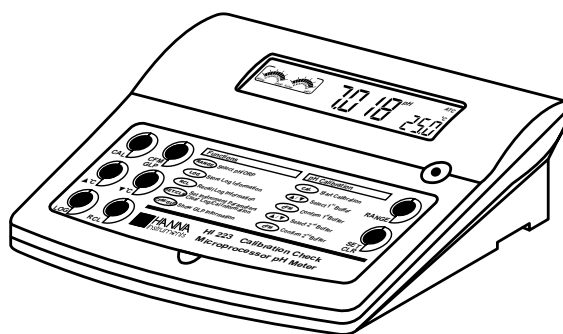


## Instruction Manual

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# HI 221 HI 223

### pH/mV/°C Bench Meters with Calibration Check



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**HANNA**  
instruments  
Manufacturer since 1978

**CE**  
[www.hannainst.com](http://www.hannainst.com)

Dear Customer,  
 Thank you for choosing a Hanna Instruments product.  
 Please read this instruction manual carefully before using the instrument.  
 This manual will provide you with the necessary information for correct use of the instrument, as well as a precise idea of its versatility.  
 If you need additional technical information, do not hesitate to e-mail us at [tech@hannainst.com](mailto:tech@hannainst.com) or turn to the back cover for our worldwide contact list.  
 These instruments are in compliance with CE directives.

## WARRANTY

HI 221 and HI 223 are guaranteed for two years against defects in workmanship and materials when used for their intended purpose and maintained according to instructions. The electrodes and the probes are guaranteed for a period of six months. This warranty is limited to repair or replacement free of charge.

Damage due to accidents, misuse, tampering or lack of prescribed maintenance are 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 packaged 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 complete with:

- **HI 1131P** 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
- 12 VDC 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

**HI 221** and **HI 223** are logging microprocessor-based pH/ORP/temperature bench meters with Calibration Check.

Calibration Check performs a set of diagnostic tests during calibration using the history of electrode slope and offset to detect problems that can cause loss of accuracy.

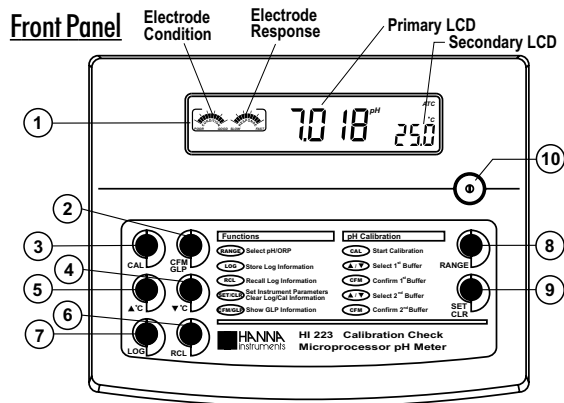
Calibration Check Features are:

- **Enhanced Calibration Messages**  
During calibration the user is warned if one or more parameters are not suitable to perform an accurate calibration.
- **Electrode Condition on LCD Display**  
Determined from the electrode offset and slope.
- **Electrode response time on LCD Display**  
Determined from electrode performance during calibration.
- **Calibration Alarm Time Out**  
Can be programmed from 1 to 7 days or can be disabled.

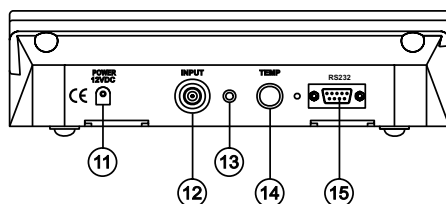
Other features include:

One or two point calibration with seven memorized buffers (1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45 pH), logging up to 100 samples (for **HI 221**) and 500 samples (for **HI 223**), last calibration date and data (GLP), pH reading with manual or automatic temperature compensation and PC software interface.

## FUNCTIONAL DESCRIPTION



### 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 the calibration mode.
- 4) **▼ / °C** key, to manually decrease temperature, or other parameters.
- 5) **▲ / °C** key, to manually increase temperature, or other parameters.
- 6) **RCL** key, to enter or exit the recall mode.
- 7) **LOG** key, to store measured data.
- 8) **RANGE** key, to select the measurement range or to switch the focused data.
- 9) **SET / CLR** key, to enter the Setup mode or clear calibration history.
- 10) **ON / OFF** switch.
- 11) Power supply socket.
- 12) BNC electrode connector.
- 13) Pin input socket.
- 14) Temperature probe socket.
- 15) RS232 serial communication connector.

**Note:** Pin input socket cannot be used as a reference input for electrodes with separate reference.

## HI 221 SPECIFICATIONS

Range	- 2.00 to 16.00 pH
	± 699.9 mV ± 2000 mV
	- 20.0 to 120.0 °C
Resolution	0.01 pH
	0.1 mV (± 699.9 mV) 1 mV (± 2000 mV)
	0.1 °C
Accuracy @ 20 °C/68 °F	± 0.01 pH
	± 0.2 mV (± 699.9 mV) ± 1 mV (± 2000 mV)
	± 0.4 °C
Calibration Check	Yes
Computer Interface	Opto-isolated RS232
pH Calibration	1 or 2 point, 7 buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45)
Logging	100 points
Temperature Compensation	Manual or Automatic from: - 20 to 120 °C
pH Electrode	HI 1131P glass body, single junction refillable cell, BNC + pin (included)
Temperature Probe	HI 7669/2W stainless steel probe (included)
Input Impedance	10 <sup>12</sup> Ω
Power Supply	12 VDC adapter (included)
Dimensions	240 x 182 x 74 mm (9.4 x 7.1 x 2.9")
Weight	1.1 kg (2.5 lb) kit with holder 2.5 kg (5.5 lb)
Environment	0 - 50 °C (32 - 122 °F) max RH 95 % non condensing
Warranty	2 years

