCD. One of the two options ("Pnt" or "OFFS") will start blinking (see pH CALIBRATION PROCEDURE for details, page 11).

Press the **ARROW** keys to toggle between "Pnt" and "OFFS" options.

Press **CFM** to save the behaviour for one-point calibration.

Press **CAL** to escape without saving.

INSTRUMENT ID PARAMETER SET (HI 112, HI 113 only)

Press **CAL** when the instrument ID is displayed. The instrument ID (0000 to 9999) will start blinking.

Press the **ARROW** keys to change the instrument ID value.

Press **CFM** to save the modified instrument ID value.

Press **CAL** to escape without saving.

CURRENT TIME SET

Press **CAL** when the current time is displayed. The hour will start blinking.

Press the **ARROW** keys to change the hour.

Press **RANGE (SEL** for **HI 110)**. The minutes will start blinking.

Press the **ARROW** keys to change the minutes.

Press **CFM** to save the modified value.

Press **CAL** to escape without saving.

CURRENT DATE SET

Press **CAL** when the current date is displayed. The year will start blinking.

Press the **ARROW** keys to change the year.

Press **RANGE**. The month will start blinking.

Press the **ARROW** keys to change the month.

Press **RANGE**. The day will start blinking.

Press the **ARROW** keys to change the day.
Press **CFM** to save the modified value.
Press **CAL** to escape without saving.

BEEP STATUS SET

Press **CAL** when the beep status is displayed. Beep status (On or OFF) will start blinking.

Press the **ARROW** keys to change the beep status (On or OFF).
Press **CFM** to save the modified beep status.
Press **CAL** to escape without saving.

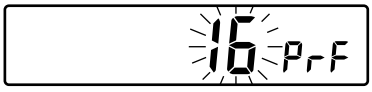
BAUD RATE SET (HI 112, HI 113 only)

Press **CAL** when the baud rate is displayed. The baud rate (600, 1200, 2400, 4800 or 9600) will start blinking.

Press the **ARROW** keys to change the baud rate value.
Press **CFM** to save the modified baud rate value.
Press **CAL** to escape without saving.

SERIAL COMMUNICATION COMMAND PREFIX SET (HI 112, HI 113 only)

Press **CAL** when the command prefix is displayed. The command prefix (0 to 47) will start blinking.



Press the **ARROW** keys to change the command prefix.
Press **CFM** to save the modified command prefix value.
Press **CAL** to escape without saving.

Note:
- See the PC interface section on page 25 for a complete explanation.
- The command prefix must be 16 if **HI 92000** PC software is used.

TEMPERATURE CALIBRATION (for technical personnel only)

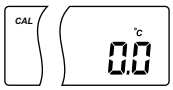
All the instruments are factory calibrated for temperature.

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

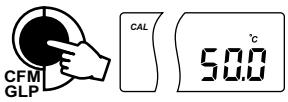
If the temperature measurements are inaccurate, temperature recalibration should be performed.

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

- Prepare a vessel containing ice and water and another one containing hot water (at a temperature of around 50 °C). 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.
- With the instrument off, press and hold down the **CAL**&**MEM** keys, then power on the instrument. The "CAL" tag will appear and the secondary LCD will show 0.0 °C.



- Immerse the temperature probe in the vessel with ice and water as near 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, "READY" tag will appear and "CFM" tag will blink.
- Press **CFM** to confirm. The secondary LCD will show 50.0 °C.



- Immerse the temperature probe in the second vessel as near 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, "READY" tag will appear and "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 (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 or three-point calibration can be performed at 0.0 mV, 600.0 mV and 1800.0 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 **MR&CFM** 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, "READY" tag will appear and "CFM" tag will blink.
- Press **CFM** to confirm. The secondary LCD will display 600 mV.
- Set 600.0 mV on the simulator.
  When the reading is stable and close to the selected calibration point, "READY" tag will appear and "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, "READY" tag will appear and "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. 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. If calibration process is stopped after 600 mV is confirmed, the 600 mV range is calibrated and calibration parameters are memorized.