## HI 223 SPECIFICATIONS

Range	- 2.00 to 16.00 pH - 2.000 to 16.000 pH
	± 999.9 mV ± 2000 mV
	- 20.0 to 120.0 °C
Resolution	0.01 pH 0.001 pH
	0.1 mV (± 999.9 mV) 1 mV (± 2000 mV)
	0.1 °C
Accuracy @ 20 °C/68 °F	± 0.01 pH ± 0.002 pH
	± 0.2 mV (± 699.9 mV) ± 0.5 mV (± 999.9 mV) ± 1 mV (± 2000 mV)
	± 0.4 °C
Calibration Check	Yes
Computer Interface	Opto-Isolated RS232
pH Calibration	1 or 2 point, 7 buffers available (1.68, 4.01, 6.86, 7.01, 9.18, 10.01, 12.45)
Logging	500 points
Temperature Compensation	Manual or Automatic from: - 20 to 120 °C
pH Electrode	HI 1131P glass body, single junction refillable cell, BNC + pin (included)
Temperature Probe	HI 7669/2W stainless steel probe (included)
Input Impedance	10 <sup>12</sup> Ω
Power Supply	12 VDC adapter
Dimensions	240 x 182 x 74 mm (9.4 x 7.1 x 2.9")
Weight	1.1 kg (2.5 lb) kit with holder 2.5 kg (5.5 lb)
Environment	0 - 50 °C (32 - 122 °F) max RH 95 % 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 mains line.

## ELECTRODE AND PROBE CONNECTIONS

For HANNA P Type pH or ORP electrodes (with internal reference) connect the electrode's BNC to the socket on the back of the instrument and the pin to the appropriate socket.

**Note:** Electrode condition and response information is displayed on the bar graph gauges during the day the calibration is performed, only if HANNA P type (PIN) electrodes are used.

If the electrode is not recognized as a HANNA P type electrode, the bar graph gauges will blink (25 seconds OFF, 4 seconds ON, full bar graph).

For temperature measurement 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 instrument performs a self test.

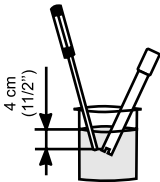


- The "Unscrew electrode refilling cap" message reminds the user to loosen or remove the electrode refilling cap to improve the electrode's response time.
- The instrument automatically defaults to pH measurement mode unless a HANNA P type ORP electrode is detected.

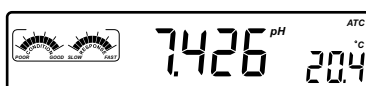
## pH MEASUREMENT

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

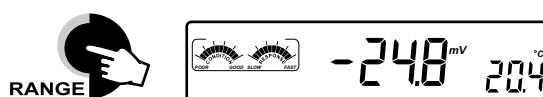
- Submerge the tip (4 cm/1½") of a properly conditioned electrode (see page 31) and the temperature probe into the sample to be tested. Allow time for the electrode to stabilize.



- The pH is displayed on the primary LCD and the temperature on the secondary LCD.



- The pH reading is out of range, the closest full-scale value will be displayed blinking on the primary LCD.
- It is also possible to view the mV reading by pressing the **RANGE** key.



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, this 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 to the electrode as possible and wait for a few minutes.



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

The display will then show the default temperature of 25 °C or the last recorded temperature reading with the "°C" symbol blinking.



The temperature can now be adjusted with the **ARROW** keys (from -20.0 °C to 120.0 °C).



### ORP MEASUREMENTS

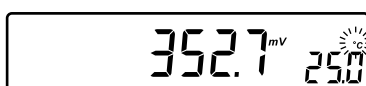
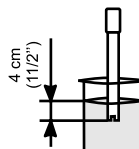
An optional ORP electrode must be used to perform ORP measurements (see Accessories).

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.

Pretreatment solutions are available to condition the electrode and speed up the response time.

- The instrument automatically defaults to the ORP measurement mode if HANNA P type ORP electrode is detected.
- Submerge the ORP electrode tip (4 cm/1½") into the sample. Allow a few minutes for the reading to stabilize.



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

### TAKING TEMPERATURE MEASUREMENTS

Connect the HI 7669/2W temperature probe and turn the instrument on. Dip the temperature probe into the sample and allow the reading on the secondary LCD to stabilize.



## pH CALIBRATION

Calibrate the instrument frequently, especially if high accuracy is required. For best results and constant display of electrode condition and electrode response on the bar graph gauges we suggest at least a daily calibration.

The instrument should be re-calibrated:

- Whenever the pH electrode is replaced.
- At least once a day.
- After testing aggressive chemicals.
- If high accuracy is required.
- If CAL DUE message is displayed during measurement.

Every time you calibrate the instrument use fresh buffers and perform an electrode cleaning procedure (see page 32).

### 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.

## PROCEDURE

The user has a choice of 7 memorized buffers: pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 and 12.45.

It is always recommended to perform a two-point calibration, however the instrument also allows a one-point calibration, as described on page 11.

## TWO-POINT CALIBRATION

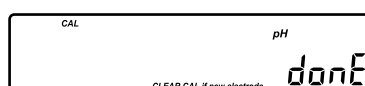
For most applications it is recommended that pH 7.01 or 6.86 buffers be used as the first calibration point and pH 4.01 (for acidic samples) or pH 9.18/10.01 (for alkaline samples) as the second calibration point.

**Note:** The pH 12.45 buffer is not for general measurement; use only if the sample is very alkaline to avoid sodium error.

- Immerse the pH electrode and the temperature probe approximately 4 cm (1½") into the buffer solution of your choice (pH 1.68, 4.01, 6.86, 7.01, 9.18, 10.01 or 12.45) and stir gently. The temperature probe should be close to the pH electrode.
- Press the CAL key. "CAL" and "pH" tags will be on, and the "CLEAR CAL if new electrode" tag will blink.



- Press the CLR key if you are using a new electrode or want to clear the calibration history. The instrument will display the "done" message for a few seconds.



It is very important to clear the calibration history when a new electrode is used because all error and warning messages that appear during calibration depend on the calibration history.

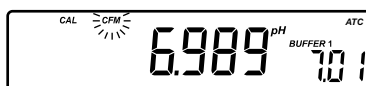
- Press the CAL key, or wait a few seconds to continue.

**Note:** The above behavior happens only if calibration history is not empty.

- The instrument will display the measured pH on the primary LCD, and the most common buffer ("7.01") on the secondary LCD along with "CAL", "pH" and "BUFFER 1" tags.
- The "⌚" tag will blink until the reading has stabilized.



- Press the **ARROW** keys to select a different buffer value, if necessary.
- When the reading is stable and close to the selected buffer, the “**CFM**” tag will blink and if enabled, an audible signal will sound.



- Press the **CFM** key to confirm the calibration. The instrument will ask for a second calibration buffer and display the measured pH on the first LCD line and the second calibration buffer on the second LCD line.



- If necessary, press the **ARROW** keys to select a different buffer value.
- Note:** The instrument will automatically skip the buffer used for the first point. It also skips 6.86 if 7.01 was used, and vice versa. Likewise, it will skip 9.18 if 10.01 has been used, and vice versa.
- Rinse the electrode in one of the beakers of the second buffer solution, then 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.
  - The “**8**” indication will blink on LCD until the reading has stabilized.
  - When the reading is stable and close to the selected buffer, the “**CFM**” tag will blink.
  - Press the **CFM** key to confirm the calibration.

The instrument will return to normal operation and will memorize the calibration data.

**Note:** Press the **RANGE** key any time during calibration to display the temperature reading.



### ONE-POINT CALIBRATION

- Proceed as described in “two-point calibration”.
- Press the **CAL** key after the first calibration point has been confirmed.

The instrument will return to normal operation and will memorize the one-point calibration data.

## ENHANCED CALIBRATION MESSAGES

The stored calibration history is used to issue error and warning messages during calibration to help ensure the highest accuracy.

As electrode aging is normally a slow process, substantial changes from previous calibrations are likely due to a temporary problem with the electrode or buffers. Calibrating under these conditions will give measurement errors.

### ERROR MESSAGES

Error messages appear if one or all of the calibration parameters are out of accepted windows. When these messages are displayed, calibration cannot be confirmed.

#### WRONG BUFFER

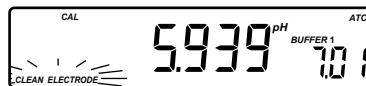
This message appears when the difference between the pH reading and the value of the selected buffer is too big. If this error message is displayed, check if you have selected the proper calibration buffer.



#### CLEAN ELECTRODE

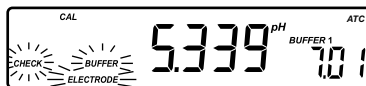
This error message indicates a bad electrode condition (offset out of accepted window, or slope under the accepted lower limit).

Clean the electrode according to the Cleaning Procedure on page 32 to improve its condition and repeat the calibration. This ensures the removal of film, dirt or deposits on the glass bulb and reference junction.



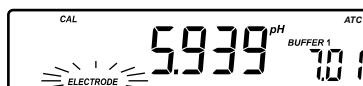
#### CHECK ELECTRODE alternating with CHECK BUFFER

This error message appears when electrode slope exceeds the highest accepted slope limit. You should check your electrode and use fresh buffer.



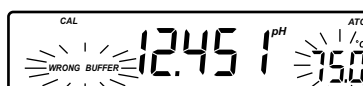
### ELECTRODE

This message appears if the cleaning procedure performed as a result of the above two messages is found by the instrument to be unsuccessful. Replace the electrode.



### WRONG BUFFER TEMPERATURE

This message appears if the temperature of the buffer is outside the defined buffer temperature range.



### WARNING MESSAGES

During calibration, the Calibration Check feature analyzes the electrode calibration history and warns the user when problems have been detected. It is possible to over ride the warning messages and confirm the calibration but it is not recommended.

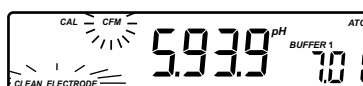
### CLEAR CAL IF NEW ELECTRODE

This warning is displayed any time the new calibration parameters are better than the previous parameters. You can clear the calibration history by pressing the CLR key, or continue by pressing the CAL key.



### CLEAN ELECTRODE

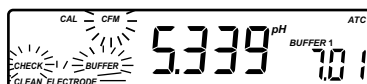
This warning appears during Calibration Check for the second calibration buffer when the instrument has detected a small variation of offset or both offset and slope parameters. This variation may result from dirt on the electrode. Refer to the electrode cleaning procedure. This ensures the removal of film, dirt or deposits on the glass bulb and reference junction.



### CLEAN ELECTRODE alternating with CHECK BUFFER

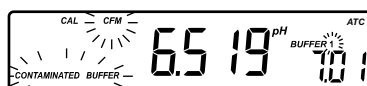
This warning appears during Calibration Check in the first calibration buffer as

a result of unacceptable offset variation or in the second calibration buffer as a result of unacceptable slope variation. This variation may result from dirt on the electrode or contaminated buffer. Refer to the electrode cleaning procedure or use fresh buffer.



### CONTAMINATED BUFFER

This warning message appears in order to alert that the buffer could be contaminated. Refresh your buffer and continue the calibration procedure.