RELATIVE mV CALIBRATION (HI 111 AND HI 113)

- Press **CAL** when the instrument is in RELATIVE mV measurement mode. The "mV" and "⧖" tags will blink. Absolute mV is displayed on the primary LCD and "AbS" message is displayed on the secondary LCD.
- When the absolute reading is stable and in measurement range, the instrument asks for confirmation.
- If the reading is out of range, "WRONG" tag will be displayed.
- Press **CFM** to confirm the absolute value. The instrument will display 0.0 mV on the primary LCD and "rEL" message on the secondary LCD. In this moment the relative mV offset is equal to absolute mV reading.
- Use the **ARROW** keys if you want to change the displayed relative mV value.
- Press **CFM** to confirm the relative mV value. The relative mV offset is displayed on the primary LCD and "OFF" message on the secondary LCD for a few seconds. The instrument returns to measurement mode.

Note: The relative mV value can be changed only inside the relative mV offset window (± 2000 mV).

PC INTERFACE (HI 112 AND HI 113)

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 920010** cable connector. Make sure that your instrument is switched off and plug one connector to the instrument RS232C socket and the other into the serial port of your PC.

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

<command prefix> <command > <CR>

where: <command prefix> is a selectable ASCII character between 0 and 47.

<command> is the command code (3 characters).

Note: Either small or capital letters can be used.

SIMPLE COMMANDS

PHR	Sets the range to pH 0.001 resolution
MVR	Sets the range to mV (**HI 113** only)
MRS	Sets the range to relative mV (**HI 113** only)
RNG	Is equivalent to pressing **RANGE**
CAL	Is equivalent to pressing **CAL**
CFM	Is equivalent to pressing **CFM/GLP**
UPC	Is equivalent to pressing the **UP** arrow key
DWC	Is equivalent to pressing the **DOWN** arrow key
MEM	Is equivalent to pressing **MEM**
MRR	Is equivalent to pressing **MR**
SET	Is equivalent to pressing **SET**

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

- n=0 pH range/0.001 resolution
- n=1 pH range/0.01 resolution
- n=3 mV range
- n=4 Relative mV range

COMMANDS REQUIRING AN ANSWER

pH? Causes the instrument to send the pH reading. If the range is set to mV, "Err6" is received.

MV? Causes the instrument to send the mV reading. If the range is set to pH, "Err6" is received.

MR? Causes the instrument to send the relative mV reading. If the range is set to pH or mV, "Err6" is received.

TM? Causes the instrument to send the temperature reading.

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

- pH, mV and temperature reading on pH range.
- mV and temperature reading on mV range.
- Rel mV, absolute mV and temperature reading on Rel mV range.

MDR Requests the instrument model name and firmware code.

PAR Requests the setup parameters setting (instrument ID, calibration alarm time-out, pH range, beep status).

GLP Requests the calibration data record.

Note:

- "Err8" is sent if instrument is not in measurement mode.
- "Err7" is sent if mV are asked during pH calibration mode.
- "NAK" (21) character is sent when the instrument receives an unknown or a corrupted command.

Note: Invalid commands will be ignored.

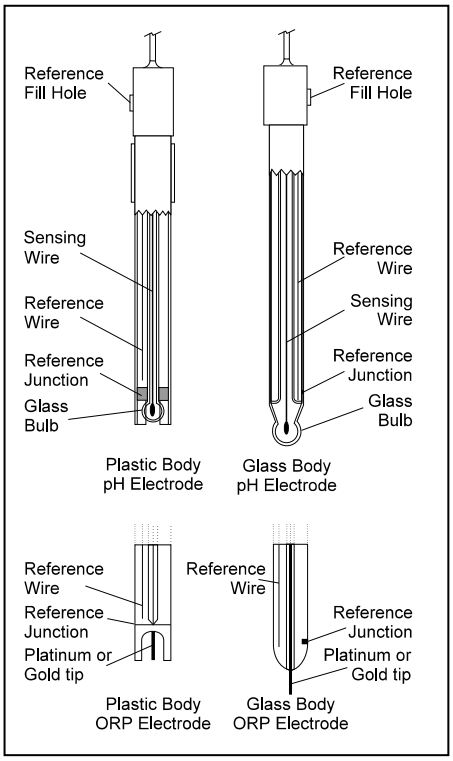
pH BUFFER TEMPERATURE DEPENDENCE

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	13.42
5	41	1.67	4.00	6.95	7.10	9.39	10.24	13.20
10	50	1.67	4.00	6.92	7.07	9.33	10.18	13.00
15	59	1.67	4.00	6.90	7.04	9.27	10.12	12.81
20	68	1.68	4.00	6.88	7.03	9.22	10.06	12.63
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	9.10	9.92	12.13
40	104	1.69	4.04	6.84	6.98	9.07	9.88	12.04
45	113	1.70	4.05	6.83	6.98	9.04	9.85	11.84
50	122	1.71	4.06	6.83	6.98	9.01	9.82	11.70
55	131	1.72	4.07	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	6.85	6.99	8.95	9.76	-
70	158	1.74	4.12	6.85	6.99	8.93	9.75	-
75	167	1.76	4.14	6.86	7.00	8.91	9.74	-
80	176	1.77	4.16	6.86	7.01	8.89	9.73	-
85	185	1.78	4.17	6.87	7.02	8.87	9.74	-
90	194	1.79	4.19	6.88	7.03	8.85	9.75	-
95	203	1.81	4.20	6.89	7.04	8.83	9.76	-

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

ELECTRODE CONDITIONING & MAINTENANCE



PREPARATION PROCEDURE

Remove the protective cap of the pH electrode.

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

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

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

For refillable electrodes:

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

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

For AMPHEL® electrodes:

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

MEASUREMENT

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

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

STORAGE PROCEDURE

To minimize clogging and assure a quick response time, the glass bulb and the junction 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 28 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.

For refillable electrodes:

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

Follow the Storage Procedure above.

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.

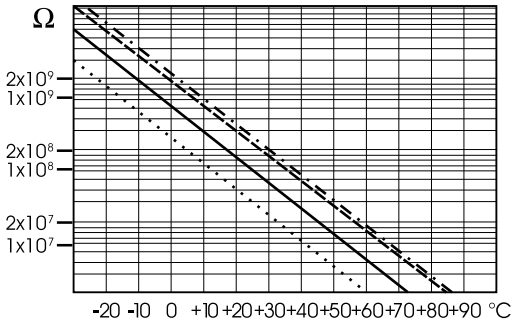
IMPORTANT: After performing any of the cleaning procedures, rinse the electrode thoroughly with distilled water, refill the reference chamber with fresh electrolyte (not necessary for gel-filled electrodes) and soak the electrode in **HI 70300** or **HI 80300** Storage Solution for at least 1 hour before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

TROUBLESHOOTING GUIDE

SYMPTOMS	PROBLEM	SOLUTION
Slow reponse/excessive drift.	Dirty pH electrode.	Soak the electrode tip in HI 7061 or HI 8061 solution for 30 minutes and then clean the electrode.
Readings fluctuate up and down (noise).	Clogged/dirty junction. Low electrolyte level (refillable electrodes only).	Clean the electrode. Refill with fresh solution (for refillable electrodes only).
Out of range in the mV scale.	Dry membrane/junction.	Soak in HI 70300 or HI 80300 storage solution.
The meter does not accept the buffer solution for calibration.	Out of order pH electrode.	Follow the cleaning procedure. If still no results, replace the electrode.
If the display shows: "pH" and " -2.00" or "16.00" blinking.	Out of range in the pH scale.	a) Recalibrate the meter. b) Make sure the pH sample is in the specified range. c) Check the electrolyte level and the general state of the electrode.
If the display shows: "mV" and "-2000" or "+2000" blinking	Out of range in the mV scale.	Electrode not connected.
The meter does not work with the temperature probe.	Broken temperature probe.	Replace the temperature probe.
The meter fails to calibrate or gives faulty readings.	Broken pH electrode.	Replace the electrode.
At startup the meter displays all LCD tags permanently.	One of the keys is blocked.	Check the keyboard or contact the vendor.
"Err xx" error message displayed.	Internal error.	Power off the meter and then power it on. If the error persists, contact the vendor.