## ELECTRODE CONDITION & ELECTRODE RESPONSE TIME

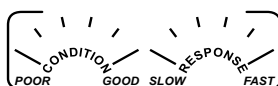
When using an appropriate HANNA P Type BNC electrode with pin, **HI 221** and **HI 223** will assess electrode condition and response time during each calibration, and display the calibration status for the rest of the day.



The digital gauge for electrode condition is a representation of the offset and slope performance of the electrode. The response gauge is a function of the stabilization time between the first and second calibration buffers. These gauges reflect electrode performance and should be expected to slowly decrease over the life of the electrode.

The condition and response gauges show the electrode's condition at the time of calibration only and are displayed for the rest of the day the calibration is performed. For a continuous display of electrode condition at the time of calibration, daily calibration is necessary. The condition and response are also visible when viewing GLP data.

If the instrument is not calibrated or it has been calibrated only at one point or if the calibration history was deleted, the electrode condition and the electrode response gauges will be empty.



Also, when the instrument cannot evaluate the electrode response or pH 1.68 or pH 12.45 buffer were used as calibration buffer, the response gauge will be empty. If the electrode is in a very poor condition the first condition segment will blink. If electrode response is very slow the first response segment will blink.

## GOOD LABORATORY PRACTICE (GLP)

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

All data regarding the last calibration (one or two points) is stored for the user to review when necessary. This data includes the following: calibration time stamp, offset (in mV), slope (in mV/pH), electrode condition and response gauges, calibration buffers and the amount of time until a new calibration is required.

### CALIBRATION ALARM TIME-OUT

HI 221 and HI 223 allow the user to set the number of days before the next required pH calibration. This value can be set from 1 to 7 days. The default value is OFF (disabled).

The instrument checks if the time-out time has expired. If the time has elapsed, the **CAL DUE** will blink as a reminder.

Note: If the instrument was not calibrated, or if the calibration history was deleted, the **CAL DUE** message will be displayed even if this feature is disabled in the SETUP menu.

If the instrument was calibrated using an electrode with pin and the electrode is changed with an electrode without pin or vice-versa **CAL DUE** will blink. This feature helps ensure use of a calibrated instrument.

### LAST CALIBRATION DATA

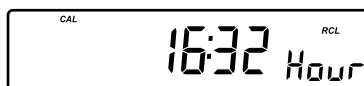
Last calibration data is stored automatically after a successful calibration.

To view the pH calibration data, press the **GLP** key when the instrument is in pH measuring mode.

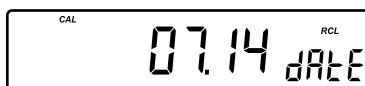
The instrument will display the time of the last calibration.

Press the **ARROW** keys to view the following logged calibration parameters (pressing the **▲** / °C key):

- The time (hh:mm).



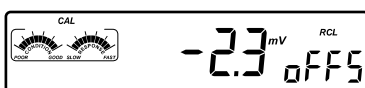
- The date (mm.dd).



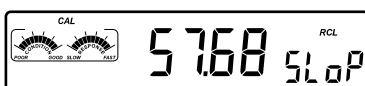
- The year (yyyy).



- The pH calibration offset.

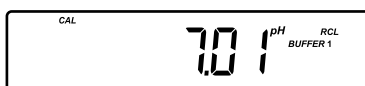


- The pH calibration slope in mV/pH normalized to 25 °C.

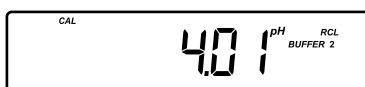


**Note:** If you calibrate using electrodes with pin the electrode condition and response gauges appear while the offset and slope are displayed.

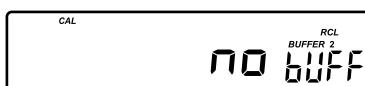
- The first pH calibration buffer along with any warning messages issued while calibrating at this point.



- The second pH calibration buffer along with any warning messages issued while calibrating at this point.



**Note:** If the last calibration was a single point calibration, the message for the second buffer will be: "no BUFF".



- The selected resolution of the instrument during calibration (HI 223 only).



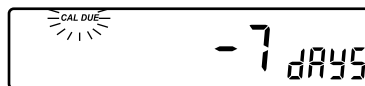
- The calibration Alarm Time-Out status:  
if disabled



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



or if expired (7 days ago)



Press the **GLP** key at any time and the instrument will return to measuring mode. If calibration has not been performed, the instrument displays "no CAL" blinking.



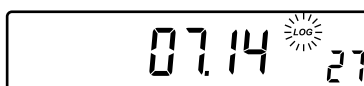
## LOGGING

Up to 100 (HI 221) or 500 (HI 223) LOG samples can be stored in memory.

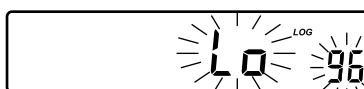
### LOGGING THE CURRENT DATA

To store the current reading into memory press the **LOG** key while in measuring mode.

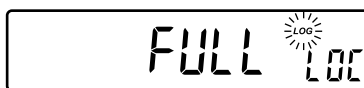
The instrument will display the current date (mm.dd) on the primary LCD, the record number on the secondary LCD and the "LOG" tag will blink for a few seconds (see example below: record No. 27 dated July 14):



If there are less than 5 memory locations remaining, the record number and the "Lo" message will blink to alert the user.



If the log space is full, the "FULL LOC" message will be displayed and no more data will be saved.



When the **LOG** key is pressed, a complete set of information is stored. The parameters of a record are date, time, pH, mV, temperature, and pH calibration data. If a HANNA P Type ORP electrode is used pH information is not stored.

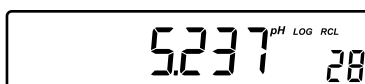
### VIEW LOGGED DATA

Press the **RCL** key to retrieve the information stored while in measuring mode. If no data were logged the instrument displays:



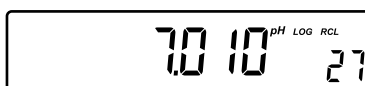
Otherwise the instrument will display log data on the primary LCD and the last stored record number on the secondary LCD, along with the "LOG" and the "RCL" tags.

**Note:** The "LOG" and "RCL" tags remain on LCD while instrument is in the viewing logged data mode.

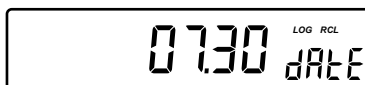


Press the RCL key at any time to return to measuring mode.

Press the ARROW keys to scroll between same parameter for different records, while pH, mV, temperature, "Hour", "Year", "oFFS", "SLoP" or "dEL record" is displayed:



or to scroll between different dates while "dAtE" or "dEL date" is displayed.

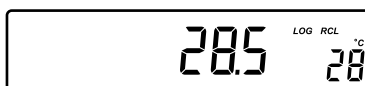


Press the RANGE key and the instrument will display the next logged parameter, as follows:

- The mV value on the primary LCD and the record number on the secondary LCD.



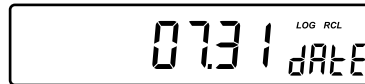
- The temperature value on the primary LCD and the record number on the secondary LCD.



- The time on the primary LCD and the "Hour" message on the secondary LCD.



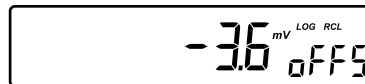
- The **date** on the primary LCD and the “**dAtE**” message on the secondary LCD.



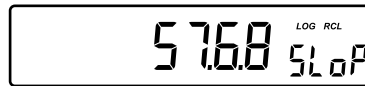
- The **year** on the primary LCD and the “**YEAr**” message on the secondary LCD.



- The calibration **offset** on the primary LCD and the “**oFFS**” message on the secondary LCD.



- The calibration **slope** on the primary LCD and the “**SLoP**” message on the secondary LCD.



**Note:** Before displaying the “Hour”, “Year”, “oFFS” or “SLoP” messages, the record number is displayed for about one second.

The **RANGE** key has no effect if “nuLL” record message is displayed on the first LCD line.

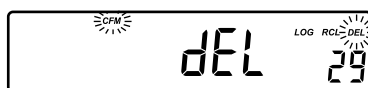


or if “nuLL” date message is displayed.

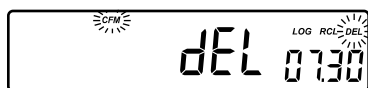


You can skip this message by selecting an undeleted record (date) using the **ARROW** keys.

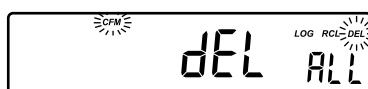
- The “dEL” message on the primary LCD and the selected record or date on the secondary LCD. The “CFM” and the “DEL” tags will blink:



Press **SET** key to select the current record, the records from the selected date or all records to be deleted.  
the date.

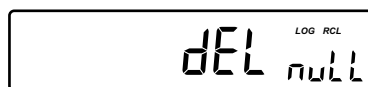


or “ALL” records.



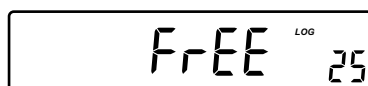
Press the **ARROW** keys to change the record or the date.

Press the **CFM** key to confirm the deleting of the selected record, all the records for the selected date, or all the records and the instrument will display on the secondary LCD the “null” message.



**Note:** • Pressing **RANGE** key the instrument skips to the pH information on the next undeleted record.

- The instrument optimizes the usage of the memory when it returns to measurement mode after a deleting operation is performed. This will change the record numbers of logged data.
- If all the records are deleted the instrument returns to the measuring mode.
- After the **LOG** key is pressed or “dEL” is confirmed the instrument will display the amount of free log space for about one second (example: 25 records free).



## SETUP

Setup mode allows viewing and modification of the following parameters:

- Calibration Alarm Time Out
- Instrument ID
- Current Time (hour & minute)
- Current Date (month & day)
- Current Year
- pH Resolution (HI 223 only)
- Beep Status
- Baud Rate (serial communication)
- Command Prefix (serial communication)

To enter the Setup mode press the **SET/CLR** key while the instrument is in measuring mode. Press **SET/CLR** key to exit SETUP mode.

Select a parameter with the **ARROW** keys.

Press the **CAL** key to change a parameter value. The selected parameter will start to blink.

Press the **RANGE** key to toggle between the displayed parameters.

Press the **ARROW** keys to increase or decrease the displayed value.

Press the **CFM** key to save the modified value or the **CAL** key to cancel.

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

### CALIBRATION ALARM TIME OUT CHANGE

Press the **CAL** key when the calibration time out is displayed. Calibration time out (OFF= disabled or 1 to 7 days) will begin blinking.

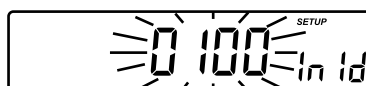


Press the **ARROW** keys to change the calibration time out value.

Press the **CFM** key to save the modified calibration time out value or press the **CAL** key to cancel without saving the calibration time out.

### INSTRUMENT ID PARAMETER CHANGE

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



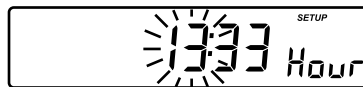
Press the **ARROW** keys to change the instrument ID value.

Press the **CFM** key to save the modified instrument ID value or press the **CAL** key to cancel without saving the instrument ID.