TEMPERATURE CORRELATION FOR pH SENSITIVE GLASS

The resistance of glass electrodes partially depends on the temperature. The lower the temperature, the higher the resistance. It takes more time for the reading to stabilize if the resistance is higher. In addition, the response time will suffer to a greater degree at temperatures below 25 °C.



Since the resistance of the pH electrode is in the range of 50 – 200 Mohm, the current across the membrane is in the pico Ampere range. Large currents can disturb the calibration of the electrode for many hours.

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

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

Typical Electrode Life

Ambient Temperature	1 – 3 years
90 °C	Less than 4 months
120 °C	Less than 1 month

Alkaline Error

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

Sodium Ion Correction for the Glass at 20-25 °C		
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

ACCESSORIES

pH BUFFER SOLUTIONS

HI 70004P pH 4.01 Buffer Sachets, 20 mL, 25 pcs
HI 70007P pH 7.01 Buffer Sachets, 20 mL, 25 pcs
HI 70010P pH 10.01 Buffer Sachets, 20 mL, 25 pcs
HI 7001L pH 1.68 Buffer Solution, 500 mL
HI 7004L pH 4.01 Buffer Solution, 500 mL
HI 7006L pH 6.86 Buffer Solution, 500 mL
HI 7007L pH 7.01 Buffer Solution, 500 mL
HI 7009L pH 9.18 Buffer Solution, 500 mL
HI 7010L pH 10.01 Buffer Solution, 500 mL
HI 7001L pH 1.68 Buffer Solution in FDA approved bottle, 500 mL
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 SOLUTIONS

HI 70300L Storage Solution, 460 mL
HI 80300L Storage Solution in FDA approved bottle, 460 mL

ELECTRODE CLEANING SOLUTIONS

HI 70000P Electrode Rinse Sachets, 20 mL, 25 pcs
HI 7061L General Cleaning Solution, 460 mL
HI 7073L Protein Cleaning Solution, 460 mL
HI 7074L Inorganic Cleaning Solution, 460 mL
HI 7077L Oil & Fat Cleaning Solution, 460 mL
HI 8061L General Cleaning Solution in FDA approved bottle, 460 mL
HI 8073L Protein Cleaning Solution in FDA approved bottle, 460 mL
HI 8077L Oil & Fat Cleaning Solution in FDA approved bottle, 460 mL

ELECTRODE REFILL ELECTROLYTE SOLUTIONS

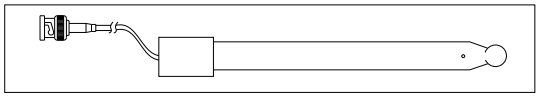
HI 7071 3.5M KCl + AgCl Electrolyte, 4x30 mL, for single junction electrodes
HI 7072 1M KNO_3 Electrolyte, 4x30 mL
HI 7082 3.5M KCl Electrolyte, 4x30 mL, for double junction electrodes
HI 8071 3.5M KCl + AgCl Electrolyte in FDA approved bottle, 4x30 mL, for single junction electrodes
HI 8072 1M KNO_3 Electrolyte in FDA approved bottle, 4x30 mL
HI 8082 3.5M KCl Electrolyte in FDA approved bottle, 4x30 mL, for double junction electrodes.

ORP PRETREATMENT SOLUTIONS

HI 7091L Reducing Pretreatment Solution, 460 mL
HI 7092L Oxidizing Pretreatment Solution, 460 mL

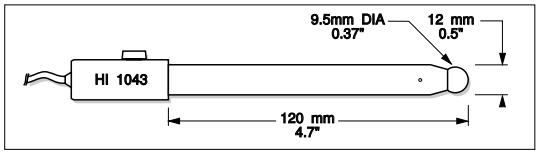
pH ELECTRODES

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



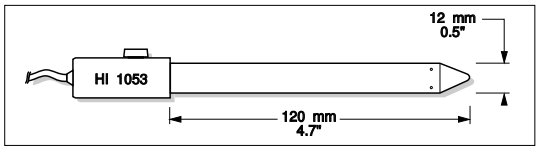
HI 1043B

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



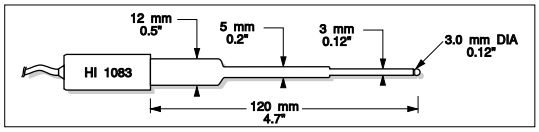
HI 1053B

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



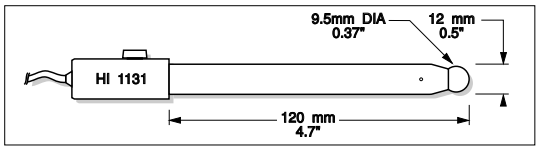
HI 1083B

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



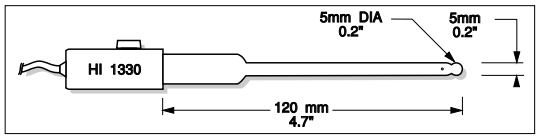
HI 1131B

Glass-body, single junction, refillable, combination **pH** electrode.
Use: general purpose.



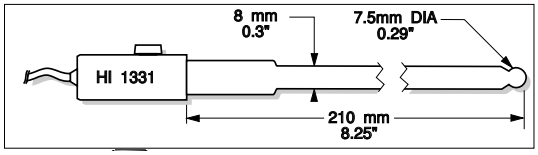
HI 1330B

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



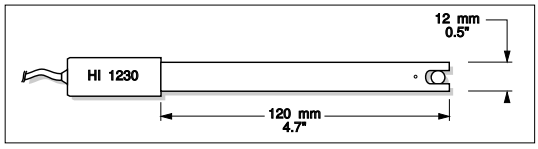
HI 1331B

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



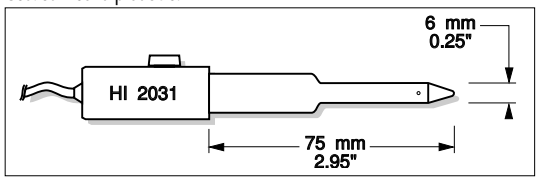
HI 1230B

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



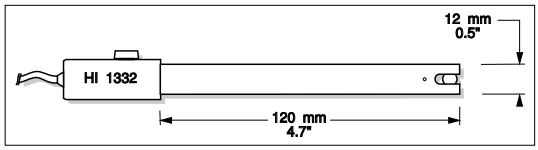
HI 2031B

Glass-body, semimicro, conic, refillable, combination **pH** electrode.
Use: semisolid products.