**Note:** The instrument ID is downloaded to a PC as part of a logged data set to identify it's origin.

### **CURRENT TIME SET**

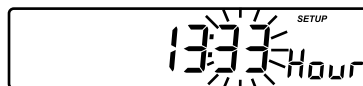
Press the **CAL** key when the current time is displayed. The hour will begin blinking.



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

Press the **RANGE** key. The minutes will begin blinking.

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



Press the **CFM** key to save the modified value or press the **CAL** key to cancel without saving the time.

### **CURRENT DATE SET**

Press the **CAL** key when the current date is displayed. The month will begin blinking.

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



Press the **RANGE** key. The day will begin blinking.

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



Press the **CFM** key to save the modified value or press the **CAL** key to cancel without saving the date.

### CURRENT YEAR SET

Press the **CAL** key when the current year is displayed. The year will begin blinking.



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

Press the **CFM** key to save the modified value or press the **CAL** key to cancel without saving the year.

### pH RESOLUTION SET (HI 223 ONLY)

Press the **CAL** key when the pH resolution is displayed. The pH resolution (0.001 or 0.01) will begin blinking.



Press the **ARROW** keys to change the pH resolution.

Press the **CFM** key to save the modified pH resolution or press the **CAL** key to escape without saving the pH resolution.

### BEEP STATUS SET

Press the **CAL** key when the beep status is displayed. The beep status (On or OFF) will begin to blink.



Press the **ARROW** keys to change the beep status (On or OFF).

Press the **CFM** key to save the modified beep status or press the **CAL** key to cancel without saving the beep status.

**Note:** If enabled, an audible signal will follow each key press. Inactive keys have a longer beep. A longer beep is also sounded when the limits of the range of a parameter are reached.

An audible signal will also sound when the reading becomes stable during calibration.

### SERIAL COMMUNICATION BAUD RATE SET

Press the **CAL** key when the baud rate is displayed. The baud rate (600, 1200, 2400, 4800 or 9600) will begin to blink.



Press the **ARROW** keys to change the baud rate.

Press the **CFM** key to save the modified baud rate or press the **CAL** key to cancel without saving the baud rate.

### SERIAL COMMUNICATION COMMAND PREFIX SET

Press the **CAL** key when the command prefix is displayed. The command prefix (0 to 47) will begin to blink.



Press the **ARROW** keys to change the command prefix.

Press the **CFM** key to save the modified command prefix value or press the **CAL** key to cancel without saving the command prefix.

**Note:** See the PC Interface section on page 28 for a complete explanation. The command prefix must be 16 if the HI 92000 PC software is used.

## TEMPERATURE CALIBRATION (FOR TECHNICAL PERSONNEL ONLY)

The instruments are factory calibrated for temperature.

Hanna's temperature probes are interchangeable and temperature calibration is not necessary when replaced.

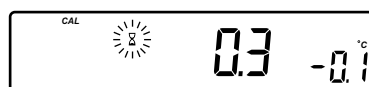
If the temperature measurements are not accurate, temperature recalibration should be performed.

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

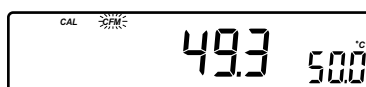
- Switch off the instrument.
- Prepare a vessel containing ice and water and another one containing hot water (around 50 °C). Place insulation material around the vessels to minimize temperature changes during calibration.
- Use a **ChecktempC** or a calibrated thermometer with a resolution of 0.1 °C as a reference thermometer.
- Immerse the temperature probe and the ChecktempC into the vessel

containing ice and water. Wait a few minutes for the probe to stabilize.

- Press the **CAL** and **LOG** keys simultaneously and then switch the instrument on. After a few seconds, the instrument enters the temperature calibration mode. The “**CAL**” tag will come on. The primary LCD will display the measured temperature or the “- - -” message if the measured temperature is out of range. The secondary LCD will display 0.0 °C (First calibration point). The “**⊗**” tag will blink until the reading has stabilized.
- Use the **ARROW** keys to set the reading on the secondary LCD to that of ice and water measured by ChecktempC (for example, -0.1 °C).



- When the reading is stable and close to the selected calibration point, the “**CFM**” tag will blink.
- Press the **CFM** key to confirm the calibration or the **CAL** key to leave the calibration mode.
- The secondary LCD will display 50.0 °C (Second calibration point).
- Immerse the temperature probe and the ChecktempC into the second vessel.
- Allow a few minutes for the probe to stabilize.
- The “**⊗**” tag will blink until the reading has stabilized.
- Use the **ARROW** keys to set the reading on the secondary LCD to that of the hot water bath.
- When the reading is stable and close to the selected calibration point, the “**CFM**” tag will blink.



- Press the **CFM** key to confirm the calibration or the **CAL** key to leave the calibration mode.

**Note:** If the measured value is not close enough to the displayed value on secondary LCD, the “**WRONG**” tag will blink. In this case, check if the value set on secondary LCD and the temperature measured with **ChecktempC** are close. Change the temperature probe and restart calibration if necessary.

## mV CALIBRATION (FOR TECHNICAL PERSONNEL ONLY)

All instruments are factory calibrated for mV.

Hanna's pH and ORP electrodes are interchangeable and mV calibration is not needed when replaced.

If the mV measurements are not accurate, mV recalibration should be carried out.

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 mV, +600 mV and +1800 mV.

- Switch off the instrument.
- Attach a mV simulator with an accuracy of at least  $\pm 0.1$  mV to the BNC connector.
- Press the **RCL** and **CFM/GLP** keys simultaneously and switch the instrument on. After a few seconds, the instrument enters the mV calibration mode.
- The primary LCD will show the "CAL" and "mV" tags along with measured mV and the secondary LCD will display 0.0 calibration point.
- Set 0.0 mV on the simulator.
- The "mV" tag will blink on LCD until the reading has stabilized.
- When the reading is stable, the "CFM" tag will blink.
- Press the **CFM** key to confirm the calibration.
- The instrument will prompt for a second calibration point and will display 600 on the secondary LCD line.
- Set the simulator to +600.0 mV.
- The "mV" tag will blink on the LCD until the reading has stabilized.
- When the reading is stable, the "CFM" tag will start to blink.
- Press the **CFM** key to confirm the calibration.
- The instrument will prompt for a third calibration point and will display 1800 on the secondary LCD line.
- The two-point mV calibration is now complete.
- Set +1800.0 mV on the simulator.
- The "mV" tag will blink on the LCD until the reading has stabilized.
- When the reading is stable, the "CFM" tag will start to blink.
- Press the **CFM** key to confirm the calibration.
- The instrument will memorize the calibration and return to measuring mode.

**Note:** Press the **CAL** key to leave the calibration mode at any time.

If the measured value is not close to the calibration point, the “**WRONG**” tag will start to blink. In this case, check if the value set on the simulator is the same as the calibration value on the instrument. Set the proper value on the simulator.

## PC INTERFACE

Data transmission from the instrument to the PC can be done with the HI 92000 Windows® compatible software (optional). The HI 92000 also offers graphing and on-line help.

Data can also 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. Make sure that your instrument is switched off and plug one end into the instrument’s RS232C socket and the other end into the serial port of your PC.

**Note:** Cables other than HI 920010 may use a different configuration, in which case communication between the instrument and the PC may not be possible.

If you are not using optional Hanna HI 92000 software, please see the following instructions.

The Command Prefix must be 16 when using HI 92000 software.

### SENDING COMMANDS FROM PC

It is also possible to remotely control the instrument with any terminal program. Use the optional Hanna 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 pH meter the scheme is:

<command prefix> <command> <CR>

where: <command prefix> is a selectable ASCII character between 0 and 47 (default 16).

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

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

### **SIMPLE COMMANDS**

RNG	Is equivalent to pressing the RANGE key
CAL	Is equivalent to pressing the CAL key
CFM	Is equivalent to pressing the CFM/GLP key
UPC	Is equivalent to pressing the UP arrow key
DWC	Is equivalent to pressing the DOWN arrow key
SET	Is equivalent to pressing the SET/CLR key

### **COMMANDS REQUIRING AN ANSWER**

pH?	Causes the instrument to send the pH reading ("Err 1" is sent if out of range). If the range is set to mV, "Err 6" is received.
MV?	Causes the instrument to send the mV reading ("Err 2" is sent if out of range). If the range is set to pH, "Err 6" is received.
TM?	Causes the instrument to send the temperature reading ("Err 3" is sent if out of range).
MDR	Requests the instrument model name and firmware code.
PAR	Requests the setup parameters (instrument ID, calibration alarm time-out, pH range, beep status).
NSL	Requests the number of logged samples.
GLP	Requests the calibration data record.
LOD xxx	Requests the xxx <sup>th</sup> record logged data.
LOD ALL	Requests all logged data.

Invalid commands will be ignored. The characters sent by the instrument are always capital letters. When the instrument receives an unknown or a corrupted command, it will send a character CAN (ASCII Code 24).

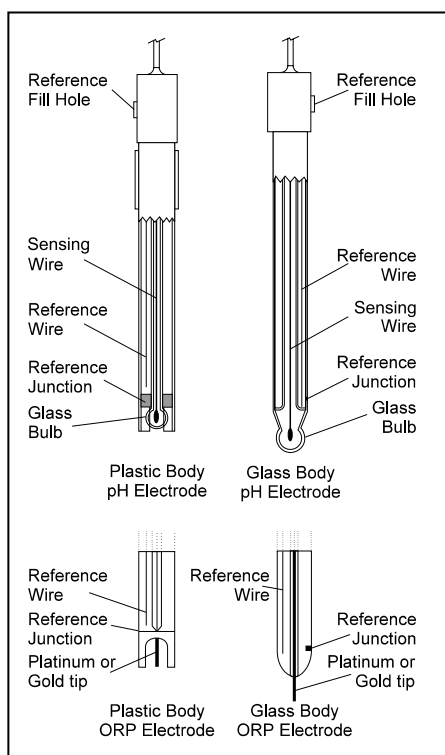
## pH VALUES AT DIFFERENT TEMPERATURES

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 VALUES						
°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	13.21
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	9.98	11.98
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	11.45
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	-

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

## ELECTRODE CONDITIONING & MAINTENANCE



### PREPARATION

Remove the protective cap.

**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 condition the electrode by soaking it 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 using a plastic refilling pipette (HI 740157).

As recommended by the LCD message on instrument on start-up, remove or loosen the fill hole screw on the electrode for better performance.

### **STORAGE**

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 or HI 7082 or HI 8082 for double junction electrodes). Follow the Preparation Procedure on page 31 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 or HI 7082 or HI 8082 for double junction electrodes) using a plastic refilling pipette (HI 740157). Allow the electrode to stand upright for 1 hour.

Follow the Storage Procedure above.

### **CLEANING PROCEDURES**

- General Soak in HANNA HI 7061 or HI 8061 General Cleaning Solution for approximately 30 minutes.
- 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 for approx. 30 seconds.