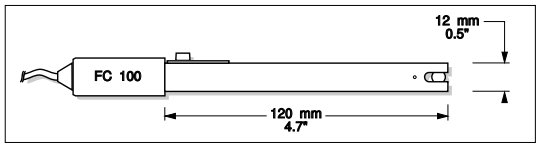
HI 1332B

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



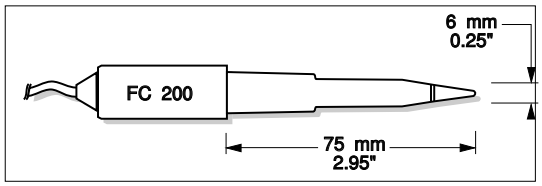
FC 100B

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



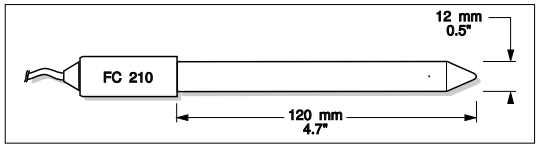
FC 200B

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



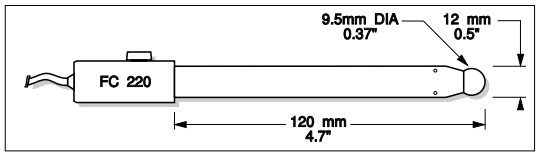
FC 210B

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



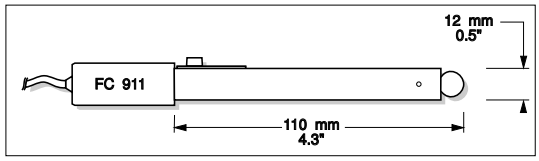
FC 220B

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



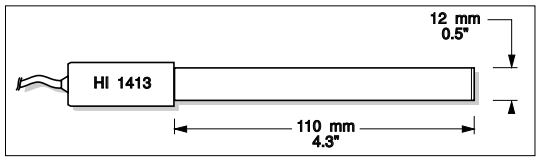
FC 911B

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



HI 1413B

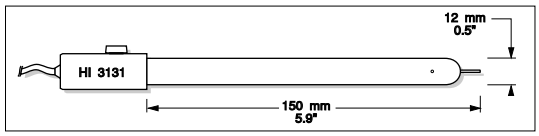
Glass-body, single junction, flat tip, Viscolene, non-refillable, combination **pH** electrode. Use: surface measurement.



ORP ELECTRODES

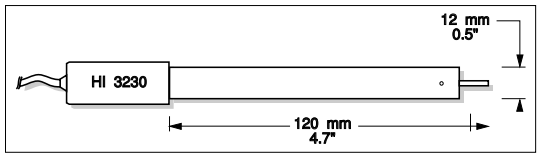
HI 3131B

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



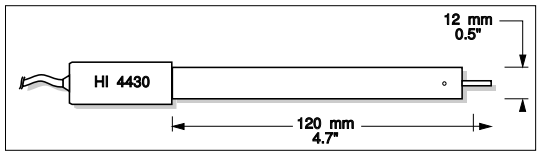
HI 3230B

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



HI 4430B

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

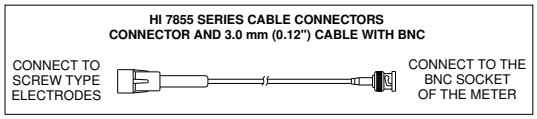


Consult the Hanna General Catalog for more electrodes with screw-type or BNC connectors.

Ultem® is registered Trademark of "General Electric Co."
Kynar® is registered Trademark of "Pennwalt Corp."

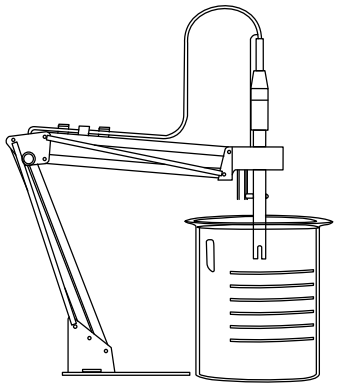
EXTENSION CABLE FOR SCREW-TYPE ELECTRODES (SCREW TO BNC ADAPTER)

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



OTHER ACCESSORIES

HI 710005 Voltage adapter from 115 VAC to 12 VDC (USA plug)
HI 710006 Voltage adapter from 230 VAC to 12 VDC (European plug)
HI 710012 Voltage adapter from 240 VAC to 12 VDC (UK plug)
HI 710013 Voltage adapter from 230 VAC to 12 VDC (South Africa plug)
HI 710014 Voltage adapter from 230 VAC to 12 VDC (Australia plug)
HI 76405 Electrode holder



HI 8427 pH and ORP electrode simulator with 1 m (3.3') coaxial cable ending in female BNC connectors
HI 931001 pH and ORP electrode simulator with LCD and 1 m (3.3') coaxial cable ending in female BNC connectors
HI 7669/2W Temperature probe with 1 m (3.3') cable
HI 92000 Windows® compatible software
HI 920010 9 to 9-pin RS232 cable

RECOMMENDATIONS FOR USERS

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

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

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

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

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

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

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