**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.

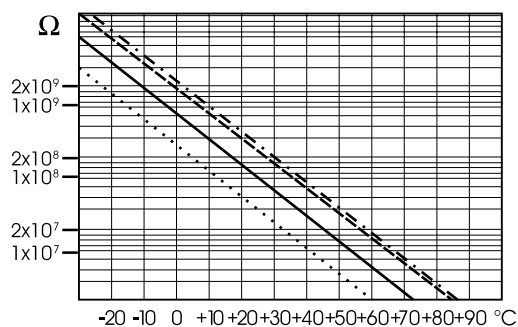
## TROUBLESHOOTING GUIDE

SYMPTOMS	PROBLEM	SOLUTION
Slow response/excessive drift.	Dirty pH electrode.	Soak the electrode tip in HI 7061 or HI 8061 solution for 30 minutes and then clean the electrode.
The reading drifts. Low electrode condition.	Bad or dirty pH electrode.	Soak the electrode tip in warm (approx. 50-60°C) HI 7082 or HI 8082 solution. Refill with fresh solution (for refillable electrodes only). Replace 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).
If the display shows first LCD line blinking during pH measurement.	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 first LCD line blinking during mV measurement.	Out of range in the mV scale.	Electrode not connected.
Out of range in the mV scale.	Dry membrane/junction.	Soak in HI 70300 or HI 80300 storage solution for at least one hour.
The meter does not work with the temperature probe.	Broken temperature probe.	Replace the temperature probe.

SYMPTOMS	PROBLEM	SOLUTION
AMPHEL Electrodes do not respond to pH changes.	The battery is run down.	Replace the electrode.
The meter fails to calibrate or gives faulty readings.	Broken pH electrode.	Replace the pH electrode.
At startup the meter displays all LCD tags permanently.	One of the keys is blocked.	Check the keyboard or contact the vendor.
Explicit warnings are displayed on the LCD during pH calibration.	Dirty electrode or contaminated buffers.	Follow displayed instructions.
The electrode condition and response gauges are not displayed after calibration.		Use the HANNA P type electrodes and check the pin connection.
The electrode condition and response gauges are empty.	- The meter is not calibrated on the current day - only one point calibration is done.	Perform a two point calibration.
The meter displays empty Electrode Response scale.	Not enough data to evaluate response time.	Repeat calibration more carefully.
"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 depending on the composition of the glass, 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 <sup>-1</sup> Na <sup>+</sup>	13.00	0.10
	13.50	0.14
	14.00	0.20
1.0 Mol L <sup>-1</sup> Na <sup>+</sup>	12.50	0.10
	13.00	0.18
	13.50	0.29
	14.00	0.40

## ACCESSORIES

### pH CALIBRATION 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 7001M	pH 1.68 Buffer Solution, 230 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

### REFILL ELECTROLYTE SOLUTIONS

HI 7071	3.5M KCl + AgCl Electrolyte, 4x30 mL, for single junction electrodes
HI 7072	1M KNO <sub>3</sub> 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

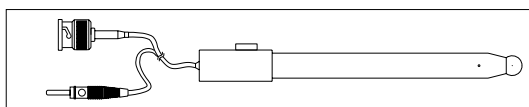
- HI 8072 1M KNO<sub>3</sub> Electrolyte in FDA approved bottle, 4x30 mL
- HI 8082 3.5M KCl Electrolyte in FDA approved bottle, 4x30 mL, for double junction electrodes

**ORP PRETREATMENT SOLUTIONS**

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

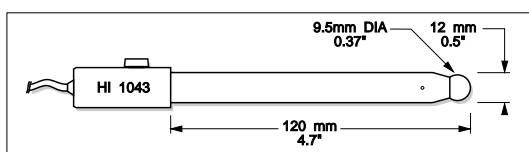
**pH ELECTRODES**

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



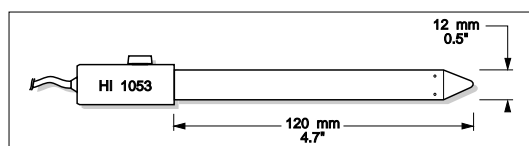
**HI 1043P;** Use: strong acid/alkali.

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



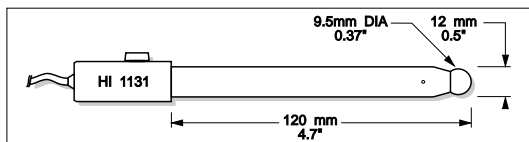
**HI 1053P;** Use: emulsions.

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

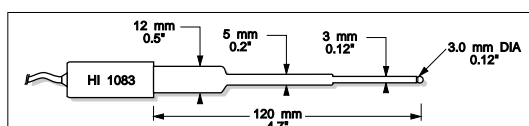


**HI 1131P;** Use: general purpose.

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

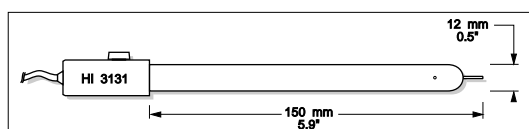


**HI 1083P**; Use: biotechnology, micro titration.  
Glass-body, micro, Viscolene, nonrefillable, combination pH electrode



### **ORP ELECTRODES**

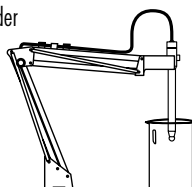
**HI 3131P**; Use: titration.  
Glass-body, refillable, combination platinum ORP electrode



Consult the Hanna General Catalog for more electrodes with BNC and pin connectors.

### **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 African plug)
- HI 710014 Voltage adapter from 230 VAC to 12 VDC (Australian plug)
- ChecktempC Pocket-size thermometer (range -50.0 to 120.0 °C)
- 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 740157 Plastic electrode refilling pipet (20 pcs)
- HI 92000 Windows® compatible software
- HI 920010 9 to 9-pin RS232 cable

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

## RECOMMENDATIONS FOR USERS

Before using this product, make sure that it is entirely suitable for the environment in which it is used.

Operation of this instrument in residential areas could cause unacceptable interferences to radio and TV equipment, requiring the operator to take 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 instrument's EMC performance.

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

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

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

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